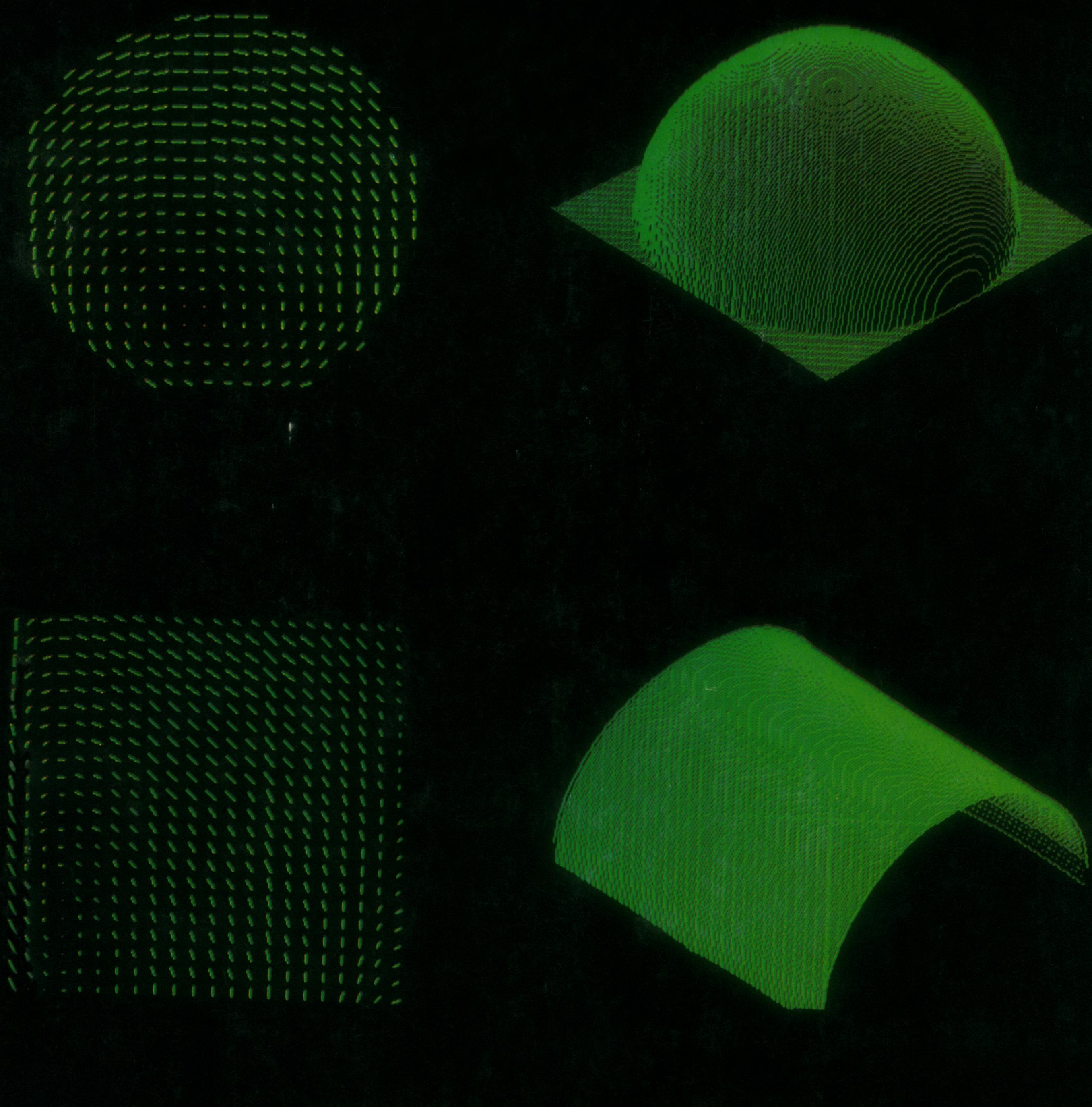
22 June 1984 • Vol. 224 • No. 4655 $2.50

# SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



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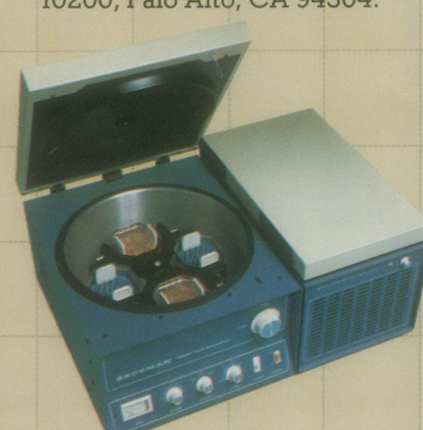

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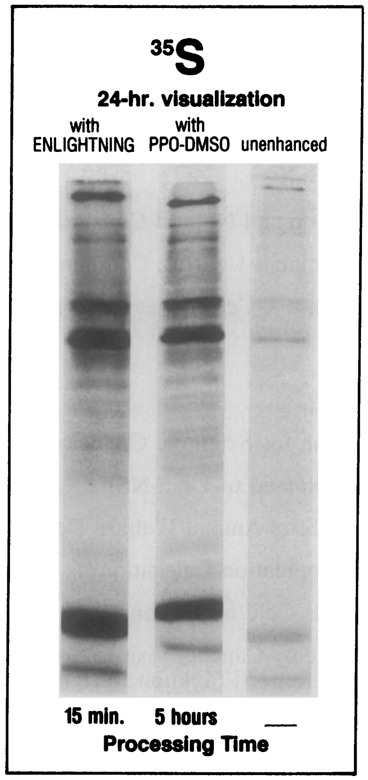


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ISSN 0036-8075
22 June 1984
Volume 224, No. 4655

# SCIENCE





**SCIENCE is published weekly on Friday, except the last week in December, by the American Association for the Advancement of Science, 1515 Massachusetts Avenue, NW, Washington, D 20005.** Second-class postage (publication No. 484460) paid at Washington, D.C., and at an additional entry. Now combined with **The Scientific Monthly®**  Domestic individual membership and subscription (51 issues): $56. Domestic institutional subscription (51 issues): $93. Foreign postage extra: Canada $24, other (surface m $27, air-surface via Amsterdam $65. First class, airmail, school-year, and student rates on request. Single copies $2.50 ($3 by mail); back issues $3 ($3.50 by mail); Biotechnology issue, $5 ($5.50 by ma classroom rates on request. **Change of address:** allow 6 weeks, giving old and new addresses and seven-digit account number.  **Postmaster:** Send Form 3579 to *Science*, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005. *Science* is indexed in the *Reader's Guide to Periodical Literature* and in several specialized index

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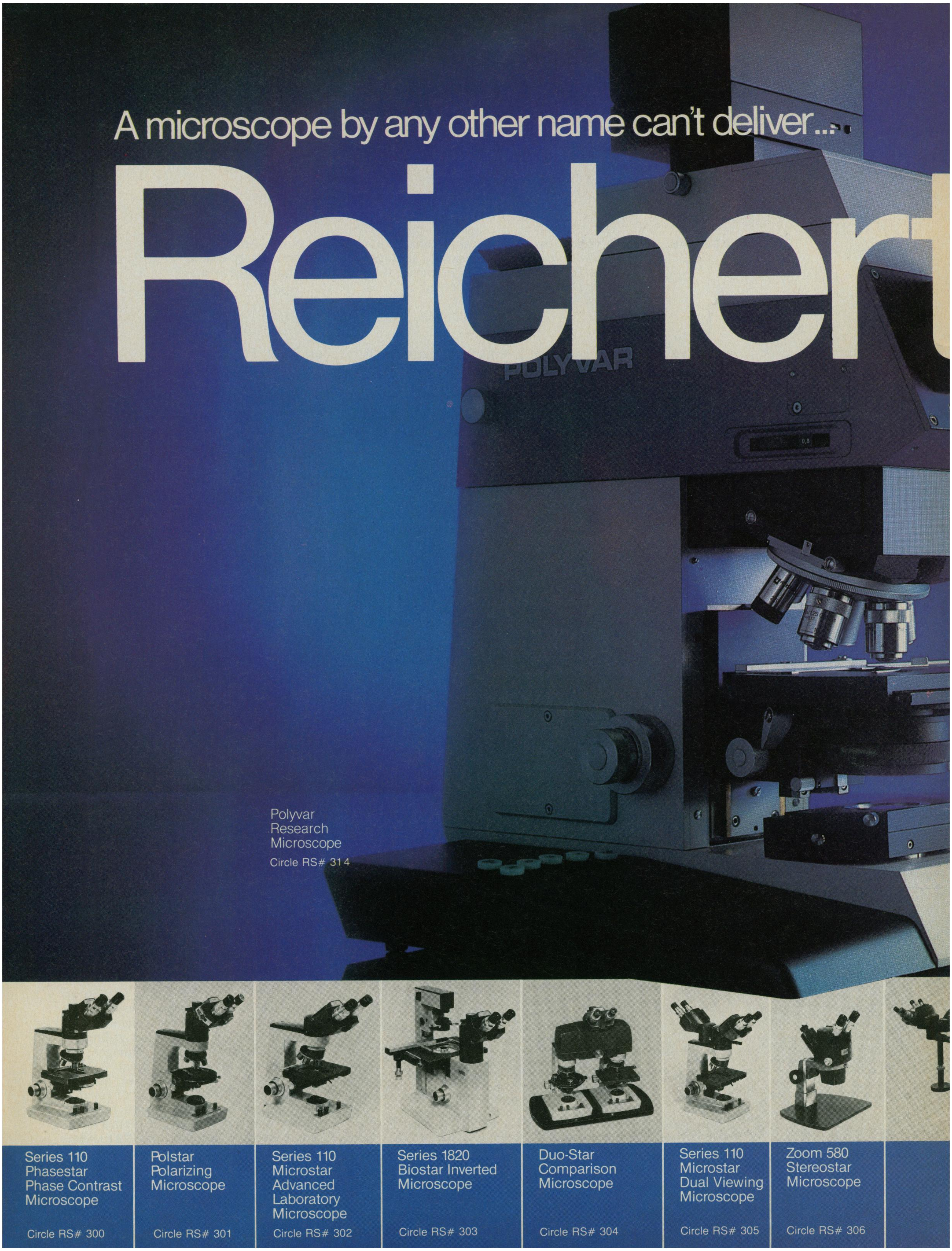
**COVER**

(Left) Optic flow images (retinal pattern velocities caused by scene motion) from a rotating sphere and cylinder. (Right) Shapes causing the images, as derived by a computational vision process. Such processes use mathematical models of physical laws and assumptions about nature to recover physical information about scenes from input images. See page 1299. [John Aloimonos, Computer Science Department, University of Rochester, Rochester, New York 15627]



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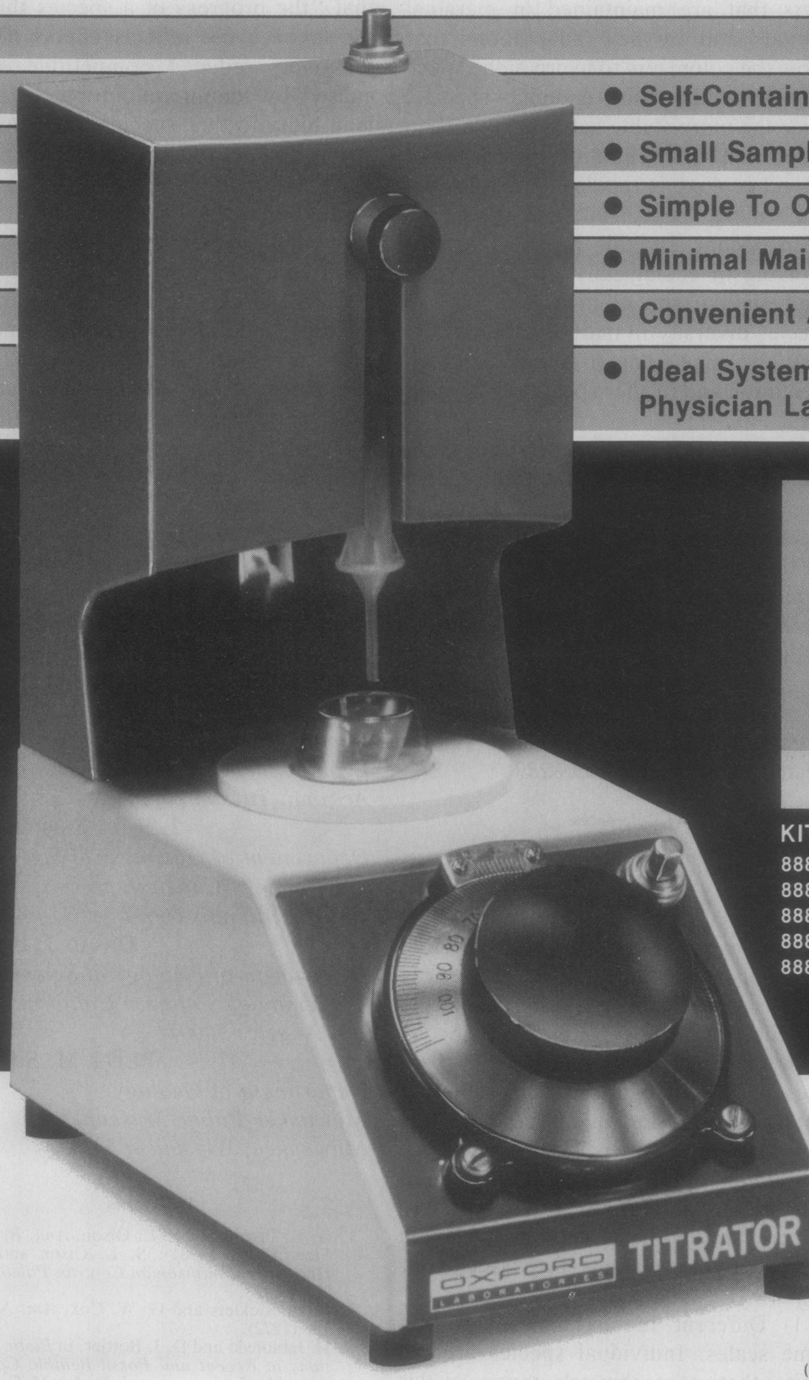


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22 June 1984, Volume 224, Number 4655

# SCIENCE



## Chemistry Without Test Tubes

To those whose experience in chemical research laboratories was 20 years ago or more the modern counterpart is a strange place. New instrumentation with electronic components has revolutionized analytical capabilities. It has also made accessible crucial experiments and theoretical calculations that could not previously be performed. Some present-day measurements can be made with speeds and sensitivities that are five to ten orders of magnitude better than those of two decades ago.

In a symposium at the recent AAAS meeting in New York and in an earlier report,* leading chemists were enthusiastic about new opportunities for research that have been created. They emphasized three major frontiers. The first is the opportunity to understand, in the most fundamental sense, chemical reactivity and how to control it. The second is to improve understanding of catalyses. The third is to extend to the molecular level understanding of life processes. A few examples are appropriate.

The study of why and how chemical changes take place has been especially facilitated by new instrumentation. Lasers, computers, molecular beams, ion cyclotron resonance, and many more tools have opened and facilitated new research approaches. Of these, lasers have been particularly helpful. Their short pulse durations permit probing of chemical reactions in times ranging from $10^{-6}$ to $10^{-12}$ seconds. Lasers also provide tunable, extremely narrow, frequency light sources and thus greater diagnostic sensitivity and selectivity. With high-power sharply tunable lasers it is possible to excite one particular degree of freedom of many molecules in a sample. During the interval in which these excited states persist, such molecules react as if that particular degree of freedom is at a high temperature while all the rest of the degrees of freedom of the molecule are cold. Today we know much about the chemistry of molecules at the ground state. The study of their behavior under excitation will greatly improve our understanding and ability to devise important applications.

Catalysts are already important technologically. It is estimated that 20 percent of the gross national product is generated through their use. Much of the present art was developed through empirical research. New equipment facilitating fundamental studies of processes on a molecular level is now available. One result is the rapid development of surface science. Because of the unsatisfied bonding capability of atoms at surfaces, the chemistry there is different from that of reactants brought together in solution or as gases. When chemists are able to identify molecular structures on the surfaces they will be able to understand and control events there.

Other frontiers of research include homogeneous catalyses, metal cluster chemistry, and stereoselective catalysts. An important branch of homogeneous catalysis has developed from research in organometallic chemistry. An example is rhodium dicarbonyl diiodide employed in the commercial production of acetic acid from methanol and carbon monoxide. Stereoselective catalysts now being discovered will surely have important applications in the synthesis of biological molecules. If a complex molecule has many chiral carbon atoms and a synthetic process produces all of them, only a tiny fraction of the product is likely to have the desired biological activity.

The chemists state, and rightly so, that their science has been underfunded relative to other major disciplines. They point to many new research opportunities and to the needs of the $175-billion chemical industry for new knowledge and trained people. They remind us that although chemicals now produce a favorable balance of payments of $12 billion a year, leadership in some areas of research has moved to other countries. Their pleas for funds to enable them to purchase state of the art instrumentation should be granted, and their efforts to support training of the next generation of chemists supported.—PHILIP H. ABELSON

*Research Briefing Panel on Selected Opportunities in Chemistry, in *Research Briefings 1983* (National Academy Press, Washington, D.C., 1983).

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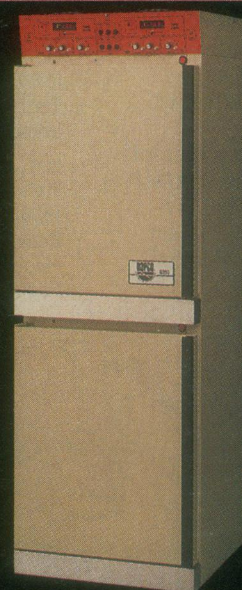

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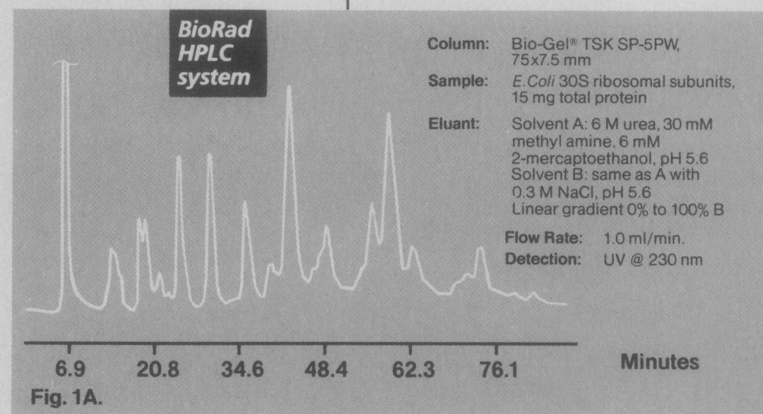
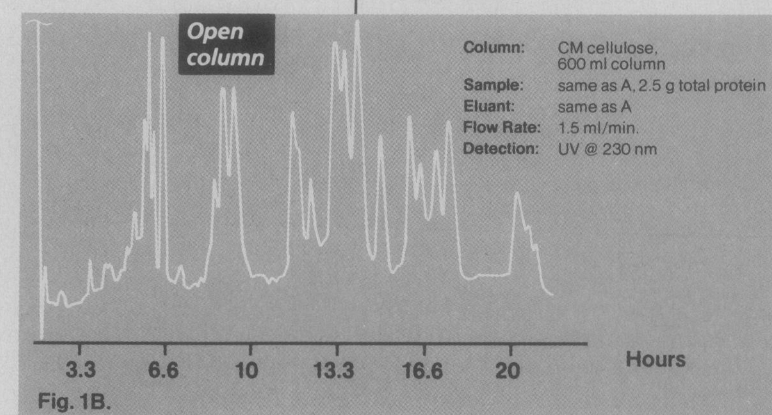
***The Tools:*** new ion exchange HPLC system from Bio-Rad.

***The Proof:*** rapid separation of 30S ribosomal proteins.




*Gradient separations of total protein from E. coli 30S ribosomal subunits.*

*Data provided by Malcolm S. Capel, Dept. of Molecular Biophysics and Biochemistry, Yale University.*

Bio-Rad's protein separation system.

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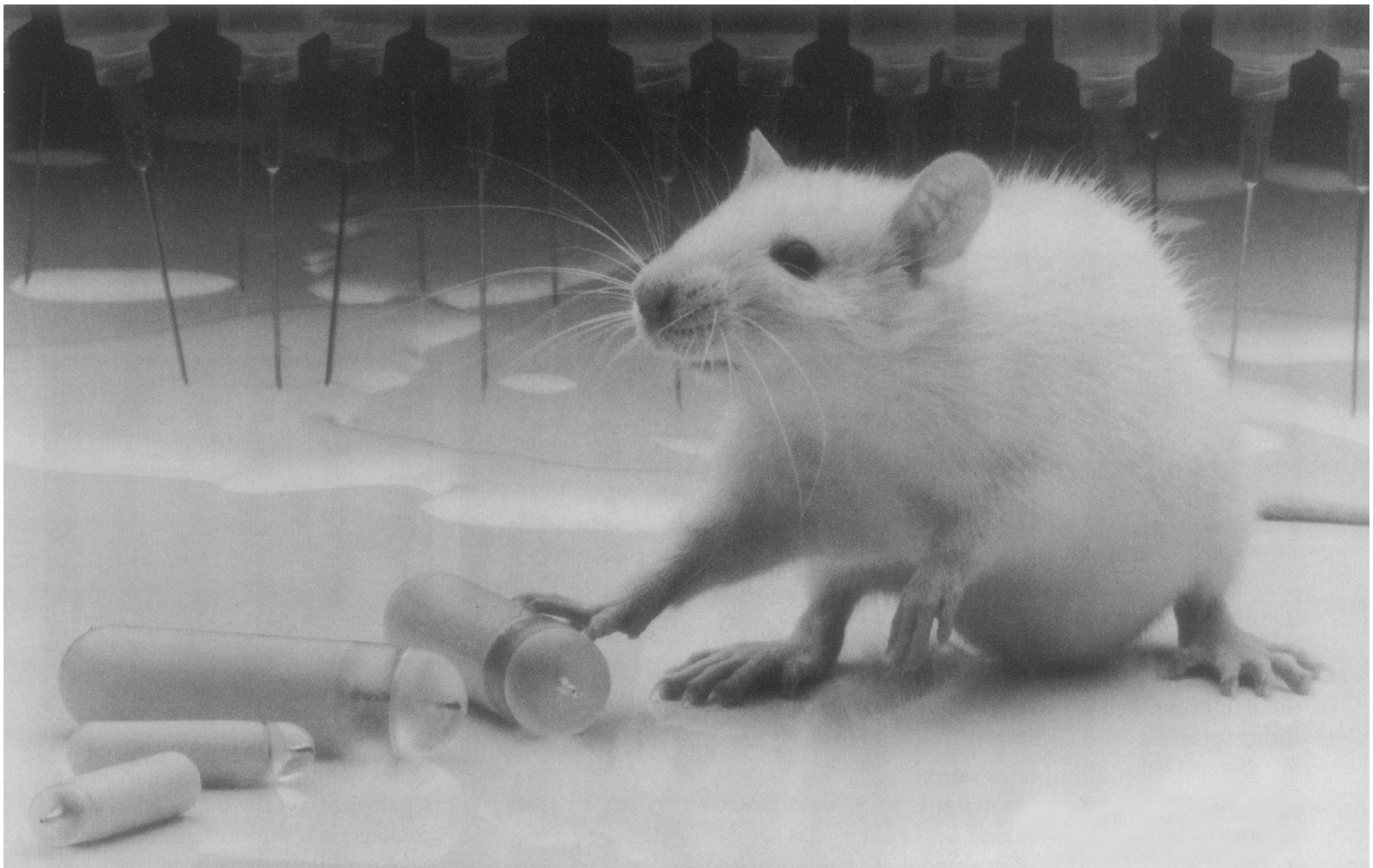

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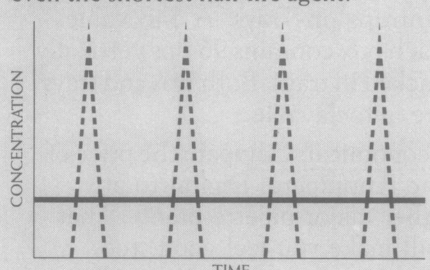


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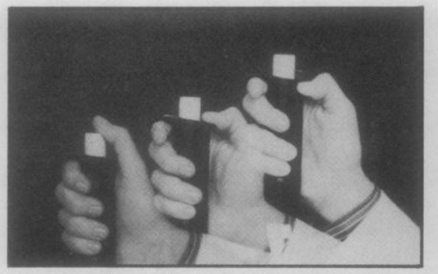

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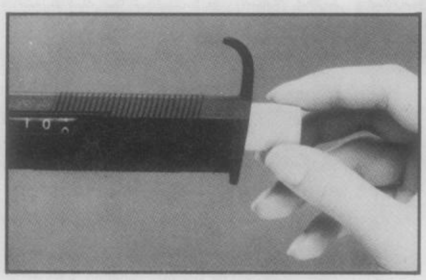

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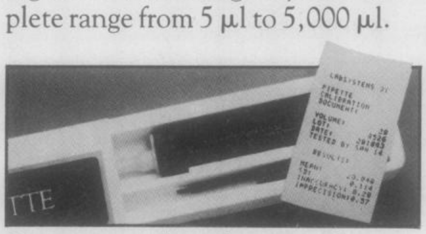

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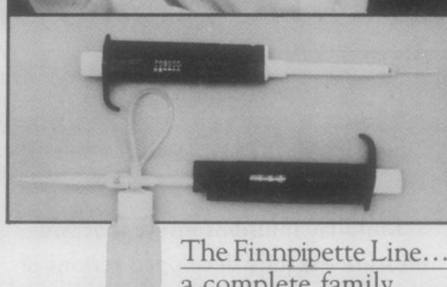

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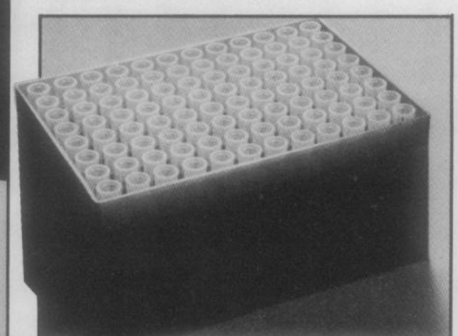

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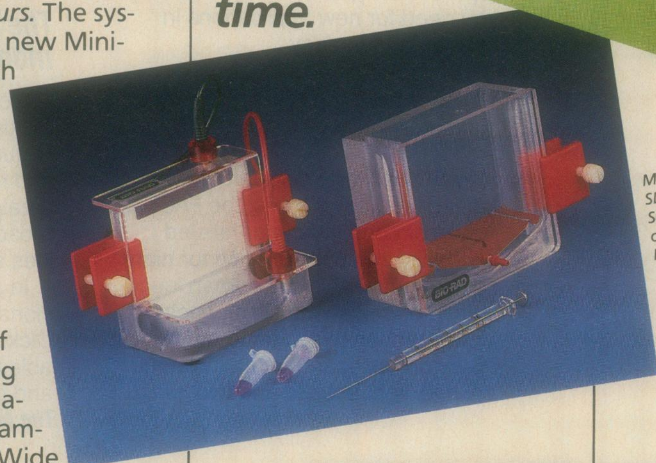


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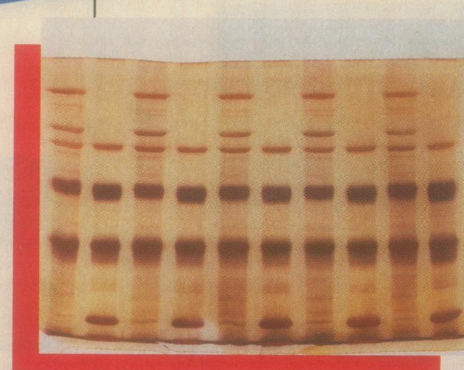

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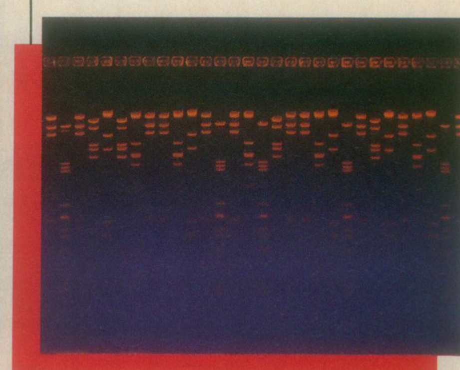

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