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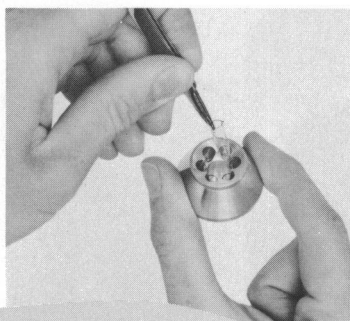
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COVER

Simulated vase, assembled from scale molecular model, inspired a two-step synthesis of the compound it represents. The enforced concave interior of the compound makes it a cavitand (a molecular container) capable of hosting guests of moderate molecular dimensions. See page 1177. [Donald J. Cram, Department of Chemistry, University of California, Los Angeles 90024]



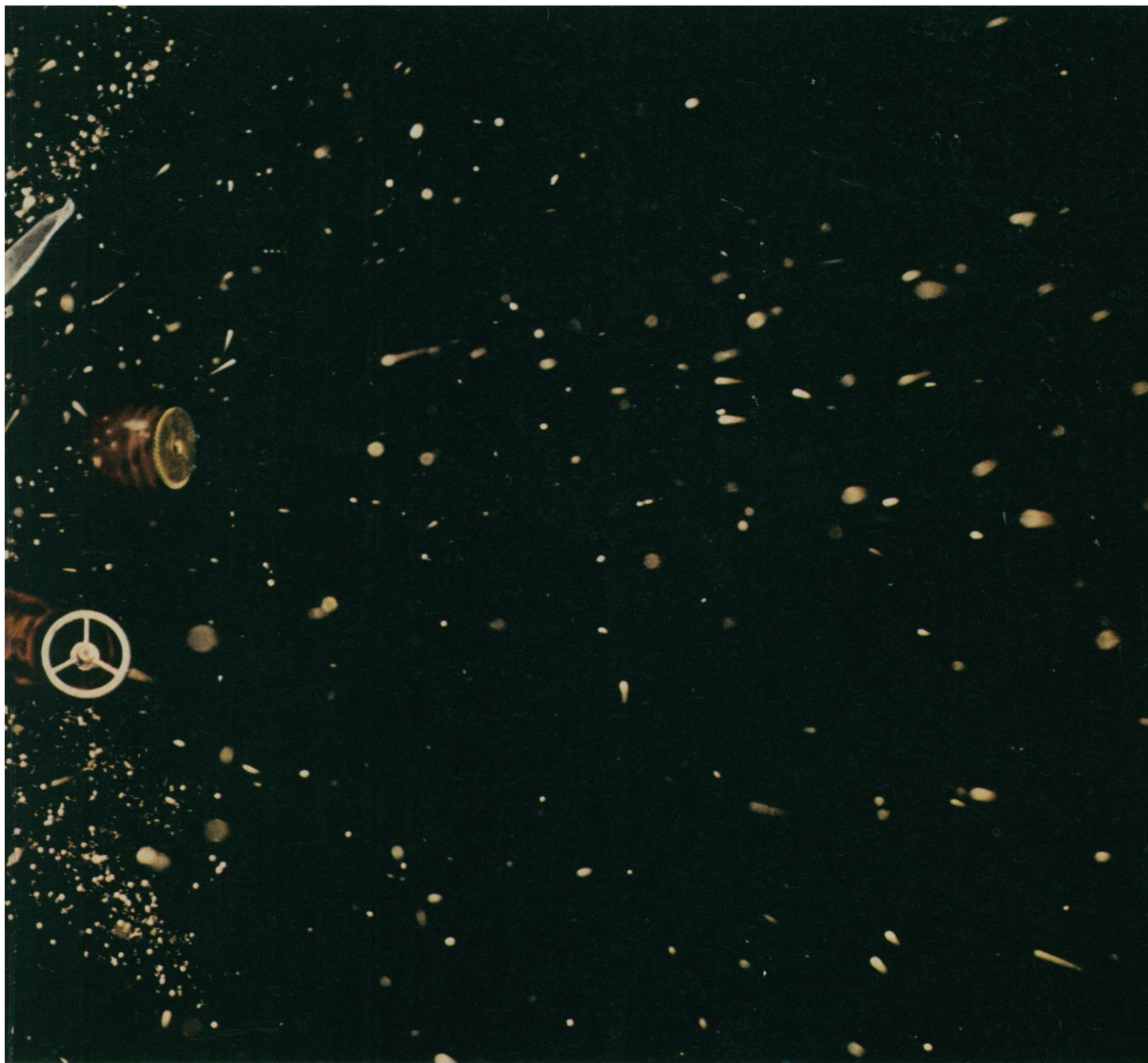
An IBM 3081: subatomic physics at Stanford

Finding the pieces in one billionth of a second.

Trying to see how a watch works by slamming two together and examining the pieces is a popular analogy with physicists. It explains how they examine the innermost secrets of subatomic particles.

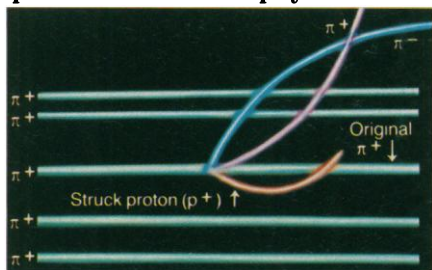
The watches represent matter and antimatter—electrons and positrons that whirl in opposite directions through a 1.3-mile ring at the Stanford Linear Accelerator Center (SLAC). Approaching the speed of light, they collide and generate bursts of subatomic shards that last for only a tiny sliver of time.

An IBM 3081 processor at SLAC has proved a smashing success in finding meaning in millions of bits



of data from these experiments, which may run for weeks or months.

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A significant event at SLAC. Positive pion (π^+) strikes proton (p^+) creating two new pions, one negative and one positive. Four other pions pass through with no contact.

immediate access to experimental results."

They can think about the problem, and not worry about the computer, with microcode-assisted VM/CMS. With this flexible IBM software and the 3081's reliability, physicists can, with confidence, steal a look for a significant event during the experiment.

Dickens explains, "Before, people might say, 'If I'd only known what was happening, I'd have done things differently.' Now they see the results as they happen."

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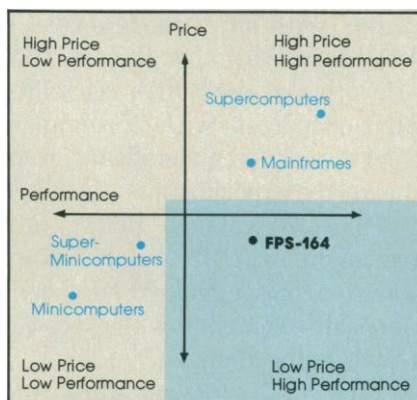
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Solutions Using Sparse Matrices

$$\begin{bmatrix} c_1 & d_1 & 0 & e_1 & & & & \\ b_2 & c_2 & d_2 & 0 & e_2 & & & 0 \\ 0 & b_3 & . & . & . & . & & \\ a_4 & 0 & . & . & . & . & . & \\ & a_5 & . & . & . & . & . & \\ & . & . & . & . & . & . & e_{n-3} \\ 0 & & . & . & . & . & . & 0 \\ & & . & . & . & . & . & d_{n-1} \\ & & & a_n & 0 & b_n & c_n & \end{bmatrix}$$

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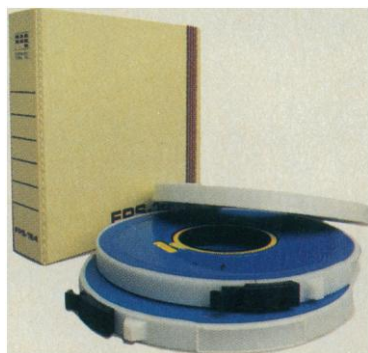
The FPS-164 is presently being used in applications such as computational chemistry and physics, structural analysis, finite element analysis, oil reservoir modeling, and electronic circuit design.

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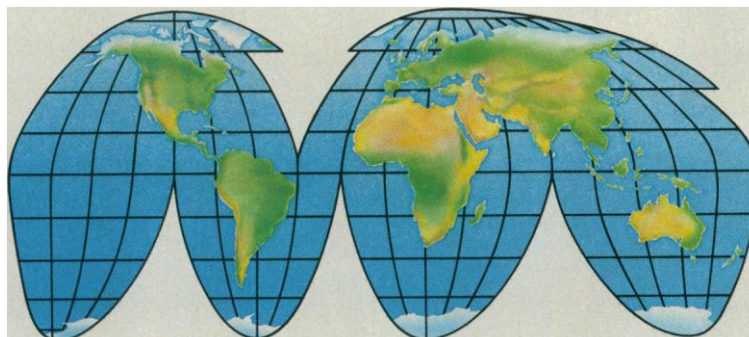
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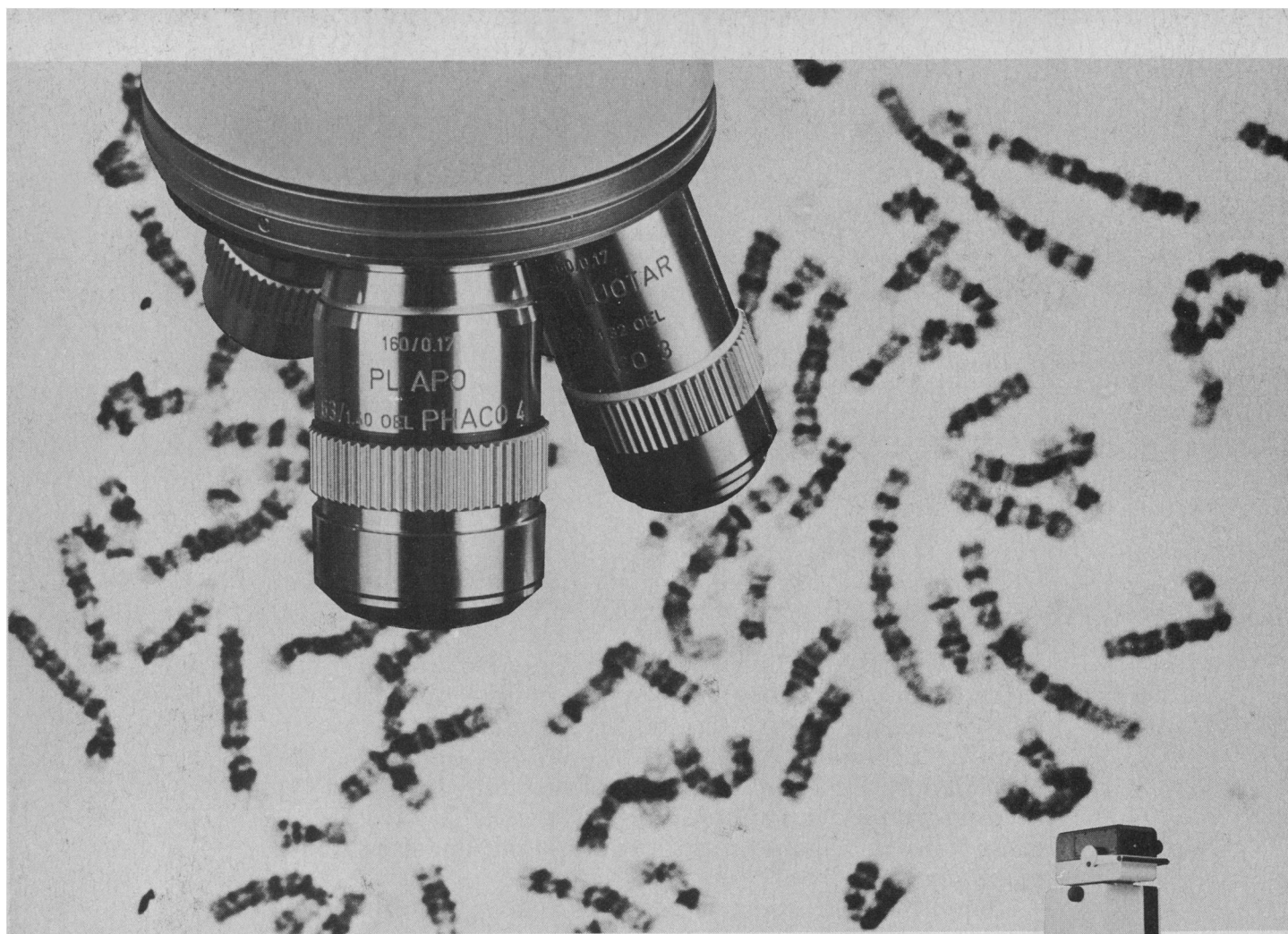
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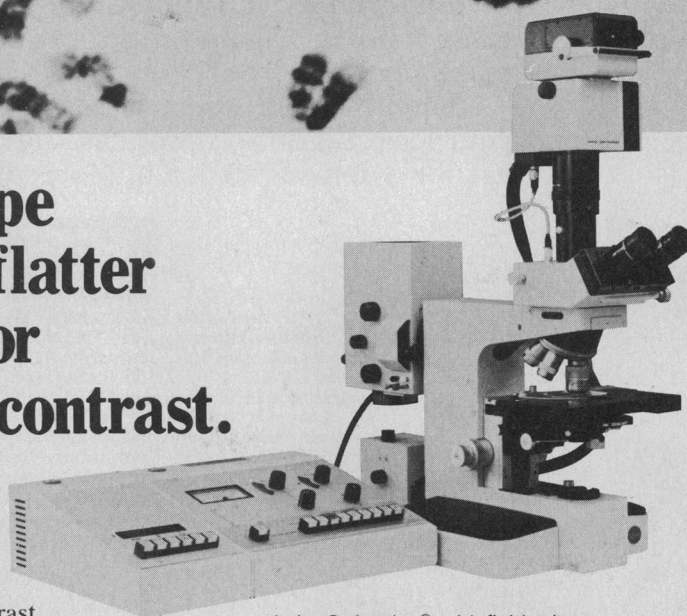


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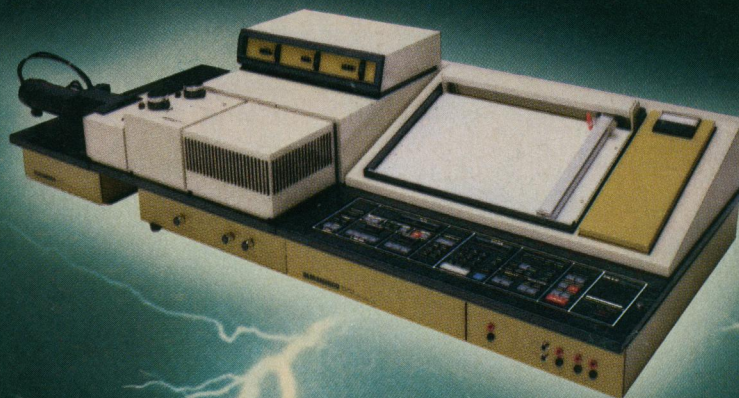


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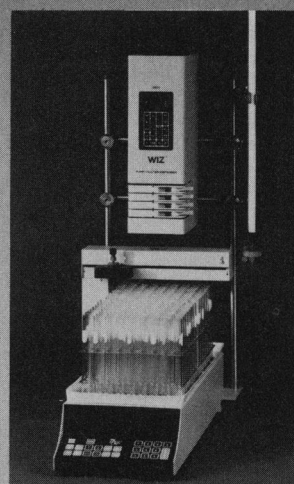
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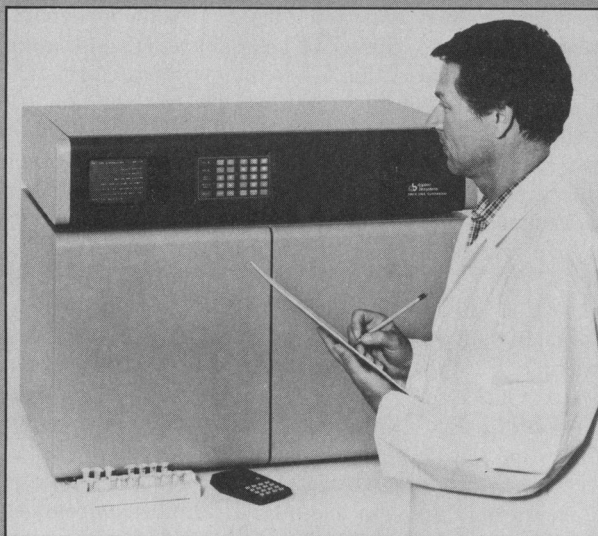


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BIOSYSTEMS UPDATE

A New DNA Synthesizer with Guaranteed Performance

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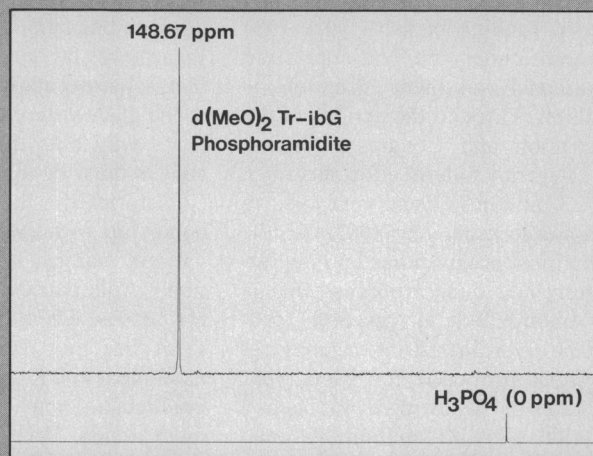
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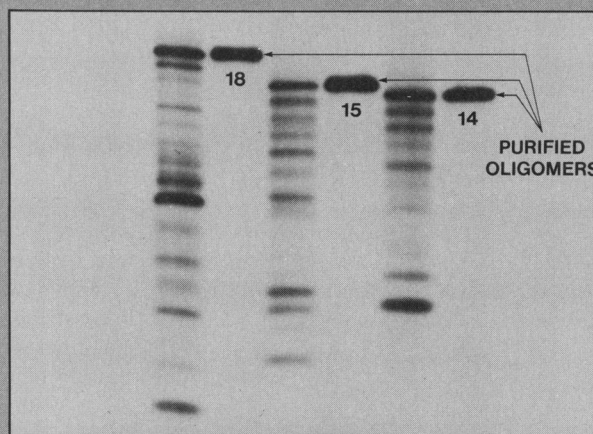
The synthesizer is designed for reliability, with the same microvalves used in our Model 470A Gas-Phase Protein Sequencer. All reagent deliveries are gas-pressure driven. There are no mechanical pumps or syringes. Reagents contact only fluorocarbon polymers and glass and there is no need to clean or backflush the system after use.

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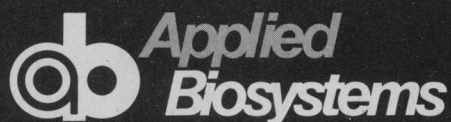


No DNA synthesizer is better than its reagents. Our phosphoramidite nucleosides are synthesized to exacting purity standards: each lot is ^{31}P NMR quality-assured and a copy of the spectrum is included in every shipment.



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TIAA announces MOD ONE...

a brand new concept in personal life insurance
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- cuts first-year premiums up to 50%
- gives discounts of 33⅓% to 40% on large policies

Is digging up that first premium stopping you from providing all the financial protection your family deserves? Then here's really good news. With the introduction of MOD ONE* October 1, 1982, Teachers Insurance has cut up to 50% from initial premiums on term policies of \$100,000 to \$249,000. And we've trimmed off even more for policies of \$250,000 and above. This means you now need only about half as much premium money "up front" to start a large new TIAA policy. Putting it another way, for roughly the same outlay as before you can now begin a new policy that provides twice as much immediate protection for your family!

Here's what men and women aged 35, for example, now pay for 5-Year Renewable Term policies of different amounts:

First-Year Premiums for TIAA 5-Year Renewable Term Policies

Policy Amount ►	\$50,000	\$100,000	\$150,000	\$200,000	\$250,000
Issued to men aged 35					
First-year premium	\$126.75	\$169.00	\$253.50	\$338.00	\$380.25
Premium per \$1,000	\$2.53	\$1.69	\$1.69	\$1.69	\$1.52
Issued to women aged 35					
First-year premium	\$110.25	\$147.00	\$220.50	\$294.00	\$330.75
Premium per \$1,000	\$2.20	\$1.47	\$1.47	\$1.47	\$1.32

As you can see, premium rates for policies of \$100,000 to \$249,000 are ⅓ less than those for smaller policies, and for policies of \$250,000 or more, they're 40% less. Substantially lower first-year premiums for all ages and big discounts for larger policies encourage everyone to consider the higher levels of family protection they may have felt they just couldn't afford until now.

Premiums for MOD ONE policies increase beginning with the second year, but generous dividends, credited concurrently, will automatically reduce those premiums. Under the present dividend scale, expected payments for the second and subsequent years of the 5-year policy period in the examples above will be identical to the premium for the first year shown. While dividends cannot be guaranteed for the future, of course, TIAA has paid dividends on life insurance each year since 1918.

To receive personal illustrations of new MOD ONE policies, mail the coupon, or phone the TIAA Life Insurance Advisory Center Toll Free at 800-223-1200 (in New York, call collect 212-490-9000). No one will call on you as a result of your inquiry.

Eligibility to apply for TIAA life insurance is extended to employees of colleges, universities, private schools, and certain other nonprofit educational and research institutions. The employee's spouse is also eligible provided more than half of their combined earned income is from a qualifying institution.

Note to present TIAA policyowners: MOD ONE premium rates apply only to policies issued on or after October 1, 1982, but cash dividends payable in accordance with the 1982 scale will continue to provide equitable treatment for policies issued prior to that date.

*Modified first-year premium.



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S303

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Please mail me the facts about new TIAA MOD ONE life insurance policies with personal illustrations of low-cost Term policies for my age.

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Nonprofit educational or scientific employer
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If your spouse is also eligible according to the rules at left, please

fill in: Spouse's name _____ Birthdate _____

SCIENCE/SCOPE

Fusion energy machines that would turn sea water into electricity, though still 20 years away, are closer to fulfilling their promise of satisfying much of the world's energy needs. In plasma-heating experiments, Hughes Aircraft Company researchers have demonstrated the highest-performing gyrotron yet. It produced 285 kilowatts at 60 gigahertz at 45% efficiency under pulsed conditions. The short-range goal is to generate 200 KW at 60 GHz with long pulses in excess of 100 milliseconds. The long-range goal is 1 megawatt at 100 GHz. The Oak Ridge National Laboratory sponsors the program for the U.S. Department of Energy.

The electronic rocket engine is ready to be tested aboard a satellite to see how well it functions in the company of other space hardware. Hughes has delivered two engines, called mercury ion thrusters, for installation on a U.S. Air Force research satellite. The goal of the flight test is to qualify the system in space for performing such auxiliary propulsion functions as stationkeeping, attitude control, and orbit maneuvering of spacecraft. The system is designed to replace traditional chemical and gas propulsion systems, saving hundreds of pounds of weight. In operation, the thrusters are powered by the satellite's solar cells, which convert sunlight into electricity.

A new mobile radar automatically detects and tracks low-flying aircraft despite such severe clutter as a mountainous background. The Low Altitude Surveillance Radar (LASR) uses three-dimensional pulse doppler technology to pinpoint rapidly the location and altitude of ground-hugging aircraft. Current ground-based radars, with their broad-beam scanners, have trouble distinguishing a target from its background. LASR's pencil beams, which are much narrower, reduce clutter. Aircraft therefore can't hide in clutter for a surprise attack against front-line troops and armor. A prototype Hughes LASR tracked hovering helicopters and subsonic aircraft at altitudes from 10 to 6,000 feet.

Technologies of laser holography and diffraction optics have led to an experimental visor for protecting military pilots from potentially blinding laser beams. The visor reflects light at wavelengths used for lasers without significantly reducing visibility. It would replace devices employing dyes, which produce distracting discolorations, absorb light, and cut visibility. Designed by Hughes for the U.S. Navy, the visor could be adapted for ground troops.

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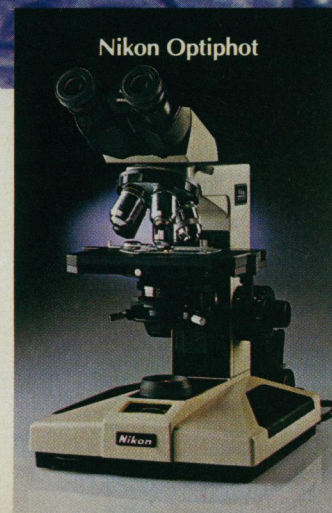
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Progress Report on Engineering Education

The need for action to meet the national crisis in engineering education remains acute. That is a chief conclusion of a follow-up report on the National Engineering Action Conference (NEAC) held last April.* The report was based in part on a survey of 32 engineering deans conducted by the Project on the Engineering College Faculty Shortage.† The deans agreed, usually by large margins, that:

- The engineering faculty shortage remains critical.
- Engineering schools are still losing faculty to industry, though at somewhat lower rates.
- Engineering faculty salaries are being raised.
- Graduate enrollment is noticeably increasing.
- Equipment and facility problems are beginning to be addressed.

Much remains to be done. As noted in a recent report,‡ the present dangers to the quality of engineering education have been masked by the abilities of the students accepted by the engineering schools. Admissions officers now have the dubious luxury of being even more selective. Thousands are being turned away as the engineering schools struggle to maintain educational quality by balancing resources against enrollments.

While the nation strives to upgrade industrial productivity, expand employment, and bolster national security, the engineering schools are being forced to forgo invaluable opportunities to produce young engineers with educations commensurate with their talents. Between 1975–1976 and 1980–1981, the ratio of students to faculty at most institutions shot up 30 to 50 percent. In overcrowded lecture halls, students are seen but not heard. In crammed laboratories, where experimental work deteriorates into mere demonstration, students may look but not touch. And with grossly inadequate capital budgets at the schools, students can read about state-of-the-art equipment but almost never use it.

There are, however, tangible signs of progress. At the state level, the Project on the Engineering College Faculty Shortage has cataloged more than 50 initiatives proposed to state governments by local academics, industry, and the professional societies. Almost half of these have brought funding by state governments, and many entail joint funding with industry. A similar catalog shows that industry has committed at least \$75 million to meeting the problem in the form of faculty grants, fellowships, equipment donations, and university-industry cooperative research agreements. To this can be added IBM's new \$50 million program to support education in manufacturing systems engineering. At the federal level, write-off provisions in the Economic Recovery Tax Act of 1981 have stimulated equipment donations to colleges and universities. And the National Science Foundation and the Department of Defense have expanded their programs-in-aid to engineering education.

In short, within this diverse, pluralistic nation, the movement to protect the quality of engineering education is gaining momentum. But the needs still far outweigh the resources being applied. In the few months since NEAC, perhaps the most hopeful sign is the growing realization that all the sectors involved can and must help resolve the situation. Many models exist, including the "action examples" produced by NEAC and those collected by the Project on the Engineering College Faculty Shortage. In reaching our pressing national goals, success will depend to a great degree on how widely and well these models are translated into further action.

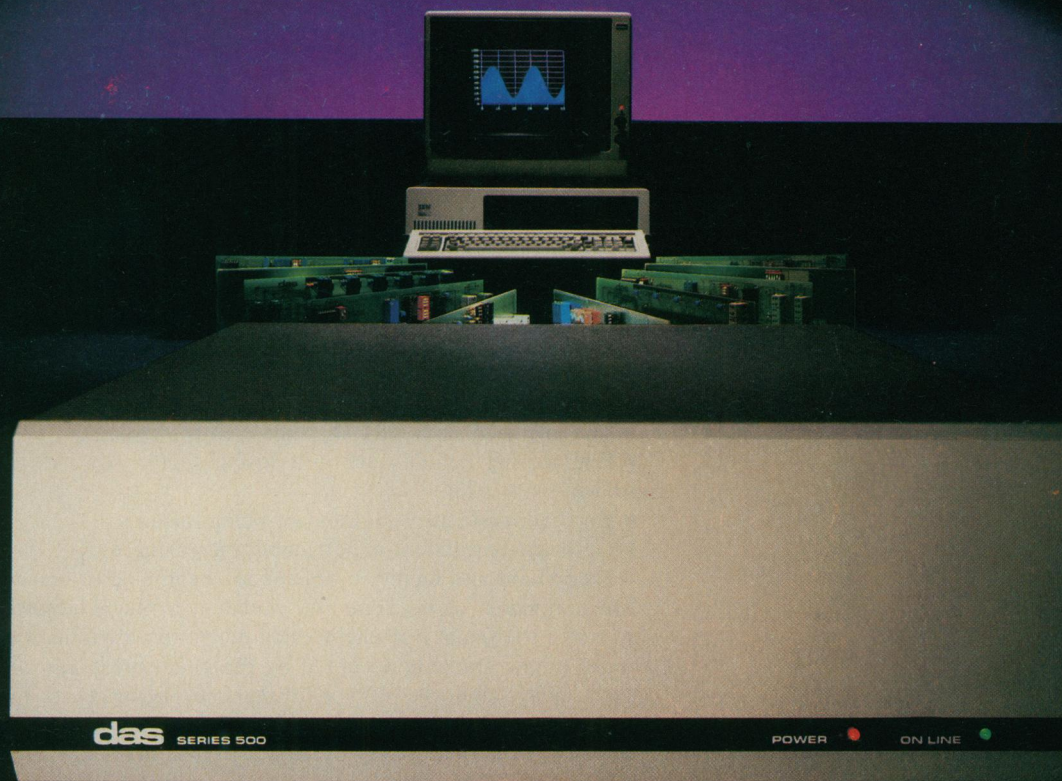
—EDWARD E. DAVID, JR., *President, Exxon Research and Engineering Company, Florham Park, New Jersey 07932*

*E. E. David, Jr., *Science*, 30 April 1982, p. 465.

†Sponsored by the American Association of Engineering Societies and the American Society for Engineering Education.

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