19 May 1978 • Vol. 200 • No. 4343 $1.50

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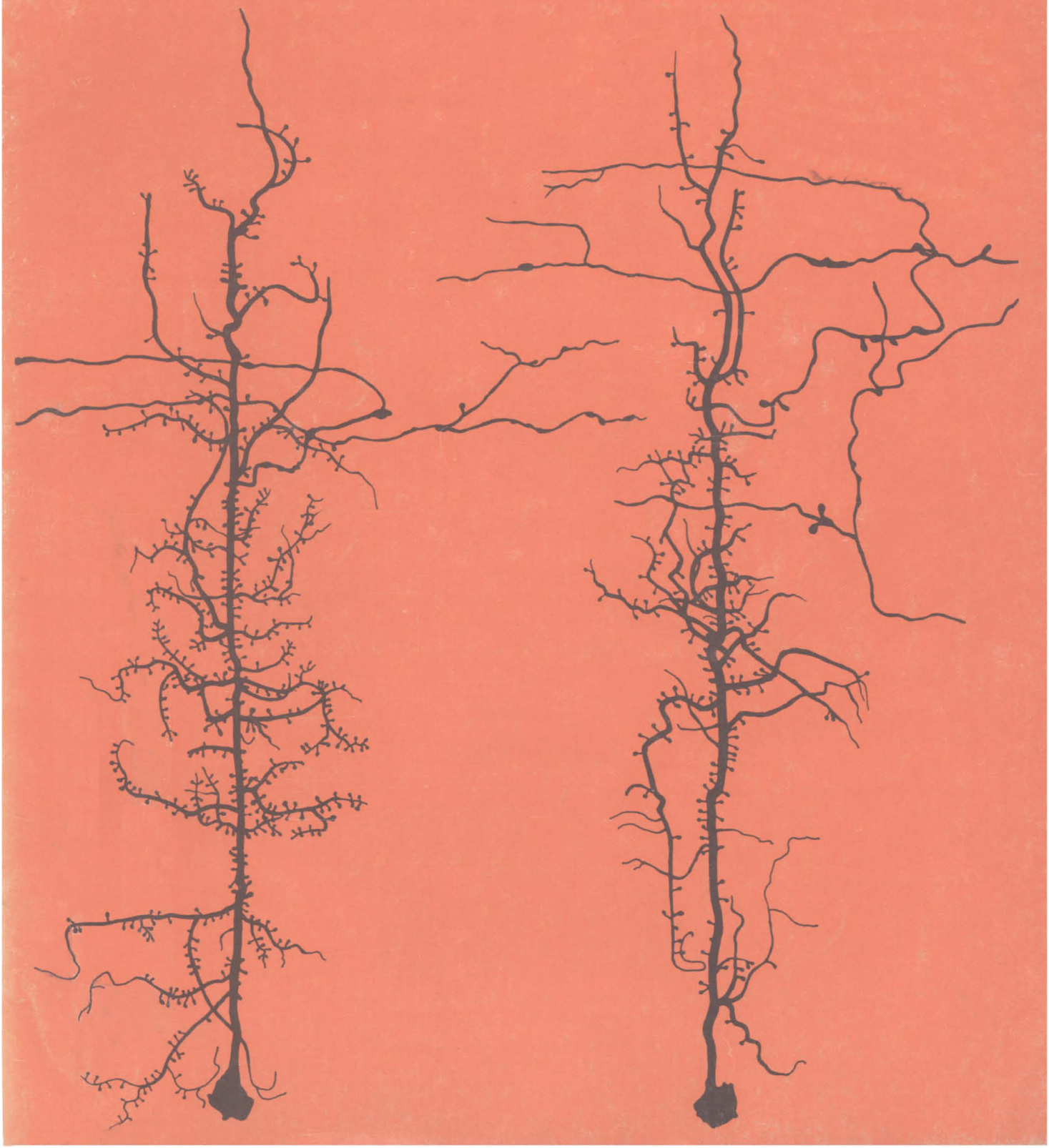

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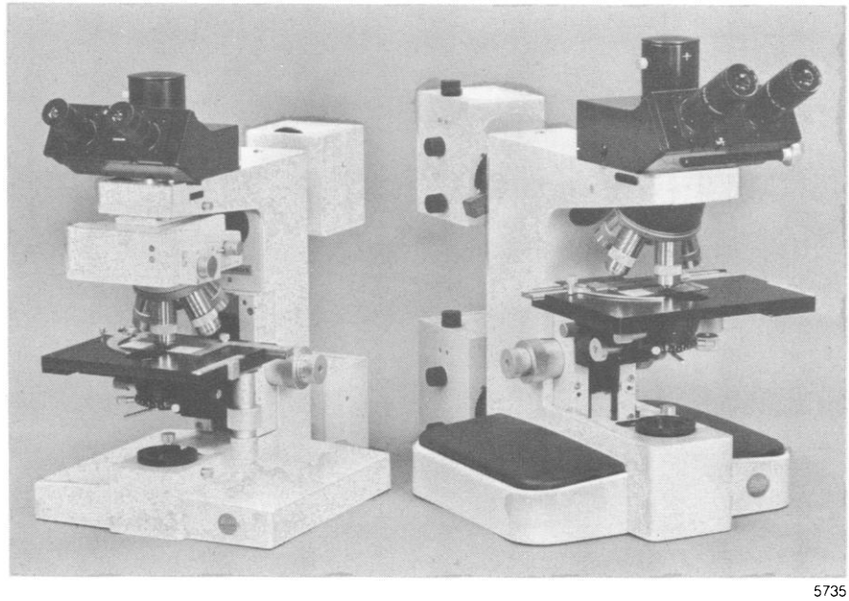

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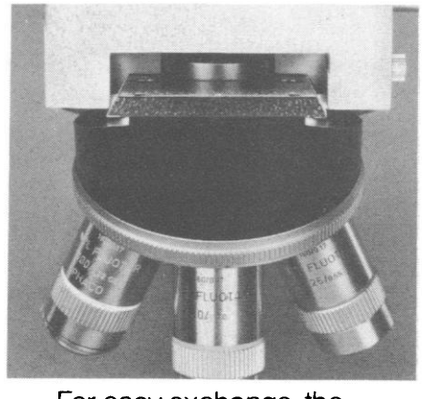

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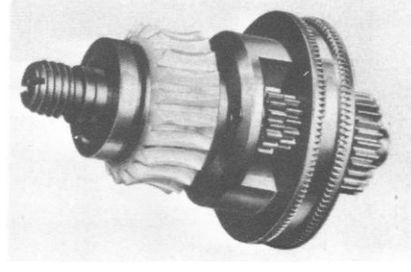

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20-Year Average Annual Costs* for $50,000 5-Year Renewable Term Policies

	Policies Issued To Men			Policies Issued To Women		
	Issue age 25	Issue age 35	Issue age 45	Issue age 25	Issue age 35	Issue age 45
TIAA	**$102.50**	**$213.50**	**$497.00**	**$ 81.50**	**$142.50**	**$316.50**
10 Largest U.S. Companies:						
Aetna	216.00	352.00	814.00	210.00	301.00	644.50
Connecticut General	223.00	378.50	816.50	204.00	313.00	673.00
Equitable	187.00	343.50	754.00	163.50	297.50	677.50
John Hancock	200.50	344.00	750.00	192.00	307.50	659.00
Massachusetts Mutual	196.00	337.50	737.00	184.50	313.00	683.00
Metropolitan	188.50	347.00	779.50	162.50	267.00	565.00
New York Life	189.00	337.50	751.00	171.00	281.00	602.00
Northwestern Mutual	163.00	300.00	684.00	147.00	264.00	592.00
Prudential	164.00	300.00	592.00	146.00	242.00	462.00
Travelers	200.50	360.50	820.00	182.00	281.00	603.00
Mean Cost for 10 Companies	**192.75**	**340.05**	**749.80**	**176.25**	**286.70**	**616.10**

*Based on 1977 premium rates and dividend scales, adjusted for interest (4%) to recognize the time value of money; dividends not guaranteed.

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the mean cost for $50,000 5-Year Renewable Term policies issued to 35-year old men by the ten largest companies is 59% higher, a dollar difference favoring TIAA, adding up to more than $2,500 over the next 20 years; even the company in the group that appears to offer the best bargain demands a cost 40% higher than TIAA's;

the mean cost for $50,000 policies issued to 35-year old women by the ten companies is double that of TIAA, indicating savings close to $2,900 for the person choosing TIAA; for the most attractive commercial policy shown, women will pay 70% more over the years than for a TIAA policy giving them the same benefits.

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Alan L. Fox, C.L.U. Joan Scott, C.L.U. Kenneth Sawyer Robert Cassidy

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Eligibility for TIAA is extended to employees of colleges, universities, private schools, and certain other nonprofit educational or scientific institutions, and to the employee's spouse when more than half of their earned income is from an eligible institution.

TIAA *The College World's Insurance Association*

ISSN 0036-8075

19 May 1978

Volume 200, No. 4343

SCIENCE

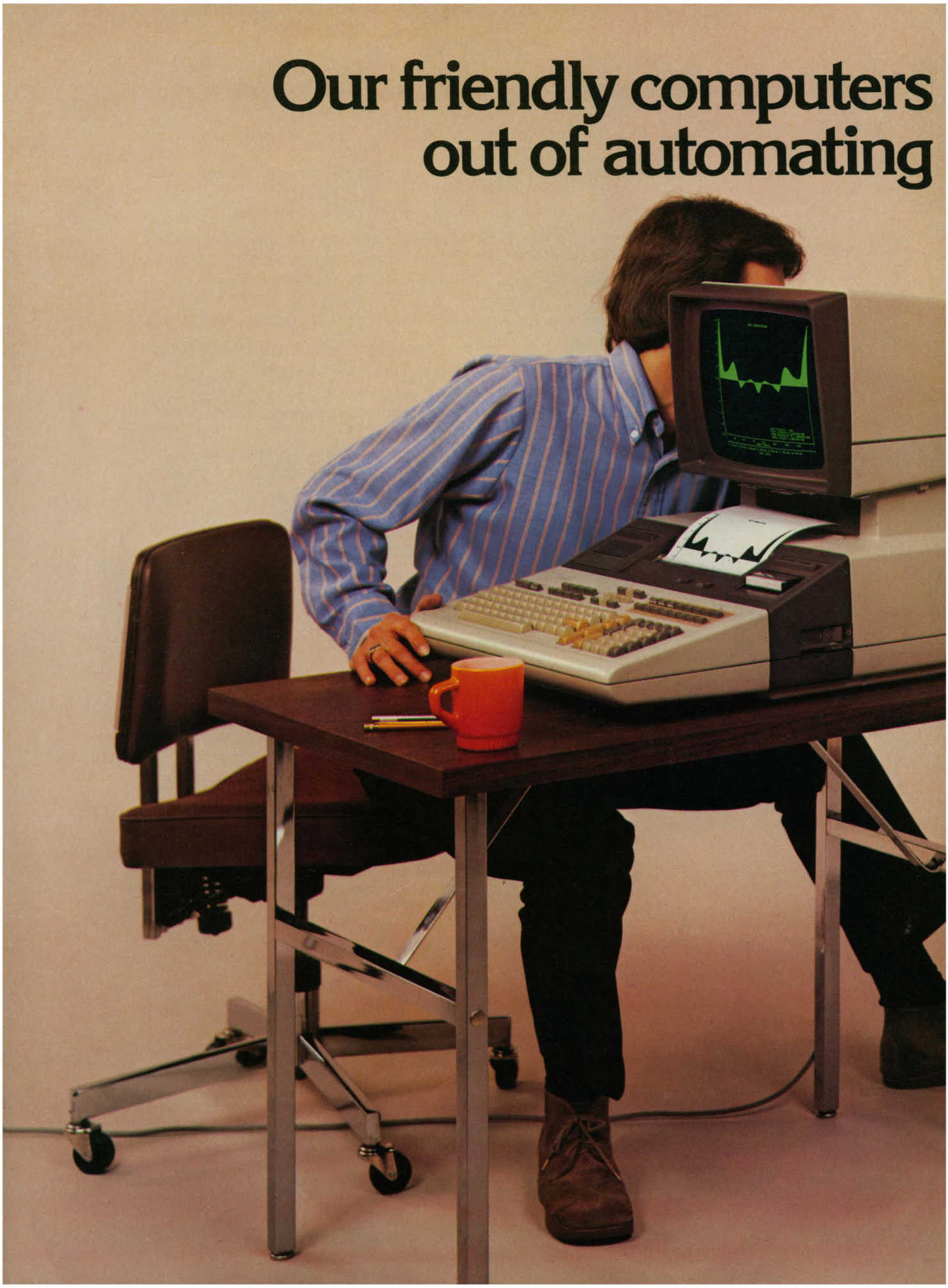
SCIENCE is published weekly, except the last week in December, but with an extra issue on the third Tuesday in September, by the American Association for the Advancement of Science, 1515 Massachusetts Ave., NW, Washington, D.C. 20005. Now combined with **The Scientific Monthly®**. Second-class postage paid at Washington, D.C., and additional entry. Member rates on request. Annual subscriptions $65; foreign postage: Canada $10; other surface $13; air-surface via Amsterdam $30. Single copies $1.50; $2 by mail (back issues $3) except **Guide to Scientific Instruments** $6. School year subscriptions: 9 months $50; 10 months $55. Provide 6 weeks' notice for change of address, giving new and old addresses and postal codes. Send a recent address label, including your 7-digit account number. **Postmaster: Send Form 3579 to *Science*, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005.** ***Science*** is indexed in two general periodical indexes—**Readers' Guide to Periodical Literature** and **Monthly Cumulating Periodical Index**—and in several specialized indexes.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

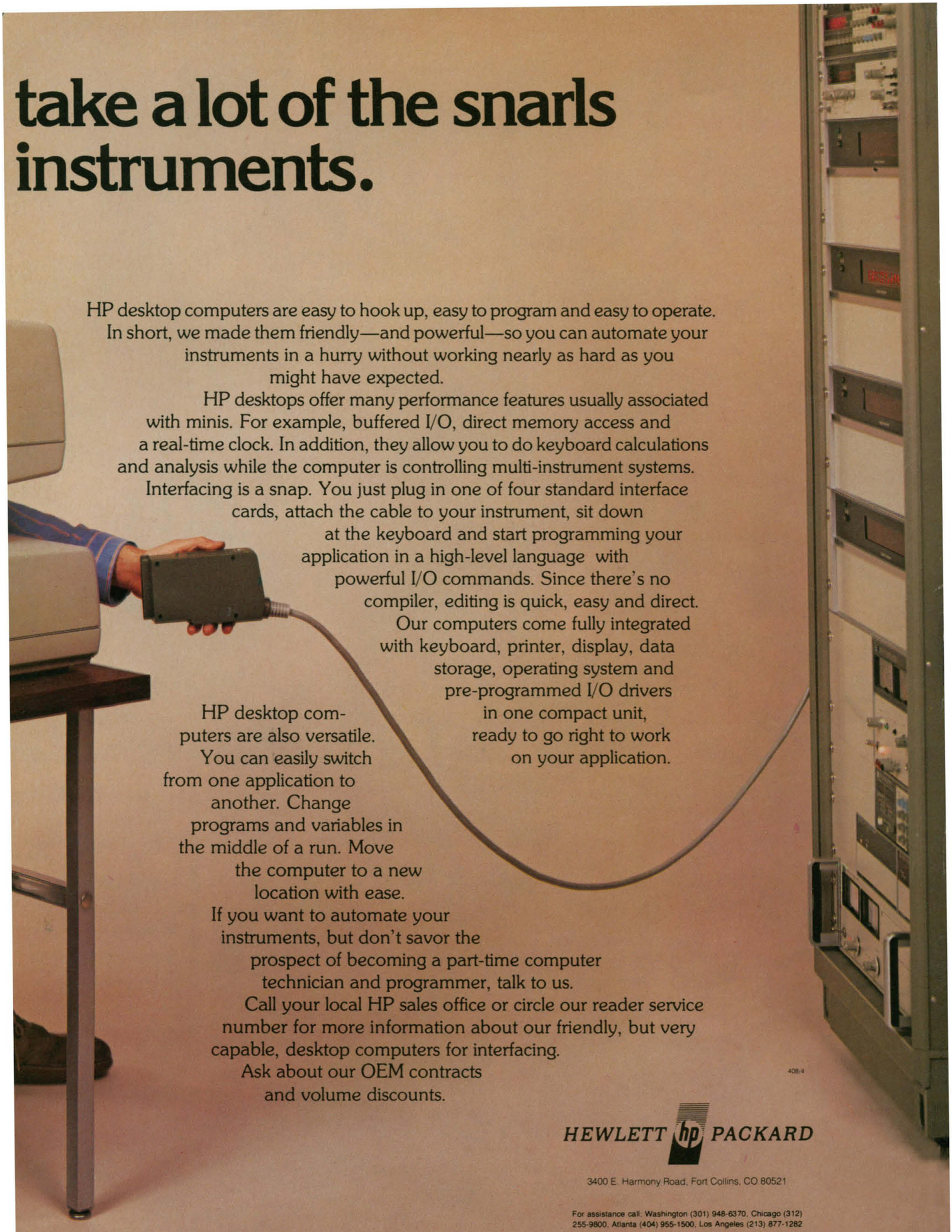
COVER

Spined pyriform interneurons found in the optic tecta of African jewel fish (*Hemichromis bimaculatus*). The left interneuron came from a community-reared fish and has more spines, as well as spines with shorter stems on the lower dendrites, than those on the right interneuron from an isolation-reared fish. See page 787. [Golgi illustration (× 630) by Richard R. Coss, University of California at Davis]

Our friendly computers out of automating



take a lot of the snarls instruments.



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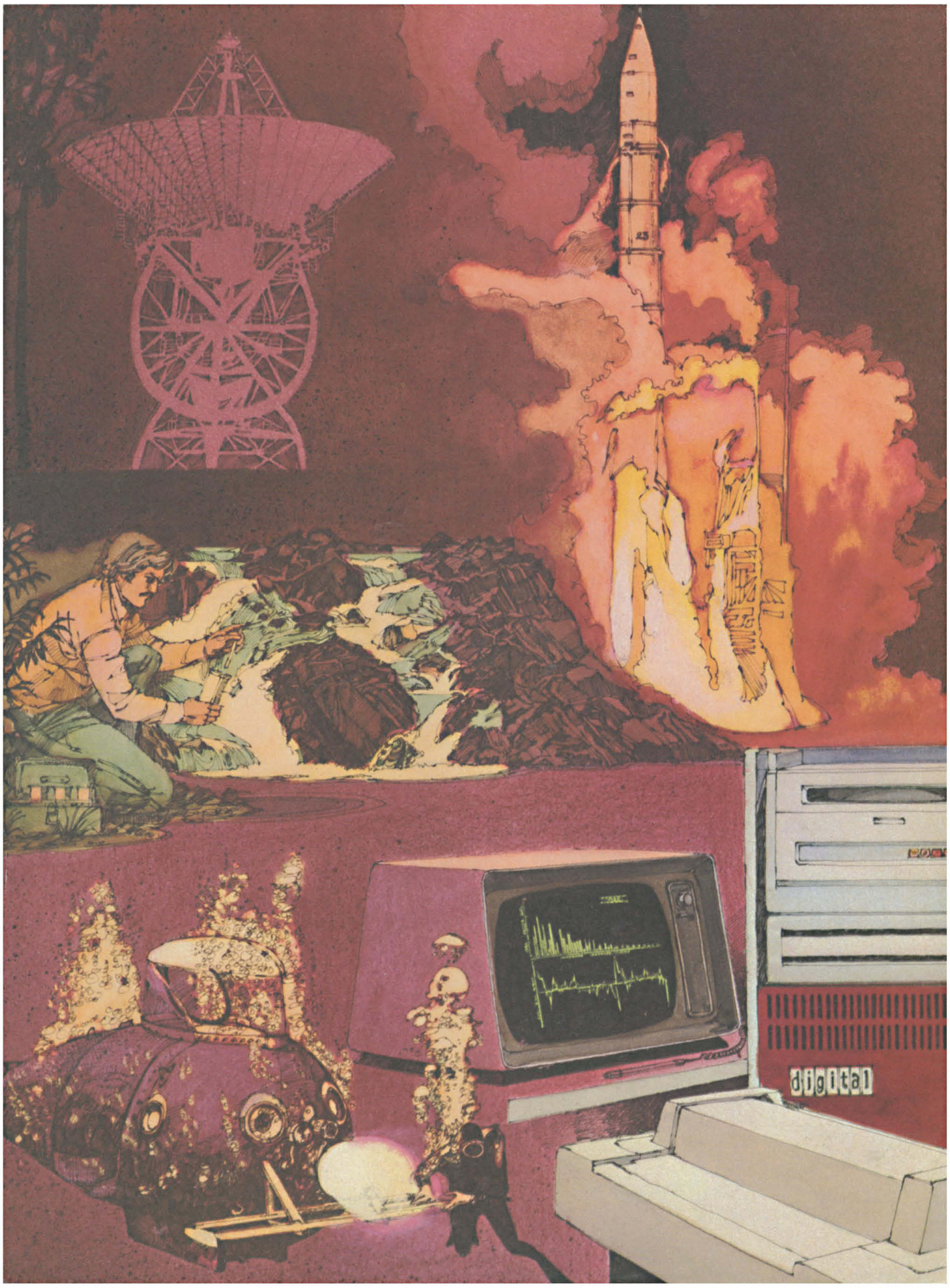
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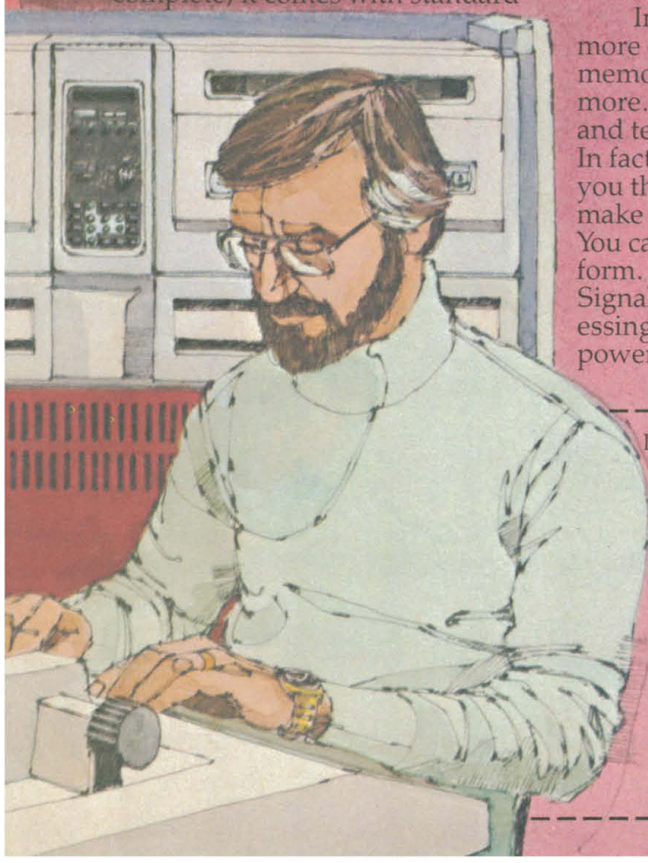

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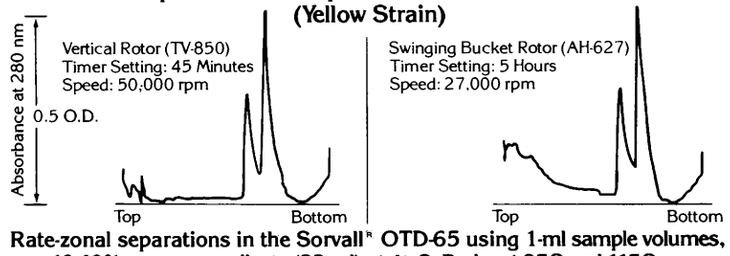
Separation of Cowpea Mosaic Virus Particles (Yellow Strain)



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- Asbestos disease in employed and high-risk groups
- Can an acceptable standard for industrial use of asbestos be projected?
- The vexing shipyard problem
- What to do about the asbestos currently in place in industry The problem of maintenance, demolition, waste disposal
- Environmental asbestos disease
- Public health control of environmental asbestos disease
- Problems in the care of the injured workman
- Anticipation of future problems

Health Effects of Halogenated Aromatic Hydrocarbons June 24, 25, 27

- Production, chemistry and distribution
- Animal toxicity and metabolism
- Human health effects
- Neurological and behavioral abnormalities
- Carcinogenicity
- Reproductive effects
- Immunological abnormalities
- The Hudson River—a case study
- Surveillance of future environmental contaminants

Public Control of Environmental Health Hazards June 28, 29, 30

- The scientific basis for estimating risk
- The consequences of environmental hazards to human health
- Scientific uncertainties in evaluation of environmental disease
- Social responses to estimated risks of environmental disease
- Public involvement in risk assessment and standard setting
- International differences in decision-making on environmental controls
- Unresolved issues in the conflict between individual freedom and social control
- Approaches to public control of environmental health hazards
- Theory and practice in risk-benefit analysis
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- Prospects for the control of environmental disease

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3rd ANNUAL AAAS COLLOQUIUM ON

R&D POLICY
R&D in the Federal Budget
R&D, Industry, & the Economy

20-21 June 1978
Mayflower Hotel
Connecticut Avenue, NW
Washington, D.C.

The AAAS R&D analysis project, sponsored by the AAAS Committee on Science and Public Policy and initiated in 1976, has resulted in two well-received books on research and development in the federal budgets for FY 1977 and FY 1978, and two highly successful colloquia in June of 1976 and 1977, attended by 200-250 AAAS members, government officials, and others.

The third annual AAAS report on R&D in the federal budget for FY 1979 and including a special section on R&D in industry and its impact on the economy will be the subject of the 3rd AAAS R&D Policy Colloquium. This June colloquium will offer a forum for constructive discussion of current issues in federal and industry R&D with officials of the Executive and Legislative branches and leaders from industry and universities. ***Research & Development: AAAS Report III*** by Willis H. Shapley and Don I. Phillips, will be available for the June 1978 colloquium.

Colloquium Topics

Topics to be discussed by leaders in government, industry, and the scientific and technical community will include:

Federal R&D - Policies and Issues

- **Current Policy Issues in R&D:** Carter administration R&D policies; federal support of basic research; policies for applied research and technology development; the "investment" concept of R&D.
- **R&D Issues in the Budget:** Issues in the FY 1979 budget; issues to be faced for FY 1980.
- **Impacts of Federal R&D:** Institutional impacts of current R&D policies and budgets on universities, federal agencies, laboratories, and industry.
- **Problems for the Future:** Future levels of federal R&D support; management and utilization of R&D funds; over-bureaucratization of federal R&D.

R&D in Industry and the Economy

- **Factors Governing Industry Investment in R&D:** Economic and financial problems; federal policies; federal regulations.
- **R&D and the Economy:** Relationships of R&D investment to future economic welfare; economic justifications for R&D.
- **R&D Investment Required:** Possible industry underinvestment in R&D; the proper level of investment might be determined; what actions industry or government should take.
- **Need for Better Understanding:** Further studies needed; problems of obtaining more meaningful data; possible useful roles of AAAS, its affiliated societies, and of industrial groups.

3rd R&D Colloquium Washington 20-21 June 1978

The third AAAS R&D Policy Colloquiu m will be held on Tuesday and Wednesday, 20 and 21 June 1978 at the MAYFLOWER HOTEL, 1127 Connecticut Ave., NW, Washington, DC 20036. [Although commercial parking is available in the vicinity of the Mayflower, the Hotel is a short walk from the Farragut North (Red Line) and Farragut West (Blue Line—connecting to National Airport) Metro stops.]

AAAS Colloquium (20-21 June) Advance Registration; enclosed is:

- ☐ **$80** Full Registration (includes lunch on both days, dinner on Tuesday, the R&D: FY 79 Report, and the Colloquium Proceedings)
- ☐ **$45** Partial Registration (includes Report and Proceedings only)
- ☐ **$25** Student Registration (includes Report and Proceedings only; available to full-time graduate or undergraduate students only)

Separate Meal Tickets (lunches at **$12** and dinner at **$16**):
☐ lunch on Tues., 20th; ☐ dinner on Tues., 20th ☐ lunch on Wed., 21st

Previous Reports and Proceedings (at **$5** each):
☐ R&D: FY 78; ☐ R&D: FY 77; ☐ Proc. 77 Col. ; ☐ Proc. 76 Col.

Program, badge, meal tickets, and R&D: FY 79 Report will be sent about 12 June; previous reports ordered will be sent as soon as possible; Proceedings of 78 Colloquium will be sent as soon as available.

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*Plus 8% D.C. sales tax; for special government-employee discount, present evidence of employment at time of Hotel Registration and ***check here*** ☐

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Be sure to list definite arrival and departure date and time. Hotel reservations will be held only until 6 p.m. unless otherwise specified. Check out time is 3:00 p.m.

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LETTERS

Methylchloroform in the Stratosphere

In the report by McConnell and Schiff (13 Jan., p. 174), the authors imply that the staff of the Environmental Protection Agency (EPA) has been unaware of or unconcerned about the potential problem of stratospheric ozone depletion by methylchloroform. The first published work suggesting an appreciably longer half-life than the about 1-year lifetime cited by the National Academy of Sciences (*1*) apppeared in 1977 (*2*). On 14 March 1977, Walter C. Barber, director of EPA's Office of Air Quality Planning and Standards, sent a memorandum to Ken Johnson, EPA's acting assistant administrator for toxic substances, on the "Significance of methylchloroform and other halocarbon solvents to stratospheric ozone depletion." Barber stated (in part), "The purpose of this memo is to advise you that our proposed strategy to control photochemical oxidants may increase the emissions of low reactivity halocarbons which would affect the stratospheric ozone layer. . . . We are advised by Dr. Altshuller in his February 14 memo to Joe Padgett that recent investigations indicate that methylchloroform, and possibly other halocarbons, may contribute to the depletion of stratospheric ozone. If this is true, our present oxidant strategy may be working at cross-purposes to the Agency's efforts to safeguard the ozone layer. . . . I would appreciate your keeping my office informed of any decisions reached by your office regarding the significance of these compounds to stratospheric ozone depletion." EPA's Office of Toxic Substances is cognizant of the issue and is reviewing the scientific evidence accumulated to date.

The investigations mentioned were those reported by Singh (*2–3*) of SRI International, Crutzen and Fishman of the National Center for Atmospheric Research (*4*), and Crinn, Rasmussen, and Robinson (*5*) at Washington State University. All of these investigations were supported in part or fully by our laboratory in EPA's Office of Research and Development. We supported this research based on the perception we had that there was insufficient concern about the effects on ozone depletion caused by more persistent chlorinated and brominated hydrocarbons. We took this position as early as 1975 in a report issued in December of that year (*6*) and submitted to the subcommittee on public health and environment of the House Committee on Interstate and Foreign Commerce by

our laboratory. In that report (*6*, p. 11) we identified methylchloroform as a key compound for which measurements were required in the troposphere and stratosphere.

It should be clear that the EPA staff has been fully aware of the need to investigate methylchloroform's role in the depletion of stratospheric ozone and that we have been following the development of scientific evidence to support the need for action very closely.

A. P. ALTSHULLER
Environmental Sciences Research Laboratory, Environmental Protection Agency, Research Triangle Park, North Carolina 27711

References

1. *Halocarbons: Effects on Stratospheric Ozone* (National Academy of Sciences, Washington, D.C., 1976).
2. H. B. Singh, *Geophys. Res. Lett.* **4**, 101 (1977).
3. ———, *ibid.*, p. 453; *Atmos. Environ.* **11**, 819 (1977).
4. P. Crutzen and J. Fishman, *Geophys. Res. Lett.* **4**, 321 (1977).
5. E. P. Grimsrud and R. A. Rasmussen, *Atmos. Environ.* **9**, 1014 (1975).
6. Environmental Sciences Research Laboratory, *Report on the Problem of Halogenated Air Pollutants and Stratospheric Ozone* (Report No. 600/9-75-008, Environmental Protection Agency, Research Triangle Park, N.C., 1975).

McConnell and Schiff state that about 15 percent of the methylchloroform released at ground level shall enter the stratosphere, making it potentially significant in the depletion of stratospheric ozone. The authors also state that the Environmental Protection Agency has classified methylchloroform a "safe" chemical because of its low reactivity (inability to produce significant photochemical pollution), thereby possibly creating a stratospheric problem. It is implied that EPA decisions involving emission control strategies are made with consideration for the lower atmosphere and largely disregard the upper atmosphere.

I believe that several conclusions of McConnell and Schiff need to be restated in better perspective.

1) Methylchloroform is important from the point of view of stratospheric ozone depletion only when a large tropospheric residence time of 8 years is used in the model. Such a model allows the calculation that about 15 percent of the methylchloroform released into the atmosphere enters the stratosphere, thus making it significant to stratospheric ozone depletion.

2) The first study (*1*) suggesting that the tropospheric residence time of methylchloroform is 7 years was published about a year ago. A second study refined the earlier analysis and suggested a tropospheric residence time of 8 to 11

years, with 8 years as the best estimate (*2*). This estimate was supported by Crutzen (*3*) with the application of his photochemical model.

3) All information available before 1977 suggested a tropospheric lifetime for methylchloroform of from 1 to 2 years (*4*, *5*). The National Academy of Sciences report published in 1976 calculated the residence time as being between 1.0 and 1.4 years (*4*).

4) Should the residence time of methylchloroform in the troposphere be 1 to 2 years, as was believed before 1977, the conclusions of the study presented by McConnell and Schiff would be invalid and the impact of methylchloroform on the stratosphere would not be significant.

5) Because the EPA control strategies referred to by the authors were formulated before 1977, it was quite justifiable to call methylchloroform a "safe" solvent. A tropospheric residence time of 1 to 2 years would mean that methylchloroform was unreactive enough to not cause photochemical pollution problems, but reactive enough to have no serious impact on the stratosphere. In addition, the stratospheric ozone destruction by chlorine-containing chemicals was probably not known at the time the EPA strategies were formulated. Thus, a case for disregard of the upper atmosphere cannot be made against EPA based on the history of EPA regulations dealing with the control of methylchloroform.

6) A longer residence time for methylchloroform in the troposphere has implications far beyond the impact of methylchloroform alone. Reduced hydroxyl radical (HO) concentration ($\approx 4 \times 10^5$ molecules per milliliter) is implied that would result in longer residence times of a vast number of atmospheric pollutants. The significance of low HO levels to the lower and upper atmospheric pollution has already been discussed in the literature (*1*–*3*). The authors appear to have "tuned" their model to achieve these low HO concentrations in order to "force fit" an 8-year methylchloroform residence time. These low HO values are in disagreement with the values in the authors' own earlier publications, as well as most other models in existence (*4*, *5*). To the best of my knowledge, Crutzen (*3*) is the only modeler who has effectively reconsidered his model and supported the hypothesis of reduced HO levels. It is commonly agreed however, that most models can be "tuned" easily to calculate low HO levels, so the results cannot be considered as confirmatory evidence (*6*). Direct measurements of HO have yet to conclusively support the hypothesis of reduced HO levels.

While I personally support a methylchloroform lifetime of 8 years, the authors have presented conclusions based on information that has only been proposed in the last year. Since the matter of longer methylchloroform lifetime in the troposphere (or low HO values) has not yet been conclusively resolved, the wide range of uncertainties should be considered. The lack of consideration of these uncertainties is a significant omission in the report by McConnell and Schiff. The inference that EPA decisions disregard the upper atmosphere may or may not be true, but the example of methylchloroform is a poor one with which to make such a case. The need for nontoxic chemicals (solvents) with lifetimes of 0.5 to 1 year ("safe") still remains a desirable goal that is consistent with the upper and lower atmospheric requirements.

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6. V. Chang, private communication.

We are sorry that the authors of the above letters have interpreted our report as an attack on the Environmental Protection Agency. This was certainly not our intention. We undertook the work primarily to study the possible effects of reasonable scenarios for future methylchloroform releases on the ozone layer. The results made it worthwhile to draw attention to the possibility that regulations directed to improvement in environmental quality at one location may simply transport the problem elsewhere.

This is precisely what did happen in the case of methylchloroform, albeit inadvertently. Legislation *was* enacted to restrict the use of trichloroethylene, and the result was a large-scale substitution of methylchloroform, for which no restrictions were indicated.

A preprint of our report was made available to EPA in November 1976. We were indeed impressed with the interest and quick response of EPA once they were alerted to the problem by our report and by others quoted in Altshuller's letter. It may be noted, however, that to

our knowledge the regulatory situation remains as described in our report.

In our calculations we did not "tune" our model to obtain hydroxyl radical (HO) concentrations to "force fit" the 8-year residence time for methychloroform. The HO concentration was generated by the model, as we described in detail. Singh is quite correct in stating that the residence time, and consequently, the conclusions reached, depends directly on the HO concentration. We have made this point very explicitly in the report. However, we also point out that there are constraints in any model calculations to any "tuning" for HO; in our case higher concentrations of HO would be incompatible with methylchloroform measurements. We understand that there are discrepancies among scientists' measurements of methylchloroform, particularly with respect to hemispheric ratios, and would support further measurements to improve the assessment of the problem.

In conclusion, we would not want to argue that EPA was unjustified in their 1970 regulatory action based on the scientific knowledge available at that time. But it does seem worthwhile to point out the need to be aware of the kinds of pitfalls that may ensue from regulations and to urge a continuing reassessment of their consequences in the light of new information.

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An Endothermic "Nessie?"

In Jean Marx's discussion of the dinosaur endothermy-ectothermy debate (Research News, 31 Mar., p. 1424), it is pointed out that dinosaur fossils have been recovered in Cretaceous Arctic Circle regions, where, perhaps, only endothermic animals could have survived.

Curiously, one of the arguments against the supposed *Nessiteras rhombopteryx* of Loch Ness (see *Science*, 9 Jan. 1976, p. 54) being a "prehistoric reptile" has been that such ectothermic animals could not survive in the almost constant 42°F temperature of the 1000-foot-deep loch.

If the endothermy school is correct, it makes the existence of *Nessiteras* more reasonable. Or, put the other way

around, maybe Jean Marx will, after all, see the day when a few dinosaurs are "rounded up and studied directly."

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Yale's Discontinued Department

The article " 'New wave in academia' wipes out department at Yale" (News and Comment, 17 Mar., p. 1189) contains several inaccuracies which should be put straight. The initiative for discontinuing the Department of the History of Science and Medicine at Yale did *not* originate in the School of Medicine. The fourth professor was George (not Charles) Rosen. At no time did the medical school "want to deploy the vacant professorship in a subject such as the ethics of medicine." In fact, the School of Medicine is currently engaged in a search for an individual to fill a senior faculty position at the rank of professor or associate professor as the head of a Section of the History of Medicine.

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Sex Differentials in Salaries: Faults in Analysis of Covariance

Much criticism has been leveled against the use of covariance procedures to adjust for known differences among populations in order to test for hypothesized differences among them. The criticisms offered by Woodward and Goldstein (9 Sept. 1977, p. 1096) of the research on "communication deviance in the families of schizophrenics" apply, with minor variations, to the work of Bayer and Astin (23 May 1975, p. 796) relative to salary differences between men and women on university faculties.

The major conclusion of Bayer and Astin is that men are paid more than women of similar academic rank, departmental affiliation (*1*), number of publications, and so forth. Variables such as number of publications are, however, fallible indicators of constructs, and being fallible they control incompletely for the target construct, research productivity. As a result, one cannot infer a salary differential because of sex from the analysis offered by Bayer and Astin.

Instead of reiterating criticisms of analysis of covariance offered by Woodward and Goldstein and many others, I refer the reader to Fig. 1, which is derived from Bayer and Astin's data (*2*). In that figure it is evident that there are sex differences in both number of publications and salary. However, inspection of this figure, and other figures (*3*) based on the means of other homogeneous groupings in the same population, indicates that there is no systematic salary differential attributable to sex per se. Although in some of these groups men seem to have been paid more than women, the opposite seems true equally often.

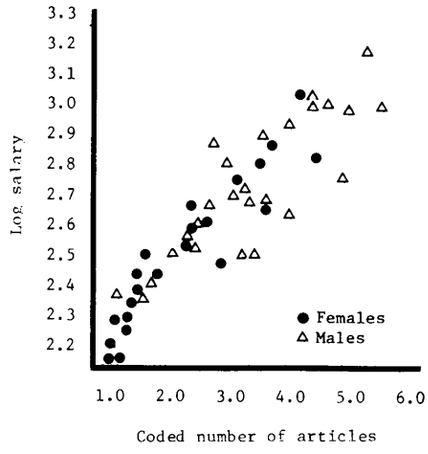

Fig. 1. Mean log salary plotted against mean number of articles for groups homogeneous with respect to sex, rank, and departmental affiliation (*3*). For each group $N \geq 25$.

In many respects this way of looking at the data is also vulnerable to criticism. No claim is made from this analysis that a sex differential in salary is not present. It seems reasonable to suppose, however, that one should be able to detect a sizable differential from inspection of such plots. On the other hand, the covariance analysis used by Bayer and Astin is known to be biased in the direction the results indicate: that is, the group higher on the fallible covariate will tend to appear disproportionately higher on the variate (when the variate and the covariate are positively correlated) even when there would be no such disproportionate difference if an infallible covariate were used.

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References and Notes

1. Departmental affiliation is a grouping of faculty according to kind of department: business, education, biology, physical sciences, social sciences, fine arts, humanities, health.
2. I thank Bayer and Astin for making these available.
3. Tables upon which Fig. 1 and the other figures are based are available from the author.
4. Supported by contract NIE-C-74-0115 from the National Institute of Education.

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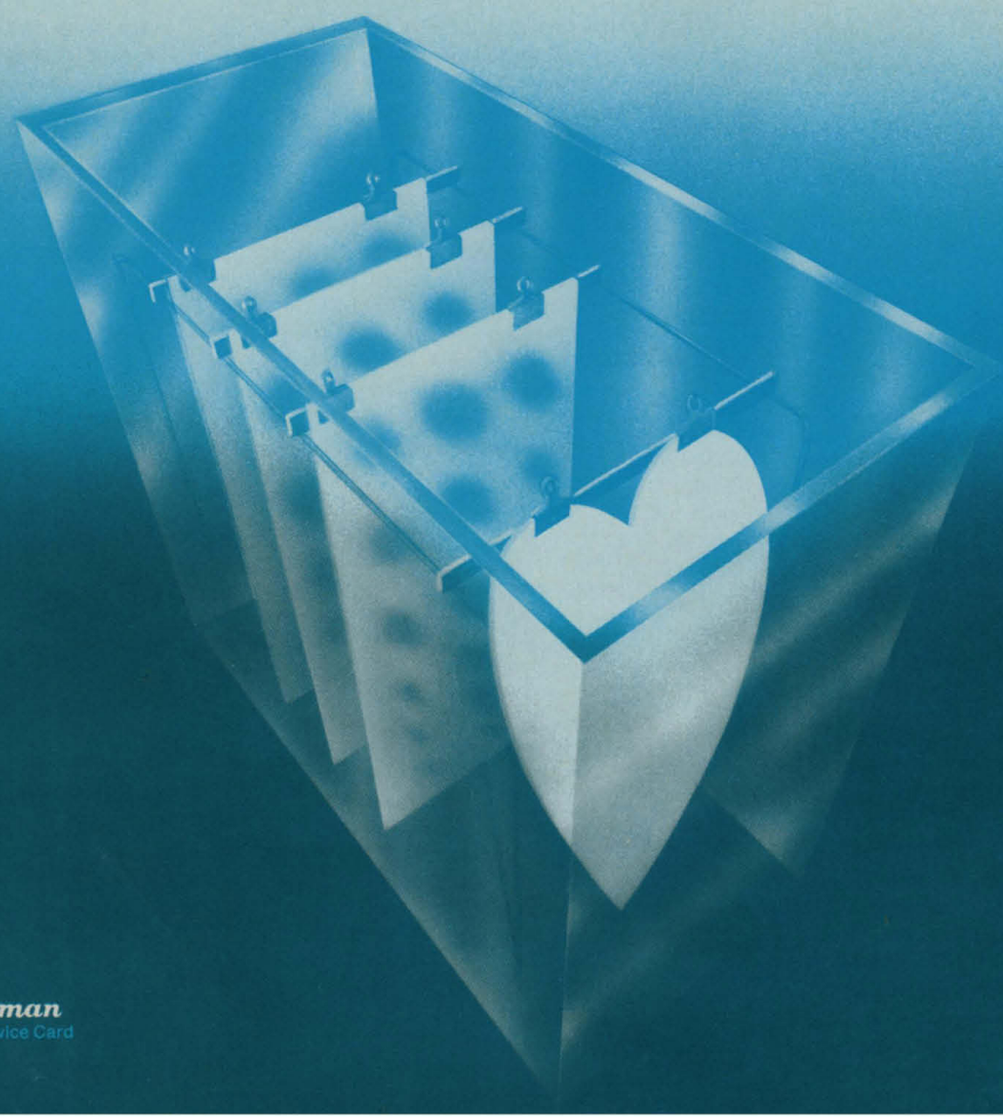

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19 MAY 1978, Volume 200, Number 4343 SCIENCE

Another Go at Federal Education

There is something beautiful and good in the vision of Cabinet rank for education. There is to be a seat at the table at last, in the heady company of defense, foreign affairs, and energy. There is a hopeful glimpse of new political power, built on a unified education constituency. Such is the spell wrought by the sorcery of reorganization.

Whether a remodeled government architecture ensures more quality and vitality in education in the United States is by no means clear. To paraphrase Thomas Huxley, size is not grandeur and territory does not make an educated nation. In the past three decades, federal education priorities have zigged and zagged and it is hard to put a name to what has come out of them, although there is evidence that federal leverage played a large role in opening up educational opportunity and that science curricula took a turn for the better. But given the built-in aversion to federal authority over the education process, expectations for striking change were too optimistic. The President sees balkanization of federal responsibility as a problem, and to an extent he is right. But pretentious efforts at reorganization are unlikely to make a difference unless driven by new consensus strategies, which to date have not turned up.

If little is to be gained by reorganizing federal education programs, the next question is whether something is to be lost. It is not an idle question, given the jarring news that the National Science Foundation is to be stripped of most of its science education programs. Although science education in NSF is not what it once was, it still commands and deserves respect in the scientific community. The prospect of its assimilation by the conglomerate department of education is unsettling, since no bill of particulars has been presented to show that a superagency would do more than distribute mediocrity uniformly.

Time was when science education made up half of the NSF budget, compared with only 8 percent of a larger budget now. If we understand the government's intentions, NSF's statutory charter for science education would not be revoked even though its programs would be handed off. Puzzling as that may be, what is even more troubling is the severing of science education from the major-purpose agency concerned with the state and progress of science. In a new education department dispensing $18 billion, the forlorn science education component would amount to two-tenths of a percent. One recalls a cherished footnote in federal budgets: "Totals may not add due to rounding." It is hard to believe that so frail a unit in so vast an empire could compete effectively in a contest of priorities.

In the absence of wars and space competitions, the importance of science education may not seem impressive to the reorganization experts. But only weeks ago the President was stressing the importance of science to our principal national purposes and calling for a new surge of technological innovation. He was right on both counts. If scientific research is a necessary public investment, surely it follows that science education is an equally necessary investment. Indeed, if a choice had to be made between more dollars for research and greater effort in science education, the case for the latter would be stronger. Human resources make or break investment in research.

Science education is not a priority that we have outgrown. As the knowledge base expands, increasing pressure is put on teaching. Both the proficiency of instruction at the secondary level and the effectiveness and competence of career counseling have profound meanings for higher education. A public which is asked to cope with difficult problems of choice in matters of health, consumerism, energy, and environmental balance can hardly assess uncertainty in the absence of better science education. There is a large and vexing job to be done. Government, which calls most of the signals for science, should be the first to understand this.—WILLIAM D. CAREY

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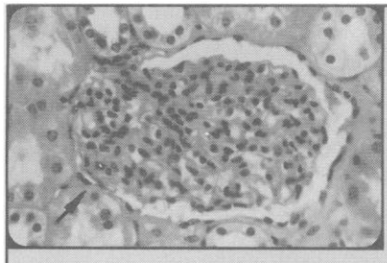

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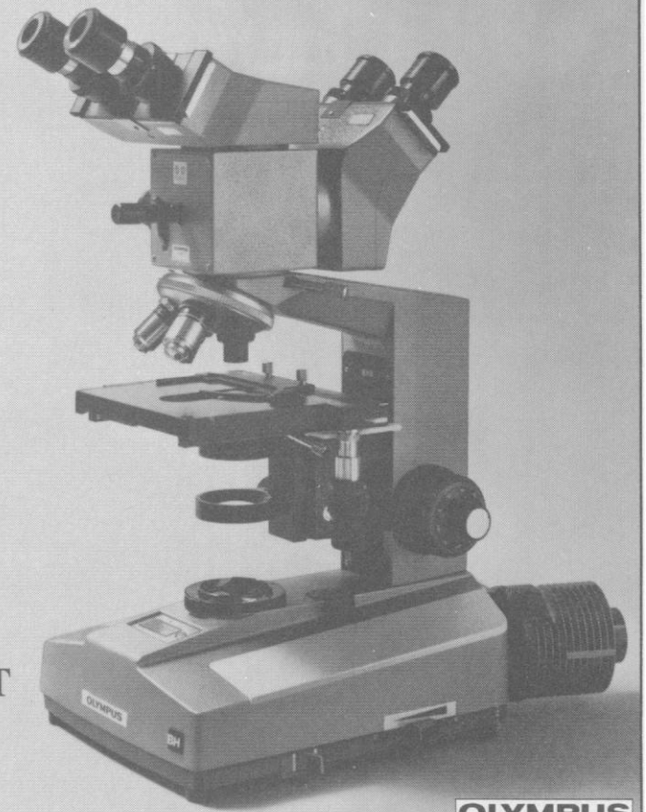

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