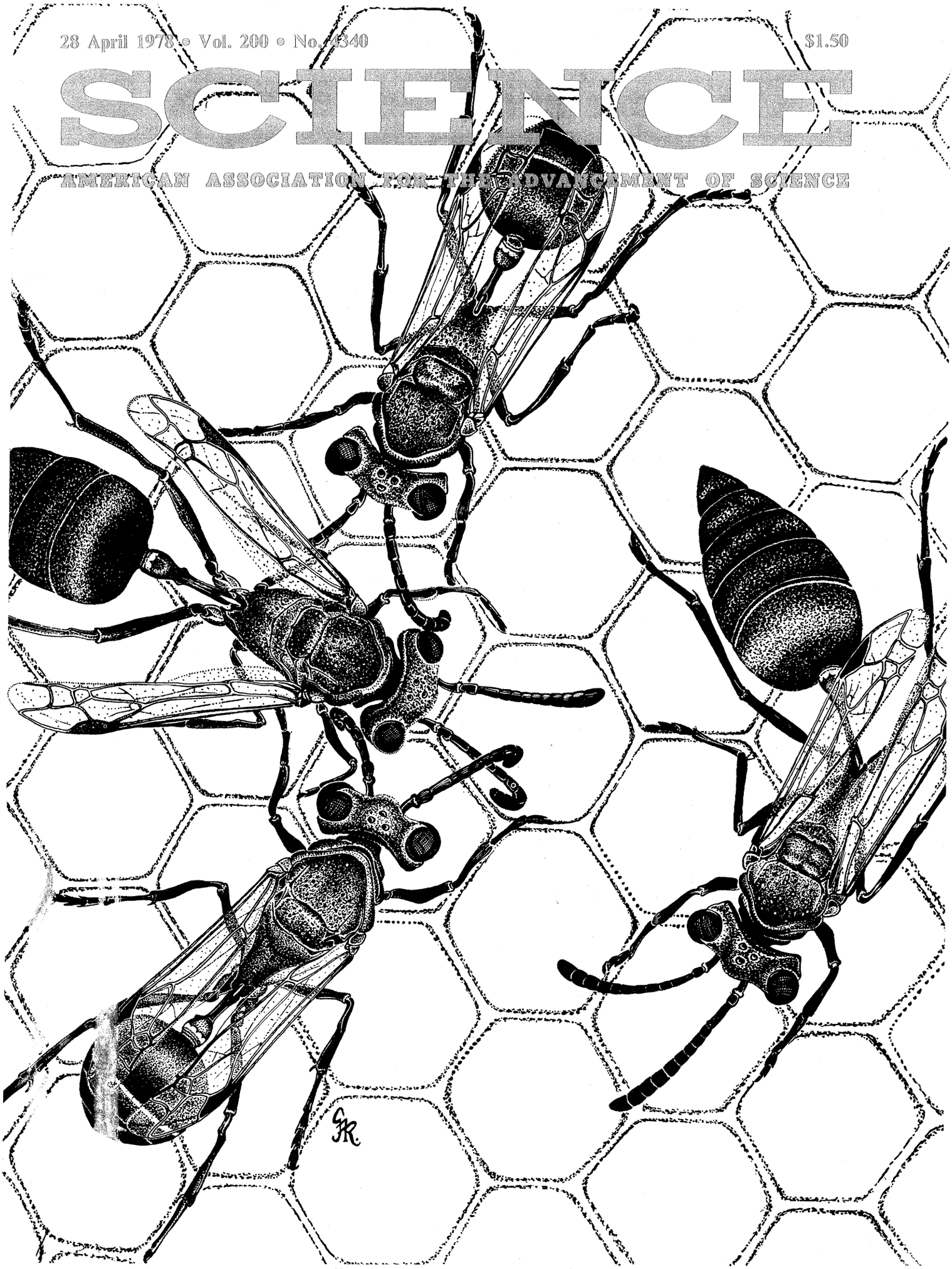
28 April 1978 • Vol. 200 • No. 4340 $1.50

SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



Best floor model. Best table top. Beckman offers them both.

For quiet-running, large capacity centrifuges, look to the Beckman J-6 and TJ-6.

J-6.

This outstanding refrigerated centrifuge spins six liters or six blood bags — 50% more than most floor models. Its modular Multi-Disc™ adapters are not only a delight to work with, they also hold a surprising number and variety of tubes.

For RIA, the new J-6 rack rotor takes 16 Biogamma™ racks; its design (patent pending) assures that all tubes receive nearly the same centrifugal force for more uniform separations. The six-place horizontal rotors hold even more RIA tubes: a total of 336 per run!

TJ-6.

This tabletop may well be the most popular new centrifuge ever introduced. It comes with refrigeration or without, and can spin 960 ml. Maxi-Carrier tube racks hold every popular-size tube, and more of them: up to 120 RIA tubes, for example. The TJ-6 also has a rotor bowl which lifts out for easy cleaning, stainless steel buckets which hold the tube racks and contain liquid in case of tube breakage, and a rotor imbalance detector.

These two superior centrifuges are what you'd expect from Beckman, the most respected name in centrifugation. For brochures on the J-6 and TJ-6 write to Beckman Instruments, Inc., Spinco Division, 1117 California Ave., Palo Alto, CA 94304. Ask for SB-480/490.

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ISSN 0036-8075

28 April 1978

Volume 200, No. 4340

SCIENCE

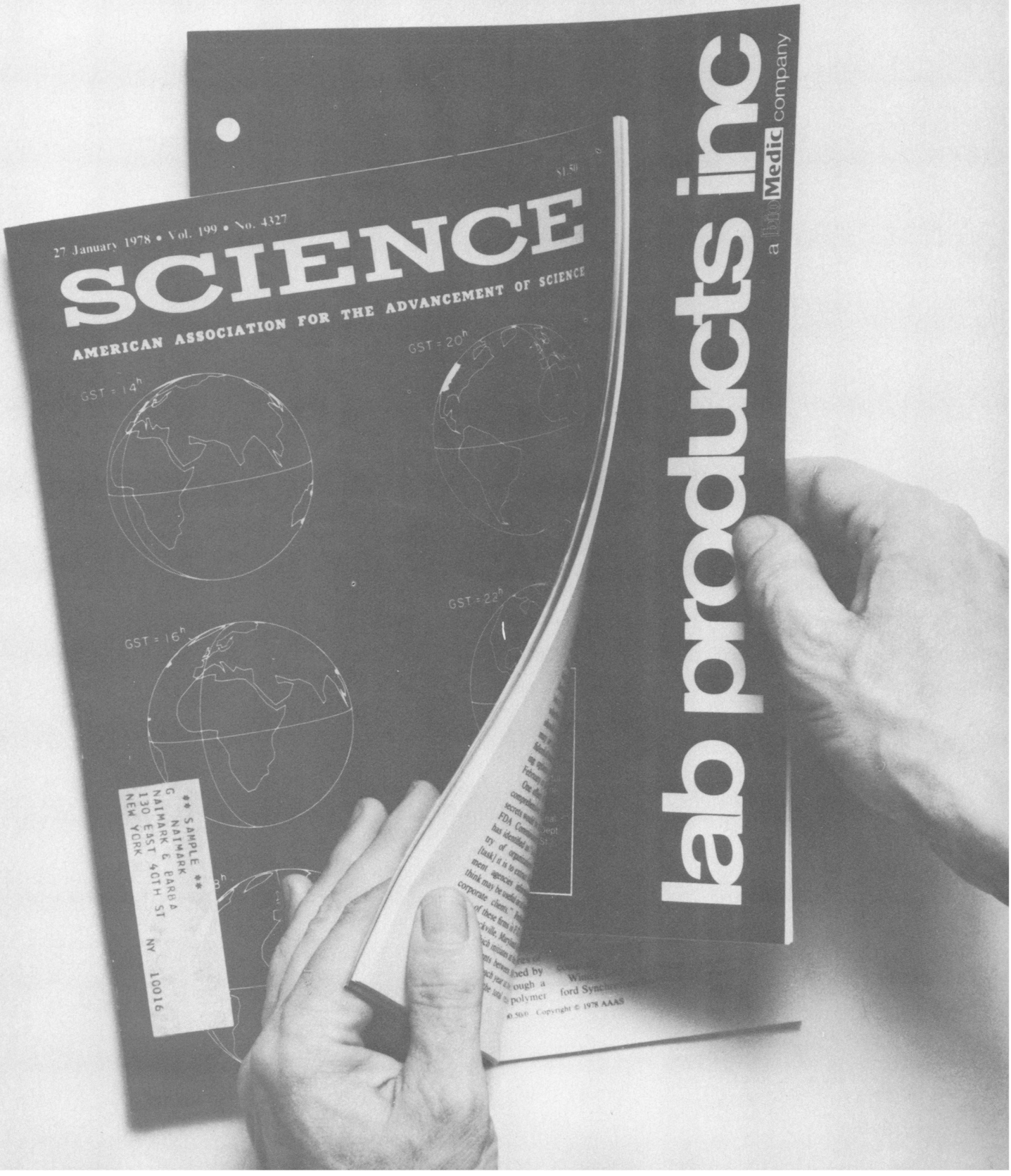
SCIENCE is published weekly, except the last week in December, but with an extra issue on the third Tuesday in September, by the American Association for the Advancement of Science, 1515 Massachusetts Ave., NW, Washington, D.C. 20005. Now combined with **The Scientific Monthly**®. Second-class postage 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

In the tropical social wasp *Metapolybia aztecoides* some subordinant egg-layers are sterilized by being forced to leave the colony or become workers. Dominance relations involved stereotyped displays: two workers "dance" at a queen (left center), while another queen (right) bends aggressively as they approach. See page 441. [Drawing by Gerardo Ravassa, Cali, Colombia]

"Whatever possessed you to run the entire 68-page Lab Products catalog in the January 27, 1978 issue of SCIENCE?"



A. We'll answer that if you'll first sit still for some "stage-setting".

Q. Like what?

A. Well, initially we ought to tell you a little about our client Lab Products, a most impressive designer, developer, and manufacturer of products for laboratory animal housing and care.

Q. Why so impressive?

A. Simply because they combine two rare qualities: (1) an unusual sensitivity to the needs of their marketplace, and (2) an innovative energy that enables them to interpret these needs skillfully and then to respond to them promptly.

Q. So?

A. So . . . as a result of all this, they have rapidly become leading suppliers of plastic cages, metal cages, laminar flow systems, bedding, automatic watering systems, etc. And that impressive product line is described in their 68-page catalog.

Q. Okay, but why then convert a 68-page catalog into what is probably the longest ad in scientific journal history?

A. Simply because this approach provided *instantaneous exposure* of the company's entire product line to the widest possible audience.

Q. But why—with all of the scientific journals available—was SCIENCE chosen for this signal honor?

A. For two compelling reasons. First, as the official organ of the AAAS, it provides access to that rather fantastic audience of approximately 150,000 *key* technical people. Secondly, almost *every* decision-making individual concerned with *any* scientific activity reads this magazine. This then virtually guarantees that almost every potential customer will see—and actually own—this catalog. And *now* . . . not some eight months from now.

Q. You've made your point . . . but who are *you?*

A. Naimark & Barba, Inc., an advertising/marketing organization that has serviced a wide range of technical and health care companies with traditional advertising services, marketing consultation, market research, the development of specialized books, etc.

Q. Just three final questions:
(a) How do I learn more about Lab Products?
(b) How do I learn more about SCIENCE?
(c) How do I learn more about you?

A. The three final answers:
(a) See the January 27, 1978 issue of SCIENCE or write Mr. George Gabriel, Chairman of the Board, Lab Products Inc. (a bioMedic • company), 365 W. Passaic Street, Rochelle Park, New Jersey 07662.
(b) Contact Mr. Dick Charles, Advertising Sales Manager, SCIENCE, 1515 Broadway, New York, New York 10036.
(c) Contact Dr. George M. Naimark, President, Naimark & Barba, Inc. at the address below.

Or use the coupon(s) below.

Naimark & Barba, Inc.
130 East 40th Street
New York, New York 10016
(212/Le 2-4566)

P.S. We don't just run 68-page catalogs in SCIENCE. Check this issue page 386.

Circle No. 276 on Readers' Service Card

Mr. George Gabriel
Chairman of the Board
Lab Products Inc.
365 W. Passaic Street
Rochelle Park, New Jersey 07662

☐ I'd appreciate a copy of your current catalog.

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New York, New York 10036

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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 Colloquium 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.

REGISTRANT'S NAME _____
(last name) (first and initial)

REGISTRANT'S AFFILIATION _____

REGISTRANT'S ADDRESS _____
(street and number)

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(city) (state and ZIP)

Mail to: AAAS Meetings R&D; 1776 Massachusetts Ave., NW; Washington, DC 20036

AAAS Colloquium (20-21 June) Hotel Reservation:

ROOM: ___ Single ($46*); ___ Double ($58*); ___ Twin ($58*)

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

ARRIVAL: Date _____; Time: _____

DEPARTURE: Date _____; Time: _____

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.

NAMES AND ADDRESSES OF ALL OCCUPANTS OF ROOM:

Name _____ Name _____

Address _____ Address _____

City_____State_____ZIP_____ City_____State_____ZIP_____

Mail to: AAAS Meetings R&D; 1776 Massachusetts Ave., NW; Washington, DC 20036

DIGITAL, APRIL, 1978.

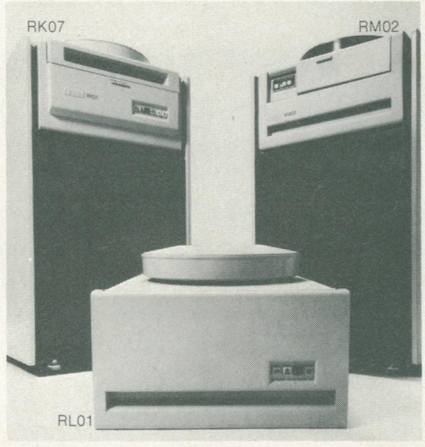
DIGITAL SPINS THREE NEW DISKS. $900, $450, AND $300 PER MEGABYTE.

The cost of disk capacity just plunged dramatically with the introduction of three new Digital disks.

The first is the new RL01, a 5MB cartridge disk, featuring an embedded track following servomechanism, universal power supply, and extraordinary simplicity—just 5 modules and 11 subassemblies. The RL01 plus controller is the lowest priced disk subsystem available from any minicomputer manufacturer. A typical RL01 subsystem, with a controller and two drives, offers 10MB for under $9,000...that's only $900 per MB.

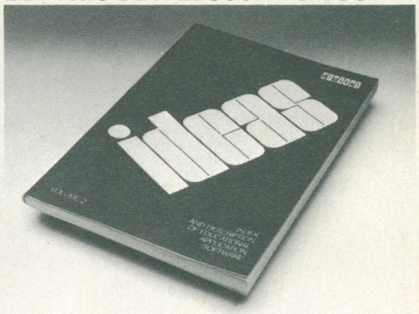
The new RK07 is a mid-range (28MB), high performance cartridge disk drive with features normally found on expensive drives over 100MB. And in a typical subsystem with controller and two drives, can provide 56MB for only $25,000...$450 per MB.

And the new RM02 provides 67MB capacity for UNIBUS systems at the lower-than-ever price of $18,000. Put two of these together with a controller in a typical subsystem and for just $41,000 you get 134MB...just $306 per MB.



All the new disks deliver exceptional hardware reliability features including wide design tolerances, broad environmental specs, and advanced cooling systems. And you get remarkable maintainability through sophisticated diagnostic software, modular assembly, easy-access design, and extensive error reporting. To find out all about them, and Digital's commitment to disk leadership, check the box.

LET THIS BE A LESSON TO YOU.



It's the second in a series of Digital catalogs of new applications programs for educators. *IDEAS: VOL. 2* gives teachers and administrators a close-up look at the 270 newest and best software packages available from publishers across the country. Subjects include administration, social science, math, CAI, and games, among many others. For your free copy, check the coupon.

SPRING SALE ON MEMORIES.

Digital memory, with Digital quality, Digital reliability, and Digital compatibility, is ready for immediate delivery now! And at lower prices than ever before. Check the box.

DISTRIBUTED COMPUTING: WHY THE COOKIE DOESN'T CRUMBLE.

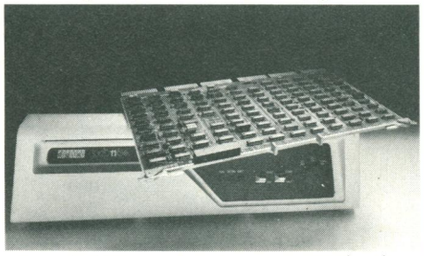
From England comes the tastiest application story of the month. A major bakery, with a capacity of 1.25 million cookies per hour, has replaced the batch computing equipment on its factory floor in favor of a distributed computing network, hosted by a PDP-11/40. Forty-one data entry, video display, and video monitoring units, run by five microprocessor nodes, are connected to the host processor through a Digital DUP-11 synchronous interface. A PDP-11/03 acts as a front-end processor for the host in a star-loop network that monitors and controls the baking and packaging operations. Projected savings for production monitoring indicate payback on the equipment in 15 months. Ummmm.

NEED SUPPLIES? CALL US COLLECT. AND CHARGE IT!

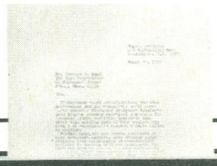
Here's a better way to order your disk packs, cartridges, floppies, ribbons, paper, ink, cleaning fluid, tapes, canisters, filters, and even your tables and chairs. It's the new SOS HOTLINE. A supply line with a phone number you can call and place an order up to $2,000. You can even use your American Express or Master Charge. Delivery in 48 hours. Check the coupon and find out more. Or give it a try. Dial (800) 258-1710. In New Hampshire 884-5718.

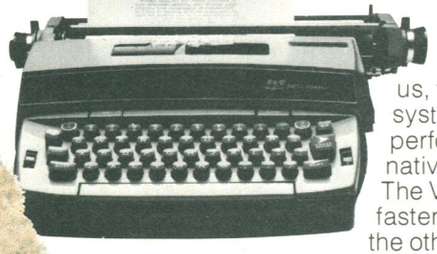
PDP 11/34 COMES UP WITH SOME FAST CACHE.

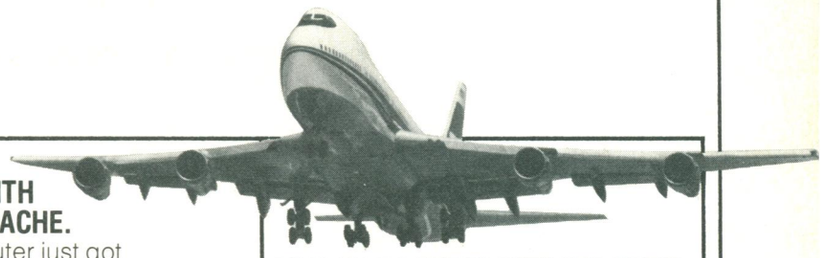
A fast computer just got faster. You can now add 2K bytes of high-speed RAM cache direct map memory to your PDP-11/34, get a hit



rate of 90%, and get a system that's 60% faster. Deliveries in May. Buy as a system or field upgrade. Check the box.







VAX-11/780 FORTAN "TAKES OFF."

Three major airlines, faced with the need for more pilot simulator time, and more realistic simulators, have contracted for flight simulators built around the new VAX-11/780.

Giant program capacity, 4 billion bytes of virtual memory, unmatched speed, great real-time capability, large word size, and price make the choice of VAX a natural for flight simulators.

In fact, benchmark after benchmark is showing the VAX to be one of the truly great FORTRAN machines, even with its mini price tag. Four times as fast, half the cost seems the most typical benchmark. Check the box and find out why.

LETTER FROM A WISE MAN.

"I am pleased to inform you that, after consideration of the alternatives presented to us, we have decided to install Digital's VAX-11/780 system. Your product offered an impressive price/performance ratio, when compared to (the alternative), handling an academic computing load. The VAX system appears to be about 4 times faster, while only half the price of (an upgrade to the other system)."

Digital Equipment Corporation, Maynard, MA 01754. European headquarters: 12, av. des Morgines 1213 Petit-Lancy/Geneva. In Canada, Digital Equipment of Canada, Ltd.

(PRICES APPLY IN U.S. ONLY.)

digital

Tell me more about: ☐ The 3 new disks ☐ Memory Sale S48
☐ Digital Supplies ☐ *Ideas: Vol. 2* ☐ 11/34 Cache ☐ VAX-11/780

Name_____ Title_____

Company_____

Address_____

City_____ State_____ Zip_____

Mail to: Digital Equipment Corporation, 129 Parker St. (PK 3-2/M18), Maynard, MA 01754.

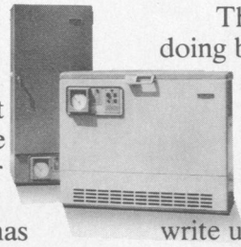
It's tough to make it with nothing more than a face lift.

Trying to cover up an unsuitable product with cosmetic surgery is tricky business in the freezer business.

But that doesn't stop a lot of people from trying.

Too many manufacturers take their home-style freezers, slap on a new label and a new coat of paint, and try to pawn them off as laboratory models. And when they succeed, they've made it possible for you to fail.

As you well know, blood and other biomedical samples are far too important to entrust to anything less than the finest laboratory freezer system money can buy.



That's why Revco has become the number one name in laboratory freezers. Because our laboratory line is our only line, not a sideline. And it's the most professional, most complete, most dependable line available anywhere.

That's the way we've been doing business for 40 years now, and we expect to keep on doing it the same way.

For further information and a copy of our new full-color catalog just call or write us at 1100 Memorial Drive, West Columbia, S.C. 29169. Area Code 803/796-1700. TWX: 810-666-2103. Cable: Revco.

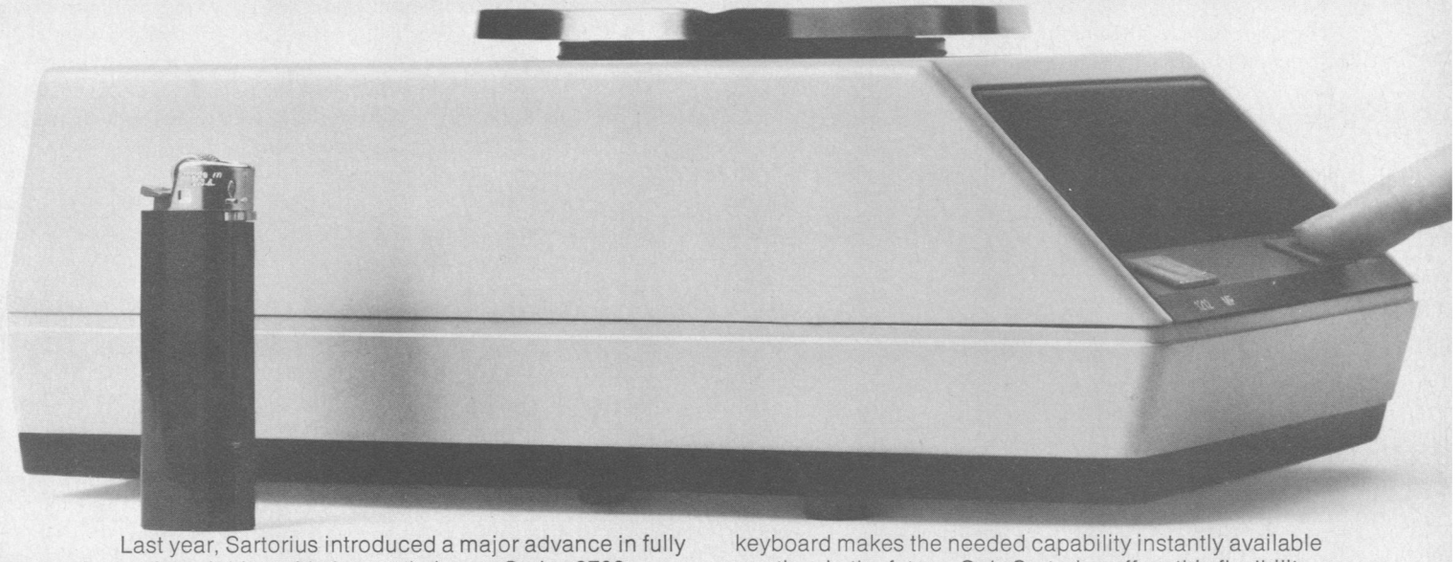
REVCO

The world's leader in ULTra-Low® temperature equipment.

Circle No. 287 on Readers' Service Card

SARTORIUS DOES IT AGAIN!

Introducing new microprocessor-equipped electronic balances with new capabilities, new add-on data keyboards, and new low (from $1,295) prices.



Last year, Sartorius introduced a major advance in fully electronic weighing with the revolutionary Series 3700 Balances.

This year, Sartorius does it again with its new MP models. These extremely versatile electronic top-loading balances utilize Texas Instruments microprocessors to vastly expand data handling and processing capabilities.

With optional plug-in keyboards that can be added anytime, MP models can be used to convert weight data, select programs, recall information and even calculate results.

Some typical applications for these balances include: instantaneous conversion from metric to non-metric calibration (weighings in pounds, ounces, carats, grains, pennyweights, etc.), parts counting, mean weight determination, percentage weighing, and variable integration time for more precise animal weighings.

MP models also provide complete weighings in 1-2 seconds, instant electronic taring, automatic overload protection, a built-in vibration filter, data storage memory, and are available with BCD and analog outputs.

Can you afford to buy a new balance without these capabilities?

When you choose a Sartorious MP model, you have selected a balance that will be quite as advanced tomorrow as it is today. Even if you do not need all its capabilities now, the purchase of the appropriate plug-in keyboard makes the needed capability instantly available any time in the future. Only Sartorius offers this flexibility.

For all their advanced technology, Sartorius MP models, priced as low as $1,295 are significantly less expensive than many other electronic balances without such features. For literature, write: Sartorius Balances Division, Brinkmann Instruments, Inc., Cantiague Road, Westbury, N.Y. 11590.

sartorius

MODEL (Partial Listing)	1205MP	1202MP	1212MP Dual Range	1204MP	3716 Dual Range	1203MP	3713MP Dual Range	3802MP	3804MP
Weighing Range	0-160g	0-300g	0-30g 0-300g	0-1200g	0-120g 0-1200g	0-3000g	0-300g 0-3000g	0-6000g	0-16000g
Readability	0.001g	0.01g	0.001g 0.01g	0.01g	0.01g 0.1g	0.1g	0.01g 0.1g	0.1g	0.1g
Price	$2295.	$1295.	$1650.	$2195.	$1845.	$1595.	$2495.	$3340.	on request

Circle No. 183 on Readers' Service Card

AAAS–Newcomb Cleveland Prize
To Be Awarded for an Article or a Report Published in *Science*

The AAAS–Newcomb Cleveland Prize is awarded annually to the author of an outstanding paper published in *Science* from September through July. The competition year starts with the 2 September 1977 issue of *Science* and ends with that of 28 July 1978. The value of the prize is $5000; the winner also receives a bronze medal.

Reports and Articles that include original research data, theories, or syntheses and are fundamental contributions to basic knowledge or technical achievements of far-reaching consequence are eligible for consideration for the prize. The paper must be a first-time publication of the author's own work. Reference to pertinent earlier work by the author may be included to give perspective.

Throughout the year, readers are invited to nominate papers appearing in the Reports or Articles sections. Nominations must be typed, and the following information provided: the title of the paper, issue in which it was published, author's name, and a brief statement of justification for nomination. Nominations should be submitted to AAAS–Newcomb Cleveland Prize, AAAS, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005. Final selection will rest with a panel of distinguished scientists appointed by the Board of Directors.

The award will be presented at a session of the annual meeting at which the winner will be invited to present a paper reviewing the field related to the prizewinning research. The review paper will subsequently be published in *Science*. In cases of multiple authorship, the prize will be divided equally between or among the authors; the senior author will be invited to speak at the annual meeting.

Deadline for nominations: postmarked 15 August 1978

Nomination Form
AAAS–Newcomb Cleveland Prize

AUTHOR: _____

TITLE: _____

_____

DATE PUBLISHED: _____

JUSTIFICATION: _____

(Continue on additional sheet, if necessary)
Machine reproduction of this form may be used.

Separate most samples in less than a minute with an Eppendorf® Micro Centrifuge.

Just as Eppendorf Micropipettes greatly simplify sample pick-up, Eppendorf Micro Centrifuges greatly simplify sample separation.

Compact and quiet-running, Eppendorf Micro Centrifuges are precision instruments that maintain constant high speed regardless of load. Because of their very high speed, these centrifuges are ideally suited for a wide variety of clinical and research applications, particularly those involving separation of heat-sensitive materials.

For maximum speed, choose Model 5412. It accepts twelve disposable Eppendorf 1.5ml test tubes in an angled rotor, or twelve 500µl, 400µl or 250µl tubes using adapters. It reaches 15,000 rpm (RCF 12,800xG) in just ten seconds, and stops in fifteen seconds.

For maximum capacity, choose Model 5413. It accepts forty 1.5ml, 400µl or 250µl tubes in four vertical carriers that each hold ten tubes horizontally. Model 5413 attains a maximum speed of 11,500 rpm (RCF 6,500xG).

Both models are equipped with automatic 15-minute timer, safety switch (prevents operation with top open) and safety lid lock (prevents opening lid while centrifuge is spinning).

For literature describing Eppendorf Micro Centrifuges, test tubes, adapters and accessories, write: Eppendorf Division, Brinkmann Instruments, Inc., Cantiague Road, Westbury, N.Y. 11590. In Canada: Brinkmann Instruments (Canada), Ltd.

A DIVISION OF BRINKMANN

Eppendorf Micro Centrifuges

Circle No. 182 on Readers' Service Card

LETTERS

Cover Caption: April Fools'?

I stared for some time at .your 31 March (1 April minus 1?) cover trying to perceive the blue catecholamine varicosities contacting the orange neurophysin-containing neurons. After a while I concluded that you had really published the tracks of a pair of yetis crossing a snow-covered lava flow, but were embarrassed to admit it. It was with a sense of disappointment that I turned to page 1461 and discovered that the tracks were those of a doped-up rat with inky feet. Pity.

ALAN T. MOFFET
Owens Valley Radio Observatory, California Institute of Technology, Pasadena 91125

The *Science* cover of 31 March has black marks in patterns resembling the tracks of a plantigrade animal. On the other hand, the cover explanation (on page 1389) mentions blue varicosities and an orange neuron and ascribes the picture to McNeill and Slakek, referring the reader to page 1461. Since the only orange I could detect was in the orange-red *Science* title, and since there was no blue that I could see, I was afraid my eyes were deteriorating rapidly. Fortunately, page 1461 has illustrations of patterns like those on the cover, and these are labeled "hind footprints."

I am still worrying about McNeill and Slakek. Are they trapped on some sort of a Möbius strip with those blue varicosities and that orange neuron? Schallert *et al.*, who wrote the report on page 1461, do not mention these poor souls and their colorful companions.

W. J. MATHEY
1944 Nicholson Drive, Baton Rouge, Louisiana 70802

See the erratum on page 286 of the 21 April issue.—EDITOR

Committee on National Statistics

I write to elaborate on Constance Holden's brief reference to the Committee on National Statistics in her article "ABASS [Assembly for Behavioral and Social Sciences]: Social sciences carving a niche at the Academy" (News and Comment, 17 Mar., p. 1183).

First, the Committee's purposes are far broader than looking at "which numbers to count," although even that is a far from simple matter. What to count? What to measure? How to count and measure? How to analyze the resulting counts and measures? How to make the numbers and analyses clear and available to heterogeneous audiences? Those are just some of the general rubrics for the Committee's activities.

Second, the Committee is by no means confined to statistical questions related to social policies—unless you define "social policy" so broadly as to include all matters of public policy. The Committee's charter is to study statistical issues arising anywhere in the public policy domain, whether the context be social, physical, biological, or whatever. The Committee has already published the studies *Setting Statistical Priorities*, *Surveying Crime*, and (jointly with other units in the Academy) *Environmental Monitoring*. It expects shortly to publish a report of an experiment in survey techniques under the provisional title *Privacy and Confidentiality as Factors in Survey Response*. It is currently working on such diverse topics as statistics on productivity, the effect of changes in the atmospheric ozone on the incidence of skin cancer, and procedures for dealing with undercount in population censuses.

The Committee has thus been busy carrying out the activities projected in my 1973 *Science* article (*1*), written soon after the Committee was formed.

WILLIAM H. KRUSKAL
Committee on National Statistics, National Academy of Sciences–National Research Council, Washington, D.C. 20418

References

1. W. Kruskal, *Science* **180**, 1256 (1973).

Benzene: Consumer and Occupational Exposure

I was greatly interested in the letter "Benzene in consumer products" from R. J. Young *et al.* (28 Jan, p. 248) both for the technical information contained and for the insight provided into the approach to such problems that is now common in many regulatory agencies. The letter mentions in the same breath the proposal for the Occupational Safety and Health Administration to lower *occupational* exposure limits to average concentrations in air of 1 part per million and a petition to remove all benzene products from the market. The implication of the letter appears to be that the high atmospheric benzene concentrations observed in a simulated domestic consumer exposure, well above the pro-

posed occupational exposure level, lasting 30 minutes, may justify severe restriction or elimination of all benzene-containing products from the consumer market.

While I hold absolutely no brief for benzene products, it seems rash to push for such a step on the evidence provided. To start with, it would have to be shown that *occasional* consumer exposure to high concentrations would lead to health effects comparable to those from *continuous* exposure to lower concentrations over a 40-hour working week that might result in an equivalent cumulative intake. Such effects of acute exposure would depend on normal elimination rates, and one would clearly need to distinguish between regulating commercial operations and occasional short-term uses by the general public. In addition, one would have to show that replacement compounds, for example, for paint strippers, would themselves not result in equally bad or worse effects than the banned materials.

None of these remarks should be construed as arguing against the desirability of reducing unnecessary exposures to benzene or of exploring possibly less harmful alternatives. However, we have seen too many other cases where the public has been misled by discussions of supposed health hazards when high-level short-term exposures were extended, with little or no qualification, to cases of long-term, continuous exposures, be it to chemicals, food additives, or radiation.

G. G. EICHHOLZ

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Energy Costs: Nuclear Versus Oil

President Carter quoted some interesting figures at the opening of the international Nuclear Fuel Cycle Evaluation (INFCE) meeting about the capital requirements of various energy resources, per "barrel of oil per day [bpd], or its equivalent derived at the ultimate site of use." The figures were: zero to $3500 for conservation, $10,000 for North Sea oil, $20,000 for Alaskan oil, and $200,000 to $300,000 for nuclear power. The President concluded that "there is a tremendous cost" for the use of nuclear power.

This argument derives directly from Amory Lovins' recent writings (*1*). Aside from the inappropriateness of judging the cost of an energy source by its capital requirements alone, the num-

bers themselves are three times too low for Alaskan oil and three to five times too high for nuclear power. Apparently Lovins equates a kilowatt of oil thermal energy with a kilowatt of nuclear electric energy, ignoring thermodynamic losses and the cost of an oil-fired power plant. The interim replacement of short-lived oil field investments is also ignored. On the nuclear side, Lovins used very high costs for nuclear power plants and electric grids, an extremely low capacity factor, and an additional 43 percent "miscellaneous" category, to reach a total of $5000/kW. A more realistic calculation (*2*) gives $1650/kW in 1976 dollars, including fuel cycle facilities and electric grids. Transferring to Lovins' oil base at 0.0324 bpd/kW (the oil requirements of a new, combined-cycle, oil-fired plant), the capital requirements are $56,700/bpd for nuclear power and $66,100/bpd for oil.

Even more important than these costs is that to produce oil one must own, or capture, the land that has the oil under it. Many of the countries participating in INFCE do not have the option of an Alaskan oil investment, because their territories do not contain oil deposits. Presumably they might acquire oil-producing territory by aggression, but such a strategy would surely be costly.

The energy experts attending the INFCE meeting must surely have noticed the use of Lovins' soft numbers by President Carter. It would seem desirable for the President to ask for a less extreme viewpoint from his speechwriters if the United States is to have a useful impact on world energy policies.

JAY JAMES, JR.

614 Canon Drive,
Kensington, California 94708

References

1. A. B. Lovins, *Soft Energy Paths* (Friends of the Earth–Ballinger, Cambridge, Mass., 1977); *Foreign Affairs* **55**, 65 (October 1976).
2. Analysis by the writer, based on data from EPRI Technical Assessment Group, *Technical Assessment Guide* (Electric Power Research Institute, Palo Alto, Calif., 1977); I. A. Forbes and J. C. Turnage, *Exclusive Paths and Difficult Choices: An Analysis of Hard, Soft, and Moderate Energy Paths* (Energy Research Group, Framingham, Mass., 1977).

The Sociobiology Debate

The controversy on the human nature-nurture issue that ensued at the AAAS annual meeting (12–17 February 1978) in the symposium entitled "Sociobiology: Beyond Nature-Nurture" tended to obscure any rational dialogue within the symposium's stated topic. Apparently some individuals would repress scientific discourse and research solely on the grounds that it might be misunderstood or misused by the wrong people. Sociobiology and its concepts are in their infancy. There are no claims to date by authentic sociobiologists as to *definite* race or sex differences in either human behavior or human cognition. There are only theories and preliminary evidence.

The groups and individuals who argue against research or discussion of sociobiology appear not to understand the most basic, underlying concept of sociobiology and behavioral genetics: $P = G + E + (G \times E)$, where P is the measured value for some character of an individual (behavior or otherwise), G is the value conferred upon the individual by its genotype, E is the environmental deviation resulting from all nongenetic causes, and $(G \times E)$ is the deviation resulting from genotype-environment interactions or the differential response of different genotypes to different environments (*1*). Therefore, it is apparent that the analysis of any phenotype is applicable only to that particular set of genotypes and environments in which it has been studied.

The implications of the above statement are quite straightforward. The study of sociobiology may not only help us understand better the causes of our behaviors and other characters but also help us direct our efforts toward restructuring our society in the ways we desire. Environmental engineering occurs not only in man, but in other life forms; genetic engineering has just begun. Both may suit our purposes. If, in researching a particular behavior, we find that most of the population variance is due to genotype, it may be that we have not studied enough existing environments or that we have not yet modified our environment sufficiently to increase the environmental variance. Closed minds on either side of the nature-nurture controversy will only continue its existence as a political juggernaut. There does not exist an either-or answer to this artificial dialectic. The real answer for human behavior and cognition analysis lies somewhere between and beyond nature-nurture. Sociobiology, beyond nature-nurture, contains the elements of our future. Let us get on with the work.

DARIUS BAER

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References

1. G. E. McClearn and J. C. DeFries, *Introduction to Behavioral Genetics* (Freeman, San Francisco, 1973).

INSERM CONFERENCES INSERM CONFERENCES INSERM CONFERENCES INSERM CONFERENCES INSERM CONFERENCES

The French Institute of Health and Medical Research (Institut National de la Santé et de la Recherche Médicale) is organizing a series of meetings on advanced research topics in various biomedical fields. The meetings which started last year, are known as the INSERM CONFERENCES.

The aims of the conferences are:
- to foster the exchange of ideas, to evaluate new methods and new lines of investigation;
- to bring together scientists, mostly from European countries, working in universities and public or private research institutions. The meetings will be held under the direct responsibility of a chairman and a co-chairman.

The INSERM CONFERENCES have the following special features:
- only highly topical subjects are dealt with;
- if possible, the data presented should not have been the subject of any earlier complete publication, a condition which therefore excludes general reviews;
- the Conferences do not publish proceedings or any other material, even in a summarized form.

The chairman of each INSERM Conference will invite 15 to 20 scientists to give a report in line with the above conditions. The number of contributions will be limited to three or four per session and, at the discretion of the chairman, at least one third of the time will be given over to discussion and brief informal communications.

In addition to the invited speakers, at least fifty participants will attend the meeting, and efforts will be made to select young scientists. Experienced research workers from fields other than those relating to the Conference will also be welcome to attend. Participants will be chosen in such a way as to enable those engaged in all types of scientific research to establish personal contacts, exchange information and find new ways of working together.

PRACTICAL ARRANGEMENTS

The INSERM CONFERENCES 1978 will be held at the Domaine de Seillac, near Blois (180 km from Paris), during the months of October and November 1978 (full address: Domaine de Seillac, 41150 Seillac, France). Each conference will last three and a half days, from Sunday evening (departure from Paris) to Thursday afternoon. Working sessions will be held from 9 a.m. to 12.30 p.m. and from 5.30 p.m. to 8 p.m. On free afternoons, participants will have a wide choice of leisure activities at the Domaine de Seillac and in the surrounding area (Tennis, Table-tennis, bicycling, visit to the Castles of the Loire).

REGISTRATION FEE AND SPECIAL FUND

Participants whose applications are accepted but who are not invited speakers, will be asked to pay their registration fee and board (1000 FF). A special fund will be made available to the chairman of each Conference, enabling him to pay part of the expenses of some participants requesting such assistance.

PROGRAMME FOR 1978

Four INSERM CONFERENCES are scheduled for 1978.
The first two conferences (T-CELL DIFFERENTIATION AND ITS RELATIONSHIPS TO IMMUNE REGULATION - HORMONAL CONTROL OF GENE EXPRESSION) were announced in the last issue of this journal.
The programmes for the other two conferences (DEVELOPMENTAL NEUROBIOLOGY - RECOMBINANT DNA AND EUKARYOTIC GENOME) are listed below.

Scientists wishing to attend one of these two conferences have to submit this application form BEFORE JUNE 20th to INSERM Conferences, 101, rue de Tolbiac - 75645 PARIS CEDEX 13, France - Telephone : 584-14-41.

APPLICATION FORM:

CONFERENCE ON: .....
(Name - Date)

NAME, TITLE and POSITION: .....

.....

INSTITUTION (with address and phone number): .....

.....

See overleaf...

NEUROBIOLOGY

DEVELOPMENTAL NEUROBIOLOGY - November 5-9

Jean-Pierre Changeux, chairman; Wolf Singer, co-chairman.

Monday - November 6 :

Morning session : **Embryogenesis**
Discussion leader : Monroe COHEN
Speakers : M. HEISENBERG, R. GARDNER, N. LE DOUARIN, Michel WEBER

Evening session : **Synaptogenesis I**
Discussion leader : M.J. KEATING
Speakers : M.C. PRESTIGE, J. JANSEN, M.C. BROWN

Tuesday - November 7 :

Morning session : **Synaptogenesis II**
Discussion leader : L. GAREY
Speakers : Monroe COHEN, B. SAKMANN, H. BETZ, D. PURVES

Evening session : **Hormonal factors**
Discussion leader : R. SIDMAN
Speakers : G. RAISMAN, R. BALASZ, J. NUNEZ

Wednesday - November 8 :

Morning session : **Genetic factors**
Discussion leader : B. SAKMANN
Speakers : C. SOTELO, F. CREPEL, R. SIDMAN, P. BATESON

Evening session : **Environmental factors**
Discussion leader : D. PURVES
Speakers : M.J. KEATING, L. GAREY, M. IMBERT, W. SINGER

Thursday - November 9 :

Morning session : **Human development**
Discussion leader : P. BATESON
Speakers : M. JEANNEROD, H. PRECHTL, T. BAUER

RECOMBINANT DNA AND EUKARYOTIC GENOME - November 12-15

Pierre Chambon, chairman; Philippe Kourilsky, co-chairman.

All aspects of Recombinant DNA research and their impact on the study of eukaryotic genome structure and function will be discussed. The list of speakers includes:

G. BERNARDI (Paris)
M. BIRNSTIEL (Zürich)
H. BOYER (San Francisco)
G.C. FAREED (Los Angeles)
W. FIERS (Gent)
D. FLAVELL (Amsterdam)
W. GEHRING (Basel)
W. GILBERT (Cambridge U.S.A.)
F. LACROUTE (Strasbourg)
P. LEDER (Bethesda)
B. MACH (Genève)
K. MURRAY (Edinburgh)
V. PIROTTA (Heidelberg)
F. ROUGEON (Paris)
H. SCHALLER (Heidelberg)
V. SGARAMELLA (Pavia)
P. SLONIMSKI (Gif-sur-Yvette)
P. TIOLLAIS (Paris)
S. TONEGAWA (Basel)
M. VAN MONTAGU (Gent)
C. WEISSMAN (Zürich)

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DO NOT ENCLOSE PRE-PAYMENT WITH THIS APPLICATION FORM

28 April 1978, Volume 200, Number 4340 **SCIENCE**

Needed: Better Data About Academic Science

The information system which provides data for policy decisions about U.S. academic science has fundamental flaws. Yet the quality of such decisions rest, to some degree, on the quality of these data.

Paradoxically, fewer information requests could be made by federal agencies (and related national organizations) but the data would be more useful if presently diverse retrieval activities were better coordinated. Spriestersbach and Farrell* recently documented the burden of federal demands for information on one university. Redundant requests for data about graduate science—enrollment, Ph.D.'s produced, expenditures, and so on—constitute a modest portion of this burden.

More to the point, it is difficult, if not impossible, to relate data from different agencies. In two recent studies—an evaluation of the National Science Foundation's Science Development Program and research commissioned by the President's Biomedical Research Panel—my colleagues and I have attempted to create such a merged data file. This was necessary because different agencies or groups retrieve the best (or the only) data about different characteristics of science departments. For example, NSF has the best data on federal expenditures by discipline, while the National Research Council has virtually complete information about Ph.D.'s and their job placement. The following are some of the problems we encountered.

- Academic fields are defined and classified differently. For example, in the NRC Doctorate Record File Ph.D.'s indicate their own fields (which may not match their departments), while the key file about National Institutes of Health funding references actual departments, and NSF's funding file aggregates departments into "disciplines."
- During the past decade many state universities developed strong branch campuses with graduate programs. Agencies vary as to whether they report activities at the main campus only or at the main campus and branch campuses identified separately, or lumped together. As a further complexity, the point at which a branch campus is considered sufficiently active to be recognized by an agency (or, in fact, by the university itself) varies.
- Some files fail to separate data about the medical or agriculture schools from data about the main unit. Thus, all federal expenditures for biochemistry are reported as one datum for a particular university.

The astute reader will realize that successive sections of *Science Indicators 1976* had to be based on data derived from different definitions.

Policy analysts frequently discover that indicators of the same phenomenon provided by two agencies do not agree. One reason is that different organizations use different sources. For example, the NRC polls doctorate recipients. The NSF gets enrollments from department chairmen. The National Center for Educational Statistics retrieves both enrollment and Ph.D. statistics from university-level administrators such as registrars.

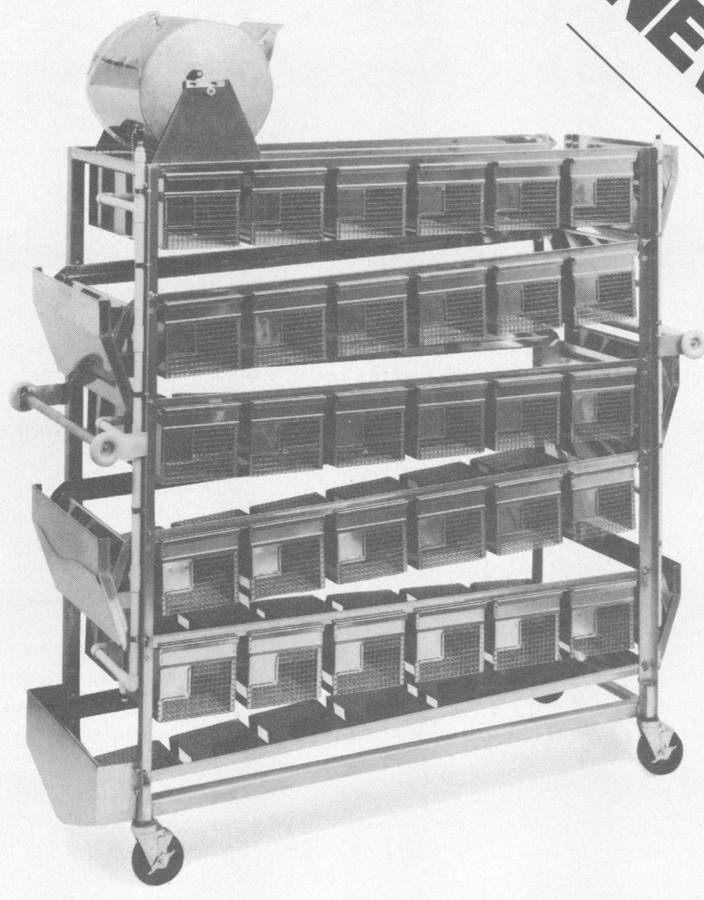
Each agency has developed its own definitions and retrieval techniques to be consistent with its organizational objectives. And agency officials may fear that the loss of control over these activities that standardization might require will undermine the realization of those objectives. Although it is problematic, this need not present an insurmountable obstacle.

Thoughtful policy-makers and analysts have reviewed these issues and suggested a variety of solutions. For example, last year both the Paperwork Commission and a federal interagency committee chaired by NSF's Robert Wright issued detailed recommendations for agency cooperation about this problem. But the implementation of these recommendations has been glacial at best.

In my opinion the university science community, which has much to gain from more consistent data and less burdensome requirements, should press for more government action on this problem.—DAVID E. DREW, *Rand Corporation, Santa Monica, California 90406*

*D. C. Spriestersbach and W. J. Farrell, *Science* **198**, 27 (1977).

NEW PRODUCT



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Flame Photometer

The IL643 Auto Cal measures sodium, lithium, and potassium concentration in serum, plasma, and urine samples. The unit calibrates itself and features an internal cesium standard rather than using lithium for sodium and potassium and using potassium for lithium. This eliminates changeover from mode to mode and the steps for cleaning, flushing, and changing the diluent, diluter, or dilution ratio. The cesium standard requires smaller amounts and thus reduces the amount of salt introduced to the flame. A piston diluter uses 16-microliter samples and a working diluent. The IL643 will automatically analyze 80 samples per hour in combination with a printer-sampler. Instrumentation Laboratory. Circle 725.

Newly offered instrumentation, apparatus, and laboratory materials of interest to researchers in all disciplines in academic, industrial, and government organizations are featured in this space. Emphasis is given to purpose, chief characteristics, and availability of products and materials. Endorsement by *Science* or AAAS is not implied. Additional information may be obtained from the manufacturers or suppliers named by circling the appropriate number on the Readers' Service Card (on page 382A and 462A) and placing it in the mailbox. Postage is free.

—RICHARD G. SOMMER

Scintillation Vial Capper

Cap-A-Vial is a hand-held motorized unit designed to cap or uncap trays of 100 20-milliliter glass scintillation vials (all with size 22 caps). The vials are processed ten at a time and the device eliminates the need for the operator to handle the vials individually. Cap-A-Vial is positioned by tabs on the capping arm; the operator presses a button and a motor drives a camshaft with eccentric, elastomer cams that rotate the caps. A switch determines direction of rotation. A safety switch prevents operation until the unit is in position. A snap-on magazine holds the caps. A. H. Thomas. Circle 728.

Biological Specimen Freeze-Thaw Apparatus

System R201/200R offers eight combinations of rate and time for freezing biological specimens for storage or for thawing them for use in the laboratory. The programmable temperature controller provides individual set ramps of up to 5.9 hours at a particular temperature. Range of these temperatures is from −180° to +35°C. Atomized liquid nitrogen is injected into the working chamber of the refrigeration unit to effect cooling and a 1-kilowatt, open-wound resistance element is used for thawing. A platinum resistance thermometer in the 28-liter chamber monitors the temperature. A chart recorder provides a record of the process. Polaron Instruments. Circle 729.

Biological Safety Cabinet

The work area in this device is constantly bathed in a laminar flow of sterilized air at 85 to 100 feet per minute. There are separate filters for intake and exhaust. At each pass, 70 percent of the air is recirculated and 30 percent is discharged. The filters are 99.99 percent effective for particles 0.3 micron or larger in diameter. The worker's hands may penetrate the air curtain, but the columnar nature of the flow prevents passage of contaminants into or out of the work area. The cabinet is made of stainless steel and has exteriorly mounted fluorescent lighting. A variety of sizes is available. Bio-Safe. Circle 730.

Calcium Analyzer

The Nova 2 determines the concentration of ionized calcium directly from samples of whole blood in anaerobic collection tubes. The calcium electrode is highly specific for calcium even in the presence of magnesium ions. The flow paths in both the calcium and reference electrodes are designed to eliminate air bubbles and clotting and trapping of samples. The Nova 2 also has a microcomputer to control its operation and to analyze the data collected. The device is precise to better than 0.005 millimole of ionized calcium. Operation is simple and each test is performed in 70 seconds. NOVA Biomedical. Circle 726.

Disposable Hand-Operated Micropipette

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Literature

Mycoplasma Detection describes a kit for use with tissue cultures. Bio-Assay Systems. Circle 732.

Microcomputers details a full line of hardware, accessories, and software in kit and assembled forms. Tandy Computer. Circle 733.

Labware is devoted to the Nalgene plastic line and includes new products such as autoclavable carboys, transparent volumetric flasks, and centrifuge tubes. Nalge. Circle 735.

Particle Counters describes sizing instruments for use with liquid and gaseous samples. Royco Instruments. Circle 736.

Tube and Muffle Furnaces are listed in a catalog that features design specifications, dimensions, and applications in the laboratory. Fisher Scientific. Circle 737.

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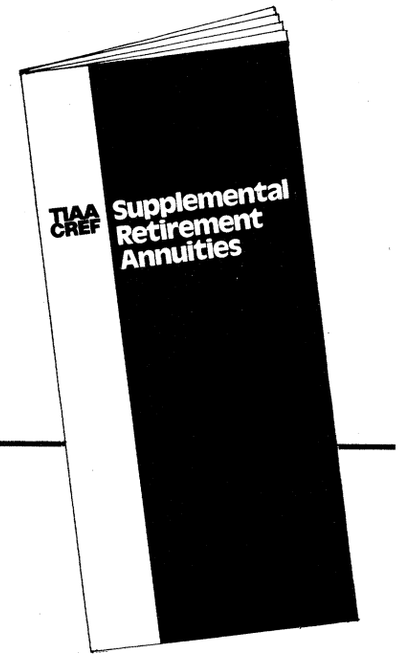

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(Continued from page 422)

months at NGS analyzing the magnitude of the problem of round-off errors when the readjustment equations are solved by Helmert blocking. He concluded, on the basis of a statistical analysis of the problem, that round-off errors should not cause the computed solution to have fewer significant digits than are thought to be needed. (The NGS investigators want four or five significant digits. Meisl says they are certain to get two to three and are very likely to get four to five.) One reason for Meisl's optimism is that the zeros of the matrix facilitate the computations.

If the solutions to the readjustment equations are incorrect after all, will the NGS investigators recognize it? According to Schwarz, they will. He says they will look at the magnitudes of the position corrections specified by the solutions. If the solutions are correct, the magnitude of the corrections to particular points should be consistent with the magnitudes of corrections for nearby points. The solutions can also be analyzed to determine the estimated errors made in measuring the positions of points. The NGS investigators have some idea of what those errors should be, so they can decide whether the computer solutions make sense. In general, Schwarz says, the corrections should be on the order of 2 to 4 m.

Considering the magnitude of the readjustment project, it might be expected that NGS would be a large and well-funded agency. But NGS has a staff of just 300 people and an annual budget of just $10 million. Moreover, only about one-third of its staff is working on the readjustment of the horizontal control points. (Many of those not working on this readjustment project are surveyors who participate in projects, partially funded by state governments, to determine coordinates of points in between the control points of the datum.) Of the $10 million allocated each year to NGS, about $1 million goes toward paying for computer services. The NGS has no computer of its own but must buy computer time from NOAA.

Despite the small size and limited budget of NGS, its researchers are a proud and confident group who clearly view the task of adjusting the North American Datum as within their means. Hanson notes that the datum will undoubtedly have to be adjusted again, perhaps in 50 to 100 years. But next time, with the knowledge gained from this attempt, the task should be much easier.

—GINA BARI KOLATA