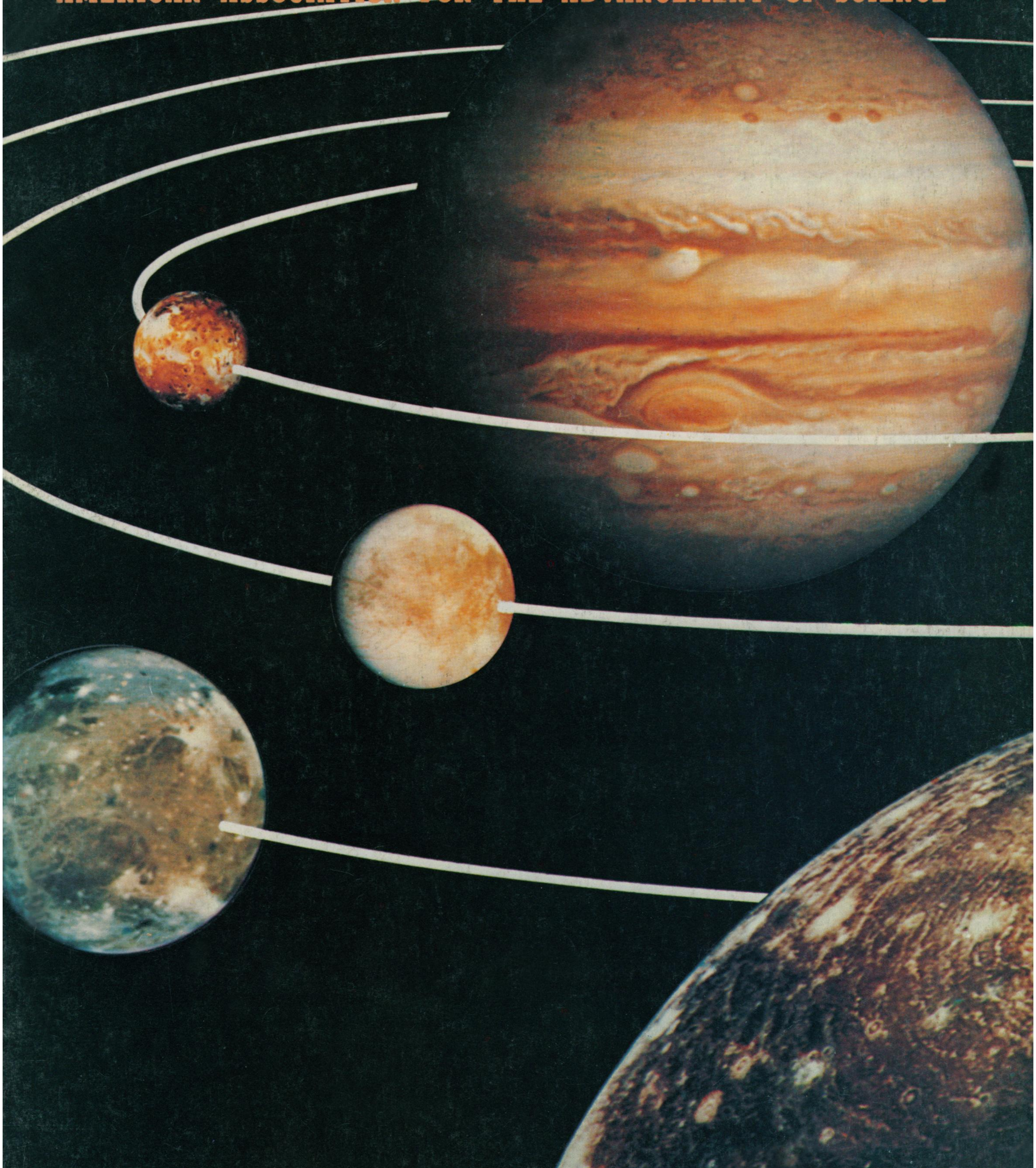
1 June 1979 • Vol. 204 • No. 4396 $1.50

SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



The new hypersensitization

Despite all that has been learned in recent decades by radio astronomy and x-ray astronomy from above the atmosphere, nobody is advocating that the optics of the great telescopes in the world's observatories be salvaged to make beer bottles.

Time on those magnificent instruments gets ever harder to earn.

At the Royal Photographic Society's tercentenary celebration of the Greenwich Observatory, R. L. Jenkins *(left below)* of the Kodak Research Laboratories in Harrow, England, brought glad tidings of more time to parcel out to the deserving.

Latter-day three-hour exposures put a pinch on telescope time that was never felt when photons from afar had merely to land on the Astronomer Royal's personal retina.

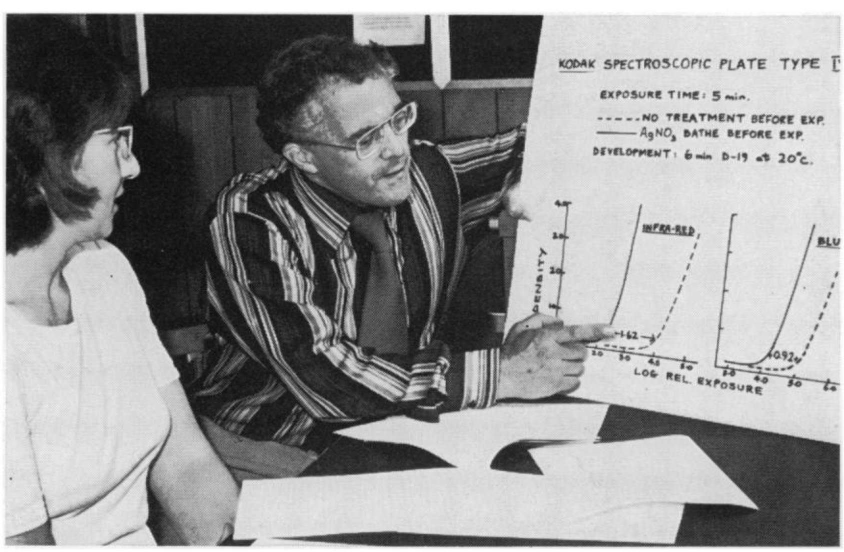
Jenkins' research partner G. C. Farnell shows below that bathing a plate in silver ions just before exposure greatly cuts the time needed to pick up all that's going to be picked up before sky light takes over and obscures the view. The speed enhancement is greatest for the plates we make for infrared astronomy.

Though the treatment must be done very carefully for good results, a dip before exposure into nothing more advanced technologically than .001N aqueous silver nitrate solution markedly increases speed, particularly towards long exposure times. In other words, low-intensity reciprocity failure is greatly reduced.

There is no reason why plates couldn't have been preexposure dipped into $AgNO_3$ before Rosemary Jenkins and Geoff Farnell were born. Astronomers are doing it now. Hindsight! It's so clear and penetrating!

If this is important to you and news to you, and you have to know more, write Kodak, Dept. 55-S, Rochester, N.Y. 14650; ask for Publication P7-670.

Kodak



© Eastman Kodak Company, 1979

WHAT'S BETTER THAN SPEED READING?

SPEED LEARNING

(SPEED PLUS COMPREHENSION)

Speed Learning is replacing speed reading because it's easy to learn . . . lasts a lifetime . . . applies to everything you read . . . and is the only fully accredited course with the option of college credits.

Do you have too much to read and too little time to read it? Do you mentally pronounce each word as you read? Do you frequently have to go back and re-read words or whole paragraphs you just finished reading? Do you have trouble concentrating? Do you quickly forget most of what you read?

If you answer "yes" to any of these questions — then here at last is the practical help you've been waiting for. Whether you read for business or pleasure, school or college, you will build exceptional skills from this major breakthrough in effective reading, created by Dr. Russell Stauffer at the University of Delaware.

Not just "speed reading" — but speed reading-thinking-understanding-remembering-and-learning

The new *Speed Learning Program* shows you step-by-proven-step how to increase your reading skill and speed, so you understand more, remember more and use more of everything you read. The typical remark made by the 75,000 slow readers who completed the *Speed Learning Program* was: "Why didn't someone teach me this a long time ago?" They were no longer held back by the lack of skills and poor reading habits. They could read almost as fast as they could think.

What makes Speed Learning so successful?

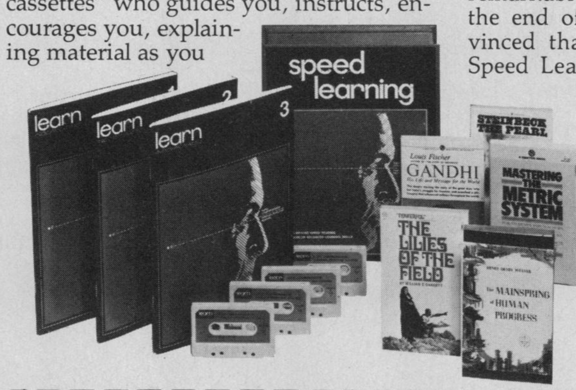
The new *Speed Learning Program* does not offer you a rehash of the usual eye-exercises, timing devices, costly gadgets you've probably heard about in connection with speed reading courses or even tried and found ineffective.

In just a few spare minutes a day of easy reading and exciting listening, you discover an entirely new way to read and think — a radical departure from anything you have ever seen or heard about. Research shows that reading is 95% *thinking* and only 5% eye movement. Yet most of today's speed reading programs spend their time teaching you rapid eye movement (5% of the problem) and ignore the most important part (95%) *thinking*. In brief, *Speed Learning* gives you what speed reading *can't*.

Imagine the new freedom you'll have when you learn how to dash through all types of reading material *at least* twice as fast as you do now, and with greater comprehension. Think of being able to get on top of the avalanche of newspapers, magazines and correspondence you have to read . . . finishing a stimulating book and retaining facts and details more clearly and with greater accuracy than ever before.

Listen-and-learn at your own pace

This is a practical, easy-to-learn program that will work for you — no matter how slow a reader you think you are now. The *Speed Learning Program* is scientifically planned to get you started quickly . . . to help you in spare minutes a day. It brings you a "teacher-on-cassettes" who guides you, instructs, encourages you, explaining material as you read. Interesting items taken from *Time* Magazine, *Business Week, Wall Street Journal, Family Circle, N.Y. Times* and many others, make the program stimulating, easy and fun . . . and so much more effective.



Executives, students, professional people, men and women in all walks of life from 15 to 70 have benefited from this program. Speed Learning is a fully accredited course . . . costing only 1/5 the price of less effective speed reading classroom courses. Now you can examine the same, easy, practical and proven methods at home . . . in spare time . . . without risking a penny.

Examine Speed Learning FREE for 10 days

You will be thrilled at how quickly this program will begin to develop new thinking and reading skills. After listening to just one cassette and reading the preface you will quickly see how you can achieve increases in both the speed at which you read and in the amount you understand and remember.

You must be delighted with what you see or you pay nothing. Examine this remarkable program for 10 days. If, at the end of that time you are not convinced that you would like to master Speed Learning, simply return the program and owe nothing. See the coupon for low price and convenient credit terms.

Note: Many companies and government agencies have tuition assistance plans for employees providing full or partial payment for college credit programs.

In most cases, the entire cost of your Speed Learning Program is Tax Deductible.

EARN COLLEGE & CONTINUING EDUCATION CREDITS FOR SPEED LEARNING

COLLEGE CREDITS

You may obtain *2 full semester hour credits* for course completion, wherever you reside. Credits offered through Whittier College (California). Details included in your program.

PROFESSIONAL SOCIETIES

Speed Learning is offered internationally to members of professional associations such as: American Chemical Society, Foundation for Accounting Education, Institute of Electrical and Electronics Engineers and dozens more. Consult your Education Director for information.

BUSINESS, INDUSTRY, GOVERNMENT

Many companies and government agencies offer Speed Learning as a wholly-paid or tuition reimbursement program. Consult your Training or Personnel Director for details.

21 SCMA

learn INCORPORATED 113 Gaither Drive, Mount Laurel, N.J. 08054

Please send me the Speed Learning Program at $89.95 plus $3.00 for handling and insured delivery.

Please check the method of payment below:

☐ Check or money order enclosed for items ordered. New Jersey Residents add 5% sales tax.

☐ Please charge my credit card under the regular payment terms: ☐ Bank Americard ☐ Master Charge Interbank No.______ ☐ American Express ☐ Diners Club

Card No.______ Exp. Date______

I understand that if after 10 days I am not delighted in every way, I may return the materials and obtain a full refund with no questions asked.

Name______

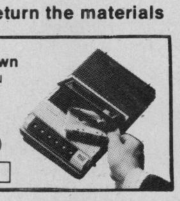
Address______

City______ State______ Zip______

x Signature______

If you don't already own a cassette player, you may order this Deluxe Cassette Recorder for only $49.95. (Includes handling and delivery.)

Check here to order ☐



Outside U.S.A. $99.95 + $3 surface mail — airmail extra

ISSN 0036-8075

1 June 1979

Volume 204, No. 4396

SCIENCE

BOARD OF DIRECTORS

EDWARD E. DAVID, JR., Retiring President, Chairman; KENNETH E. BOULDING, President; FREDERICK MOSTELLER, President-Elect; ELOISE E. CLARK; MARTIN M. CUMMINGS; RENÉE C. FOX; ANNA J. HARRISON

CHAIRMEN AND SECRETARIES OF AAAS SECTIONS

MATHEMATICS (A): Garrett Birkhoff, Ronald Graham
PHYSICS (B): Arthur L. Schawlow, Rolf M. Sinclair
CHEMISTRY (C): Fred Basolo, William L. Jolly
ASTRONOMY (D): Peter S. Conti, Donat G. Wentzel
PSYCHOLOGY (J): Frances K. Graham, Meredith P. Crawford
SOCIAL AND ECONOMIC SCIENCES (K): David L. Sills, Gillian Lindt
HISTORY AND PHILOSOPHY OF SCIENCE (L): Melvin Kranzberg, Diana L. Hall
ENGINEERING (M): Daniel C. Drucker, Donald E. Marlowe
EDUCATION (Q): Fletcher G. Watson, James T. Robinson
DENTISTRY (R): Carl J. Witkop, Jr., Harold M. Fullmer
PHARMACEUTICAL SCIENCES (S): Samuel Elkin, Robert A. Wiley
INFORMATION, COMPUTING, AND COMMUNICATION (T): Mary E. Corning, Madeline M. Henderson

DIVISIONS

ALASKA DIVISION: Daniel B. Hawkins, President; T. Neil Davis, Executive Secretary
PACIFIC DIVISION: Glenn C. Lewis, President; Alan E. Leviton, Secretary-Treasurer
SOUTHWESTERN AND ROCKY MOUNTAIN DIVISION: James W. O'Leary, President; Lora M. Shields, Executive Officer

SCIENCE is published weekly on Friday, except the last week in December, by the American Association for the Advancement of Science, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005. Second-class postage (publication No. 484460) paid at Washington, D.C., and at an additional entry. Now combined with **The Scientific Monthly®.** Copyright © 1979 by the American Association for the Advancement of Science. Domestic individual membership and subscription (51 issues): $34. Domestic institutional subscription (51 issues): $70. Foreign postage extra: Canada $12, other (surface mail) $15, air-surface via Amsterdam $40. First class, airmail, school-year, and student rates on request. Single copies $1.50 ($2 by mail); back issues $2.50 ($3 by mail); classroom rates on request. **Change of address:** allow 6 weeks, giving old and new addresses and seven-digit account number. **Postmaster:** Send Form 3579 to *Science*, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005. *Science* is indexed in the *Reader's Guide to Periodical Literature* and in several specialized indexes.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

MIKE MC CORMACK
RUSSELL W. PETERSON
JOHN C. SAWHILL
CHEN NING YANG
WILLIAM T. GOLDEN
Treasurer
WILLIAM D. CAREY
Executive Officer

GEOLOGY AND GEOGRAPHY (E)
Linn Hoover
Ramon E. Bisque
BIOLOGICAL SCIENCES (G)
Donald S. Farner
Walter Chavin
ANTHROPOLOGY (H)
James B. Watson
Priscilla Reining
MEDICAL SCIENCES (N)
Theodore Cooper
Leah M. Lowenstein
AGRICULTURE (O)
J. Lawrence Apple
Coyt T. Wilson
INDUSTRIAL SCIENCE (P)
Herbert I. Fusfeld
Robert L. Stern
STATISTICS (U)
Richard L. Anderson
Ezra Glaser
ATMOSPHERIC AND HYDROSPHERIC SCIENCES (W)
Eugene W. Bierly
Glenn R. Hilst
GENERAL (X)
Ruth B. Pitt
S. Fred Singer

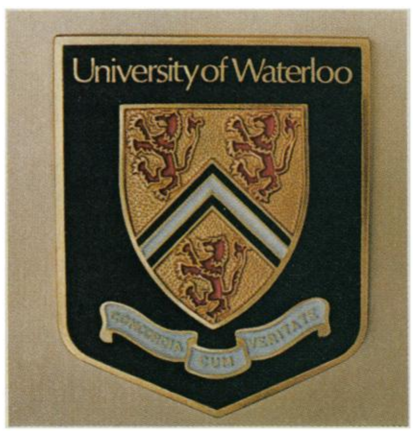
The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to foster scientific freedom and responsibility, to improve the effectiveness of science in the promotion of human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

COVER

Images acquired by Voyager 1 during its dash through the Jovian system were assembled in this abstraction to portray the diversity of phenomena to be found there. Jupiter, with the Great Red Spot seen in the southern hemisphere, is surrounded by the four Galilean satellites. Io, the innermost, is mottled by bizarre colors and is now known to be intensely volcanically active. Europa, the brightest, displays pastel markings crossed by global ribbons, perhaps reflecting tectonics of immense scale. Ganymede, third from Jupiter, shows a complex network of intersecting stripes that bound peculiar grooved terrain. Callisto, the outermost, displays an ancient cratered surface with enormous vestigal concentric ring systems, apparently the last records of tremendous impacts into its soft, icy crust. See page 913. [Jet Propulsion Laboratory, Pasadena]

How small IBM computers students run 10,000

Although it has been in existence for less than a quarter of a century, the University of Waterloo is the third largest university in Ontario and has gained a reputation for academic innovation. About half of the 15,000 students alternate their studies at the Waterloo, Ont., campus with periods of actual work experience with employers throughout Canada. And some 80% take at least one course in computing, reflecting the University's strong commitment to the computer for instruction, problem solving and research.



With this emphasis on computing, it is not surprising that the University should be active in new ways to increase the usefulness of computing systems for students. It scored a major advance not long ago with the advent of a system for online, video-terminal program preparation by large numbers of students – a system given the acronym WIDJET (Waterloo Interactive Direct Job Entry Terminal system).

An IBM-licensed program, WIDJET is an interactive multiuser system that runs on one or more IBM Series/1 computers. At Waterloo, using three Series/1s, it provides thousands of student programmers with the advantages of ready access to the computer – without the prohibitive costs that time sharing would involve. At the same time, it represents a marked improvement, both in function and expense, over punched card methods of program preparation.

From cards to terminals

As the student computing load grew at Waterloo, increasing dissatisfaction was felt with methods which required a student submitting a program to punch a deck of cards, run the deck through a card reader and then wait at a printer for the result to be returned from the central computer – especially since the process is usually a repetitive one. Moreover, the cost of the cards and printout paper had mounted to about $21,000 a month or over $250,000 a year. "You might say a switch to video terminals was in the cards," says J. Wesley Graham, professor of computer science at Waterloo.

The low-cost interactive WIDJET system was the solution. In this system, most of the workload handled by the central computer is shifted to one or more of the Series/1 computers to which a number of terminals are linked. Programs being prepared at the terminals can be developed interactively – that is, in back-and-forth conversational mode – with the help of an editing capability resident at the Series/1 computers.

The Series/1 solution

"The Series/1 is an ideal base for such an interactive system, both in terms of its capabilities and of IBM service and reliability," says Professor Graham. "We now have 2,500 student programmers authorized to use WIDJET through as many as 200 terminals. On a normal day, we'll get 10,000 jobs submitted – up to 20,000 at a peak period. Because we've removed the constraints associated with card handling, the average submission has grown to around 200 lines of code, instead of 50. Yet with WIDJET, the six hours a week a student programmer typically puts in at a terminal nets out to only about one minute of actual processing time on our System/360 and 370 central computers. The rest is absorbed by the Series/1 and the

help University of Waterloo programs a day.

WIDJET system.

"And we've found that what we've saved on punched cards in a single year alone more than paid for a Series/1."

Personalized use

The Waterloo student using a WIDJET terminal keys in his or her identification plus a personal "invisible" password. Then he or she can create programs or data, edit material from a previous terminal session, or run a program. Any material the student wants saved can be placed in a personal file stored directly on the Series/1; there is no need to access the main computer when starting or ending a WIDJET session. The main computer is accessed only when a program is actually compiled or run. Since all of a student's output is identified by a personal number, no copying of another student's program is possible. As a result, students can receive a large part of their grade from an assessment of all their computer work performed during the term.

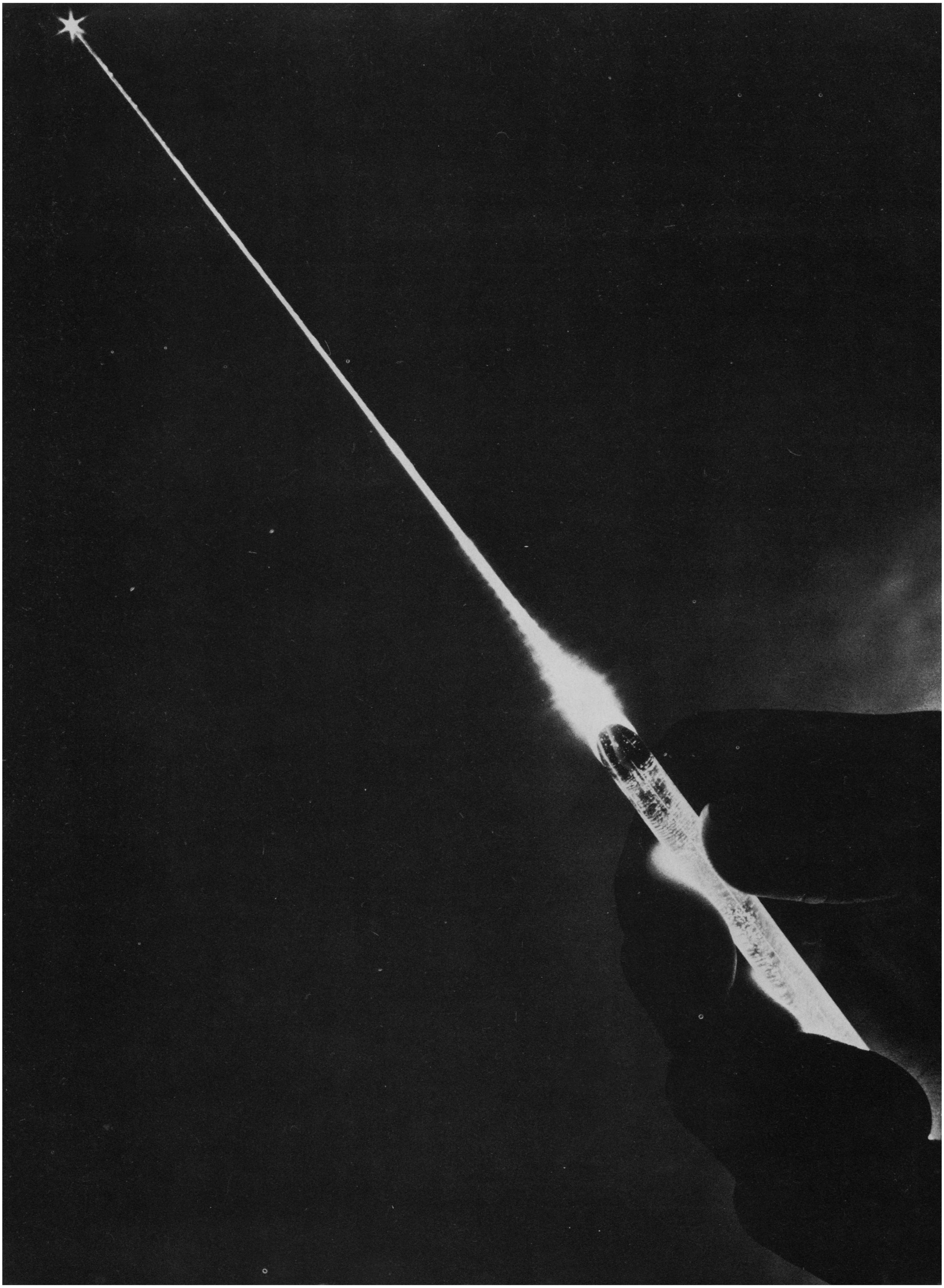
WORKING WITH WIDJET: Professor J. Wesley Graham with a University of Waterloo student at an IBM 4978 terminal.

There is also a "public library" on the Series/1 which, unlike the personal file, can be used by all students; teachers can place class announcements and program and problem assignments in this library to be copied by their students.

A standalone, too

In addition to functioning as a front-end adjunct to a central computer, the WIDJET Series/1 system can also operate in a "standalone" mode in which all jobs are submitted to the Series/1 itself. The standalone configuration can be converted to the front-end configuration by installing a multileaving remote job entry (MRJE) module. For more information, write IBM General Systems Division, College/University Programs, A06B1, P.O. Box 2150, Atlanta, GA 30301.

IBM®



Why this one-of-a-kind invention didn't end up as the only one of its kind.

Every new invention needs another new invention—the one that can mass-produce it at an affordable cost.

For example, Bell Labs invented a process for making the glass rods from which hair-thin fibers used in lightwave communications can be drawn. The fibers have far greater capacity than conventional copper wires, so they'll help keep costs down. In fact, they've been carrying voice, data, and video signals under city streets for about two years in a Bell System demonstration.

But standard lightwave systems will require *miles* of the fiber, produced at low cost and to specifications nothing short of microscopic.

That's where Western Electric's Engineering Research Center comes in.

A Unique Center

The Center is devoted exclusively to manufacturing research.

Here, a highly trained team of scientists and engineers probe fundamental questions about materials and processes. They provide Western Electric factories with pre-tested,

proven ways to manufacture products based on the latest technology coming out of the laboratory.

For example, while Bell Labs scientists were inventing new glass fibers, Western Electric engineers and scientists were tackling the manufacturing problems involved.

The fibers had to be drawn from molten glass at high speeds, with less than a 1% deviation in diameter.

But how do you control a "thread" of glass being spun at rates up to 15 feet per second?

Scientists and engineers at the Center discovered that laser light beamed onto the fiber cast a characteristic pattern. By correlating the pattern to the fiber's diameter, they were able to build a monitoring system into the fiber drawing machinery. It measures the fiber 1000 times per second, automatically adjusting production to keep the diameter constant.

The system works so well that in all the miles of fiber produced by Western Electric, the diameter varies by no more than 30-millionths of an inch.

The Key to the Future

In the Bell System, technology is the key to keeping costs down. It is the key to constantly improving your phone service.

And Western Electric's Engineering Research Center is an essential link between the ideas of the laboratory and the realities of the factory.

So your Bell Telephone Company can make the best one-of-a-kind inventions a part of your phone service.

Keeping your communications system the best in the world.

Western Electric

AAAS Colloquium on

R&D Policy

19-20 June 1979

Mayflower Hotel
Connecticut Avenue, NW
Washington, D.C.

"The budget analysis that the AAAS prepares for these meetings keeps getting better; the latest, third in a series, is a fine, item-by-item review of federal R&D spending and now qualifies as the best way of tracking the complexities of science and money in the US."

— Dan Greenberg, New Scientist, 29 June 1978

Colloquium Topics

- *Federal R&D* • R&D issues in the FY 1980 budget • Federal policies on R&D • Outlook for FY 1981 and the future • Problems in the budget process
- *Industry R&D and the Economy* • Problems of R&D in industry • Emerging federal policies on innovation • Impacts on economic outlook of federal and industry policies on R&D and innovation
- *International Aspects of R&D* • R&D and international competitiveness • R&D and international cooperation and assistance • R&D and U.S. foreign policy
- *Science and Basic Research* • Impact of federal policies and practices on the conduct of research • Universities and academic science • Federal scientific institutions and capabilities • Basic and long-term research in industry • Public accountability versus excessive paperwork

Colloquium Speakers

Speakers at the colloquium will include:

Jordan Baruch, Assistant Secretary for Science and Technology, Department of Commerce
Kenneth Boulding, President, AAAS
The Honorable George E. Brown, Jr., Chairman, Subcommittee on Science, Research, and Technology, U.S. House of Representatives
Jacob Clayman, President and Secretary-Treasurer, Industrial Union Department, AFL-CIO
The Honorable Don Fuqua, Chairman, Committee on Science and Technology, U.S. House of Representatives
J. Herbert Hollomon, Director, Center for Policy Alternatives, MIT
Carl Kaysen, Vice Chairman and Director of Research, The Sloan Commission on Government and Higher Education
Hugh F. Loweth, Deputy Associate Director, Science and Energy Technology, Office of Management and Budget
Robert P. Morgan, Chairman, Department of Technology and Human Affairs, Washington University, and Member, COSEPP
Arthur Obermeyer, President, Moleculon Research Corporation
Thomas R. Pickering, Assistant Secretary of State, Bureau of Oceans and International Environmental and Scientific Affairs
Frank Press, Director, Office of Science and Technology Policy, Executive Office of the President
Elliot Richardson, Ambassador at Large and Special Representative of the President to the Law of the Sea Conference
Nathan Rosenberg, Department of Economics, Stanford University
Harrison Shull, Research Professor of Chemistry, Indiana University
Dorothy M. Simon, Vice President for Research, AVCO Corporation
Senior OMB Official

Research and Development: AAAS Report IV covering R&D in the federal budget for FY 1980, data on R&D in industry, international aspects of R&D, and other topics related to R&D and public policy is being prepared by Willis H. Shapley and Don I. Phillips and will be available in advance to Colloquium registrants. Registrants will also receive the published proceedings of the Colloquium.

4th R&D Colloquium — Washington 19-20 June 1979

The fourth AAAS R&D Policy Colloquium will be held on Tuesday and Wednesday, 19 and 20 June 1979 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 (19-20 June) Advance Registration—enclosed is:

- ☐ **$85** Full Registration (includes lunch on both days, dinner on Tuesday, the R&D: FY 80 Report, and the Colloquium Proceedings)
- ☐ **$48** 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 **$17**):
☐ Lunch on Tues., 19th; ☐ Dinner on Tues., 19th; ☐ Lunch on Wed., 20th

Previous Reports and Proceedings (at **$5** each):
☐ R&D FY 79; ☐ R&D: FY 78; ☐ R&D: FY 77
☐ Proc. 78 Col.; ☐ Proc. 77 Col.; ☐ Proc. 76 Col.

Program, badge, meal tickets, and R&D: FY 80 Report will be sent about 8 June. Registrations received after 8 June will be held at the AAAS Registration Desk at the Mayflower Hotel. Previous reports ordered will be sent as soon as possible. Proceedings of 79 Colloquium will be sent as soon as available.

Registrant's Name ______________________________
(last name) (first and initial)

Affiliation ______________________________

Address ______________________________
(street and number)

____
(city) (state and zip) (telephone number)

☐ **Please check here if you need special services due to handicap. We will contact you prior to the meeting.**

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

Mayflower Hotel Reservation—AAAS Colloquium (19-20 June)

(Reservations received after 4 June cannot be guaranteed)

Room: ___ Single ($50*); ___ Double ($62*); ___ Twin ($62*)

*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______

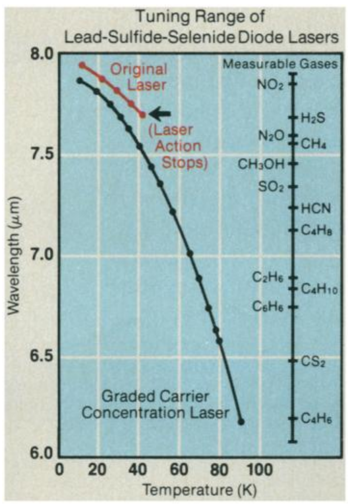
Please indicate any special housing needs due to a handicap ______________________________

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

More tunability, more durability for the world's smallest lasers.

"Tunable semiconductor diode laser" is a long name for a speck of lead-salt crystal. When tuned (by adjusting temperature) to emit the infrared wavelength that a particular gas can absorb, this tiny device can beam through a mixture of gases and quantify even small amounts of the targeted gas.

When research on diode lasers began here at the General Motors Research Laboratories, their tuning range was limited to about 1% of the infrared spectrum. Even modest temperature increases (to extend tunability) caused energy losses in the crystal that stopped laser action.

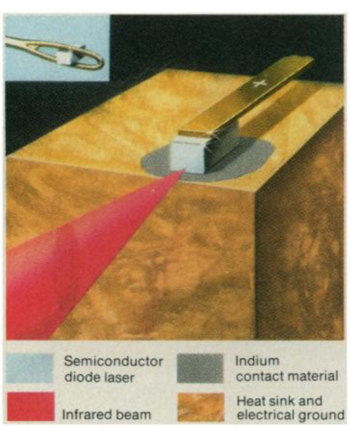


However, by producing a unique form of lead-sulfide-selenide single crystal that reduces these losses, our physicists developed a new type of semiconductor laser having 10 times the tuning range.

There were problems besides limited tunability. One was degradation from diffusion of the electrical contact material, indium, into the crystal. Interposing layers of gold and platinum ended that difficulty.

Another problem: The crystal would separate from the heat sink after repeated cycling down to the necessary cryogenic temperatures. That, too, was resolved . . . by a better chip-mounting arrangement.

As a result of these and other advances in tunable semiconductor diode lasers, even the sky won't be the limit of their usefulness. For example, such miniature searchlights may permit the measurement of gases surrounding the planets. They are already scheduled by NASA for satellite probings of our own stratosphere. And here on earth, they're now ready to play a significant role in monitoring pollution.



We currently have openings for Ph.D.s in engineering and the physical and mathematical sciences. If interested, please send your resume to: GMR Personnel, Dept. 615. An Equal Opportunity Employer.

General Motors Research Laboratories
Warren, Michigan 48090

1 June 1979, Volume 204, Number 4396

SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Science serves its readers as a forum for the presentation and discussion of important issues related to the advancement of science, including the presentation of minority or conflicting points of view, rather than by publishing only material on which a consensus has been reached. Accordingly, all articles published in *Science*—including editorials, news and comment, and book reviews—are signed and reflect the individual views of the authors and not official points of view adopted by the AAAS or the institutions with which the authors are affiliated.

Editorial Board

1979: E. PETER GEIDUSCHEK, WARD GOODENOUGH, N. BRUCE HANNAY, MARTIN J. KLEIN, FRANKLIN A. LONG, NEAL E. MILLER, JEFFREY J. WINE

1980: RICHARD E. BALZHISER, WALLACE S. BROECKER, CLEMENT L. MARKERT, FRANK W. PUTNAM, BRYANT W. ROSSITER, VERA C. RUBIN, MAXINE F. SINGER, PAUL E. WAGGONER, F. KARL WILLENBROCK

Publisher

WILLIAM D. CAREY

Editor

PHILIP H. ABELSON

Editorial Staff

Managing Editor ROBERT V. ORMES
Business Manager HANS NUSSBAUM
Assistant Managing Editor JOHN E. RINGLE
Production Editor ELLEN E. MURPHY

News Editor: BARBARA J. CULLITON

News and Comment: WILLIAM J. BROAD, LUTHER J. CARTER, CONSTANCE HOLDEN, ELIOT MARSHALL, DEBORAH SHAPLEY, R. JEFFREY SMITH, NICHOLAS WADE, JOHN WALSH. *Editorial Assistant,* SCHERRAINE MACK

Research News: BEVERLY KARPLUS HARTLINE, FREDERICK F. HARTLINE, RICHARD A. KERR, GINA BARI KOLATA, JEAN L. MARX, THOMAS H. MAUGH II, ARTHUR L. ROBINSON. *Editorial Assistant,* FANNIE GROOM

Consulting Editor: ALLEN L. HAMMOND

Associate Editors: ELEANORE BUTZ, MARY DORFMAN, SYLVIA EBERHART, JUDITH GOTTLIEB, RUTH KULSTAD

Assistant Editors: CAITILIN GORDON, LOIS SCHMITT, DIANE TURKIN

Book Reviews: KATHERINE LIVINGSTON, *Editor;* LINDA HEISERMAN, JANET KEGG

Letters: CHRISTINE KARLIK

Copy Editor: ISABELLA BOULDIN

Production: NANCY HARTNAGEL, JOHN BAKER; YA LI SWIGART, HOLLY BISHOP, ELEANOR WARNER; JEAN ROCKWOOD, LEAH RYAN, SHARON RYAN

Covers, Reprints, and Permissions: GRAYCE FINGER, *Editor;* CORRINE HARRIS, MARGARET LLOYD

Guide to Scientific Instruments: RICHARD SOMMER

Assistant to the Editors: RICHARD SEMIKLOSE

Membership Recruitment: GWENDOLYN HUDDLE

Member and Subscription Records: ANN RAGLAND

EDITORIAL CORRESPONDENCE: 1515 Massachusetts Ave., NW, Washington, D.C. 20005. Area code 202. General Editorial Office, 467-4350; Book Reviews, 467-4367; Guide to Scientific Instruments, 467-4480; News and Comment, 467-4430; Reprints and Permissions, 467-4483; Research News, 467-4321. Cable: Advancesci, Washington. For "Instructions for Contributors," write the editorial office or see page xi, *Science*, 30 March 1979.

BUSINESS CORRESPONDENCE: Area Code 202. Membership and Subscriptions: 467-4417.

Advertising Representatives

Director: EARL J. SCHERAGO

Production Manager: MARGARET STERLING

Advertising Sales Manager: RICHARD L. CHARLES

Marketing Manager: HERBERT L. BURKLUND

Sales: NEW YORK, N.Y. 10036: Steve Hamburger, 1515 Broadway (212-730-1050); SCOTCH PLAINS, N.J. 07076: C. Richard Callis, 12 Unami Lane (201-889-4873); CHICAGO, ILL. 60611: Jack Ryan, Room 2107, 919 N. Michigan Ave. (312-DE-7-4973); BEVERLY HILLS, CALIF. 90211: Winn Nance, 111 N. La Cienega Blvd. (213-657-2772); DORSET, VT. 05251: Fred W. Dieffenbach, Kent Hill Rd. (802-867-5581)

ADVERTISING CORRESPONDENCE: Tenth floor, 1515 Broadway, New York, N.Y. 10036. Phone: 212-730-1050.

Mission to Jupiter and Satellites

This issue contains first scientific reports of the Voyager 1 mission to Jupiter and its satellites. It also has a description of the telecommunication system that maintains two-way transfer of information between Earth and a spacecraft 700 million kilometers away. The excellence in communication equipment on Voyager 1 and the new results obtained mark the mission as a high point in this country's space effort. At a moment when unease and gloom abound, it is good to have evidence of continued competence among us.

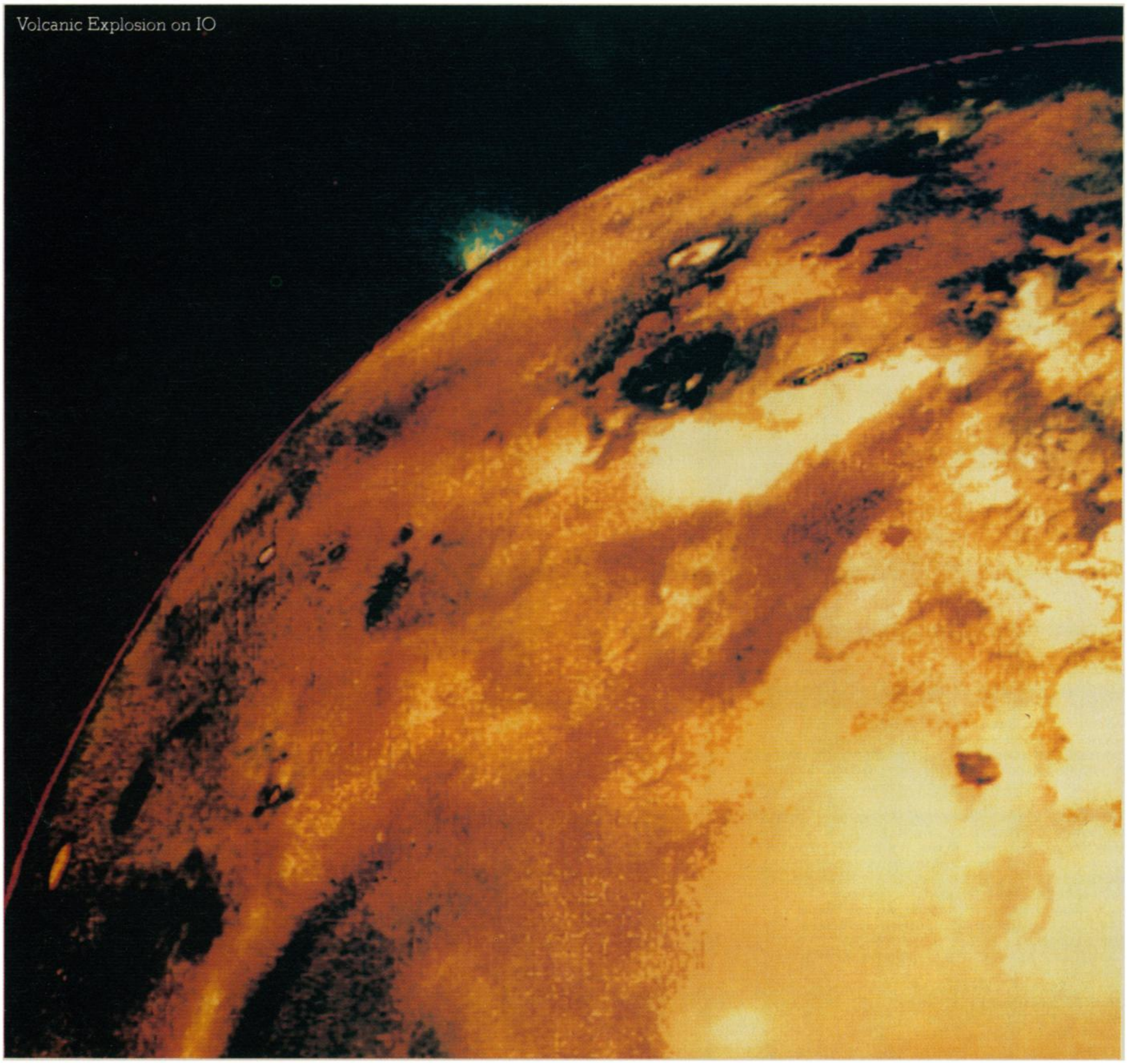
To most people, the payoff of the mission is in the form of striking pictures of Jupiter and its satellites. For scientists, results from other observing equipment on Voyager 1 are also important. A smaller group is interested in how the results were communicated back to Earth and in the control of the spacecraft in its travels through space. The reception of large numbers of pictures and other information was made possible by advances in communications. On Earth some radio stations broadcast with a power of 50,000 watts, yet one's radio may not receive such a station 100 kilometers away. Voyager 1 transmits with a power of 10 to 30 watts, yet its signals are dependably received at a distance of 700 million kilometers. The circumstances in the two instances are quite different; nevertheless, the dependable reception of signals from deep space is a technological feat. Part of the trick is a good directional antenna at the spacecraft accurately pointed at Earth. Even so, the signal energy reaching Earth is less than 10^{-18} watt per square meter, and this weak signal is detected reliably in spite of all manner of background electromagnetic noise. This capability is the result of steady improvement over the past 15 years. The present system is a factor of 150,000 better than that used with the 1965 Mariner mission to Mars.

Substantial evolution has also occurred in spacecraft. Voyager 1 has incorporated many improvements over its Mariner predecessors. This is especially true of the computer systems on board. The changes reflect opportunities created by advances in microelectronics. They are also responsive to needs created when a spacecraft is far away. The transit time for a message from Earth to Jupiter is about 40 minutes. Onboard computers must control the functioning of Voyager 1, including the scheduling and pointing of its scientific equipment. It is also desirable to preserve flexibility to meet contingencies. For example, during the 18 months of travel from Earth to Jupiter, the planet's restless atmosphere was observed from Earth. To optimize picture-taking in the vicinity of Jupiter, it was necessary to reprogram an onboard computer by commands from Earth. This can be done only slowly but the flexibility proved to be very useful.

As can be seen in this issue, a large amount of information was accumulated about Jupiter and its satellites. Particularly striking were some of the 18,000 photographs of the Jupiter system including color pictures of Jovian clouds and images of Jovian lightning, auroras, and meteor trails. Jupiter, with its large magnetic field, energetic particles, electromagnetic emissions, and complex atmospheric motions, will continue to be a closely studied object. On this occasion, however, photographs and other observations of the Jovian satellites produced the most novel information. For example, the two outer satellites Ganymede and Callisto are ice-covered and show preserved craters, apparently formed 4 billion years ago when an intense episode of cratering occurred in the solar system. The satellite Io has no ice and impact craters, but has been the scene of volcanic activity which continues. Plumes of dust and vapor reaching up to 285 kilometers were noted. The internal heat in Io seems to be due to tidal friction rather than radioactivity, and the surface of the satellite is renewed at least every 10 million years.

Our generation is likely to be the first to understand how the solar system was formed. The Voyager missions move us toward that goal.

—PHILIP H. ABELSON



VOLCANO ON IO.

An exciting discovery by NASA's Voyager 1 on Jupiter's Red Moon. You can be part of the future excitement at JPL. Just forward your resume to:

Jet Propulsion Laboratory,
California Institute of Technology,
Attention: Professional Placement
4800 Oak Grove Drive
Pasadena, CA 91103

THERE'S ONLY ONE JPL

AN EQUAL OPPORTUNITY EMPLOYER.

Annual Meeting San Francisco

3–8 January 1980

Call for Contributed Papers

Poster Sessions Only—Deadline: 7 September 1979

The next Annual Meeting of the AAAS will be in San Francisco at the San Francisco Hilton and St. Francis Hotels, 3-8 January 1980. Plan to attend (Information about the Meeting, as well as Housing and Registration forms, will appear in the 21 Sept. issue of *Science*.)

Although it is too late to submit suggestions for symposia for this Annual Meeting, contributed papers can be sent in up to 7 September 1979. Instructions for abstracts are given below and a sample is shown. Contributed paper sessions are of the POSTER type; in such sessions each contributor will have a bulletin board on which to place text and graphic material (of an oversized nature) for an extended period of time so that the work can be discussed with all interested parties (see *Science*, 28 June 1974, page 1361).

Please note that all contributions must be submitted (and signed) by an AAAS member or fellow (although this person need not be one of the authors).

Instructions for Contributors

Type abstracts, using a clean (new) ribbon, on ordinary white bond paper (8.5 by 11 inches; 21.5 by 28 cm) according to the format shown on the right (the example is reduced to about one-half of the linear dimension; your abstract will be printed *directly from your copy* at about two-thirds of its linear dimensions). Indicate at the top of the page the letter of the AAAS Section which comes closest to your subject matter (a full list will be found at the bottom of the contents page of any issue of *Science*), as well as two or three words which give the subspecialty involved.

It is very important to keep your abstract within the limits of a 5-inch (12.7-cm) square. If it is too wide, it will be returned; if it is too long, it may be arbitrarily cut. Note that your original will be our camera-ready copy, so type and letter as neatly as possible.

At the bottom of the page, left side, type the name and address of the person who should be contacted regarding the abstract (that is, the person we should notify of where and when the presentation should be made). On the right side, type the name and affiliation of the AAAS member or fellow who is submitting the abstract and have this person sign the abstract. *The privilege of submitting a contributed-paper abstract for the Annual Meeting is limited to AAAS members or fellows, but this person need not be one of the authors.*

Send the *original* together with three copies of your abstract to:

Contributed Papers
AAAS Meetings Office
1776 Massachusetts Avenue, NW
Washington, D.C. 20036

NOT LATER THAN 7 SEPTEMBER 1979

Abstract submitted for a POSTER SESSION at the AAAS Annual Meeting in San Francisco (3-8 January 1980).

AAAS Section nearest subject matter ______________________

Subspecialty of this Section ______________________

|—— 5 *inches* (12.7 *cm*) ——|

5 *inches* (12.7 *cm*)

Indent Five Spaces and Type Title in Upper and Lower Case Letters and Underline. AUTHOR'S NAME (Institution in Parentheses), SECOND AUTHOR (Institution).*

Skip a space and type abstract. The full width of the column of typed material should be 5 inches (12.7 cm) and must not extend beyond that. Abstracts which are wider than this will not be printed (only the title and authors will be printed). The total length of the material, from top of title to bottom of footnotes, should not exceed 5 inches (12.7 cm); material which takes up more than this space is subject to arbitrary cutting. All special symbols and signs which must be hand lettered (e.g., π) should be rendered in reproducible black ink as clearly and carefully as possible. The entire submission should be of camera-ready quality so that it can be photographed, turned into a plate, and printed. The printed abstract will be about 2/3 the size of the typed version. Avoid paragraphing as this wastes space. However, you may use your alloted space to neatly letter in equations and diagrams, as you deem necessary,

$$-\frac{\hbar^2}{2m}\nabla^2\psi + V\psi = i\hbar\frac{\partial\psi}{\partial t}$$

as indicated in this example.

*Skip a space and type footnotes. Author's names should be in all upper case letters; institutions in upper and lower case letters.

Person to be contacted about abstract:

Full Name
Complete Address

Submitted by AAAS member:

Type name of member
Type affiliation of member

____
(signature of member)

Beckman L8's: the Ultra

Six years ago, Beckman engineers set out to design a new type of ultracentrifuge. Every concept of existing ultracentrifuge designs was completely reevaluated in the light of the newest technology. The result is the Model L8 — a series of three ultracentrifuges so remarkable and so advanced that they introduce a new era in preparative ultracentrifugation.

Ultra-8™: The Most Advanced Ultracentrifuge Drive.

The Ultra-8 drive is a frequency-controlled induction motor. It drives the rotor directly and is located inside the vacuum system. As a result, there are no brushes to wear, no gears, no high-speed vacuum seal. We warrant the Ultra-8 drive for 16 billion revolutions — twice as long as any other drive system. It needs no external cooling water, even in the 80,000-rpm Model L8-80. And the drive module is small and easily replaced.

Microprocessor-Control: The Ultimate in Precision.

You select rotor speed, run time, and other parameters by finger pressure on the touch control panel — no knobs or switches. During the run, real time data, including either time remaining or elapsed time, are displayed in brightly lit digital form. Audible and visual signals show important operating conditions.

Memory-Pac™ Programmable Module: The Ultimate in Convenience.

If you want to make duplicate runs using the same rotor speed, temperature, etc., simply instruct the Memory-Pac module to remember them. It will reset these run conditions precisely each time you insert it into the L8 panel. No time spent, no chance for error. An erasable label on the Memory-Pac module allows you to note the programmed conditions. You can reprogram Memory-Pac modules in seconds — as often as you wish.

Built-in "Extras."

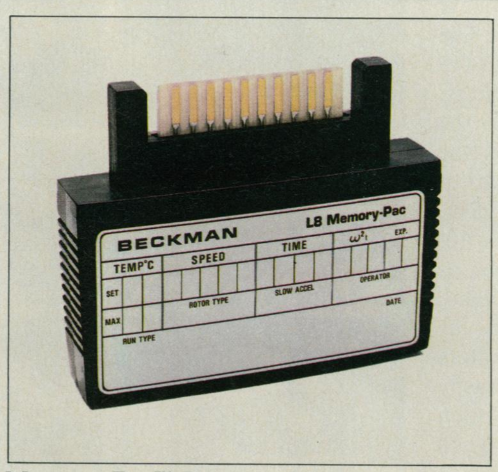
The Dry Cycle removes moisture from the chamber so that the next run can be started instantly. The advanced ω^2t Integrator has recall capability that allows you to reproduce band positions more precisely. There are built-in programs for slow starts with shallow gradients, and for zonal operation. Internal diagnostic systems make servicing simple.

Seven New Rotors.

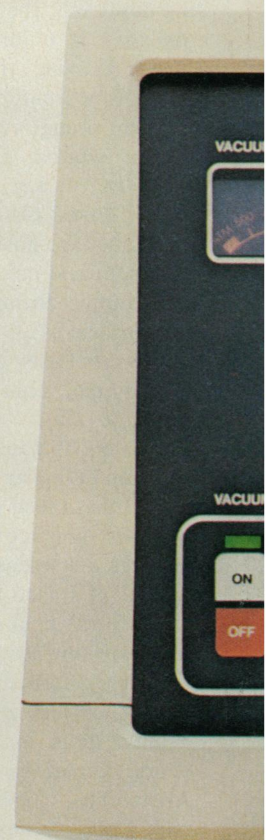
Seven new high-performance rotors are being introduced with the L8's, including the Type 80 Ti which generates up to 602,000 *g* for the fastest possible separations.

For complete information on the L8's and their new rotors, write for Brochure SB-580 to Beckman Instruments, Inc., Spinco Division, 1117 California Avenue, Palo Alto, CA 94304.

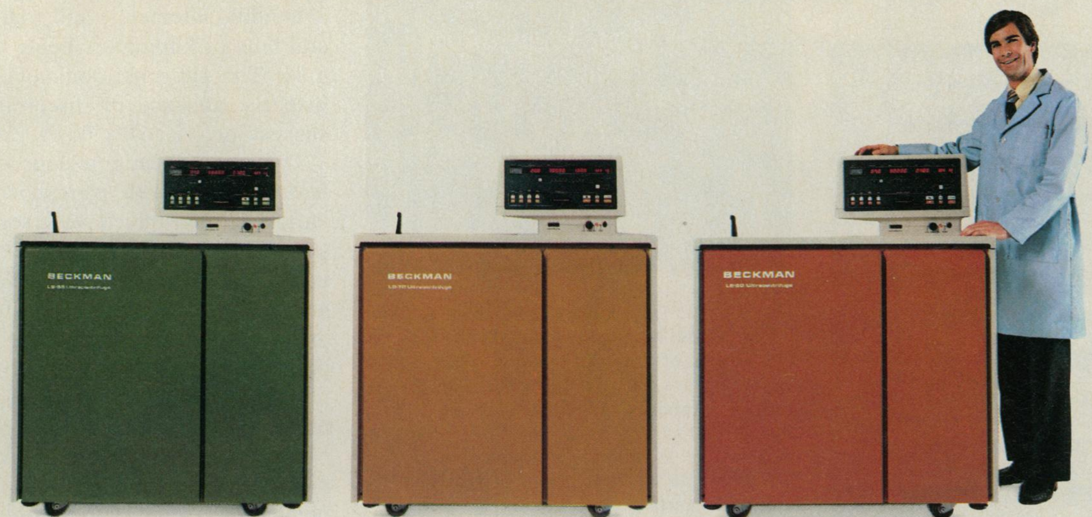
Ultra-8™ Drive Module.



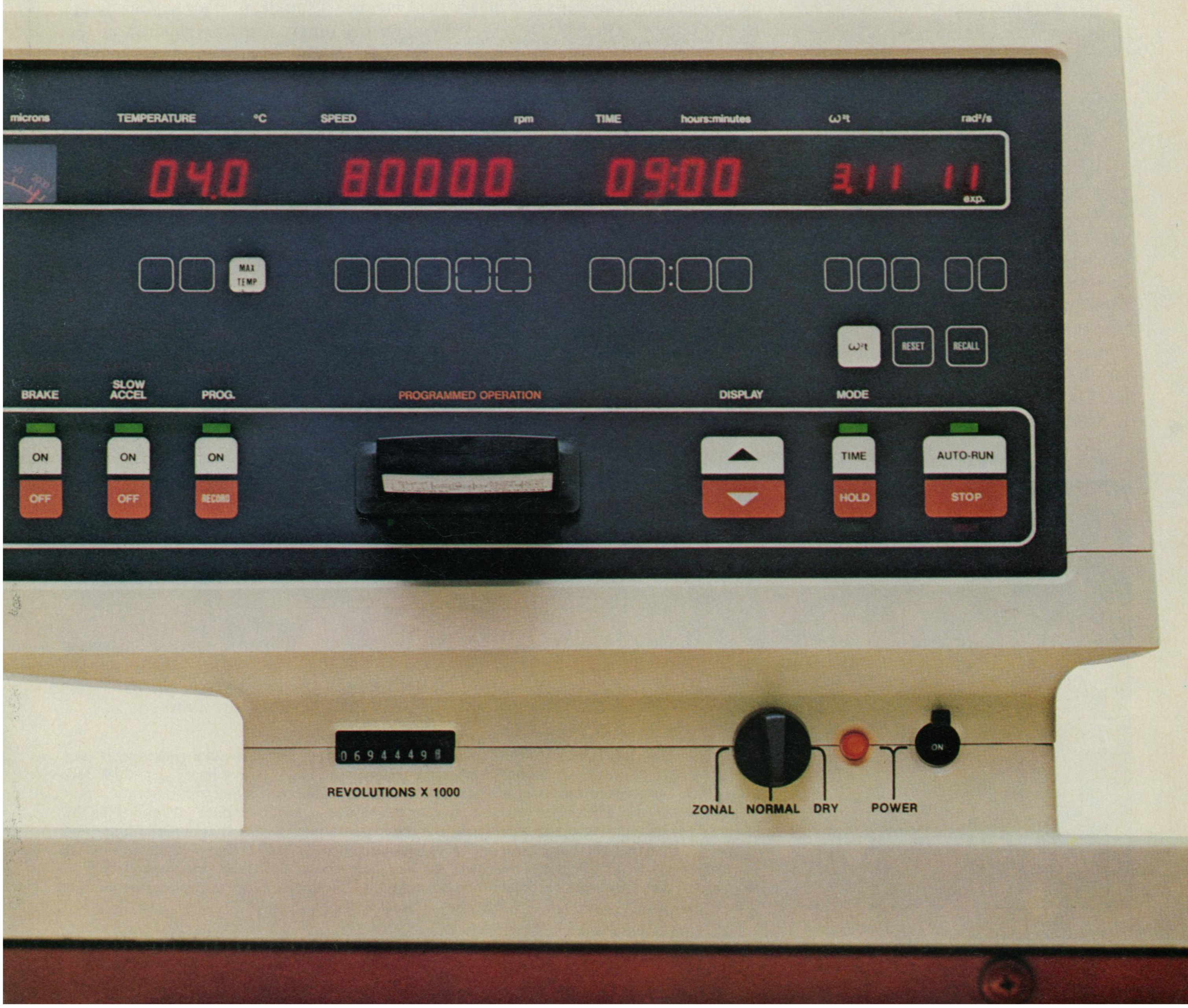
Memory-Pac™ Program Module.



centrifuges of the 80's.



Model L8-55, 55,000 rpm, 407,000 *g* Model L8-70, 70,000 rpm, 505,000 *g* Model L8-80, 80,000 rpm, 602,000 *g*



Special

Science Reprint Offer

VOYAGER I

The 1 June 1979 issue of **SCIENCE** features exclusive reports on the U.S. space flight of Voyager I to Jupiter. Because of the significance of these reports, we are offering an 80-page reprint of the Jupiter papers, illustrated with 14 full-color photographs of Jupiter and its satellites.

Subject areas covered include

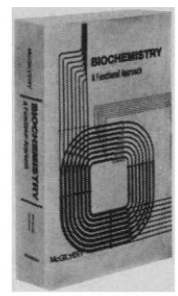
- **extraterrestrial volcanism**
- **infrared observations of Jupiter**
- **profiles of the Jovian atmosphere and ionosphere**
- **magnetic field studies**
- **plasma wave observations**

Available at $2.00 per copy while supplies last. To order your copy of this special Voyager I **SCIENCE** reprint, please send your name, address, and remittance to

Voyager I Reprints
American Association for
the Advancement of Science
1515 Massachusetts Ave., NW
Washington, D.C. 20005

Remittance must accompany all orders under $10.00

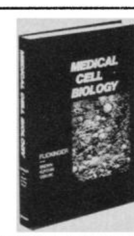
The 1979 Saunders Texts



McGilvery
Biochemistry
A Functional Approach
2nd Edition

Our leading biochemistry text—now completely updated! It's rigorous, clinical treatment of the subject suits the needs of your medical and upper-level biochemistry students. Numerous illustrations and a two-color format aid in student comprehension of structural formulas and reactions. Send for your copy today—in time for the fall semester.

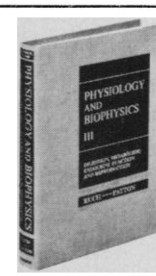
By **R.W. McGilvery,** PhD. In collaboration with **Gerald Goldstein,** MD. About 825 pp. 640 ill. Two-color. About $27.50. Ready soon. **Order #5912-8.**



Flickenger et al.
Medical Cell Biology

Material encompassed in this text includes cell physiology and ultrastructure, molecular biology and genetics and biochemistry. Clinical points are specifically related to basic science principles to emphasize the fundamental role of biology in medicine.

By **Charles J. Flickenger,** MD, **Jay C. Brown,** PhD, **Howard C. Kutchai,** PhD and **James W. Ogilvie,** PhD. 566 pp. 370 ill. $22.50. April 1979. **Order #3721-3.**



Ruch & Patton
Physiology and Biophysics
Vol. I, **The Brain & Neural Function**
20th Edition

Five years in the making, this new edition contains the latest data from both human aid and animal studies on subjects such as brain structure and function; somatic, auditory, olfactory and visual sensation; memory; and speech.

Edited by **Theodore Ruch,** PhD and **Harry D. Patton,** PhD, MD. About 770 pp., 375 ill. About $33.00. Ready soon. **Order #7821-1.**

To order titles on 30-day approval, enter order number and author: SCIENCE 6/79

AU: AU: AU:

Please Print:

FULL NAME

POSITION & AFFILIATION (IF APPLICABLE)

ADDRESS

CITY STATE ZIP

☐ check enclosed (send postpaid) ☐ bill me (plus postage and handling) Prices differ outside US and are subject to change

W.B. Saunders Co.

P.O. Box 207, Philadelphia, Pa. 19105
Attn. Journal Department
1 Goldthorne Avenue, Toronto, Ontario M8Z 5T9, Canada
1 St. Anne's Road, Eastbourne, East Sussex BN21 3UN, England
9 Waltham Street, Artarmon NSW 2064, Australia