

7 July 1978 • Vol. 201 • No. 4350

\$1.50

# SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE





# Research & Development: AAAS Reports

The informative and topical series of reports on research and development budgets and policies produced by the AAAS and used as the basis for the annual AAAS-sponsored June colloquium on R&D policy are . . .

- **Designed to** promote a wider and clearer understanding of R&D funding and policy issues
- **Addressed to** the scientific, technical, and public policy communities and to those responsible for policy and funding decisions on R&D
- **Written by** Willis H. Shapley, formerly a senior Bureau of the Budget official and Associate Deputy Administrator of NASA, and Don I. Phillips of the AAAS.

## Now Available

**RESEARCH & DEVELOPMENT: AAAS REPORT III**, by Willis H. Shapley and Don I. Phillips.

Retail price: \$6.00.\*

**Report III** expands the scope of the series to include R&D in industry and the impact of R&D on the economy, as well as R&D in the federal budget:

*R&D in the Federal Budget: FY 1979 (Part I)* provides an analysis of the federal budget's R&D content, the policies on which it is based, significant trends, and the basic issues of current and future concern in federal R&D.

*R&D, Industry, & the Economy (Part II)* gives a picture of R&D in industry and its nature and content, recent trends, and future outlook. *Part II* brings into focus the complex issues that center around interrelations of R&D and our economic system which have major implications for R&D policy in government and in industry.

## Also Available

**AAAS REPORT I Research & Development in the Federal Budget: FY 1977**, by Willis H. Shapley.

The first report in the series lays a foundation for the succeeding volumes with an exposition of the complexities of the federal budget process.

A readable volume of lasting value.

Retail price: \$5.00 (quantities limited).\*

**AAAS REPORT II Research & Development in the Federal Budget: FY 1978**, by Willis H. Shapley, Don I. Phillips, and Herbert Roback.

The second report in the series gives an analytic summary and interpretation of R&D in the FY 1978 federal budget and a discussion of significant R&D policy issues that face policy-makers.

Retail price: \$5.00.\*

**Research & Development: AAAS Report Series**—Constructive and thought-provoking readings on vital issues facing the R&D community and the nation today. ORDER YOUR COPIES NOW!

Report	
R&D '79	\$ 6.00
R&D '78	\$ 5.00
R&D '77	\$ 5.00
R&D Set	\$14.00 (3 volumes)

A limited number of copies of the June 1976 and 1977 colloquium proceedings is available. Retail price: \$5.00\*each. Proceedings of the June 1978 colloquium will be available in September 1978. Retail price:\$6.00\*.

Send your name, address and list of titles to:

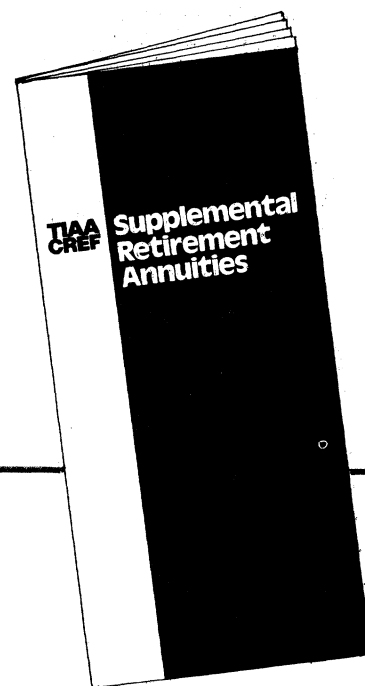


American Association for the Advancement of Science  
Department L  
1515 Massachusetts Avenue, NW  
Washington, D.C. 20005

All orders under \$10.00 must be prepaid.

\* AAAS member discount: 10% off retail price.

# TIAA-CREF Supplemental Retirement Annuities



## for tax-deferred annuity programs

Supplemental Retirement Annuities (SRA's) are new forms of TIAA and CREF contracts designed expressly for use by persons who want to set aside tax-deferred retirement funds over and above amounts being accumulated under their institution's basic retirement plan. They are available for employees of colleges, universities, private schools and certain other nonprofit educational organizations with tax-deferred annuity (salary-or-annuity option) programs. Through a properly drawn agreement with their institution, staff members may divert part of their compensation before taxes to the purchase of these new contracts.

**And SRA's are cashable at any time.** This means that if the money accumulated by salary reduction is needed before retirement, the SRA contracts can be surrendered for their cash value. Benefits, whether payable in cash or as income, are taxable as ordinary income when received.

For more information and answers to questions send for your copy of the booklet on Supplemental Retirement Annuities.

<b>S</b> end me a booklet describing TIAA-CREF Supplemental Retirement Annuities.		<b>TIAA CREF</b>
Name _____	Date of Birth _____	
Address _____ Street _____		
City _____	State _____	Zip _____
Nonprofit Employer _____		
Teachers Insurance and Annuity Association 730 Third Avenue, New York, New York 10017		wi

# SCIENCE

<b>LETTERS</b>	Crustal Drilling: Future Plans: <i>J. R. Heirtzler</i> ; Federal R & D and Local Needs: <i>M. Carballo</i> ; <i>J. M. Friedlander</i> ; Chimpanzees: Preserving the Species: <i>F. B. Orlans</i> . . . . .	6
<b>EDITORIAL</b>	Domestic Exploration for Materials. . . . .	7
<b>ARTICLES</b>	An Unusual Lightning Flash at Kennedy Space Center: <i>M. A. Uman</i> et al. . . . .	9
	Neural Organization and Evolution of Thermal Regulation in Mammals: <i>E. Satinoff</i> . . . . .	16
	Nuclear Waste: Increasing Scale and Sociopolitical Impacts: <i>T. R. LaPorte</i> . . . . .	22
<b>NEWS AND COMMENT</b>	Resources for the Future, Will It Merge with Brookings?. . . . .	29
	<i>Briefing</i> : House's Mr. Health Seeks New Career; Flexible Thought Gets Tentative Blessing; Speculative Thought Gets Definite Blessing . . . . .	30
	Assumptions About R & D's Link to Economic Growth Questioned . . . . .	32
	<i>Science in Europe</i> /British May Use Telephones, TV's, to Tap Data Bank . . . . .	33
	Animal Rights Advocate Urges New Deal . . . . .	35
<b>RESEARCH NEWS</b>	Capturing Sunlight: A Revolution in Collector Design . . . . .	36
<b>AAAS NEWS</b>	Hans Nussbaum, AAAS Business Manager, Retiring After 32 Years: <i>J. Walsh</i> ; NSF Chautauqua-Type Short Courses; Twenty Media Interns in 1978 Program; Fourth Candidate for Board of Directors Election; Kirtley F. Mather, 1888-1978 . . . . .	40

BOARD OF DIRECTORS					
EMILIO Q. DADDARIO Retiring President, Chairman	EDWARD E. DAVID, JR. President	KENNETH E. BOULDING President-Elect	ELOISE E. CLARK MARTIN M. CUMMINGS	RENÉE C. FOX BERNARD GIFFORD	
CHAIRMEN AND SECRETARIES OF AAAS SECTIONS					
MATHEMATICS (A) Mark Kac Ronald Graham	PHYSICS (B) D. Allan Bromley Rolf M. Sinclair	CHEMISTRY (C) William E. McEwen William L. Jolly	ASTRONOMY (D) Paul W. Hodge Donat G. Wentzel		
PSYCHOLOGY (J) Brenda Milner Meredith P. Crawford	SOCIAL AND ECONOMIC SCIENCES (K) Kurt W. Back Gillian Lindt	HISTORY AND PHILOSOPHY OF SCIENCE (L) Robert S. Cohen Diana L. Hall	ENGINEERING (M) Robert B. Beckmann Donald E. Marlowe		
EDUCATION (Q) Marjorie H. Gardner James T. Robinson	DENTISTRY (R) Sholom Pearlman John Termine	PHARMACEUTICAL SCIENCES (S) John G. Wagner Raymond Jang	INFORMATION, COMPUTING, AND COMMUNICATION (T) Eugene Garfield Madeline M. Henderson		
DIVISIONS					
ALASKA DIVISION		PACIFIC DIVISION		SOUTHWESTERN AND ROCKY MOUNTAIN DIVISION	
Donald H. Rosenberg President	Keith B. Mather Executive Secretary	Glenn C. Lewis President	Alan E. Leviton Secretary-Treasurer	James W. O'Leary President	Lora M. Shields Executive Officer
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. Copyright © 1978 by the American Association for the Advancement of Science. 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 the Reader's Guide to Periodical Literature and in several specialized indexes.					

# AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

<b>BOOK REVIEWS</b>	The Work Ethic in Industrial America, 1850–1920, <i>reviewed by C. N. Degler</i> ; Comets, Asteroids, Meteorites, <i>T. Owen</i> ; Recognition of Complex Acoustic Signals, <i>J. L. Gould</i> ; Books Received . . . . .	42
<b>REPORTS</b>	Copper Porphyrins in Deep-Sea Sediments: A Possible Indicator of Oxidized Terrestrial Organic Matter: <i>S. E. Palmer and E. W. Baker</i> . . . . .	49
	Noble Gases in the Murchison Meteorite: Possible Relics of <i>s</i> -Process Nucleosynthesis: <i>B. Srinivasan and E. Anders</i> . . . . .	51
	Seismic Amplitude Measurements Suggest Foreshocks Have Different Focal Mechanisms than Aftershocks: <i>A. Lindh, G. Fuis, C. Mantis</i> . . . . .	56
	Daylight Time-Resolved Photographs of Lightning: <i>R. E. Orville, G. G. Lala,</i> <i>V. P. Idone</i> . . . . .	59
	$\beta$ -Adrenergic Receptors in Aged Rat Brain: Reduced Number and Capacity of Pineal Gland to Develop Supersensitivity: <i>L. H. Greenberg and B. Weiss</i> . . . .	61
	Attraction by Repellents: An Error in Sensory Information Processing by Bacterial Mutants: <i>M. A. Muskavitch et al.</i> . . . . .	63
	6-Mercaptopurine Treatment of Pregnant Mice: Effects on Second and Third Generations: <i>T. J. Reimers and P. M. Sluss</i> . . . . .	65
	Peptide Formation in the Prebiotic Era: Thermal Condensation of Glycine in Fluctuating Clay Environments: <i>N. Lahav, D. White, S. Chang</i> . . . . .	67
	Histamine H <sub>1</sub> Receptor-Mediated Guanosine 3',5'-Monophosphate Formation by Cultured Mouse Neuroblastoma Cells: <i>E. Richelson</i> . . . . .	69
	Enhancement of Conditioned Arterial Pressure Responses in Cats After Brainstem Lesions: <i>M. A. Nathan et al.</i> . . . . .	71
	Effects of Naloxone on Schizophrenia: Reduction in Hallucinations in a Subpopulation of Subjects: <i>S. J. Watson et al.</i> . . . . .	73
	Induction of <i>Zugunruhe</i> by Photostimulation of Encephalic Receptors in White-Crowned Sparrows: <i>K. Yokoyama and D. S. Farner</i> . . . . .	76
	Anxiety Change Through Electroencephalographic Alpha Feedback Seen Only in High Anxiety Subjects: <i>J. V. Hardt and J. Kamiya</i> . . . . .	79

MIKE MC CORMACK FREDERICK MOSTELLER	RUSSELL W. PETERSON CHEN NING YANG	WILLIAM T. GOLDEN Treasurer	WILLIAM D. CAREY Executive Officer
GEOLOGY AND GEOGRAPHY (E) Gerald M. Friedman Ramon E. Bisque	BIOLOGICAL SCIENCES (G) Ursula K. Abbott Walter Chavin	ANTHROPOLOGY (H) June Helm Priscilla Reining	
MEDICAL SCIENCES (N) Leon O. Jacobson Leah M. Lowenstein	AGRICULTURE (O) James B. Kendrick Coyt T. Wilson	INDUSTRIAL SCIENCE (P) David B. Hertz Robert L. Stern	
STATISTICS (U) Samuel W. Greenhouse Ezra Glaser	ATMOSPHERIC AND HYDROSPHERIC SCIENCES (W) Kenneth C. Spengler Glenn R. Hilst	GENERAL (X) Allen V. Astin Joseph F. Coates	

## COVER

Cloud-to-ground lightning flash with several channels. The photograph illustrates the complexity which makes observations of lightning difficult and understanding elusive. See page 9. [William H. Beasley, University of Florida, Gainesville]

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.

# 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

1978: RICHARD E. BALZHISER, JAMES F. CROW, HANS LANDSBERG, EDWARD NEY, FRANK W. PUTNAM, MAXINE SINGER, PAUL E. WAGGONER, F. KARL WILLENBROCK

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

## Publisher

WILLIAM D. CAREY

## Editor

PHILIP H. ABELSON

## Editorial Staff

### Managing Editor

ROBERT V. ORMES

### Assistant Managing Editor

JOHN E. RINGLE

### Business Manager

HANS NUSSBAUM

### Production Editor

ELLEN E. MURPHY

*News and Comment:* BARBARA J. CULLITON, *Editor*; LUTHER J. CARTER, CONSTANCE HOLDEN, DEBORAH SHAPLEY, R. JEFFREY SMITH, NICHOLAS WADE, JOHN WALSH, *Editorial Assistant*; SCHERRAINE MACK

*Research News:* ALLEN L. HAMMOND, *Editor*; RICHARD A. KERR, GINA BARI KOLATA, JEAN L. MARX, THOMAS H. MAUGH II, WILLIAM D. METZ, ARTHUR L. ROBINSON, *Editorial Assistant*; FANNIE GROOM

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

*Assistant Editors:* CAITILIN GORDON, RUTH KULSTAD, LOIS SCHMITT, DIANE TURKIN

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

*Letters:* CHRISTINE KARLIK

*Copy Editors:* ISABELLA BOULDIN, OLIVER HEATWOLE

*Production:* NANCY HARTNAGEL, JOHN BAKER; YA LI SWIGART, 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: *Advances*, Washington. For "Instructions for Contributors," write the editorial office or see page xi, *Science*, 30 June 1978.

BUSINESS CORRESPONDENCE: Area Code 202. Business Office, 467-4411; Circulation, 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.

# Domestic Exploration for Materials

A civilization with a high standard of living is dependent on adequate supplies of many kinds of materials. Some elements are of critical importance. For example, chromium is an essential component of low-corroding stainless steels. Cobalt is needed to bond diamonds in cutting tools. The United States is dependent on outside sources for supplies of these and more than a score of other elements.

This country began the 20th century with more than its share of easily exploitable domestic resources. American prosperity and assurance of raw materials were reinforced by the results of geologic exploration elsewhere. Therefore, in the 1950's and early 1960's large parts of the world's oil and mineral reserves were owned by American companies. Most of the remaining reserves were under the control of friendly, stable governments. But great changes have occurred. The future of much of Africa is uncertain. American domination of foreign resources has ended. A long-term decline in the grade of domestic ore reserves has continued.

With an economy increasingly vulnerable to disruptions of supplies, with security of supplies uncertain, and with a diminished ability to pay for imports, intensified efforts to lessen U.S. dependence on foreign sources are needed.

Thus far there has been little action by the federal government; on balance, the government has hindered efforts to increase mineral supplies. During the past decade large areas of the most promising public lands have been closed to exploration. Funds available to the U.S. Geological Survey for mineral exploration have been modest. Support from the National Science Foundation for research on mechanisms of ore formation has been small. Industry is active in exploration, but the extent is not readily gauged.

The quest for ore deposits is handicapped by lack of knowledge of how elements are mobilized in the earth. Many of them are present in an average abundance of a few parts per million or less. But when found in ores they may have been concentrated by a factor of  $10^4$  or more.

Processes relevant to the genesis of ore deposits probably go back to the beginning of the solar system. Apparently this planet was assembled from heterogeneous materials and some of the heterogeneity persists on a large scale. The earth has been a laboratory in which many chemical separations have occurred. The environment of these events has changed with time. The interior of the earth was hotter in early times than it is today. When magmas reached the surface, weathering and subsequent sedimentation occurred in an oxygen-poor atmosphere. The ores in Precambrian rocks differ from those formed later and in general are more valuable. Precambrian rocks outcrop in substantial areas of Africa but form a smaller fraction of the surface of the United States. Surface rocks here are underlain by Precambrian formations, but the United States has had no systematic drilling program to examine them.

Our knowledge about later chemical events affecting mineralization is not much better. Most of the ore that has been found in this country was discovered by primitive techniques—you might say, by stumbling over it. Recently, the discovery process has been aided by results from Landsat satellites and by the concept of colliding tectonic plates, but much of the physical chemistry of the mobilization of elements remains a mystery. For example, many ores occur as insoluble sulfides. How were the cations concentrated and brought to their final position? Where did the sulfur come from? If we understood this process and others we could predict much better where and how to explore for ores.

A decade or more elapses from the time of discovery of an ore body to exploitation. If this country is not to become a pawn in an international game of materials, it must begin to develop a more vigorous materials policy.

—PHILIP H. ABELSON

*Announcing a  
New, Primary Journal:*

## **NUTRITION AND CANCER**

**An International  
Journal  
(Quarterly)**

Dr. Gio B. Gori  
*Editor*

Dr. Lon Crosby  
*Assistant Editor*

Diet and nutrition play a major role in the causation and prevention of cancer and in the therapy and rehabilitation of the cancer patient. The emergence of this research area defines the need for a journal to collect relevant information from various disciplines and to serve as a focal point for its dissemination. The journal is international and multi-disciplinary in nature. The scope of the journal includes etiology, prevention and therapy as related to diet and nutrition. Etiologic aspects include clinical and experimental research in nutrition, carcinogenesis, epidemiology, anthropology, toxicology/pharmacology, biochemistry/metabolism, food production, and prevention. Abstracts will be entered into the CANCERLIT data base, accessible through the National Library of Medicine.

First issue to appear  
September, 1978

\$48.00 per year

*Order from:*  
The Franklin Institute Press  
Box 2266  
Phila., Pa. 19103

## **The Meeting's Not Over Yet!**

**It can go for as long—and whenever—you like.**

CEBAR has high-quality tapes of some of the sessions from the 1976, 1977, and 1978 AAAS Annual Meetings.

There are tapes on atmospheric sciences, medical sciences, social and behavioral sciences, physical and mathematical sciences, environmental sciences, energy, resources policy—and just about any subject in which you're interested. Your staff or class can share in the information of AAAS meetings because these tapes include both the lectures as well as question-and-answer sessions.

Write to CEBAR and ask for a complete list of AAAS tape titles and prices.

**AAAS Cassettes, c/o CEBAR Communications, Inc.  
2735 Central Street, Evanston, Illinois 60201**

## **SB&F**

**Science Books & Films** is the quarterly review magazine which each year gives you reviews of 1000 new science trade/text books and 250 new 16mm science films.



In each issue you will find brief, informative, and authoritative reviews written and signed by specialists in the various fields. Our reviewers let you know the strengths and weaknesses of each book or film before you buy it.

SB&F can help you find the science books and films you need quickly and easily—with complete citations, ordering information, descriptive evaluations, nine explicit level designations (kindergarten [K] through professional [P]), four ratings, highly recommended (\*\*) to not recommended (NR).

Order from



American Association for the Advancement of Science  
SB&F Subscription Department  
1515 Massachusetts Avenue, NW, Washington, DC 20005

\$16/year for AAAS members; \$17.50/year for nonmembers; \$32 for two year subscription





## Data System Assists in Cancer Research



Senior Programmer Karen McNitt works with the 3354 system.

The Frederick Cancer Research Center, located in rural Maryland about 40 miles west of Baltimore, carries out a broad program of studies on the causes, mechanisms, treatment and prevention of cancer.

The Chemical Carcinogenesis Program is one of the major activities. Its scope ranges from animal and *in vitro* bioassays to studies of the effects of chemicals on cellular and genetic mechanisms. The term "chemicals" is used in the broadest sense and includes the well-known nitrosamines, the polynuclear hydrocarbons and even carcinogens that are formed within the body itself as metabolites of otherwise innocuous substances.

Studies of this nature require a great deal of high quality analytical chemistry, both to characterize the materials under study and to search out and identify the metabolites formed.

A Hewlett-Packard 3354 Lab Automation System, located in the computer center, serves many of the analytical instruments. These are widely scattered, often with only one or two instruments in a particu-

lar location. To provide terminal facilities adjacent to each location extensive use has been made of modems and existing telephone lines.

Pete Bostian, in charge of scientific programming at the computer center, says "We're planning to cover as many lab functions as possible with the 3354. Right now one transmission loop is fully loaded. We're in the process of reconfiguring the loops to split the load about evenly. This will make future expansion much easier.

"All our chromatographic analysis is on the system, along with some scintillation work that uses BASIC programs. We've interfaced a calorimeter, an optical densitometer, a fluorescence spectrophotometer and an amino acid analyzer."

Kevin Johnston is Administrator of the Chemical Carcinogenesis Program. In his opinion, "The data system is rapidly becoming indispensable to our work. We have access to other computing facilities but for much of our work the on-line data collection and immediate reporting is very important. The disc backup is also valuable; it lets us re-examine data quickly. We do a lot of this because we seldom know when we run an analysis all of the ways we may need to interpret it. With the multifaceted approach used at this Center we often want to go back and re-study some older results in light of new information."

At present the system serves laboratories in two buildings; plans are underway to extend it to a total of five. For additional information please check Lab Automation Systems on the Reply Card.

The new 7672A Automatic Sampler can be loaded with up to 99 sample bottles at a time. This permits around-the-clock operation for improved utilization of your gas chromatographic instrumentation.

The 7672A uses cassettes with 99 labeled sample holders connected in an endless chain. Cassettes are removable, so one can be in operation while another is being loaded with samples as they become available. An electrical output identifies the bottle being sampled for use with a laboratory data system.

A new tilting mount is standard with the 7672A. It lets you swing the sampler away from the injection port area for manual sample injection, while maintaining the sampler alignment so that it can be put back into operation when needed.

For more information about this new aid to lab productivity please check 99 Samples on the Reply Card.

### IN THIS ISSUE Summer 1978

#### Volume 8 Number 2

- Data System in Cancer Research
- 99 Bottle Sampler Capacity
- Urinary Organic Acids
- Peak Height? Peak Area?
- Antimycotic Assay
- Antiepileptic Analysis with Multiple Internal Standards
- Purge and Trap Sampler



# Urinary Organic Acids Identified and Quantified Automatically Using GC/MS

Analyses of the urine of infants who exhibit failure-to-thrive symptoms are often used to determine possible enzymatic deficiencies. Similar analyses are performed when the physician suspects a metabolic imbalance as the cause of a particular disease or symptom. Diagnosis requires both identification and quantitation of the compounds present.

The GC/MS technique can produce quantitation with a GC flame ionization detector and identification by the mass spectrometer with a single sample injection.

A recent case involved analysis of the organic acid extract of urine from an infant with failure-to-thrive symptoms. The TMS derivatized extract was analyzed using an HP 5985A GC/MS system equipped with an HP 7920 Disc Drive. The 50 megabyte capacity of this drive enables it to store both data and libraries, including the 25,560 spectra NBS Library. BATCH Processing software provides automatic sample injection, data collection and report generation after the user has entered the operating conditions.

On completion of the analysis the system closes the data file, constructs a total ion chromatogram, detects peaks using a threshold selected by the user, subtracts background, produces plots, tabulates or graphs the requested peaks and performs the quantitative analysis. Finally it compares the background-corrected spectra with the libraries and prints the information used to identify the organic acid constituents.

In this case GC flame ionization and MS total ion chromatograms were produced simultaneously (Figure 1). They show excellent agreement in peak shape and resolution with, as expected, some differences in response due to the different methods of ionization. An integrated FID report is available for further quantitative data manipulations and comparisons.

Figure 2 is a typical spectrum obtained during the run and corres-

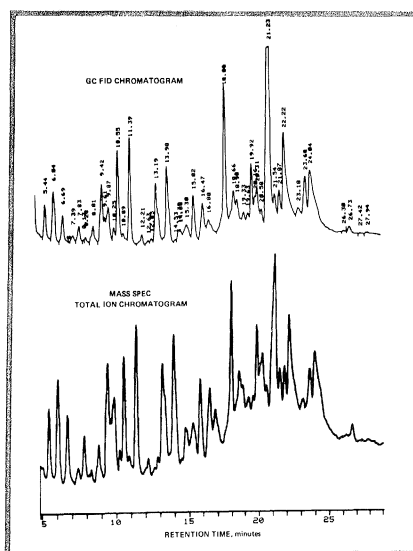


Figure 1: Comparison of chromatograms simultaneously obtained from GC with FID (top) and mass spectrometer.

ponds to the peak at 21.2 minutes retention time. Comparison with the NBS Library (Figure 3) indicates that this peak is the TMS derivative of acetaminophen. The full spectrum was retrieved from the 7920 Disc and plotted (Figure 4). Direct comparison with the library spectrum confirms the identification.

More information about GC/MS systems and their advantages will be sent to you if you check GC/MS Systems on the reply card.

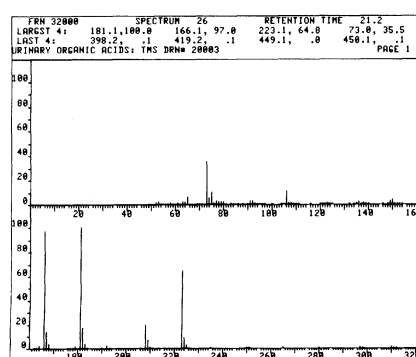


Figure 2: Mass spectrum of TMS derivative of acetaminophen, typical of those obtained during the GC/MS run.

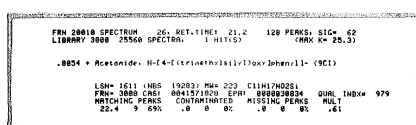


Figure 3: Library search result of comparing mass spectrum (Figure 2) with NBS spectral library and identifying compound as TMS derivative of acetaminophen.

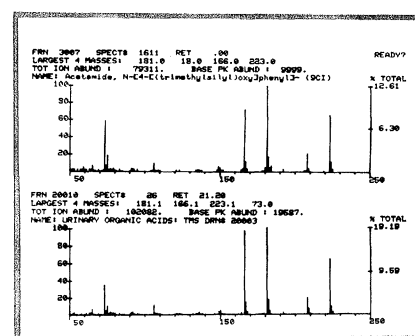


Figure 4: Visual comparison of NBS library spectrum (top) and spectrum of unknown, confirming unknown to be TMS derivative of acetaminophen.

## Heights or Areas?

### Take Your Pick

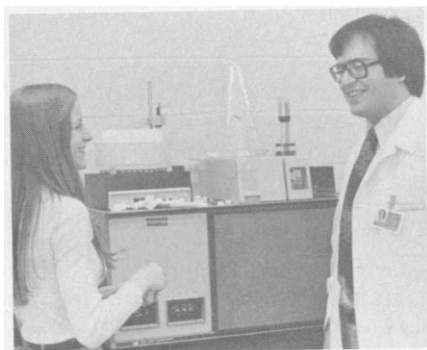
What is the best way to measure peak size? This is one of those arguments that will probably never be completely settled. Current practice leans heavily toward areas yet there are circumstances where peak height makes sense, particularly when a long-established procedure was developed using heights and it's important to maintain continuity in the analytical records.

The software for the 3350 Lab Automation Systems has now been enhanced to provide a choice of either peak height or peak area measurement. Heights are baseline-corrected, with the baseline determined by the same method used in peak area measurements. Thus heights can be obtained relative to a fixed horizontal baseline, a tangent skim baseline, a forced baseline, a drift-corrected baseline or whatever the situation requires.

In exploratory and method development studies the 3350 Systems provide for storage of the raw (unprocessed) instrumental data. This recorded data can then be examined using both peak areas and peak heights to determine which is the better choice for the problem at hand.

For additional information on the 3350 Lab Automation Systems please check Peak Heights on the Reply Card.

# DNA and RNA Studies by Liquid Chromatography



Research Assistant Maria Wilburn and Dr. Robert Diasio discuss experiments with the 1084 LC and fraction collector.


Dr. Robert Diasio and his associates at the Medical College of Virginia are using liquid chromatography extensively in their studies of the metabolic pathways leading to the nucleic acids. Their particular interest is in the mechanisms and kinetics by which the constituents are taken up and processed by the cell.

At present the laboratory uses three Hewlett-Packard Series 1080 Liquid Chromatographs. Dr. Diasio has these comments, "LC is an extremely powerful tool in this sort of work. Being a separation technique, it lets us look at both the raw material and the metabolites at the same time. We use fraction collection and a scintillation counter in most of our studies. The comparison between the UV detector charts and the scintillation results can be very enlightening when we're working with these complex biological systems."

In a recent paper Dr. Diasio describes a clinical application of liquid chromatography which grew out of his work with the pyrimidine bases. 5-Fluorocytosine is used as an antimycotic agent. Most of this drug is excreted unchanged in the urine. If kidney function declines it can

build up in the body and produce severe toxic effects. Kidney transplant and cancer patients on immunosuppressive therapy are susceptible to these infections, some of which cause a decrease in renal function.

Using an adaptation of the methods developed for the nucleic acid studies, Dr. Diasio can obtain assays of the blood levels of 5-fluorocytosine in about 30 minutes. This compares to 12 or more hours for the usual microbiological assay. LC eliminates interference from other drugs often used in conjunction with 5-fluorocytosine and yields better accuracy, particularly at the very critical toxic levels.

For a reprint of this paper, and information on the instrumentation used to produce it, please check LC Assay on the Reply Card. 

## Lab Automation System Simplifies a Multiple Internal Standard Analysis

Many biochemical analyses can be greatly improved by the use of more than one internal standard. Some procedures almost demand it if reliable data are to be obtained. The penalty paid for better data is primarily increased calculation time. The fact that multiple standards are used does not complicate sample preparation since a mixture can be prepared beforehand and added to the samples as though it were a single standard.

A Hewlett-Packard 3354 Lab Automation System has been tailored for the analysis of antiepileptic drugs by writing three LAB BASIC programs. The drug analysis programs perform three functions:

A dialog program accepts information on the names of the drugs, the internal standard to be used for each and the number and composition of the calibration mixtures. All of this is stored in a parameter file for later use.

A calibration program compares the results of the calibration runs with the data in the para-

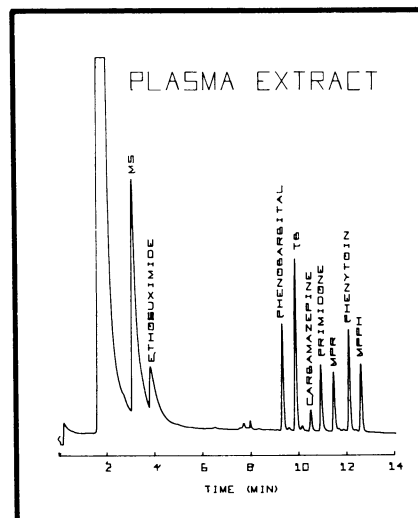
meter file, calculates the appropriate area ratios for each drug, performs a least squares fit of the calibration data and places the results in the parameter file.

A calculation program uses the data in the parameter file to interpret the results of a sample run and generate a report of analysis.

The 3354 system was also used (by means of the sequence function) to control an Automatic Sampler. Comparisons of data obtained with manual injection and automatic injection show that automation of the injection process generally yields improved analytical precision. A second, but by no means secondary, benefit is the amount of operator time saved by automatic injection.


Studies of several drug/internal standard combinations show that the choice of internal standard has a very large effect on the quality of the data produced.

Sample preparation is a significant factor in analyses such as this.

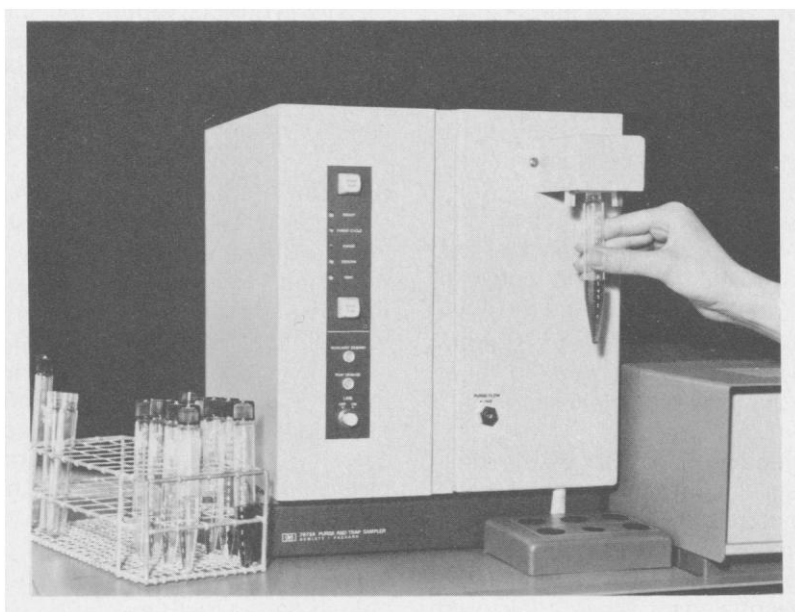


Plot of chromatogram from a raw data file using a Hewlett-Packard 7202 plotter.

Every step is a potential source of error and consumes valuable working time. In this study a nitrogen-phosphorus detector was used. The selectivity of this detector permitted shortening the sample preparation from 23 steps to only 8, a very worthwhile improvement.

A Technical Paper describing this study is now available. Just check Multiple Standards on the Reply Card for your copy. 

# New Sampler Automates Purge and Trap Analysis



Analysis of trace level volatiles in water has been a difficult analytical problem, yet concern over drinking water quality (and proposed EPA regulations) indicates a need for a large number of these analyses.

The new Hewlett-Packard 7675A

Purge and Trap Sampler is a fully automatic device for removing and concentrating the volatiles in water, then injecting them into a chromatograph or GC/mass spectrometer for analysis. A typical chromatogram of part per billion levels of trihalomethanes in water is shown in Figure 1.

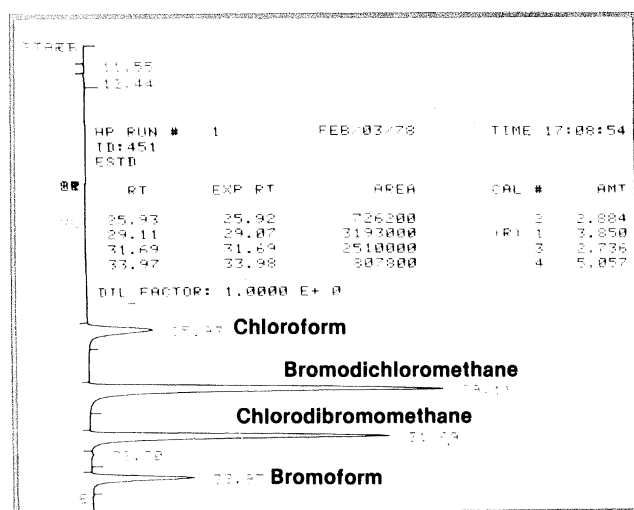


Figure 1: Trihalomethanes, 3-6 ppb, 1 ml water sample, ECD ATTN 2048, 40°C to 225°C @ 10°/min., 1/8" x 10' SS, 0.1% SP-1000/Carbopack C 80/100 mesh.

The 7675A sampler passes a stream of purge gas through the sample. Volatiles are concentrated on a suitable trapping column held at ambient temperature by a cooling air flow. When this purge cycle ends the trap is switched into the carrier gas stream and heated rapidly to desorb the volatiles. A "start" signal is sent to the chromatograph at the same time.

When desorption ends and while the analysis continues the trap is switched back into the purge gas stream and heated 50°C higher to drive off any low-volatility material. It is then cooled in preparation for the next run.

Once the sample container is in place and the START RUN key on the sampler is pressed the entire process is fully automatic. The operating cycle is shown schematically in Figure 2.

Further information on this sampler can be obtained by checking Purge and Trap Sampler on the Reply Card.

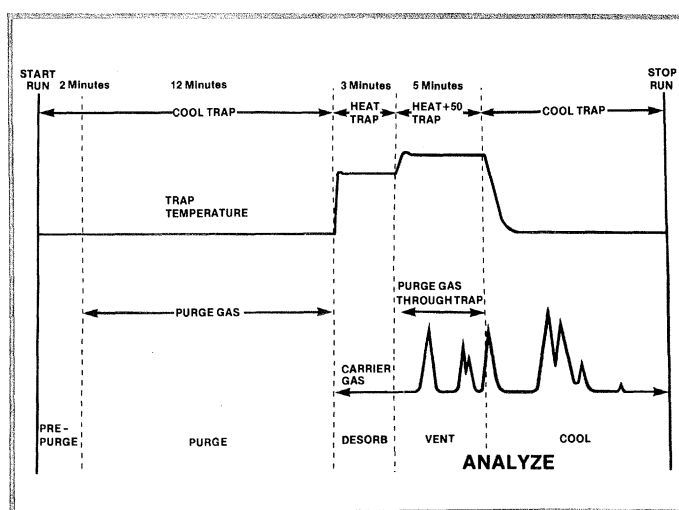


Figure 2: Operating cycle of the Purge and Trap Sampler



For assistance call: Washington (301) 948-6370, Chicago (312) 255-9800, Atlanta (404) 955-1500, Los Angeles (213) 877-1282, Toronto (416) 678-9430; or write: Hewlett-Packard, Route 41, PA 19311. Europe: 7 Rue du Bois du Lan, P.O. Box, CH-1217 Meyrin 2, Geneva, Switzerland (022) 82 7000. Japan: Yokogawa-HP, 29-21, Takaidohigashi 3-Chome Suginami-ku, Tokyo 168, Japan 03-331-6111. Intercontinental: 3200 Hillview Avenue, Palo Alto, CA 94304 (415) 856-1501.