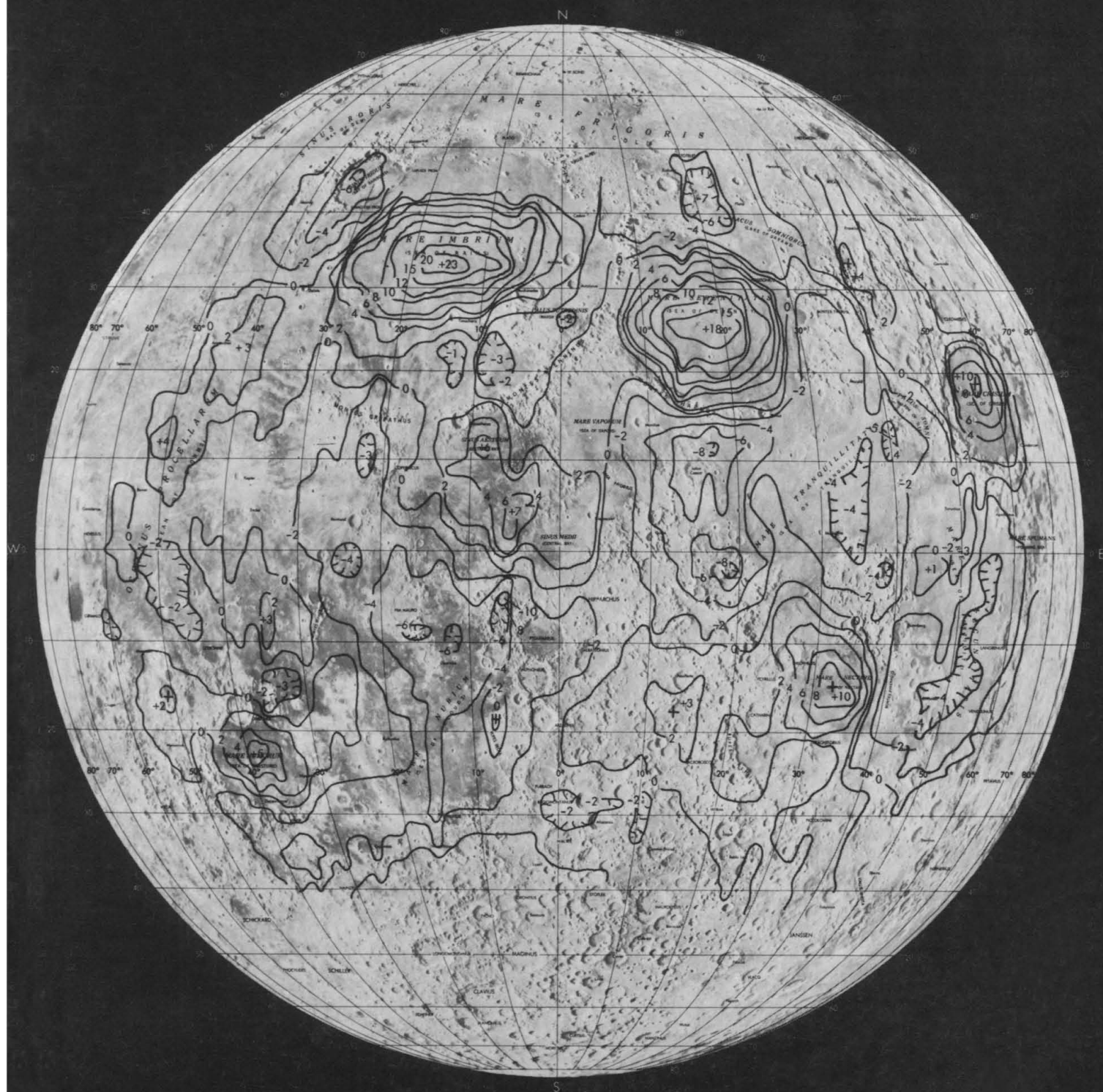


SCIENCE

















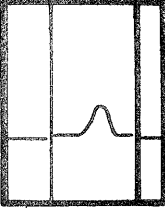

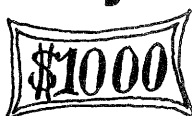



16 August 1968

Vol. 161, No. 3842

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



LUNAR GRAVIMETRICS

\$'s and ¢-trifuge plan: a simple plan for getting separations  at 65,000 rpm and 420,000g with a new  Model L2-65B preparative ultracentrifuge from  Instruments, that includes two new high-performance rotors   from a choice of nine          plus an advanced-design zonal rotor  from a choice of four     or  schlieren optics for your old Model L  or  schlieren optics for your  new Model L2-65B plus a saving  of  or a saving  of  if you trade in two   old rotors; and, if you are strapped for space , a trade-in allowance for your old  Model L!

MAIL TO:

Beckman

INSTRUMENTS, INC.

SPINCO DIVISION

1117 CALIFORNIA AVENUE
PALO ALTO, CALIFORNIA • 94304

- ☐ Your simple plan boggles the mind; please have a salesman call to explain.
- ☐ I think I understand your plan to simplify getting the maximum capabilities of ultracentrifugation at a savings. Please send me your literature.

NAME

TITLE

INSTITUTION

ADDRESS

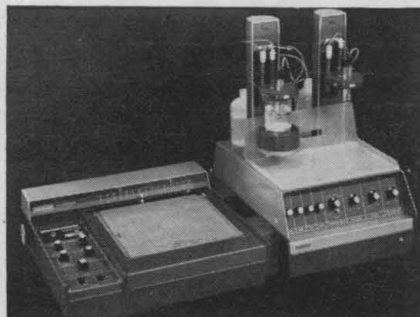
CITY

STATE

ZIP

INTERNATIONAL SUBSIDIARIES: GENEVA; MUNICH; GLENROTHES, SCOTLAND; TOKYO; PARIS; CAPE TOWN; LONDON; MEXICO CITY; STOCKHOLM; VIENNA





**New fully Automatic
Recording Titrator.**
Self-contained. Simple to
operate. Modular design.

You can give it a job and walk away. It can perform a complete titration without supervision. It can perform titrations automatically whether the endpoint is known or unknown. And with the proper accessories, it can be used as a pH Stat to perform enzyme assays and obtain kinetic rate information. A completely modular design provides a wide choice of instrument configurations suited for performing pH, redox, and other types of potentiometric titrations from the routine to the most complex. No special operator skill is

required to obtain maximum results. Versatility and performance can be enhanced by simply adding a module. Then walk away from the most advanced automatic recording titrator in the field. That's why we call it The Mind Free-er. For complete details, contact your Beckman Sales Engineer or write for Data File #6.

Beckman®

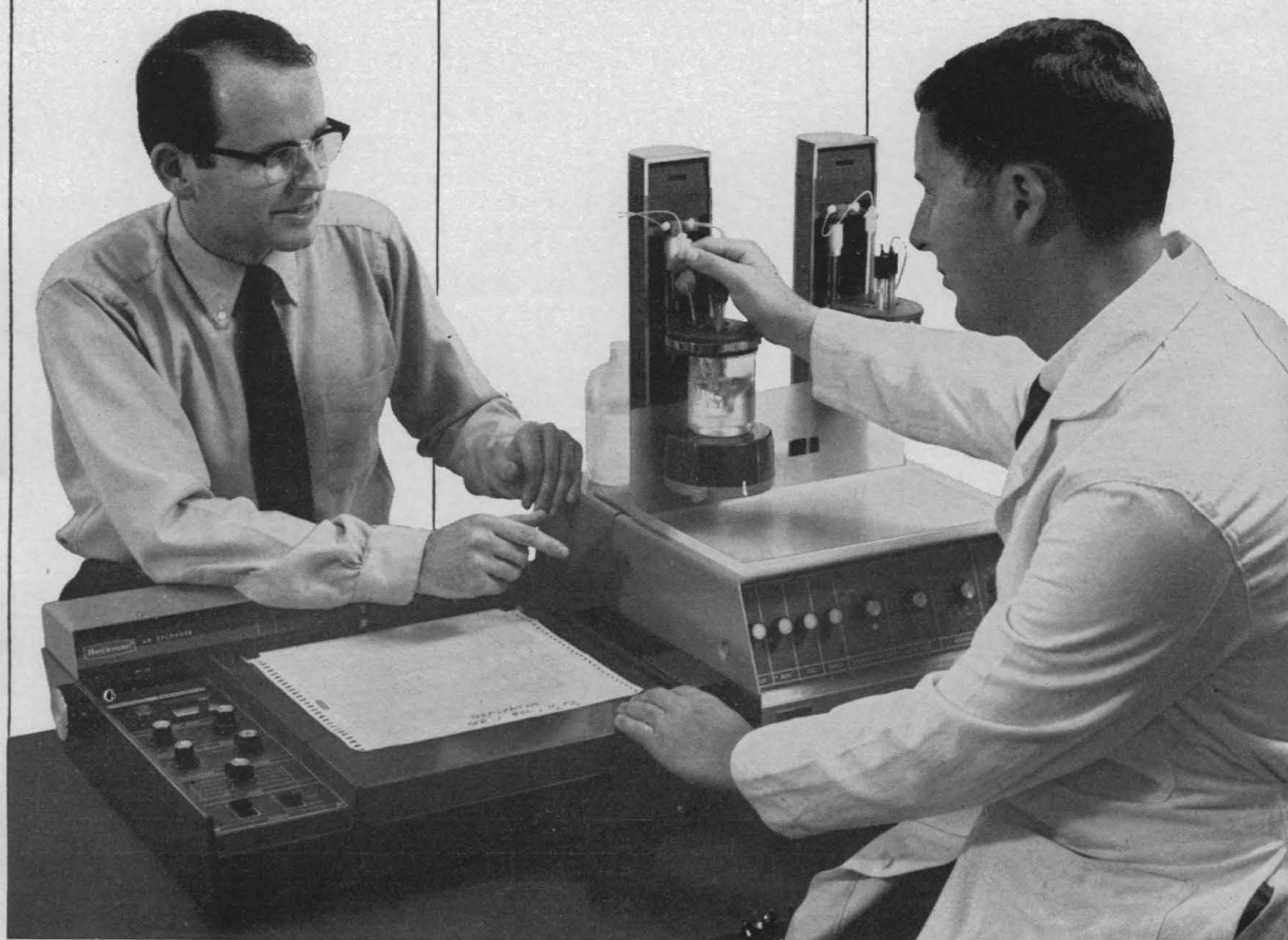
INSTRUMENTS, INC.

SCIENTIFIC INSTRUMENTS DIVISION

FULLERTON, CALIFORNIA • 92634

INTERNATIONAL SUBSIDIARIES: GENEVA; MUNICH; GLENROTHES, SCOTLAND;
TOKYO; PARIS; CAPE TOWN; LONDON; MEXICO CITY; STOCKHOLM; VIENNA

In Titration... Beckman introduces the Mind Free-er



Vol. 161, No. 3842

SCIENCE

BOARD OF DIRECTORS

WALTER ORR ROBERTS
President

H. BENTLEY GLASS
President-Elect

BARRY COMMONER
HUDSON HOAGLAND

GERALD HOLT
MINA S. REES

VICE PRESIDENTS AND SECTION SECRETARIES

MATHEMATICS (A)
A. H. Taub
Wallace Givens

PHYSICS (B)
Stanley S. Ballard
Albert M. Stone

CHEMISTRY (C)
Ralph Shriner
Milton Orchin

AST
Thor
Fran

ASTRONOMY (D)
Thornton L. Page
Frank Bradshaw Wood

ANTHROPOLOGY (H)
Gabriel W. Lasker
Anthony Leeds

PSYCHOLOGY (I)
Delos D. Wickens

SOCIAL AND ECONOMIC SCIENCES (K)
Guy E. Swanson
Eugene B. Skolnikoff

HISTORY AND PHILOSOPHY OF SCIENCE
Robert Bruce Lindsay
Raymond J. Seeger

PHARMACEUTICAL SCIENCES (Np)
Andre Archambault
Joseph A. Oddis

AGRICULTURE (O)
Daniel G. Aldrich, Jr.

INDUSTRIAL SCIENCE (P)
Donald W. Collier
Burton V. Dean

EDUCATION (Q)
Willard J. Jacob
J. Myron Atkin

DIVISIONS

ALASKA DIVISION

Richard Hill	Irma Duncan
President	Executive Secretary

PACIFIC DIVISION
Garrett Hardin Robert C. Miller
President Secretary

SOUTHWESTERN AND ROCKY MOUNTAIN DIVISION
Terah L. Smiley Marlowe G. Anderson
President Executive Secretary

SCIENCE is published weekly on Friday and on the fourth Tuesday in November by the American Association for the Advancement of Science, 1515 Massachusetts Ave., N. Washington, D.C. 20005. Now combined with the **Scientific Monthly**. Second-class postage paid at Washington, D.C. Copyright © 1968 by the American Association for the Advancement of Science. Annual subscriptions: \$12; foreign postage: Americas \$3; overseas \$5; single copies, 50¢ (back issues, \$1) except **Guide to Scientific Instruments**, which is \$2. School year subscriptions: 9 months, \$9; 10 address label. SCIENCE is indexed in the **Reader's Guide to Periodical Literature**.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Radiocarbon: Analysis of Inorganic Carbon of Fossil Bone and Enamel: <i>V. Haynes</i>	687
Seismic and Bathymetric Evidence of a Fracture Zone on Gorda Ridge: <i>J. Northrop, H. W. Menard, F. K. Duennebie</i>	688
Magnesium Sulfate Interactions in Seawater from Solubility Measurements: <i>R. M. Pytkowicz and R. Gates</i>	690
Cytokinin from Soluble RNA of <i>Escherichia coli</i> : 6-(3-Methyl-2-butenylamino)-2-methylthio-9- β -D-ribofuranosylpurine: <i>W. J. Burrows et al.</i>	691
<i>Drosophila melanogaster</i> Treated with LSD: Absence of Mutation and Chromosome Breakage: <i>D. Grace, E. A. Carlson, P. Goodman</i>	694
Trophoblast Antigenicity Demonstrated by Altered Challenge Graft Survival: <i>J. F. Hulka and K. Mohr</i>	696
Ruminant-Like Digestion of the Langur Monkey: <i>T. Bauschop and R. W. Martucci</i>	698
Olefins of High Molecular Weight in Two Microscopic Algae: <i>E. Gelpi et al.</i>	700
Vascular Injury and Lysis of Basement Membrane in vitro by Neutral Protease of Human Leukocytes: <i>A. Janoff and J. D. Zeligs</i>	702
Aggression in Adult Mice: Modification by Neonatal Injections of Gonadal Hormones: <i>F. H. Bronson and C. Desjardins</i>	705
Lysergic Acid Diethylamide: Sensitive Neuronal Units in the Midbrain Raphe: <i>G. K. Aghajanian, W. E. Foote, M. H. Sheard</i>	706
Taste Stimuli: A Behavioral Categorization: <i>D. N. Tapper and B. P. Halpern</i>	708
<i>Technical Comments</i> : Crescentic Landforms along the Atlantic Coast of the United States: <i>M. M. Ball and A. C. Neumann; F. A. Dolan and J. C. Ferm</i>	710
MEETINGS Environment of the Primitive Earth: <i>R. Siever</i>	711

LEONARD M. RIESER
H. BURR STEINBACH

KENNETH V. THIMANN
JOHN A. WHEELER

PAUL E. KLOPSTEG
Treasurer

DAEL WOLFLE
Executive Officer

GEOLOGY AND GEOGRAPHY (E)
Claude C. Albritton, Jr.
Richard H. Mahard

ZOOLOGICAL SCIENCES (F)
Vincent Dethier
David E. Davis

BOTANICAL SCIENCES (G)
Warren H. Wagner, Jr.
Arthur W. Cooper

ENGINEERING (M)
Paul Rosenberg
Newman A. Hall

MEDICAL SCIENCES (N)
Shields Warren

DENTISTRY (Nd)
Barnet M. Levy
Richard S. Manly

INFORMATION AND COMMUNICATION (T)
J. C. R. Licklider
Heen E. Stewart

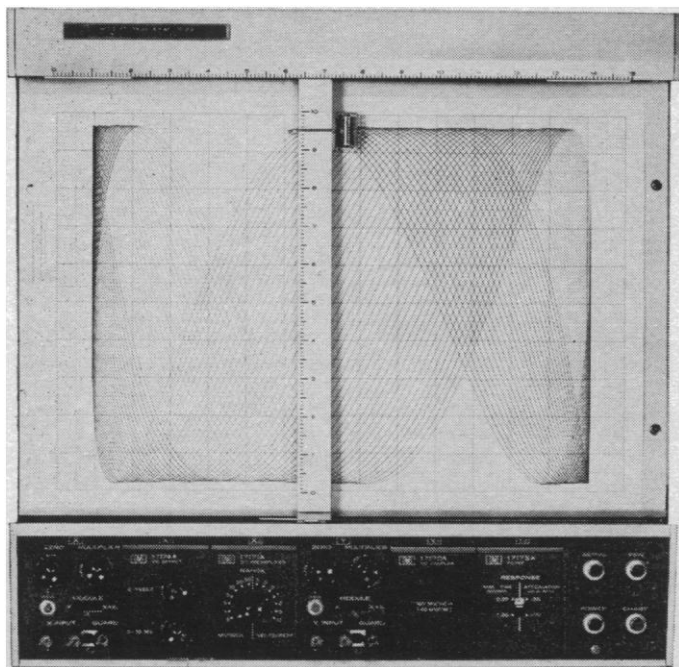
STATISTICS (U)
Chester I. Bliss
Rosedith Sitgreaves

COVER

Lunar gravimetric map of the earth-side hemisphere obtained from Lunar Orbiter spacecraft tracking data. The newly discovered dense mass concentrations (mascons) under each of the ringed seas (maria) are shown. The units are keyed with the table under Fig. 1, page 681. [The topographic map is a standard ACIC lunar map. The overlay is from Jet Propulsion Laboratory, California Institute of Technology, Pasadena]

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 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.

A new concept in x-y recording:



Something new has entered the X-Y recorder field. The new Hewlett-Packard 7004A X-Y Recorder, with dynamic performance over $1000''/\text{sec}^2$ acceleration and slewing speed of $30''/\text{sec}$ —unparalleled in the recorder industry—offers plug-in convenience for unprecedented versatility in either analog or digital applications. SIX plug-ins let you convert this precision, solid-state $11'' \times 17''$ X-Y recorder into many different recorders—and either X-Y, Y-T or X-T operations—and the variations are nearly endless, because there are more to come.

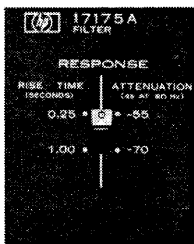
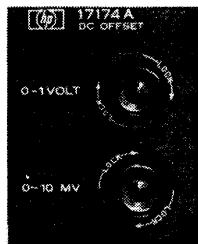
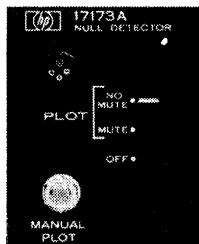
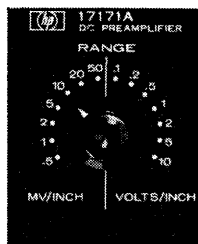
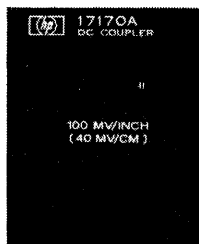
Plug-in expandability with highest dynamic performance!

With plug-in units constantly being developed, the HP 7004A X-Y Recorder offers you guaranteed versatility combined with superior performance. Price: 7004A, \$1295.

Here's what's available now:

- DC coupler, 100 mV/inch. \$50.
- DC amplifier, 0.5 mV to 10 V/inch with 14 calibration ranges. \$250.
- Time base, 8 calibrated sweep speeds. \$200.
- Null detector, up to 50 plots/second. \$200.
- DC offset, continuously adjustable to 1 V. \$100.
- Filter, 55 dB rejection at 50 Hz and above. \$75.

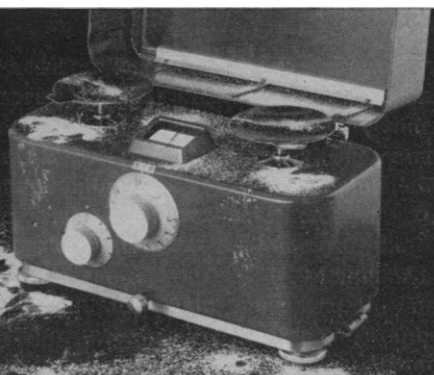
For a complete brochure and data sheet call your local HP field engineer or write Hewlett-Packard, Palo Alto, California 94304; Europe: 54 Route des Acacias, Geneva.



HEWLETT  PACKARD
GRAPHIC RECORDERS

11706A

You can 'snow'
a Torbal balance
with pigment,
abrasive dust,
chemicals, or
any powder



but it will never 'snow' you back.

Sometimes you can't help it. In certain weighing situations no matter how hard you try, a balance gets dirty from spilled or overflowing powders. Or from dust in the air.

When this happens on a conventional knife-edge balance, the knife-edge fulcrum becomes dirty—gets gummed up, and eventually wears. Increased friction, decreased sensitivity and inaccuracy result. (In time even small amounts of dirt in the atmosphere will have this effect.)

On the other hand, with a Torsion Balance based on fulcra which twist instead of roll, this cannot happen. There are no friction pivots or knife-edge fulcrum; thus no metal-to-metal wear, and the weighing mechanism

cannot be affected by foreign material. The balance will not become sluggish, it retains its initial accuracy and sensitivity, and because of its virtually one-piece construction, adjustment is permanent.

The Torbal DWL2 shown above is a 120-gram capacity balance with a dial accuracy of 5 mg.; silicon fluid damping for fast weighing; dials with 9 g x 1 g, and 1 g x 0.01 g graduations, to eliminate use of small loose weights. Write today for literature.

The Torsion Balance Company TORBAL
Department J
Main Office and Factory: Clifton, N.J.;
Sales Offices: Birmingham, Ala.; Chicago, Ill.;
Richardson, Tex.; San Mateo, Cal.; Pittsburgh, Pa.;
Plants and Offices in Montreal, Quebec and London, England

Toxicity of New Drugs

My letter of 8 July 1966 expressed concern as to whether pharmaceutical manufacturers investigating new drugs were reporting toxicity findings to the Food and Drug Administration. As a drug investigator, I became aware of this problem when I learned that the toxicity data of our Dornwal study for Wallace and Tiernan in 1961 had not been reported to the FDA. The suppression of information about this tranquilizer led a federal district court to impose a maximum \$40,000 fine on the company and place its medical director on probation for 1 year.

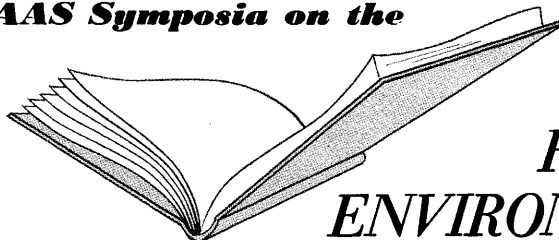
I reviewed reports of 26 new drug studies made between 1954 and 1966 and asked the FDA if the reports about safety had ever been received from the pharmaceutical companies as required by the New Drug Section of the Pure Food and Drug Law of 1938. This law, which is the result of the 100 deaths of the 1937 sulfanilamide disaster, requires a manufacturer to test each new drug for safety and submit the data to the government before the drug can be marketed. My concern was confirmed when I learned that the FDA had received only 10 of 26 reports on drug safety which had been submitted to 19 pharmaceutical manufacturers. The 14 companies which failed to submit toxicity reports included some of the largest and most scientifically capable pharmaceutical houses.

I recommend that Congress require each investigator of new drugs to send a copy of his entire report to the FDA and other government agencies concerned with drug safety and efficacy. Also the law should require that each new drug investigator be provided with reports of all other investigators who are studying the same or similar compounds. New drug research demands full exchange of information among the responsible scientists. Maximum safety demands informed collaboration between the investigator, the federal government, and the pharmaceutical manufacturer. The Senate Subcommittee on Antitrust and Monopoly headed by Senator Philip A. Hart of Michigan is currently studying changes in the laws governing drug research. Drug investigators should express their views to this subcommittee.

PAUL LOWINGER

School of Medicine,
Wayne State University, 951 East
Lafayette, Detroit, Michigan 48207

AAAS Symposia on the



HUMAN ENVIRONMENT

☐ **AGRICULTURE AND THE QUALITY OF OUR ENVIRONMENT.** Nyle C. Brady, Editor. 1967. A* \$11.50, retail \$13.50.

☐ **ESTUARIES.** George H. Lauff, Editor. 1967. A* \$24.00, retail \$27.00.

A*—Special price for cash orders by AAAS members.

☐ **AIR CONSERVATION**—The Report of the AAAS Air Conservation Commission. James P. Dixon, Chairman. 1965. A* \$7.00, retail \$8.00.

☐ **OCEANOGRAPHY**—Invited lectures presented at the first International Oceanographic Congress. Mary Sears, Editor. 4th prtg. 1966. A* \$12.50, retail \$14.75.

To AAAS PUBLICATIONS, 1515 Massachusetts Ave., NW, Washington, D.C. 20005
Please accept my order for the volumes checked above.

My check or money order in the amount of \$_____ is enclosed.

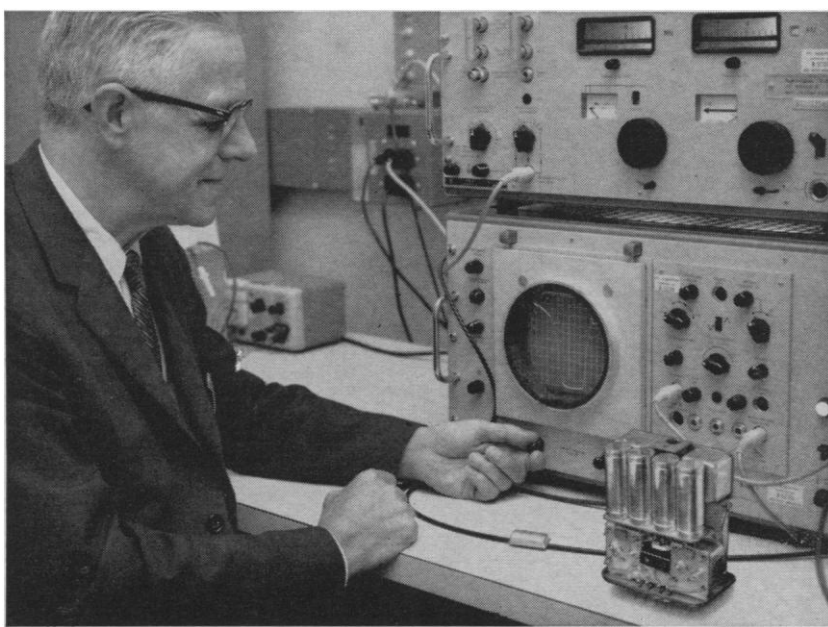
Name (please print) _____

Address _____

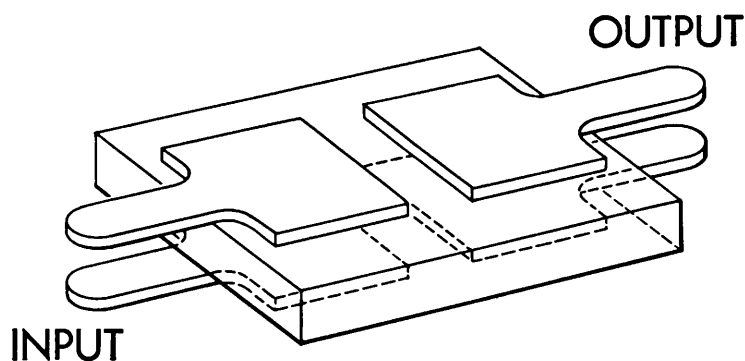
City _____ State _____ Zip Code _____

Report from
**BELL
LABORATORIES**

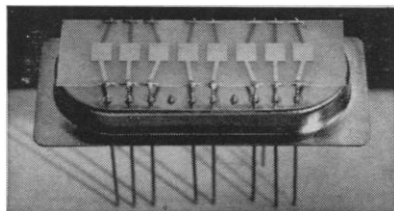
A Monolithic Filter



Roger A. Sykes, who directed the development program, checking the transmission characteristics of an eight-section 10-MHz monolithic filter (the tiny unit directly under the scope face). This unit replaces the larger filter seen to the right on the bench. Half-power points are 3.2 kHz apart.



Simple monolithic filter. Input and output resonators are formed by evaporating metal areas into opposite faces of a quartz plate. The resonators are coupled through the intervening quartz. Below, in actual size, is an eight-resonator monolithic quartz filter.



Electrical filters are widely used in communications systems to perform the important basic function of selecting, rejecting, and discriminating among various bands of frequencies.

Today's filters, depending on the design, might require a dozen or more components, including several quartz crystals. But now, as a result of work at the Allentown, Pa., location of Bell Telephone Laboratories, it is possible to design a quartz filter as a single, "monolithic" device.

The new filter is based on the fact that vibrational energy can be confined or "trapped" by pairs of metal-plated areas on opposite sides of a plate of crystalline quartz. The region within the crystal bounded by these areas thus becomes a localized resonator. A small amount of energy extends beyond this local region, however, and this energy can couple elastically to other resonators placed on the same piece of quartz. By choosing a suitable number of resonators and by spacing them properly, one can change the bandwidth of the filter and shape its in- and out-of-band characteristics.

The drawing (left) shows the simplest case—an input resonator and an output resonator coupled through the quartz plate. This would filter out all but a very narrow band of frequencies. The photograph (bottom) shows an eight-section filter designed to transmit a wider band of frequencies, with strong attenuation outside the band.

Monolithic filters are smaller and less expensive than earlier designs. Several types, in the 6-MHz to 20-MHz range, are now being produced for coaxial communications systems by the Western Electric Company in Merrimack Valley, Mass.



Bell Telephone Laboratories
Research and Development Unit of the Bell System

"LE BAIN A TOUT FAIRE"

GILSON OMNIBATH

A truly versatile
laboratory waterbath

Select *one* model to perform ALL the chores in your lab. Seven different models. Four representative models are pictured.



Table-top Model O-1
• Circulating
• Immersion

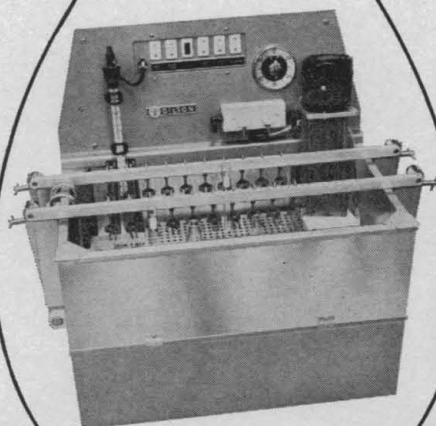
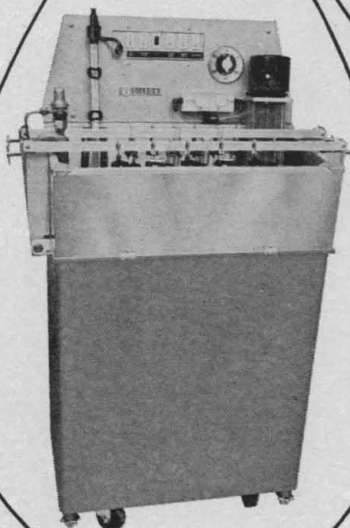
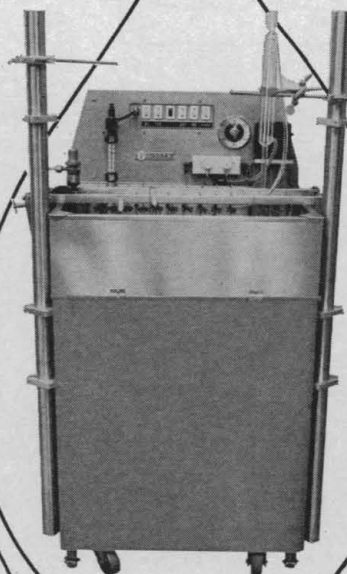


Table-top Model S0-1
• Shaking
• Circulating
• Immersion



Floor Model SR0-2
• Refrigerated • Shaking
• Circulating • Immersion



Floor Model MSR0-2
• Apparatus Masts
• Refrigerated • Shaking
• Circulating • Immersion

ALL MODELS CONTAIN
stirring and circulating pump, bell-
sounding timer, perforated platform
for uniform bath temperature; mer-
cury column thermoregulator, two
valves to control external circulation.

WRITE OR PHONE
GILSON MEDICAL ELECTRONICS, INC.
3000 West Beltline Highway
Middleton, Wisconsin 53562
Telephone: 608/836-1551



EUROPEAN Manufacturing Branch: Gilson Medical Electronics
(FRANCE) 69, Rue Gambetta • 95 — Villiers-Le-Bel, France

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

1968	1969
ROBERT L. BOWMAN	EMIL HAURY
JOSEPH W. CHAMBERLAIN	WILLARD F. LIBBY
JOHN T. EDSALL	EVERETT I. MENDELSON
ALEXANDER HOLLAENDER	JOHN R. PIERCE
GORDON J. F. MACDONALD	KENNETH S. PITZER
NEAL E. MILLER	ALEXANDER RICH
DE WITT STETTEN, JR.	CLARENCE M. ZENER

1970

GUSTAF O. ARRHENIUS	RICHARD C. LEWONTIN
FRED R. EGGAN	ALFRED O. C. NIER
HARRY F. HARLOW	FRANK W. PUTNAM
MILTON HARRIS	

Editorial Staff

Editor

PHILIP H. ABELSON

<i>Publisher</i>	<i>Business Manager</i>
DAEL WOLFE	HANS NUSSBAUM

Managing Editor: ROBERT V. ORMES

Assistant Editors: ELLEN E. MURPHY, JOHN E. RINGLE

Assistant to the Editor: NANCY TEIMOURIAN

News Editor: JOHN WALSH

Foreign Editor: DANIEL S. GREENBERG*

News and Comment: JOHN WALSH, LUTHER J. CARTER, BRYCE NELSON, PHILIP M. BOFFEY, ANDREW JAMISON, MARTI MUELLER, ANN H. LARUS.

Book Reviews: SYLVIA EBERHART

Editorial Assistants: SUSAN AXELRAD, JOANNE BELK, ISABELLA BOULDIN, ELEANORE BUTZ, BEN CARLIN, HELEN CARTER, GRAYCE FINGER, NANCY HAMILTON, OLIVER HEATWOLE, ANNE HOLDSWORTH, KONSLYNNIETTA HUTCHINSON, ELEANOR JOHNSON, PAULA LECKY, KATHERINE LIVINGSTON, LEAH RYAN, LOIS SCHMITT, BARBARA SHEFFER, YA LI SWIGART, ALICE THEILE

* *European Office:* 22 Mulberry Walk, London, S.W. 3, England (Telephone: 352-9749)

Advertising Staff

<i>Director</i>	<i>Production Manager</i>
EARL J. SCHERAGO	KAY GOLDSTEIN

Advertising Sales Manager: RICHARD L. CHARLES

Sales: New York, N.Y., 11 W. 42 St. (212-PE-6-1858), ROBERT S. BUGBEE; Scotch Plains, N.J., 12 Unami Lane (201-889-4873), C. RICHARD CALLIS; Medfield, Mass. 02052, 4 Rolling Lane (617-359-2370), RICHARD M. EZEQUELLE; Chicago, Ill. 60611, 919 N. Michigan Ave., Room 426 (312-DE-7-4973), HERBERT L. BURKLUND; Los Angeles 45, Calif., 8255 Beverly Blvd. (213-653-9817), WINN NANCE.

EDITORIAL CORRESPONDENCE: 1515 Massachusetts Ave., NW, Washington, D.C. 20005. Phone: 202-387-7171. Cable: Advancesci, Washington. Copies of "Instructions for Contributors" can be obtained from the editorial office. See also page 1709, *Science*, 29 December 1967. ADVERTISING CORRESPONDENCE: Rm. 1740, 11 W. 42 St., New York, N.Y. 10036. Phone: 212-PE-6-1858.

Toward Better Vocational Education

For a favored sixth of the youth of this country, the educational system represents a pleasant pathway to a successful career. The remaining five-sixths are not so fortunate, and many find that their training has prepared them for nothing. Today skilled labor is in short supply. It is often necessary to wait weeks for services such as automobile repairs. Nevertheless, many young people are unemployed, including one out of every four nonwhite teen-agers.

As a nation we have been preoccupied with fostering excellence of a limited group while neglecting the overwhelming majority of our youth. One measure is federal expenditures. During the last fiscal year the government provided \$4.5 billion for higher education and only \$256 million for vocational education. Moreover, there have been many curriculum reform efforts benefiting college-bound students while vocational curricula have been little improved. One of our greatest mistakes has been to accord special prestige to a college degree while displaying indifference toward quality in craftsmanship. We reward verbal skill and abstract reasoning and deny dignity to manual workers.

A major source of many of our present domestic problems is that the educational system has not kept pace with the social changes around it. Much of the curriculum is admirably designed for the horse-and-buggy era. Today less than 5 percent of employment is on the farm. The big component of the labor force (about 45 percent) is white-collar workers. Among the blue-collar workers (about 37 percent), only about a tenth are employed as common laborers. In our society there is little place for the man or woman who has no special skill. If our increasingly technological society is not to deteriorate, we must find means of helping the young find useful roles whatever their particular aptitudes.

Under President Kennedy, a beginning was made in meeting this challenge with the passage of the Vocational Education Act of 1963. Among its many provisions was a mandate for periodic review by an Advisory Council on Vocational Education. The Council, under the chairmanship of Martin W. Essex, rendered its report* in December 1967, and many of its recommendations are being enacted into law.

Bills (H.R. 18366 and S. 3077) have passed the House of Representatives and the Senate unanimously, and a compromise conference version will be enacted. The bills authorize substantially increased funds for vocational education. The legislation attempts to correct deficiencies in both the federal and state administration of programs in vocational education. One mechanism is to earmark funds for such items as post-secondary training, training of groups with special needs, and exemplary and innovative projects.

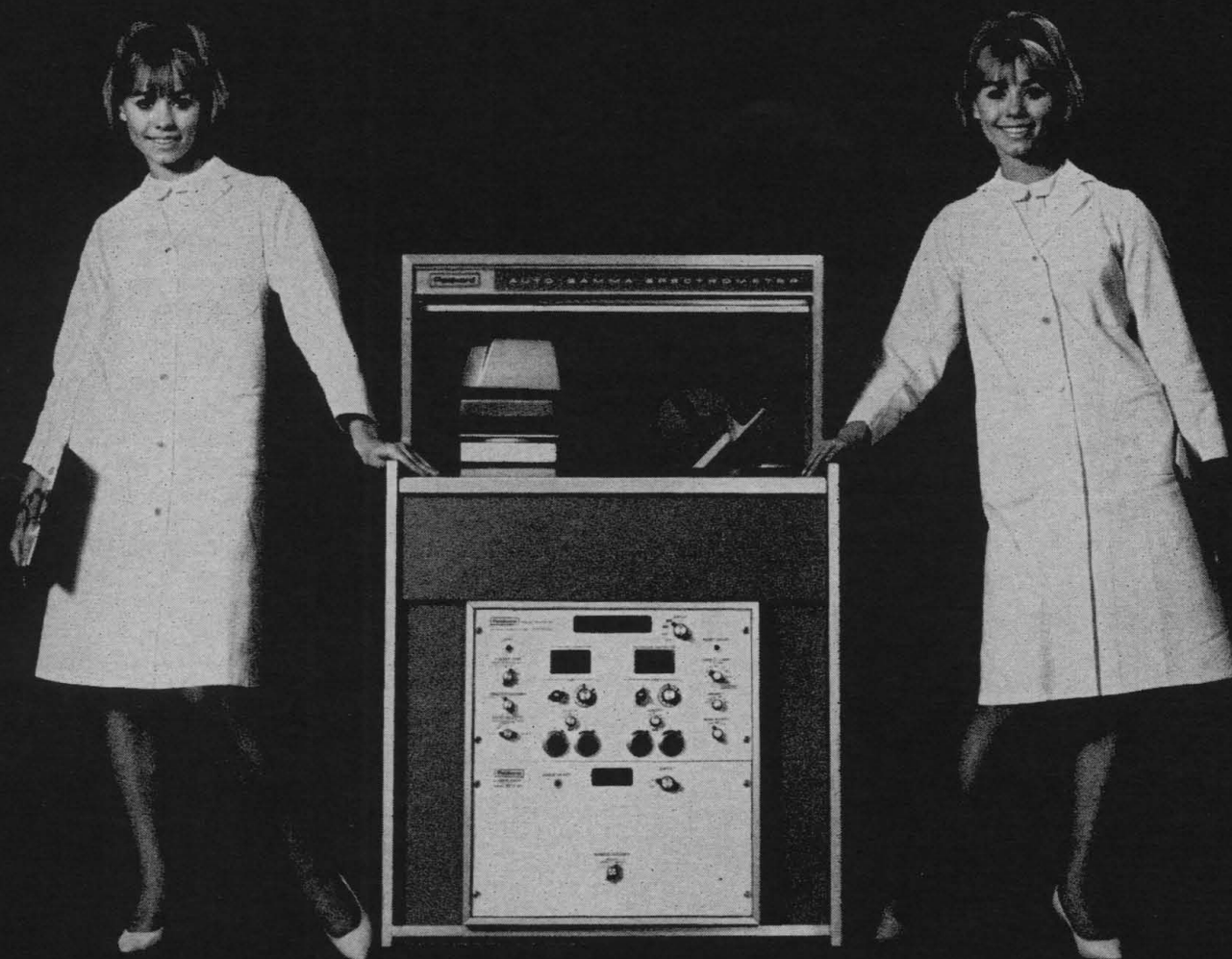
The new legislation authorizes grants to colleges, universities, and other institutions for research and training programs. Support for development and dissemination of vocational educational curriculum materials is endorsed. The bills also give new emphasis to cooperative educational programs involving alternate periods of study and on-the-job training, and to residential vocational schools that would make it more feasible for disadvantaged youths to benefit from occupational training.

The new legislation will constitute a substantial step. However, the problem of preparing youth for the 21st century is now only being addressed. There is much need for involvement by many who have previously been oblivious to a great educational need.—PHILIP H. ABELSON

* Advisory Council on Education, U.S. Department of Health, Education, and Welfare, "Vocational Education: The Bridge Between Man and His Work"; published in condensed form as *Notes and Working Papers Concerning the Administration of Programs Authorized under Vocational Education Act of 1963* (Government Printing Office, Washington, D.C., 1968).

NEW DUAL CHANNEL AUTO-GAMMA[®] SPECTROMETER

Now you can get two-channel gamma
operation at the single-channel price



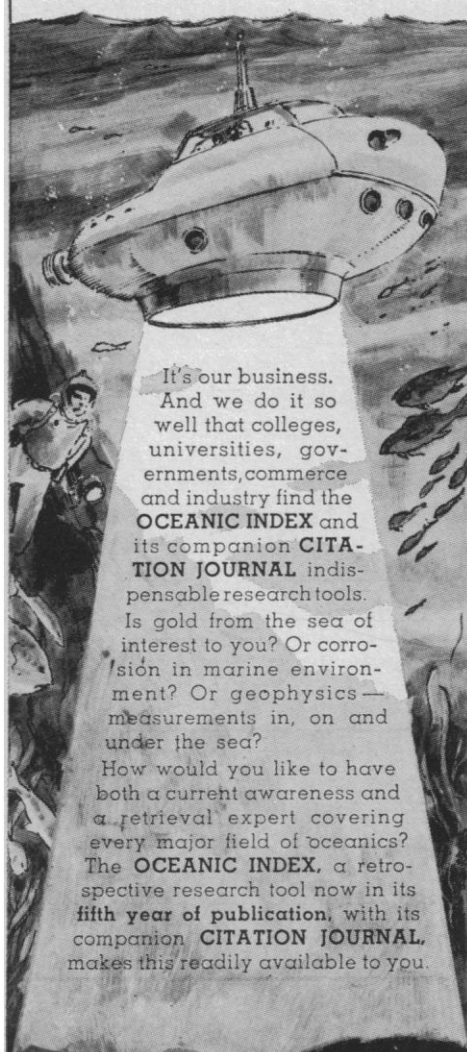
Model 5212 is a unique, automatic gamma counting system for either single or double-labeled samples. For two-channel analysis the system is automatically programmed to count each isotope sequentially, using a single scaler. Samples are changed automatically, and the data for each channel is recorded by a digital printer. Low, constant backgrounds are ensured by a patented 100-sample automatic changer. ■ Though it has two-channel capability, Model 5212 is modestly priced . . . costs less than you would expect to pay for Packard's single-channel system. It is an ideal instrument for the laboratory where analysis of double-labeled gamma samples is becoming increasingly important, but volume of counting does not justify purchase of a full two-channel

system. ■ Model 5212 is one of Packard's complete line of gamma counting instruments, which range from manual, single-channel instruments to automatic, 400-channel systems for the most sophisticated analysis. Your Packard Sales Engineer can recommend a system exactly suited to your needs. Call him, or write for Bulletin 1064 U to Packard Instrument Company, Inc. 2200 Warrenville Road, Downers Grove, Illinois 60515, or Packard Instrument International S.A., Talstrasse 39, 8001 Zurich, Switzerland.

Packard

**Who wants to read
1,700 magazines
every month?**

We do.



It's our business.
And we do it so
well that colleges,
universities, gov-
ernments, commerce
and industry find the
OCEANIC INDEX and
its companion **CITA-
TION JOURNAL** indis-
pensable research tools.
Is gold from the sea of
interest to you? Or corro-
sion in marine environ-
ment? Or geophysics—
measurements in, on and
under the sea?
How would you like to have
both a current awareness and
a retrieval expert covering
every major field of oceanics?
The **OCEANIC INDEX**, a retro-
spective research tool now in its
fifth year of publication, with its
companion **CITATION JOURNAL**,
makes this readily available to you.

The **CITATION JOURNAL**, with more
than 1,000 citations and selected ab-
stracts in each issue, tells you what is
currently published in your area of
interest, who wrote it, the specific
source from which it was taken (over
1,700 journals in 12 language groups,
contracts, reports, conference and
symposia proceedings, legislation,
patents, theses) and the author's
organizational affiliation.

Use of the **KEYTALPHA** (Keyterm Al-
phabetical) **INDEX** enables the user
to rapidly answer retrieval problems
either through the complete **OCEANIC
INDEX** or computer tapes in **KWIC**,
KEYTALPHA and **UDC** formats.

For further information, contact:
OCEANIC RESEARCH INSTITUTE
6811 La Jolla Boulevard
La Jolla, Calif. 92037 (714) 459-2654
CABLE ADDRESS: OCEANIC

H. D. Holland (Princeton) proposed that reactions of the type chlorite + calcite + CO_2 = dolomite + kaolinite + quartz + water have exerted a considerable buffering effect on atmospheric CO_2 during much of geologic time. But he suggested that before the evolution of land plants the CO_2 content of the atmosphere was approximately 10 times greater than at present, and that the pH of ocean water was approximately one half of a pH unit lower. W. T. Holser (Chevron Oil Field Research Co.), after noting the deficiency of salt and gypsum deposits in the Precambrian, pointed out the difference between the ratios of S^{32} to S^{34} of late Precambrian evaporites and organic shales as evidence of activity of sulfate-reducing bacteria at that time. He presented the secular variation of ratios of S^{32} to S^{34} in evaporites, showing pronounced variations that he attributed to non-steady withdrawal and supply of isotopically light sulfides with respect to the oceanic reservoir. L. G. Sillén (Swedish Royal Institute of Technology) proposed an equilibrium model for the oceans based on free exchange between atmosphere, ocean and crust, and dominance of silicate equilibria in controlling oceanic pH and atmospheric CO_2 . He used the nine-component system $\text{CO}_2\text{-H}_2\text{O-CaO-MgO-AL}_2\text{O}_3\text{-K}_2\text{O-Na}_2\text{O-HCl-SiO}_2$ to present probable phase relations and emphasized equilibrium models as the most important first approximation of this complex system. P. K. Weyl (State University of New York, Stony Brook) hypothesized an oceanic density gradient layer (thermocline) at a depth near 100 meters in which life may have originated and evolved. This layer would have been protected from ultraviolet radiation fed by convective cells from the sea surface and the low rate of diffusion in the layer would have led to an early accumulation of free oxygen. G. Nicholls (University of Manchester, United Kingdom) sought to infer evolutionary changes in the composition of seawater by following a chain of calculations from terrestrial abundances of trace elements to the abundance of sodium in Precambrian sediments, which seem to be richer in sodium than later rocks. He explained the richness of nitrogen as the result of lack of chemical "winnowing" during sedimentation in the early Precambrian.

The last morning was devoted to questions related to the origin of life. C. Ponnamperna (NASA Research Center, Ames, California) described a

scheme for synthesis of organic compounds from H, C, N, and O; reviewed energy sources, ultraviolet being by far the most important; and attempted to develop criteria for biogenic origin of organic compounds. J. Oró (University of Houston) discussed the evolution of self-replicating proto-DNA and similar molecules from primitive organic compounds in the early Precambrian. He argued for the need for estimates of maximum and minimum permissible concentrations of necessary building materials, such as sulfur and phosphorus. L. Margulis (Boston University) distinguished between evolution of prokaryotic and eucaryotic cells and emphasized the importance of free oxygen in the atmosphere as a precondition for the evolution of eucaryotic organisms, which probably took place later in the Precambrian. A. R. Palmer (State University of New York, Stony Brook) summarized worldwide distribution of Early Cambrian faunas and concluded that shelled representatives of the major phyla and of many minor groups within the phyla all appeared within about 5 million years, but significantly later than the first records of metazoans without shells.

Discussion of papers was spirited and it appeared that there was no general agreement on the types of models to be used for the evolution of the earth's crust or for the evolution of the oceans or atmospheres. Equilibrium models vied with complex feedback mechanisms for support. The rock record was invoked to support many models but our current ways of looking at it seem not to provoke convergence to a unique solution. There was more general agreement that much of the Precambrian rock record showed no great differences from later rock sections in gross aspect. It seems that the general earth surface system, including the presence of primitive life, was established by 3.5 billion years ago, leaving only the first billion years of the earth's history for many significant events to have taken place. In the absence of any rock record of that first billion years, it may be that organic chemical investigations of the first steps in the formation of prebiogenic compounds and then the evolution of the first cell will prove to be the best guides to the nature of the physical and chemical environment of the earliest stage of earth history.

RAYMOND SIEVER
*Department of Geological Sciences,
Harvard University,
Cambridge, Massachusetts 02138*