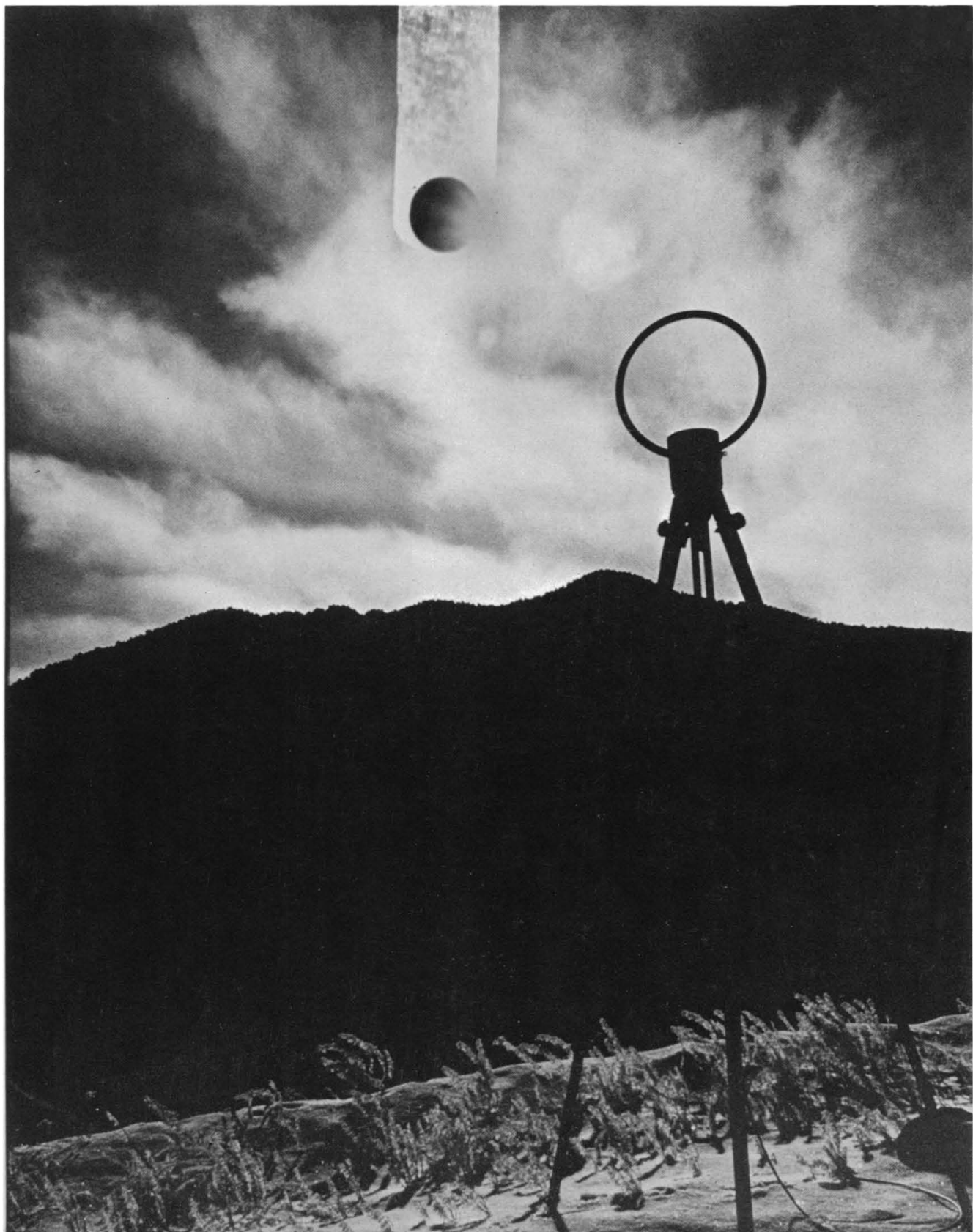


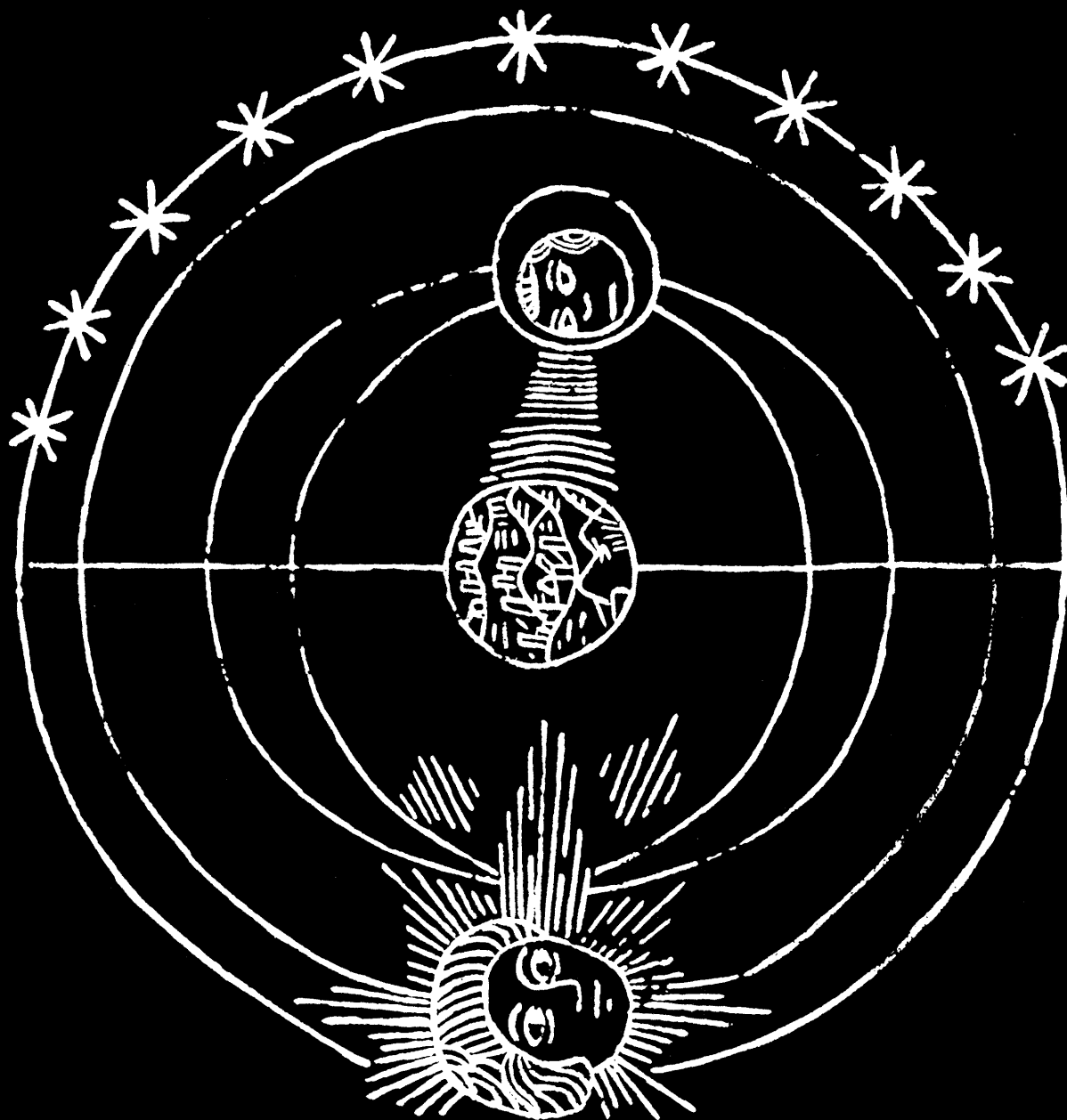
SCIENCE

29 August 1969

Vol. 165, No. 3896

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE





AAAS-WESTINGHOUSE SCIENCE WRITING AWARDS 1969

To encourage and recognize outstanding writing on the natural sciences and their engineering and technological applications (excluding medicine) in newspapers and general circulation magazines.

Three awards of \$1000 each for science writing: in newspapers with daily circulation of over 100,000; in newspapers with daily circulation of less than 100,000; in general circulation magazines.

Contest year. Material must have been published within the United States, October 1, 1968, through September 30, 1969.

Deadline date for submitting entries is October 10, 1969.

For entry blanks and detailed rules, contact Grayce A. Finger, Dept. W, American Association for the Advancement of Science, 1515 Massachusetts Avenue, N.W., Washington, D.C. 20005.

A product worth feeding to the pigs



The pig is a land animal. The arteries that bring human food calories from

the country to the city would fail were it not for the work of the pig in transforming the seeds of the large grass, corn, into tasty protein. The most important muscle involved in this work encloses the sow's uterus. It must be protected from atony.

The general conception of the pig is depicted at left. The picture is not wholly lacking in truth. Pigs survive under inelegant conditions. They can be used for garbage disposal—in fact, were so used by bygone generations of men. It is now hard to make money that way. (Money has a vital but very complex part in the global ecosystem.)

To make money on pigs today, the

animal is not permitted to waste time wallowing. It is encouraged by every means to concentrate on ingesting a most carefully designed diet. Corn, its major component, is rich in polyunsaturated fats. Polyunsaturated fats are fine for man and beast, but they raise the need for the natural antioxidant, vitamin E. If that need is unmet, the sow's uterus will have lost its tone and will falter after having ejected but a few dozen piglets in her lifetime.

One of our functions in the economy is to manufacture vitamin E from certain natural oils. We are pleased to report that the more efficient brands of pig feed now contain our product.

Anybody want B.O.D. data?

Science's serving maid, photography, must mind her manners.

A laboratory complex that takes full advantage of her many manifestations generates an effluent that may impose its share of Biochemical Oxygen Demand in neighboring waters above ground or out of sight. The time to ignore such matters is running out. Those in a position to understand about Biochemical Oxygen Demand will be

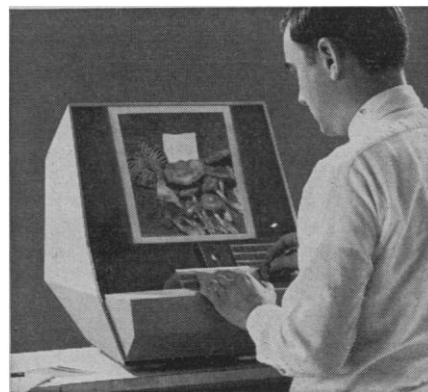
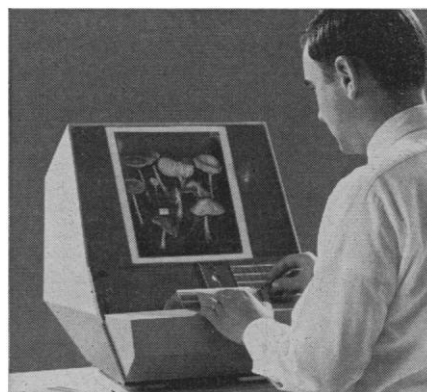
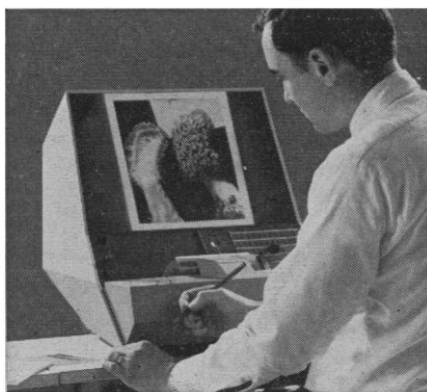
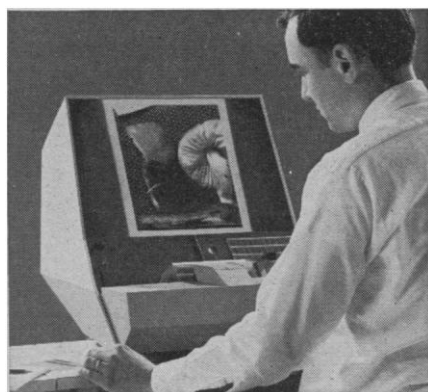
among the first to agree.

They may also be called upon for counsel on adequate capacity for the secondary waste treatment by which BOD is microbiologically worked off before discharge to environment. The calculation of load would be easier if data were readily available for specific ingredients. It therefore seems a good idea to publish such data for widely used chemical products of our own

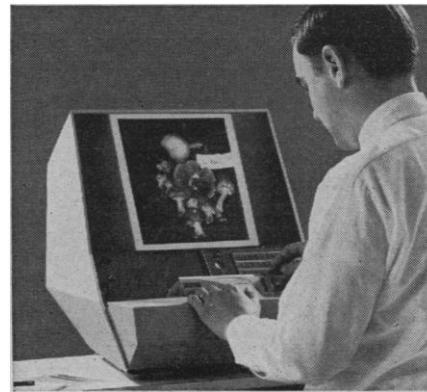
manufacture. This we have now done in a practical primer entitled "Disposal of Photographic-Processing Wastes." It contains data also on what ions and compounds may be present in our proprietary processing preparations.

Order as Kodak Publication No. J-28 (\$1) from Department 454, Eastman Kodak Company, Rochester, N. Y. 14650.

Price subject to change without notice.



Attention, systematists: Systematics is your game. Business systems is ours. A relationship may develop. **Color microfilm has arrived.** If color is an important taxonomic character for you, microfilm organized in jackets may now be ready to maintain order among a great wealth of taxa. Talk to the people in your own institution who know microfilm equipment. Then inquire about color microfilm from Business Systems Division, Dept. WL, Eastman Kodak Company, Rochester, N. Y. 14650.



EASTMAN KODAK COMPANY An equal-opportunity employer

29 August 1969

Vol. 165, No. 3896

SCIENCE

LETTERS	On-the-Job Training Offer Rebuffed: <i>H. Meltzer</i> and <i>G. Cohen</i> ; Fresh Water for Agriculture: <i>D. A. Korenstein</i> ; <i>A. M. Weinberg</i> ; <i>J. J. Hanan</i> ; Esoteric Measurements: <i>C. Buck</i> ; Unreliable Results: <i>M. F. Ryan</i> ; Slippery Polymers: <i>H. M. Stauffer</i> ; Phenomena of Psychic Research: <i>R. A. McConnell</i>	850
EDITORIAL	Microcosms in a World Apart	853
ARTICLES	Hydroxyl and Water Masers in Protostars: <i>M. M. Litvak</i>	855
	Acetylcholine Action: Biochemical Aspects: <i>J. Durell</i> , <i>J. T. Garland</i> , <i>R. O. Friedel</i>	862
	The National Bureau of Standards Prepares for the 1970's: <i>R. D. Huntoon</i> , <i>S. Lichtenstein</i> , <i>G. A. Finger</i>	867
NEWS AND COMMENT	FDA and Panalba: A Conflict of Commercial, Therapeutic Goals?	875
	Trouble at Nevada Research Center	880
	Open University: Britain's New Venture in Higher Education	881
BOOK REVIEWS	<i>Men in Groups</i> , reviewed by <i>M. H. Fried</i> ; other reviews by <i>J. B. Irwin</i> , <i>H. L. Shapiro</i> , <i>L. Uhr</i> , <i>P. H. Klopfer</i> , <i>G. Bistis</i> , <i>D. J. Prager</i>	883
REPORTS	Transient Circulation Event near the Deep Ocean Floor: <i>R. A. Schwartzlose</i> and <i>J. D. Isaacs</i>	889
	Timing of the Apparent Effects of Cloud Seeding: <i>J. L. Lovasich</i> et al.	892
	Mars: Water Vapor in Its Atmosphere: <i>T. Owen</i> and <i>H. P. Mason</i>	893
	Glossopterid Leaves from the Middle Jurassic of Oaxaca, Mexico: <i>T. Delevoryas</i>	895
	Seismicity of Colorado: Consistency of Recent Earthquakes with Those of Historical Record: <i>R. B. Simon</i>	897

BOARD OF DIRECTORS

WALTER ORR ROBERTS
Retiring President, Chairman

H. BENTLEY GLASS
President

ATHELSTAN SPILHAUS
President-Elect

RICHARD H. BOLT
BARRY COMMONER

HUDSON HOAGLAND
GERALD HOLTON

VICE PRESIDENTS AND SECTION SECRETARIES

MATHEMATICS (A)
Mark Kac
F. A. Ficken

PHYSICS (B)
Nathaniel H. Frank
Albert M. Stone

CHEMISTRY (C)
Charles G. Overberger
Leo Schubert

ASTRONOMY (D)
John W. Firor
Frank Bradshaw Wood

ANTHROPOLOGY (H)
Jesse D. Jennings
Anthony Leeds

PSYCHOLOGY (I)
Wendell R. Garner
William D. Garvey

SOCIAL AND ECONOMIC SCIENCES (K)
Sheldon and Eleanor Glueck
Harvey Sapolsky

HISTORY AND PHILOSOPHY OF SCIENCE (L)
Loren C. Eiseley
Raymond J. Seeger

PHARMACEUTICAL SCIENCES (Np)
Joseph P. Buckley
Joseph A. Oddis

AGRICULTURE (O)
T. C. Byerly
Michael A. Farrell

INDUSTRIAL SCIENCE (P)
Gordon K. Teal
Burton V. Dean

EDUCATION (Q)
R. Will Burnett
J. Myron Atkin

DIVISIONS

ALASKA DIVISION

Victor Fischer
President

Irma Duncan
Executive Secretary

PACIFIC DIVISION

William C. Snyder
President

Robert C. Miller
Secretary

SOUTHWESTERN AND ROCKY MOUNTAIN DIVISION

Newell A. Younggren
President

Marlowe G. Anderson
Executive Secretary

SCIENCE is published weekly on Friday and on the fourth 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. Copyright © 1969 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 months, \$10. Provide 4 weeks notice for change of address, giving new and old address and zip codes. Send a recent address label. SCIENCE is indexed in the *Reader's Guide to Periodical Literature*.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Obstructive Lung Disease and α_1 -Antitrypsin Deficiency Gene Heterozygosity: <i>F. Kueppers, R. Fallat, R. K. Larson</i>	899
Ascorbic Acid: Cofactor in Rabbit Olfactory Preparations: <i>K. O. Ash</i>	901
Mammalian DNA Polymerase: Separation of Binding from Incorporation of Deoxyribonucleoside Triphosphates: <i>P. Ove and J. Laszlo</i>	903
Sex Attractant of Female Dermestid Beetle <i>Trogoderma inclusum</i> Le Conte: <i>J. O. Rodin et al.</i>	904
Paramagnetic Unit in Spinach Subchloroplast Particles: Estimation of Size: <i>E. C. Weaver and H. E. Weaver</i>	906
Nitrogen Fixation by <i>Gloeocapsa</i> : <i>J. T. Wyatt and J. K. G. Silvey</i>	908
Maturation of Renal Organic Acid Transport: Substrate Stimulation by Penicillin: <i>G. H. Hirsch and J. B. Hook</i>	909
Quantal Secretion from Adrenal Medulla: All-or-None Release of Storage Vesicle Content: <i>O. H. Viveros, L. Arqueros, N. Kirshner</i>	911
Micelle Formation between 5-Hydroxytryptamine and Adenosine Triphosphate in Platelet Storage Organelles: <i>K. H. Berneis, M. Da Prada, A. Pletscher</i>	913
Degradation and Disappearance of ortho, para Isomer of Technical DDT in Living and Dead Avian Tissues: <i>M. C. French and D. J. Jefferies</i>	914
Sarcoma-Producing Cell Lines Derived from Clones Transformed in vitro by Benzo[a]pyrene: <i>J. A. DiPaolo, R. L. Nelson, P. J. Donovan</i>	917
<i>Plasmodium malariae</i> : Transmission from Monkey to Man by Mosquito Bite: <i>P. G. Contacos and W. E. Collins</i>	918
Thermoregulatory Responses to Intra-Abdominal Heating of Sheep: <i>R. O. Rawson, K. P. Quick, R. F. Coughlin</i>	919
Hair Color, Molt, and Testis Size in Male, Short-Tailed Weasels Treated with Melatonin: <i>C. C. Rust and R. K. Meyer</i>	921
Orientation by Pigeons: Is the Sun Necessary?: <i>W. T. Keeton</i>	922
<i>Technical Comments</i> : Carbonic Anhydrase in Seawater: Carbonato Complexes: <i>K. V. Krishnamurty</i> ; Plasticity of Hypothalamic Motivational Systems: <i>R. A. Wise</i> ; Spin-Orbit Resonance of the Inner Planets: <i>P. M. Campbell</i>	929
MEETINGS Cellular Immunity: <i>N. A. Mitchison</i> ; Sleep and Biorhythmicity: <i>A. Hobson</i>	931

MINA S. REES
LEONARD M. RIESER

H. BURR STEINBACH
KENNETH V. THIMANN

WILLIAM T. GOLDEN
Treasurer

DAEL WOLFLE
Executive Officer

GEOLOGY AND GEOGRAPHY (E)
Richard H. Mahard
William E. Benson

ZOOLOGICAL SCIENCES (F)
David Bishop
David E. Davis

BOTANICAL SCIENCES (G)
William A. Jensen
Arthur W. Cooper

ENGINEERING (M)
Paul Rosenberg
Newman A. Hall

MEDICAL SCIENCES (N)
Allan D. Bass
F. Douglas Lawrason

DENTISTRY (Nd)
Robert S. Harris
Richard S. Manly

INFORMATION AND
COMMUNICATION (T)
Dale B. Baker
Ileen E. Stewart

STATISTICS (U)
Ezra Glaser
Rosedith Sitgreaves

ATMOSPHERIC AND HYDROSPHERIC
SCIENCES (W)
Robert M. White
Louis J. Battan

COVER

Apparatus used for precise antenna-pattern measurements at National Bureau of Standards, Boulder, Colo. The "golden apple" (top), a small metal ball containing transistors and batteries, is supported only by a Mylar thread, obviating the use of conventional equipment which distort the field. As the loop-shaped transmitting antenna (right) moves, a tiny light glows on the ball when the radio field reaches a certain intensity. See page 867. [Schaeffer and Seawell, Black Star]

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.



**If you think SDS
just builds computers,
write our last name
a hundred times.**

Scientific Data Systems A Xerox Company El Segundo, Calif.

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

1969

EMIL HAURY	KENNETH S. PITZER
WILLARD F. LIBBY	ALEXANDER RICH
EVERETT I. MENDELSON	CLARENCE M. ZENER
JOHN R. PIERCE	

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

Publisher

DAEL WOLFLE

Business Manager

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: LUTHER J. CARTER, BRYCE NELSON, PHILIP M. BOFFEY, MARK W. OBERLE, MARTI MUELLER, SCHERRAINE MACK

Book Reviews: SYLVIA EBERHART

Editorial Assistants: JOANNE BELK, ISABELLA BOULDIN, ELEANORE BUTZ, HELEN CARTER, GRAYCE FINGER, NANCY HAMILTON, OLIVER HEATWOLE, ANNE HOLDSWORTH, PAULA LECKY, KATHERINE LIVINGSTON, VIRGINIA NUSSLE, SANDRA RATTLE, PATRICIA ROWE, LEAH RYAN, LOIS SCHMITT, BARBARA SHEFFER, RICHARD SOMMER, YA LI SWIGART, ALICE THEILE

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

Advertising Staff

Director

EARL J. SCHERAGO

Production Manager

KAY GOLDSTEIN

Advertising Sales Manager: RICHARD L. CHARLES

Sales: NEW YORK, N.Y. 10036: Robert S. Bugbee, 11 W. 42 St. (212-PE-6-1858); SCOTCH PLAINS, N.J. 07076: C. Richard Callis, 12 Unami Lane (201-889-4873); MEDFIELD, MASS. 02052: Richard M. Ezequille, 4 Rolling Lane (617-444-1439); CHICAGO, ILL. 60611: Herbert L. Burklund, Room 2107, 919 N. Michigan Ave. (312-DE-7-4973); BEVERLY HILLS, CALIF. 90211: Winn Nance, 111 N. La Cienega Blvd. (213-657-2772).

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 7, *Science*, 4 July 1969. ADVERTISING CORRESPONDENCE: Rm. 1740, 11 W. 42 St., New York, N.Y. 10036. Phone: 212-PE-6-1858.

Microcosms in a World Apart

Our cities are sick, and their condition grows worse. Morale has deteriorated under the impact of lawlessness, pollution, and the ugliness of the environment. Obsolete, the cities are fashioned in accord with the realities of a century ago. The long-range solution is to build cities of radically new design. However, that is a task of a generation or more, and the crisis is now. We must look for measures that can be implemented quickly. In this search we can learn from the examples of other peoples who have also faced overcrowding.

The visitor to European cities sees much that could with advantage be adapted here. Consider, for example, the Tivoli in downtown Copenhagen. In a parklike area of moderate size are ponds and waterfowl, together with music, theater, dining, dancing, and amusement concessions. The Tivoli is fenced in, and there is a nominal admission charge. With security, the solid citizens of Copenhagen can relax and enjoy their holiday outings.

Another such area, perhaps even more desirable, is the Palmengarten in Frankfurt. Located near the middle of the city, it features botanical displays of extraordinary variety and beauty. The park is small by American standards. Yet skilled landscaping makes it seem larger than it is. Inside its boundaries one has the impression of being in a world apart. There are ponds, wooded paths, grassy glades, and flower gardens—a delightful spot for a stroll or relaxation in the sunshine. Moreover, there are microcosms within the world apart. In one small greenhouse is a marvelous collection of orchids. Near it is another building housing a great variety of cactuses. Yet another greenhouse contains huge tropical pond lilies. In a larger glassed-in space are luxuriant palm trees; at one end of the big room there is a waterfall with a fish pond beneath it. The enveloping greenery and the sounds of falling water combine most agreeably to lift the spirit.

In Europe, beauty is not confined to a few parks. At the typical crossroads, instead of billboards there are carefully tended flower gardens. Indeed, there are flowers almost everywhere, even at the airports.

The traveler returning from Europe is greeted with brutal ugliness. What a miserable welcome! Yet it is a fair sample of what he is likely to see in most cities. Pitifully little thought and energy have been devoted to bringing beauty to urban centers. Yet the opportunity is often available. Consider the Mall associated with Independence Hall in Philadelphia. Its area is comparable to that of two European parks, and it occupies some very expensive real estate. The Mall has a static vista, fountains, and some benches frequented principally by derelicts. For refreshment one may buy pretzels from street vendors. In contrast, one of the most attractive features of the Society Hill section of Philadelphia is a tiny 18th-century garden located a few hundred meters from Independence Hall. This plot, tended by the Pennsylvania Horticultural Society, is frequently replanted, so that every few weeks it provides a different display. Though small, the garden is excellent in the quality and variety of its planting, and it pleases many passersby.

This country has park facilities whose value as real estate totals multibillions of dollars. We are not getting our money's worth, and it is time that constructive thought and effort were devoted to making it possible for the majority of our citizens to enjoy what could be achieved in the way of spirit-building recreational facilities.—PHILIP H. ABELSON

AUDIOTAPES OF AAAS ANNUAL MEETING SYMPOSIA AND PANEL DISCUSSIONS

Dallas, Texas, 26-31 December 1968

Through a cooperative arrangement between AAAS and Science Service, tape recordings of 15 symposia and panel discussions, presented at the Annual Meeting of the AAAS, are now being released at cost for general distribution. The objective of this undertaking is to make the proceedings of these meetings rapidly available to a wide public.

In a number of sessions, some information was presented on slides. Authors should be contacted directly for copies. Because of a serious epidemic of influenza at the time of the Dallas meeting, a few of the contributions were not given by the originally announced authors.

Tapes are sold as self-contained, half-day sessions. They can be purchased as conventional open reels (3¾ inches per second speed) that can be played back on any conventional audiocassette player, or as cassettes for playback on a cartridge player. Each half-day session is identified, for ordering purposes, by a number ("1/68," "2/68," and so on). An order form is at the bottom of this page.

Acknowledgment is made to Ampex Corp. for assistance in recording and distribution and to WAMU, American University, for aid in editing.

The Scientific Research Society of America (RESA) Annual Address and Discussion

- 1/68, 3 hours, \$7.00

The Financial Crisis in Science

- 2/68, 3 hours, \$7.00

Review of United States Science Policy

- 3/68, 3 hours, \$7.00 (Part I)
- 4/68, 3½ hours, \$8.50 (Part II)

Science, Technology, and Latin American Development

- 5/68, 3 hours, \$7.00 (Part I)
- 6/68, 3 hours, \$7.00 (Part II)

Unanticipated Environmental Hazards Resulting from Technological Intrusions

- 7/68, 3 hours, \$7.00 (Part I)
- 8/68, 3 hours, \$7.00 (Part II)
- 9/68, 3 hours, \$7.00 (Part III)

Water Importation into Arid Lands

- 10/68, 3 hours, \$7.00 (Part I)
- 11/68, 3 hours, \$7.00 (Part II)

Genetic Technology: Some Public Considerations

- 12/68, 3 hours, \$7.00 (Part I, Possibilities, Purposes, and Problems of Genetic Manipulation)
- 13/68, 3 hours, \$7.00 (Part II, Public Policy for Genetic Manipulation)

Global Effects of Environmental Pollution

- 14/68, 3 hours, \$7.00 (Part I)
- 15/68, 4 hours, \$10.00 (Part II)
- 16/68, 3 hours, \$7.00 (Part III)

Space Applications: Earth Oriented Applications of Unmanned Earth Satellites

- 17/68, 3 hours, \$7.00

The Direction of Programming Languages for the Scientist

- 18/68, 3½ hours, \$8.50

The Social Relevance of Physics

- 19/68, 3 hours, \$7.00

Pulsars

- 20/68, 4 hours, \$10.00

The Use of Space by Animals and Men

- 21/68, 3 hours, \$7.00 (Part I, Relation of Territoriality to Dominance)
- 22/68, 3 hours, \$7.00 (Part II, Factors Influencing Intraspecific Contact)
- 23/68, 3 hours, \$7.00 (Part III, Population Density and Crowding)
- 24/68, 3 hours, \$7.00 (Part IV, The Role of Distance in the Evolution of Communication)
- 25/68, 3 hours, \$7.00 (Part V, Environmental Conditions and Human Behavior)

Technology and Values

- 26/68, 3 hours, \$7.00

Research for the World Food Crisis

- 27/68, 3 hours, \$7.00 (Part I, Progress of Research and Technology on Food Supply and Population Control)
- 28/68, 3 hours, \$7.00 (Part II)

More complete information about the tapes appears in *Science*, 11 April 1969, pages 113-117.

Allow at least 4 weeks
for delivery

Use form below to order reels or cassettes. Enclose payment by check or money order.
Do not send cash. 5309

SCIENCE AND ENGINEERING TAPES, SCIENCE SERVICE,
1719 N St., N.W., Washington, D.C. 20036

I enclose \$_____.

Please send the following ☐ reel(s) ☐ cassette(s)

Encircle number(s) you want. Tapes are \$7.00 each unless indicated otherwise.

1/68 2/68 3/68 4/68 (8.50) 5/68 6/68 7/68 8/68 9/68 10/68 11/68 12/68
13/68 14/68 15/68 (\$10.00) 16/68 17/68 18/68 (\$8.50) 19/68 20/68 (\$10.00)
21/68 22/68 23/68 24/68 25/68 26/68 27/68 28/68

Name _____

Address _____

City _____

State _____ Zip _____



When you're the whole show, you need the one-man camera: Bolex.

A man in your position can't afford to bother with a 16mm camera that's temperamental, cumbersome, incomplete, or experimental.

You need a hundred percent solid pro camera that's proven itself from the registration claw on out. You need a Bolex. It can do anything you need it to do.

Documentary and news filming with the Vario-Switar 86 OE automatic thru-lens light metering zoom . . . close-up photography . . . available light filming, with high speed Switar* lenses . . . special effects filming . . . 12 minutes of uninterrupted shooting . . . fast action filming with 100 foot load, spring wind, and automatic threading . . . variable speed filming . . . sync. sound . . .

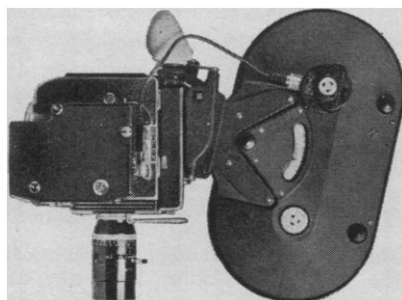
Bolex is so versatile and reliable that it becomes an extension of yourself. More than a camera. More like a friend.

For the free 32 page 16mm Product Buying Guide, write to Paillard Incorporated, 1900 Lower Road, Linden, New Jersey 07036. Or for the name of your nearest Bolex dealer, call (800) 553-9550, free. In Iowa call collect (319) 242-1867.

*Kern Switar lenses were selected to film the moon landing.

BOLEX

Paillard Incorporated: Bolex. Hasselblad. Hermes



firmed repeatedly; (ii) most of the data was considered compatible with transfer factor being an immunogen; and (iii) developments in vitro, particularly the activation of animal lymphocytes by dialyzable transfer factor of human origin, augur well for a rapid solution of the problem.

Bloom and Granger were the initiators for two separate discussion sessions devoted to the now recognized MIF and lymphotoxin as effector molecules of cellular immunity. Activated lymphocytes have now been shown to liberate factors with the following activities: MIF, LT, skin-reactivity, chemotaxis, mitogenicity, and interferon. Although the interaction of immune lymphocytes with specific antigen is required for the production of these effector molecules, the subsequent action of these effectors is nonspecific with respect to the target cells affected and, moreover, does not require the presence of antigen. With the exception of interferon, all of these agents have molecular weights around 80,000, and work is already under way to determine whether they are separate and discrete entities or reflect a single component.

The physiological role of these factors is not yet fully established. Chemotactic factor and MIF acting in concert could well account for the manifestations in vivo of delayed hypersensitivity, and the observed consequences of MIF injection can be interpreted in this light. Lymphotoxin, the cytotoxic factor, is suspected of playing a role in the homograft reaction, a concept which is supported by known instances of non-specific spread of the reaction (for example, in the kidney) but contradicted by other instances of a highly selective reaction (such as in tumors and in the skin). Experiments with antisera to the factors should rapidly resolve the problem.

In the final discussion, Uhr developed the evidence in support of immunoglobulin as the recognition unit in cellular immunity, and the thesis that the difference from humoral immunity probably hinged on a seemingly minor but essential aspect of immunoglobulin retention by thymic cells as compared to its secretion by plasma cells. The consensus was that our understanding of the effector side of the cellular immune response is now progressing rather rapidly, whereas there was less optimism concerning clarification of the induction side.

Publication (Academic Press) of the proceedings of the meeting is scheduled

for October. The first volume of the new series was *Immunological Tolerance*, proceedings of a similar meeting in 1968.

N. A. MITCHISON

National Institute for Medical Research, Mill Hill, London, England

Sleep and Biorhythmicity

The relation of sleep research and biological rhythm research was examined in a symposium during the ninth annual meeting of the Association for the Psychophysiological Study of Sleep in Boston, 20-23 March 1969. The estrangement of these two related areas of work was ascribed to the preoccupation of sleep researchers with the psychophysiology of rapid eye movement (REM) sleep since its discovery 15 years ago. Since then a profusion of data, almost all of it involving measurements over time, has appeared.

Variable sleep dimensions in the time domain include latency to onset, total duration, duration of component phases (REM and non-REM), and period length of the cyclic alternation of component phases. Yet, in the post-REM era there has, until very recently, been no critical examination of the rhythmic aspects of sleep despite the fact that a highly sophisticated set of methods exists by which they may be studied. The student of sleep who was familiar with rhythm research could, at the least, define, measure, and control for periodic phenomena in his data.

Halberg showed how rhythms, especially circadian and ultradian ones, could be detected by the use of specialized computer programs whether or not they were apparent in sleep data plotted as a function of time. The parameters of such rhythms, namely, period (τ), amplitude (C), phase (ϕ), and phase difference (Φ), can likewise be estimated. For time series or sections thereof with constant phase angle, a least-squares spectrum and a cosinor display the amplitude and amplitude-weighted phase, respectively.

These measures have been determined for sleep data from diverse sources. Pöppel reviewed the evidence of the Aschoff school for the circadian character of the human sleep-waking cycle. The period (τ) of this rhythm in subjects isolated from time-givers was about 25 hours and such "free-running" individuals showed a change in phase difference (Φ) between the