SCIENCE

29 December 1961

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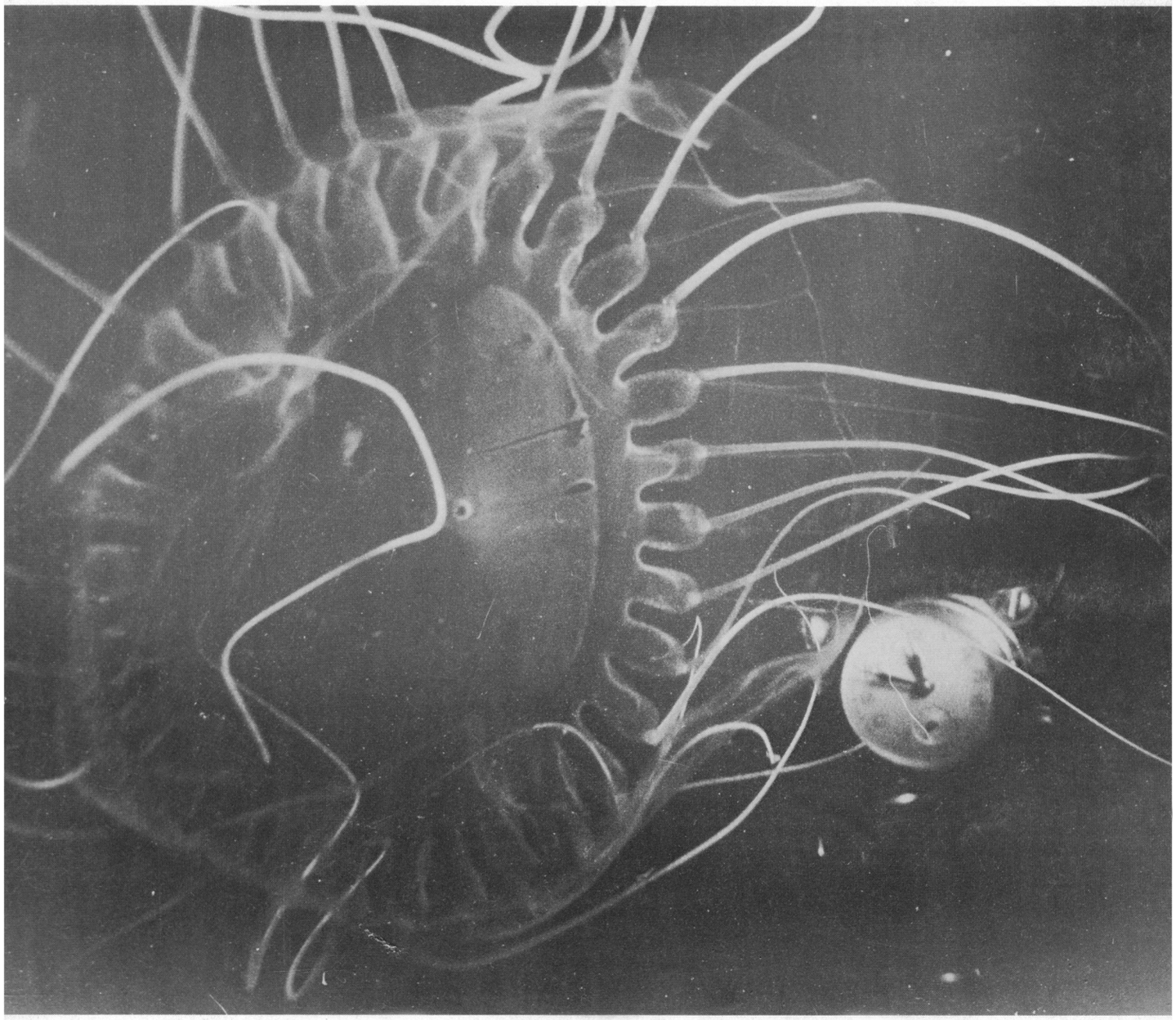
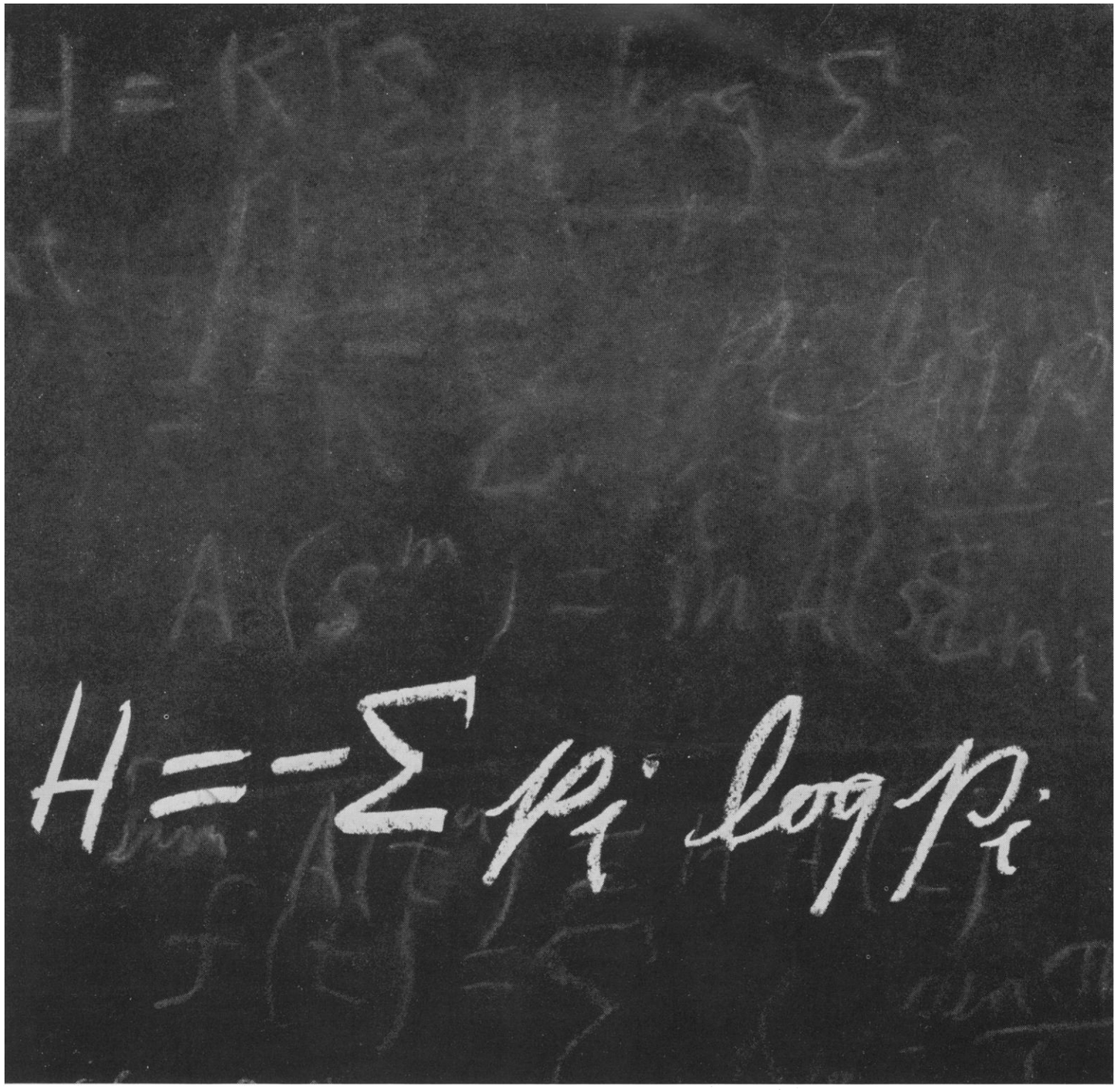
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



Index Issue



A basic formula from Information Theory . . . provides a measure of the amount of information in a particular type of message, such as TV . . . helps determine the frequency bandwidth, for example, required to transmit the messages. Information Theory, pioneered at Bell Laboratories, guides the search for better communications systems.

DISCOVERY

AT BELL TELEPHONE LABORATORIES

New knowledge comes in many forms. Sometimes it comes in a mathematical formula. Usually it comes after much thought and experiment and the fruitful interaction of different minds and abilities. Most often, too, a particular discovery is small. But many small discoveries have a way of leading to big advances at Bell Laboratories—advances like the transistor . . . or, more recently, the gaseous optical maser, forerunner of communications at optical frequencies. Opportunities for discovery are enhanced by the abilities of the scientists and engineers and the range of the facilities at Bell Laboratories, *world center of communications research and development.*

BELL SYSTEM
AMERICAN TELEPHONE & TELEGRAPH CO.
AND ASSOCIATED COMPANIES

SCIENCE is published weekly by the AAAS, 1515 Massachusetts Ave., NW, Washington 5, D.C. Second-class postage paid at Washington, D.C., and additional mailing office. Annual subscriptions: $8.50; foreign postage, $1.50; Canadian postage, 75¢.

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SCIENCE

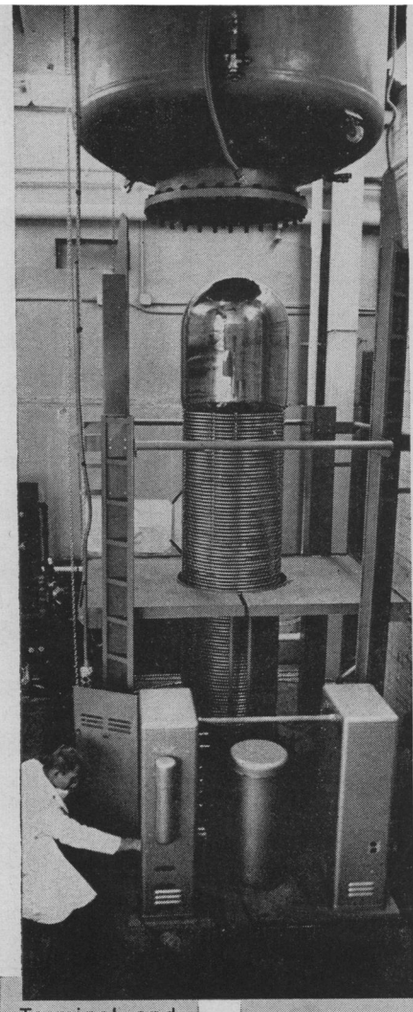
Cover

Self-portrait of rare jellyfish *(Solmissus incisa)* taken at a depth of 1000 meters off George's Bank during studies of bioluminescence in the sea. When this 12-centimeter medusa drifted into the range of the camera (designed by Breslau and Edgerton), its luminescence was picked up by a phototube, which triggered an electronic flash to take the picture. The 2-centimeter watch gives both scale and the exact moment of exposure. [George L. Clarke, Harvard University and Woods Hole Oceanographic Institution]

A Versatile New *Van de Graaff®*

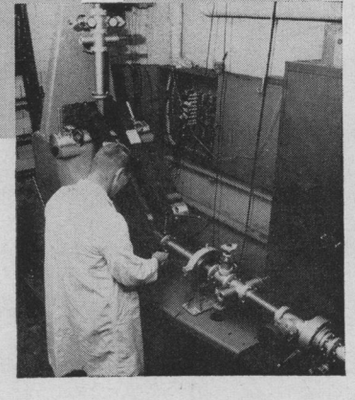
A new Van de Graaff accelerator has appeared on the scene. It did not spring full-blown from the brow of an inspired design engineer and, in fact, bears a remarkable resemblance to its predecessors. It evolved rather from both an inspired customer's need and improved state of the art. The KN-4000, at *4 Mev*, does fill in a gap in the voltage range of standard equipment. It offers great versatility of use, low installation cost, and delivers a very respectable *400 μa* of current at rated voltage. A convertible machine, it will also accelerate a full milliampere of electrons (*4 kilowatts*).

In addition to offering "beam purity" and precision, with adequate energy for a fundamental research program, its output is high enough to permit a variety of analytical and engineering uses. Neutron production would be 2×10^{12} n/sec. from the prolific Be^{9} (d,n) B^{10} reaction. Nanosecond pulsing is available. By "beam purity" we mean that accelerated particles are monoergic to within *100 electron volts*. Electronically regulated beam stability is better than one part in several thousand. Beam



Terminal and accelerating section of the KN-4000 Van de Graaff with pressure tank removed.

Precision 90° analyzing and stabilizing system.



Short-lived radioisotope production and neutron activation, radiation effects and solid state work, radiobiology, energy level determinations, and (with conversion) massive-dose studies, catalysis and polymerization are a few of the possible areas of use. An English producer of medical supplies will use the 4 kw electron output for sterilizing his product in bulk quantities. A U.S. university will use KN-4000 as a central tool in neutron physics.

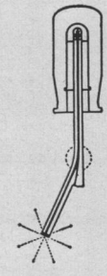
In short, with KN-4000 in your laboratory, your research program can be diverse, yet of the highest caliber. This machine will both attract and utilize top scientific and engineering personnel.

ELECTRONS
4 kilowatts of ionizing radiation

POSITIVE IONS
400 microamperes

X-RAYS
3000r per min. at 1 meter

NEUTRONS
2 x 10^{12} neutrons per sec.



HIGH VOLTAGE ENGINEERING
BURLINGTON, MASSACHUSETTS, U. S. A.

APPLIED RADIATION CORPORATION

HIGH VOLTAGE ENGINEERING (EUROPA) N. V.

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The Twelve-Pound Book

When this number of *Science* is published we will have barely room enough in our binder for volume 134 (July to December) to squeeze it in. Last year we had the same problem, so we enlarged the binders to take care of the expected growth. But we are at the end of that road, for larger binders than we used this year are not available. Even if they were, we would hesitate to use them, since the current volume and its binder will make an unwieldy twelve-pound book. We have adopted an obvious expedient: in 1962 we will publish four instead of two volumes.

For *Science*, the last few years have been notable for growth in circulation as well as in physical size. Both phenomena are in part attributable to the combination of the *Scientific Monthly* with *Science* in January 1958. It is instructive to compare *Science* in the year now ending with *Science* in 1957, the year before the combination. The following increases have occurred: circulation, from 38,000 to 71,000 (87 percent); number of editorial pages, from 1836 to 2502 (36 percent); number of advertising pages (in the face of annual increases in advertising rates), from 896 to 1686 (88 percent); gross advertising revenue, from $264,000 to about $800,000 (230 percent); total number of pages, from 2732 to 4188 (57 percent). Two-thirds of the increase in the number of editorial pages is attributable to the greater space devoted to leading articles, which went up in number from 101 in 1957 to 134 in 1961 and in number of pages from 449 to 811 (81 percent), and to letters, which went from 15 to 94 pages.

If we focus our attention on the differences between 1961 and 1960, we find that both circulation and advertising volume have climbed at a rapid rate: circulation went from 63,000 to 71,000 (13 percent); advertising pages from 1403 to 1686 (20 percent); and total pages from 3842 to 4188 (9 percent).

The growth in circulation is gratifying, but the growth in size gives us concern. How big should the weekly issues become? Our staff thinks that we have approached what should be our limit in those issues that once a month carry the customer's service or "bingo" card so dear to advertisers. Accordingly, we plan two steps. For one thing, as soon as the machinery for processing returns can be set up, we shall put "bingo" coupons in the 40 issues that do not contain the cards. If readers will use the coupons, advertisers may be more willing to use the smaller issues and thus reduce the peak loads. Secondly, we have put an upper limit on the amount of advertising that may appear in any number except the *Instrument Issue*.

As advertising increases, so should the amount of editorial material. We think it desirable that the editorial material should make up not less than about 42 percent of the total pages in any issue. Thus, if advertising should continue to increase, despite the rise in rates which takes effect next month, *Science* would continue to grow at a rate of about two pages of text for each additional three pages of advertising accepted.

We hope that the steps we plan to take will result in issues of more equal size and that at some not too distant time our annual growth in size will become asymptotic. So much for the mechanical problems we can foresee. They could be worse.—G.DuS.

Meetings

The Nature of the Real

A series of conferences on the nature of the real was held at Marquette University, Milwaukee, Wisconsin, from 12 to 15 June 1961.

Of the six principal speakers, three were physicists and three were philosophers. The physicist speakers were Eugene P. Wigner (Princeton University), Alfred Landé (Ohio State University), and Robert Maurer (University of Illinois). The philosopher speakers were R. J. Henle (St. Louis University), Paul Weiss (Yale University), and Charles DeKoninck (Laval University). Three other philosophers formally commented on the papers of the three physicists and three other physicists commented on the papers of the philosophers. The philosopher commentators were G. Klubertanz (St. Louis University), Richard Blackwell (John Carroll University), and James Weisheipl (Dominican House of Studies). The physicist commentators were Max Dresden (State University of Iowa), Albert Rose (RCA Laboratories), and L. W. Friedrich (Marquette University).

It was pointed out by the physicists that the reason why the problems of epistemology and ontology are of increased interest to the contemporary physicist is that he has found it impossible to give a satisfactory description of atomic phenomena without explicit reference to consciousness. It was suggested by one physicist that there are two kinds of reality: that of my consciousness, which is absolute, and that of other objects, which is relative and ranges over a wide spectrum.

Causality was discussed by both the philosophers and the physicists. Attempts to hold out for cause-effect continuity in all of reality falter when one encounters quantum mechanical interpretations of atomic phenomena. Two of the physicists expressed the fear that their colleagues have become so enthralled by the success of the mental constructs, or concepts, used by physicists that they unwittingly fail to distinguish purely mental concepts from the real world. As an example of this, reference was made to Bohr, who was accused of transferring the uncertainty of prediction expressed by the Heisenberg uncertainty principle into an indeterminacy of being itself, thereby treating the analysis of concepts as though such analysis were equivalent to an examination of primary data.

One of the philosophers explained that we discover physical reality through a primary form of human experience which is at the same time the primary content of human consciousness. This experience is a concrete encounter with a complex object, or set of objects. It is a knowledge encounter as well as an encounter with objects. The physical reality which we discover through continuing encounters is not only a world of existing extended beings; it is a world of movement and change, of interaction and interrelation. Insightful reflection and inference bring us to see that the existence and activity of the physical world must be understood within a framework of causes and of causal explanation.

Another of the philosophers pointed out that scientific study gives us a more objective, precise, and systematic grasp of reality than is obtainable by the commonsense man. Nevertheless, it does not give us the ultimately real. Grasp of ultimate reality is possible "only through speculation, in a dialectically sustained systematic account of the content of common experience, distilled and generalized."

It was agreed by most of the participants that, although the vast array of reproducible experiments demonstrates that there are an extraordinarily large number of phenomena that are causally related, yet the causal principal is not valid for all known sequences of phenomena. Some observables remain erratic and unpredictable despite the refined techniques used to measure them. Physicists do not attribute this to the limitations of their techniques. That leaves little choice but to accept, as an ultimate fact of the real world, the absence of causal relation linking these phenomena.

Not much light was cast during these conferences on how the acausal, relatively random, behavior at the atomic level can be the basis for ordered causal behavior at the macroscopic level. It is difficult to determine where the transition (if it can be called that) occurs between random, acausal behavior and ordered behavior, or between a random distribution of elementary particles and an ordered structure of which those same particles become the ultimate components.

The purpose of the conferences was simple and fundamental. They were held to attempt the building of a bridge

of understanding between philosophers and physicists. Until the two groups agree on the meanings of words they use in common and until they accept the scope of each other's valid areas of interest as well as understand each other's limitations, meaningful dialogue between the two is well-nigh impossible.

Recurring efforts were made on the part of many of the participants to outline the "levels of reality" within the entire spectrum of reality, from the most really real down to the most tenuously real. These conferences pointed up the problems involved in such attempts. Much needs to be done before these problems will be solved.

Both the philosophers and the physicists agreed that they must learn much from each other before a good philosophy of physics can be written, if indeed that will ever be possible.

A total of 121 persons attended the conferences. Publication of the proceedings of these conferences is planned.

L. W. FRIEDRICH
Marquette University, Milwaukee, Wisconsin

Forthcoming Events

January

22–24. Institute of the Aerospace Sciences, 30th annual, New York, N.Y. (IAS, 2 E. 64 St., New York 21)

22–26. American Mathematical Soc., annual, Cincinnati, Ohio. (AMS, 190 Hope St., Providence 6, R.I.)

23. Conference on Cardiac and Vascular Surgery, New York Heart Assoc., New York, N.Y. (R. Ober, NYHA, 10 Columbus Circle, New York 19)

23–25. American Soc. of Safety Engineers, Philadelphia, Pa. (A. C. Blackman, 5 N. Wabash Ave., Chicago 2, Ill.)

23–25. Obstetrics and Gynaecology, 2nd Asiatic congr., Calcutta, India. (S. Mitra, 4 Chowringhee Terrace, Calcutta 20)

24–26. Mathematical Assoc. of America, 45th annual, Cincinnati, Ohio. (H. M. Gehman, Univ. of Buffalo, Buffalo, N.Y.)

24–26. Thermophysical Properties, symp., American Soc. of Mechanical Engineers, Princeton, N.J. (E. F. Lype, ASME, c/o Thompson Ramo Wooldridge, 23555 Euclid Ave., Cleveland, Ohio)

24–27. American Physical Soc., annual, New York, N.Y. (K. K. Darrow, 538 W. 120 St., New York 27)

24–27. Federation of American Scientists, Natl. Council, New York, N.Y. (D. M. Singer, FAS, 1700 K St., NW, Washington 6)

25–26. Western Spectroscopy Assoc., 9th annual, Pacific Grove, Calif. (D. G. Rea, WSA, Univ. of California Space Sciences Laboratory, Berkeley 4)

25–27. Western Soc. for Clinical Research, 15th annual, Carmel-by-the-Sea, Calif. (H. R. Warner, WSCR, Latter-Day Saints Hospital, Dept. of Physiology, Salt Lake City 3, Utah)

26–29. Man and Civilization: Control of the Mind—II, San Francisco, Calif. (S. M. Farber, Univ. of California San Francisco Medical Center, San Francisco 22)

28–3. American Inst. of Electrical Engineers, New York, N.Y. (R. S. Gardner, AIEE, 33 W. 39 St., New York 18)

28–3. Pan American Assoc. of Ophthalmology, interim congr., Lima, Peru. (J. M. McLean, 525 E. 68 St., New York 21)

29–30. Carbohydrates, Cellulose, and Cellulose Industries, symp., Council of Scientific and Industrial Research, Ahmedabad, India. (Director, Ahmedabad Textile Industry Research Assoc., Ahmedabad-9)

29–31. American Soc. of Heating, Refrigerating and Air-Conditioning Engineers, St. Louis, Mo. (R. C. Cross, United Engineering Center, 345 E. 47 St., New York, N.Y.)

29–31. Institute of the Aeronautical Sciences, annual, New York, N.Y. (R. R. Dexter, IAS, 2 E. 64 St., New York 21)

29–1. Instrument Soc. of America, conf. and exhibit, Dallas, Texas. (W. H. Kushnick, ISA, 313 Sixth Ave., Pittsburgh 22, Pa.)

30–1. Military Electronics, 4th winter convention, Institute of Radio Engineers, Los Angeles, Calif. (IRE, 1435 LaCienega Blvd, Los Angeles)

30-2. Society of Plastics Engineers, annual technical conf., Pittsburgh, Pa. (T. A. Bissell, SPE, 65 Prospect St., Stamford, Conn.)

31–2. American Geophysical Union, Pacific Southwest regional, Tucson, Ariz. (A. N. Sayre, U.S. Geological Survey, Washington 25)

February

1–2. Industrial Management Engineering Conf., Illinois Inst. of Technology, Chicago. (F. A. Judd, Technology Center, IIT, Chicago 18)

1–3. Congress on Hospital Administration, 5th annual, Chicago, Ill. (American College of Hospital Administrators, 840 N. Lake Shore Dr., Chicago)

4–7. American Inst. of Chemical Engineers, natl., Los Angeles, Calif. (American Petroleum Inst., 1271 Avenue of the Americas, New York 20)

5. World Meteorological Organization, Working Group on Networks of the Commission for Synoptic Meteorology, Geneva, Switzerland. (Secretary, WMO, Geneva)

5–6. Gustav Stern Symp. on Perspectives in Virology—III, New York, N.Y. (M. Pollard, Lobund Inst., Univ. of Notre Dame, Notre Dame, Ind.)

5–7. American Acad. of Allergy, annual, Denver, Colo. (Scientific Liaison Office, Natl. Research Council, Sussex Dr., Ottawa, Ont., Canada)

5–9. Electroforming Applications, symp., American Soc. for Testing and Materials, Dallas, Tex. (ASTM, 1916 Race St., Philadelphia 3, Pa.)

6–7. Vertebrate Pest Control Conf., Sacramento, Calif. (M. W. Cummings, Univ. of California, Davis)

6–8. Society of the Plastics Industry, Re-

inforced Plastics Div., Chicago, Ill. (Scientific Liaison Office, Natl. Research Council, Sussex Dr., Ottawa, Ont., Canada)

7–9. Military Electronics, Inst. of Radio Engineers, Los Angeles, Calif. (M. E. Brady, Space Technology Laboratories, P.O. Box 95001, Los Angeles)

7–10. American College of Radiology, annual, New York, N.Y. (ACR, 20 N. Wacker Dr., Chicago 6, Ill.)

8. Problems in Food Processing, Assoc. of Vitamin Chemists, Chicago, Ill. (H. S. Perdue, Abbott Laboratories, N. Chicago)

8. Tissue Homotransplantation, 5th biennial conf., New York, N.Y. (W. Dameshek, New England Center Hospital, 171 Harrison Ave., Boston 11, Mass.)

9–11. National Open Hearth and Blast Furnace Conf., American Inst. of Mining, Metallurgical, and Petroleum Engineers, Detroit, Mich. (E. O. Kirkendall, AIME, 29 W. 39 St., New York 17)

12–16. Management of Science Information Centers, Inst. on Information Storage and Retrieval, 4th, Washington, D.C. (L. H. Hattery, Center for Technology and Administration, American Univ., 1901 F St., NW, Washington 6)

12–23. Latin American Seminar on Irrigation, 2nd, Panama City, Panama. (J. Melendez, Jefe, Depto. de Ingenieria, Ministerio de Agricultura, Comercio e Industrias, Panama City)

13–14. Sanitary Engineering, 4th conf., Urbana, Ill. (B. B. Ewing, Dept. of Sanitary Engineering, Univ. of Illinois, Urbana)

14–16. Biophysical Soc., 6th annual, Washington, D.C. (D. Cowie, Dept. of Terrestrial Magnetism, Carnegie Institution of Washington, 5241 Broad Branch Rd., NW, Washington 15)

14–16. Solid State Circuits, intern. conf., Philadelphia, Pa. (L. Winner, 152 W. 42 St., New York 36)

14–17. National Soc. of College Teachers of Education, Chicago, Ill. (E. J. Clark, Indiana State College, Terre Haute)

16–18. Medical Congr. in Honor of the Centennial of Bretonneau, Tours, France. (Directeur, École Nationale de Médecine, Tours)

17–24. Pan American Medical Women's Alliance, 8th congr., Manizales, Colombia. (C. Carthers, 1661 Riverside Ave., Suite B, Jacksonville, Fla.)

18–22. American Inst. of Mining, Metallurgical, and Petroleum Engineers, annual, New York, N.Y. (E. O. Kirkendall, AIME, 29 W. 39 St., New York 17)

18–22. Technical Assoc. of the Pulp and Paper Industry, annual, New York, N.Y. (TAPPI, 360 Lexington Ave., New York 17)

19–21. American Educational Research Assoc., Atlantic City, N.J. (G. T. Buswell, 1201 16 St., NW, Washington 6)

19–21. Tracking and Command of Aerospace Vehicles, Inst. of the Aerospace Sciences, San Francisco, Calif. (IAS, 2 E. 64 St., New York 21)

19–22. American Concrete Inst., annual, Denver, Colo. (W. A. Maples, 22400 W. Seven Mile Rd., P.O. Box 4754, Redford Station, Detroit 19, Mich.)

19–22. Industrial Ventilation Conf., E. Lansing, Mich. (Engineering Dept., Michigan State Univ., E. Lansing)

19–23. American Soc. of Civil Engineers, Houston, Tex. (W. H. Wisely, 345 E. 47 St., New York 17)

19–23. Automatic Control in the Iron and Steel Industry, intern., Brussels, Belgium. (Institut Belge de Régulation et d'Automatisme, 98 Chausèe de Charleroi, Brussels 6)

20–21. International Inst. of Sugar Beet Researchers, winter congr., Brussels, Belgium. (O. J. Kint, IISBR, 152 rue Beauduin, Tirlemont, Belgium)

21–25. National Assoc. for Research in Science Teaching, Washington, D.C. (H. Branson, Dept. of Physics, Howard Univ., Washington 1)

22-24. American Acad. of Forensic Sciences, Chicago, Ill. (W. J. R. Camp, Univ. of Illinois, 1853 W. Polk St., Chicago 12)

22–24. Genetics Soc. of Canada, Winnipeg, Man., Canada. (Scientific Liaison Office, Natl., Research Council, Sussex Dr., Ottawa, Ont., Canada)

23–24. American Physical Soc., Austin, Tex. (K. K. Darrow, APS, Columbia Univ., New York 27)

23–24. Canadian Aeronautical Inst., mid-season meeting, Halifax, Nova Scotia. (Scientific Liaison Office, Natl. Research Council, Sussex Dr., Ottawa, Canada)

25–1. Pan American Assoc. of Oto-Thino-Laryngology and Broncho-Esophagology, Caracas, Venezuela. (C. M. Norris, 3401 N. Broad St., Philadelphia 40, Pa.)

(See 22 December issue for comprehensive list)