SCIENCE 28 December 1962
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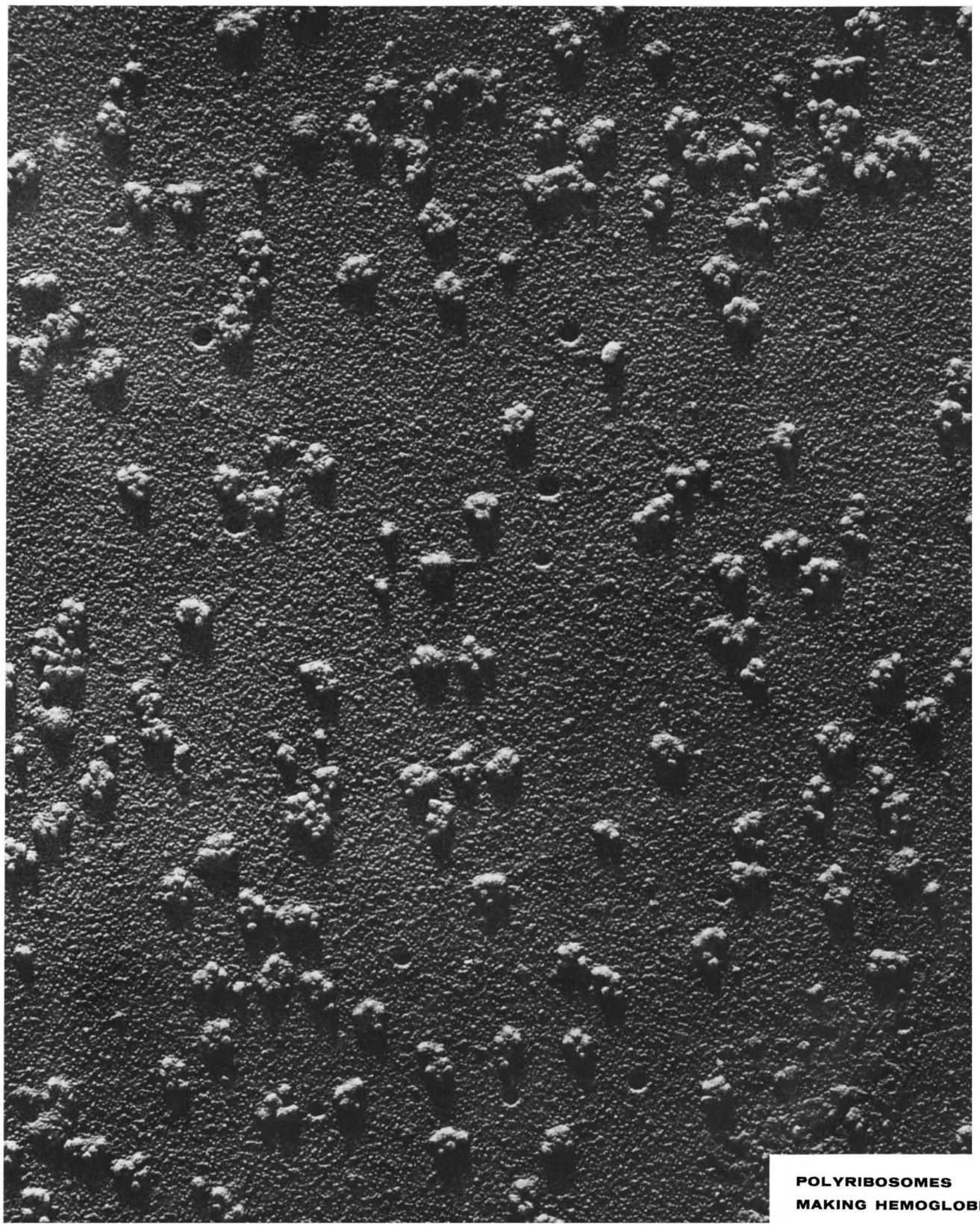

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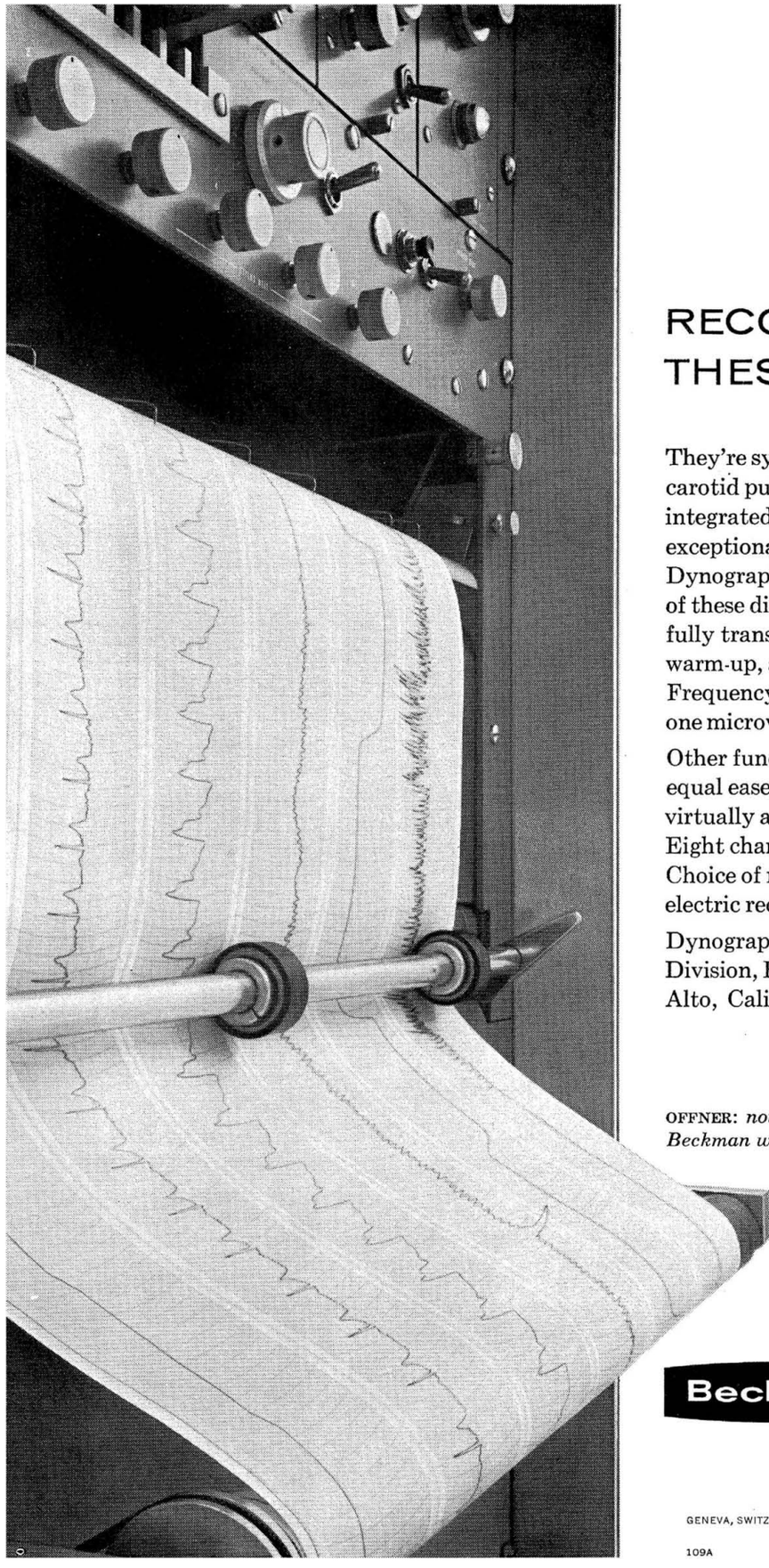

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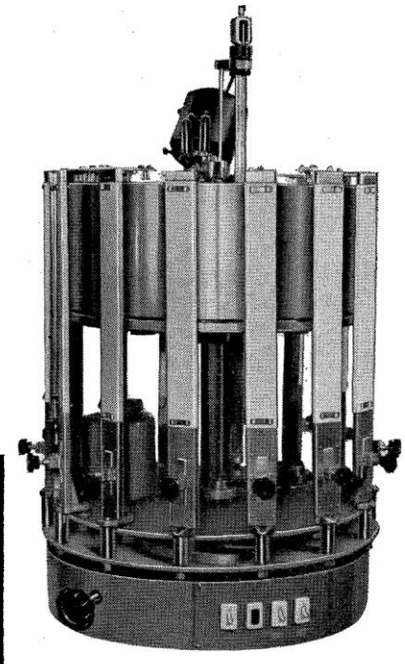

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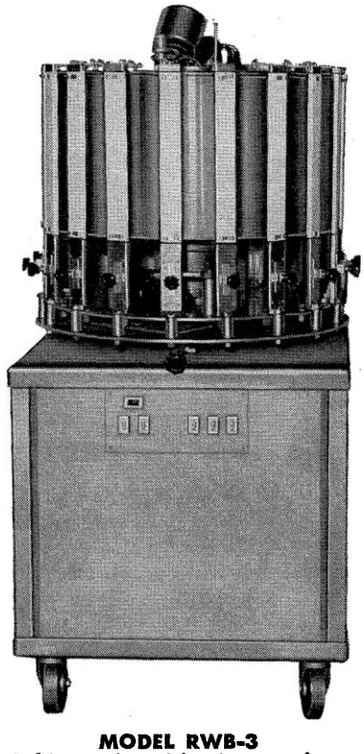

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SCIENCE

Cover Hemoglobin is synthesized in reticulocyte cells on a cluster of ribosomal particles. These clusters, called polyribosomes, can be isolated from osmotically lysed cells. The electron micrograph was made by depositing the clusters on an electron microscope grid and then shadowing with platinum (about × 80,000). See page 1399.

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28 December 1962, Volume 138, Number 3548

SCIENCE

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Science and the Humanities

Take away science and technology from our civilization and there would remain only chaos and starvation. We exist in complete dependence on an organizational and production complex which provides food, clothing, shelter, and the common defense. Less obvious, but equally important, is the philosophic significance of the knowledge which science has generated. Attaining an understanding of the natural laws which govern our lives and the universe about us is a profoundly enriching experience. Unfortunately, only a relatively few citizens, mostly scientists, understand the implications of science or can visualize its future impact. Some humanists, having only the haziest concept of science, have come to regard it as a mysterious and intractable Frankenstein. Others are more constructive and have discussed the need for communication between scientists and nonscientists and especially between scientists and politicians. The gap between the scientists and other citizens is growing, and scientists will have to assume a substantial share of leadership in meeting the problem. Hence it is timely to present one aspect of the matter. On page 1375 of this issue, James H. Mathewson discusses "Science for the citizen—an educational problem." Mathewson has addressed himself to the question of college curricula for the scientist and nonscientist, and he argues thoughtfully concerning the inadequacies of present approaches. He points out:

> . . . elementary science courses are not taught with a broadening function in mind. They are designed to train the science major in specialized fact, theory, and technique from the start. They generally cover only one field in science, with little instruction in how the subject relates to other fields inside or outside of science. Under these circumstances the nonscience major finds his encounter with science a torment of meaningless detail, providing little that he may profitably use for a wider purpose than satisfying an academic regulation. He does not need to become a specialist in a science; he does need to understand the essential nature of science as a whole and his relation to it.
>
> The science major remains correspondingly undereducated. He is frequently permitted to avoid all but the briefest exposure to nonscience courses and activities.

Mathewson proposes revisions of the content of survey courses. We believe that implementation of his ideas would have constructive consequences. But we doubt that his suggestions are sufficiently comprehensive to meet the challenges of the need. First, a quibble about his proposal that the humanists study scientists rather than science. An implication is that there is such a thing as a type specimen, a standard sample, a guaranteed genetically pure "long-hair." Actually, in behavior and thought pattern no two scientists are alike. Many, however, are characterized by a hunger for knowledge that does not stop at the boundaries of their specialties. Once their formal education is finished they inquire into other fields. After the rigors of training in science, the subject content of the humanities seems hardly more difficult than a good novel. While it is feasible for a scientist to overcome deficiencies in earlier training it is almost impossible for humanists to acquire a knowledge of science once the formal educational process is completed. An average man, or even a superior one, cannot learn science from scratch. Our principal comment, then, is that a drastic revision of the educational process, including secondary school training, is overdue. We believe that a realistic curriculum for the secondary schools might well include almost continuous exposure to science, beginning in the primary grades. This would give partial recognition to the realities of a changing world and enrich immeasurably through philosophic values the lives of all.—P.H.A.

Meetings

Quantum Chemistry and Solid State Physics

Something of a mile-marker has been reached in the area of testing and applying quantum theory. This was the feeling of many who attended the Symposium on Quantum Chemistry and Solid State Physics, 27 August to 1 September 1962, as they listened to W. Kolos (Polish Academy of Science) describe a successful and precise calculation of the four-body problem that is the H_2 molecule (two electrons and two protons), a calculation which accounted for nuclear motion and incorporated 80 terms.

The symposium was sponsored by the Quantum Chemistry Institute at Uppsala University under the stimulating guidance of Per-Olov Lowdin. It was held at Rättvik, a tiny Swedish resort town. The topics of discussion were numerous, from the four-body problem already mentioned, to considerations of density matrices in many-body theory, solid state theory, and ligand field theory, to recent work in quantum biology, including suggestive considerations of the tunneling of protons that could affect gene, DNA, RNA, and protein synthesis. It was apparent in the discussions that the means of application, and even to some extent the quantum theory itself, in certain of its details and in its time dependency, is still being tested. Much work that was reported dealt with the means available now to circumvent the considerable mathematical and computational difficulties which beset the quantum chemist.

Progress in solving problems with the Schrödinger equation has been made on several fronts. J. Coleman, P. O. Löwdin and F. Sasaki described advances in the density matrix approach in many-body theory, while N. Bazley and D. W. Fox told of new methods for determining lower limits of the energy levels of atomic and molecular systems. The problem of electron–electron interaction (correlation) was discussed in terms of the alternant molecular orbital scheme (different orbitals for different spins) by R. Pauncz for hydrocarbons, by G. Dermit for diamond, and by J. W. Moskowitz for the interesting hypothetical molecule, annular H_6.

A statistical theoretical study along the lines of the Fermi-Thomas approach was described for atoms by R. Gaspar. The evaluation of zeta-function expan-

sions for molecular integrals was described by Moskowitz. Remarks on linked-cluster expansions were presented by Löwdin. An interesting extension of density matrix theory in a Hückel-type approximation was made and applied to conjugated hydrocarbons and benzenoid compounds containing heteroatoms by H. Looyenga of Nederlandse Centrale Organisatie, T.N.O., Delft.

In masterful presentations, B. and A. Pullman described the considerable progress in understanding the relative reactivity and natural selection of many molecules of biological importance. Quantum chemistry has been helpful in interpreting the role of enzyme constituents important in oxidation reduction reactions, in the calculation of stability to ultraviolet radiation, in evaluation of the role of functional molecular *portions* (as opposed to whole molecules) in carcinogen action, and in the evaluation of hydrogen bonding through the amino acid residues as potential pathways for electron transfer. Löwdin presented an interesting and potentially fruitful notion of protonic tunneling between the doubly hydrogen-bonded base pairs of the double-stranded DNA molecule. If such a process did occur, it was pointed out, then inversion of pairing and other faulty storage of information could occur. This then has direct implications in the problems of mutations, evolution, ageing, and tumor inception.

Recognition was given the perennial problem of phase determination in electron and x-ray diffraction determinations by K. Hedberg.

There are new areas where quantum chemistry is being used to solve major problems. The determination of the cage-like structure of the many new polyhedric organic and inorganic molecules was discussed by R. H. Hoffman, and the many-electron approach of Naziere-Pines to the treatment of the dielectric constant of a solid and the consequent estimation of London intermolecular force terms was developed by Jan Linderberg. H. A. Pohl discussed the nature of carrier transport vis-à-vis molecular overlap in molecular solids with special reference to conductivity and to piezoresistivity; the existing gap in the theory of carrier mobility in solids in the transition range between that well described by wave-packet "drifting," and that describable by "hopping" processes (between about 500 and 0.01 cm^2/volt sec); the much needed extension of theory using random coordinate spacings to the problems of electronic transport processes in amorphous solids and liquids; and the problem of the near identity of the activation energy of conduction to the lowest triplet energy in molecular solids of organic nature. Finally, Coleman made a laudatory reference to the equation of Wentzel for many particles which is relativistically invariant; and Löwdin presented a challenging discussion of the reaction rate problem in terms of the wave mechanical *evolution operator* for the time dependent Schrödinger equation. Löwdin urged a fresh consideration of the evolution operator in treating kinetic problems and expressed confidence that it would become a powerful tool.

The attending scientists, who came from many nations, united in expressing their deep appreciation for the hospitality extended them by their Swedish hosts, and for the stimulating approaches in quantum chemistry presented at the Symposium.

HERBERT A. POHL
Department of Chemistry, Polytechnic Institute of Brooklyn, Brooklyn, New York

Forthcoming Events

January

18–19. **Blood**, annual symp., Detroit, Mich. (G. F. Anderson, Dept. of Physiology and Pharmacology, Wayne State Univ., 1401 Rivard St., Detroit 7)

21–23. Chemistry and Biochemistry of **Seed Proteins**, intern. conf., New Orleans, La. (C. H. Fisher, Southern Utilization Research and Development Div., Agricultural Research Service, U.S. Dept. of Agriculture, P.O. Box 19687, New Orleans 19)

21–23. Institute of the **Aerospace Sciences**, annual, New York, N.Y. (IAS, 2 E. 64 St., New York 21)

21–24. American **Meteorological** Soc., annual, New York, N.Y. (R. L. Pfeffer, Lamont Geological Observatory, Columbia Univ., Palisades, N.Y.)

21–24. Advances in **Gas Chromatography**, intern. symp., Houston, Tex. (A. Zlatkis, Chemistry Dept., Univ. of Houston, Houston)

22. Infectious Diseases of the **Heart and Circulation**, conf., New York, N.Y. (C. A. R. Connor, New York Heart Assoc., 10 Columbus Circle, New York 19)

22–24. **Reliability and Quality Control**, natl. symp., San Francisco, Calif. (L. W. Ball, Boeing Co., P.O. Box 3707, Seattle 24, Wash.)

23–25. **Elevated Temperature Mechanics**, intern. conf., 3rd Navy Structural Mechanics Symp., New York, N.Y. (by invitation). (A. M. Freudenthal, 624 Mudd Bldg., Columbia Univ., New York 27)

23–26. American Assoc. of **Physics Teachers**, New York, N.Y. (R. P. Winch,

Recent AAAS Symposium Volumes

#72. **Spermatozoan Motility.**

1962. 322 pages. 113 illustrations.
Edited by: David W. Bishop.
For the first time the details of sperm motility are here presented in monograph form. A wealth of previously unpublished data. A valuable souce of reference for the student and investigator, as well as for the practitioner of applied reproductive biology.

Retail Price: $7.50. *AAAS Member's Cash Price*: $6.50.

#71. **Great Lakes Basin.**

1962. 320 pages. 92 illustrations.
Edited by: Howard J. Pincus.
The reader will find here material on pure and applied science, accounts of new research and reviews of material published elsewhere, historical and social studies, and pleas for action and planning.

Retail Price: $7.50. *AAAS Member's Cash Price*: $6.50.

#70. **Fundamentals of Keratinization.**

1962. 202 pages. 136 illustrations.
Edited by: Earl O. Butcher and Reidar F. Sognnaes.
The fields of anatomy, dentistry, dermatology, medicine, pathology, and zoology are represented in this volume.

Retail Price: $6.50. *AAAS Member's Cash Price*: $5.75.

#69. **Biophysics of Physiological and Pharmacological Actions.**

1961. 612 pages. 212 illustrations.
Edited by: Abraham M. Shanes.
A bird's-eye view of a number of principles now considered important. Useful for teaching, as well as for research purposes.

Retail Price: $13.50. *AAAS Member's Cash Price*: $11.75.

#68. **Sciences in Communist China.**

1961. 884 pages. 23 illustrations.
Edited by: Sidney H. Gould.
". . . strongly recommended to all who are in search of facts and source material on the sciences in China."—*Science*, 22 September 1961

Retail Price: $14.00. *AAAS Member's Cash Price*: $12.00.

#67. **Oceanography.**

1961. 2nd printing, 1962. 665 pages. 146 illustrations.
Edited by: Mary Sears.
"I know of no other volume that so well defines oceanography, its purpose, opportunities and requirements."—*Science*, 9 June 1961

Retail Price: $14.75. *AAAS Member's Cash Price*: $12.50.

#66. **Germ Plasm Resources.**

1961. 394 pages. 59 illustrations.
Edited by: Ralph E. Hodgson.
"This book will be of interest to nonplant and animal breeders, for the rather general treatment of various topics . . . allows for rapid perusal."—*Bulletin of the Entomological Society of America*, September 1961

Retail Price: $9.75. *AAAS Member's Cash Price*: $8.50.

#65. **Aging . . . Some Social and Biological Aspects.**

1960. 436 pages. 65 illustrations.
Edited by: Nathan W. Shock.
"The 26 contributors include many of the most respected names in American gerontology, and the chapters cover a wealth of material."—*Journal of Gerontology*

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#64. **Calcification in Biological Systems.**

1960. 526 pages. 283 illustrations.
Edited by: R. F. Sognnaes.
"Those interested in current concepts of mineralization of calcified tissues will find in this text the sources of current knowledge on the subject."—*American Journal of Orthodontics*, May 1961

Retail Price: $9.75. *AAAS Member's Cash Price*: $8.50.

#63. **Congenital Heart Disease.**

1960. 372 pages. 147 illustrations.
Edited by: Allan D. Bass and Gordon K. Moe.
"Should serve as a valuable and concise summation of the more important aspects of congenital heart disease."—*American Journal of Cardiology*, August 1961

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Williams College, Williamstown, Mass.)

23–26. American Group **Psychotherapy** Assoc., annual, Washington, D.C. (AGPA, 1790 Broadway, New York 19)

24–27. American **Mathematical** Soc., annual, Berkeley, Calif. (AMS, 190 Hope St., Providence 6, R.I.)

25–6. International College of **Surgeons**, West Indies congr., aboard *S.S. Santa Rosa.* (Secretariat, 1516 Lake Shore Dr., Chicago 10, Ill.)

26. Association for **Symbolic Logic**, Berkeley, Calif. (T. Hailperin, Dept. of Mathematics, Lehigh Univ., Bethlehem, Pa.)

26–28. **Mathematical** Assoc. of America, annual, Berkeley, Calif. (H. M. Gehman, Univ. of Buffalo, Buffalo 14, N.Y.)

27–1. American Inst. of **Electrical Engineers**, winter general meeting, New York, N.Y. (R. S. Gardner, AIEE, 33 W. 39 St., New York 18)

28–2. American **Library** Assoc., Chicago, Ill. (D. H. Clift, ALA, 50 E. Huron St., Chicago 11)

28–2. **Body Composition**, conf., New York, N.Y. (J. Brozek, Dept. of Psychology, Lehigh Univ., Bethlehem, Pa.)

30–1. Military **Electronics**, natl. winter convention, Los Angeles, Calif. (F. P. Adler, Space Systems Div., Hughes Aircraft Co., Culver City, Calif.)

31–1. American Soc. for **Engineering Education**, college-industry conf., Atlanta, Ga. (W. L. Collins, Univ. of Illinois, Urbana)

31–1. Society of **Rheology**, annual western regional meeting, Emeryville, Calif. (T. L. Smith, Stanford Research Inst., Menlo Park, Calif.)

31–2. Western Soc. for **Clinical Research**, annual, Carmel-by-the-Sea, Calif. (H. R. Warner, Latter-day Saints Hospital, Dept. of Physiology, Salt Lake City 3, Utah)

February

4–8. **Rice Genetics** and **Cytogenetics**, symp., Los Baños, Laguna, Philippines. (Inter. Rice Research Inst., Manila Hotel, Manila, Philippines)

4–9. Recent Trends in **Iron and Steel Technology**, symp., Jamshedpur, India. (Secretary, Indian Inst. of Metals, 31 Chowringhee Rd., Calcutta, India)

4–20. Application of **Science and Technology** for the Benefit of Less Developed Areas, U.N. conference, Geneva, Switzerland. (Science Conference Staff, Agency for International Development, 826 State Dept. Annex 1, Washington 25)

5–14. International **Radio** Consultative Committee, Plan Subcommittee for Asia, New Delhi, India. (V. Barthoni, 128 rue de Lausanne, Geneva, Switzerland)

6–9. American College of **Radiology**, Chicago, Ill. (F. H. Squire, Presbyterian–St. Luke's Hospital, 1753 W. Congress St., Chicago 12)

8–18. United Nations Committee on **Industry and Natural Resources** in Asia and the Far East, Bangkok, Thailand. (S. Santitham, Rajadamnern Ave., Bangkok)

10–15. **Management** Function in Research and Development, conf., Pasadena, Calif. (Management Development Section, Industrial Relations Center, California Inst. of Technology, Pasadena)

10–16. **Planned Parenthood,** intern. conf., Singapore. (V. Houghton, Intern. Planned Parenthood Federation, 69 Eccleston Sq., London, S.W.1, England)

11–14. American Soc. of **Heating, Refrigerating, and Air-Conditioning Engineers,** New York, N.Y. (R. C. Cross, 345 E. 47th St., New York 17)

11–14. Industrial **Lubrication,** intern. conf. and exhibit, London, England. (E. V. Paterson, Scientific Lubrication, 217a Kensington High St., London W.8)

11–15. Quantum **Electronics,** intern. symp., Paris, France. (Secrétariat, Troisième Congrès International d'Electronique Quantique, 7 rue de Madrid, Paris)

12–14. **Lysozomes,** symp. (by invitation), London, England. (Ciba Foundation, 41 Portland Pl., London W.1)

13–15. **Electrochemistry,** 1st Australian conf., part I, Sydney, Australia. (F. Gutmann, Physical Chemistry Dept., Univ. of New South Wales, Kensington, N.S.W., Australia)

13–16. National Soc. of College Teachers of **Education,** Chicago, Ill. (E. J. Clark, Indiana State College, Terre Haute)

14–15. American Soc. for **Quality Control,** Textile and Needles Trades Div., annual conf., Clemson, S.C. (H. F. Littleton, c/o Charles H. Bacon Co., Lenoir City, Tenn.)

15–14 Apr. **Aeronautics and Space,** intern. exhibition, São Paulo, Brazil. (Santos Dumont Foundation, Avenida Ipiranga N°. 84, São Paulo)

16–23. Caribbean **Dental** Convention, Port of Spain, Trinidad. (A. V. Awon, 43–45 Frederick St., Port of Spain)

17–21. Technical Assoc. of the **Pulp and Paper** Industry, annual, New York, N.Y. (TAPPI, 360 Lexington Ave., New York 17)

18–20. American **Standards** Assoc., natl. conf., New York, N.Y. (ASA, 10 E. 40 St., New York 16)

18–20. **Biophysical** Soc., annual, New York, N.Y. (A. Mauro, Rockefeller Inst., New York)

18–20. **Electrochemistry,** 1st Australian conf., part II, Hobart, Tasmania. (J. N. Baxter, Chemistry Dept., Univ. of Tasmania, Hobart)

18–25. Expert Committee on **Food Additives,** FOA/WHO, Rome, Italy. (Intern. Agency Liaison Branch, Office of the Director General, Food and Agriculture Organization, Viale delle Terme di Caracalla, Rome)

19–22. **Radiochemistry,** inter-American conf., Montevideo, Uruguay. (Pan American Union, Washington 6)

20–22. Fundamental **Cancer** Research, annual symp., Houston, Tex. (L. Dmochowski, Section of Virology and Electron Microscopy, M. D. Anderson Hospital, Houston 25)

20–22. **Solid-State Circuits,** intern. conf., Philadelphia, Pa. (F. J. Witt, Bell Telephone Laboratories, Inc., Murray Hill, N.J.)

20–23. National Assoc. for Research in **Science Teaching,** Washington, D.C. (J. D. Novak, Biological Science Dept., Purdue Univ., Lafayette, Ind.)

20–24. Diseases of the **Chest,** intern. congr., New Delhi, India. (M. Kornfeld, American College of Chest Physicians, 112 E. Chestnut St., Chicago 11, Ill.)

21–22. American Soc. for **Quality Control,** regional conf., Las Vegas, Nev. (S. R. Wood, Dept. 61, Bldg. 160, Aerojet-General Corp., Azusa, Calif.)

22–23. American **Psychopathological** Assoc., annual, New York, N.Y. (F. A. Freyhan, c/o St. Elizabeths Hospital, Washington 20, D.C.)

23–28. American Soc. for **Testing** and **Materials,** Atlantic City, N.J. (H. H. Hamilton, 1916 Race St., Philadelphia 3, Pa.)

24–25. Unit Processes in **Hydrometallurgy,** symp., Dallas, Tex. (F. T. David, Colorado School of Mines, Golden)

24–27. **Diffusion,** intern. conf., Palm Springs, Calif. (J. A. Biles, Univ. of Southern California, School of Pharmacy, Los Angeles 7)

24–28. American Inst. of **Mining, Metallurgical, and Petroleum Engineers,** annual, Dallas, Tex. (E. Kirkendall, AIME, 345 E. 47 St., New York 17)

25–27. Advanced **Marine Engineering** Concepts for Increased Reliability, symp., Ann Arbor, Mich. (G. L. West, Jr., Dept. of Marine and Nuclear Engineering, Univ. of Michigan, Ann Arbor)

25–1. **Environmental Engineering,** natl. conf., Atlanta, Ga. (W. H. Wisely, American Soc. of Civil Engineers, 345 E. 47 St., New York, N.Y.)

26–27. **Dairy Engineering,** natl. conf., East Lansing, Mich. (C. W. Hall, Dept. of Agricultural Engineering, Michigan State Univ., East Lansing)

26–1. Society of **Plastics Engineers,** annual technical conf., Los Angeles, Calif. (G. P. Kovach, Foster Grant Co., 289 N. Main St., Leominster, Mass.)

27–3. American College of **Cardiology,** Los Angeles, Calif. (D. Scherf, 55 E. 86 St., New York 27)

28–2. Experimental Aspects of **NMR Spectroscopy,** Pittsburgh, Pa. (W. A. Straub, Applied Research Laboratory, U.S. Steel Corp., Monroeville, Pa.)

March

1–3. **Developing Brain and Binding Sites** of Brain Biogenic Amines, intern. symp., Galesburg, Ill. (H. E. Himwich, Research Div., Galesburg State Research Hospital, Galesburg)

2–6. Canadian Assoc. **of Radiologists,** annual, Quebec, Canada. (J. L. Léger, 1555 Summerhill Ave., Montreal 25, P.Q., Canada)

4–6. Association of **Iron and Steel Engineers,** western meeting, Los Angeles, Calif. (T. J. Ess, 1010 Empire Bldg., Pittsburgh 22, Pa.)

4–6. **Wildlife Management** Inst., Detroit, Mich. (C. R. Gutermuth, 709 Wire Bldg., Washington 5)

4–8. **Analytical Chemistry and Applied Spectroscopy,** 14th annual, Pittsburgh, Pa. (W. A. Straub, Applied Research Laboratory, U.S. Steel Corp., Monroeville, Pa.)

4–9. **Astronautics,** 3rd Inter-American symp., São Paulo, Brazil. (Symp. Secretariat, Sociedade Interplanetaria Brasileira, Caixa Postal 6450, São Paulo)