

SCIENCE

VOL. 100

FRIDAY, SEPTEMBER 22, 1944

No. 2595

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SCIENCE: A Weekly Journal devoted to the Advancement of Science. Editorial communications should be sent to the editors of SCIENCE, Lancaster, Pa. Published every Friday by

THE SCIENCE PRESS

Lancaster, Pennsylvania

Annual Subscription, \$6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building, Washington 25, D. C.

NEW METHODS IN THE STUDY OF STELLAR SPECTRA¹

By DR. OTTO STRUVE

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THIS year marks the one hundredth anniversary of one of the greatest contributions to astronomy: In 1844 Bessel published a paper on the *Astronomische Nachrichten* in which he showed that the slow angular proper motions of Procyon and Sirius are slightly irregular and that in the case of Sirius the departures of the observations from uniform, rectilinear motion are suggestive of a period of fifty years. Eighteen years later Alvan G. Clark discovered a faint companion to Sirius in the place predicted by Bessel's successors. The period of this companion, according to a recent orbit by Volet, is 49.94 years—almost precisely the value deduced by Bessel. The extraordinary physical character of the companion of Sirius—the first white dwarf known to astronomers—has been the subject of many recent investigations on the structure of the stars and on the properties of matter in the

degenerate state. These remarkable advances in physical science were possible because Sirius is not a single star, but is a binary pair in which the brilliant primary serves as an indicator of the distance, size and mass of the system. The fundamental contribution by Bessel consisted in the use of a new method: The proper motions were used to reveal the existence of an invisible (until then) companion.

It is appropriate that in view of this anniversary I should devote my address to a description of several new methods which have been of help in our investigations of double stars. We are no longer dependent solely upon visual observations of wide pairs which can be resolved in our telescopes or upon accurate proper motions to infer the existence of invisible companions. Photometric measurements of the brightnesses of certain stars show periodic oscillations which can only be explained if we assume that in a close unresolved pair the plane of the orbit lies in the line of sight and that each component eclipses the other once

¹ Address of the retiring vice-president and chairman of Section D of the American Association for the Advancement of Science (1943).

ultramicroscopic particles, free Brownian movement in a liquid as fluid as water is far too large and rapid to permit of photographic recording.

We are indebted to Dr. L. Marton, of Stanford University, and Dr. Otto Beeck and Mr. A. E. Smith, of

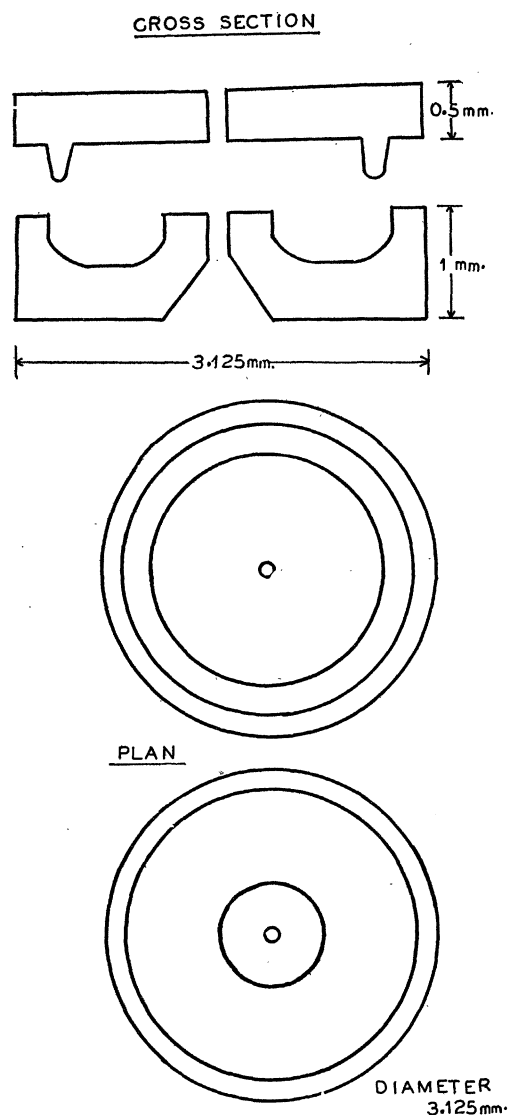


FIG. 1. Perforated platinum discs used to form enclosed electron microscope cell; cell and cover shown in cross section and in plan.

the shell Development Company, Emeryville, for their very generous cooperation in operating the Stanford microscope and the Berkeley R.C.A. microscope, respectively. Without this, our work could not have been carried out.

I. M. ABRAMS
J. W. MCBAIN

STANFORD UNIVERSITY

A METHOD FOR CENTRIFUGING AT LOW TEMPERATURE

THE laboratory centrifuge is often employed in the preparation of many biological materials. In a good many cases, especially in enzyme work, it is desirable or necessary to centrifuge at a low temperature. We have adapted a Type 1-SB International Centrifuge to run at a low temperature as described below. The centrifuge is in no way impaired for other regular uses.

The drain in the bottom of the centrifuge case is plugged with a rubber stopper, and small pieces of dry ice are placed on the bottom of the case. The amount of dry ice is determined by the length of time of centrifuging. A 17-inch circle of sheet metal with a 5-inch center hole is inserted in the case and is lodged tightly on the bottom of the case over the dry ice by tamping the metal circle along the outer edge. The centrifuge head is placed in position and the centrifuge is ready for use. It is desirable but not necessary to obtain partial insulation of the centrifuge by covering with several layers of cloth.

E. B. MCQUARRIE

R. G. KLUENER

SCHENLEY RESEARCH INSTITUTE, INC.,
LAWRENCEBURG, IND.

BOOKS RECEIVED

- BISPHAM, WILLIAM NEWBOLD. *Malaria, Its Diagnosis, Treatment and Prophylaxis*. Illustrated. Pp. viii + 197. Williams and Wilkins Company. \$3.50. 1944.
- BLAIR, MORRIS MYERS. *Elementary Statistics*. Illustrated. Pp. xiv + 690. Henry Holt and Company. \$3.50. 1944.
- BRILL, A. A. *Freud's Contribution to Psychiatry*. Pp. 244. W. W. Norton and Company. \$2.75. 1944.
- CASWELL, HOLLIS L. *Science in Childhood Education. Practical Suggestions for Teaching*. Pp. vii + 86. Bureau of Publications, Columbia University. \$.60. 1944.
- CHANEY, RALPH W., CARLTON CONDIT and DANIEL I. AXELROD. *Pliocene Floras of California and Oregon*. Illustrated. Pp. vii + 407. Carnegie Institution of Washington. \$4.50, paper cover—\$5.00, cloth cover. 1944.
- DANNE, HAROLD A. *The Life Energy of Species*. Illustrated. Pp. 27. Harold A. Danne, Engineering Laboratories, 131 West 98th Street, New York, N. Y. 1944.
- EMERY, W. L. *Ultra-High-Frequency Radio Engineering*. Illustrated. Pp. x + 295. The Macmillan Company. \$3.25. 1944.
- FRANKLIN, PHILIP. *Methods of Advanced Calculus*. Illustrated. Pp. xii + 486. McGraw-Hill Book Company. \$4.50. 1944.
- ROSS, HERBERT H. *The Caddis Flies, or Trichoptera of Illinois*. Illustrated. Pp. 326. Illinois Natural History Survey, Natural Resources Building, Urbana, Illinois. \$1.00. 1944.
- THORNE, P. C. L. and E. R. ROBERTS. *Inorganic Chemistry (Fritz Ephraim)*. Fourth edition. Illustrated. Pp. xii + 921. Nordeman Publishing Company. \$8.75. 1944.



1944 BOOKS IN *Chemistry*

ORGANIC SYNTHESSES—Vol. 24

NATHAN L. DRAKE, *Editor-in-chief.*

Covering the procedures developed in the past year, this latest in the series of annual volumes gives the most convenient laboratory methods for preparing various organic chemical reagents in one-half-pound to five-pound lots. *August.*

119 pages; 6 by 9; \$2.00

EXERCISES IN SECOND YEAR CHEMISTRY

By WILLIAM H. CHAPIN, *Emeritus Professor of Chemistry*; WERNER H. BROMUND, *Assistant Professor of Chemistry*; LUKE E. STEINER, *Professor of Chemistry*; all at Oberlin College.

An extensively revised edition, with more emphasis on methods of calculation applied in the mathematical treatment of fundamental theory. Much new material has been added, and there is more detailed discussion of theoretical background and the procedures involved. *March.*

Fourth Edition; 216 pages; 8½ by 10½; \$3.00

THE CHEMISTRY OF CELLULOSE

By EMIL HEUSER, *The Institute of Paper Chemistry.*

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624 pages; 5½ by 8½; \$7.50

PROTECTIVE AND DECORATIVE COATINGS—Vol. IV

Edited by JOSEPH J. MATTIELLO, *Vice President and Technical Director, Hilo Varnish Corporation.*

This fourth volume of a five-volume treatise on all phases of the paint and varnish industry covers special studies: wetting and grinding principles, properties of the manufactured product, microscopy, emulsions, high-vacuum technology, ultraviolet absorption. *February.*

419 pages; 6 by 9; \$5.00

QUANTUM CHEMISTRY

By HENRY EYRING, *Professor of Chemistry, Princeton University*; JOHN WALTER, *Instructor in Physics, Princeton University*; GEORGE E. KIMBALL, *Assistant Professor of Chemistry, Columbia University.*

This book goes beyond the material usually offered in introductory books in quantum mechanics. It includes treatments of the theory of reaction rates, optical activity, molecular structure, spectroscopy, and group theory. *January.*

394 pages; 5½ by 8½; \$5.00

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By W. A. KOEHLER, *Professor of Chemical and Ceramic Engineering, West Virginia University.*

Volume II of "Principles and Applications of Electrochemistry" (Volume I, "Principles," by H. Jermain Creighton). Includes new data on certain types of storage battery, chlorine caustic cells, magnesium from sea water, new types of furnace, electroplating, and other important matters. *January.*

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By CHESTER M. SUTER, *Director of Chemical Research, Winthrop Chemical Company.*

A comprehensive and thorough treatment. The book considers practical values of compounds, as well as their chemical properties. Methods of preparation, general properties, common reactions and derivatives are given. *January.*

858 pages; 5½ by 8½; \$10.00

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By HORACE G. DEMING, *Professor of Chemistry, University of Nebraska.*

An elementary survey, giving a clear presentation of principles, and an accurate summary of the chief chemical industries and outstanding industrial materials. Includes recently developed aspects of the science. *January.*

Second Edition; 706 pages; 5½ by 8½; \$3.75

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