

Frank Horton by R. Whiddington, G. B. Jeffry by E. C. Titchmarsh, Irving Langmuir by Hugh Taylor, W. C. M. Lewis by C. E. H. Bawn, F. E. Simon by N. Kurti, and F. C. M. Störmer by S. Chapman. All these men made notable contributions to experimental and theoretical physics and chemistry and several of them, notably Hartree and Simon, had close associations with American scientists and made frequent visits to the United States. Langmuir, our own distinguished scientist, was of course a foreign member of the Royal Society, as was also Störmer, whose mathematical researches on the aurora made him internationally famous.

Each article is accompanied by a photograph of the subject, though unfortunately in most cases not dated. Some may find it of interest to note that the average age at death of the individuals described was 76 and that only four were under 65 when they died. What this proves about science as a healthy occupation must be left to the experts.

Stellar Populations: Conf. Proc. (Pontifical Academy of Science & the Vatican, May 1957). Edited by D. J. K. O'Connell, S.J. 544 pp. (North-Holland, Holland) Interscience Publishers, Inc., New York, 1958. \$10.00. Reviewed by E. J. Öpik, *Armagh Observatory, N. Ireland and University of Maryland.*

THE introductory section, with organizational and historical details, contains as its central part an address by His Holiness the Pope, outlining the astronomical and physical problems of stellar populations and evolution with their philosophical background. The address, delivered in French and provided with an English translation, constitutes a competent and stimulating setting of the subjects to be discussed by the conference.

The proceedings are presented in eight chapters, each consisting of several formal papers followed immediately by a discussion: I—Galaxies and their Stellar Populations; II—Star Clusters of Our Galaxy as Representatives of Stellar Populations; III—Young Population I Stars in the Spiral Arms of Our Galaxy; IV—Physical Variable Stars and Stellar Populations; V—Stellar Evolution and Element Abundances; VI—Stellar Populations in Our Own Galaxy; VII—Population Groups and Kinematic Behaviour in Our Galaxy; VIII—Summary of the Discussions (prepared by F. Hoyle and J. H. Oort). There are altogether 34 papers, presented by W. Baade (3), J. H. Oort (3), B. Lindblad (2), A. Sandage (4), A. D. Thackeray (2), D. J. K. O'Connell (1), A. Blaauw (2), G. H. Herbig (1), J. J. Nassau (2), M. Schwarzschild (1), F. Hoyle (4), E. E. Salpeter (1), B. Strömberg (2), W. A. Fowler (1), W. W. Morgan (2), D. Chalange (1), L. Spitzer (1), and G. Lemaître (1). They represent a most authoritative and complete review of the present-day state of our knowledge of the facts and causes of stellar evolution. Remarkable is the degree of agreement reached by this gathering in the interpretation

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of the difficult problems involved; this, undoubtedly, is a sign that a reliable basis for the understanding of stellar evolution now exists.

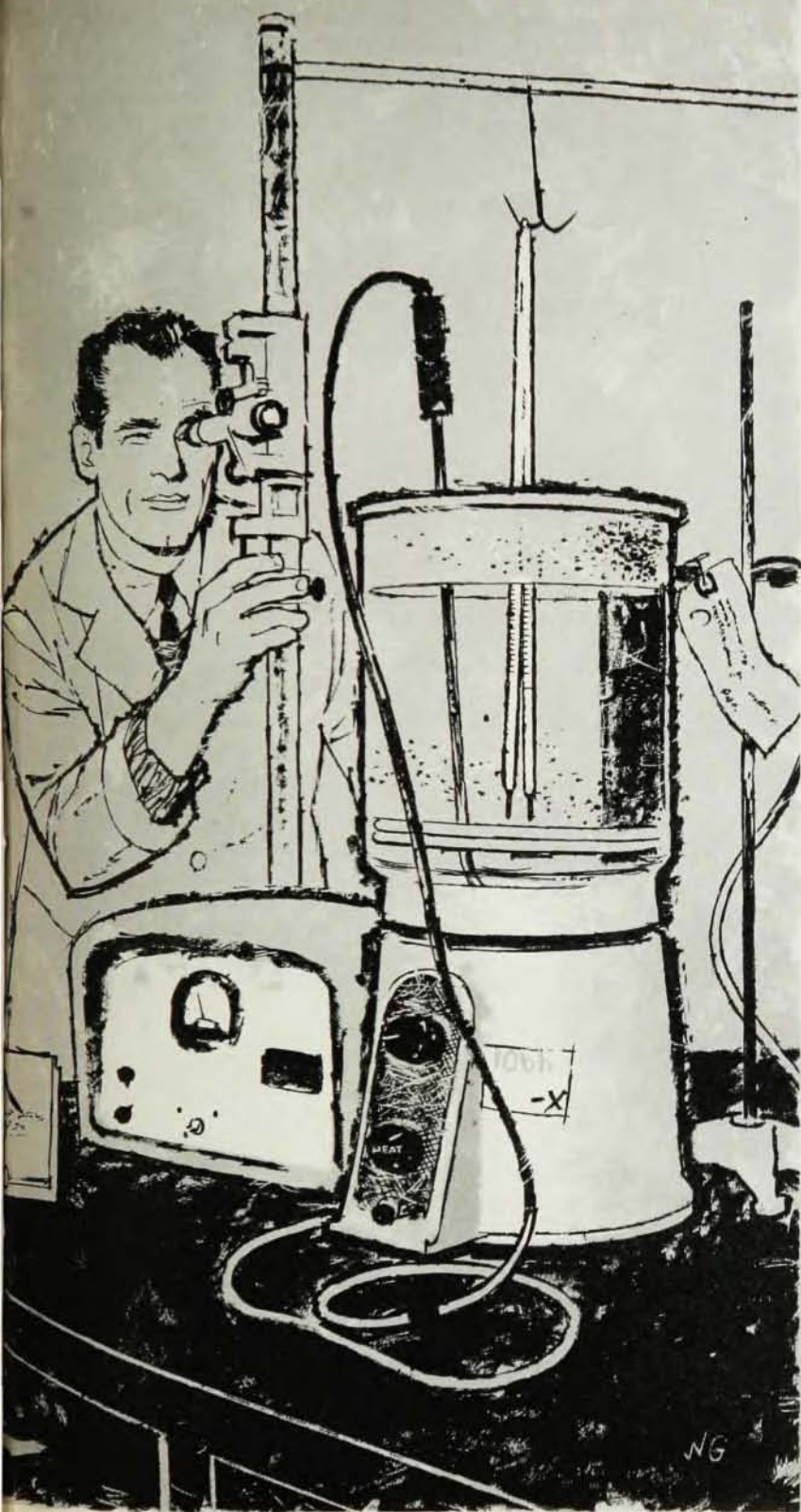
Three major developments occurred on the road to this understanding.

The first stems from the discovery by Shapley around 1915 of the difference between the stellar populations of globular clusters and our galactic surroundings. This was elaborated by Baade who, in 1943, from a study of the stellar contents of the Andromeda Nebula and its companion galaxies, concluded that two types of population exist: a "young" Population I, prominent in our surroundings, now known to be connected with the diffuse matter of the spiral arms of galaxies from which stars are continually born; and an "old" Population II, characteristic of the globular clusters where diffuse matter is absent, and where no new stars are formed.

The second development comes from the realization that the main source of stellar energy consists in thermonuclear reactions, leading to the conversion of hydrogen into helium. Following the work of Atkinson, Houtermans, Gamow, von Weizsäcker, and Bethe, by 1938 the laws of energy generation were sufficiently known to be applied to the study of stellar structure.

The third followed from the theoretical study of the structure and evolution of unmixed stars, initiated in 1938 by the reviewer; great advances were made recently by M. Schwarzschild and his co-workers, also by F. Hoyle, and others. Contrary to the naïve conception of old, of stars "cooling" with time and contracting, the theory indicates the expansion of a dwarf star into a giant which then, apparently, loses mass gradually or in explosion and ends as a superdense white dwarf. The explanation of the structure of giant stars is one of the triumphs of theoretical astrophysics. There is also no need in postulating energy sources other than thermonuclear reactions and gravitation. Annihilation of matter by, say, proton-antiproton reactions, formerly advocated to explain the longevity of supergiants, is not indicated; the supergiants are not long-lived and, for their short lifetimes of the order of millions or tens of millions of years, are well served by the conventional sources of energy.

Less clear is the question of the origin of the "metals", i.e., of the elements heavier than helium. At the conference the prevailing idea was that of an originally hydrogenic material, gradually enriched by the heavier elements, built up in stellar interiors and injected into the interstellar medium through supernova explosions or similar events. In that case the metal content of the interstellar medium would increase with time, and young stars, or those of Population I, should contain a greater percentage of the heavier elements than the old stars of Population II. In general this is confirmed by observation but there are notable exceptions, such as the old galactic cluster M67 with a normally high metal content. The metal content seems to be in better correlation with velocity than with age, high-velocity objects, including the globular clusters,



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being poor in metals. In the reviewer's opinion, this can be accounted for by laying the emphasis on the place of origin: the metals of the interstellar gas condense into dust which, for purely mechanical reasons, concentrates near the galactic plane, leaving almost pure hydrogen and helium gas in the galactic corona. Objects which condensed from the corona are poor in metals and, for dynamical reasons, have high velocities. The low-velocity objects from the galactic disc and spiral arms absorb much of the dust and are rich in metals. In such a case there may have existed a considerable metal content in the galaxy at the very beginning.

These, and related problems are discussed in the book by foremost experts in the observational and theoretical field. The book is indispensable to all students of stellar evolution, stellar structure, the origin of the elements, and the origin of the galaxies.

Books Received

- APPLICATIONS OF FINITE GROUPS. By J. S. Lomont. 346 pp. Academic Press Inc., New York, 1959. \$11.00.
- THE DETERMINATION OF MOLECULAR STRUCTURE. By P. J. Wheatley. 263 pp. Oxford U. Press, New York, 1959. \$5.60.
- THE EARTH: its Origin, History and Physical Constitution (4th Revised Ed.). By Sir Harold Jeffreys. 420 pp. Cambridge U. Press, New York, 1959. \$13.50.
- PRINCIPLES OF COLLEGE PHYSICS. By George Shortley and Dudley Williams. 913 pp. Prentice-Hall, Inc., Englewood Cliffs, N. J., 1959. \$9.00.
- ANALYSIS OF STRAIGHT-LINE DATA. By Forman S. Acton. 267 pp. John Wiley & Sons, Inc., New York, 1959. \$9.00.
- THE PHYSICAL SCIENCES (4th Revised Ed.). By E. J. Cable, R. W. Getchell, W. H. Kadesch, W. J. Poppy, H. E. Crull. 553 pp. Prentice-Hall, Inc., Englewood Cliffs, N. J., 1959. \$6.95.
- STANDARD X-RAY DIFFRACTION POWDER PATTERNS, Vol. 8, Apr. 1959. By H. E. Swanson, N. T. Gilfrich, M. I. Cook, R. Stinchfield, P. C. Parks. 76 pp. NBS Circular 539. US Govt. Printing Office, Washington, D. C., 1959. Paperbound \$45.
- A NEW METHOD IN THE THEORY OF SUPERCONDUCTIVITY. By N. N. Bogoliubov, V. V. Tolmachev, D. V. Shirkov. Translated from Russian. 121 pp. Consultants Bureau, Inc., New York, 1959. \$5.75.
- A SUPPLEMENT TO "HELIUM". By E. M. Lifshits and E. L. Andronikashvili. Translated from Russian. 167 pp. Consultants Bureau, Inc., New York, 1959. \$7.50.
- THE STRUCTURE OF ELECTROLYTIC SOLUTIONS: Based on Electrochem. Soc.-NSF Symp. (Washington, D. C., May 1957). Edited by Walter J. Hamer. 441 pp. John Wiley & Sons, Inc., New York, 1959. \$18.50.
- BIOGRAPHICAL MEMOIRS of the US National Academy of Sciences, Vol. 33. 484 pp. Published for NAS by Columbia U. Press, New York, 1959. \$5.00.
- THEORIE DER STABILITÄT EINER BEWEGUNG. By Joel G. Malkin. Translated from Russian into German by W. Hahn and R. Reissig. 402 pp. R. Oldenbourg, Munich, Germany, 1959. DM 47.00.
- THERMODYNAMICS. By Gordon J. Van Wylen. 567 pp. John Wiley & Sons, Inc., New York, 1959. \$7.95.
- THE PHYSICS OF ELECTRICITY AND MAGNETISM. By William Taussig Scott. 635 pp. John Wiley & Sons, Inc., New York, 1959. \$8.75.
- ILLUSTRATED GUIDE TO U. S. MISSILES AND ROCKETS. By Stanley Ulanoff. 128 pp. Doubleday & Co., Inc., Garden City, N. Y., 1959. \$3.95.
- GENETICS, RADIOBIOLOGY AND RADIOLOGY: Proc. of Mid-Western Conf. (May 1958). Edited by Wendell G. Scott and Titus Evans. 149 pp. Charles C Thomas, Springfield, Ill., 1959. \$5.50.
- ASTRONOMY. By Theodore G. Mehlin. 392 pp. John Wiley & Sons, Inc., New York, 1959. \$7.95.
- GROUP THEORY: and its Application to the Quantum Mechanics of Atomic Spectra (Revised Ed.). By Eugene P. Wigner. Translated from German by J. J. Griffin. 372 pp. Academic Press Inc., New York, 1959. \$8.80.
- GENERAL CIRCUIT THEORY. By Gordon Newstead. 144 pp. (Methuen, England) John Wiley & Sons, Inc., New York, 1959. \$3.00.
- INTERACTIONS NUCLÉAIRES AUX BASSES ÉNERGIES ET STRUCTURE DES NOYAUX: Proc. Internat'l Cong. of Nuclear Physics (Paris, July 1958). Edited by Mrs. P. Gugenberger. 950 pp. Dunod, Paris, France, 1959. 9500 fr.
- LINEAR NETWORK ANALYSIS. By Sundaram Seshu and Norman Balabanian. 571 pp. John Wiley & Sons, Inc., New York, 1959. \$11.75.
- COLLEGE PHYSICS. By Franklin Miller, Jr. 608 pp. Harcourt, Brace and Co., New York, 1959. \$7.25.
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- MOLECULAR SCIENCE AND MOLECULAR ENGINEERING. By Arthur R. von Hippel, et al. 446 pp. The Technology Press of MIT & John Wiley & Sons, Inc., New York, 1959. \$18.50.
- VECTOR SPACE AND ITS APPLICATION IN CRYSTAL-STRUCTURE INVESTIGATION. By Martin J. Buerger. 347 pp. John Wiley & Sons, Inc., New York, 1959. \$12.00.
- ANALYTICAL TRANSIENTS. By T. C. Gordon Wagner. 202 pp. John Wiley & Sons, Inc., New York, 1959. \$8.75.
- THE NUCLEAR OPTICAL MODEL: Internat'l Conf. Proc. (Fla. State U., Mar. 1959). Edited by Alex E. S. Green, Charles E. Porter, Davis S. Saxon. 277 pp. Fla. State U. Studies No. 32. The Florida State U., Tallahassee, 1959. Paperbound \$1.00.
- MR. WIZARD'S EXPERIMENTS FOR YOUNG SCIENTISTS. By Don Herbert. 187 pp. Doubleday & Co., Inc., Garden City, N. Y., 1959. \$2.95.
- METHODS OF EXPERIMENTAL PHYSICS. L. Marton, Editor-in-Chief. Vol. 1, *Classical Methods*, edited by Immanuel Esterman. 596 pp. Academic Press Inc., New York, 1959. \$12.80.
- A STUDY OF THE TEACHING OF PHYSICS BY FILM AND TELEVISION: An AAPT-AIP Evaluation Program (1957-58). By Grant O. Gale. 125 pp. American Inst. of Physics, New York, 1958. Paperbound single copies (limited no. available) no charge; multiple copies \$3.00 each.