

A chapter from the history of science

THE QUEST FOR ABSOLUTE ZERO: The Meaning of Low Temperature Physics. By K. Mendelssohn. 254 pp. McGraw-Hill, New York, 1966. Paper \$2.45

by Martin E. Straumanis

The aim of this series is to provide authoritative introductory books for university students that may also be of interest to the general reader. The book of Kurt Mendelssohn of the Clarendon Laboratory, Oxford, England, admirably fulfills this aim. The author is a recognized authority in low-temperature physics: He worked with Walther Nernst in Berlin and also studied under Max Planck, Albert Einstein and Erwin Schrödinger.

The book shows us not only how lower and lower temperatures were gradually reached but also, as it states in the subtitle, the effect of low temperatures on other phenomena.

The book is nearly completely unmathematical. (For advanced readers Mendelssohn wrote other books, among which is *Cryophysics*, Interscience Publishers, 1960.) It does not contain references but instead lists recommended books at the end.

The Quest etc. starts with Christmas Eve 1877 at the Academy of Sciences in Paris, with Louis Cailletet reporting results of his experiments on liquefaction of acetylene. However, Cailletet's article hardly had been read when it was announced that two days earlier, on 22 December, the Academy had received a telegram from Raoul Pictet (Geneva) that he had liquefied oxygen under 320 atmospheres and 140° of cold, the latter obtained by a combined use of sulfurous and carbonic acids. Thus a new branch of physics, cryophysics, was born although cooling machines were patented by Werner Siemens (Germany) as early as 1857. Priority problems are discussed and the principles of heat removal are given.

The story switches to the old capital of Poland—Cracow—where S. F. Wroblewski and Carol Olszewski worked on condensation of oxygen and hydrogen. In connection with these matters the author discusses the van der Waals equation and various other problems

of low-temperature physics, for example, the use of the Joule-Thomson effect in construction of cooling machines (Hampson-Linde, 1895) that substitute for the aforementioned Siemens expansion engine.

Production of solid and liquid hydrogen by Dewar and his attempts to liquify helium are described in the next chapter, "London 1898." Many details regarding low temperature work can be found, including the invention of the Dewar vessel and the quarrels with W. Hampson and William Ramsey. The author writes that Dewar's rule in his own laboratory was as absolute as that of Pharaoh, and he showed deference to no one except the ghost of Faraday whom he met occasionally at night in a gallery behind the lecture room (p. 73). However in his experiments to liquify helium, Dewar reached an estimated temperature of 9°K.

Still lower temperatures were attained by H. Kamerlingh Onnes in Leiden (1908). Mendelssohn describes in detail the liquefaction of helium as well as the discovery of superconductivity. The lowest temperature attained was 0.83°K (in 1922).

The next three chapters (the third law, quantization and indeterminacy) are the most interesting in the whole book. And that is understandable because the author worked in Walther Nernst's laboratory in which the third law of thermodynamics originated. Hence he discusses the Nernst theorem, free energy, entropy, decrease of specific heat with temperature, the rule of Louis Dulong and Alexis T. Petit, thermal energy, zero-point energy, characteristic temperature and electric conductivity of metals. Thereby the experimental facts together with the theoretical explanations are given with the great ideas and principles developed by L. Boltzmann, Nernst, Planck, Einstein, Niels Bohr, Louis de Broglie, Max Born, Werner Heisenberg, Schrödinger, A. Sommerfeld and W. Pauli.

The next chapter, "Magnetic Cooling," tells about a proposal made by William F. Giauque and Peter Debye, and how the idea was realized by the former. Finally a temperature as low as 0.00016°K was reached by Francis Simon at Oxford in 1956. The problem of measurement of very

low temperatures is also mentioned.

The last two chapters are devoted to superconductivity (Kamerlingh Onnes) and superfluidity (Peter Kapitza, Moscow). Again not only the experimental facts are mentioned but also the theoretical explanations (on the basis of Fritz London's electrodynamics, A. A. Abrikosov's and Lev D. Landau's theories).

The book is well written, is easy to read and covers the subject well. Therefore it can be recommended to students and even to teachers who wish to make their respective courses more interesting and to give a physical interpretation of the constants of the equations. The book contains 45 two-color diagrams and 22 photographs.

* * *

The reviewer is professor of Metallurgical Engineering at the University of Missouri at Rolla and works on precision lattice-constant determination at low temperatures (down to 40°K and below).

