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M Meetings

Temperature Symposium

Temperature ranks as one of the important physical quantities, and its measurement and understanding have provided some of the most difficult and challenging problems, both experimental and theoretical, in the field of physics. An international symposium on "Temperature, Its Concept and Measurement" was held in Washington, D. C., on October 28, 29, and 30, 1954, to review the present status of such problems. This was the third temperature symposium, the first having been held in Chicago in 1919. The second temperature symposium, which was sponsored by the American Institute of Physics, was held in New York City in 1939. It covered a very wide range of topics, and its proceedings were published under the title, *Temperature, Its Measurement and Control in Science and Industry*, Reinhold, New York (1941).

It was felt that the time had come to review and summarize the developments which had taken place since 1939, with the emphasis to be placed on the fundamental concepts of temperature and its measurement. The meeting was sponsored jointly by the American Institute of Physics, the National Bureau of Standards, and the Office of Ordnance Research, Department of the Army, and the sessions were held at the National Bureau of Standards. More than 400 registrants attended the five half-day sessions to hear 25 invited papers on various aspects of problems in thermometry.

A. V. Astin, Director of the National Bureau of Standards, reported, in his introductory remarks which opened the symposium, on the action taken in October 1954 by the Tenth General Conference on Weights and Measures to redefine the absolute temperature scale. The General Conference adopted the proposal which had been made originally by Kelvin in 1854, and re-introduced by Giauque in 1939, to define the absolute scale of temperature on the basis of a single fixed point; this point is to be the triple point of water, to which is assigned the value 273.16°K, exactly.

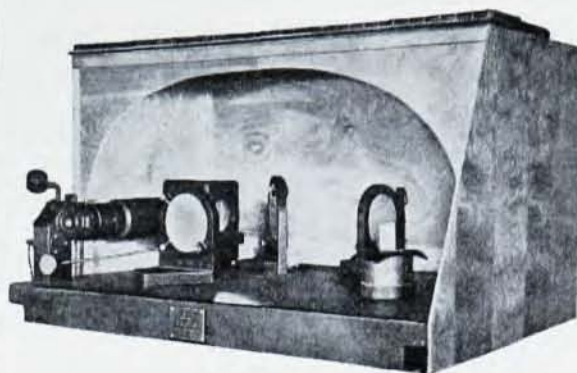
The opening session of the symposium, with M. W. Zemansky (City College of New York) as chairman, was devoted to discussions of the general concepts of temperature. H. C. Wolfe (Cooper Union) surveyed the general concept of temperature as applied to systems in equilibrium, and outlined the procedure for establishing a temperature scale. He also pointed out the limitations to the general concept which arise in attempting to deal with nonequilibrium systems. Some special cases were treated in greater detail by F. E.

Simon (Oxford University) who discussed the concept of temperature near absolute zero; G. H. Dieke (Johns Hopkins University) who outlined the procedures and difficulties involved in measuring high temperatures in gases; and, C. H. Payne-Gaposchkin (Harvard University) who presented a survey of the latest measurements of stellar temperatures. In a later session on transient phenomena, a group of papers were presented on the theoretical aspects of the temperature concept under nonequilibrium conditions and on the approach to equilibrium. The speakers for that session were I. Prigogine (Université Libre de Bruxelles), K. F. Herzfeld (Catholic University of America), and J. G. Kirkwood (Yale University).

The experimental aspects of temperature measurement were emphasized in three of the sessions. In a session entitled "Standards and Scales", with F. G. Brickwedde (National Bureau of Standards) as chairman, there were discussions of the current status of the International Temperature Scale (ITS) and of the thermodynamic temperature measurements. J. A. Beattie (Massachusetts Institute of Technology) reviewed the nature of the problems involved in precision gas thermometry. H. Moser (Physikalisch-Technische Bundesanstalt, Braunschweig) described recent measurements made in his laboratory with a new type of gas thermometer on the thermodynamic temperature of the gold point. No determinations of the gold point temperature have been reported since the work of Day and Sosman in 1911. Moser reported that his preliminary determinations give values in essential agreement with the accepted value 1063°C . The maintenance of the ITS and the methods of precision thermometry at some of the national standardizing laboratories were described by J. A. Hall (National Physical Laboratory, Teddington) and H. F. Stimson (NBS). H. Preston-Thomas (National Research Council, Ottawa) reported on measurements of the stability of the freezing point of zinc, which has been suggested to replace the sulfur boiling point as a fixed point of the ITS.

At temperatures below that of the oxygen boiling point (about 90°K) there is no internationally accepted "practical" scale, that is, a scale that is realizable by thermometers more convenient than the gas thermometer but which is based on primary calibrations with the gas thermometer. The status of those scales which are in use was discussed by R. B. Scott (NBS, Boulder) for the range 90° to 5°K , and by R. P. Hudson (NBS) for the range 5° to 1°K .

In a session devoted to experimental measurements, with P. E. Klopsteg (National Science Foundation) as chairman, a wide variety of topics were discussed relating to methods which are used for temperature measurement at the extremes of low and high temperature. Included were papers by D. de Klerk (Kamerlingh Onnes Laboratory, Leiden) on methods applicable to the range 0.001° to 1°K , and by H. van Dijk (Leiden) on magnetic methods for temperatures above 1°K . In the high temperature range H. P. Broida (NBS) presented a survey of methods for temperature



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measurement in flames and hot gases, with particular emphasis on methods involving the measurement of radiant energy. W. Lochte-Holtgreven (Kiel University) described experiments performed in his laboratory on high current electric arcs in which temperatures as high as 50 000°K were determined from measurements on the degree of ionization in the arc.

Following the papers on the measurement of extreme temperatures, H. J. Hoge (Leeds and Northrup Company) described the procedures in use in industrial temperature measurement. The possibilities of using superconductors and semiconductors as thermometers were discussed by J. G. Daunt (Ohio State University) and S. A. Friedberg (Carnegie Institute of Technology). A new thermometer based on the temperature dependence of sound velocity in a gas was described by D. R. Pardue and A. L. Hedrich (Diamond Ordnance Fuze Laboratories).

The final session of the symposium was devoted to the discussion of a number of special topics including measurements of temperature in shock waves, A. R. Kantrowitz (Cornell University); in atomic explosions, F. G. Brickwedde (NBS); and in the upper atmosphere, H. E. Newell, Jr. (Naval Research Laboratory).

The success of the symposium was attested to not only by the large attendance, but also by the lively discussions on topics covering the range from millidegrees to megadeegrees. Publication of the symposium proceedings is being arranged by the American Institute of Physics. The book is expected to be published by the Reinhold Publishing Corporation by the fall of 1955, under the editorship of H. C. Wolfe of Cooper Union.

Arnold M. Bass

National Bureau of Standards

Ferrimagnetism

A Conference on Ferrimagnetism was held at the Naval Ordnance Laboratory, White Oak, Maryland, on the 11th and 12th of October, 1954. Ferrimagnetism is L. Néel's word for the type of ferromagnetism which occurs in certain oxides of the iron group elements, notably those of spinel structure—the "ferrites". In these substances the magnetic moments of the ions are not lined up parallel, as in iron, but have some kind of ordered antiparallel structure which, however, usually does not have equal numbers or sizes of moments pointing in the two directions, so that there is a net magnetic moment. In the special case where exact compensation of the moments occurs, we have the related phenomenon of antiferromagnetism.

The ferrites, of which a variety can be conveniently produced in ceramic form, have a large and growing practical importance, primarily based on their high resistance, which makes high-frequency applications possible. However, the emphasis at this conference was not on devices and materials for practical use but on the basic physics and chemistry of the materials.

If there was a central theme of the conference it was this: the broad outlines of Néel's theories of ferri-