A History of Thermal Analysis

PLATINUM IN THE MEASUREMENT OF HIGH TEMPERATURES

For thousands of years man has been slowly learning how to regulate fire to yield the degree of heat required for individual purposes. No method of temperature measurement was available to him, however, until early in the seventeenth century and then only up to about 300°C, and the measurement of higher temperatures had to await the discovery and use of platinum.

In a Special Issue of *Thermochimica Acta* devoted to the history of thermal analysis Dr. R. C. Mackenzie, of the Macaulay Institute for Soil Research in Aberdeen, has presented two most interesting papers that together form a monumental and scholarly survey of the whole subject from the earliest times to the present day (1984, **73**, (3), 249–367).

The first of many applications of platinum in the measurement of higher temperatures was due to Guyton de Morveau who designed a pyrometer in 1803 that employed a platinum rod supported in a refractory groove with its free end in contact with the short arm of a bent lever, the longer arm serving as a pointer moving over a graduated scale, all made in platinum. Some years later, in 1821, Professor J. F. Daniell, of King's College, London, devised an improved form that overcame the deficiencies of de Morveau's instrument and in which the temperature was determined by the difference in expansion of a platinum rod and an earthenware tube.

Neither of these instruments was capable of measuring really high temperatures, nor were they of appreciable accuracy. A discovery was now made, however, as Dr. Mackenzie clearly brings out, that was to lead to one of the two reliable and accurate methods of temperature measurement that are still in extensive use in both the manufacturing industry and scientific research. It was in Berlin in 1821 that Thomas Johann Seebeck described the deflection of a magnetic needle caused by the electric current generated when one of the junctions of two dissimilar metals was heated. While it did not occur to Seebeck to make use of his discovery for the measurement of temperature, this invaluable effect was employed five years later by Antoine César Becquerel who decided that the most suitable combination of metals was a circuit consisting of platinum and palladium. With this combination he was able to arrive at the determination of temperatures up to 1350°C by extrapolation.

An iron-platinum thermocouple was then used by Professor C. S. M. Pouillet of Paris, while Henri Regnault, making use of the same couple, found such irregularities that he roundly condemned the whole idea of the thermoelectric method, his troubles arising, of course, from the use of iron as one element. Later, in 1862, Becquerel's son Edmond, again using platinum and palladium "as these two metals are not altered by the action of heat", succeeded in rehabilitating the reputation of the thermocouple, but it was not until 1872 that Professor Peter Tait of Edinburgh, using platinum against iridium-platinum, devised a sound relationship between e.m.f. and temperature, so making possible the development of accurate pyrometry.

But the successful practical use of the thermocouple was mainly due to the work of Henri Le Chatelier, Professor of Metallurgy at the École des Mines in Paris, who in 1885 concluded that platinum against rhodium-platinum gave the most consistent results.

Dr. Mackenzie's fascinating account of the history of these and other developments, including the later work of Roberts-Austen and the concept of the platinum resistance thermometer proposed by Sir William Siemens in 1871, will be of immense interest to all physicists and metallurgists concerned in any way with the control and measurement of temperature. L.B.H.