Chirurgical Society—one, a research paper by Marshall Hall in early 1800s, two papers were presented to the Royal Medical and medical need for accurate measurement of temperature. In the detected without instruments and for centuries there was little as the centigrade scale, 373°C is the boiling point of water. freezing point of water and, as the units remain at the same intervals the Latin for “one hundred steps”. In 1848, Lord Kelvin proposed by the Swedish astronomer, Anders Celsius in 1742, with 0°C another Swede, Carl Linnaeus, suggested reversing this to make 0°C alcohol filled thermometer in 1709 and a mercury filled thermometer century1. Daniel Fahrenheit modified Galileo’s ideas to produce an instrument six inches long which in the medical literature. The instrument available was a 12 inch thermometer which was placed in the axilla and took 25 minutes to read – not really a practical measuring device. Dr. Thomas Clifford Albott, another Fellow of the Society, refined the thermometer in 1866, producing an instrument six inches long which could be read in five minutes. This, combined with a textbook by Wunderlich, Temperature in Diseases2, led to a gradual acceptance of temperature measurement in medicine.

William Squire, who, as a medical student, gave the first anaesthetic in London in 1846, was also one of the first to use these practical thermometers to make detailed observations of temperature fluctuations in man. Initially, the normal range of human temperature required investigating and he noted “Rise from a warm bed, dress in the cold air, or bathe in the coldest water and half a degree of Fahrenheit of temperature is gained; the days duties will before long demand another half degree; out-door exercise still more.”

Thus it will rarely happen that a temperature of 99 degrees, even in the axilla is not reached by noon”. Squire was an important early epidemiologist and used temperature measurements to conduct studies on infectious diseases such as croup, diphtheria, measles, rubella and whooping cough “...” [Dr Squire’s work] set others thinking and recording... It is not too much to say that our public health administrators owe him a debt of gratitude for providing material which has served over and over again to guide them in their practice”.

These developments in temperature measurement paralleled the development of anaesthesia and, as experience with anaesthesia grew in the late 1800s, there was increasing awareness that ether was hot in summer, infection remained a major problem and it was often difficult to determine the cause of postoperative fever. Stiffling summer operating conditions and three deaths from postoperative fever were discussed at a meeting of the Surgical Division of the New York Academy of Medicine in November 1900, which concluded that heatstroke was “a real and an important post-operative complication”. In 1946, Commander Mortimer Genauer summarised all the cases in the literature. He stated, “though each describes a different group of symptoms, clinicians discuss them together because all occur as a result of some imbalance of the heat-balancing mechanism”. It was some years later, in 1960, that malignant hyperthermia was first described as a separate disease entity.

Concomitant with this work on postoperative fever, in 1950 Bigelow and his colleagues began a series of papers which demonstrated the safety and usefulness of hypothermia for cardiac surgery. By 1959, hypothermia was employed extensively for cardiace surgery and a range of other surgical procedures, making temperature monitoring increasingly important for anaesthetists.

Several thermal sensing devices were available but none was simple or useful across all applications. The old mercury bulb thermometer was used conventionally but was not practicable as a monitor. The Marsh Vapor Tension Thermometer had a gas-filled reservoir gauge which served as the sensor and was connected to a calibrated gauge via a Bourdon tube and a series of gears. “Accuracy is within one-half degree Fahrenheit. The unit is rugged, compact, portable, and affords a simple and relatively inexpensive means of measuring deep body temperatures”. The sensing element of this device could be used in either the oesophagus or the rectum but it was relatively large and cumbersome and the connecting tubing was not long.

A variety of electronic devices were available but all had some physical limitations. Thermistors are small resistors with special characteristics; as the temperature of the thermistor changes the resistance varies inversely and is measured on a Wheatstone bridge circuit. This allows measurement of temperature over a large range. Thermistors were contained in red rubber catheters, easily sterilised and soft enough to be inserted into the oesophagus or rectum. The units were compact and robust but still fairly cumbersome. The McKesson Platinum Wire Thermometer also worked on a resistance concept and had a large flanged probe which worked well in the rectum but could not be inserted in the oesophagus.

There were also devices based on thermocouples, a junction of dissimilar metals in which an electric current is generated in direct proportion to temperature change. These devices were not straightforward. “The purchaser of a thermocouple unit must prepare his own thermocouples. Lead wire may be obtained in one hundred foot rolls, and leads up to thirty feet in length may be employed... Plastic intranasal or nasal oxygen tubing, one end of which is thermally sealed, makes an ideal insulator, and also aids inatraumatically inserting one or two leads together into the body orifices”.

By 1978 the hazards of inadvertent hypothermia and malignant hyperthermia were well recognised and it was known that early recognition of temperature aberrations reduced anaesthetic morbidity and mortality. Routine monitoring was recommended but electronic equipment remained fragile and expensive. It is only in recent years that cheap, disposable temperature probes have allowed routine monitoring of temperature in all operations of any significant duration.

References