for recording the time. The most familiar types of registering thermometers are modifications of the common liquid-in-glass thermometer.

John Rutherford’s maximum, invented before 1790, was an ordinary mercurial thermometer placed, horizontally; the column pushed before it a small steed index which was left, at the highest point reached and was drawn down again to the liquid by a magnet when the instrument had to be reset. It is, little, used now. Negretti and Zambra’s maximum has a constriction in the tube near the bulb, past which the mercury easily expands but cannot return when the temperature falls, since the column breaks at the narrowed point when the fluid in the bulb begins to contract. The instrument is set for a fresh observation by shaking the detached portion of the column back down the tube. The clinical thermo­meters used by physicians are instruments of this type, and are made with a very open scale to read only in the neighbourhood of the normal temperature of, the human body. In the Phillips orWalferdin maximum a portion of the mercury is separated from the rest by a minute bubble of air. It is placed horizontally and as the temperature rises the detached portion of the column is pushed forward but is not withdrawn when the main column retreats towards the bulb in cooling. , It is set for a new observa­tion by bringing it into a vertical position and tapping it slightly. By reducing the length of the, index and the bore of the stem this thermometer may be made suitable for use in any position without altering its register.

The minimum thermometer in most common use is that of Rutherford, invented in 1790. It is a spirit thermometer, pre­ferably filled with amyl alcohol, to reduce risk of distillation, in the column of which a small porcelain index is included. The instru­ment is hung horizontally, and, as the temperature falls, the index is drawn back through surface tension by the end of the column. When the temperature rises the liquid flows past the index, which is left at the lowest point attained. To prepare the instrument for a fresh observation it is inverted, when the index falls, back against the end of the column. James Six’s combined maximum and minimum thermometer *(Phil., Trans., 1782)* consists of, a U-tube, the bend of which is filled with mercury. One leg contains spirit above the mercury and terminates in a bulb, also full of spirit. The other leg also contains a column of spirit above the mercury, but terminates in a bulb containing air and vapour of spirit mixed. With increase of temperature the spirit in the full bulb expands; the mercury in consequence is pushed round the bend and rises to a greater or less extent in the other leg, carrying before it a steel index which thus marks the maximum tempera­ture. With cold the spirit in, the full bulb contracts, and the mercury moves back carrying with it a second index which marks the minimum temperature. The instrument is set by drawing down the two indices upon the two ends of the mercury column by means of a magnet.

With a mercury thermometer a continuous record of tempera­ture can only be, obtained by the aid of photography, a method which has been in use for many years at some first-class obser­vatories, but which cannot be generally employed on account of the expense and the elaborate nature of the apparatus required. The commonest type of recording thermometer works on the principle of the Bourdon pressure-gauge. The bulb consists of a curved metallic tube filled with liquid, the expansion of which with rise of temperature tends to straighten the tube. The movements are recorded on a revolving drum by, a pen carried at the end of a light lever attached to the bulb. This form of instrument is widely employed for rough work, but it has a very limited range and is unsuitable for accurate work on account of want of sensitiveness and of great liability to change of zero, owing to imperfect elas­ticity of the metal tube. For accurate work, especially at high temperatures, electrical thermometers possess many advantages, and are often the only instruments available. They are com­paratively free from change of zero over long periods, and the ther­mometer or pyrometer itself may be placed in a furnace or elsewhere at, a considerable distance from the recording apparatus. The principal types are the thermocouple and the platinum resistance thermometer already described, which may be employed for record­ing purposes, without altering the thermometer itself, by connexion to a suitable recording mechanism. The methods in use for record­ing the indications of electrical, thermometers may be classified as in § 24 under the two headings of (1) deflexion methods and (2) balance methods. Deflexion methods, in which the deflexion of the galvanometer is recorded, are more suitable for rough work, and balance methods for accurate measurements. The most delicate and most generally applicable method of recording the deflexions of a mirror galvanometer is by photographing the move­ments of the spot of light on a moving film. Almost any required scale or degree of sensitiveness may be obtained in this manner, but the record cannot be inspected at any time without removal and development. Since the forces actuating the needle of the galvanometer are very small, it is out of the question to attach a pen or marking point directly to the end of the pointer for record­ing a continuous trace on a revolving drum, because the errors due to friction with the recording sheet would be excessive. This difficulty has been avoided in many electrical instruments by depressing the pointer so as to mark the paper only at regular intervals of a minute or so, leaving it completely free for the greater part of the time. The record thus obtained is discontinuous, but is sufficient for many purposes. For, accurate measurement, or for obtaining an open scale over a particular range of temperature, it is necessary to employ some form of balance method as already explained in § 24.

36. *Electric Recorder, Balance Method.—*The application of the electric balance, potentiometer or Wheatstone-bridge for recording changes of resistance or electromotive force has been effected by employing a galvanometer of the movable coil type as a relay. The deflexion of the galvanometer to right or leit, according as the resistance or E.M,.F. increases or diminishes, is made to actuate one or other of a pair of motors for moving the contact point on the bridge wire, and the recording pen on the drum in the corre­sponding direction. A continuous record free from friction error is thus obtained, since the galvanometer does not actuate the pen directly. With an electrical resistance thermometer it is possible in this way to obtain continuous pen-and-ink records on a scale of an inch or more to the degree, reading to ∙01° C. and practically free from zero error over any desired range from — 200° to +1500°C. With a thermocouple, employing the potentiometer method, the same apparatus can be used with advantage, but it is not possible to obtain so open a scale on account of the smallness of the thermo­electromotive force available.

The attainment of sufficient delicacy in the relay mechanism turns on the employment of a rotating or vibrating contact in combination with a moving coil galvanometer of the siphon­recorder type. This was first successfully effected by Callendar *(Trans. R. S. Canad.,* 1897) for records of radiation and tem­perature, and has since been applied to submarine telegraphy by S. G. Brown and by A. Muirhead. The mechanism of Callendar's electrical recorder, as arranged for temperature measurements, is described and illustrated in *Engineering,* May 26, 1899, and in a treatise on *Pyrometry* by Le Chatelier and Boudouard. Electrical recording instruments of both types are now coming into extensive use for industrial purposes in the measurement of furnace tempera­tures, &c., for which they are particularly suitable, because the recording apparatus can be, placed at any distance from the furnaces which may be considered most convenient, and can be connected to any one of a set of furnaces in succession whenever it is desired to obtain a record.

Authorities.—There is no special work on the subject of ther­mometry in English, but most of the principles and methods are described in text-books on heat, of which Preston’s *Theory of Heat* may be specially mentioned. For recent advances in ther­mometry the reader should consult the original papers, the most important of which have been cited. The greater part of the recent work on the subject will be found in the publications of the Bureau International des Poids et Mesures de Sèvres (Paris), of the Reichsanstalt (Berlin), of the Bureau of Standards, U.S.A. (Washington), and of the National Physical Laboratory (London). (H. L. C.)

**THERMOPYLAE (Gr.** *θepμós,* hot, and *πυλη,* gate), **a** Greek pass leading from Locris into Thessaly between Mount Oeta and the sea (Maliac Gulf). It is chiefly famous for the heroic defence made by Leonidas, the Spartan king, with 300 Spartan soldiers against the Persian army of Xerxes advancing upon Greece in 480 (see Leonidas and authorities there quoted). Two other famous battles took place at the pass. In 279 b.c. Brennus and the Gauls were checked for several months by a Greek army under the Athenian Calippus, and in 191 Antiochus of Syria vainly attempted to hold the pass against the Romans under M'. Acilius Glabrio. In the time of Leonidas the pass was a narrow track (probably about 14 yds. wide) under the cliff. In modem times the deposits of the Spercheius have widened it to a breadth of 1½ to 3 m. broad. The hot springs from which the pass derived its name still exist close to the foot of the hill. There is one large spring used as a bath and four smaller ones, and the water, which is of a bluish green colour and contains lime, salt, carbonic acid and sulphur, is said to produce good effects in cases of scrofula, sciatica and rheu­matism. The accommodation for bathers is, however, quite inadequate.

For the topography see Grundy, *Great Persian War,* pp. 277-291.

**THÉROIGNE DE MÉRICOURT, ANNE JOSÈPHE** (1762- 1817), a Frenchwoman who was a striking figure in the Revolu­tion, was born at Marcourt (from a corruption of which name she took her usual designation), a small town in Luxembourg, on the banks of the Ourthe, on the 13th of August 1762. She was the daughter of a well-to-do farmer, Peter Théroigne. She