X. Description of a thermometer which marks the greatest degrees of heat and cold, from one time of observation to another, and may also register its own height at every instant

Alex. Keith Esq. F.R.S. F.A.S. Edin.

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gard to dyeing wool and silk, in which it may be employed with success; and in giving an account of this difference, I think the cause of it may be found in the nature of the gall-nuts. 1. The acid which they exclusively contain, as Berthollet has proved, facilitates the decomposition of the soap with which the cottons have been impregnated, and the oil then remains fixed in their tissue, and in a greater quantity, as well as in a more intimate combination. 2. The gall-nuts, which owe their development to animal bodies, retain a character of animalisation, which they transmit to the vegetable stuff, and by these means augment its affinities with the colouring principle of the madder; for it is well known of what utility animal substances are to facilitate this combination. This animalisation becomes useless in operating upon woollen or silk.

X. *Description of a Thermometer which marks the greatest Degrees of Heat and Cold, from one Time of Observation to another, and may also register its own Height at every Instant.* By ALEX. KEITH, Esq. F.R.S. and F.A.S. Edin. From the Transactions of the Royal Society of Edinburgh, Vol. IV. 1798.

THERMOMETERS have hitherto been defective for meteorological purposes, in so far as they only point out the degree of heat at the moment of inspecting them, but do not show what the difference has been, from the time of one observation to another.

The ingenious Robert Hook, in the end of the last century, mentions his intention of making a thermometer for the above purpose; but it does not appear that it was ever executed: neither does he explain how it was to have been done.

The thermometer, invented by Mr. James Six, as described in the 72d volume of the Philosophical Transactions of the
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Royal Society of London, is made to shew its greatest rise or fall from one period of observation to another. This is done by means of two small pieces of black glass, which float on two different surfaces of mercury, within two glass tubes hermetically sealed. These floats, when raised to their greatest height, adhere to the sides of the tube, by means of a spring of glass, and become stationary, although the mercury falls. After the observer has noted the temperature, he, by a magnet held in his hand, draws down the float to the surface of the mercury, in consequence of a small bit of steel wire being enclosed in the float, and the instrument is prepared for another observation. This is an ingenious invention, but requires too delicate workmanship to be fit for common use: besides, it cannot be made to record the degrees of heat at intermediate periods.

The thermometer lately invented by Dr. Rutherford, of Balilish, and described in the 3d vol. of the Edinburgh Transactions, is also an ingenious contrivance, but has the same defect of marking only the extreme points to which the liquor has risen or fallen in two separate glass tubes.

Some years ago it occurred to me, that an air thermometer might be used for the purposes required; and accordingly I read to this society a description of the instrument. But having formed another instrument of a more simple construction, I beg leave to give a description of it.

AB, fig. 1. (Plate I.) is a tube about 14 inches long, and $\frac{3}{4}$ of an inch calibre, of thin glass, sealed or closed at top. To the bottom, which is bent upwards, there is joined a glass tube 7 inches long, and $\frac{1}{10}$ ths of an inch calibre, open at top. The tube AB is filled with alcohol, and from B to E is filled with mercury.—As liquids are incompressible by weight in any perceptible degree, neither the alcohol nor mercury will be affected by the weight of the atmosphere.

FD is a scale of brass or ivory, about $6\frac{1}{2}$ inches long, divided in the usual way. E is a small conical piece of ivory or glass, of a proper weight, made to float on the surface of the

Fig. 3.

Fig. 4.

Fig. 2.

Fig. 1.

Engraved by Lowry

the mercury in the smaller tube ; to which float is joined a wire, termed the float-wire, reaching to H, having a knee bent at a right angle, which raises one index, and depresses another, according as the mercury rises or falls. This part of the apparatus is defended from wind or rain by means of a glass tube $7\frac{1}{2}$ inches long, closed at top and open at bottom, so wide as to slide easily over the scale, and, by means of a brass rim cemented to it, made to fit exactly to the circular base of the scale. This cover need not be taken off, except when the instrument is to be prepared for an observation. [The operation of the float and indexes will be better understood from fig. 4, where a similar apparatus, but belonging to a newly invented barometer, is represented on a larger scale.]

F G is the scale fixed to a circular piece of wood or brass D, through which the small tube is made to pass. From G to F is a piece of the smallest gold wire stretched along the scale, fixed at the ends by two pins. L L are two indexes, formed of thin black oiled silk, pierced by the small wire in such a manner as to slide upwards and downwards with a very small force not more than two grains. H, the knee of the float-wire before described, is made to encompass the small wire between the two indexes, so that, when the float rises, the upper index is moved upwards, and, when it descends, it leaves the upper index stationary, and pushes down the lower one, which is also left stationary when the float rises. When the instrument is to be prepared for an observation, the one index is to be pulled down, and the other raised, by means of a bit of wire, bent for the purpose, until both of them touch the knee of the float-wire : and when it is again observed, the upper index will point out the greatest degree of heat, and the lower the greatest degree of cold, since the time they were set.

If this thermometer is to be adapted to a piece of clock-work, in order to record the degrees of heat at each hour and minute of time, it ought to be made of larger dimensions,

figs.

sions. The large tube may be 40 inches long, and not increased in diameter; but the small tube ought to be enlarged in diameter, and not in length. The alcohol will thus be affected by heat or cold in as short a time as that before described.

It is unnecessary to explain the clock-work. It is sufficient to say, that a hollow cylinder of any light substance, 7 inches long and 5 inches diameter, is made to revolve upon a vertical axis once in 31 days or a month; a piece of smooth vellum or paper is put round this cylinder, pasted only at the joining, but so as to make it adhere close to the cylinder: on this are drawn 31 equal perpendicular divisions, numbered at top, 1, 2, 3, &c. each of which is subdivided into six parts, to answer to 4 hours. The length of this cylinder is divided by lines surrounding it, or zones, in such number as to correspond to the scale of Fahrenheit's therm. viz. from 0 to 100°. These divisions ought to be engraved on copper, and a number of impressions thrown off on smooth or vellum paper, in order that one may be ready to put on each month.

MN, fig. 2. represents the cylinder covered with one of these impressions. PP is the scale fixed to the frame in which the cylinder turns. The divisions on this scale correspond to those on the cylinder.

Q is a piece of black lead pencil, joined to the end of the float-wire, in place of the knee before mentioned. This pencil is made to press lightly on the cylinder, by means of the small weight R. And as the pencil rises or falls by heat and cold, it marks the degrees on the scale of the cylinder; and the cylinder being constantly revolving, the division for each day and parts of a day will successively be marked by the pencil, which will leave a trace, describing an undulated line, distinctly delineating the temperature of each day through the month. These papers, when taken off and bound together, will make a complete register of the temperature for the year; or, if they are pasted to one another,
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in their order, they will form a thermometrical chart, by which the variations of heat and cold, during the year, may all be seen and compared by one glance of the eye.

By inspecting fig. 2. the effect of the instrument may be seen. It appears that the paper had been put on the cylinder the first day of the month, at midday, when the thermometer stood at 45° ; that it fell gradually till midnight to 25° ; thereafter it rose till the 2d, at 1 P. M. when it stood at 42° ; then it descended at midnight to 35° ; that on the 4th at noon it rose to 50 ; and at noon the 10th of the month it stands at 40° .

If 3 inches be added to the length of the cylinder, it may be made to delineate the variations of the barometer as well as the thermometer, and thereby to form a complete chart or view of the progress of both of them. And if instruments of this kind were kept in different parts of the country, and their charts compared together, it would afford much information with regard to meteorology.

XI. Description of a Barometer, which marks the Rise and Fall of the Mercury from two different Times of Observation; invented by ALEX. KEITH, Esq. F. R. S. and F. A. S. Edin. From the Transactions of the Royal Society of Edinburgh, Vol. IV. 1798.

ABCD, fig. 3. (Plate I.) is a glass tube bent in the manner represented, open at D, and hermetically sealed at A. From A to B is 8 inches long, and about $\frac{3}{4}$ of an inch calibre. From B to C $31\frac{1}{2}$ inches long, and about $\frac{1}{4}$ inch calibre. And from C to D $4\frac{1}{2}$ inches long, and $\frac{1}{2}$ inch calibre. The tube is filled with mercury, the length from A to E being $29\frac{1}{2}$ inches. When the tube is hung perpendicularly, the mercury will fall from B towards E, leaving a vacuum from A to B. When the atmosphere becomes heavier,