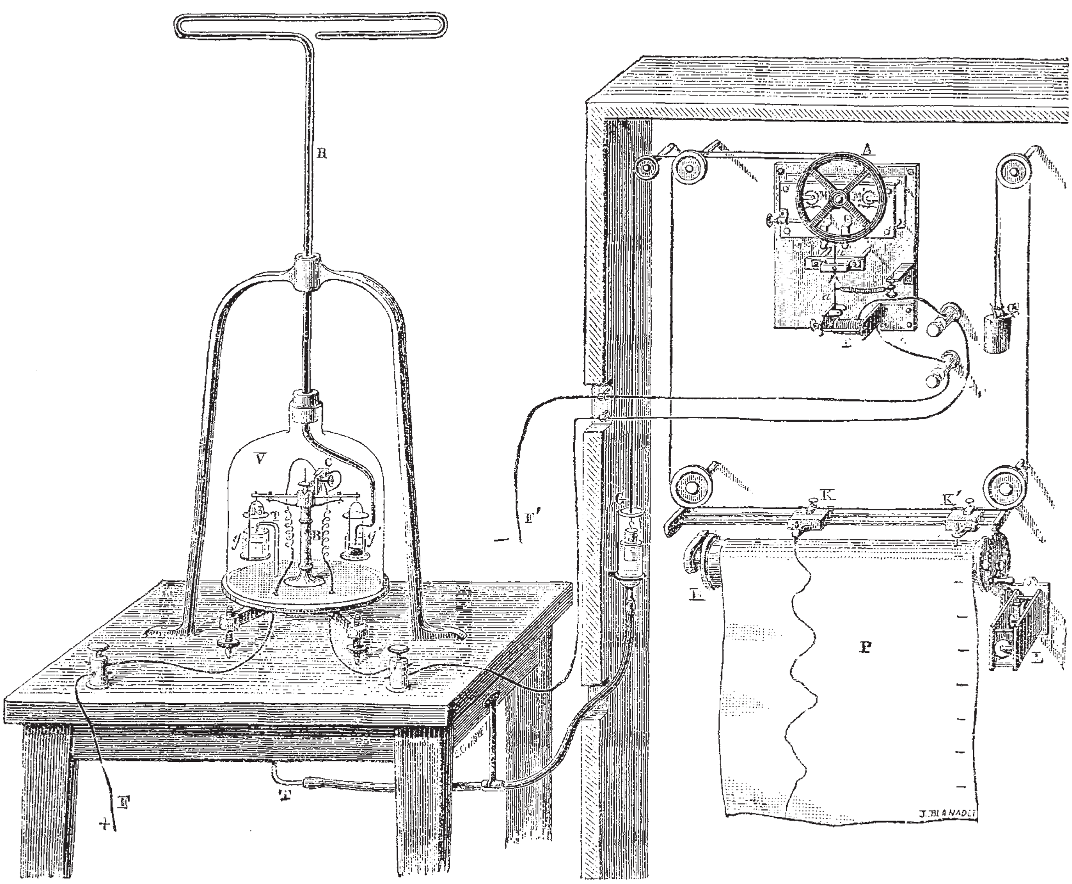
A NEW REGISTERING THERMOMETER[1]

THE registration of temperature is one of the most difficult of meteorological problems. Among the registering instruments employed the thermometer is certainly that to which most attention has been devoted, and yet no solution has hitherto given results altogether satisfactory. The extreme mobility of the temperature of the air and the small force at our disposal for acting upon the registering apparatus, are special hindrances to the solution of the problem. In England, in the various observatories, the photographic method is used. The reservoir of the thermometer is placed outside under cover, and the tube, entering the wall, is re-curved vertically in the interior; a photographic apparatus placed opposite this column of mercury registers the different heights. This process necessitates a thermometric reservoir of considerable volume in order that the displacements of the column of mercury may be appreciable for very small variations. These exigencies affect the sensitiveness of the apparatus; it is not a less serious inconvenience that the reservoir must be placed near the wall of the shelter where the self-recording photographic apparatus is arranged. In Switzerland the metallic thermometer is employed, and is more easily managed, but here again the metallic spiral must be placed very close to the registering apparatus.

The new registering thermometer which M. Hervé Mangon has sought to construct by utilising the differential wheelwork of M. Redier, seems to us based upon a sound principle. It consists of a mercurial thermometer with weights so arranged that the thermometer may



M. Hervé Mangon's New Registering Thermometer, constructed by M Redier.

be placed at such a distance from any dwelling as not to be subject to the influence of surrounding objects. Communication between the thermometer and the registering apparatus is established by means of electricity.

The instrument consists of two quite distinct parts:—1. The thermometer proper, and the balance which serves to indicate the differences of weight which are the result of variations of temperature. 2. The registering apparatus. The thermometer, the diameter of the mercurial column of which we have considerably amplified in our illustration, to render it appreciable, is composed of a very fine tube, R; it presents a large surface, containing in reality only a very thin column of mercury. This tube R is supported by a cast-iron frame-work, and is connected with a bell-glass V; its very slender extremity is plunged into a small cup g', containing mercury, and placed upon one of the scales of the balance B.

The balance B is an ordinary balance of precision; it bears above the beam a small metallic disc which determines a contact at C every time the equilibrium is broken in consequence of an increase of temperature. The second scale also bears a cup g, containing glycerine. A glass tube T T, connected with the registering apparatus, dips into this cup g, and communicates at its other extremity with another cup, G, which forms a vessel communicating with the former. The bell-glass V covers the balance, and permits the exposure, without danger, of that part of the instrument to the inclemencies of the air. It will be at once seen how to arrange things in order to put the instrument

[1] From an article in *La Nature* by M. Gaston Tissandier.

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in working order. After having fixed in its support the tube filled with mercury, and being assured that the fine extremity dips well into the cup *g′*, we place the balance in equilibrium by adding weights to the other scale. The bell-glass V, which has been raised for this operation, is then put in its place, and the instrument is ready for action.

The registering apparatus is composed of the double differential wheelwork of M. Rédier, which works as follows :—Two wheels M and M′ moving in opposite directions, are terminated by small flies, very delicate, and turning very swiftly ; they are connected by a differential train, the axis of which carries a pulley with a double groove A. Between the two flies oscillates a needle, one extremity of which serves to arrest alternately one of the two flies. At the other extremity *a*, of the needle, is a soft-iron pallet on which acts an electro-magnet E, every time contact is made by the balance at C. The needle is mounted on an axis which permits it to oscillate right or left according as it obeys the electro-magnet or a small antagonistic spring.

The double-grooved pulley A carries two threads the one attached to the pencil K and terminating in a weight O, the other bearing a small cylinder and plunging into the cup G containing glycerine and connected by a tube with the cup *g* placed on one of the scales of the balance. Of course the cups G and *g* must be placed in the same horizontal plane. A cylinder H, moved by the clockwork L, carries the paper. A second pencil K′ serves to trace upon the paper a small mark intended to control the progress of the wheel-work L. This mark may be made automatically by an electric contact proceeding from a regulator of precision.

Let us see now how things work. Suppose the temperature rises (the explanation which follows will account for the mode of action of the apparatus when the temperature falls), the weight of the mercury in the cup at *g′* will increase, the equilibrium will be destroyed, and the contact C of the balance will be established ; the electro-magnet E will attract the end *a* of the needle, and the fly of the wheel M′ will be free ; the pulley A will then turn to the left, the float will sink in the cup G, and the pencil will be directed towards K′. The float of the cup G, in descending, will raise the level of the liquid at G, and at *g*, and consequently will increase the weight in the scale of the balance which holds the cup *g*, and at the moment that equilibrium is thus again established, the contact at C will be broken. The end *a* of the needle ceasing to be attracted by the electro-magnet will respond to the appeal of the antagonistic spring, and disengage the other fly. This fly of the second wheel M disengaged, permits the pulley A to turn to the right, drawing the pencil from K′ to K, and causing the float of the cup G to reascend, and consequently diminishing the weight at *g*. That loss of weight breaks anew the equilibrium of the balance, the contact at C is re-established, and the same course is repeated as we have explained above.

It will be seen from what we have said that the clockwork is always in motion—now to the right, now to the left—even when the temperature does not vary ; the curve obtained has then the aspect of a small zigzag, but so fine that it is difficult to detect it. This arrangement permits, so to speak, the double wheel M M′ to test the balance for the slightest change in the conditions of equilibrium.

The tube T T connecting the two cups G and *g* may be placed underground, and the electrical communication between the balance and the electro-magnet E is easily established at any distance desired.

On the prolonged axis of the pulley A we may place a rigid needle, and indicate by a simple transmission the temperature on a large card placed outside.

This apparatus has been constructed in a thoroughly artistic manner by the able constructor, M. Redier.

NEW ELECTRIC LIGHTS

AN examination of the voluminous records of the Patent Office discloses the fact that the activity in a particular line of invention periodically waxes and wanes. After slumbering for a number of years the problem of procuring effective electrodes for the production of the luminous electric arc has of late been revived, and with a success hitherto unattained. The immediate cause of this has probably been the recent improvements of magneto-electric machines culminating in the Gramme and the Siemens machines. An efficient source of electricity for the production of the light having been supplied by these and other machines of a similar kind, a stimulus was given to the invention of electrodes or *wicks* which would employ the magneto-electric current to best advantage in giving out light. The old faults of the carbon points had never been quite overcome. The manufacture of the points from soft-wood charcoal, fine coke dust, lamp-black, calcined sugar, tar, resin, or mineral oil, &c., had done much to render their consumption steady and uniform ; and the regulators of Serrin and Dubosq had very successfully overcome the widening of the luminous arc by the wasting of the positive electrode. For large fixed lights with several sets of luminous points, such as are employed as beacon-lights on land or at sea, the ordinary carbon points thus improved answered very well, but for the purposes of general illumination they are still defective. To give a light suitable to a room or hall the points require to be small, and any inequalities in their action are very discernible in the light. One great difficulty to be overcome, too, is the division of the light. How to cause the current from a powerful magneto-electric machine to produce a number of separate small lights, such as would be essential for the lighting of streets or buildings ? If the different lights were all joined up "in circuit" and the currrent sent through the whole series one after another, the break-down of any one of the series would extinguish the whole and plunge the street or building into darkness.

During the last thirty years there have been many attempts made to secure good electrodes for the electric light as well as devices for adjusting them. Electrodes of spongy platinum, palladium, and iridium have been used. Another plan was to make the positive electrode a fine stream of mercury flowing from a funnel and breaking upon a negative electrode of carbon or platinum placed underneath. An objection to these metals was the coloured lights they produced owing to the incandescence of their vapours in the arc. The carbon electrodes were given divers shapes, and various combinations of carbon and metal electrodes suggested. For instance, it was proposed to use bar electrodes emitting the light from their sides, and also to fuse iridium between two carbon electrodes. An ingenious plan for getting a steady light was proposed by Mr. Harrison in 1857. It consisted in giving a rotary motion to the positive electrode and pointing the negative electrode at right-angles to it and giving the latter a motion of translation, so that fresh surface of the positive carbon was always appearing in front of the negative carbon. A similar idea was again patented in 1874 by Messrs. Wildman and Whitehouse. About twenty years ago there was a great deal of activity in this direction, but up till quite lately the usual carbon points have always been fallen back upon.

Within the last five years, however, two notable new lights have made their appearance, namely, the lights of Lodighin and of Jablochkoff. M. Alexandre Nicolævitch Lodighin is a Russian engineer of St. Petersburg. His plan was first publicly tried there in 1873, and patented in England in the previous year. It is designed to facilitate the use of the electric light for general lighting purposes. The great defect of the ordinary carbon points is the flickering of the light caused by the consumption