[Engineer.]

INSTRUMENT FOR MARKING ASTRONOMICAL TIME.

By E. K. HORN.

FIG. 1 represents simply a sliding vernier attached to a graduated scale, the vernier to be moved gently and regularly forwards and backwards by hand, in unison with the beat of a time-keeper vibrating seconds of time; then if the vernier be stopped at the signal of the observer it will mark the elapsed interval since the preceding second. With this simple instrument great accuracy is not aimed at, but as after a little practice the time recorded by it may be assumed at within a tenth of a second, it may be found useful as a companion to the chronometer either in the camp or on ship board. If greater accuracy be required, let Fig. 2 represent a metronome beating seconds of time with a graduated arc placed at the back of the upper part of the pendulum, which latter carries with it at the extreme end a vernier vibrating freely, just barely clear

FROM 0" TO 0" EQUALS ONE SECOND OF TIME

FIG. 1.

FIG. 2.

INSTRUMENT FOR MARKING ASTRONOMICAL TIME.

of the graduated arc. Let *a a a* be three foot screws for adjusting the perpendicularity of the pendulum; *b*, a ball for adjusting the vibrations of the pendulum to seconds of time; *c c*, a sliding trigger; *d d d*, a spring clamp—similar to a letter clip—on cardboard, but clipping, when free, against the pendulum, and locking it against the leather plate *e e*; *f f f f*, adjusting screws for bringing the graduated arc into coincidence with the vernier. When the instrument is required for use, raise the spring clamp and set it under the trigger; adjust the pendulum perpendicularly by the foot screws, and its time rate of seconds by the ball *b*, then set the pendulum going in unison with the vibrations of the time-piece. At the instant of the observer's signal—or the observer may be furnished with a signal wire attached to the trigger—free the clamp which locks the pendulum, note the preceding second, and the vernier will record the elapsed interval since with considerable accuracy.

[Nature.]

THE MECHANICAL EQUIVALENT OF HEAT.

M. PULJ, of Fiume, has recently published a description of a school apparatus for determining the mechanical equivalent of heat. The apparatus is of very simple construction,

APPARATUS FOR ILLUSTRATING THE MECHANICAL EQUIVALENT OF HEAT.

and consists of a calorimetric and a dynamometric part, which is connected with a rotating arrangement, such as may be found in any physical laboratory.

The calorimetric part of the apparatus is formed of two truncated hollow cones of cast-iron, fitting the one into the other. The inner one, *a*, does not quite reach to the bottom

of the outer, *b*, and it projects a little above it. The outer cone, *b*, can be fixed, co-axially, into the spool of the driving machine. The inner cone contains mercury. If, now, the driving machine be set a-going and the inner cone held fast, heat is produced through friction of the touching surfaces of the cones.

For measurement of the work transformed into heat, the arrangement is as follows: To the wooden lid, *a*, of the inner cone is screwed a light wooden beam, *f*, horizontally. Through the beam and lid passes a perforation for receiving the thermometer. At a little distance from the beam, *f*, and at the same height, there is a fixed pulley, *g*, over which is passed a cord with a scale at its pendant extremity, while the other end is attached to the end of one arm of the beam (the second arm of the beam acts as counter weight). When the driving machine is put in action, the cones rub together, and the outer cone tends to carry the inner one and its beam round with it in the direction of rotation. With a certain weight in the scale, the horizontal part of the cord will form with the axis of the beam a right angle. From the length of the beam-arm, the amount of weighting, and the number of rotations, may be deduced the work that is transformed into heat; and from the water value of the calorimeter, and the increase of its temperature, can be reckoned the quantity of heat produced.

From twenty-eight experiments (in which the amount of heat radiated from the calorimeter was taken into account), the average value obtained for the mechanical equivalent of heat was 425.2, with a mean error ± 5.4 . A second series of experiments was made, with the arm of the beam in any position with reference to the cord. A simple arrangement—wooden triangle with arc-division—served for measuring the angle which the axis of the beam-arm formed with its normal position (in which it forms a right angle with the cord). From the observed values of this angle, and from the quantities already referred to, the number obtained for the mechanical equivalent of heat was 426.7, with a mean error ± 5.9 .

The apparatus is especially to be recommended for lecture experiments, because the method of experimenting is extremely simple, and the carrying out of the experiment takes very little time. A single experiment occupies 30-60'.

[Chemical News.]

POCKET BLOWPIPE.

By P. CASAMAJOR.

Pocket Blowpipe.—In his incomparable book, "On the Use of the Blowpipe in Chemical Analyses and Mineralogical Determinations," Berzelius says that "As it is very desirable, especially for those who study mineralogy, that the blowpipe should take up little room and be convenient to carry without depriving it of its essential qualities, several chemists have endeavored to attain the last limit of simplicity in the construction of this instrument. The most remarkable blowpipes in this respect are those of Tennant and of Wollaston."

Not being fully satisfied with these, nor with other forms which have come under my notice, I have endeavored to attain "the last limit of simplicity," in the instrument represented in Figs. 1 and 2. The former represents the blowpipe packed for carrying in the pocket with the jet put away inside of the main tube, while Fig. 2 represents the same instrument with the jet in its place when ready for use. The main tube is a cylinder with an elliptical section, which is preferable to a circular section, as the curved jet takes up considerable room in one direction, which would entail the necessity of having a circular tube of about half diameter. This would be clumsy to carry and inconvenient to blow into. A tube, whose section is an ellipse with a major axis of half an inch, may be made quite flat, affording a small package for the pocket and a convenient mouthpiece.

In Fig. 2, representing the blowpipe as mounted for work, I have sketched with dotted lines another blowpipe with a jet of the usual shape, that the portability of the new blowpipe may be appreciated, while it may be seen that in every essential quality it does not differ from the one with the full length of stem.

For the length of blowpipes, Berzelius gives the distance of 8 inches from the mouthpiece to the tip of the jet, adding, however, that for every operator this distance must be such as to afford the clearest view of the substance under examination. A blowpipe similar to the one represented in Figs. 1 and 2, which I have in my possession, and whose length from the mouthpiece to the tip of the jet is 8 inches, has a main tube whose length is only $4\frac{1}{2}$ inches. The relation of $4\frac{1}{2}$ to 8 is a

If the stem of the blowpipe is made in two pieces, while the jet is made with a double curve, the length when put up for the pocket can be reduced to $3\frac{1}{2}$ inches, which gives the still smaller relation of $3\frac{1}{2}$ to 8, which I believe has never before been attained. I have one of these dimensions whose stem is formed of two conical portions with circular sections. When packed for carrying, one cone fits within the other, and the curved jet is placed inside of the inner cone. As the stem when developed is longer than when made of only one piece, the jet is shorter and less curved than that represented in Figs. 1 and 2, and it finds ample room in the

Fig. 2.
Scale $\frac{1}{2}$ Fig. 1.
Scale $\frac{1}{2}$ Fig. 3.
Scale $\frac{1}{2}$ Fig. 4.
Actual size

POCKET BLOWPIPE.

inner cone. By making the two portions of the stem cylindrical, and screwing them together, a more clumsy and expensive instrument is obtained, but also one whose portions are held more firmly together.

To avoid projections on the surface of the blowpipe, the socket in which the jet is inserted is formed by a tube soldered at both ends in the interior of the blowpipe. It is indicated by dotted lines in Figs. 1 and 2. On the side of this tube a hole is pierced to allow the air to pass out into the jet.

When the jet is put up in the interior of the stem, it may be wrapped up in a piece of paper to keep it from dropping out. When needed, it may be picked out or shaken out.

Mouthpieces.—Extra mouthpieces of horn, wood, or ivory should be avoided, as they invariably fit loosely. Berzelius advises that blowpipes be made either of silver or tin-plate without extra mouthpiece; those made of brass are disagreeable to the mouth and leave a bad smell on the hands. Although silver is a better conductor of heat than any other substance, Berzelius tells us that he was never inconvenienced by the heating of his silver blowpipe even after very prolonged blowing.

Plating brass with either silver or nickel can only be considered as a palliative, as the nobler metal soon wears off. German silver is a very good material for blowpipes, as it is almost free from taste and smell when clean, and is a bad conductor of heat.

For blowpipes made of baser metals, mouthpieces may be made of silver and soldered on. I can propose another material which fits tightly on the stem, which is pleasant to the mouth, and which may be renewed in a few seconds at a trifling expense. This consists of a piece of rubber tubing slipped over the mouth of the blowpipe.

Charcoal-Holder.—Charcoal, although one of the most necessary agents in blowpipe analysis, is also one of the most troublesome on account of its bulk, which is disproportionate to that of every other substance employed in determinations of this kind. This defect is aggravated by the circumstance that only a small portion serves as support, while the greater part is used as a handle to keep the useful portion at a safe distance from the hand of the operator. A consideration of this and a desire of economizing a troublesome agent induced me to cut up my charcoal into blocks of various sizes, about as long as they were wide, which I tried to hold before the blowpipe flame by means of tongs and forceps. Finding the use of these inconvenient, I was led to adopt the charcoal-holder represented in Figs. 3 and 4, which differs from tongs and forceps in holding the charcoal from behind so that no portion of the holder comes between the charcoal and the flame, and in being able to hold the charcoal firmly without any pressure from the hand of the operator.

This holder is made of metallic strip somewhat less than inch wide, and of sufficient thickness not to bend when in use. German silver is the best material, for reasons already pointed