actual conformations of the great terrestrial divisions of land and sea, arcs of longitude are, I imagine, especially likely to be affected by such causes.

The views which I have now attempted to express are by no means new, but it has not appeared necessary to cite authorities. I am indebted to many writers, but I should be sorry to have to assign to each the measure of the influence which his learning has had on the drawing up of this brief, which I hope some geodesist will now take up and argue more fully and more ably.

Dehra J. HERSCHEL

THE ROYAL SOCIETY SOIRÉE

ON Wednesday last week the President of the Royal Society gave a *soirée* at Burlington House, which was largely attended, and at which a considerable variety of apparatus were exhibited and many experiments made. Mr. Crookes showed his exhausted tubes and other apparatus, illustrating various phenomena connected with molecular physics in high vacua. The experiments made by these were the following:—

1. *Dark Space round the Negative Pole.*—When the spark from an induction coil is passed through an ordinary vacuum tube, a dark space is seen round the negative pole. The shape and size of this dark space do not vary with the distance separating the poles; nor, only very slightly, with alteration of battery power, or with intensity of spark. This well-known dark space appears to be a layer of molecular disturbance identical with the invisible layer of molecular pressure or stress, the investigation of which has occupied the exhibitor some years.

2. *The Electrical Radiometer.*—An ordinary radiometer is furnished with aluminium cups for vanes. The fly is supported by a hard steel cup, and the needle point on which it works is connected with a platinum terminal sealed into the glass. At the top of the radiometer bulb a second terminal is sealed in; the radiometer can therefore be connected with an induction coil, the movable fly being made the negative pole. At low exhaustions a velvety violet halo forms over each side of the cup. On increasing the exhaustion the dark space widens out, retaining almost exactly the shape of the cup; the bright margin of the dark space becomes concentrated at the concave side of the cup to a luminous focus, and widens out at the convex side. On further exhaustion, the dark space on the convex side touches the glass, when positive rotation takes place.

3. *Green Phosphorescent Light of Molecular Impact.*—At very high exhaustions the dark space becomes so large that it fills the tube, and when German glass is used the sides are beautifully illuminated with a greenish yellow phosphorescent light.

4. *Projection of Molecular Shadows.*—The rays exciting this green phosphoresence will not turn a corner in the slightest degree, but radiate from the negative pole in straight lines, casting strong and sharply-defined shadows from objects which happen to be in their path. The best and sharpest shadows are cast by flat disks, and not by narrow pointed poles; no green light is seen in the shadow itself, no matter how thin, or whatever may be the substance from which it is thrown.

5. *Magnetic Deflection of the Trajectory of Molecules.*—The stream of molecules, whose impact on the glass is accompanied by evolution of light, is very sensitive to magnetic influence, and the shadow can be deflected by bringing a small permanent magnet near, the amount of deflection of the stream of molecules being in proportion to the magnetic power employed. The trajectory of the molecules forming the shadow is curved when under magnetic influence.

6. *Focus of Heat of Molecular Impact.*—Great heat is evolved when the concentrated focus of molecular rays from a nearly hemispherical aluminium cup is allowed to fall on a strip of platinum-foil, the heat sometimes exceeding the melting-point of platinum.

7. *Mechanical Action of Projected Molecules.*—An actual material blow is given by the impinging molecules. A small vaned wheel being used as an indicator, by appropriate means the molecular shadow of an aluminium plate is projected on the vanes. When entirely in the shadow the indicator does not move, but when the molecular stream is deflected so that one-half of the wheel is exposed to molecular impact it rotates with extreme velocity.

8. *Phosphorogenic Properties of the Molecular Stream.*—Substances known to be phosphorescent under ordinary circumstances shine with great splendour when subjected to the negative discharge in a high vacuum. (*a.*) *Becquerel's Luminous Sulphide of Calcium* shines with a bright blue-violet light, and when on a surface of several square inches, is sufficient to faintly light a room. (*b.*) *The Diamond* is very phophorescent. Most diamonds from South Africa phosphoresce with a blue light. Diamonds from other localities shine with different colours, such as bright blue, apricot, pale blue, red, yellowish green, orange, and pale green. One large fluorescent diamond gives almost as much light as a candle when phosphorescing in a good vacuum. (*c.*) *The Ruby* glows with a rich full red, and it is of little consequence what degree of colour the stone possesses naturally, the colour of the phosphorescence is nearly the same in all cases.

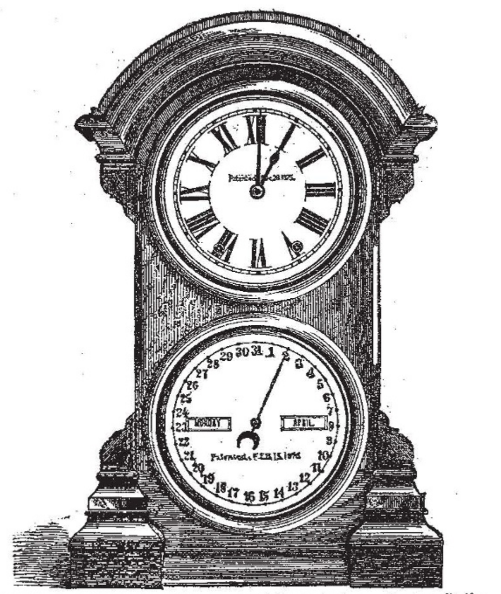
Besides these experiments the working of the writing telegraph, exhibited by Mr. E. A. Cowper, attracted much interest. The nature of this invention we described when it was first announced, and gave a specimen of the kind of writing produced. Other exhibits deserving notice were Prof. Guthrie's broken glass in frames, illustrating the fracture of colloids, Edison's loud-speaking telephone, Messrs. Preece and Stroh's synthetic curve machine, and frame of curves produced thereby; their automatic phonograph, electromagnetic vowel-sounder, stereoscopic curves, synthetic sounder and syren, and phonautograph. Apparatus and instruments of various kinds were also exhibited by Messrs. Browning, Hilger, and Tisley and Co. Among Mr. Hilger's exhibits was a quartz spectroscope for the ultra-violet rays, constructed for the Scientific Society of Stettin, under the direction of Dr. Schönn.

A NEW CALENDAR CLOCK

IT has always been a matter of surprise that the Americans can produce their well-known eight-day clocks in such large quantities, so uniformly good for ordinary purposes, and at such very moderate cost. Their general efficiency is proved by the increasing demand for them; not only are they sold in the American made cases, but separate movements are extensively imported and cased in England. One of the largest firms by which they are produced, that of Seth Thomas and Co., at Thomaston, Conn., has recently introduced a library or office clock of very moderate cost, one form of which is shown in the accompanying figure. This consists of the ordinary eight-day striking movement supplemented by an interesting and ingenious mechanism for operating the calendar; by its means not only the month and day of the week and month are indicated as in ordinary calendars, but the several months have their allotted number of days, an additional day being given to February in leap-year. Of course contrivances for effecting this object have long been known, but they always add so materially to the cost that they are prevented from coming into general use.

It would be impossible to fully explain the mechanism employed without the aid of drawings; a general description must therefore suffice. As will be seen, the calendar dial is placed below the clock dial, and is divided on its circumference from 1 to 31. Two openings on a horizontal diameter allow drums to show the month and day of the week respectively, and a central hand points out the day of the month. A cam, formed like the snail of an English striking-clock, but without the steps, is caused to rotate once in twenty-four hours by the clock movement, so that a pendant, resting on it, is raised through a space of about 1 inch in that period and allowed to fall, the weight being supplemented by the tension of a spiral spring; this is the sole connection between the calendar and clock. During the ascent of the pendant a detent passes over one tooth of a wheel fixed to the week-day drum, which is thus carried round through a corresponding interval when the release occurs. At the same time a precisely similar action, performed on a wheel fixed to the axis that carries the hand, causes it to advance one figure.

Just as the cam driven by the clock accomplishes the change from day to day, so a second cam on the central axis of the calendar alters the month; the detent, on being released, carries forward one tooth of a 12-toothed wheel. It remains to explain the device for allotting the requisite number of days to each month and correcting

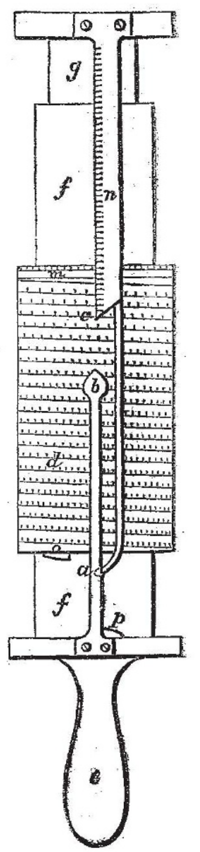


8-day Parlour Calendar, No. 4. Height 25 inches. Spring-Strike. 8-inch Dials.

for leap year. The axis of the month drum carries an irregular shaped cam, which may be conceived to be divided radially into twelve parts. Those arcs of the circumference that correspond to 31-day months are left untouched; 30-day months have their arcs filed away to the corresponding chord; and for February a depression is made equal to three times that of other months such as April. A light spring holds a bent arm against this cam, the arm being so placed that at the end of each short month it can ride on a metallic arc carried round with the hand; the acting length of this arc corresponds to one or three teeth of the dial-wheel if the 30th or 28th is the last day, and the arm entirely escapes it when thirty-one days are to be indicated. Whenever it is thus held out of its natural position, the arm prevents the check-spring that limits the movement of the dial-wheel from falling into its place, and the detent is thus enabled to advance the hand through two or four spaces instead of the usual one. An additional day is given in leap-year by a simple application of the well-known sun and planet wheel of Watt. The central fixed wheel is coaxial with the month-drum and has sixteen teeth; the planet-wheel, pivoted on the cam, has twenty teeth, and carries a sector of such a radius that, when superposed on the February depression, it diminishes the fall of the arm so that it rides on an arc corresponding to two teeth instead of three. It will be seen that the above numbers of teeth are so chosen that the wheel carrying this sector is only brought into an identical position once in every four (annual) rotations of the month-drum; the necessary correction is therefore effected.

SPIRAL SLIDE RULE [1]

THE method of multiplying and dividing by means of a rule was first introduced by Gunter about the year 1606 by the construction of a scale of two equal parts divided logarithmically, the readings being taken off with a pair of compasses. Oughtred about 1630 invented the rule composed of two similar logarithmic scales sliding in contact, but the difficulty of estimating the reading between two graduations then first became important. It is easy to see that it requires but little practice to place a graduation in one scale opposite to a position obtained by estimate between two graduations in the other scale, but it becomes a much more tiresome and uncertain process when both of the readings required to be placed in juxtaposition fall between two graduations on their respective scales. With practice, however, this operation can be effected with considerable accuracy provided the graduations are not too close together; hence to enable the calculations to be performed with a sufficient degree of approximation there has always been a desire to increase the scale and consequently the total length of the instrument. To attain this object and at the same time preserve the portable size of the instrument Prof. Everett designed his slide rule, but the range of this is now far surpassed by the invention by Prof. Fuller of the spiral slide rule.



The instrument can be readily understood from the accompanying figure.

d is a cylinder that can be moved up and down or turned round on the cylinder *ff*, attached to and held by the handle *e*. Upon *d* is wound in a spiral a single logarithmic scale. Two other indices, *c* and *a*, whose distance apart is equal to the axial length of the spiral, are attached to the cylinder *g*, which slides in *f* and thus enables the operator to place them in any required position relative to *d*. *o* and *p* are two stops which when placed in contact bring the index *b* to the commencement of the scale. *m* and *n* are two scales, one attached to the movable indices and the other to the cylinder *d*.

By the spiral arrangement the length of the scale can be made very great, and as only one scale is required the effective length is double that of an ordinary straight rule. The scale is made 500 inches, or 41 feet 8 inches long, and the instrument is thus equivalent to a straight rule 83 feet 4 inches long or a circular rule 13 feet 3 inches in diameter. The first three digits of a number are printed on the rule throughout the scale, much increasing the facility of reading off. The method of using the different indices will be best understood by examples. For multiplication—bring 100 to the fixed index *b* and place the movable index to the multiplicand,

[1] By George Fuller, M.Inst.C.E., Professor of Engineering, Queen's University, Ireland.