

temperature the results are more difficult to interpret; while nitrogen maintains its nearly constant value for P.V., helium decreases rapidly, then increases, and the same peculiarity is to be remarked with the other gases, although they do not give the product of P.V. coinciding with that calculable by assuming that the increase of P.V. is proportional to the rise of absolute temperature.

These last experiments must be taken as merely preliminary; but they show that further research in this direction would be productive of interesting results.

The spectra of these gases have been accurately measured by Mr. E. C. C. Baly, with a Rowland's grating; the results of his measurements will shortly be published. It may be remarked, however, that the colour of a neon-tube is extremely brilliant and of an orange-pink hue; it resembles nothing so much as a flame; and it is characterised by a multitude of intense orange and yellow lines; that of krypton is pale violet; and that of xenon is sky-blue. The paper contains plates showing the most brilliant lines of the visible spectrum.

That the gases form a series in the periodic table, between that of fluorine and that of sodium, is proved by three lines of argument:—

(1) The ratio between their specific heats at constant pressure and constant volume is 1.66.

(2) If the densities be regarded as identical with the atomic weights, as in the case with diatomic gases such as hydrogen, oxygen and nitrogen, there is no place for these elements in the periodic table. The group of elements which includes them is:—

Hydrogen. 1	Helium. 4	Lithium. 7	Beryllium. 9
Fluorine. 18	Neon. 20	Sodium. 23	Magnesium. 24
Chlorine. 35.5	Argon. 40	Potassium. 39	Calcium. 40
Bromine. 80	Krypton. 82	Rubidium. 85	Strontium. 87
Iodine. 127	Xenon. 128	Cæsium. 133	Barium. 137

(For arguments in favour of placing hydrogen at the head of the fluorine group of elements, see Orme Masson, *Chem. News*, vol. lxxiii., 1896, p. 283).

(3) These elements exhibit gradations in properties such as refractive index, atomic volume, melting-point and boiling-point, which find a fitting place on diagrams showing such periodic relations. Some of these diagrams are reproduced in the original paper. Thus the refractive equivalents are found at the lower apices of the descending curves; the atomic volumes, on the ascending branches, in appropriate positions; and the melting- and boiling-points, like the refractivities, occupy positions at the lower apices.

Although, however, such regularity is to be noticed, similar to that which is found with other elements, we had entertained hopes that the simple nature of the molecules of the inactive gases might have thrown light on the puzzling incongruities of the periodic table. That hope has been disappointed. We have not been able to predict accurately any one of the properties of one of these gases from a knowledge of those of the others; an approximate guess is all that can be made. The conundrum of the periodic table has yet to be solved.

ACTION OF TERRESTRIAL MAGNETISM ON THE RATES OF CHRONOMETERS.

IN the issue of the *Comptes rendus* of the Paris Academy of Sciences for November 26, vol. cxxxi., pp. 859-865, there is an important communication by Prof. A. Cornu, dealing with an experimental investigation of the action of a terrestrial magnetic field on the rate of a magnetised chronometer.

The observations have been carried out on a pocket half-chronometer, provided with anchor-escapement, compensated balance and palladium spiral, whose rate had previously been very satisfactory, but which had inadvertently become magnetised by a large electro-magnet. The generally prevalent idea is that a magnetised watch is quite untrustworthy until it has been completely demagnetised, but the author's research has convinced him that there is evidence of a regular law in the rate of such an affected timepiece, and therefore it should be possible

to neutralise the disturbance, either by tables of correction formulæ, or by suitably disposed compensators.

The magnetisable parts are the pivots, anchor, spring, balance-wheel and accessories to the escapement. In watches of precision all direct contacts between steel parts are avoided by the use of hard stone bearings, so that the mutual actions are inductive effects. If, then, the watch be laid on a horizontal table at a definite orientation, the only disturbing external force capable of affecting its rate will be the terrestrial magnetic field. To test this, provision was made for varying the orientation of the balance by making the horizontal support movable about a vertical axis, and then keeping the watch or clock for several days successively in the four positions corresponding to the hours XII, III, VI, IX, pointing respectively to the Magnetic North.

Systematic observations from 1898 June 20 to 1900 November 17, furnish a series of values for the variations in rate at the four orientations, and the discussion of them has enabled Prof. Cornu to show that they may be represented by a *sinusoid*. The magnetic state of the watch remains sensibly constant; the semi-amplitude of the variations with the orientation was 10.37 secs., and the mean azimuth of the ascending node of the sinusoid about 260° 21'. This result is especially interesting and important in that this sinusoidal law is identical with that obtaining when a watch having a balance wheel slightly out of equilibrium is hung with its dial vertical and oriented to different azimuths. That is, gravity also produces, if the mean amplitude remains constant, a couple proportional to the vertical projection of the eccentricity of the centre of gravity. Here a series of observations of the rate of the same watch before it was magnetised are given, taken during the period 1890 October 26-1891 January 25, showing the fulfilment of the sinusoid law in this respect.

It would thus appear that the condition discovered by Phillips (*Annales des Mines*, 6th series, vol. ix., p. 321, 1866) for eliminating the disturbance due to gravitation may also be applied to the compensation for magnetisation.

As a crucial test of the truth of his deductions, Prof. Cornu performed a substitution experiment in which the earth's magnetism was directly allowed for. In a piece of cork of exactly the same form as the watch a cylindrical hole was cut in the position corresponding to the balance wheel. In this was supported a small compass needle, and the whole supported on a horizontal table. By means of a jointed arm a bar magnet was held in such a position that the earth's magnetism was neutralised, leaving the needle astatic. This done, the watch was substituted for the cork, the orientation of the balance wheel being the same as the small compass in the cork. This substitution of cork model, getting astatic position by bar magnet, and replacement of watch, was repeated for the four orientations, and the daily rate carefully determined. It was found to be sensibly *constant in all positions*.

The paper concludes with the following summary:—

(1) Chronometers of precision are influenced by variations of the magnetic field in which they are placed to an amount depending on the degree of magnetisation of the balance wheel and spring.

(2) It is important to determine the magnetic moment of the balance wheel, mounted or not on the spiral.

(3) In observatories studying chronometer rates it is necessary to regularly determine the comparative variations in four rectangular azimuths for calculating the formulæ of correction.

(4) In all cases it should be the endeavour to attain an amplitude of 440° for the oscillations of the balance wheel, as recommended by Phillips, to eliminate the action of the terrestrial magnetic couples.

(5) For precaution, in observatories as well as on board ship, it would be well to envelop each chronometer with a thick box of iron, so that the relative action of the terrestrial field may be lessened.

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THE EFFECTS OF AN EARTHQUAKE ON HUMAN BEINGS.

CAPTAIN DUTTON'S valuable memoir on the Charleston earthquake of 1886 contains many accounts of the effects of this great earthquake on human beings. Nowhere could they be more vivid than in Charleston itself. "On every side," says one witness, "were hurrying forms of men and women, bare-headed, partially dressed, some almost nude [the earthquake