There is another point with regard to testing with Wheatstone's Bridge, which is not noticed in the review, but to which I may be allowed to direct attention;—that is, the position of the galvanometer. It is not indifferent in which diagonal of the bridge the battery and galvanometer are placed when the branches are unequal. In such a case the method is much more delicate when the galvanometer is placed in the diagonal joining the junction of the two largest resistances with the junction of the two smallest. As, I believe, we have in this laboratory the only Wheatstone's bridge yet constructed after Mr. Schwendler's design, by which the position of the galvanometer and battery can be altered by the shifting of four plugs, I have made a few tests which will show the advantage of this arrangement.

The diagonal joining the junction of the branches with the junction of the comparison coil and the resistance measured is called *m n*; the other diagonal being *p q*.

Resistance measured.	No. of cells used.	Resistance of branches.	Alteration of comparison coil.	Deflection of galvanometer in diagonal	
Units.		Units.	Units.	*m n*	*p q*
		$\frac{b}{a}$			
90	1	$\frac{100}{100}$	2	148	147
—	—	$\frac{100}{1000}$	20	53	122
—	—	$\frac{10}{1000}$	200	7½	34½

It will thus be seen that when the branch resistances are equal it is indifferent in which diagonals the galvanometer and battery are placed; but this is not the case when branch *a* is greater than branch *b*. It is hardly necessary to observe that in a practical test more than one cell would be used when the branches are unequal, in order to obtain much larger deflections, and more accurate measurements. HERBERT MCLEOD

Royal Indian Engineering College, Cooper's Hill, January 6

The Unseen Universe—Paradoxical Philosophy

THE principle of continuity forbids us to imagine that the collocation called the atom has existed as it is from all eternity. This the authors of the "Unseen Universe" have insisted upon, and I need not go further than their title-page to remind Mr. Hallowes that in like manner they do not contemplate a future eternal existence for the atom.

But this principle cannot tell us what was the exact nature of the thinkable antecedent of the present universe, nor can it tell us the exact nature of that state which will follow the disappearance of the present system. There are, however *strong scientific analogies* which lead us to believe that the thinkable antecedent of the present system was a spiritual unseen, which not only developed but which now sustains the present order.

Is it therefore necessary that I myself should in like manner help to sustain some inferior universe? I repudiate any such obligation. I am not fit for it.

Because a little boy has a father, is it logically essential that he should likewise have a son?

HERMANN STOFFKRAFT

Schloss Ehrenberg, Baden, January 11

Molecular Vibrations

IN NATURE, vol. xix. p. 158, col. 2, is the following:—

"It has been suggested that the same molecule may be capable of vibrating in different ways, and thus of yielding different spectra, *just as a bell may give out different notes when struck in different ways.*" It is well to note that the bell as a whole gives but one sound, and the other sounds are not true harmonics, but come from parts of the bell, either before the whole is in vibration or from parts badly amalgamated, flaws in the metal, air-bubbles in pouring into the mould, lack of homogeneity, inequalities in the mould, &c.

The noises in a belfry are most discordant, whereas harmonics form a succession of consonances—octave, fifth, fourth, major and minor thirds, seventh and treble octave.

WM. CHAPPELL

The Electric Light

WHILE so many experiments are being made on lighting by the incandescence of infusible materials produced by electric currents, it is well to point out that Dr. Draper, as early as 1844, used a strip of platinum so heated to determine the facts that all solid substances become incandescent at 977° F., that light increases in refrangibility and intensity, and that the order of the colours emitted followed the true prismatic order as the temperature increases.

Dr. Draper says: "Among writers on optics it has been a desideratum to obtain an artificial light of standard brilliancy. The preceding experiments furnish an easy means of supplying that want, and give us what might be termed a 'unit lamp.' A surface of platinum of standard dimensions raised to a standard temperature by a voltaic current will always emit a constant light. A strip of that metal one inch long and $\frac{1}{20}$th of an inch wide, connected with a lever by which its expansion might be measured, would yield at 2,000° a light suitable for most purposes. Moreover, it would be very easy to form from it a photometer by screening portions of the shining surface. An ingenious artist would have very little difficulty, by taking advantage of the movements of the lever, in making a self-acting apparatus in which the platinum should be maintained at a uniform temperature, notwithstanding any change taking place in the voltaic current." (*Vide* Draper's "Scientific Memoirs," p. 45.)

Wimbledon, January 11 W. H. PREECE

Force and Energy [1]

III.

IN consequence of energy not being a directed quantity we come at once upon an important distinction between transference of energy and transference of momentum. There may be a large force exerted, *i.e.*, a large amount of momentum rapidly transferred, without there being any accompanying transference of energy. In the distance V on the two sides of a given section of the stressed material through which the two opposite streams are flowing, there is lodged a certain amount of motion which is the same in the one portion on the one side of the section as in that on the other side. The momentum and the energy lodged in each portion are simply different functions of one and the same motion. In unit time the whole of the motion in the portion on the one side of the section is transferred into the portion on the other side, and *vice versâ*. The resulting quantitative transference of the one function of the motion is double what would take place if only one, instead of two, opposite streams were flowing through the section, the reason being that this function is a directed quantity. The resulting quantitative flow of the other function of the motion is zero, because it is a function which has no direction. The rate of transference of momentum, or the force, is in this case eE, the sign being given by the sign of e. Suppose, now, one only of these streams of motion to be flowing past the section, the rate of transference of momentum being $\frac{1}{2}eE$, where e is the geometrical ratio of extension, or the strain. The rate of transference of energy remains to be calculated. The material may be either at rest or in motion. In fact whether it is to be considered at rest, or at what velocity it is to be considered moving, depends altogether upon the set of bodies relatively to which the motion is to be measured. Its relative velocity may also be either uniform or variable. The relative velocity of the centre of inertia of the material lying between two given sections will be uniform if the whole of the motion measured in any quantitative way flowing in through one of these sections is equal to that simultaneously flowing out at the other.

Suppose that before the force begins to act there is a uniform velocity, v_0, throughout a given length. As soon as there is a uniform force, $\frac{1}{2}eE$, throughout this whole length, the flow being only in one direction, one half the particles will have at any instant the velocity, v_0, while the other half has the velocity $(v_0 + v)$, where $v = e\sqrt{\frac{E}{\mu}}$.

$V = \sqrt{\frac{E}{\mu}}$ being the velocity of stream-flow; there is in the length V lodged an amount of momentum $(V\mu v_0 + \frac{1}{2}V\mu v)$ for unit section throughout that length. Of this amount $\frac{1}{2}V\mu v = \frac{1}{2}eE$ is transmitted forwards per unit of time. The mean velocity of the material is also $(v_0 + \frac{1}{2}v)$.

[1] Continued from p. 219