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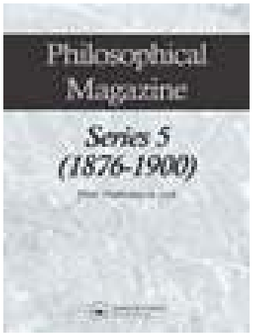

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LIII. *On the Importance of Experiments in relation to the Mechanical Theory of Gravitation.* *By* S. TOLVER PRESTON*.

THE assumption of "action at a distance" has notoriously tended to check experimental inquiry in relation to the mechanical cause of gravitation, as it has hindered investigation in other branches of physics. At one time, for instance, on the basis of this theory of "action at a distance," electric action was supposed to propagate itself in some mysterious way across space without the intervention of matter; so that all substances were assumed to play a perfectly neutral part in the passage of the electric action—until Faraday, rising above the prejudices of his time, put this question under the test of experiment, and by his discovery of a "specific inductive capacity," demonstrated the supposition thus formed to be false. Yet so great was the strength of preconceived opinion, that notoriously Faraday's discovery was not fully accepted until years afterwards, when its practical application to telegraph-cables forced it on the attention of electricians.

So now in the present day, in spite of the continual demolition of spiritualistic views (*i. e.* views of action without the intervention of matter) by advancing science, the *modus operandi* of gravitation remains the one outstanding subject for doubt; and it appears to be assumed by many (much in analogy with the former question of "specific inductive capacity") that experiments with the view to decide whether any minute specific differences might exist in the effects of gravity, dependent on structure, form, &c. of substances, would be out of place—gravity being rather considered as something *not* physical at all (although admitted, as it were, by courtesy into "*physical*" science).

No doubt it may be agreed at the outset here that such specific differences in gravific effects (if they exist) must be very small, or they would have been accidentally detected. But the history of science shows that phenomena are often not detected by accident, but have to be carefully searched for. Where would the discovery of diamagnetism (for example) have been without a careful investigation? Here it was generally assumed beforehand that, with the exception of certain isolated magnetic substances (iron &c.), no specific differences would exist in the behaviour of bodies in general to magnetism (which was, in the same way, supposed to be an occult kind of "action at a distance"), until Faraday, again resorting to rigorous experiment, broke down once more this belief, and that only after the most careful and laborious investigations.

* Communicated by the Author.

May not analogous considerations apply to gravity (still regarded by some as the result of a mystic "action at a distance"), and which, as an actual fact, now remains as the last remnant of spiritualism to be expelled from physics. In relation to this subject, Sir William Thomson, in an important development of Le Sage's theory of gravitation, published in the Philosophical Magazine for May 1873, makes the following suggestive remark, viz. that, assuming certain possible conditions to exist, "crystals would generally have different permeabilities* in different directions, and would therefore have different weights according to the direction of their axes relatively to the direction of gravity. No such difference has been discovered; and it is certain that, if there is any, it is extremely small. Hence the constituent atoms, if æolotropic as to permeability, must be so but to an exceedingly small degree" (page 331)†.

Might not this point be worthy of experiment? Although the discovery of some such minute specific differences would not, in point of principle, be necessary to the establishment of the truth of the *existence* of an explanation for gravitation, yet a discovery of this kind would be highly interesting as a confirmation of the truth of the particular explanation afforded by the *kinetic* theory of gases (which depends on the permeability of gross matter by a gaseous æther, whose minute component particles have an extremely long mean path). The groundwork of this explanation (*i. e.* the one first started in very crude form by Le Sage, of Geneva) is now, it may be observed, generally regarded by competent judges as the only *conceivable* rough basis on which an intelligible mechanical theory of gravitation admits of being built.

The main object of this paper is to call more particular attention to the desirability of an experimental search in relation to the mechanical theory of gravitation, or to the expediency of a more precise and exact observation of gravific effects under diverse conditions of form, structure, &c. of

* It should be kept in view, that one of the essential conditions of Le Sage's theory is that gross matter should be permeable by the minute particles of a finer material, or æther.

† Sir William Thomson remarks further as follows in relation to this point, viz.:—"A body having different permeabilities in different directions would, if of manageable dimensions, give us a means for drawing energy from the inexhaustible stores laid up in the ultramundane corpuscles—thus: first, turn the body into a position of maximum weight; secondly, lift it through any height; thirdly, turn it into a position of maximum weight; fourthly, let it down to its primitive level. It is easily seen that the first and third of those operations are performed without the expenditure of work; and, on the whole, work is done by gravity in operations 2 and 4" (page 331).

bodies, with a view to determine if certain small specific variations may not have escaped notice, owing to their *not having been searched for*, on account of the bias of preconceived ideas, and the lethargy produced by the influence of preformed theories. Crystalline bodies of birefracting properties &c. which, in relation to the luminiferous æther, are permeable to light with different velocities in different directions, may specially suggest themselves for experiment.

Since the successful pursuit of a research of this kind, where specific differences of a very minute character are in question, would no doubt entail considerable experimental resources, with refined and delicate apparatus, which might not be at the disposal of every one, the more therefore does it become desirable to attract general attention to the subject. The comparative dearth of discovery of any great physical principle (of a fundamental character at least) within the last few years would seem, if any thing, to call for additional zeal in experimental enterprise. Although a negative result to the investigations would not be decisive one way or the other in regard to the validity of the explanation of gravity afforded by the kinetic theory (for, of course, it is well conceivable that such specific variations in gravific effect, if they exist, might be too minute for detection with the appliances at our command), yet a positive result would be so highly interesting and important, that even a small prospect of success would amply repay the labour of a careful trial, and enlist usefully the skill and ingenuity of experimenters.

Heatherfield, Bournemouth,
March 2, 1881.

LIV. *Intelligence and Miscellaneous Articles.*

THE EFFECT OF GREAT COLD UPON MAGNETISM.

BY JOHN TROWBRIDGE.

AN investigation upon the magnetic condition of steel and upon the magnetic permeability of iron is now in progress in the Physical Laboratory of Harvard University. The preliminary experiments are interesting, since they show that very low temperatures exercise far greater influence on the magnetic condition than has been noticed by previous observers.

It is stated by Wiedemann* that the cooling below the temperature at which steel is magnetized enfeebles the magnetic condition. A bar which was magnetized at 6° C. or 8° C. gave at 4° C. and −25° C. intensities represented by 5·08 and 4·90. This represents a loss of less than 4 per cent. In my experiments the magnetic bar magnetized at 20° C., when subjected to a tempera-

* Daguin, *Traité de Physique*, nouv. ed., "Influence de la température d'aimantation."