

Or, if the gravitation is less in the crossed than in the parallel position, and in constant ratio, the difference is less than 1 in 16,000 in the one case and less than 1 in 2800 in the other.

We may compare with these numbers the difference of rate of travel of yellow light through a quartz crystal along the axis and perpendicular to it. That difference is of quite another order, being about 1 in 170.

As to other possible qualities of gravitation, I shall only mention that quite indecisive experiments have been made to seek for an alteration of mass on chemical combination,<sup>1</sup> and that at present there is no reason to suppose that temperature affects gravitation. Indeed, as to temperature effect, the agreement of weight methods and volume methods of measuring expansion with rise of temperature is good, as far as it goes, in showing that weight is independent of temperature.

So while the experiments to determine *G* are converging on the same value, the attempts to show that, under certain conditions, it may not be constant, have resulted so far in failure all along the line. No attack on gravitation has succeeded in showing that it is related to anything but the masses of the attracting and the attracted bodies. It appears to have no relation to physical or chemical condition of the acting masses or to the intervening medium.

Perhaps we have been led astray by false analogies in some of our questions. Some of the qualities we have sought and failed to find, qualities which characterise electric and magnetic forces, may be due to the polarity, the + and -, which we ascribe to poles and charges, and which have no counterpart in mass.

But this unlikeliness, this independence of gravitation of any quality but mass, bars the way to any explanation of its nature.

The dependence of electric forces on the medium, one of Faraday's grand discoveries for ever associated with the Royal Institution, was the first step which led on to the electromagnetic theory of light now so splendidly illustrated by Hertz's electromagnetic waves. The quantitative laws of electrolysis, again due to Faraday, are leading, I believe, to the identification of electrification and chemical separation, to the identification of electric with chemical energy.

But gravitation still stands alone. The isolation which Faraday sought to break down is still complete. Yet the work I have been describing is not a failure. We at least know something in knowing what qualities gravitation does not possess, and when the time shall come for explanation all these laborious and, at first sight, useless experiments will take their place in the foundation on which that explanation will be built.

### SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 13.—M. Maurice Lévy in the chair.—On the neogenic regions of Lower Egypt and the Isthmus of Suez, by MM. C. Depéret and R. Fourtau. Of the Miocene formation the following were recognised:—The Burdigalian, or first Mediterranean stratum, by the presence of *Echinolampas amplus*, *Scutella Innesi*, *Lovenia*, *Cidaris avenionensis*, *Amphiope truncata* and other fossils; the Vindobonian, or second Mediterranean stratum, by a blue lime containing *Pecten cristato-costatus* and numerous echinoderms. Of the Pliocene, in the neighbourhood of Cairo, are layers of yellowish sand containing *Clypeaster aegyptiacus* and other characteristic fossils.—The area of the basins of Russia in Asia, by M. J. de Schokalsky. The map is made upon the scale of 1 in 4,200,000, and the area evaluated by means of a sheet of celluloid divided in square millimetres. The area found is 16,085,000 sq. kilometres.—On a hypsometric map of European Russia, by M. J. de Schokalsky. The previous map of M. de Tillo was limited by the latitude 60° N.; the present map includes the whole of European Russia upon a scale of 1 in 15,300,000.—Observations of the Borelly comet, made at the Observatory of Algiers with the 31.8 cm. equatorial, by M. F. Sy.—A new arrangement of apparatus serving to measure geodesic bases, by M. Alphonse Berget. Ruled plates of iron floating in a bath of mercury are used instead of the ordinary scales. The method has the advantage of securing without trouble the absolute horizontality of the rules; two consecutive rules are necessarily in the same horizontal plane, since their mercury baths are connected; there is no correction necessary for the flexure of the rules, and the temperature correction is much more certain.—Stereoscopic vision of curves traced by a phase apparatus, by M. Marc Dechevrens.—Properties of magnetic

<sup>1</sup> Landolt, *Zeit. für Phys. Chem.*, xii. 1, 1894. Sanford and Ray, *Physical Review*, v. 1897, p. 247.

deposits obtained in a magnetic field, by M. Ch. Maurain. Iron was deposited in a magnetic field either from a solution of ferrous and ammonium chlorides, or from a solution of ferrous sulphate in sodium pyrophosphate. It was found that the intensity of magnetisation of different layers of the deposit growing in a uniform field has the same value, and that the uniform magnetisation acquired by a deposited strip increases with the strength of field in which the deposit is obtained.—The rôle of discontinuities in the propagation of explosive phenomena, by M. Paul Vieille. On the assumption of an adiabatic elasticity, together with continuity, the velocities of wave propagation found in certain cases are too great. It is necessary to assume that the phenomenon is discontinuous.—Action of hydrogen upon the sulphides of arsenic, by M. H. Pélabon. Details of experiments of the interaction of realgar and hydrogen in sealed tubes at 610° C. The reaction is a reversible one, and the limit is affected by the introduction of an excess of arsenic.—The properties of the blue oxide of molybdenum, by M. Marcel Guichard. The blue oxide is a molybdate, and could not be obtained free from water, two oxides of molybdenum only existing in the anhydrous state, MoO<sub>2</sub> and MoO<sub>3</sub>.—On the colouring matter of *Echinus esculentus*, by M. Griffiths.—On the composition of the ashes of some medicinal plants, by M. Griffiths.—On a cause of error in the examination of wines for salicylic acid, by M. J. Ferreira da Silva. The method of Petlet and Grobert will indicate the presence of salicylic acid in a pure wine that is really free from it. The official German method gives exact results.—On a variety of the anthrax bacillus; a short asporogenic form, *Bacillus anthracis brevigenmans*, by M. C. Phisalix. In the organism of the dog the *B. anthracis* undergoes important modifications, becoming shorter with a rapid and complete segmentation. It is still uncertain whether this should be regarded as a variety or a new species.—Anti-hepatic serum, by M. C. Delezenne.—Application to man of the regeneration of confined air by means of sodium peroxide, by MM. A. Desgrez and V. Balthazard. The apparatus described weighs twelve kilograms, and by its means a man can penetrate easily into an irrespirable atmosphere.

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