December 7, 1848.

The EARL OF ROSSE, President, in the Chair.

The Rev. James Challis, George Bishop, Esq., Captain Clerk, R.A. were admitted into the Society.

The Marquis of Northampton gave notice that His Grace the Archbishop of Canterbury would be proposed at the next Meeting for election and for immediate ballot, to which, as a Spiritual Peer of the Realm, His Grace is entitled.

Dr. Faraday then delivered the Bakerian Lecture, illustrative of his paper, entitled "Experimental Researches in Electricity. Twenty-second Series. § 28. On the Crystalline Polarity of Bismuth and other bodies, and on its relation to the magnetic form of force."

In this paper the author states that in preparing small cylinders of bismuth by casting them in glass tubes, he had often been embarrassed by the anomalous magnetic results which they gave, and that having determined to investigate the matter closely, it ended in a reference of the effects to the crystalline condition of the bismuth, which may be thus briefly stated. If bismuth be crystallized in the ordinary way, and then a crystal, or a group of symmetric crystals, be selected and suspended in the magnetic field between horizontal poles, it immediately either points in a given direction, or vibrates about a given position, as a small magnetic needle would do, and if disturbed from this position it returns to it. On re-suspending the crystal so that the horizontal line which is transverse to the magnetic axis shall become the vertical line, the crystal then points with its maximum degree of force. If it be again re-suspended so that the line parallel to the magnetic axis be rendered vertical, the crystal loses all directive force. This line of direction, therefore, which tends to place itself parallel to the magnetic axis, the author calls the *Magnecrystallic axis* of the crystal. It is perpendicular, or nearly so, to the brightest and most perfect of the four cleavage planes of the crystal. It is the same for all crystals of bismuth. Whether this magnecrystallic axis is parallel or transverse to the magnetic axis, the bismuth is in both cases repelled from a single, or the stronger of two poles; its diamagnetic relations being in no way affected. If the crystal be broken up, or if it be fused and resolidified, and the metal then subjected to the action of the magnet, the diamagnetic phenomena remain, but the magnecrystallic results disappear, because of the confused and opposing crystalline condition of the various parts. If an ingot of bismuth be broken up and fragmentary plates selected which are crystallized uniformly throughout, these also point; the magnecrystallic axis being, as before, perpendicular to the chief plane of cleavage, and the external form, in this respect, of no consequence.

The effect takes place when the crystal is surrounded by masses of bismuth, or when it is immersed in water, or in a solution of sulphate of iron, and with as much force, apparently, as if nothing intervened.

The position of the crystal in the magnetic field is affected by the approximation of extra magnets, or of soft iron; but the author does not believe that this results from any attractive or repulsive force exerted on the bismuth, but only from the disturbance of the lines of force or resultants of magnetic action, by which they acquire as it were new directions; and, as the law of action which he gives, is, that *the line or axis of magnecrystallic force tends to place itself parallel, or as a tangent, to the magnetic curve or line of magnetic force, passing through the place where the crystal is situated*, so the crystal changes its position with any change of direction in these lines.

A common horse-shoe magnet exhibits these phenomena very well: the author worked much with one lifting 30lbs. by the keeper; but one that can raise a pound or two only, is sufficient for many of the actions. When using the electro-magnet, the advantage of employing poles with large plane opposed faces is mentioned as being considerable, for then diamagnetic phenomena are almost or entirely avoided and the peculiar magnecrystallic relations then appear.

The peculiar force exerted in these phenomena is not either attractive or repulsive, but has for its distinctive character the tendency to place the crystal in a definite position or direction. The author further distinguishes it from that described by M. Plücker in his interesting memoir upon the repulsion of the optic axes of crystals by the poles of a magnet*, in that, *that* is an equatorial force, whereas *this* is an axial force.

Crystals of *antimony* were then submitted to a similar magnetic examination, and with the same results. But there were also certain other effects produced of arrest and revulsion, the same in kind as those described in a former series of the 'Experimental Researches' (par. 2309, &c.); these are wrought out and eliminated, and the results described.

Arsenic also proved to be a body capable of pointing in the magnetic field, like bismuth and antimony.

The paper describing the foregoing results is dated 23rd of September, 1848. In a later paper of the date of 20th October, 1848, the author continues his researches. Native crystals of iridium and osmium, and also crystallized titanium and tellurium, appeared to be magnecrystallic: crystals of zinc, copper, tin, lead, gold, gave no signs of this condition. Crystals of sulphate of iron are very strongly affected by the magnet according to this new condition, and the magnecrystallic axis is perpendicular to two of the planes of the rhomboidal prism; so that when a long crystal is employed, it will not, as a mass, point between the poles, but across the line joining them. On the other hand, the sulphate of nickel has its magnecrystallic axis parallel, or nearly so, to the length of the ordinary prism. Hence bodies, both magnetic and diamagnetic, are, by their crystalline condition, subject to the magnetic force, according to the law already laid down. Diamond, rock-salt, fluor spar, boracite, red

* Poggendorff's Annalen, lxxii. Oct. 1847; or Taylor's Scientific Memoirs, vol. v. p. 353.

oxide of copper, oxide of tin, cinnabar, galena, and many other bodies, presented no evidence of the magnecrystallic condition.

The author then enters upon a consideration *of the nature of the magnecrystallic force.* In the first place he examines closely whether a crystal of bismuth has exactly the same amount of repulsion, diamagnetic or other, when presenting its magnecrystallic axis *parallel* or *transverse* to the lines of magnetic force acting on it. For this purpose the crystal was suspended either from a torsion balance, or as a pendulum thirty feet in length; but whatever the position of the magnecrystallic axis, the amount of repulsion was the same.

In other experiments a vertical axis was constructed of cocoon silk, and the body to be examined was attached at right angles to it as radius; a prismatic crystal of sulphate of iron, for instance, whose length was four times its breadth, was fixed on the axis with its length as radius and its magnecrystallic axis horizontal, and therefore as tangent; then, when this crystal was at rest under the torsion force of the silken axis, an electro-magnetic pole was so placed, that the axial line of magnetic force should be, when exerted, oblique to both the length and the magnecrystallic axis of the crystal; and the consequence was, that, when the electric current circulated round the magnet, the crystal actually *receded* from the magnet under the influence of the force, which tended to place the magnecrystallic axis and the magnetic axis parallel. Employing a crystal or plate of bismuth, that body could be made to *approach* the magnetic pole under the influence of the magnecrystallic force; and this force is so strong as to counteract either the tendency of the magnetic body to approach, or of the diamagnetic body to retreat, when it is exerted in the contrary direction. Hence the author concludes that it is neither attraction nor repulsion which causes the set, or determines the final position of a magnecrystallic body.

He next considers it as a force dependent upon the crystalline condition of the body, and therefore associated with the original molecular forces of the matter. He shows experimentally, that, as the magnet can move a crystal, so also a crystal can move a magnet. Also, that heat takes away this power just before the crystal fuses, and that cooling restores it in its original direction. He next considers whether the effects are due to a force altogether original and inherent in the crystal, or whether that which appears in it, is not partly induced by the magnetic and electric forces; and he concludes, that the force manifested in the magnetic field, which appears by external actions and causes the motion of the mass, is chiefly, and almost entirely *induced*, in a manner subject indeed to the crystalline force and additive to it, but at the same time exalting the force and the effects to a degree which they could not have approached without the induction. To this part of the force he applies the word *magneto-crystallic*, in contradistinction to the word magnecrystallic, which is employed to express the condition, or quality, or power, which belongs essentially to the crystal.

The author then remarks upon the extraordinary character of the power, which he cannot refer to polarity; and gives expression to certain considerations and views which will be best learned from the paper itself. After this, he resumes the consideration of Plücker's results "*upon the repulsion of the optic axes of crystals*" already referred to, and arrives at the conclusion that his results and those now described have one common origin and cause. He then considers Plücker's results in relation to those which he formerly obtained with heavy optical glass and many other bodies. In conclusion he remarks, "How rapidly the knowledge of molecular forces grows upon us, and how strikingly every investigation tends to develope more and more their importance and their extreme attraction as an object of study! A few years ago magnetism was to us an occult power affecting only a few bodies; now it is found to influence all bodies, and to possess the most intimate relations with electricity, heat, chemical action, light, crystallization, and, through it, with the forces concerned in cohesion; and we may, in the present state of things, well feel urged to continue in our labours, encouraged by the hope of bringing it into a bond of union with gravity itself."

December 14, 1848.

Sir R. H. INGLIS, Bart., Vice-President, in the Chair.

The Chairman announced that the Earl of Rosse had nominated as Vice-Presidents—The Marquis of Northampton, The Dean of Westminster, George Rennie, Esq., G. B. Airy, Esq., W. R. Grove, Esq., Sir R. H. Inglis, Bart.

His Grace The Archbishop of Canterbury was elected into the Society.

The following paper was read:—

"On the effect of surrounding Media on Voltaic Ignition." By W. R. Grove, Esq., M.A., F.R.S.

The author refers to some experiments of his published in the Philosophical Magazine for December 1845, and in the Bakerian Lecture for 1847, relating to the difference of ignition generated in a platinum wire heated by the voltaic current, when the wire is immersed in atmospheres of different gases. In the present paper these experiments are continued, the current being passed through two platinum wires both in the same voltaic circuit, but immersed in atmospheres of different gases.

It appears from these experiments that the heat generated in the wire is less in hydrogen and its compounds than in other gases; and that when the wires and their atmospheres of gas are immersed in given quantities of water, the water surrounding the hydrogenous gases is less heated than that surrounding those which contain no hydrogen.

Similar experiments, in which the wires are immersed in different liquids, are then given; the heat developed appears not to depend on the specific heat of either the gases or the liquids.