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I. Does Magnetism posses any Influence over Organic Forces?

H. F. Baxter Esq.

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Mr F. B. W. White exhibited abnormal specimens of *Listera cordata*, *Ranunculus acris*, &c.

Mr Archibald Hewan, of Old Calabar, sent specimens of *Scleria Flagellum*. He says: "To this sedge, growing to the height of several feet, supporting itself by intertwining upon neighbouring shrubs, may be truly applied the motto, 'Nemo me impune lacessit,' it catches so speedily upon a very slight contact with it."

Mr M'Nab gave the following report on the flowering of plants in the open air in the Botanic Garden:—*Eranthis hyemalis*, January 16, 1862; *Corylus Avellana*, January 18; *Rhododendron atrovirens*, January 26; *Garrya elliptica*, January 28; *Crocus susianus*, January 28; *Helleborus purpureus*, January 29; *Leucojum vernum*, February 1; *Galanthus plicatus*, February 1; *Crocus vernus* vars., February 2; *Hepatica triloba*, February 7.

Professor Balfour mentioned that Professor Blume, the celebrated Dutch botanist, and an honorary member of the Society, had just died at Leyden, and that Willem Henderick de Vriese, another celebrated botanist, had also died at Leyden, on 23d January last. He had also to record the death of Mr Borrer, the eminent English botanist, and a Fellow of the Society; also that of Mr John Livingston, who had contributed valuable physiological papers to the Society's proceedings.

13th March 1862.—Professor BALFOUR, Vice-President,
in the Chair.

The following Gentlemen were duly elected Resident Fellows of the Society:—

JOHN MACDONALD, Esq.

THOMAS R. FRASER, Esq.

The following Donations to the Society's Library were laid on the table:—

Proceedings of the Royal Horticultural Society, Vol. II., No. 3.—From the Society.

The Canadian Naturalist and Geologist, Vol. VI., No. 6.—From the Natural History Society of Montreal.

Vegetable Morphology—its History and Present Condition. By Maxwell T. Masters.—From the Author.

Mittheilungen der naturforschenden Gesellschaft in Bern aus dem Jahre 1858–1860.—From the Natural History Society of Berne.

Verhandlungen der Schwizerischen naturforschenden Gesellschaft bei ihrer 43 Versammlung in Bern, 1858.—From the same.

Atti della Societa Elvetica delle Scienze Naturali riunita in Lugano, 1860.—From the Society.

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The following Donations to the Society's Herbarium were announced :—

From Dr Carrington—Specimens of *Scirpus Holoschanus* and *S. australis*.

From Mr John Sadler, specimens of the following British Mosses :—*Orthotrichum anomalum*, *O. rupestre*, *O. stramineum*, *O. rivulare*, *O. leiocarpum*, *O. Drummondii*, *O. Hutchinsii*, *O. pulchellum* and *Dicranum Grevilleanum*, collected by Dr Greville in 1823 on Ben-y-Gloe.

The following Donations to the Museum of Economic Botany at the Botanic Garden were noticed :—

From Mr F. Conquergood—Specimens of Spanish grass, *Macrochloa tenacissima*, with paper manufactured from it. The plant is the *Spartum* of the Romans, and the *Sparton* of the Greeks.

From Mr S. C. Mackenzie—The following fruits, modelled in wax, by the Misses Mackenzie, Calcutta :—Jackfruit, Guava, Custard-apple, country and Bombay Mangoes, Pomegranate, Bananas, Lichi, Taulsance (seed of *Borassus flubelliformis*), Kurralah (*Momordica Charantia*.)

From Mr R. G. Foggo—Specimens of Beech showing natural grafting.

From Mr William Gorrie—Lichi Fruit (*Nephelium Litchi*.)

Professor BALFOUR made a few remarks on the death of James Townsend Mackay, LL.D., M.R.I.A., Curator of the Botanic Garden, Trinity College, Dublin. Dr Mackay was a Nestor in botany, and was well known as the author of "Flora Hibernica." He died 25th February last, of bronchitis, at Dawson Grove, near Dublin, at the age of 87. For many years he had been affected with paralysis. He was attended assiduously by his friend Dr Croker. His remains were interred in Mount Jerome cemetery. He was elected a member of the Society in December 1836.

The following Communications were read :—

I. *Does Magnetism possess any Influence over Organic Forces?* By H. F. BAXTER, Esq.

The most inattentive observer of natural phenomena would soon be led to infer, that between the variations of the seasons and the development of organised bodies, whether plants

or animals, a most intimate relation and connection existed ; that between heat and light on the one hand, and vegetation on the other, the connection would be found, upon the least reflection, to be so intimate and dependent that the former might be considered, in ordinary language, as the cause of the latter. No special observation, by means of experiment, would be requisite to confirm this conclusion. It is far otherwise, however, with regard to phenomena in which no periodicity or variation during their occurrence is observed ; influences may exist, and be producing powerful effects, and yet, from their constant action, be entirely overlooked,—here, it need not be remarked, we require specific observation for their elimination. Now, since the discovery of diamagnetism, and the fundamental fact that *all* substances whatever are subject to magnetic influence, the conclusion that terrestrial magnetism must exercise some most important part over natural phenomena is irresistibly forced upon our minds. To solve one of the questions which naturally arise from this conclusion was the object of the present investigation ; and although the results were negative, from the inadequacy of the means employed, the principles upon which the experiments were conducted may perhaps be of some value, and worthy of publication ; but a minute detail of the experiments themselves may not be necessary, and will therefore be omitted.

Becquerel,* in some experiments upon the influence of electricity over the circulation of the sap in the Chara, placed a stem of the plant in a helix traversed by a current of electricity, so that the convolutions should be either parallel or perpendicular to the motion of the sap ; but no influence appeared to be exerted over the circulation of the fluid.

Dutrochet† submitted a plant (Chara) for ten minutes to the influence of a powerful electro-magnet (which could support about a couple of tons weight), without any effect being observed upon the motion of the fluid.

Wartmann‡ says, “ that one of the principal objects of his observations has been that of the influence of electro-magnetic

* *Traité de l'Electricité*, t. vii. p. 250.

† *Comptes Rendus*, t. xxii. p. 621 (1846).

‡ *Philosophical Magazine*, 1851, p. 378.

induction on the circulation of the sap and the direction of the organs ;” but has not, so far as I am aware, published his experiments or the results.

The experiments of which the following are the results were undertaken during the years 1852, 1853, 1854, and 1855 ; and it was during this inquiry that the question arose as to “the influence of magnetism over chemical action,” which formed the subject of two papers that have already appeared in the *Edinburgh New Philosophical Journal* ;* and in these papers will be found described the magnet and electro-magnet that were employed on the present occasion. Although the results of the experiments recorded in the present paper were, for the most part, obtained prior to that inquiry, they may nevertheless form a natural sequel to it. Their publication has been delayed from a hope that some more positive results might, on further investigation, be obtained ; but the want of the necessary means, and the expense attending the prosecution of the experiments, were such that the inquiry has, for the present, been reluctantly abandoned.

As it may be considered a law in vegetable physiology that all plants have a tendency, during the germination of the seeds, to develop in two diametrically opposite directions (the root and the stem), the question arose, might not this direction be altered or counteracted by submitting the seeds whilst germinating to the influence of magnetic force ? The experiments will be arranged under two heads : *First*, those in which the line of magnetic force was directed *perpendicularly* to the seed ; and, *secondly*, those in which the line of force was directed *transversely* to the seed.

§ 1. *Line of Magnetic Force perpendicular to the Seed.*

The large magnet was placed on a table horizontally, $3\frac{1}{2}$ feet from a window looking west—the marked pole uppermost.

The seeds of various plants, such as mustard, cress, rape, radish, peas and beans (broad), were made to vegetate in two boxes, one of which was placed between the poles of the magnet, the other out of the magnet’s influence, but subject, in other respects, to similar conditions. In whatever way the

* *Edin. New Phil. Jour.*, New Series, vol. v, p. 235 ; vol. vi. p. 25.

experiment was varied, there was no effect observed that could be attributed to the result of the magnet. The influence of light over the direction of the plant was very decided, and almost led, at the commencement of the inquiry, to the supposition that the results might be due to that of the magnet; but upon removing this source of interference, by screening the plants from the light, the effect ceased.

The beans (broad) were planted with the hilum and micropyle directed in every possible way. They were also made to vegetate in water, being suspended by means of threads, without any effect upon the *direction* of the radicle or plumule being observed.

The lines of force were concentrated by means of a bar of soft iron, so as to lessen the space between the poles; the results were the same.

The beans were made to vegetate in water, supported by means of pieces of cork, so as to render them moveable, under the supposition that they might take up some definite position in the magnetic fluid, but no effect was observed. Great difficulty, however, was experienced in these experiments in consequence of capillary action. If the vessel contained more than one seed, they were frequently drawn towards each other; or, if the vessel was small, they floated towards the sides. Some of the effect might have arisen from diamagnetic action driving the mass outwards. There was another circumstance which interfered with the results; as the plant grew, the stem, becoming heavier than the root, leaned more or less to one side, until it was completely overbalanced.

As *time* forms an important element in the consideration of the results, there is one circumstance connected with these experiments which must not be overlooked—viz., the difficulty in procuring a standard of comparison. It was impossible to get two seeds to vegetate and grow exactly alike,—for the buds and roots to appear at the same time,—although the greatest care was taken to obtain them of the exact weight, size, and appearance. Any one might easily have been led to the conclusion, that vegetation was either increased or rendered more rapid under certain conditions of the experiment than in others, had it not been checked by counter experiments.

The seeds were now made to vegetate around the poles of a magnet in the following manner:—Two circular stout bars of soft iron formed the terminals of the poles, and which could be separated to different distances at pleasure. The lower one was passed through the bottom of a flower-pot containing mould, in which the seeds vegetated; no effect was observed. An absence of the roots in the beans, on the sides contiguous to the pole, was observed; but as this fact was also noticed under other circumstances, when the seed was growing near to a solid body, it could not be referred to any repulsive action on the part of the magnet.

The beans were made to vegetate in water, instead of the mould, being suspended by means of corks or thread; no effect. The vessel was placed on the pole, and the upper pole over it, without any result being obtained.

§ 2. *Line of Magnetic Force transverse to the Seed.*

The first experiments were undertaken with Professor Wheatstone's large electro-magnet, but the difficulty in procuring and maintaining a *constant* force rendered the results doubtful.

The large magnet was now placed vertically, the marked pole being south.

A long, deep, but narrow trough, with moveable glass sides, which fitted into grooves in a wooden frame, was now employed; the space (the width) could be adjusted to a quarter, or half an inch, or to one inch, and its length was two feet, so that a portion could be placed between the poles of the magnet, whilst the remaining portion extended beyond the influence of the poles. To concentrate the magnetic force, two soft iron bars, or rather plates of iron, were so adjusted as to form the terminals, and prevented from coming into immediate contact by pieces of wood.

The seeds were made to vegetate chiefly in mould, and in several experiments some effect appeared to be produced; the mustard or cress which was growing in the part between the poles was occasionally higher than in that portion out of the influence of the poles. This effect, however, appeared to be due to the influence of the light; for when the outer portion

of the trough was screened from light by means of pieces of wood, the differences were not observed.

Beans were suspended in various directions, and made to vegetate in water, the trough having been made water-tight. No roots or mere prominences appeared on the sides in contact with those of the trough, but similar appearances were observed in those seeds that were out of the magnet's influence.

The experiments were varied by arranging the magnet with the marked pole north, then east, and then west. The results in all these instances were similar.

We should certainly not be justified, from these negative results, in coming to the conclusion, that magnetism is without any influence whatever over vegetation. I am far more disposed to conclude that the forces connected with the plant and its development are of such a nature as to resist the power of the magnet that was employed, and therefore would require more powerful means to make any effect perceptible. The reasons for forming this opinion may be gathered from my concluding observations.

Concluding Remarks.

It must be borne in mind that the present investigation comprises the question, whether Magnetism in a quiescent state (*i e.*, not in motion) has any influence over vegetation? Whether Magnetism when in motion has any influence, is another question. I will confine my observations first, to the former.

"It is a curious sight," says Faraday,* "to see a piece of wood, or of beef, or an apple, or a bottle of water, repelled by a magnet, or, taking the leaf of a tree and hanging it up between the poles, to observe it to take an equatorial position. Whether any similar effects occur in nature among the myriads of forms which, upon all parts of its surface, are surrounded by air, and are subject to the action of lines of magnetic force, is a question which can only be answered by future observation." My object has not been to develop the facts connected with the phenomena usually termed *diamagnetic*—that is to say, the influence of magnetism upon masses; but to

* Experimental Researches, vol. iii. *para.* 2451.

study the influence of magnetic force upon other forces whilst in action, and to ascertain whether or no the *structure* of bodies might not be governed in their formation by it. Professor Tyndall,* in a paper entitled "On the Nature of the Force by which Bodies are Repelled from the Poles of a Magnet," relates some experiments respecting the magnetic properties of wood. Of thirty-five specimens examined, he found that they all took up a definite position in the magnetic field; the line coinciding with the direction of the fibre being equatorial (diamagnetic); only one specimen (bog oak) taking up the axial position—and this was due to the extraneous matters (iron) with which the wood was impregnated. The different woods varied in their power of set, but they evidently showed an intimate connection to exist between the structure of the wood and the line or direction of the magnetic force. Let us consider for a moment the general facts connected with vegetation. We have plants growing upon a large magnet, the earth, and therefore under the constant influence of magnetic forces. There is every reason to believe, for experiment proves it, that the actions which take place in plants, viz., nutrition, secretion, and absorption, are accompanied with the development of electrical currents; and wherever electric currents are developed, we know that magnetism exerts a directive influence over them. There is no reason to suppose that magnetism initiates or originates these currents unless motion is superadded. Instead, therefore, of considering the ascent of the stem as an instance of diamagnetic repulsion, is it not more likely and probable that the organic actions of the plant—secretion, nutrition, and absorption,—under the influence of terrestrial magnetism, are so far governed as to be obliged to take up a certain line of direction, the resulting effect terminating in the form and mode of growth which we find plants to assume? These may be looked upon as wild notions; but the real point is, are they true or false?

With regard to the other question, viz., What grounds have we for supposing that magnetism when in motion may have some influence over vegetation? as I am not aware of any experiments having been undertaken for the purpose of eluci-

* Philosophical Magazine, 1855.

dating this point, let us refer to facts which bear upon it. Whenever a closed circuit of conducting matter, whether metals or otherwise, cuts or intersects magnetic lines of force in certain directions, a current of electricity is evolved in that circuit. It matters not which is in motion, the circuit or the magnet; and therefore, if a tree be in motion or a man be walking, and intersecting the magnetic curves or lines of magnetic force of the earth, and *if* there are closed circuits of conducting matter within his body or within the tree, electric currents are necessarily developed. Now we know that there are electric currents developed in the animal body as well as in plants, independent of magnetic influence.* I do not suppose, as was said just now, that magnetism *originates* these currents in plants, and therefore not in animals; but I think it highly probable, that both in plants and animals, whilst intersecting the magnetic curves of the earth by motion, that the same influence may be exerted over these currents, either by increasing them, if in the same direction, or by lowering their intensity if in a contrary direction, or if the tendency to their formation be too weak, by then aiding the actions for their formation. With respect to plants, Knight† has related some experiments, in which a tree was made to move to and fro in one direction, in a segment of a circle, and he found upon examining the tree afterwards, that it was thicker in the line of motion than in any other direction, in the proportion of 13 to 11. This result he attributes to motion; and he also alludes to exposed trees, agitated by winds and storms, as presenting a difference in their structure and growth as compared to those of an unexposed forest tree. I will ask this question, May not these results—I will not say they are—be due to the circumstance, that during the motion the magnetic curves of the earth are intersected, and consequently the various actions which take place in the plants—viz., secretion, nutrition and absorption—are influenced by the electric currents that are called forth within it?

The same observations may be made in regard to animals. Theoretically speaking, motion of parts, or in other words,

* Essay on Organic Polarity. Churchill. 1860.

† Physiological Papers.

exercise, ought to show some results; and does not experience prove this? Look at the blacksmith's arm. Nature never intended the plant, much more the animal, to remain in one constant position; an intersection of the magnetic curves of the earth may perhaps be as necessary a condition, if not for vital action, still for the development of the different forms that are observed in substances possessing structure, as the influence of heat and light is found to be for the development and maintenance of that action.

P.S.—Since writing the above paper, I find that the subject, "The Influence of Railway Travelling upon Individuals," has been brought before the attention of the medical profession in the "Lancet." It would be premature to say how far any of the effects that have been observed may or may not be due to the intersection of the magnetic curves of the earth, until we know more of the nature of the influence that might be exerted.

II. *Notes on Cyperaceæ, No. 2. On Scirpus Holoschænus, and S. australis.* By BENJAMIN CARRINGTON, M.D., F.L.S. (Plate VI.)

In 1849 I received from the Edinburgh Botanical Society a variety of *Holoschænus* (Link.), having a more graceful habit, and differing as follows from the Broughton Borrows plant, which is the typical form (*H. vulgaris*, Link., *H. Linnaea*, Reichenbach's *Flora excurs*).

The *stems*, 18 inches to 3 feet in height, are much more slender, terete, and tapering gradually into the long, setaceous bract. Base of the stem clothed with acute brown sheaths, the margins of which dissolve into a beautiful fibrous network. Upper sheaf ending in a long leaf, resembling the larger bract in form.

Capitula 3 to 5, about as large as a pea, either sessile, or solitary on short compressed stalks; never three or more on a pedicel, the central one larger than the rest, forming compound heads, as in *S. Holoschænus*.

Spikelets ovate-acute, giving a more muricate appearance to the capitulum.