THE

PHILOSOPHICAL MAGAZINE

AND JOURNAL:

COMPREHENDING

THE VARIOUS BRANCHES OF SCIENCE,

THE LIBERAL AND FINE ARTS,

AGRICULTURE, MANUFACTURES,

AND COMMERCE.

By RICHARD TAYLOR, F.L.S.

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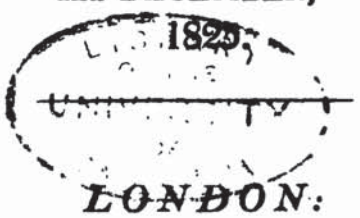
"Nec aranearum sane textus ideo melior quia ex se fila gignunt, nec noster vilior quia ex alienis libamus ut apes." Just. Lips. *Monit. Polit.* lib. i. cap. 1.

VOL. LXVI.

FOR

JULY, AUGUST, SEPTEMBER, OCTOBER, NOVEMBER, and DECEMBER,



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Silica	61·88
Magnesia	25·83
Protoxide of iron	9·12
Oxide of manganese	9·31
Oxide of chrome	0·33
Loss by ignition	0·45
	106·92—[?]

This mineral consequently contains for three equivalents of silica only one of magnesia, and is therefore to be considered as a trisilicate of magnesia; while the mineral of the olivine kind, from the Siberian and South American masses, as well as the olivine from the basalts, and chrysolite, are merely a simple silicate of magnesia. Whether, moreover, the oxide of chrome that occurs in it really belongs to its composition, or is only accidentally contained in it as an alloy of chrome and iron, cannot yet be decided by these experiments.

The discovery of this properly olivinic mineral in the meteoric iron at Gotha not only affords a proof of the difference of this iron from that of Pallas, but is certainly important also in regard to the knowledge of meteoric stones particularly; because, according to the silica and magnesia which is found in it, it is not improbable that this very kind of olivine forms pre-eminently the basis of meteorites.

Note.—To the concluding remark of Professor Stromeyer may be added a memorandum of Humboldt on a remarkable aërolite, a notice very interesting in respect to the science of meteoric stones, but still indeed very incomplete.

At the session of the Pharmaceutic Society at Paris, on the 16th May, Baron Humboldt announced that there had been found an aërolite which is really a volcanic production, because it consists of crystals of augite. It remains still doubtful whether it was ejected from a lunar volcano.

LIX. *A Letter from M.* Ampere *to M.* Gerhardi *on various Electro-dynamic Phænomena.**

I BEG to return you many thanks for the copy of your observations upon the work of the Chev. L. Nobili which you were kind enough to send me.

Your answers to several objections contained in that work against some parts of my theory of electro-dynamic phænomena appear to me in general very just, and are indeed in my opinion quite satisfactory. They had for the most part struck

* From the *Annales de Chimie*, tom. xxix. p. 373.

me

me when I read M. Nobili's work; in which, moreover, there are researches upon various circumstances of electro-dynamic phænomena which abound in interest.

You have plainly shown, sir, that the result of all the experiments described in that work entirely agrees with that deducible from my mode of explaining electro-dynamic phænomena. I must, however, add two observations to those you have already made on that subject. The first relates to my having asserted in a letter to Mr. Faraday dated April 18th, 1823, that the mutual action of two complete circuits, or of two assemblages of complete circuits, cannot produce the continuous rotatory movement in one of those two circuits or assemblages. (See my *Recueil d'Observations Electro-dynamiques*, p. 366.)—You have great reason, as well as M. Nobili, to reproach me with having stated in that passage (of a letter written in great haste), in too general a sense, a fact which is only true of complete circuits, or assemblages of complete circuits, which are *solid*; i. e. *of invariable form in their whole extent.* That it is true in that case, will be easy for you to ascertain; because in every position of two complete circuits, where one tends to impart to the other a motion of continuous rotation, it happens that whenever that motion takes place, the moveable complete circuit supports itself upon the other, and that the motion cannot continue without one of the two circuits having, where they meet each other, a liquid portion that the other can cross. But if I was wrong in that passage of my letter to Mr. Faraday, in not explaining that restriction, by saying "complete solid circuits, and of an invariable form in their whole extent," it was because I thought that the first glimpse of that passage would show that I meant to speak only of that sort of circuit; for the experiment of Mr. Faraday himself (where a magnet turns continually round a vertical conductor) has been known to me for a length of time; and it is evident from my formula, that in that case the continuous motion of rotation must take place, whether the electrical current do or do not cross the magnet, provided the mercury in which it is set up can open to let the magnet pass; in a word, provided the fixed circuit be in a liquid part. I was, moreover, led to think that what I said relative to the impossibility of producing a motion of continuous rotation by their mutual action would be confined to solid complete circuits, as that restriction omitted in my letter to Mr. Faraday was explained most completely in two places of my *Recueil*.

At page 235 of that collection of observations I have thus explained myself: "As soon as I saw, about the end of October 1821, the work of Mr. Faraday, in which he published, a

short time before, his important discovery of the continuous motion of rotation of a voltaic conductor round a magnet and of a magnet round a conductor, and in which he states that he was not enabled by the action of the latter to turn a magnet on its axis, I endeavoured to produce that sort of motion by causing magnets to act in every way I could imagine upon the moveable conductor which I had hitherto made use of in all my experiments, the two extremities of which were placed in the axis of rotation. I soon arrived at this general result, that so long as that circumstance is allowed to exist in a conductor, of which all the parts *are connected invariably together*, the continuous motion of rotation is impossible; and I easily concluded that it was equally so, by the mutual action of a magnet and a complete circuit of *invariable form*, since such a circuit may always be considered as the union of two portions of conductors, of which the extremities are in the same axis of rotation taken at pleasure."

And at page 356, in repeating that it is impossible to produce that sort of motion by employing magnets alone, or *solid* conductors forming complete circuits, I explained in a note at the bottom of the page the expression "*solid conductors*" thus; "It is to be understood by this expression, that all the parts of the portion of that conductor which forms a complete or nearly complete circuit are invariably connected together, and cannot alter their respective situations. When that portion is composed of two or several moveable pieces separately, or is formed entirely or partly of a liquid conductor, the motion of continuous rotation becomes possible."

You perceive, sir, that the limitation which establishes the correctness of what I have advanced, in the case where a rotatory movement becomes impossible, is pointed out in the most express terms in the above note contained in my *Recueil*, immediately preceding my letter to Mr. Faraday, and which was published more than two years ago.

The second observation relates to the remark that you make at page 16 of your paper, in consequence of your having deduced from the expression,

$$\frac{\pi m^2 i i'}{29}\left(\cos\theta' - \cos\theta'' - \cos\theta_1' + \cos\theta_1''\right),$$

which I gave in page 28 of my *Précis de la Théorie des Phénomènes Electro-dynamiques*, to represent the rotatory momentum produced by the action of an electro-dynamic solenoid on a conductor (which action may be in general compared to that produced on the same conductor by a magnet), that, supposing the two extremities of the conductor, and the two poles of the solenoid, or of the magnet, to be at the same time in the axis

of

of rotation, the continuous movement of the axis would take place when one of the poles is between the two extremities of the conductor, and the other pole without the space bounded by these extremities. This result from my formula agrees with that of the experiment made by means of the apparatus shown in Plate I. (fig. 1), although in this apparatus the lower extremity N of the moveable conductor MABN, which is immersed in the mercury of the cup PQ, is not terminated exactly at the axis. This is occasioned, on one hand, by the cosines of the angles θ_1' and θ_1'', relatively to the extremity N, differing but very slightly from the values -1 and $+1$ which these cosines would have if it were precisely in the axis; and on the other hand, by the value of the rotatory momentum, expressed in functions of the angles θ', θ'', θ_1', θ_1'' being applicable to this case, because the various points of the conductor are at much greater distances from the currents from the magnet than the radii of the circumferences described by these currents. But if we could suppose the conductor to penetrate the magnet, and terminate at a point D of the axis situated in its interior, we cannot say precisely what would be the result of such a supposition, which however it would be impossible to realize. For, the points of the portion CD of the moveable conductor being infinitely near to the currents from the magnet, the radii of circumferences described by those currents could no longer be considered as very small, relatively to the distances between each other and the points we are speaking of: thence the expression of the rotatory momentum which has been calculated without reference to the powers of those radii, superior to the third, would cease to give the value of that momentum. Therefore, if in the apparatus we have just described we were to substitute for the magnet an electro-dynamic helix, there would be still a continuous rotatory movement as long as the lower extremity N of the moveable conductor was outside of that helix, as it is outside of the magnet LL' (fig. 1): but if the helix having still for its axis that round which the moveable conductor is made to revolve, the moveable conductor may be disposed as in fig. 2, so that its lower extremity N should be, in like manner as its upper M, precisely in the axis. By making the horizontal portion BC of that conductor pass between the whorls of the helix, it would no longer have a tendency to revolve round the axis of those whorls; because for each of them there would be upon BC a point O, such as the rotatory momentum imparted by the action of the whorl to the portion MABO, in order to make it revolve in one direction, will be destroyed by an equal momentum, and of a contrary sign, resulting from the action of the same whorl to turn the

portion OC in a contrary direction. The opposition of those two actions evidently takes place only from the circumstance that the portion OC of the moveable conductor is in the interior of the helix; whereas the portion MABO is on the outside: but that circumstance cannot take place unless there be points of the moveable conductor at a distance from the two whorls between which it passes, less than that from one whorl to another; and then the value of the rotatory momentum in the function of the angles θ', θ'', θ'_1, θ''_1 is no longer applicable, as it rests upon these two suppositions; 1st, that the distance between two consecutive circular currents is infinitely small; and, 2d, that the distance from the several points of the moveable conductor to those currents is very great, relatively to the radii of the circles which they describe. The case, however, in which the value found for the rotatory momentum no longer exists, is peculiar to the electro-dynamic helices, and cannot be applied to magnets, since the moveable conductor cannot pass between the electric currents to which they owe their properties, and since the radii of the circles described by those currents are of a minuteness corresponding to the order of dimensions of the particles of bodies.

Thus no real difference appears between the action of a magnet and that of an electro-dynamic solenoid. It may be seen that the helix which is substituted for the latter, acts like a magnet, with the exception of that case only where a portion of the moveable conductor passes between its whorls, and extends into the interior of that helix; which circumstance cannot take place with respect to the magnet, of which the circular currents surround each particle. It may at the same time be perceived why the value of the rotatory momentum mentioned above ceases at the same time to express the action of the helix, although it always represents precisely that of the magnets; and how the continuous rotation of the moveable conductor (disposed as in fig. 1) is by no means opposed to the case of equilibrium which I have deduced between the two constants k and n of my formula, the relation

$$2k + n = 1,$$

and which I have proved by the experiment described at pages 311 and 312 of my *Recueil*. In that experiment the equilibrium takes place between the two actions formed by the circular horizontal conductor; the first, in one direction, upon the portion of the moveable conductor which corresponds to the interior of this circular conductor; the second, in a contrary direction, upon the portion of the moveable conductor which is exterior to it. Now, in the apparatus (fig. 1) the latter is quite exterior to the magnet; there is therefore action in one

one direction only, and the movement of continuous rotation is a necessary consequence of it. It is useless to add, that if the actions exerted by the horizontal conductor upon the two portions of the moveable conductor (which I have just mentioned) force it to turn in opposite directions, it is because the current from this last conductor cannot approach that of the horizontal conductor in one of those portions without diverging from it in the other, and *vice versâ*. However, as the manner in which I have established the relation

$$2k + n = 1$$

was not, perhaps, sufficiently rigorous, as I had verified it only on a describing current, either an entire or a semi-circumference, whereas it ought to have been done upon each *element* of the circular horizontal current, I have therefore produced another instrument, by which the same relation between n and k may be obtained in a more simple manner, and the inconvenience which I have just spoken of is avoided; because the experiment which I make with that instrument proves at once that the action of a complete circuit on an element of the electric fluid is always perpendicular to the direction of this element, which is sufficient to demonstrate that $2k + n = 1$, as I shall show in a note which I intend to publish shortly, and where the description of the instrument here presented will be found.

Paris, Aug. 16th, 1825.

LX. *Memoir on a new Electro-dynamic Experiment, on its Application to the Formula representing the mutual Action of the two Elements of Voltaic Conductors, and on some new Results deduced from that Formula.* By M. Ampere.*

THE manner in which I have determined the relation between the two co-efficients of the formula by which I represented the mutual action of the two elements of electric currents, in the memoir which I read before the Academy on the 10th of June 1822, being liable to some difficulties, I have endeavoured to establish this relation in a more simple and direct manner. I succeeded in this very easily by means of an instrument which I shall first describe; I will then present some new results which I have deduced from this formula.

On a stand TT' Plate I. (fig. 3) in the shape of a table, two

* From the *Annales de Chimie et de Physique*, tom. xxix. p. 381. This memoir was read at the Royal Academy of Sciences of Paris, at the sitting of the 12th of September last.

columns

Fig. 1.

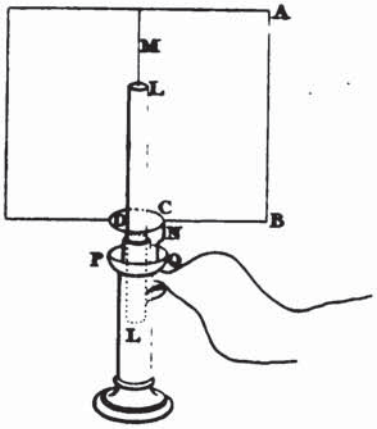
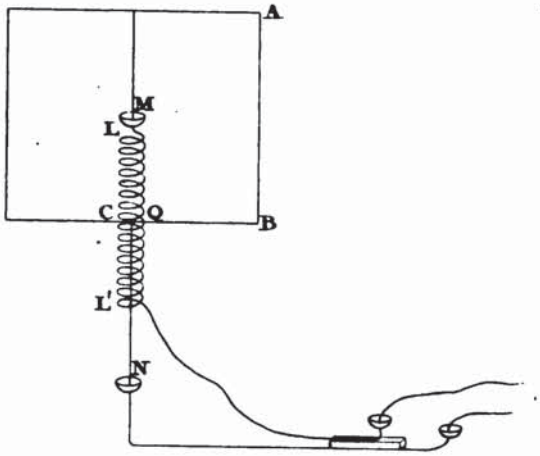


Fig. 2.



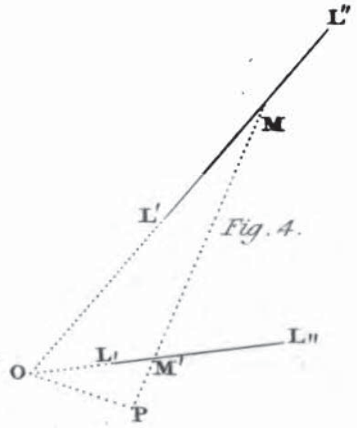


Fig. 4.

Fig. 3.

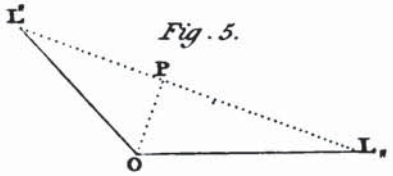


Fig. 5.

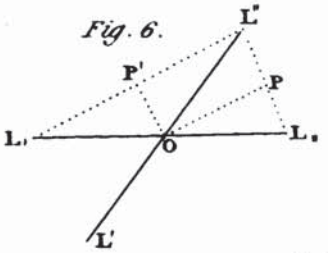


Fig. 6.

Porter Sc.