

The communication being now made at A and D with the battery, the spiral will immediately arrange itself, as in the last case, in a plane perpendicular to the magnetic meridian. This experiment is originally due to M. Ampere, but the mode of suspension described is that of Professor Van den Boss. See *Edin. Journ. of Science*, No. XII.

A needle upon a different construction, also due to M. Ampere, is shown in (fig. 23.)

The same otherwise.

286. The directive quality of the galvanic wire has been since exhibited in a variety of ways, much more simple than that above described, of which we shall only state the following:

M. de la Rive's apparatus.—This consists of a small galvanic combination attached to a cork; the plate of zinc is nearly half an inch wide, and extends about one and a half or two inches below its cork, its upper end passing through the same; the slip of copper is of equal width to the zinc, but passes round it, being thus opposed to both its surfaces, as in Dr. Wollaston's construction; its upper end also appears through the cork. A piece of copper wire, covered with silk thread, is coiled five or six times, and tied together so as to form a ring about an inch in diameter, and the ends of the wire are connected, by solder, one with

the zinc, and the other with the copper slip above the cork. See (fig. 25).

When this small apparatus is placed in water, slightly acidulated with sulphuric or nitric acid, the ring becomes highly magnetic, and will arrange itself in a plane perpendicular to the magnetic meridian, or it will at least indicate a tendency to take up that position, but the escape of the bubbles, arising from the decomposition of the water, prevents it from preserving a fixed direction.

Its magnetic qualities, however, are more obviously shown by bringing to it a strong magnet. The one I made use of is cylindrical, about three quarters in diameter, and 18 inches in length. This being applied at the distance of several inches, the ring was immediately attracted, or repelled, accordingly as one or the other of the poles of the magnet was presented, or accordingly as one or the other side of the wire was opposed to the latter. When the result of the application is attraction, the cork will advance towards the extremity of the magnet, and if the latter be held horizontally, and in a line with the centre of the former, this will continue to advance till the pole of the magnet is within the ring, and then proceed with considerable velocity till it reaches the middle of the magnet, where it remains perfectly stationary. If now the magnet be withdrawn, and changed end for end,

and re-introduced into the ring, the latter will go off from the magnet, turn itself round when quite free from it, again advance, and settle itself as before in the centre.

This very simple apparatus, which may be made at the expense of about a shilling, throws great light upon the nature of the electro magnetic action, and proves most satisfactorily that, notwithstanding the intimate relation between the electro magnetic and simple magnetic fluids, they are not identical; for no possible arrangement of simple magnets can be made that would lead one of them beyond the pole of another to find its state of equilibrium in the middle of the latter. At the same time all the above facts will be found perfectly consistent with the hypothesis that has been advanced; for it will be seen, when the wire and cork are in equilibrio, as above stated, that an observer, conceiving himself situated as in (art. 258), will have the north end of the magnet to his left hand, and the south to his right, at equal distances, and acting therefore with equal and opposite powers; consequently the wire itself ought to be in equilibrio, and when disturbed from it will have a tendency to regain it, and hence be subject to all the conditions of motions that have been described. This is in fact very similar to experiment 4, the difference only consisting in this, that in the present case the wire is moveable and the

magnet fixed, whereas in the former the wire was fixed and the magnet free ; the explanation is of course the same in both.

Another form of this apparatus is shown in (fig. 26.)

Both the above apparatuses are much improved by fixing to the cork a light glass cylinder A B to contain the acid, instead of floating them in it ; the apparatus may then be floated on common water, and all the facts exhibited as above described.

This appendage to the original construction is due to Mr. James Marsh,* already mentioned.

287. *Apparatus of Prof. Van den Boss.*— Here C D (fig. 27) is a copper plate, E G a similar one of zinc, about an inch square, kept from touching each other by the interposition of some small piece of wood : both plates are attached and suspended to slender brass wires P and R. The wire P enters at P, in the hollow space formed by a case of very thin quills inserted into each other, about 6 or 7 inches long. The end of the wire comes out of the quill at the extremity T, and

* This ingenious workman has just completed a portable electro galvanic apparatus ; which within the space of little more than a cubic foot, contains not only the necessary galvanic combination, but also all the instruments necessary for repeating nearly the whole of the experiments detailed in this Section.

returns, being wound as a spiral about it to the other extremity V, where it again enters the quill, and proceeds in a right line to R, where coming out it descends, and is attached to the other plate. The whole is suspended in equilibrio to a piece of untwisted silk X. The plates are now dipped into dilute acid, and the whole is suspended at X, when immediately the magnetic quality of the wire becomes manifest; but, like the former instrument, it is not so sensible to the terrestrial as to the action of a strong artificial magnet, with which its extremities T and V may be attracted or repelled, according as the one or the other pole of the magnet is applied; and which ought necessarily to be the case agreeably to the explanation given in the preceding case.

EXPERIMENT XVII.

To examine the inclination of a freely suspended galvanic wire as affected by the terrestrial magnetism.

288. This is an experiment of M. Ampere, in which he employs the apparatus exhibited in (fig. 28), where the galvanic circuit is carried on from the extremity of the battery towards V, passes by V-S, through the steel pivot *k*, placed on the metallic plate N, and thence through the rectangle A B C D; whence, passing through the tube *x y*,

U

Fig. 24

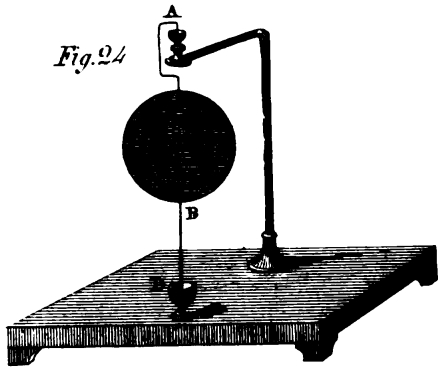


Fig. 32

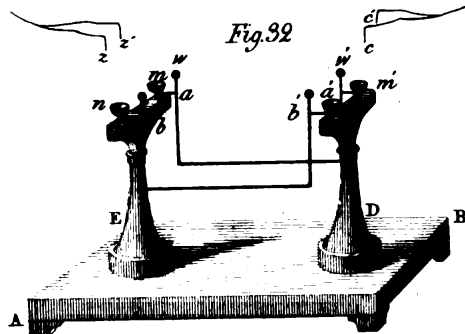


Fig. 21

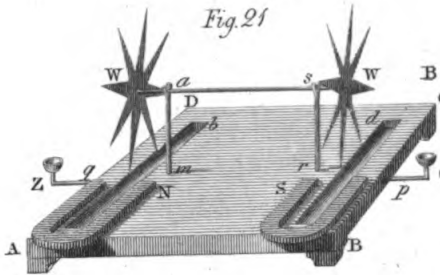


Fig. 23

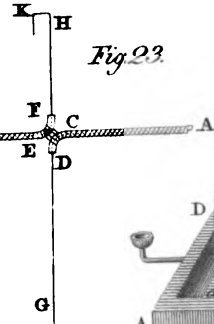


Fig. 29

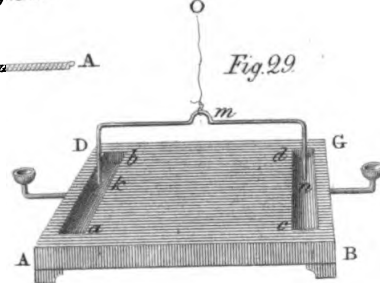


Fig. 28

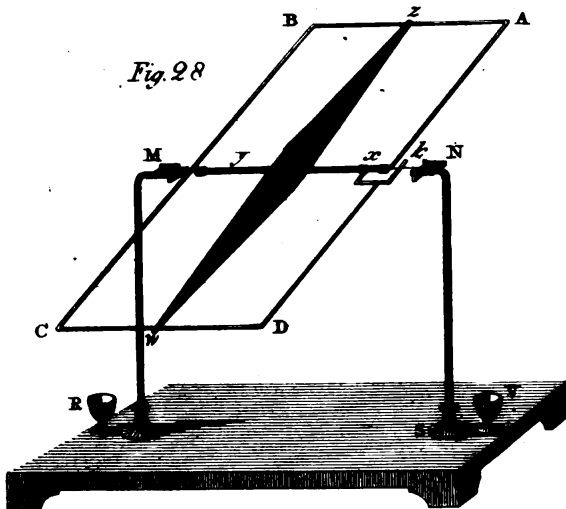


Fig. 31

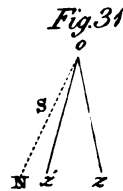


Fig. 30

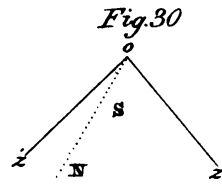


Fig. 29

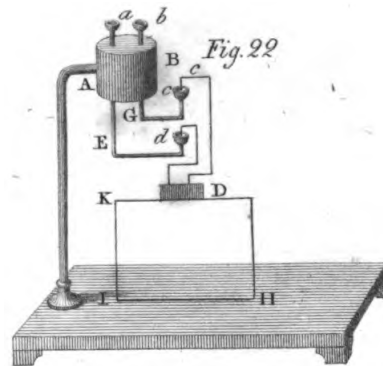


Fig. 25

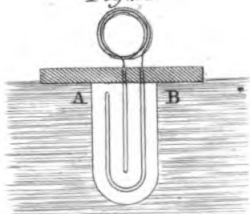


Fig. 26

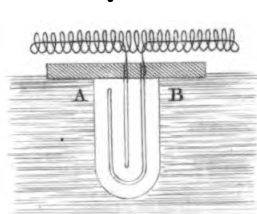
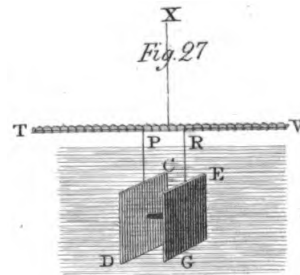


Fig. 27



Drawn by P. Barlow Junr.

Engraved by W. Lowry.