the iron cylinder could be destroyed or reversed at plea­sure. Upon making magnetic contact, the needle was de­flected ; continuing the contact, the needle became indif­ferent, and resumed its first position: on breaking the con­tact. It was again deflected, but in the opposite direction to the first effect, and then it again became indifferent. When the magnetic contacts were reversed, the deflections were reversed. When the magnetic contact was made, the de­flection was such as to indicate an induced current of elec­tricity in the *opposite* direction to that fitted to form a mag­net, having the same polarity as that really produced by contact with the bar magnet.”

But in order to show that it was by the approximation of the magnets that the momentary induced current was excited, Dr Faraday substituted for the soft iron cylinder a cylindrical magnet 8½ inches long, and ¾ths of an inch in diameter. He introduced one end of this magnet into the axis of the helix, and then, the galvanometer needle being stationary, the magnet was *suddenly thrust in,* the needle was then instantly deflected in the same direction as if the magnet had been formed by any of the two preceding pro­cesses. “ Being left in, the needle resumed its first posi­tion, and then the magnet being *withdrawn,* the needle was deflected in the opposite direction. These effects were not great, but by introducing and withdrawing the magnet, so that the impulse each time should be added to those pre­viously communicated to the needle, the latter could be made to vibrate through an arc of 180° or more.@@1”

Although the law which governs the evolution of elec­tricity by magneto-electric induction, is very simple, yet Dr Faraday has found it rather diffi­cult to express it, except in refer­ence to diagrams. We shall there­fore give it in his own words. “ If in fig. 74, PN represent a horizontal wire passing by a mark­ed magnetic pole, so that the di­rection of its motions shall coin­cide with the curved line proceed­ing from below upwards ; or if its motion parallel to itself be in a line tangential to the curved line, but in the general direc­tion of the arrows ; or if it pass the pole in other directions, but so as to cut the magnetic curves@@2 in the same general direction, or on the same side as they would be cut by the wire if moving along the dotted curved line ; then the current of electricity in the wire is from P to M. If it be carried in the reverse direction, the electric current will be from N to P. Or if the wire be in the vertical position, as at P'N', and it be carried in similar directions, coin­ciding with the dotted horizontal curve, so far as to cut the magnetic curves on the same side with it, the current will be from P' to N,. If the wire be considered a tangent to the curved surface of the cylindrical magnet, and it be car­ried round that surface into any other position, or if the magnet itself be revolved on its axis, so as to bring any part opposite to the tangential wire ; still, if afterwards the wire be moved in the directions indicated, the current of electricity will be from P to N ; or if it be moved in the opposite direction, from N to P ; so that as regards the mo­tions of the wire past the pole, they may be reduced to two, directly opposite to each other, one of which produces a current from P to N, and the other from N to P.

“ The same holds true of the unmarked pole of the mag­net, except that if it be substituted for the one in the figure, then, as the wires are moved in the direction of the arrows, the current of electricity would be from N to

P, and when they move in the reverse direction, from P to N.

“ Hence the current of electricity which is excited in metal when moving in the neighbourhood of a magnet, de­pends for its direction altogether upon the relation of the metal to the resultant of magnetic action, or to the mag­netic curves, and may be expressed in a popular way, thus : Let AB (fig. 75) represent a cy­linder magnet, A being the mark­ed pole, and B the unmarked pole ; let PN be a silver knife-blade resting a- cross the magnet, with its edge up­ward, and with its marked or notched side towards the pole A ; then in whatever direction or position this knife be moved edge foremost, either about the marked or the unmarked pole, the current of electricity produced will be from P to N, provided the intersected curves proceeding from A abut upon the notched surface of the knife, and those from B upon the unnotched side. Or, if the knife be moved with its back foremost, the current will be from N to P in every possible position and direction, provided the intersected curves abut on the same surfaces as before. A little model is easily constructed, by using a cylinder of wood for a magnet, a flat piece for the blade, and a piece of thread connecting one end of the cylinder with the other, and passing through a hole in the blade, for the magnetic curves; this readily gives the result of any possible direction.

“ When the wire under induction is passing by an elec­tro-magnetic pole, as for instance, one end of a copper helix traversed by the electric current the direction of the current in the approaching wire is the same with that of the current in the parts or sides of the spirals nearest to it, and in the receding wire the reverse of that in the parts nearest to it.

“ All these results show that the power of inducing electric currents is circumferentially exerted by a magnetic resultant, or axis of power, just as circumferential mag­netism is dependent on, and is exhibited by an electric current.”@@5

Dr Faraday has made several experiments with the large compound magnet of Dr G. Knight, belonging to the Royal Society, and consisting of 450 bar magnets, each 15 inches long. The electrical effects which it exhibited were very striking. When a soft iron cylinder, 13 inches long, was put through the compound hollow helix, with its ends arranged as two general terminations, and these connected with the galvanometer ; then, when the iron cylinder was brought in contact with the two poles of the magnet, so powerful a rush of electricity took place, that the needle whirled round many times in succession. When Dr Fara­day brought the helix alone near to or between the poles, the needle was thrown 80°, 90°, or more, from its natural position.

Dr Faraday failed in obtaining evidence of chemical decomposition by the magnet, or any sensation on the tongue, or any effect on a frog, but he afterwards, by an armed loadstone of Professor Daniell’s, lifting 30 pounds, not only thought that he perceived a sensation on the tongue, and a flash before the eyes, but was able to produce a very powerful convulsion in the limbs of a frog, every

@@@1 Experimental Researches, p. 11, or Phil. Trans. 1832, p.

@@@2 By magnetic curves, I mean the lines of magnetic forces, however modified by the juxtaposition of poles, which would be depicted by

iron filings, or those to which a very small magnetic needle would form a tangent.

@@@3 Experimental Researches pp. 32, 34.