tween the two cups of mercury by two copper cylinders grasped in the hands, a strange sort of shock will be expe­rienced, which is sometimes almost intolerable. Chemical decompositions are also readily effected, and the amount will be proportioned to the quantity of electricity in circu­lation.

The magneto-electric machine has been greatly improved by Mr E. M. Clarke, magnetical instrument maker, Lon­don. It is represented in fig. 79, where A is the battery of bent bar magnets rest­ing against the vertical board B, and by means of a bar of brass C, with a bolt and screw-wheel, the magnets can be drawn firmly to the board B, or taken from it. One of the keepers or armatures D is screwed into a brass mandrill between the poles of the magnets, and it is made to revolve by the multiplying wheel E. This armature has two coils of fine copper wire 1500 yards long wrapped round its cylinders, the beginning of each coil being soldered to the armature D, from which also projects a brass stem carrying the break piece H, which can be fastened in any required position by a binding screw. A hollow brass cylinder K, to which the ends of the coils are soldered, being insulated by means of a piece of hard wood attached to the brass stem. An iron wire spring O presses at one end against the cylinder K, and is kept in contact with it by a screw in a brass strap M in the wooden block L. A square brass pillar P fits also a square opening in the other brass strap N on the other side of the block L. A metallic spring Q rubs gently upon the break piece H, and is retained in perfect metallic contact with it by a screw in the pillar P, the two straps of brass M, N, are connect­ed by a piece of copper wire T, and in this state the parts D, H, Q, P, N are in connexion with the commencement of each coil, and the parts K, Ο, M with the termination of each coil. The perfect metallic contact thus obtained by the spring and break, enables Mr Clarke to dispense entire­ly with the use of mercury, which is at all times a trouble­some accompaniment of machinery.

But the great superiority of Mr Clarke’s machine arises from his employing two different armatures, and thus being enabled to produce the separate effects of quantity and in­tensity to the full extent of the power of his battery. Having, in November 1834, tried the effects of coils of wire of different thicknesses, he found that the thick copper bell wire gave brilliant sparks, but no perceptible shock, while very fine wire gave powerful shocks, but very feeble sparks. By means of the *intensity armature,* which is that shewn in fig. 79, the various experiments made with a number of separate galvanic plates may be performed, while the in­tense agony produced by its shocks is intolerable: It can, at the same time, electrify the most nervous person without occasioning the least uneasiness. It decomposes water and the neutral salts. It deflects the gold leaves of the electro­scope, charges the Leyden jar; and by an arrangement of wires from the mercury box to the battery, the electricity is made visible, passing from the magnetic battery to the ar­mature, and sparks and brilliant scintillations of steel can be obtained.

The *quantity armature* differs greatly from the inten­sity one, as is shewn in fig. 80, which exhibits the method of producing the spark. The weight of the iron in the cylinders is much great­er than in the intensity one, the copper wire is much thicker, and its length is only forty yards. By this armature all the experiments can be made which are usually per­formed by a sin­gle pair of vol­taic plates of large surfaces, or by a calorimotor; but it will not do for any of the intensity experiments. It produces such large and brilliant sparks, that a person can read small print from the light it produces. Il ignites gunpowder and platina wire, without enclosing the wire in a hermetically sealed glass case. It deflagrates gold and silver leaf, and produces brilliant scintillations from a small steel file. It produces also rotatory motions in delicately suspended wire frames round the poles of a vertical horse-shoe magnet,@@1 and all the other effects of voltaic electricity.

Several very curious and unexpected results were ob­tained on a magneto-electric machine of very large dimen­sions, which Mr Clarke exhibited at the meeting of the Electrical Society. The battery was separated into two parts connected by the armatures, the quantity armature being at one side, and the intensity one at the other. The quantity armature had a short coil of thick insulated cop­per wire, and the intensity one had 15,375 yards of fine copper wire. The intensity arrangement, to the surprise of every body, gave no decomposition, but gave an excru­ciating, and even dangerous shock, while the quantity ar­rangement gave one cubic inch of the mixed gases in four minutes. Considering these unexpected results as owing to a compound action produced by the rotation of the two armatures, he arranged the magnets as in his first machines, the only difference being in the size of the new machine, and in the armatures being moved by a crank and treadles. The battery was composed of ten cut and polished steel bars, each four feet long, the whole weighing 156 lbs. Ac­cording to Mr Noad,@@2 the novel results of the experiments were the great amount of gas given by the quantity arma­ture, viz. one cubic inch in one and a half minutes, and the trifling decomposing effect of the intensity armature. The intensity spark was long, straggling, and noiseless, like a spark at the striking distance from the prime conductor of an electrical machine, while the quantity spark had the usual stellar form, but was attended with a loud snapping noise, as in the discharge of a Leyden jar. Both the sparks, however, were equally luminous. By employing a second­ary coil, Mr Noad has given shocks with the quantity ar­mature, almost as powerful as those obtained from the in­tensity one, by using the form of coil first proposed by Pro­fessor Callan of Maynooth, and the contact-breaker of Dr Golding Bird.

The following arrangement (fig. 81 ) for producing powerful shocks, and strong chemical action by secondary currents, was first given by Dr Golding Bird. Upon a reel, with a hollow axis three inches long, wound about 60 feet of cop-

@@@1 See Loud, and Edin. Phil. Mag., Oct. 1836, No. 54, vol. ix. p. 262, and Noad’s Lectures, p. 344.

@@@2 Lectures on Electricity, p. 352.