Sect. VII—*On the Physiological Effects of Voltaic Electricity.*

The effect of voltaic electricity on animal bodies is ana­logous to that of ordinary electricity, a subject which we have already treated at considerable length.@@\*

The galvanic shock is not conveyed through the skin of the human hand in the same manner as the electric shock. This arises from its low intensity, in consequence of which it can be transmitted only through good conductors. The best way is to grasp with both hands wet, two silver spoons, or two metallic belts, and by means of them form a connec­tion between the poles of the battery.

A luminous spark is produced by voltaic electricity, when the eye forms part of the circuit. This may be done by placing a piece of silver between the gums and the upper lip, and inserting a silver probe into the nostrils. If a piece of zinc is then laid upon the tongue, and the two metals brought into contact, the flash will be seen. This, and other affections of the eye, were observed by Ritter, who declares that when the positive pole was inserted, in his eye he *saw objects darker and less,* and when the negative pole acted upon the eye, he saw the same objects *brighter and larger.* But according to Purkinje, the only differ­ence is, that the *positive* pole excites less light than the negative pole. Purkinje also observed, that by the appli­cation of the positive pole to the eye, a *yellow* light was excited, while the *negative* pole excited a *violet* light, brighter and more abundant than the yellow. He also ob­served that the luminosity was excited principally at the base of the optic nerve, and at the *foramen centrale* of the retina. With the *positive* pole the base of the nerve ex­hibited a bright *violet* light, and the dark foramen was sur­rounded with a double rhomboidal limb of *yellow* light ; but with the *negative* pole the base of the nerve was *black,* and the foramen was *violet,* and surrounded with a *violet* rhomboidal limb, at a little distance from the foramen. He noticed also, that when the voltaic circuit was broken, the preceding colours passed into their opposite or comple­mentary ones.

If a living leech, or an earthworm, is placed upon a crown piece, laid upon a piece of zinc of a larger size. It experiences no uneasiness while it touches the silver only ; but when it stretches itself, and touches the zinc. It in­stantly draws itself back, as if it had received a shock.

The influence of voltaic electricity upon the muscles of animals after death, is very remarkable. This subject lias been recently investigated by Marianini, Nobili, Peltier, and Becquerel ; but our limits will not permit us to give even the shortest account of their labours.@@2 We must content ourselves with mentioning a few interesting facts. If the negative and positive wires are inserted in the ears of an ox or sheep taken from the body of the animal recent­ly killed, strong convulsive motions will be excited in the muscles of the face, whenever the circuit is completed, provided the battery have an hundred pair of plates. Lite seems to be restored, and the animal to be under great suffering. The eyes open and shut, and roll in their sock­ets ; the pupils dilate ; the nostrils expand and vibrate ; and the jaws move as in mastication. If a horse is sub­jected to powerful galvanic action, when recently killed, the struggles of its limbs can scarcely be restrained by se­veral persons.

Similar experiments were made in Glasgow in 1811, by Dr Ure, on the body of a criminal after execution. He used a battery of 270 pair of four inch plates. When the spinal marrow and sciatic nerve were made the points of communication with the positive and negative poles, the whole body shuddereα as with cold. The left side was most powerfully convulsed ; and upon moving one of the rods from the hip to the heel, the knee being previously bent, the leg was thrown out with such violence as nearly to knock over one of the assistants. By acting upon the nerves connected with the respiratory system, a laborious breathing instantly commenced, and the chest heaved and sunk. When a communication was made between the super- orbital nerve and the heels, “ most extraordinary grimaces,” says Dr Ure, “ were exhibited, by running the wire in my hand over the edges of the plates in the last trough, from the 220th to the 278th pair. Thus, fifty shocks, each greater than the preceding ones, were given in two seconds. Every muscle of his countenance was simultaneously thrown into fearful action. Rage, horror, despair, and anguish, and ghastly smiles, united their hideous expression in the mur­derer’s face, surpassing far the wildest representations of a Fuseli or a Kean. At this period, several of the specta­tors were obliged to leave the room, from terror or sick­ness, and one gentleman fainted.” The last experiment made by Dr Ure consisted in transmitting the voltaic cur­rent from the spinal marrow to the ulnar nerve. “ The fingers now moved nimbly, like those of a violin performer. An assistant who tried to close the fist, found the hand to open forcibly in spite of his efforts. When one rod was applied to a slight incision on the top of the fore finger, the fist being previously clenched, the fingers extended instantly ; and from the convulsive agitation of the arm, he seemed to point to the different spectators, some of whom thought he had come to life." In these experi­ments the *positive* wire communicated with the *nerve,* and the *negative* with the *muscles.*

M. Becquerel mentions he effect produced by a pile of 100 plates, upon the head of a person who had been guil­lotined. The two poles of the pile communicated with the two ears, wetted with salt water. The muscles of the face experienced the strongest contractions, and the action of the eye-lids was extremely distinct. Aldini obtained an­alogous, though feebler effects, in experiments on a body after a natural death. Experiments of a similar kind have been made upon insects and fishes. Μ. Zanotti of Bolog­na, having killed a cigala, (grasshopper,) he placed it in contact with the two extremities of the pile, when it im­mediately moved, and emitted the sounds which are pecu­liar to it. M. Becquerel mentions also, that a fish whose head had been cut off half an hour before, struck the table with its tail, when excited by the voltaic current, and its whole body leaped about the table.

Sect. VIII.—*On the Secondary Agency of Electric currents.*

Dr Faraday has shown that many cases of voltaic decom­position of substances held in solution by water, such as nitric acid, ammonia, &c., are due not to the direct action of the current, but to the secondary agency of the elements of decomposed water. He, however, conceived that the hydracids in solution are directly decomposed by the current. Mr Connell has endeavoured to show that the decomposition of these substances also is secondary. This he did by connecting them by asbestus with distilled water, and making the acid negative and the water positive, when it was found that no chlorine or iodine was carried to the positive pole until after some time, when the acid itself had been carried over ; whereas, when the battery was revers­ed so as to cause evolution of oxygen in the acid solution, chlorine or iodine immediately appeared by the combina­tion of the nascent oxygen with hydrogen of the hydracid. From an extensive series of experiments on solutions in water, alcohol, and other solvents, Mr Connell has been

@@@1 Se Electricity, vol. viii. p. 609, &c. and p. 638, &c.

@@@5 See Becquerel's Traité, &c, tom. iv. p. 211—255, for full and interesting details on this branch of the subject.