In order to understand how the electricity of each galvanic pair is accumulated in the pile, let C, fig. 4, be a plate of *copper,* or a *negative* element, communicating with the ground by a wire or chain, W. When a plate of *zinc* Z, or a *posi­tive* element, of the same size, is placed above it, a decomposition of electricity will take place at the instant of contact ; the *negative* electricity will pass in­to the copper and through the wire W into the ground ; while the *positive* electricity will enter the *zinc,* and ac­cumulate, till its tension, or the thickness of the electrical stratum, is a maximum which we shall call 1. If we were to make the zinc plate Z communicate with the ground by another wire, the positive electricity with which it is charged will be carried off like the negative electricity from the copper disc, and the electricity, set free by the con­tact of the two metals, would be carried off as soon as it is generated. By uniting the extremities of the two wires the electricities would be recomposed, and a continual cir­culation of electricity would take place. The disc of *cop­per* C, communicating with the ground as in the figure, and the *zinc* disc Z, having an electrical intensity equal to 1, let us place upon Z a wet disc D of card. The positive electricity will pass from Z to D till the tension of the elec­tricity in D is equal to 1, a fresh supply arriving from the contact of the two metals. The same electrical state will continue when a second plate of copper, C2, is placed above the disc D. But if we place a second plate of zinc, Z2. It will acquire from the copper beneath it and the wet disc an electrical intensity equal to 1, and from its own action on the copper it will acquire another portion of electricity equal to 1, so that its electrical intensity will be 2. While this is going on, the negative electricity developed in the copper will be neutralised by the positive electricity which it possesses, and in the first pair, CZ, there will be a new development, by which the first zinc disc Z will be brought back to an intensity 1, as well as the disc D and the second copper C2. Hence the second zinc disc, Z2, can be in equi­librium only when it has an intensity double of that possess­ed by the first. In like manner the third zinc disc will have an intensity 3, the fourth 4, and so on, the fortieth having an intensity 40.

In the voltaic pile which we have now described, the *negative,* or copper pile, communicates with the earth, and the intensity of the *positive* electricity increases, at every pair, from 1 to 40. If we take another pile of similar dimensions, in which the zinc or positive pile communi­cates with the earth, then the intensity of the negative electricity will increase from 1 to 40. Let us now place these two poles together, so that the two poles in com­munication with the ground are supported by a wet disc of card, we shall have a pile of eighty pair of plates, in the middle of which the electricity is in its natural state. Its in­tensity being there 0, while at one end there will be a *posi­tive* pile whose intensity is 40, and at the other end a *nega­tive* pile whose intensity is also 40.

In a voltaic pile thus insulated we have electricity of op­posite kinds accumulated at its two poles, and of any inten­sity we choose. If we now place a wire in contact with one pole, and another wire in contact with the other, and bring their extremities together, we shall observe an *elec­tric spark.* By separating them and again bringing them together, another spark will be seen, so that there is a con­tinual current of fire passing from the one extremity or pole of the wire to the other.

If we now unite the two extremities of the two wires, so as to close the circuit, every thing will appear to be at rest, but, notwithstanding this state of apparent repose, the elec­

trical actions are still going on ; the electrical fluid is de­composed in each pair of plates, and again recomposed in the conducting wires. In order to prove this, we have only to interpose a piece of slender wire between the extremi­ties or poles of the conducting wires, when it will either become hot, or red hot, or white hot, or be fused, according as it is longer or shorter, or of a greater or a less diameter. In like manner, water, acids, and other compound substances are all decomposed when placed between the poles and the wires, so as to form part of the galvanic circuit.

CHAP. I.—DESCRIPTION OF GALVANIC APPARATUS.

In performing these experiments, and drawing from this powerful agent all the electrical energy which it is calcu­lated to yield, a great variety of apparatus has been employ­ed. When a voltaic pile consists of many couples, their superincumbent weight presses all the water or other fluid from the discs of card or cloth, and thus injures the action of the pile. In order to avoid this, Volta introduced the *“couronne des tasses,”* which is represented in fig. 5, where A, B, D, &c., are three or more glass vessels containing acidulated water or diluted sul­phuric acid ; the plates Z and C of zinc and copper, about two inches square, are soldered to the ends of a bent metallic wire, M, N, &c., and are immersed in the water in the vessels. About thirty of these cups are sufficient to give a shock. When the circuit is closed, by joining the ends of the wires W, W,gas is actively evolved at all the surfaces of the plates, but when the cir­cuit is broken the evolution of gas ceases in the copper plate, and becomes less copious in the zinc.

A valuable modification of the “ *couronne des tasses,”* called the *trough battery,* was suggested by Dr Wilkinson and Dr Babington. Plates of zinc and copper, about four inches square, are joined together in pairs, by being solder­ed at one point. The pairs of plates are then attached to a strip of well dried and varnished wood, A B, fig. 6, so that the whole can be placed in a trough, T T, made of earthen- ware or wood, with as many partitions as there are pairs of plates. When the trough is of earthenware the partitions are of the same sub­stance, but if they are made of wood the partitions are made of glass. When diluted sulphu­ric acid is poured into the cells of the trough T T, the battery A B, is immersed in it, so that each pair shall be separated from the adjoining one by a partition of the trough. This apparatus has the great advantage of allowing us to clean or repair the plates, without pouring out the fluid, which can also be changed with great facility. The powerful voltaic battery, constructed for the Royal Institution by Mr Eastwick, under the direction of Sir H. Davy and Mr Children, is upon this plan. It consists of 2000 double plates, and its acting surface is 128,000 square inches. When a battery consists of a number of these troughs unit-