each other, with all the positive poles at one end, and the negative at the other, and the poles of the same name joined. This arrangement will increase the surface, while the number is the same.

“ When the battery is to be used. It is to be lifted off the frame, and dipped into a wooden trough lined with lead, into which the acid has been poured, or it may be placed in the leaden trough, and the liquid poured into it, till the cells are full. It is then to be placed on the frame, and the rest charged in succession.”

Mr Candie of Glasgow constructed six batteries on this principle, of twenty-five triads each, and they were found superior to a battery on Wollaston's construction, “ with the same number of plates, but the plates of which contained double the surface.” This comparison was made in the manner proposed by M. Μ. Gay Lussac and Thenard. “ Two of Dr Wollaston’s batteries, each containing ten triads in porcelain troughs, evolved a certain volume of gas in *seventeen* minutes, while a battery of the new construc­tion, with the same number of triads, but presenting only one half the surface of the other, yielded the same volume of gas in *fourteen* minutes.” This effect, as Mr Hart re­marks, could arise only from the superior means of insula­tion possessed by his battery.

Very great improvements have been made on the galva­nic battery by Dr Robert Hare of Philadelphia, whose *Gal­vanic deflagrator,* as he calls it, is represented in fig. 14, which represents an apparatus consisting of two troughs, each of which is ten feet long. Each trough contains 150 galvanic pairs. The galvanic series, A B, in the upper trough, is shewn, as it appears when the acid is off the plates, CD being the part of the trough containing the acid when it is off the plates. In the lower trough EF, the galvanic series is omitted, in order that the interior may be better under­stood. The series belonging to this trough is shewn in fig. 15. The pairs are contained in three boxes, each containing fifty pairs. In pla­cing these *three* boxes in the trough, a little space is left between them and that side of the trough in which the acid enters, so that instead of flowing over them. It may run down out­side, and rise up within them.

The pairs of the series consist of copper cases, about se­ven inches long, three wide, and half an inch thick, each containing a zinc plate equal­ly distant from its sides, and prevented from touching it by grooved stripes of wood. Each zinc plate is sol­dered to one side of the adja­cent case of cop­per, as shewn in

fig. 16, the copper cases being open only at the top and bottom. The copper cases are separated from each other by very thin veneers of wood.

The two troughs, AB, EF, are joined lengthwise, edge to edge, so that when the sides of the one are *vertical,* those of the other must be *horizontal.* Hence, by turning the handle H a quarter of a revolution, the two troughs thus united upon pivots which support them at the ends, will be so raised that any fluid in the one trough must flow into the other, and by reversing the action must flow back again. In this way, the galvanic series being placed in one of the troughs, and the acid in the other, the plates may, by means of the handle H, be all simultaneously subjected to the action of the acid, or relieved from it. The pivots are made of iron, coated with brass or copper, and a metallic communication is made between the coating of the pivots and the galvanic series. The lower trough, EF, is con­nected with the upper one, AB, by metallic rods, *mn, op,* joining the two handles, H, *h.*@@1

In the course of his experimental researches in electri­city, Dr Faraday was led to the construction of a voltaic trough, in which the coppers, passing round both surfaces of the zincs, should not he separaten from each other, ex­cept by an intervening thickness of paper, or in some other way, so as to prevent metallic contact, and should thus con­stitute a compact, powerful, and economical instrument. He found, however, that Dr Hare had in the trough, which we have above described, anticipated him in his contrivance. The arrangement of Dr Hare, who separated the copper plates by thin veneers of wood, and poured the acid on and off the plates, by a quarter revolution of an axis, which carries both the troughs with the plates, and another trough to collect and hold the liquid, was applied by Mr Faraday as the most convenient. His zinc plates were cut from rolled metal, and, when soldered to the copper ones, had the form shewn in fig.

17. They were then bent over a guage into the shape fig. 18, and when packed in the wooden trough, were disposed as in fig. 19, small plugs of cork be­ing used to prevent the zinc from touching the copper plates, and a single or double thick­ness of cartridge paper being interposed between the conti­guous surfaces of copper to pre­vent their contact. A trough of forty pairs of plates could thus be unpacked in five mi­nutes, and repacked again in half an hour ; and the whole se­ries occupied only fifteen inches in length. A trough of this kind, with forty pairs of plates *three* inches square, was com­pared with one of forty pairs of four inch plates, having dou­ble coppers, and used in porcelain troughs, with insulating cells, and having the same strength of acid; and the former was found equal to the latter in the ignition of platina wire, in the discharge between points of charcoal, and in the strength of the shock. The following are the advantages of this form of trough enumerated by Dr Faraday:—1. It is so compact that one hundred pair of plates may go into a trough three feet long. 2. The copper bearings, on which the pivots rest, afford fixed terminations, which Dr Faraday connects with two cups of mercury fastened in front of the stand of the instrument. These fixed terminations give

@@@1 Silliman’s Journal, vol. vii p. 347, and vol. v. p 94.