the great advantage of arranging an apparatus to be used in connection with the battery, before the latter is put in action. 3. The trough is ready for use in a few seconds, a single jug Of diluted acid being sufficient to charge one hundred plates. 4. When the trough has performed a quarter of a revolution. It becomes active, and the experi­ment has the advantage of the *first contact* of the zinc and acid, which is *twice,* and sometimes *thrice,* that which the battery can produce a minute or two after. 5. When the experiment is finished, the liquid can be instantly poured from between the plates, and hence the latter is never need­lessly wasted, the acid unnecessarily exhausted, or the zinc uselessly consumed. The charge, too, is mixed and made uniform, and the advantage of a *first contact* is obtained in the next experiment. 6. The saving of zinc is so very great, that Dr Faraday estimates the zinc to be *thrice* as effective as that in the ordinary form of battery. 7. The surfaces of the zinc and copper plates may be brought much nearer to each other when the battery is constructed, and remain so till it is worn out. 8. Thinner plates of zinc will do the duty of thicker ones, and rolled zinc, which is the purest,@@1 may be used. 9. The purity of the diluted acid is proportioned to the quantity of zinc dissolved. 10. The acid is more easily exhausted, so that we need not use an old charge a second time. 11. By using a due mix­ture of nitric and sulphuric acid for the charge, no gas is evolved from the troughs. Among the defects of this form of the battery, Dr Faraday enumerates the precipi­tation of copper on the zinc plates, which he considers as arising chiefly from the papers between the coppers retaining acid when the trough is emptied, which acid, acting slowly on the copper, forms a salt, which gradu­ally mingles with the next charge, and is reduced on the zinc plate by the local action, and hence the power of the whole battery is reduced. Dr Faraday proposed to remedy this evil, by using slips of glass to separate the coppers at their edges.@@2

The defect thus pointed out by Mr Faraday, was particu­larly experienced by Mr James Young of the Andersonian University, Glasgow, who has proposed a form of battery in which these papers are not required, and having construct­ed several dozens of instruments in the new form, he found that from the same surfaces of zinc, electricity, the same in quantity and tension, is produced in both Dr Hare’s form and his, but that in the new construction, this effect is produced with *half* the quantity of sheet copper, which arises from both sides of the copper plates being presented to surfaces of zinc. The following is Mr Young’s construction. Sup­posing the breadth of the required plates to be two inches, the sheet copper and zinc are cut into ribbands, two inches broad and five inches long, and a portion cut out as in fig. 20. The ribbon is thus divided into two squares of two inches, and united at A, and having a piece projecting at B. Fig. 20, representing a single plate, either of zinc or copper, is bent at A, as in fig. 21. A plate of zinc thus bent, is then united to a similar one of copper, by soldering together the projecting parts BB, as in fig. 22, and this is the only metallic communication existing between them. Each pair of plates is constructed as in fig. 22. In arrang­ing a number of pairs to form a battery, they are interlaced so that a copper square comes in between each couple of zinc squares, and *vice versa.* This arrangement is not easily described. At the positive end of the battery there is a single copper plate, which is soldered at the top to the last double copper plate, as seen in fig. 23, which represents three pairs properly arranged, and also the way in which they should be fitted up, and kept steadily apart in a wooden frame. This frame is made of two solid pieces of wood, into which are dove-tailed two cross bars, *ee, e',* in front, with two similar ones behind. The grooves in the cross bars for receiving the edges of the plates, are formed by placing the four cross bars together, and sawing a little way into one side of them all every eighth of an inch or so in their length, so as to form a set of parallel grooves. This affords us a better security against metallic contact than the wedges of cork in Dr Hare’s battery, which are apt to slip out.

The frame, fig. 23, with its plates, may be introduced into a porcelain or wooden trough, TT, containing the diluted acid. Mr Young prefers a single trough to Dr Hare’s two connected troughs, and by means of an axis of stout wire, A B, carrying two pullies, P P, the frame and battery can be raised out of the fluid.

Mr Warren de la Rue made an important step, by using a solution of sulphate of copper as the exciting agent in voltaic batteries. Oxygen is thus supplied to the zinc by the oxide of copper; no gas is evolved; and the action being thus rendered continuous, the effect is fully equal to that momentarily produ­ced by immersion in acids. The battery which Μ. de la Rue considers best adapted to the use of sulphate of copper, is shown in fig. 28. Thezinc plateis shown in fig.25. It should be tinned on the top A, previous to the amalgamation of the rest of the plate. The zinc plate is retained in its place by grooves cut out of the two slips of wood BB, to within 3-4ths of an inch of the bottom. The copper plates are formed into cells, painted on the out­side (as in fig. 26,) five inches square and one inch wide, E,E, being two ears of copper for suspending the cell in its place, and A, a slip of copper to be soldered to the zinc plate in the adjacent cell. As the zinc plates do not de­scend lower than within 3-4ths of an inch of the bottom of the cells, the space thus left may contain the deposits aris­ing from decomposition of the sulphate of copper. The cells are supported in a long wooden frame, by means of the ears E,E, by hooks driven through them as shown in fig.

27. In order to receive the charge when the battery is in action, Μ. de la Rue employs the contrivance shown in fig.

@@@1 Dr Faraday found rolled Liege or Moιselman's zinc the purest.

@@@s Phil. Trans. 1835, Parc ii.