taking care not to add more than will dissolve all the silver, but rather to leave a little silver undissolved, even with the liquid quite hot; by this means, the presence of much free acid is avoided, and an after-loss of cyanide of potassium and escape of poisonous fumes of prussic acid prevented. Each ounce of silver requires nearly one and three-quarter ounces of strong nitric acid to dissolve it.

The solution of nitrate of silver obtained is now considerably diluted with *distilled* water in a capacious vessel of stoneware, and there is added to it, in portions at a time, with stirring, a solution of cyanide of potassium of moderate strength as long as a white precipitate or cloud, which is cyanide of silver, is produced; this precipitate is allowed to subside between each addition, and it is very particular that as the precipitate produced becomes less copious the cyanide of potassium solution should be added more sparingly and at longer intervals of time, and that on no account should that liquid be added after it fails to produce a precipitate. This point requires some care and experience, but may be known by the cyanide of potassium solution producing a *transparent* but slightly brown appearance where it passes into the white and cloudy liquid: this transparency is caused by its dissolving the suspended fine particles of cyanide of silver; if by accident too much cyanide of potassium has been added, a cautious addition of nitrate of silver solution (for which purpose a little should be reserved) in a similar manner, will bring it back to the neutral or proper point: the whole is then well stirred and allowed to subside until the supernatant liquid is quite clear. Each ounce of silver dissolved requires nearly half an ounce of cyanide of potassium of ordinary quality to precipitate it.

The supernatant liquid is then filtered through a calico bag, the sediment put into the bag, and the bag filled five or six times successively with spring water. A small quantity of hydrochloric acid is added to the filtered liquid to precipitate any dissolved silver (of which there is always more or less) in the form of chloride of silver: this is allowed to subside, the clear liquid is thrown away, and the sediment retained on account of its silver.

Now, the wet contents of the filter are transferred to a capacious vessel, and to it is added, with constant stirring, a strong solution of cyanide of potassium until it is all dissolved, a memorandum of how much cyanide of potassium is used being made, because the amount varies greatly in different cases and is dependent upon the quality of that substance. If the cyanide of potassium is of ordinary quality, each ounce of silver employed will require about two or two and a half ounces of cyanide of potassium to re-dissolve it; whatever the quantity required to re-dissolve the cyanide of silver may be, an equal additional amount should now be added to the mixture to constitute *free* cyanide, and sufficient water then added to dilute the solution to the proportion of one ounce of silver per gallon, or any other strength that may be desired: the solution now only requires to be filtered and it is ready for use.

In coating articles with silver by means of this liquid a voltaic battery is employed: the battery varies in its arrangement in different establishments and in different cases, but always contains dilute sulphuric acid and plates or bars of zinc. The battery most commonly used consists of a sheet of copper and a plate of amalgamated zinc immersed in a mixture of oil of vitriol and water contained in a large stoneware jar; the zinc plate is connected by a copper wire with the articles to be coated, and the sheet of copper is connected by another copper wire with a sheet of pure silver, which is hung in the plating solution near the articles. In this arrangement the electricity is generated by the action of the acid and water upon the surface of the zinc, and passes from the zinc through that liquid to the sheet of copper, then along the copper wire to the sheet of silver, then through the plating-liquid to the articles to be coated, and back to the zinc plate by the other copper wire.

The electricity in passing from the surface of the sheet of silver into the plating-liquid causes the cyanide of potassium to act upon that metal and dissolve it, and at the same time the electricity passing into the surface of the articles decomposes the solution in contact with them and causes it to yield up its silver to those surfaces; and these two simultaneous actions are perfectly equal in amount, *i. e.*, for every ounce of silver dissolved on one side an ounce of silver is deposited on the other, and thus the amount of silver in solution remains unaltered for an indefinitely long period. The only alteration that takes place in the liquid is that it becomes unequal in composition in different parts—that portion of it about the dissolving-plate becomes richer in silver and specifically heavier, and therefore sinks to the bottom of the vat, whilst that about the articles becomes poorer in silver, specifically lighter, and rises to the surface; and this inequality renders it necessary to stir the liquid occasionally, otherwise the quality of the metal deposited upon the articles would be different at the upper ends to what it is at the lower ones.

In most electro-plating establishments two or three such battery-cells as those described are used for depositing silver, and in the early period of plating a much larger number was used. When several cells are employed, the zinc plate of the first one is connected by a wire with the copper of the next, and so on throughout the series, leaving the extreme copper at one end and the extreme zinc of the other to be connected with the vat in the manner described: by this means there is a course opened throughout for the electricity to circulate, and each additional cell or pair of plates imparts an additional impulse to the electric current.

Several other kinds of voltaic batteries besides the one described are also extensively used in electro-deposition; there is Smee's battery, which contains a sheet of platinized silver instead of the sheet of copper; Grove's, which consists of amalgamated zinc in dilute sulphuric acid and a sheet of platinum in strong nitric acid, the two liquids being kept from mixing freely, but allowed to touch each other by means of a separating diaphragm or cell of unglazed (*i. e.* porous) earthenware; and Bunsen's battery, which is similar to Grove's; graphite (obtained from gas retorts) being, however, employed instead of the sheet of platinum. Daniell's battery, which consists of amalgamated zinc in dilute sulphuric acid, and copper in a solution of sulphate of copper, the two liquids being