HOW TO COPY COINS AND MEDALS BY ELECTRICITY.

By the Author of "The Microphone, and How to make One," &c.

ABOUT fifty years ago a discovery was made in electrical science which fairly took the world by surprise. It consisted in the curious fact that the current from an electric battery is capable of depositing different metals on surfaces properly prepared to receive them.

Before this new power of electricity was known, the reproduction of a medal or coin must have been a tedious as well as a costly process; but now the work consists more in preparation than anything else, for the electricity does the real part of it, slowly depositing the metal without our help.

We will suppose that some friend has a medal of which we want a copy. With his permission we will commence our work by obtaining an impression of it, which we will call a mould. First give the surface which we wish to copy a greasy coating by rubbing it with a piece of cotton wool which has been moistened with oil. Next wrap one or two thicknesses of writing-paper round it, so that a rim about half an inch high may be formed round its edge. This rim can be secured where the join occurs by a piece of gummed postage-stamp edging. The paper rim now forms a flat pan, of which the medal represents the bottom (see Fig. 1). By filling this pan with plaster of Paris we shall have obtained an exact but reversed copy of the medal.

The preparation of the plaster requires some

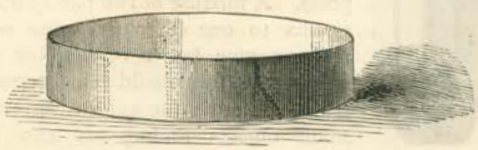

FIG. 1.

care, and must be used as follows. Fill a breakfast-cup with clean cold water, and sprinkle into it about two tablespoonfuls of the finest plaster of Paris, the exact quantity being, of course, governed by the size of the object to be copied. The white powder will immediately sink to the bottom of the cup, and after it has remained there for two minutes, and has perfectly settled, the clear water must be carefully decanted from it, leaving the plaster behind like thick cream. This cream must be ladled on to the medal with a spoon, a camel's-hair brush being used to help it to run into every crevice, and to dispel air-bubbles. The operation must not be hurried, but at the same time it must not be delayed, or the creamy-looking plaster will quickly subside into a hard useless mass.

Having covered the medal with plaster up to the top edge of the paper rim, it must be put aside to set and harden, and should not be touched for an hour or two. The paper rim can then be carefully unfastened, and with a little gentle persuasion the plaster cast will separate from the medal. It should now be examined to see that no air-bubbles have found their way to the design, as, should this be the case, another mould must be made, and we must this time be more careful in our use of the camel's-hair brush, as it was doubtless our negligence in that respect which led to the mishap.

All being well, the mould must be put aside for as long as possible, in order that it may dry. In hot weather it will soon be ready for further treatment. This consists in a bath of wax, which is necessary to render it impervious to the water in which it is afterwards placed. The wax should be melted in a saucer, and the plaster mould should remain in it until it is thoroughly saturated, when it may be lifted out and allowed to cool. The mould should be placed on end while cooling, in case any superfluous wax should remain to obliterate the design. When cold, the design must be very carefully brushed over with the best black lead, such as is used for polishing grates. This is to give it a metallic surface capable of conducting electricity. The reason for this you will presently see.

We must now arrange our electric battery, which, for articles of small size, will be of a very simple description. Indeed, the apparatus and battery will be combined in one vessel. An earthenware pot or a gallipot must be three parts filled with a saturated solution of sulphate of copper—or blue stone, as it is commonly called. A solution is called saturated when the water used ceases to dissolve any more of the crystals of copper. It should be made by pouring boiling water upon the

powdered crystals, and occasionally stirring the mixture. It must not be used until cold.

Inside the gallipot must be placed a porous cell made of clay, which can be generally obtained at the chemist's. If this cannot be had, a little pot

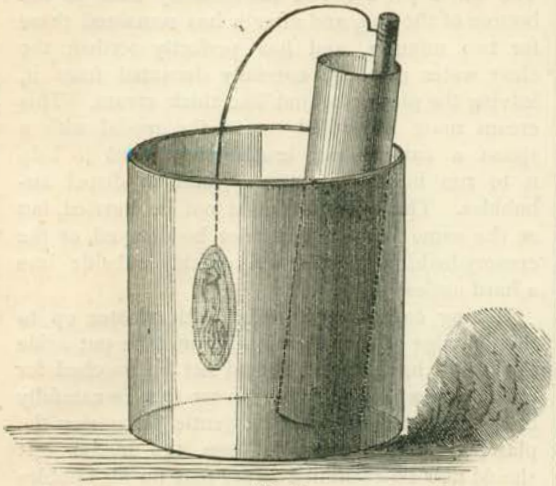

FIG. 2.

made by passing a few thicknesses of brown paper round a ruler, and fastening the bottom and sides with sealing-wax, will answer the purpose, but a proper clay cell is best. This porous pot must now be held in the larger pot, and filled with water which has been rendered sour by sulphuric acid, taking care that the level of both fluids must correspond. The proper mixture for the porous cell is one part of the acid to eight parts of water. It is best to obtain it at the chemist's mixed in these proportions, for in its crude state it is nasty stuff to handle. A single drop of it will burn a hole in carpet or any kind of clothing, and will make a bad sore if it touches the skin. It can be obtained at the oil-shop under the name of oil of vitriol.

A rod of zinc is now placed inside the porous cell. This rod should be previously dipped in the acid solution and then rubbed with quicksilver by means of a piece of flannel. It will then have a brilliant coating which will protect it from the corrosive action of the acid. A copper wire is twisted round the top of the zinc rod, to the end of which the plaster mould is fastened, the wire being of such a length that it will dip over into the outer vessel. The complete arrangement is shown at Fig. 2. The manner in which the wire is fastened to the mould is a point of some importance. It should be wrapped round the plaster as shown in Fig. 3. The shaded portion represents the blackened surface, and the darkened line at the top of the figure indicates where the black-lead is purposely left on the edge to form a metallic connection between the wire and the mould; the rest of the edge should be scraped perfectly clean with a knife before it is placed in the solution, otherwise it will become coated with the copper deposit in such a way that there will be great difficulty in separating it from the electrotype formed upon it. The corresponding portion of the wire should be coated with wax for the same reason.

Having taken all these precautions, which will, I dare say, seem rather tedious, but which are really necessary to success, and having taken the greatest care that our solutions have not been in any way mixed, we can place the mould in position, and put the apparatus away in some place where it will not be disturbed. In winter, a warm place should be chosen, as extreme cold almost stops the electric action. In from eighteen to twenty-four hours we shall find that the black lead surface of the plaster has become coated with a thick deposit of copper, which can easily be separated from it, and which presents an absolutely faithful copy of the medal with which we commenced our proceedings.

When the newly-made medal has been parted from the connecting wire, it should be heated to redness in a clear fire, and gradually cooled—for without such treatment it will be extremely brittle. The edges may now be trimmed and filed, so as to give it a good finish, and the face may be polished with rotten-stone and oil. The medal can afterwards be mounted on card, and placed in a cabinet as the first contribution to a collection of such works of art.

There are various other substances besides plaster which can be used for mould-making. Gutta percha is one of the best, but some care is necessary in using it, and it can only be applied where the thing to be copied is capable of bearing great pressure. It should be softened in boiling water, and immediately applied to the object in a press. A mixture of two parts gutta-percha to one of marine glue will perhaps give better results, but in either case the mould must remain attached until quite cold. For very small objects sealing-wax can be used—seals can, in fact, be accurately reproduced by means of the apparatus, care being taken that they are attached to the wire and black-leaded in the manner described. Moulds can also be made of a fusible metal made of bismuth 2 ozs., tin 1 oz., and lead 1 oz., but it is

FIG. 3.

rather difficult to work. This alloy possesses the peculiarity of melting at a heat below that necessary to boil water. An old practical joke consisted in having a teaspoon made of it, and handing the same at table to some unsuspecting friend. Directly it was placed in the hot tea it disappeared from view, much to the friend's astonishment.

So far, I have explained the process known as the single cell method of electrotyping, which is all very well for reproducing medals and similar small articles. It is perhaps also the best system for workers who do not possess an electric battery. But for those who are more fortunate in having one, as those must be who have carried out my instructions how to make a microphone, there is a far better plan of operating. This I will now describe.

Referring back to page 171 of the last volume, where the microphone battery is described, you will notice that the three cells of which it is composed are joined together in a particular manner—that is, the copper coil of one cell is joined to the zinc plate of its fellow. For our present purpose we will place the three cells in a triangle on a piece of board. Fig. 4 shows the manner in which they must stand. It will be seen that the terminal wires are dipping into a fourth vessel of somewhat larger size. This last contains a saturated solution of sulphate of copper, as used in the single cell arrangement already described. The size and shape of this vessel are immaterial—it may consist of a gallipot, or if you wish to exert your ingenuity, you may make it yourself of wood, and line it with pitch, so that it may be water-tight. Should you adopt this latter plan the shape of the box should be tall and narrow, in order to economise as much as possible the solution of copper.

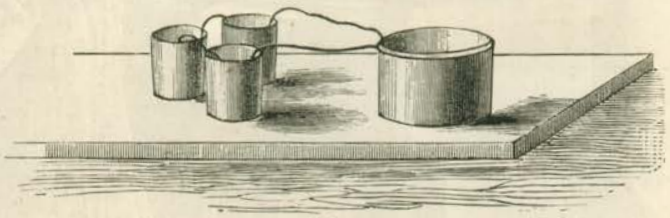

FIG. 4.

Having seen that the battery is in good order, and having placed the solution in its receptacle—be it box or gallipot—we will now try the simple experiment of placing the terminal wires in the solution and leaving them there for a night. But special care must be taken that they do not touch one another. If our battery be properly joined cell to cell, and if all the connecting parts be clean, we shall, in the morning, find that a strange thing has happened to the terminal wires, for that proceeding from the copper side of the battery has shrunk in size, while that belonging to the zinc has increased. The latter is in fact covered with a beautiful crystalline mass of pure red metallic copper. If we allow the action to go on, the difference between the wires will become still more apparent, until the one is quite exhausted. If, previous to this experiment, we weigh the two wires, we shall afterwards find that the loss of the one is exactly counterbalanced by the gain of the other. It was the accidental discovery of this action upon the wires of a battery which led to the introduction of the art of electro-metallurgy. It now only remains for us to profit by this experiment. We can take a mould of plaster, wax, gutta-percha, or fusible alloy, and fasten it to the end of the zinc-plate wire, attaching to the other wire a piece of sheet copper of about the same size as the mould. The metal will then gradually deposit itself on the latter, and must be treated in every respect as in the former case.

Very good results may be obtained by copying the plaster of Paris medallions which are often sold in the streets. They measure about four inches in diameter. In order to copy one of these, we must first soak it in water for half an hour. A rim of greased paper about one inch high must then be fastened round it, and into this melted wax must be poured. It must not be separated from the wax until the latter is quite cold. This mould must be black-leaded in the usual way, and I may here mention that the very best kind of black-lead must be used, for the commoner kinds will not conduct electricity well, and the work may be much delayed in consequence.

The applications of electrotyping are most varied, and far too many for me even to enumerate in the space now at my disposal. But at some future time I may devote another article to a description of some of the things which may be made by its aid. With solutions containing gold and silver, all kinds of things may be coated with those valuable metals.

The silver and gold processes are not easy to work, besides being rather expensive; I will therefore say no more about them. Another reason why I do not describe them is that their practice necessitates the use of one of the most deadly poisons known to the chemist. A poisonous substance such as this is not fit for little fingers to meddle with; and I feel quite sure that when I tell you so you will agree with me to let it alone.