

separated by a porous partition, is not much used for electro-plating; and the preference of one battery over another for electro-deposition depends partly upon the bias of the plater in favour of that particular battery, but chiefly upon the special purpose for which the battery is intended; in cases where great resistance is offered to the passage of the electric current, as in solutions for coating articles of iron, &c., with brass, the more powerful batteries of Grove and Bunsen are used. Whichever of these batteries is employed, and whatever may be the metal intended to be deposited, the article to receive the coating is always connected with the zinc plate of the battery, and the metal to be dissolved is connected with the copper, silver, carbon, or platinum, as the case may be.

All metallic articles that are to be coated with silver or other metals by electro-process require to be perfectly cleaned and prepared before being placed in the plating-liquid, otherwise the metal deposited upon them will not adhere properly. To clean them they are at first immersed in a boiling solution of caustic potash to remove greasy and tarry matters; then, if they are formed of German silver, brass, or copper, they are washed in water, dipped momentarily into aquafortis, again washed in water, then dipped into a very dilute solution either of nitrate of mercury or of cyanide of mercury and potassium, and immersed in the silver-plating vat. In cases where it is desired to know the quantity of silver deposited upon them, they are weighed after cleansing, and also at intervals during the process of deposition. Articles formed of Britannia metal, lead, tin, and similar metals or alloys, are not dipped into aquafortis, but immersed in a weak silver solution immediately from the caustic potash liquid, to receive a thin preparatory electro-coating, and then transferred to the ordinary silver vat. The thickness of silver deposited upon articles is frequently very minute, as may be judged from the fact that full-sized iron snuffers are sometimes wholly coated with silver for two-pence each pair, and other common articles at proportionate prices.

After receiving the coating of silver, much remains to be done to the articles before they assume a saleable condition, they have to be "scratched" by a bundle of revolving fine brass wires to remove asperities; burnished to make them bright; in some cases they have to be "oxidized" in particular parts. This consists in wetting those parts with a solution of bichloride of platinum, which blackens those portions; and, in other cases, different parts, as, for instance, the interior of cream-jugs, sugar-basins, &c., have to be electro-gilded. And in cases where portions of the exterior have to be gilded, the remaining surface is coated with copal varnish, to prevent the gilding from taking place on those parts. And, finally, the articles are washed in clean water, and at once immersed in hot, dry sawdust, which absorbs the moisture and dries them quickly, before they have time to tarnish. The processes of preparing and finishing articles are, in nearly all cases, much more troublesome than that of plating itself.

These various points of information are only the outlines of the process of electro-plating, and for the details the reader is referred to the various published works on the subject.

The scientific perfection of electro-deposition consists in its definite mathematical character. Under carefully prepared conditions, all the chemical actions that occur in the battery and plating-vat stand in certain precise mathematical relations to each other; for every $32\frac{1}{2}$ parts of zinc dissolved in each cell of the battery, there are 108 parts of silver dissolved and 108 parts deposited in the vat; or if it be a copper solution, $31\frac{1}{2}$ parts of copper, or an antimony solution, 40 parts of antimony; for every $32\frac{1}{2}$ parts of zinc dissolved in the battery, there are 9 parts of water decomposed, and if it be a Smee's, or a common zinc and copper cell, there is 1 part of hydrogen set free at the negative silver or copper plate; and similarly with all the chemical actions taking place in the various battery-cells and depositing liquids. Each action in a given circuit stands in a certain mathematical relation to each and all the others, and this is known as the law of "definite electro-chemical action."

The artistic advantage of electro-deposition consists in the great facilities it affords for the exercise of taste and design, and for more accurately imitating the forms of nature, as in rocks, animals, fruits, trees, &c. And its domestic utility and household economy consist in the greater degree of cleanliness and beauty obtained at so moderate a cost.

As long as arts and manufactures are left to be directed and improved by simple experience, their progress is extremely slow; but directly scientific knowledge is successfully applied to them, they advance with astonishing speed. For years the manufacture of plated metal wares existed without making any material progress; but, on the application of science, its progress became surprising, and called the attention of all persons to the new process.

Thirty years ago electro-plating for commercial purposes was unknown; but as soon as Jacobi and Spencer made known the results of their electrical experiments upon metallic solutions, the manufacture of plated wares began to advance; and so rapid has been its progress, that, at the present time, thousands of persons are employed in it, and electro-plate productions are used in all parts of the world.

Thus it is that man, to some extent the servant, but hoping to become more the master of nature, is daily striving to acquire a greater knowledge of the workings of natural forces, and to apply those forces to human benefit; he first becomes the obedient disciple of nature, in order that he may ultimately become its director; and so great a degree of success has already resulted from this course, that we are justified in expecting that, at some future time, science will extend its helping hand to all trades and manufactures, and that ultimately scientific principles will be universally recognized as the great "regulators of productive industry."

THE MANUFACTURE OF VEGETABLE OILS.

Whether considered as a medium for the application of colour in works of art, or of utility as the principal source of illuminating power where gas is unattainable, or as the lubricator without which all machinery, from the simple clock of the