ELECTRO-METALLURGY.

The deposition of metals in the process of electrometallurgy is of two kinds, electroplating and electrotyping. When our object is to coat a metal with a thin metallic film of some other metal, the object to be coated is immersed in a solution of some salt of the metal to be deposited. A current is passed from the bath to the object, so as to decompose the salt and deposit the metallic portion of it on the object, which is a negative electrode.

ELECTROTYPING.

The art of copying seals, types, medals, etc., by the galvanic current in metal, more especially copper, is called electrotyping. An impression is first taken in gutta percha, wax, fusible metal, or other substance which takes, when heated, a sharp impression. While the impression is still soft, a wire is inserted into the side of it. It is then covered with plumbago to give it conductivity, a camel hair brush being used for this purpose. The wire is then attached to the zinc pole of a weakly charged Daniell's cell, and the copper plate is attached by a wire to the copper pole of the cell. When the impression and the copper plate are dipped into a strong solution of the sulphate of copper, they act as the — and + electrodes. The copper of the solution begins to deposit itself on the impression, first at the blackleaded surface in the vicinity of the connecting wire; then it gradually creeps over the whole conducting surface. After a day or two, the impression is taken out; and the copper deposited on it, which has now formed a tolerably strong plate, can be easily removed by inserting the point of a knife between the impression and the edge of the plate. On the side of this plate, next the matrix, there is a perfect copy of the original seal.

ELECTROPLATING.

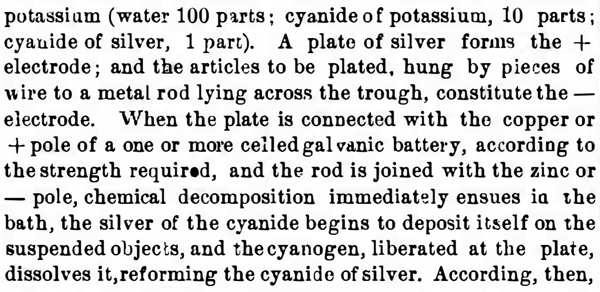
The very useful art of coating the baser metals with silver by the galvanic current is called electroplating. Theoretically it is very simple, but it requires very considerable experience and skill to make a successful application of it. Articles that are electroplated are generally made of brass, bronze, or copper. When tin, steel, iron, zinc, or lead is electroplated, it must be first electro-coppered, as silver does not adhere to the bare surfaces of these metals. Great care is taken in cleaning the articles previous to electroplating, for any surface impurity would spoil the success of the operation. They are first boiled in caustic potash, to remove dry adhering grease; they are then immersed in dilute nitric acid, to dissolve any rust or oxide that may be formed on the surface; and they are finally secured with fine sand. Before being put in the silvering bath, they are washed with nitrate of mercury, which leaves a thin film of mercury on them, and this acts as a cement between the article and the silver.

The bath wherein the electroplating takes place is a large trough of earthenware or other non-conducting substance. It contains a weak solution of cyanide of silver in cyanide of potassium (water 100 parts; cyanide of potassium, 10 parts; cyanide of silver, 1 part). A plate of silver forms the + electrode; and the articles to be plated, hung by pieces of wire to a metal rod lying across the trough, constitute the — electrode. When the plate is connected with the copper or + pole of a one or more celled galvanic battery, according to the strength required, and the rod is joined with the zinc or — pole, chemical decomposition immediately ensues in the bath, the silver of the cyanide begins to deposit itself on the suspended objects, and the cyanogen, liberated at the plate, dissolves it, reforming the cyanide of silver. According, then, as the solution is weakened by the loss of the metal going to form the electro coating, it is strengthened by the cyanide of silver formed at the plate. The thickness of the plating depends on the time of the immersion. The electric current thus acts as the carrier of the metal of the plate to the objects immersed. When the plated articles are taken from the bath, they appear dull and white; the dullness is first removed by a small circular brush of brass wire driven by a lathe, and the final polish is given by burnishing.

ELECTROGILDING.

The operation of electrogilding very closely resembles that of electroplating. The solutions are always alkaline, and usually consist of the cyanide or chloride of the metal, dissolved in an alkaline cyanide. To prepare the gold bath, two ounces of fine gold are dissolved in *aqua regia*; and the solution is evaporated till it has the consistence of syrup. Water is then added, together with two ounces of cyanide of potassium, and the mixture is boiled. The quantities named give about twelve gallons of solution.

The negative electrode consists of the article to be gilded. The positive electrode is a plate of fine gold, which constitutes a soluble electrode, and serves to keep the solution at a constant strength. In order that the gilding may be well done, the bath must be maintained, during the operation, at temperature of from 140° to 160° Fahrenheit.



The accompanying engraving represents a form of apparatus which is very frequently employed. The poles of the battery are connected with two metallic rods resting on the top of the cistern which contains the bath. The articles to be gilded are hung from the negative pole or rod. From the positive rod is hung a plate of gold, whose size should be proportional to the total surface of the articles which form the negative electrode.

The same arrangement of the battery and the cistern for holding the bath is applicable for electrotyping and electroplating as well as electrogilding.

GENERAL DIRECTIONS.

The success or failure of the electrotype process depends very much on the preparation of the copper solution, and on the strength of the battery. A perfectly saturated solution is not so well adapted for the purpose as such a solution diluted with one fourth part of water. To prevent it from becoming too weak by the deposition of metallic copper, some crystals of the sulphate are added during the process. The strength of the battery, in relation to the strength of the solution, causes the metals to be deposited either as a black powder, in a crystalline form, or as a flexible plate. The metals are deposited as a black powder when the current of electricity is so strong that hydrogen is evolved from the negative plate in the decomposition cell. The crystalline state occurs when there is no evolution of gas, and no tendency thereto. The regular deposit takes place when the electric current is stronger in relation to the solution than in the last case, but is not sufficiently strong to cause the evolution of gas.

There are various methods of preparing the solution for electroplating and of dissolving the silver, but the cheapest and best is to dissolve the silver in a solution of cyanide of potassium, by the action of a voltaic battery. Dissolve 1½ ounces of cyanide of potassium in 1 gallon of water; place one of two flat porous vessels in this solution to within half an inch of the mouth, and fill them to the same hight with the solution; in these porous vessels, place small plates or sheets of copper, and connect them with a zinc terminal of a battery; in the large solution place a sheet or sheets of silver connected with the positive pole of the battery. This arrangement being made at night, and the power employed being five Daniell's cells, the zincs seven inches long by seven in circumference, it will be found in the morning that the solution is ready for use. The strength of the solution recommended is that of one ounce of silver to the gallon. An ounce and a half of silver to one square foot of surface gives an excellent plating. A few drops of bisulphate of carbon confer peculiar qualities upon the silver.

NICKEL-PLATING.

Nickel-plating is now very extensively carried on for the covering of articles hitherto plated with silver. Nickel is very easily deposited, and may be prepared for this purpose by dissolving it in nitric acid, then adding cyanide of potassium to precipitate the metal; after which the precipitate is washed and dissolved by the addition of more cyanide of potassium. Or the nitrate solution may be precipitated by carbonate of potash; this should be well washed, and then dissolved in cyanide of potassium; a proportion of carbonate of potash will be in the solution, which is not found to be detrimental. The sulphate of nickel is also a soluble salt, and the metal is reduced more readily from it than from the nitrate. It is preferable to use the solution as strong as possible. Nickel forms a compound with the cyanide of potassium on boiling the oxide in a solution of that salt, which takes up a considerable quantity. The acetate of nickel is easily formed, by adding pyroligneous acid to the oxide of nickel, but it is a bad solution for obtaining reguline or pure metal. The chloride of nickel is formed by dissolving the metal in muriatic acid. It forms a fine green colored salt, and a very excellent one for nickel plating. It may be used with a nickel positive pole, with one or two Daniell cells.

Absence of Mind.

We heartily concur with the Philadelphia *Ledger* in its assertion that among the bad habits, which are usually classed with the minor faults of mankind, is that of absence of mind. Says the writer: "We have all laughed at the awkward blunders of the absent-minded, their irrelevant remarks, their ludicrous mistakes, their forgetfulness of the ordinary proprieties of life. Often, however, serious results ensue through these seemingly trivial oversights; property is wasted, friends estranged, losses incurred, health and even life sacrificed. In times of strong excitement or peril of any kind, nothing is so valuable as presence of mind. It is not exactly courage, or fortitude, or sagacity, or judgment, but rather the calm and well poised ability to marshal all these forces into action just where and when they are most needed. How many lives have been saved and disasters averted by this simple endowment! How much of the heroism which we delight to honor may be traced to this potent source!

It is precisely this attribute of which the absent minded man is destitute. Whatever be his knowledge, or wisdom, or skill, however excellent his motives and intentions, however great his powers and capacities, he has not that control over them that ensures the rightful action of each in its own time and place. He is continually off guard, surprised, confused, unprepared. His mind may be of the finest order, but it is not at its post of command, and his powers are scattered and lost like soldiers without a leader.

It is not only in times of emergency that this presence of mind is essential. Every hour of our lives must depend upon it for value and efficiency. If a man would be a prosperous farmer, a skillful mechanic, or a successful merchant: if he would be a kind neighbor, a faithful friend or a loyal citizen: if he would be a good and true husband, or father, or brother: his mind must be present in each of these relations, not absent. It must assume its rightful dignity of command over each phase of his life in turn, and not become absorbed in one to the exclusion of the rest, nor flutter in every chance wind. This is the chief cause of absent-mindedness. The thoughts are suffered to linger about some favorite topic or to wander aimlessly, and of course the matter in hand cannot be thoroughly performed. If we cannot or do not direct our whole attention to the object on which we are engaged and banish all others, we cannot do justice to it or to our own powers. It is the mixing up of different things and the confusion of mind thus created that are largely responsible for much of the inferior work in the world, and many of its failures and disappointments.

Much of this absence of mind might be avoided if concentration of thought upon one subject at a time were made a prominent part of education. Children should be accustomed to think earnestly for short periods, and then to dismiss the subject wholly from their minds. Weariness, listlessness, and half-hearted attention should always be prevented. It is far better for a child to play with his whole soul than to study with but a fragment of it. If he be thus trained in his youth, if work and play and study, each in their turn, absorb him utterly for the time, there will be but little danger of his growing up to be an absent-minded man. Those in mature life who have unfortunately acquired this pernicious habit may, by a similar process of self-culture, gradually overcome it. No one who indulges in it can make the most of his powers in any direction or give out to the world his full value; and certainly no one in our present varied and complex civilization can fulfil his manifold relations in life unless he resolutely bring all the powers of his mind to bear upon each one of them in its own appointed season."

Discoveries.

Discoveries in Science are the result either of experiment, of thought, or of chance. An experimental discovery is usually the result of a well planned attack upon some fortress of Dame Nature—every step, every sap, and every battery being well considered and faithfully followed; or it results from the attacking force perceiving indications of some sunken mine, or unknown treasure, and following it up with care and determination. Davy's discovery of the safety lamp is an example of the first kind. Something was wanted—its requirements were well defined; Nature was asked to supply those wants and requirements, and she was forced, by experiment and enquiry, to reply. Faraday's discovery of magneto electricity was of the second kind. He was engaged in solving a difficult and intricate problem; something attracted his attention, he followed it up, traced it out, and was rewarded with the discovery of what ought to be universally called *Faradaism*.

A discovery the result of pure thought must be bared on experience. An experiment sets

—"that inward eye
That is the bliss of solitude"

a-working. The imagination is brought into play. Thought pictures something that should be, and observation finds out that it is. Graham's discovery of dialysis, and of the occlusion of hydrogen by iron, was of this character. So have been the innumerable additions made to organic chemistry by Liebig and his followers. So have been the strides made in the theory of energy by Mayer, Joule, Thomson, Clausius, and others. Experiment has set the ball rolling, thought has kept it going, and imagination has said: "If I only direct it in such a path I am sure to alight on some treasure, or it is sure to bring me to the goal I seek."

Discoveries cannot be said to be the simple result of pure chance. Newton and the apple are said to have led to the discovery of gravitation; but the apple was only the means to direct the thoughts of the philosopher in a certain channel, which certainly led to success; but he had been previously pondering and weighing innumerable other channels and courses. Galvani and the frog are said to have led to the chance discovery of voltaic electricity; but the frog may have jerked its legs on the professor's balcony, or skipped into the physicist's laboratory with the energy of a ballet dancer, before it would have led to the discovery of current electricity unless there had been a trained mind to watch its antics, to follow up its peculiarities, and to ferret out its indications.

Daguerre's discovery of the influence of the vapor of mercury upon sensitive plates of silver is another which is included among chance discoveries. He had been experimenting on silver plates rendered sensitive by iodine, and had, after exposure, put them in a cupboard full of chemicals. To his surprise he found, after a time, pictures develope themselves on the plates, attributing the effect to some chemical. He removed the chemicals one by one, until all had been removed. The effect, however, continued. He then found an unknown and forgotten flask of mercury, which gave out its vapor, and thus produced the effect observed—and this was the origin of the daguerreotype process. But this was not purely the result of chance. It was the previous training and previous experience which arranged the conditions that led to the discovery, and which enabled the mind to seize upon those very facts which resulted in success. Training and experience are therefore essential in seizing upon abnormal indications of Nature, as they are in comprehending and appreciating her laws and applying them effectively to practice.—*Telegraphic Journal.*

THE STEAM MAGNET.—M. Donato Tommasi states that, if a current of steam at a pressure of 5 to 6 atmospheres is passed through a copper tube of 0·08 to 0·12 inch diameter, and coiled spirally around an iron cylinder, the latter is magnetized so effectually that an iron needle, placed at the distance of some inch or two from the steam magnet, is strongly attracted, and remains magnetic as long as the steam is allowed to pass through the copper tube.