Hardening Iron.

Every improvement in the manufacture of iron, which is to us the " King of Metals," is to be hailed by the productive world as a positive blessing ; and however slight those improvements may be, they deserve the attention of the chronicler's pen ; how much more so, then, when they are important and practical, as are those we are about to mention.

The first is the invention of a French clergyman—Chas. Pauvert, of Targe, France—and consists in purifying iron by chemical means. He places the iron in the cementing furnace with 33 parts by weight of finely powdered charcoal, 33 parts of highly aluminous clay, 33 parts of carbonate of zinc or wood ashes, 1 of carbonate of soda, and 1 of carbonate of potash. This produces an iron which has all the properties of the best steel, and it will not lose any of its properties by being heated or drawn out. These substances by chemical action, when heated together, present the carbon in the best possible state to combine with the iron. The method of producing cast steel from this is by melting it in a crucible with about 5 to 6 per cent of the following mixtures :—4 parts of dry carbonate of soda, 3 parts of dry carbonate of potash, 3 of wood ashes, 2 of borax, 3 of oxyd of manganese, and from 4 to 7 parts of charcoal, or some highly carbonaceous body. The 4 parts of carbonate of potash may be replaced by 2 parts of caustic potash. This produces a steel of superior quality, and with more certainty than by the old method. M. Pauvert patented his invention in this country March 23, 1858.

The next invention is that of an Englishman—G. J. Fanner, of Birmingham, England—which consists in using ferrocyanide of potassium, hydro-chlorate of ammonia, and nitrate of potash in equal proportions. These are reduced to a fine powder and incorporated, and a bath made of the same substance dissolved in cold water, the prussiate of potash two ounces, the sal-ammoniac four ounces, and the saltpeter two ounces to every gallon of water. Having now the powder and the bath, the article to be hardened is heated in an open fire or furnace, and rolled in the dry powder until the surface is covered with a pellicle of fused powder, and then it is plunged in the bath where it is left until cold, and when perfectly cooled the mass is hardened. Large masses can be thus rendered extremely hard, but it seems to us to be especially applicable to the hardening of tools, journal bearings, and the like. This process was patented in the United States, April 6, 1858.

Last, but not least, comes an American invention, that of Horace Vaughn, of Providence, R. I., and patented by him March 30, 1858. He employs two pounds of bi-chromate of potash, twelve pounds of chloride of sodium, and four pounds of prussiate of potash ; these ingredients are powdered and mixed together, and they are placed in an iron box, where they are covered with powdered charcoal, and heated in a proper furnace. The articles to be hardenened are then placed in the mixture, and the whole heated until the mixture is in a state of igneous fusion, when they are removed and dipped into water, oil or certain solutions in the usual manner. The proportions for hardening wrought iron are different, being 25 per cent of prussiate of potash, 65 per cent of chloride of sodium, and 10 percent of bi-chromate of potash ; bone ash or animal charcoal or both are then added, and the whole is reduced to a state of igneous fusion, and the articles to be hardened are then put in,

Nearly all the inventions of late for hardening iron have been the result of chemistry, and we think that the more perfectly the chemical changes which occur in the transmutation of iron into steel are understood, the nearer we shall be to that great desideratum, making steel directly from the ore, which is the end to which all improvements in iron manufacture are tending.

Telegraph Conductors.

[The following is the first of two articles on this deeply interesting subject. The author is a thorough practical electrician, whose name stands very high as an inventor and electric engineer.—Eds.]

Messrs. Editors—I propose to compare the Atlantic Telegraph Cable with some other conductors more familiar to telegraph operators, and to explain some terms used in works on electrical science ; also to give some simple *formulæ* and constants to enable others to verify my conclusions.

In order to establish a current of electricity, peculiar substances, called "conductors," in which it can flow, must be employed. Suitable substances are also required to be placed in such relationship to one another that there must be a chemical reaction between them. For example, if a plate of zinc and another of copper united together by a copper wire, be dipped into a vessel containing a mixture of one part of sulphuric acid and twelve of water, the zinc will be dissolved by the action of the acidulated water, while the copper will scarcely be acted upon. The chemical actions going on in the galvanic cell while the two plates are thus united, are as follows :—Water is composed of two gases—oxygen and hydrogen. The oxygen of the water in the battery having a greater affinity for the zinc than for the hydrogen with which it is associated, leaves the latter, and unites with the former, producing the oxyd of zinc. The hydrogen makes its escape by way of the copper plate, on the surface of which it appears in bubbles, that pass off after bursting. The copper plate is, therefore, called an "electrode," or electric way. The chemical action described would very soon cease in a battery by the accumulation of oxyd on the surface of the zinc plate, were it not for the presence of the sulphuric acid, which unites with the oxyd, forming sulphate of protoxyde of zinc, commonly called sulphate of zinc. This oxyd is very soluble in water, therefore it is taken up by the water in the battery as soon as formed, thus leaving the surface of the zinc tolerably clean, for the continued action of the oxygen, until the water is saturated with the sulphate. Hydrogen escapes more freely from a rough than from a smooth surface, and for this reason the copper plates of batteries are all roughened. But what is going on in the connecting wire of the zinc and copper plates while the chemical action described has been going on in the battery ? If some short sections of the copper wire which connects the two plates be replaced with thin platina, or iron wire, these latter will become red-hot, thus indicating that electricity is flowing through the wire, and that its free passage is resisted in the iron or platina, and this is attended with the evolution of heat.

Again, if we place the two plates about a foot asunder in a glass vessel containing the acidulated solution described, and if we unite them by a wire running north and south—the copper being at the northern end—the electricity is said to flow from the copper to the zinc plate. If we now suspend a magnetic needle above and near the wire, it will not point, as it usually does, to the north, but will declinate to the west. This declination will be great according to the diameter of the wire, the size of the plates, the nearer they are together, and the proximity of the needle to the wire. The declination of the magnet will also be greater if the wire is made of silver or copper than if of lead, iron, or platina ; also if the battery is more intense in action, such as by substituting nitric for sulphuric acid in the solution. From this it is inferred that chemical actions have much to do with the production of electricity, and that all bodies offer a certain amount of resistance—some more and some less—to the flow of a current of electricity. It is found to be rigorously true that the quantity of electricity flowing in the conductor of an electric circuit is directly proportional to the intensity of the chemical action, and necessarily proportional to the total amount of resistance offered to its passage through the conductor. The following equation will, perhaps, convey this idea more clearly :—Let E represent the intensity of the chemical action, R the amount of resistance offered by all the conductors through which the current passes, and Q the amount of electricity passing at any given time—then we have $Q=E+R$. The quantity of electricity or strength of current flowing in the wire at any given time being equal to the intensity of the chemical action in the battery, divided by the amount of resistance.

The phenomena presented by electricity when at rest belongs to the science of electro-statics ; the phenomena of electricity in motion belongs to electro-dynamics. The latter must be chiefly considered in the study of the telegraph. Bodies are usually divided into two classes in connection with the flow of electric currents ; these are called conductors and non-conductors. These terms are merely relative, as it is difficult to specify the dividing line between them. The best conductors are silver, copper, and gold. Gutta percha, glass, and india rubber are the best non-conductors. As all bodies offer resistance to the passage of an electric current, that body is the best conductor which offers the least, and *vice versa*. The resistance offered by each body is called its "specific resistance." The resistance of copper being considered unity, that of silver is ·67 ; iron, 5·625 ; mercury, 50· ; distilled water, 79,000,000. The resistance to the flow of a current of electricity also depends on the dimensions and form, as well as the nature of a conductor ; but of this we shall treat in the succeeding article.

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Boston, Mass., October, 1858.

Marking Ink for Linen.

Messrs. Editors—Those who intend to prepare marking ink according to the recipe in No. 49, Vol. XIII, would do well to dissolve the nitrate of silver in rain water instead of liquor of ammonia, or else they might expose themselves or others to great danger.

Whenever a salt of silver comes in contact with ammonia, it is apt to form with it a compound more dangerous than the fulminate of silver, because more liable to detonation by the most trifling circumstances, and more terrible in its effects. The ordinary way to produce fulminate of silver is this :—Oxyd of silver is mixed with common liquor of ammonia, and left to itself for several hours, when a black powder, this identical compound, will be formed. Another way (and the one so closely resembling the recipe for the marking ink that my fears were instantly aroused) is this :—To a solution of nitrate of silver add strong liquor of ammonia. The dangerous compound in question being thus formed and in solution, is precipitated as a black powder by an alkaline solution—soda or potash. I would warn your readers not to meddle with this substance at all, for I know cases in which the death of the experimenter was caused by a drop of water falling on the preparation. The rule for guidance, therefore, in experimenting with silver is, keep the ammonia (and its salts) out of its way.

Savannah, Ga., October, 1858. L. K.

A Novel Steamer.

Some of our cotemporaries announce that Messrs. Winans, of Baltimore, Md., have just constructed a steamer which is intended to surpass in swiftness every craft that skims the seas, because she is designed to plow through the waves, and not take the trouble of rising and falling with them. This vessel is 170 feet long, and tapers to a wedge edge at both stem and stern. It is to be driven with one large center wheel having diagonal paddles, and to have very powerful engines in proportion to the tunnage. Diagonal paddles and center wheels are not new, and unless it be in the model of this steamer, we cannot perceive from the descriptions published concerning her, anything novel, or any point on which to base conclusions for greater speed than is attained by other steamers.

Useful Receipts.

Oil Varnishes.—No. 1.—Every person should know how to make these preparations for rendering objects waterproof. Linseed oil is the best to use for this purpose ; but as it dries with some difficulty, and is liable to become sticky, it requires to be treated in such a manner as to partially oxydize it, after which it dries quickly, and forms a most excellent varnish. Take a gallon of pure linseed oil, and boil it over a gentle fire for about one hour, adding gradually four ounces of sugar of lead, or litharge, or the oxyd of manganese, or the sulphate of zinc—any one of these will answer—but they must be added cautiously, and the oil stirred well while the oxyd is being fed in. The clear of this is the varnish, the sediment should be mixed with paint. Silk or cotton cloth receiving several coats of this varnish becomes completely waterproof.

No. 2.—Take a gallon of pure linseed oil, and add to it two ounces of sulphuric acid ; stir well, put it over a gentle fire in a proper vessel, and boil it for one hour. When cool it is fit for use. The sulphuric acid renders the oil quick drying, and removes its *tacky* character. This is a good recipe for painters, and manufacturers of oilcloth.

No. 3.—Take one gallon of linseed oil, and add to it about one pound of the flowers of sulphur, and boil for one hour. This is, perhaps, the best oil, or any other kind of varnish of waterproof coating, for outside work, such as porous stones or bricks which imbibe moisture. It will also render statues or other works of plaster of Paris impervious to moisture, and enable them to stand exposure to the weather. It is an excellent preservative oil varnish, and one of the most simple to make.

During the time any of these varnishes are boiling, fine shreds of india rubber may be added, and will be dissolved, and render the varnish much thicker, and superior for some purposes. In boiling oil care must be exercised not to allow the fumes to come in contact with flame, or they will take fire. The oil is also liable to fume over when the sugar of lead is added, hence the necessity of stirring well at that particular period. Turpentine renders oil *drying*, but it also injures, in a great measure, its durable qualities, by imparting to it a partly saponaceous character. The smallest amount possible of turpentine should, therefore, be used in oil varnishes or paints.

Copal Varnish.—Take one pound of gum copal, fuse it in an iron vessel over a fire, then add one pint of hot drying oil, like No. 1 varnish, and stir all well until the gum is dissolved among the oil, and the varnish becomes stringy. When cool it is thinned with turpentine. All varnishes improve with age when kept in close vessels. Copal varnish is employed for japanning tinware.

Crystal Varnish.—This beautiful varnish, which is used for maps, prints, and drawings on paper, is made by dissolving pure Canadian balsam in rectified spirits of turpentine. Equal parts of the balsam and turpentine are mixed together in a bottle or stoneware vessel, which is set in hot water, and kept in a warm situation for about a week. During this period it should be frequently agitated.

A Black Japan Varnish.—Bitumen, 2 ounces ; lampblack, 1 ounce ; Turkey umber, ½ ounce ; acetate of lead, ½ ounce ; Venice turpentine, ½ ounce, boiled oil, 12 ounces. Melt the turpentine and oil together, carefully stirring in the rest of the ingredients, previously powdered. Simmer all together for ten minutes.

Hair Lotion.—Take one pint of alcohol and two ounces of castor oil, and shake them together for fifteen minutes in a bottle. It will then be found that the alcohol has dissolved the oil, and the combination of the two makes a very excellent lotion for the hair. It can be perfumed with a few drops of the essential oils.