THE COMPOSITION AND WORKING OF ALLOYS.

Of all the known metals in use at the present time, iron and platinum are the only metals that bear welding and forging well, and iron or steel is the only metal that admits of being hardened beyond that degree which may be produced by simple mechanical means, such as hammering, rolling, &c. Yet all the metals, with the exception of platinum and its kindred metals, admit of ready fusion; and their fusibility offers an easy means of uniting them, and many of them combine with other metals with great readiness, and by mixing two or more of these metals by means of fusion an alloy may be formed that is of an entirely different nature from any of its constituents, and by the process of founding alloys may be cast into any desired form. The malleability and ductility of these metals, as well as their hardness and brittleness is often increased by alloying with each other, and these qualities are often turned to many useful and varied purposes. The ready fusion of these metals also affords a ready means of uniting two or more metals by the fusion of a third metal by the process of soldering. Some of these metals will unite with others in almost any proportion, and form a perfect chemical mixture, which in many cases produces a superior metal to either of its constituents, while in others the chemical affinity is limited, and they will only unite in certain proportions; and when mixed beyond these proportions the alloy is only a mechanical mixture, and often forms an inferior metal to either of its constituents. I have given several recipes for the formation of alloys by mixing these different metals; but in using these or other recipes in forming alloys the founder must not be guided entirely by the recipe, but he should use his own judgment as well, for the metals may contain certain impurities, or, as it is termed, be a poor metal, which will produce different results; and in order to produce good alloys a long practical experience is as essential as good recipes, for a man who has not had practical experience in forming alloys can no more produce a perfect alloy from a recipe than a school boy can produce perfect writing from his first copy.

ALLOYS OF IRON.

All admixtures added to iron make it more fusible than when pure, although the admixtures added may not be a metal. Lead can be alloyed with iron in small quantities. A small amount of lead causes iron to be soft and tough, but too much causes it to be extreme cold-short. Copper, if alloyed with iron, causes it to be extreme red-short, and more than 1 per cent of copper will cause it to be cold-short; but a small amount of copper will increase the strength of iron when cold. Arsenic imparts a beautiful white colour to iron, resembling silver, but it makes it very brittle. Tin, when alloyed with iron, makes a beautifully fine white metal, and when the tin and iron are alloyed about half-and-half the alloy is as hard as steel, but it cannot be forged. Chromium, alloyed with iron, makes an alloy that is as hard as diamond, but it is very difficult to make this alloy. Silver, alloyed with iron in small quantities, causes the iron to be very hard and brittle, and very liable to corrode. Gold can be alloyed with iron in any amount. It causes the iron to be more yellow and tough. This alloy is principally used as a solder for small iron castings. Carbon makes iron more fusible. From 1 to 2 per cent. of carbon added to iron makes hard cast iron, and from 5 to 6 per cent. makes No. 1 foundry iron. More than 5 or 6 per cent. of carbon causes iron to be very brittle, and less than 1 per cent. of carbon causes iron to be very hard and brittle. Sulphur causes iron to be both hard and brittle, either when hot or cold, and it causes molten iron to be short-lived. Fuel with sulphur in it should not be used for melting iron in contact with the fuel. Phosphorus is very injurious to iron. One-half of 1 per cent will cause iron to be very hard and brittle when cold, but it imparts a brilliant and white colour to iron more perfectly than any other metal. Silicon makes iron brittle and hard. It has a similar effect on iron to phosphorous, but it is not near so injurious to the iron. All cast iron contains more or less carbon, sulphur, phosphorus, and silicon, and as these substances predominate they form hard or soft, strong or brittle irons; and as all anthracite coal and coke contain more or less of these substances the anthracite or coke iron is less pure and more variable than the charcoal irons, and on account of the uncertainty of the amount of these impurities contained in cast iron is it very difficult to make an alloy of iron and other metals with any certainity as to the result, and for this reason alloyed iron is very little used.

GERMAN SILVER ALLOYS.

German silver is composed of 80 parts copper, 20 parts nickel, and 33½ parts zinc. The best quality of German silver is composed of 100 parts copper, 50 parts nickel, and 50 parts zinc. The white copper, or packfong of the Chinese, which is the same as the German silver of the present day, is composed of 41 parts copper, 17 parts nickel, 13 parts zinc, and 2½ parts iron. A very hard German silver is made of 8 parts copper, 4 parts zinc, 2 parts nickel, and 1 part iron. This alloy is very tenacious and ductile. A still harder German silver is made of 16 parts copper, 8 parts zinc, 4 parts nickel, and 3 parts iron. The finest quality of German silver that is made is composed of 16 parts copper, 8 parts nickel, and 7 parts zinc. Ten parts copper shavings and 4 parts arsenic, arranged in a crucible in alternate layers, and covered with a layer of common salt, make a beautiful white alloy that is almost equal to silver. In making this alloy care must be taken to avoid the fumes of the arsenic.

BRASS ALLOYS.

A very good brass is made of 16 lb. of copper, 8 lb. of zinc, and 1½ lb. of lead. This lead should be added after the copper and zinc have been melted together. These proportions of the different metals make better brass than can be made with zinc and copper. For very light castings the lead should be omitted, as it makes the alloy less fluid; but in heavy castings it makes them more solid and clean. Button brass consists of 24 parts copper to 15 parts zinc. Red brass made at Hegermuhl consists of 5½ parts copper and 1 part zinc. Brass that bears soldering well consists of 16 parts copper, and 6 parts zinc. Brass for ship nails consists of 20 parts copper, 16 parts zinc, and 2 parts iron. Red sheet brass is made of 9 parts copper and 2 parts zinc. Brass for sheathing, bolts, fastenings, &c., is composed of 6 parts copper and 4 parts zinc. This composition forms an alloy that may be rolled and worked at a red heat. Brass for pumps, and machinery requiring great tenacity, is made of 32 lb. copper, 3 lb. tin, and 2 lb. old brass. If it is desirable to have the wheels harder a little more tin may be added. An alloy for turned and finished work is made of 32 lb. copper, 4 lb. tin, and 3 lb. old brass. For nuts of coarse thread one half-pound more tin may added. As more tin is added to alloys of copper and zinc, or copper and old brass, the alloy becomes harder. Razors have been made of an alloy of 32 parts copper, 5 parts tin, and 5 parts zinc. The best white hard metal for buttons is made of 16 parts copper, 2 parts zinc, and 1 part tin.

LEAD AND COPPER ALLOYS.

Seven parts lead and 16 parts copper make a very cheap alloy, but it is rather short and easily broken. Two parts lead and 8 parts copper make a red-coloured alloy that is very tough. A red-coloured and ductile brass is made of 2 parts lead and 16 parts copper. Ordinary pot metal is made of 6 parts lead and 16 parts copper. This alloy is very brittle when hot, but tough when cold. The alloys of copper and lead are all very brittle when hot. More than one-half pound of lead cannot be alloyed with one pound of copper, for the copper will not unite with the lead, and the lead will ooze out in cooling. Alloys of lead and copper are very little used. Lead and copper alloys have a bluish, leaden hue when much lead is used, and are principally used on account of their cheapness.

(*To be continued.*)

AMERICAN COMPETITION IN EUROPE.—The *British Mercantile Gazette* says: The American exports of hardware from the port of New York to Europe, for the quarter ending March, show a considerable increase over the corresponding period of last year. The increase is mainly in household and builders' hardware, mechanics' tools, saws, cutlery, etc., which in some instances are being offered in England at quotations so low as to make it impossible that the manufacturers can derive but the barest margin of profit. A letter from New York states that advices then in hand from Europe were encouraging, and that dealers in one or two lines were quite sanguine of their efforts to create European trade. Travelers are now in England representing American houses, and there are American merchants in Sheffield who are prepared to take orders for hardware and deliver the goods within three weeks. In Canada, in a few special lines, the Americans are having it pretty much their own way. No steel rails are being sent from Sheffield to America, though once this was one of the best markets. These figures show how the Bessemer steel rail trade in America is growing: In 1873 the manufacture in the United States was 129,015 tons; in 1874, 144,914 tons. This increase continued each succeeding year until 1877, when the total was 432,169 tons.