METALLURGY OF COPPER AND ZINC.

The following is the substance of three other lectures by Dr. Percy, of London, being a continuation and completion of the course which we published on page No. 51, present volume, as taken from the *Ironmonger* :—

In several parts of Italy they practice a peculiar process for obtaining copper from iron ores. The ore employed is an iron pyrites, containing a very small amount of copper, not more than two per cent; it is broken into lumps the size of the fist, spread on a layer of brushwood and ignited; when the whole takes fire, the sulphur burns with the evolution of sulphurous acid gas, the combustion of the heap continuing for eight or ten months. When the fire has burnt itself out it is found that the outer part of each mass consists of peroxide of iron merely, the whole of the copper being concentrated in a central kernel, which often is so rich as to contain 15 per cent of metal. The kernel, after separation from the surrounding mass, is smelted in the usual manner.

The working qualities of copper are greatly influenced by minute quantities of other bodies united with it. Phosphorus in very small proportions ensures a good sound casting, and the metal can be rolled when cold, but is brittle when hot, or, as it is termed technically, is red short. Copper containing so large a proportion as 11 per cent of phosphorus is hard, grey in color, and vere sonorous When copper is granulated, mixed with a large proportion of sand and charcoal, exposed to a white heat for three or four hours, it alloys itself with silicon, the basis of sand; these samples of silicated copper possess very remarkable properties. An alloy with 11 per cent of silicon is brittle, with two per cent the alloy is tough, strong and closely resembles gun metal, and promises to be of great value in the arts. The purity of the copper used in forming the conductors for electric telegraphs is a point of great importance, as the conducting power of copper is greatly lessened by even a small admixture of foreign bodies; taking the conducting power of pure copper at 100, a minute addition of metallic arsenic or of phosphorus lessens it to 6.

Zinc, which has only been obtained in a separate state within a comparatively recent period, was certainly known to the Romans, by whom brass coins were made 2,000 years since. Zinc in its ordinary state is a bluish white metal which is brittle at ordinary temperatures, but becomes malleable when heated, and if rolled in this state retains its malleability when cold, after which it may be bent without breaking and may be softened by annealing. On the contrary, it heated nearly to its melting point it again becomes brittle, and when bent crackles like tin. The melting point of zinc is about 800° Fah. At a bright red heat it takes fire if exposed to the air, producing white oxide of zinc; this, however, is yellow when heated, and may in this condition be often seen escaping from the chimneys of brass foundries. Oxide of zinc is largely used as a white pigment; united with carbonic acid it constitutes calamine. The chief ores of zinc are calamine and zinc blende. Calamine is a carbonate of the oxide. It was formerly so abundant in England that it has been exported as ballast. At the end of last century 1,500 tuns were yearly raised in Derbyshire alone; in 1859 the whole amount in the United Kingdom was 235 tuns, chiefly from Cumberland and Ireland. The chief continental deposits of calamine are in Belgium, Silesia and Carinthia. Recently, however, large and valuable deposits have been discovered in the north west of Spain. Blende, or sulphide of zinc, the "black jack" of the miners, is a combination of zinc and sulphur; its name is derived from the German ward *blenden*, to dazzle. It is a much more abudant ore than calamine. The first process in the reduction of the blende is that of roasting in the reverberatory furnace. This has the effect of burning away the sulphur, and the zinc remains in the form of oxide. This oxide is reduced to the metallic state by heating it in closed pots with charcoal or other carbonaceous matters, when the carbonic oxide produced absorbs the oxygen from the ore, and the metallic zinc, being converted into vapor by the heat, flies off through a tube and is condensed and collected. Formerly this process was followed very extravagantly. At Swansea, even quite recently, twenty-four tuns of coal were consumed in the reduction of one tun of zinc. An improved form of retort for effecting the reduction is now employed, and the cost has consequently been diminished to less than one-half of what it was formerly by the old furnaces. The improved method of reduction is termed Silesian. Furnaces acting on the same principle, but differing considerably in detail, are also employed in Belgium, at the works of the well-known Vieille Montagne Company. The consideration of the foreign materials always present in commercial zinc is one of considerable practical importance. Iron and zinc alloy readily, and the presence of a minute quantity of iron renders the zinc unfit for rolling. When iron is present, it is indicated by minute grey specks on the bright crystalline surfaces of a freshly broken ingot of zinc. When lead and zinc are melted together and cast, the lead always is found in greater quantity on the bottom of the casting, but zinc cannot be completely deprived of lead in this manner. The effect of the presence of lead on the quality of zinc is a matter of some dispute, some observers stating that its action is very detrimental, whilst others allege that the inferior quality of the zinc under experiment depends on the mode of working. In preparing ingots of zinc for rolling, the practice is to allow the lead to subside as completely as possible.

The combination of the two metals, copper and zinc, constitutes brass, an alloy which possesses very valuable properties; it is so malleable and ductile that it can be rolled into thin sheets, shaped into vessels under the hammer, raised by stamping, drawn into wire, cast at a lower temperature than copper, taking a sharp impression, and, lastly, it is of a pleasing color, and is cheap. So malleable is brass, that it may be beaten out into leaves not exceeding the $\frac{1}{52500}$ of an inch in thickness. The composition and qualities of brass vary very much with the purposes to which it is applied. Thus, the presence of a little tin is a good addition to brass used for door plates, as it causes the metal to break up short under the graver. Brass for turning has usually about 3 ounces of lead added to every 10 pounds, the addition being made after the crucible is removed from the furnace; the addition causes the turnings to leave the tool readily. Brass is very subject to a peculiar alteration in the arrangement of its particles, by which it becomes crystalline and extremely brittle—brass wire, brass chains, &c., often, without any apparent cause, lose their tenacity and become as brittle as glass; hence it is doubtful whether brass chains should be employed in the support of heavy bodies, such as chandeliers.

The Affection of Hair Snakes.

Professor Agassiz, is writing a series of articles for the *Atlantic Monthly*, which are richly worth the subscription price of the publication. From the article in the February number we take the following extract :—

In the third division of the animal kingdom—the articulates—we have again three classes: worms, crustacea, and insects. The lowest of these three classes, the worms, presents the typical structure of that branch in the most uniform manner, with little individualization of parts.

This class includes animals of various degrees of complication of structure, from those with highly developed organizations to the lowest worms that float like long threads in the water and hardly seem to be animals. Yet even these creatures, so low in the scale of life, are not devoid of some instincts, however dim, of feeling and affection. I remember a case in point that excited my own wonder at the time, and may not be uninteresting to my readers. A gentleman from Detroit had had the kindness to send me one of those long thread-like worms (*gordius*) found often in brooks and called horse-hairs by the common people. When I first received it it was coiled up in a close roll at the bottom of the bottle, filled with fresh water, that contained it, and looked more like a little tangle of black sewing-silk than anything else. Wishing to unwind it, that I might examine its entire length, I placed it in a large china basin filled with water, and proceeded very gently to disentangle its coils, when I perceived that the animal had twisted itself around a bundle of its eggs, holding them fast in a close embrace. In the process of unwinding, the eggs dropped away and floated to a little distance. Having finally stretched it out to its full length—perhaps half a yard—I sat watching to see if this singular being, that looked like a long black thread in the water, would give any signs of life. Almost immediately it moved toward the bundle of eggs, and, having reached it, began to sew itself through and through the little white mass, passing one end of its body through it, and then returning to make another stitch, as it were, till the eggs were at last completely entangled again in an intricate net work of coils. It seemed to me almost impossible that this care of offspring could be the result of any instinct of affection in a creature of so low an organization, and I again separated it from the eggs, and placed them at a greater distance, when the same action was repeated. On trying the experiment a third time the bundle of eggs had become loosened, and a few of them dropped off singly into the water. The efforts which the animal then made to recover the missing ones, winding itself round and round them, but failing to bring them into the fold with the rest, because they were too small, and evaded all efforts to secure them, when once parted from the first little compact mass, convinced me that there was a definite purpose in its attempts, and that even a being so low in the scale of animal existence has some dim consciousness of a relation to its offspring. I afterward unwound also the mass of eggs, which, when coiled up as I first saw it, made a roll of white substance about the size of a coffee-bean, and found that it consisted of a string of eggs, measuring more than twelve feet in length, the eggs being held together by some gelatinous substance that cemented them and prevented them from falling apart. Cutting this string across, and placing a small section under the microscope, I counted on one surface of such a cut from seventy to seventy-five eggs; and estimating the entire number of eggs according to the number contained on such a surface, I found that there were not less than eight millions of eggs in the whole string. The fertility of these lower animals is truly amazing, and is no doubt a provision of nature against the many chances of destruction to which these germs, so delicate and often microscopically small, must be exposed. The higher we rise in the animal kingdom, the more limited do we find the number of progeny, and the care bestowed upon them by the parents is in proportion to this diminution.

Grain Laden Vessels Lost.

The *Journal of Commerce* states that during the month of December of last year, and thus far in January, "we have recorded the loss of some twenty-five grain loaded British vessels, going from New York to Europe, whose cargoes were insured on the other side. In every case these vessels were loaded by means of the elevators, and so rapid is this method, that but a few hours is necessary to load the largest class ship. The grain thus run in cannot be properly stowed by men in the hold, in consequence of the danger they run of suffocation from the grain overwhelming them, and from the dust arising from it, it being impossible for them to remain below longer than an hour at a time. It has no opportunity to settle or to become packed, as in the old style of stevedoring, and thus, when the vessel proceeds to sea, and is in motion, the grain shifts to leeward, almost invariably works through the ceiling into the pump wells, and so chokes up the boxes."

The idea conveyed by the foregoing statement, is that it is dangerous to the safety of vessels to be loaded by grain with elevators. This is a mistake. American vessels load in this manner and make as safe voyages as with any other cargo. The secret lies in loading them properly, and for this purpose the Board of Underwriters employ an experienced supervising agent to examine every American vessel loaded with grain in New York. There is no agent of Lloyds in this city, hence these British vessels which have been lost were not loaded properly; their cargoes shifted in severe weather and they became unmanageable wrecks. It is very difficult to load vessels with grain in bulk, and it would amply remunerate Lloyds to employ competent American agents in New York for the very purpose of examining all grain loaded British vessels.

A Connecticut correspondent writes that the culture of flax is beginning to be considerably agitated since cotton has gone up to 40 and 45 cents per pound. He says "New England can produce 400 lbs. of good, clean, swingled flax per acre, on moist, rich land."