For the Scientific American.

ON ZINC.

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HISTORY.

Zinc is a metal of the present century. Seventy years ago there were not so many pounds of it required for the wants of the whole world as there are tuns manufactured at the present time. Its production has increased two thousandfold, and we must look upon it as one of the most useful of all the metals in the whole round of chemistry.

It is true that the ancients made brass from copper and calamine; but they were not aware of the existence of metallic zinc in the mineral they employed to combine with the copper. The word zinc itself does not appear to have been used before the year 1540, and by some authorities it is traced to Zincken or Zacken, meaning the chimney stack in which the oxide collected when zinc-bearing ores were roasted. When this flue dust became known as a metal it received opprobrious names, such as "the spurious son of copper," and hence a bastard metal. Some called it coagulated mercury, and the miners thought it was unripe lead ore, and if it were left a few ages longer it would mature to something useful. It appears to have been brought to England from India towards the end of the sixteenth century, and to have received at that time the name of "spelter," which it still bears. That the Germans did not know how to make brass from the ores of zinc is conclusively shown in the history of the mines at Wiesloch, in Baden, which were worked for lead from the eleventh to the fourteenth century, during all which time the zinc ore was thrown away and finally collected in vast heaps about the mouth of the mine. These mines were re-opened in 1850, and an immense amount of zinc was obtained from the refuse that had been previously regarded as worthless.

The first German establishment for the manufacture of brass from copper and calamine, was at Goslar, in the sixteenth century. In England we have the record of all patents issued since the year 1681, and we find that the earliest mention of brass was in 1728, when a patent was granted for "a method for the more advantageous manufacturing copper oares through all the intermediate operations till it be brought into fine copper, and from thence into brasse, to be cast into plates, rodds, kettles, and other utensills in metall moulds." And we read, in 1758, that "spelter and brass might be made from a mineral which had not theretofore been made use of for such purposes. The mineral black-jack, mock-jack, or brazill, can be used to make spelter."

But by far the most important discovery relating to zinc was made by Sylvester and Hobson, in 1805. This was "a method of manufacturing the metal called zinc into wire and vessels. Zinc is made malleable and may be drawn into wire by working it at a proper heat or by annealing: 210° to 300° Fah. is such proper heat." It was in view of this discovery that we called zinc a metal of the present century; for, previous to this period, its applications had been of the most insignificant character as compared to the vast uses of the present time.

Between the years 1728 and 1859, 69 patents were issued in England chiefly relating to zinc furnaces. The SCIENTIFIC AMERICAN, for the last ten years, contains the record of twenty patents granted in the United States involving the manufacture and uses of zinc. It appears from all accounts that the first zinc made in the United States was by John Hitz, in 1838. He prepared it from New Jersey ore for the purpose of manufacturing some brass to be used for the standard weights at Washington. His method was a tedious and expensive one; but since that time great improvements have been made, and the industry has become a very important one in the United States; and as we have extensive deposits of blende and calamine, it is destined to assume still greater proportions.

OCCURRENCE.

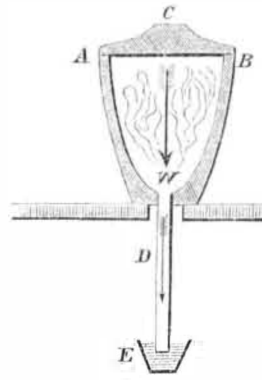
The variety of zinc minerals is not very great, but this is made up by the abundance of the few in which the metal is found.

The most conspicuous ores are blende, commonly called black-jack, which is a compound of sulphur and zinc; calamine, which may be a silicate or carbonate; zincite, an oxide; goslarite, a sulphate; and franklinite, composed of zinc, iron, and manganese, and found in New Jersey. The metal is not found in the animal or vegetable kingdom, as it would be destructive to the growth of vegetables or animals. The Germans call black-jack *blende*, because it used to blend or deceive the early miners. Its beautiful luster led them to expect to find a valuable metal; but, as all of their efforts to obtain anything from it remained fruitless, they looked upon the ore as a cheat, and called it *blende*.

PREPARATION OF ZINC.

Having sketched the history and occurrence of zinc, we come now to consider the methods of its preparation.

"The process is comparatively simple, and consists in first carefully hand-picking the ore to remove the galena, and then calcining it in a reverberatory furnace or rather oven. The roasted ore, deprived of carbonic acid, water, and sulphur, as the case may be, is then mixed with charcoal alone if prepared from calamine; but if from blende, a certain quantity of roasted calamine is also added, and the whole placed in earthen pots, or crucibles, very much like the pots used at glass works, but provided with a luted cover and also with an opening at the bottom, to which an iron pipe is fitted. After the heat has been applied sufficiently long, the volatile metals—such as arsenic and cadmium—make their way in vapor, *per descensum*, to the end of the iron tube, where they afford a flame, which the workmen distinguish by the name of the *brown blaze*; this is succeeded by a blue flame, called the *blue blaze*, which indicates the distillation of the zinc; and then the metal is condensed in the iron tube, and falls in drops and in a powdery state into a vessel placed to receive it; as may be easily imagined, the iron pipe sometimes becomes stopped, and is occasionally cleaned by a red-hot iron rod.



"A B is a large earthen crucible or pot containing a mixture of roasted zinc ore and coal or charcoal; C is the cover closely luted down; D is the iron pipe in which the zinc vapor condenses and falls into the vessel, E, containing enough water to cover the end of the pipe.

"The pipe is removed after each charge has been exhausted, in order to take out the *caput mortuum* or matter left in the crucible after distillation. The arrows show the direction of the metallic vapor, and the iron pipe is usually plugged with wood, W, which is soon reduced to charcoal, and while preventing the ore from falling out, does not stop the zinc vapor."

The above extract will serve to convey a general idea of the metallurgy of zinc; but the process is capable of important modifications, as the numerous patents on the subject abundantly show, and it is probable that we shall arrive at still simpler methods as the demand for the metal increases.

PROPERTIES OF ZINC.

Our knowledge of zinc has increased very nearly in the ratio of its employment in the arts, and the one may be said to grow out of the other; for the more we know of its properties the more easily can we imagine its uses. There are certain general facts in reference to its properties that may be found in every chemical treatise, but the recent progress of our knowledge is not contained in any single book, and can only be obtained by searching the journals of various countries. We have performed this search, and propose to give the results of our labor.

Zinc is a bluish white, brilliant metal, crystallizing in hexagonal pyramids with subordinate prismatic faces. The specific gravity of cast zinc varies from 6·8 to 7·1, and of forged from 7·19 to 7·2. It is less flexible than lead or tin when cold, and is very brittle at ordinary temperatures, and also when heated up to 410° Fah. It is malleable between 212° and 300°. Fah., the best temperature for this purpose being 248° Fah. It melts between 752° and 773° Fah, and can be readily distilled with exclusion of air. The metal possesses different properties according to the temperature at which it has been prepared; for example, when heated nearly to its point of ignition it is less flexible than when heated simply to fusion, and the point of fusion and rapidity of cooling affect its solubility in sulphuric acid. It would appear from these and other circumstances that the metal was capable of assuming different allotropic conditions. It expands more by heat than any other metal. In pure dry air or in water free of air, zinc remains perfectly bright, but in moist air or in ordinary water, it is rapidly coated with a film of oxide, which serves to protect it from further destruction. The impure metal is more readily dissolved in acids than the pure, and the evolution of hydrogen takes place very violently when a little bi-chloride of platinum is added. The action of foreign metals is explained on the principle of electric currents. Zinc which has been heated to a high degree and then suddenly cooled, is also more rapidly acted upon by acids.

Silver being taken at 100, the conducting power of zinc for electricity is 27·39; and for heat, silver being taken at 1000, the conductivity of rolled zinc is 641. One of the most important properties of zinc is its highly electro-positive character, which enables us to employ it to precipitate nearly all of the metals from their solutions. It has recently been discovered to possess great reducing power, especially for the chlorides and fluorides of the metals; and it is proposed to employ it to obtain the rare metals aluminum, magnesium, silicium, etc. It has also been found that it will displace phosphorus from bone ash, and a new method for the preparation of phosphorus is thus suggested. It dissolves gold and silver very readily, and it is proposed to substitute it for mercury in the working of the precious metals. Zinc does not alloy with bismuth nor with lead. Lead dissolves 1·6 per cent zinc, and zinc dissolves 1·2 per cent lead; zinc dissolves 2·4 per cent bismuth, and bismuth dissolves 8·6 to 14·3 per cent zinc. Zinc is acted upon by common salt with evolution of hydrogen, and the formation of a double salt of chloride of zinc and sodium and the separation of the oxide.

Zinc in concentrated sulphuric acid evolves sulphurous acid; in sulphuric acid and six parts of water, sulphureted hydrogen is given off, and pure hydrogen is only obtained from very dilute sulphuric acid. Zinc is a violent poison, and hence the action of a certain class of substances upon it ought to be carefully studied. Brandy, wine, vinegar, meat soup, milk, spring water, salt water, sugar sirups, dissolve zinc more or less, and consequently ought not to be stored in it.

Caustic soda, potash, and ammonia act very violently upon zinc, and this explains the reason why petroleum, which has been purified by means of soda, acts so powerfully upon zinc tanks, and often eats through them.

Zinc has great antiseptive properties, and is employed to keep timber from decay. When zinc is dissolved in hydrochloric acid a portion of the chloride is carried over mechanically by the hydrogen, producing a black mirror on porcelain similar to arsenic, thus exposing the chemist to an error that might have serious consequences. The action of hydrochloric acid upon zinc is immediately interrupted by chloride of mercury.

Zinc decomposes in contact with plaster, also in contact with iron. Eaves gutters should be supported by galvanized iron, and no sheet zinc should be laid on oak boards.

Zinc readily combines with phosphorus producing a valuable medicine, and a compound that can be usefully employed in the galvano-plastic art. The property of zinc that enables us to employ it in the construction of the galvanic battery was more particularly studied by Volta, and suggests the possibility of our having recourse to it as a motive power. At present the cost of zinc as an electric motor is 200 times greater than that of coal for the same power, but it does not necessarily follow that we shall never attain practical results in this direction, either by cheaper zinc or more ingeniously contrived machinery. The property of zinc to alloy with other metals, especially copper, is one of its most prized characteristics, and is the one longest known.

We have thus sketched the principal properties of zinc, and may hereafter recur to the applications of which the metal is capable.

The New "London Times" Printing Machine.

As the construction of the first steam newspaper machine was due to the enterprise of the late Mr. Walter, so the construction of the last and most improved machine is due in like manner to the enterprise of his son. The new "Walter Machine" is not, like Cowper's and Applegarth's, and Hoe's, the improvement of an existing arrangement, but an almost entirely original invention. Its principal merits are its simplicity, its accurate workmanship, its compactness, its speed, and its economy. While each of the ten-feeder Hoe machines occupies a large and lofty room, and requires 18 men to feed and work it, the new Walter machine occupies a space of about 14 feet by 5, or less than any newspaper machine yet introduced, and only requires three lads to take away, with half the attention of an overseer, who easily superintends two of the machines while at work. The Hoe machine turns out 7,000 impressions printed on both sides in the hour; but the Walter machine turns out 11,000 impressions completed in the same time.

The new invention does not in the least resemble any existing printing machine, unless it be the calendering machine, which has possibly furnished the type of it. At the printing end it looks like a collection of small cylinders or rollers. The paper, mounted on a huge reel as it comes from the paper mill, goes in at one end in an endless web, 3,300 yards in length, seems to fly through among the cylinders, and issues forth at the other in two descending torrents of sheets, accurately cut into lengths, and printed on both sides. The rapidity with which it works may be inferred from the fact that the printing cylinders (around which the stereotyped plates are fixed) while making their impressions on the paper, travel at the surprising speed of 200 revolutions a minute.

As the sheet passes inwards, it is first damped on one side by being carried rapidly over a cylinder which revolves in a trough of cold water; it then passes on to the first pair of printing and impression cylinders, where it is printed on one side; it is next reversed and sent through the other pair, where it is printed on the other side; then it passes on to the cutting cylinders, which divide the web of now printed paper into the proper lengths. The sheets are rapidly conducted by tapes in a swing frame, which, as it vibrates, delivers them alternately on either side, in two apparently continuous streams of sheets, which are rapidly thrown forward from the frame by a rocker, and deposited on the tables at which the lads sit to receive them.

The machine is almost entirely self-acting, from the pumping up of the ink into the ink box out of the cistern below stairs, to the registering of the numbers as they are printed, in the manager's room above.

Such, in a few words, is the last great invention made in connection with newspaper printing, which reflects no little credit on the enterprise of Mr. Walter and the inventive skill of the gentlemen of the *Times* staff—for it has been entirely designed and manufactured on the premises—to whom he has intrusted its execution.—*Morgan's British Trade Journal.*

Test for the Goodness of Glue.

Mr. Alfred Bird, of Birmingham, England, communicates to the *Chemical News* the following test for the goodness of glue, which he states he has found very valuable:

"Assuming that 'that' is the best glue which will take up most water—take 50 grains of the specimen, and dissolve it in 3 ounces of water in a water bath. When dissolved, set it by for 12 hours, to gelatinize; and then take an ounce chip box, place it on the surface of the gelatin and put 'shots' into the box, till it sinks down to a 'mark' on the outside. It will be found that, the stronger the glue the more shots it will take to sink the box down so that the mark shall be level with the surface of the gelatin.

"In a trial with the finest glue I ever met with, 50 grains of glue, dissolved and gelatinized, with 3 ounces of water, supported, to the mark on the box, 6 ounces of shots, at a temperature of 58° Fah. On trying the same experiment with best Russian isingl ss, 50 grains, dissolved in 3 ounces of water, supported 9 ounces of shots, the temperature being the same.

A NEW marble has been discovered in the Giant Mountains of Bohemia, which is described as in every way equal to Carrara, both in whiteness and fineness of grain, and in valuable for sculpture.