

[For the Scientific American.]

ON THE USES OF ZINC.

BY PROFESSOR CHARLES A. JOY.

We have previously given the history, occurrence, and properties of zinc, we now propose to speak of its applications. The uses of the metal are so rapidly extending that what we say of it to-day will hardly hold good to-morrow, and we can only aspire to record a small number of its many applications. We shall not confine ourselves to the metal, but shall include its salts in the enumeration.

Zinc powder, mixed with oil, is employed as a varnish to protect iron from rust, but its chief application for this purpose is known as galvanizing iron. It was discovered by Proust and afterwards more fully illustrated by De la Rive, that the presence of a little iron in zinc produces a galvanic current, and rapidly promotes the decomposition of water. Reasoning from this it was proposed to employ zinc to prevent the oxidation of metals, and hence the name of galvanizing was applied to the process.

Galvanized iron, which is now so much used for corrugated roofing, boats, buildings, spoutings, ships' sheathing, buckets, tanks, wires, and many other purposes, is prepared by first cleaning the plate by a bath of sulphuric acid and water, then washing in a concentrated solution of chloride of ammonium, and subsequently plunging it into the molten zinc. The zinc dissolves some of the iron, and forms a perfect alloy on the surface, and by repeating the immersion the thickness of the layer of zinc may be increased at pleasure. In this process there is considerable loss by the formation of a refuse alloy of zinc and iron, amounting in the United States to several hundred tons per annum. Mr. William H. Chandler, of the Columbia College School of Mines, proposes to economize this refuse by heating it in an iron kettle nearly to the point of volatilization of the zinc and allowing it to cool slowly from the bottom. An alloy of zinc and iron, containing a much larger percentage of iron than the original refuse, gradually forms, falls to the bottom of the kettle, and is removed by a perforated ladle. The operation is repeated in separate kettles until all of the dross is removed, and a good commercial spelter is obtained.

Zinc is now extensively employed as a reducing agent in the preparation of aluminum, calcium, silicium, boron, and other rare elements. It is found to act more powerfully upon chlorides and fluorides than upon oxides, although the latter are many of them reduced by it. This adaptation of zinc opens up a new field of research, and will doubtless lead to important applications in the future.

We have previously alluded to the fact that phosphorus can be expelled from a mixture of bone ash and fluor spar by means of zinc, and that this method is proposed as a substitute for the old way of making phosphorus.

The solvent properties of zinc for gold and silver at once suggest its employment for the reduction of the ores of these metals in place of the amalgamation process so long in use. The reducing property of zinc is so powerful that it forms detonating powders when mixed with any nitrates and chlorates, and if it were cheaper could be used in the manufacture of blasting powder, the same as it has been employed for pyrotechnical fuses.

Zinc has long been employed for the decomposition of water in the preparation of hydrogen gas. It was at first supposed that the purer the metal the better would be the results; but practice soon proved the contrary, and the presence of foreign metals was discovered to greatly promote the evolution of the gas. The following table shows the relative amount of gas given off in the same interval of time, by pure zinc and its alloys, according to accurate observations made by De la Rive:

	Gas obtained in same time.
Nine parts of zinc and one of iron.....	100
" " " " one of copper.....	43
" " " " one of lead.....	15
" " " " one of tin.....	12
Distilled zinc.....	5

It was also found that the acid mixture best adapted for the evolution of hydrogen was composed of one hundred parts of water and thirty-three parts of sulphuric acid. It will be apparent from this that pure distilled zinc is not at all adapted to the decomposition of water.

Zinc powder is employed to reduce the nitrates to nitrites, thus affording a cheaper method than the use of silver. It is also found to decompose the sulphide of barium, and to afford a way for the preparation of the hydrated oxide of barium instead of the old method which involved the use of copper. As the soluble salts of baryta are now largely used to prevent boiler incrustations, any cheaper methods for their production will be appreciated by our engineers. The first attempts to employ zinc white as a substitute for white lead appear to have been made by Courtois in 1782, but it was not until 1845 that the effort to introduce it met with much success. The cost of the material and the necessity for a special oil and dryer were impediments in the way of its general introduction. Even at the present time our house-painters do not appear to be as familiar with it as they ought to be. It is sometimes found to chip off; but this can be prevented by filling the pores of the wood with linseed oil, previous to applying the zinc white. Sorel prefers to use the chloride of zinc as a paint, and for this purpose prepares the following mixture:

Chloride of zinc (solution 50° B.).....	30 parts.
Cream of tartar.....	1 "
Hydrochloric acid.....	1 "
Potato starch.....	4 "
Water.....	6½ "

100

Stir in zinc white and chalk to proper consistency, and to give glance add a little linseed oil. To obtain a plastic mass like whalebone, take 50 parts potato starch, 5 parts oxide of zinc, and stir them into a mixture composed of 50 parts chloride of zinc (of 55° B.), 1 part cream of tartar, and 1 part hydrochloric acid.

The advantages claimed for zinc paint are at follows: It does not require to be rubbed to give good luster; is more durable than lead paint; withstands moisture; has no smell; protects wood from decay; renders the wood incombustible; is not a poison; does not turn black in bad gases.

The Bartlett white lead is essentially oxide of zinc with lead, and is an article lately introduced to the trade and highly commended by such high authorities as Chandler and Muspratt.

An amalgam of zinc, tin, and mercury has long been employed on the cushions of electrical machines, and is still a favorite. The late Professor Schonbein, of Basle, Switzerland, discovered a remarkable property of zinc amalgam to decompose water and to convert a portion of it into peroxide of hydrogen. It is only necessary to shake vigorously some zinc amalgam in a flask of water, to which a few drops of sulphuric acid have been added, to produce an appreciable quantity of the higher oxide of hydrogen, sufficient to show its presence by the usual reactions. As the peroxide of hydrogen has valuable bleaching and medicinal properties, this method of its preparation by means of zinc amalgam may be worthy of further investigation.

The chloride of zinc has numerous applications in the arts besides those already alluded to. In the form of a solution it is found to have a constant boiling point, and hence it is used in the laboratory to afford a bath of higher temperature than 212° Fahr.

The chloride dissolves silk and is used to separate that fiber from wool and vegetable. It is extensively used to impregnate timber to protect from decay, and at one time occasioned a good deal of remark under the name of the kyanizing process. Under the trade name of Sir William Burnett's Disinfecting Liquor, the chloride of zinc has acquired considerable celebrity.

As butter of zinc the chloride has been used as a styptic, also as an emetic. Its application for soldering steel, iron, brass, and copper by means of tin, is well known to plumbers.

The chloride of zinc, with the oxide, is employed as a substitute for gypsum in taking plastic casts, in making statuettes, as a filling for teeth, as a lute in gas manufacturing, and as a valuable cement. The applications of the chloride are so numerous that it is proposed to manufacture it by expelling hydrochloric acid from carnallite and making it pass over zinc dust or roasted ore. The object would be to use waste material in both branches of the manufacture. It has been found that zinc will alloy with magnesium, and where no more than five to twenty per cent zinc is employed the alloy is malleable and ductile. Such a mixture of metal in the form of fine filings has been used as a source of light for photographic purposes; but the great amount of smoke produced by the zinc and magnesium offers an insuperable obstacle to the employment of such a lamp in churches, caves, and confined localities. It is interesting, however, as a scientific experiment—and may be used to add to the brilliancy of fire works.

The hypochlorite of zinc can be recommended as a powerful bleaching agent. To chloride of lime, instead of sulphuric acid, add sulphate of zinc. Sulphate of lime and oxide of zinc will be precipitated and hypochlorous acid set free. It acts powerfully in the purification of whisky; also for bleaching paper, yarn, and other goods.

Newton's patent for the substitution of oxide of zinc for oxide of lead in the manufacture of glass has been successfully applied in England. The glass, is said to stand heat better, to be more translucent, and to be cheaper than when the oxide of lead is employed. The oxide of nickel is used as the bleaching agent for glass made of the oxide of zinc instead of oxide of manganese.

The compounds of zinc have extensive application in medicine; the metal is not used.

Acetate of zinc is employed as external remedy or wash for the eyes.

Carbonate of zinc is preferred as a cerate to the powdered calamine formerly used.

Chloride of zinc is prescribed in cases of cancer and as a caustic, also as a disinfectant for ships, hospitals, and dissecting rooms, and for preservation of anatomical specimens.

Zinc oxide is used for ointments.

Zinc sulphate as a tonic, astringent, and emetic.

Valerianate of zinc as an anti-spasmodic.

Cyanide of zinc as a substitute for hydrocyanic acid.

Iodide of zinc as a tonic and astringent.

Nitrate and lactate are also sometimes employed; and recently a very important medicine has made its appearance under the name of phosphide of zinc. It is given in cases where the administration of phosphorus is indicated. It is a gray crystallized body of perfectly definite composition and is prepared by passing the vapor of phosphorus in a current of dry hydrogen through melted zinc. It can be more easily prepared by heating gently one part of finely divided zinc and two parts of amorphous phosphorus in a crucible provided with a perforated cover for the passage of hydrogen gas. Phosphide of zinc is produced with a slight explosion.

Aside from its medicinal qualities this interesting compound can be employed when heated with sulphuric acid to evolve spontaneously combustible phosphureted hydrogen gas.

Galvano-plastic figures can be readily plated if they are first brushed over with a solution of nitrate of silver in alcohol, and are afterwards suspended in an atmosphere of phos-

phureted hydrogen evolved from the phosphide of zinc or made in the usual way.

The employment of zinc in the manufacture of colors is daily extending. We have a beautiful green and a yellow paint that ought to be more largely employed.

Rinnmann's green can be made of various shades according to the proportions of the materials employed, and ought to be substituted for the highly poisonous and dangerous arsenical (Scheele's) green so popular with our paper hangers: Five parts oxide of zinc and one part sulphate of cobalt give dark green; ten parts oxide of zinc and one part sulphate of cobalt give grass green; twenty parts of oxide of zinc and one part sulphate of cobalt give light grass green. By varying the mixture of iron, nickel, and cobalt oxides with the zinc, we can obtain red, yellow, and white colors. The beautiful zinc yellow is the chromate.

The use of cast zinc as a substitute for bronze has become a very extensive one in France. It is said that as many as 200,000 zinc clocks are annually made in France, and the number of statuettes, figures, and gas fixtures of all kinds can hardly be computed.

The property of zinc to throw down nearly all other metals from their solutions, is made use of to obtain the rare metal indium, and also to separate cadmium from refuse solutions. The similar precipitation of antimony is taken advantage of to coat zinc with a fine black color.

Zinc is used in dyeing, for the reduction of indigo and in preparation of indigo vat.

The oxide of zinc is preferred by many to jeweler's rouge as a polishing powder. One of the methods proposed for the manufacture of oxygen is to employ the oxide of zinc with nitrate of soda, also to reduce the sulphate of zinc according to Deville's plan.

To remove stains caused by photographic chemicals, it has been proposed to wash the hands with a concentrated solution of either sulphate or chloride of zinc, to which some acid is added at the same time. It is also well to rub the blackest stains with metallic zinc.

Zinc for fastening iron railings into stone is preferable to lead. Iron cemented with lead is consumed by rust and rapidly destroyed. The zinc sustains the chemical action in preference to the iron, and thus prevents rusting.

The part played by zinc in all of the researches and inventions of electricity and galvanism is so great that any notice of the metal would be deficient without an allusion to this use. We could also give an extended notice of the value of zinc compounds in promoting the study of organic chemistry, especially the interesting researches conducted by aid of zinc ethyl, but all this would be theoretical and foreign to the objects of this journal.

We have made no allusion to the alloys of zinc with the other metals. These are so numerous and important that we must leave them for future consideration.

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MANUFACTURE OF COTTON SEED AND COTTON SEED OIL.

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NO. IV.

In England cotton seed oil is not used as it is in this country; the oil is treated for its stearine and oleine—the stearine being used by soap and candle manufacturers, and oleine for greasing wools or forming a soft, printers' soap. The stearine is obtained by a chemical process and not by chilling the oil, as it is done here. The manufacturers of the oil South are now obliged to send their oil North to have it winter pressed, and I cannot understand yet why they do not manufacture their own stearine by the very simple English process.

Without going very far into the description of the process, I shall only state that it is based upon two operations:

1. The sulphuric acid saponification.
2. The distillation.

Under the influence of concentrated sulphuric acid the fat acids are transformed into glyceroles which separate into sulpho-glyceric acid and acid fats, the latter combining with the mineral acid, forming sulpho-stearic, sulpho-margaric, and sulpho-oleic acids. These acids being treated with boiling water the combination is broken up. The sulphuric acid set at liberty is dissolved in the water, and the fat acids are isolated.

In England they consume yearly by this process over 50,000,000 pounds of cotton seed oil, the stearine produced being made into candles.

As the soap is made from the crude oil, I shall first describe the manufacture of soap from it. Two kinds of soap are made—a white and a dark brown—the first made from the crude oil with an addition of palm oil or tallow, and the second from the foot oil resulting from the operation of clarification and resin.

THE LYE.

Two kinds of soda are used for the preparation of the lye; the "soft soda" (black ash), that is soda without salt, is first used for the pasting, and is thus prepared:

FIRST LYE.—Soda at from 33° to 36° Baumé, 1,000 pounds; lime newly burned, 200 pounds.

SECOND LYE.—For cooking the following lye is employed, which completes the saponification:

Soda, from 33° to 38° Baumé's alkalimeter, 1,500 lbs.; sal soda at from 18° to 20° by the alkalimeter, 500 lbs.; lime freshly calcined, 400 lbs. Suppose we add 10,000 lbs. of crude cotton seed oil, 2,000 lbs. of resin, 1,000 lbs. of palm oil or tallow. Total, 13,000 lbs. yielding 150 per cent of soap.

We should first use about 12,000 lbs. of the first lye at from 10° to 12° by the alkalimeter and bring this lye to a