abundance on the excited side than on those portions of the trunk where the warming is more gradual and its effects less active. Naturally, increased vitality on one side, be it animal or plant, results in developments, or larger growth of that side. There are traditions of some plants turning their flowers toward the sun ; the truth may be that the sun only promotes the growth of those blossoms upon which it sheds its direct warmth. As Dulong said, every degree of the thermometer entails a law of nature.

[For the Scientific American.]

COBALT--ITS PROPERTIES AND USES.

BY PROFESSOR CHARLES A. JOY.

In olden times the word cobalt was used to designate a whole group of worthless metals. The miners of those days were full of superstition and imagined that the genii of the mountains would resist all attempts to penetrate their mysteries, and hence they were supposed to throw all sorts of false ores and unripe metal in the way of the workman for the sake of discouraging them from their undertaking. The name of the mountain gnome or sprite was Kobold, and hence the miners called the worthless ore "Cobalt." The bright, shiny ore that vexed the workmen so much was at one time supposed to contain bismuth, and was very little used.

These are the first recorded notions, but there is little doubt that cobalt ores were used for coloring glass some thousands of years before, in Nineveh, Thebes, and Pompeii, as specimens found in those places resemble the beads and ornaments of modern times.

The first really authentic discovery of cobalt appears to have been made in 1735, by the Swedish chemist Brandt, who called it Cobalt King. Chemical analysis had not attained sufficient progress in that early day to enable any one to separate the constituents of ores with absolute certainty, and it was not until 1780 that the existence of cobalt was confirmed by Bergmann. It is a favorite idea on the part of some chemists that nickel and cobalt are one and the same thing, but this doctrine finds very few adherents, and for our purposes we shall regard it as an actual, tangible metal, with characteristic properties of its own. Cobalt is one of the metals found in the atmosphere of the sun, and in the materials that are of extra mundane origin. It usually occurs associated with nickel, arsenic, and sulphur, and is frequently an incidental product in the working of copper, bismuth, and nickel ores.

The best known minerals are smaltine, called also speiss cobalt, cobaltine, or glance cobalt, cobalt bloom, and earthy cobalt. The fact that some of the minerals contain arsenic has lead to applying the name cobalt to the black arsenic sold as a fly powder. It will be seen from the above list that this element is by no means so abundant as manganese or nickel, and in the event of its being required for certain purposes in the arts, it would be difficult to obta n it in large quantity.

There are several ways in which metallic cobalt can be prepared from its compounds, one of the earliest of which was from the oxalate. It is possible to reduce the oxide by heating two parts of the pure oxide of cobalt and one part of pure cream of tartar, for six hours, in a covered crucible lined with charcoal and at a temperature sufficient to melt steel. The regulus obtained in this way is exceedingly hard and brittle, has the color of bismuth, is magnetic, and has a specific gravity of 8·43. By re-melting in a clay crucible it can be freed from carbon, and it then has a silver-white color, specific gravity of 8·754, is softer than steel, very elastic, does not oxidize in air, nor after several days' immersion in water, and is as magnetic as iron. Becquerel found that by electrolysis a brilliant white metal goes to the negative electrode when the chloride of cobalt is first neutralized with ammonia. Prepared in this way it is quite pure, and is malleable and magnetic. By treating an aqueous solution of the chloride of cobalt with sodium amalgam, an amalgam of cobalt is formed from which the mercury can be expelled, and the cobalt obtained in the condition of a fine powder; it can afterwards be fused to a pure regulus.

The above are the chief methods for obtaining the pure metal, and we can now pass to the consideration of some of its properties.

The metal resembles steel, with a slight red tinge, is very hard, and is said by Deville to be more tenacious than iron. This latter property may hereafter give a value to wires made of cobalt where it is required to attain great strength in small compass. Arsenic and manganese render it brittle. Like pure iron it requires a very high heat to melt it, and the temperature of fusion appears to be between that of iron and gold. Its specific heat is 0·1096, and its density ranges between 8·513 and 8·7.

It is said to be magnetic when perfectly pure, and can be converted into a magnet by contact. At a very high temperature cobalt burns with a red flame yielding an oxide. Acids generally dissolve cobalt, nitric acid being especially adapted to this purpose. The metal decomposes water at a red heat, but not at ordinary temperatures. Plunged into fuming nitric acid, it is converted into the passive state, the same as iron, and the duration of this passive state is augmented by previously heating the metal.

Antimony and cobalt fused together evolve heat and light, and afford an iron-gray alloy. The alloy of cobalt and iron is exceedingly hard. Gold and cobalt yield a yellow and very fragile alloy.

The alloy of platinum and cobalt is fusible. Cobalt amalgam is white, like silver. Silver is rendered brittle by it. Alloys of lead and cobalt, and tin and cobalt, have been made, but possess little interest.

Many chemists suppose nickel to be an alloy of cobalt and some other metal. Fairbairn found that the tenacity of cast iron was greatly reduced by its mixture with nickel, and the same result is probable in the case of cobalt. Cobalt is said to reduce copper from solutions. Weiske found that cobalt was contained in nearly every brand of commercial iron he examined, sometimes to the extent of seven grammes in 100 pounds.

Finely divided metallic cobalt is soluble in a boiling solution of caustic potash, and yields a blue liquid, which is supposed to contain cobaltic acid. The finely divided cobalt for this purpose is prepared by heating an intimate mixture of pure oxide with ten to twelve per cent starch meal, or by reducing the oxide with hydrogen.

Cobalt contaminated with phosphorus has a different color from ordinary metal, and loses its luster in the air.

We can now speak of some of the compounds of cobalt that find application in the arts. The oxides and salts are distinguished for their beautiful colors—red, blue, yellow, green—hence they were early used for pigments.

If a little oxide of cobalt be added to melted glass, we obtain a mass, which, after cooling is intensely blue. When this is ground to powder it yields the well-known smalt that at one time was extensively employed by papermakers and in the laundry. The color is very fast, as it is not affected by the atmosphere or by acids or other liquids—and this fact afforded a method of detecting adulterations, as sand or pulverized glass, which was simply immersed in some coloring liquid, could easily be washed clean by an acid. Since the extensive and cheap manufacture of artificial ultramarine was established, the demand, and naturally the supply, of smalt, have greatly diminished. There is another blue color formed by the union of alumina and the oxide of cobalt, known as Thénard's blue, which has long been applied in the arts, but in consequence of its high price cannot compete with ultramarine. It can be prepared by mixing 3 parts freshly precipitated moist phosphate or arsenate of cobalt with 12 to 15 parts also freshly precipitated hydrate of alumina, and exposing, after drying, to a red heat. Thus produced it is a compact, insoluble mass, which can be ground to a fine blue powder. Rinmann's green, which is a compound of the oxides of zinc and cobalt, we described under the head of the compounds of zinc. It is a much-prized green pigment. A beautiful yellow color is produced by mixing the nitrite of potash with a solution of cobalt. A double nitrite of cobalt and potash is produced in the form of an insoluble yellow crystalline body, which is not only of value as a color but offers a remarkably delicate test for the presence of cobalt in solutions. This yellow has been used sparingly, on account of the expense, in aquarelle and oil painting.

By precipitating cobalt with phosphate of soda we have a red violet color, the shade of which varies according to the temperature at which it is prepared.

A fine cobalt brown is produced by calcining a mixture of sulphate of cobalt, ammonia, and iron.

Some of the salts of cobalt, when they contain water, are red, when they are anhydrous they appear blue. This property is made use of in what is called sympathetic ink. If we write with a dilute solution of chloride of cobalt on paper and allow the tracing to dry at ordinary temperatures, the letters will scarcely be visible. Upon the application of heat the writing becomes visible, with a blue color, or sometimes green if nickel be present. The color again disappears on the absorption of moisture.

A fine green color is produced by precipitating cobalt from its solutions by means of a mixture of prussic acid and potash, but the cost of production must prevent any extensive application of this color.

Since the discovery of photography the use of cobalt blue glass has greatly increased. It is an interesting fact in optics that blue glass permits all of the chemical rays of light to pass freely through it, while the yellow rays are intercepted. Pieces of blue glass are used to eliminate the yellow rays when the colors of flames are to be examined for the violet hue of potash, and in other cases of optical research.

The oxide of cobalt, prepared by precipitating the chloride with potassa, has been employed in rheumatism. It is emetic in the dose of 10 to 20 grains. The salts of cobalt are irritant poisons.

The employment of metallic cobalt in the manufacture of German silver would make that article too expensive for general use, but in small quantities it enters into alloys in association with nickel as an incidental component. The deposition of metallic cobalt by the battery can be accomplished the same as is now so extensively done with nickel, and this method is sometimes resorted to, to procure small quantities of the metal. Some of the salts of cobalt are of great value to the chemist in his laboratory, as affording delicate tests for the presence of other bodies.

One of the methods for the manufacture of oxygen gas from bleaching powders, is founded upon the somewhat obscure formation and subsequent decomposition of cobaltic acid. A very small quantity of a solution of cobalt suffices to evolve all of the oxygen from chloride of lime.

We have thus given the principal properties and uses of cobalt without attempting to exhaust the subject.

An Invention Wanted.

The *Herald of Health* says an instrument is very much needed to test the purity of the atmosphere, and the person who will invent and introduce such an article, which shall be simple and cheap, will not only enrich himself, but confer a great boon upon poorly ventilated humanity. We have the thermometer to tell us the temperature of the air, and we have the barometer to tell us the moisture of the air, but we have no means of cheaply and easily measuring the purity of the air. Such an apparatus is needed in every church, lecture room, and place of public gathering, and in every room occupied by human beings, either in public or in private. If people could *see* the amount of poison they were taking into their systems at every breath, they would be more careful to secure pure air to breathe. Such an invention is greatly needed, and the want will soon be supplied. Who will be the one to confer this blessing upon the race?

[For the Scientific American.]

PLATINIZED LOOKING-GLASSES.

BY C. WIDEMANN.

NO. II.

The glass being prepared by the usual method, is soaped, polished and cleansed. The Platinized Glass Works, at Wailly-sur-Aisne (France) where this new industry is carried on, possesses highly improved polishing tables, so much so that the polishing operation occupies only three hours. At the St. Gobain Works this operation requires a manipulation of 48 hours.

After the cleaning operation the glass is carried into the platinizing shop, and the composition giving the metallization is applied to the glass by means of a brush the plate is placed vertically and receives the platinizing liquid to a convenient thickness. It is first applied from bottom to top, then from left to right, and at last from right to left ; by these means the oily coating is equalized. This composition, containing a large quantity of essence of lavender, spreads itself instant ly over the surface, drying slowly and without any running Great care must be taken to avoid all dampness and dust; dampness would crisp and wrinkle the surface, and the dust would destroy the regularity of the work, as every grain of dust absorbs liquids concentrically, and thus deprives the surrounding parts.

The platinizing composition needs nothing else to be perfect than great cleanliness on the part of the operator.

In making the platinizing liquid the following materials are used: 100 grammes carefully laminated platina in very thin sheets are taken. It is soaped in order to remove all the grease that might have accumulated during the laminating operation. It is then dissolved in an aqua-regia, composed of 400 grammes nitric acid for 1,000 grammes pure hydrochloric acid. It is heated by means of a sand bath to dryness, care being taken not to decompose the chloride by excessive heat. It is then crushed in a porcelain or glass mortar, and laid on a grinding glass plate, where it is mixed with small quantities at a time of essence of lavender (rectified) care being taken not to work at too high temperature or the reaction would take place on this glass plate. Having added about 1,400 grammes of essence of lavender, the mixture is collected in a porcelain dish and left to itself for eight days, without the least disturbance. The liquid is next decanted, filtered, and left again for six days, and this filtered liquid must then be about 5° at the acid test Baumé. For the above quantity, 25 grammes litharge and 25 grammes barate of lead are taken, and ground to an impalpable powder, with 8 to 10 grammes essence of lavender. This last mixture is then added and stirred with the platinizing liquid. It is then applied as above described, care being always taken to avoid dampness and dust.

As soon as the glass plate to be platinized has received the metallic coat and is sufficiently dry, it is placed in muffles, formed of a frame of cast iron, tongued and grooved, and the parts of which slide in each other.

The fire-place is placed at the back of the oven, which arrangement gives free access to the door, through which the glass is placed in the oven. Movable frames are placed in the cast-iron frame, and receive the glasses to be heated, maintaining them in a parallel and vertical position. Hooks, properly constructed, support a large number of these frames. Also, movable sheets allow glasses of different sizes to be placed in these frames.

The vertical and longitudinal section of the oven is a long parallellogram, and its cross-section is a square. The cooking is regular; and the accidents of fire are regulated by registers or iron gates in the posterior and anterior part of the oven. A series of muffles are placed under the dome.

The platinized mirror thus obtained is of great solidity, and no metal is more resistant to the influence of atmospheric agents. Even when a mirror is thrown into a great fire, at the temperature at which the glass melts, it will have retained its metallic surface. The mirrors do not give false tints to colored objects, as the common mercury alloy does.

The reflection being obtained by the anterior surface, there exists no double reflection ; but what is still more remarkable is that the substitution of platina for tin and mercury is that it allows any kind of glass to be transformed into a mirror. The nitrous matter is polished on one face only, and having been submitted to the platinizing process reflects images without distortion from the surface of the metal itself.

Let us now come to the actual process in use; the following conditions had to be filled:

After having suppressed the use of mercury, the glass was to be perfectly colorless and deprived of every defect. The cost had to be reduced, or the old routine would not give place to progress. Not only has Dodé suppressed the use of mercury, but he has by his improvement been able to make better mirrors, for he hides by his process the faults in the glass plates, and obviates half the work of planing and polishing. In order to obtain this result it was necessary to apply the reflecting surface on the front of the glass-plate and not at the posterior surface.

A Flag for the national Capitol has been made in California of silk produced in the State, and it will soon be sent to Washington.