wedged therein by a small piece, *a m l*, fixed to the lever, *L*. For this reason the tube, *TT'*, is provided with a notch opposite the piece *a m l*, and the two arms, *a* and *m*, of the latter are shaped like a V, as may be seen in part in the plan in Fig. 2. It is now easy to understand how the system operates; when the current is not traversing the circuit, the carbons are separated; but, at the moment the circuit is closed for lighting a series of lamps, it traverses the electromagnet, which then becomes very powerful, and draws down the cores, *F*, along with the lever, *L*, the tube, *TT'*, and the carbon-holder, *CC'*, and brings the carbons in contact. The arc then forms, and the current divides between the arc and the bobbins, *E*. Its action upon the cores, *F*, becomes weak, and it can no longer balance the counterpoise, *P*, which falls back, and raises the system again. The arc thus becomes primed. The cores, *F*, however, preserve a certain amount of magnetization; the armature, *p*, is attracted, and the lever *L*, assumes a position of equilibrium such that the piece, *a m l*, wedges the rod, *CC'*, in the tube, *TT'*, and holds it sus-

FIG. 1.—MONDOS'S ELECTRIC LAMP.

ended. When, through wear of the carbons, the arc elongates, a greater portion of the current passes into the bobbins, *E*, the armature, *p*, is attracted with more force, and the lever, *L*, swings around the point, *O'*. The rotation of *L* separates the piece, *a m l*, from the rod, *CC'*, which, being thus set free, slides by its own weight and shortens the arc. The current then becomes weak in *E*, the armature, *p*, is not so strongly attracted, the lever, *L*, pivots slightly around *O'* under the action of the weight, *P*, and the brake or wedge enters the notch anew, and stops the descent of the carbon. In practice, the motions that we have just described are exceedingly slight; the carbon moves imperceptibly, and the length of the arc remains invariable.

It will be seen, then, that the lever, *L*, and the tube, *TT'*, serve exclusively for lighting, and the lever, *L*, exclusively for regulating the distance of the carbons.

This lamp exhibits great elasticity, and can operate, without a change of any part of its mechanism, with currents of very different intensities. It suffices for obtaining a proper working of the apparatus in each case, to regulate the distance

FIG. 2.—REGULATING MECHANISM.

from the weight, *P*, to the point of suspension, *O'*, and the distance from the armature, *p*, to the cores, *F*. At the Champs Elysées concerts the lamps are operating with alternating currents; but they are capable of operating with continuous ones also, although the slight tremor of the electro-magnetic system, due to the use of alternating currents and as a consequence of rapid changes of magnetization, seems in principle very favorable to systems in which the descent of the carbon is based upon friction instead of a clutch. At the Champs Elysées concerts the lamps burn crayons of 9 to 10 millimeters with a current of 9 to 10 amperes and an effective electro-motive power of 60 volts per lamp. The light is very steady, and the effect produced is most satisfactory. The dispensing with all clock-work movement and regulating springs makes this electric lamp of Mr. Mondos a simple and plain apparatus, capable of numerous applications in the industries, in wide, open spaces, in all cases where foci of medium intensity have to be employed, and where it is desired to arrange several lamps in the same circuit.—*La Nature*.

[AMERICAN POTTERY AND GLASSWARE REPORTER.]

ALUMINUM—ITS PROPERTIES, COST, AND USES.

ALUMINUM is a shining, white, sonorous metal, having a shade between silver and platinum. It is a very light metal, being lighter than glass and only about one-fourth as heavy as silver of the same bulk. It is very malleable and ductile, and is remarkable for its resistance to oxidation, being unaffected by moist or dry air, or by hot or cold water. Sulphureted hydrogen gas, which so readily tarnishes silver, forming a black film on the surface, has no action on this metal.

Next to silica, the oxide of aluminum (alumina) forms, in combination, the most abundant constituent of the crust of the earth (hydrated silicate of alumina, clay).

Common alum is sulphate of alumina combined with another sulphate, as potash, soda, etc. It is much used as a mordant in dyeing and calico printing, also in tanning.

Aluminum is of great value in mechanical dentistry, as, in addition to its lightness and strength, it is not affected by the presence of sulphur in the food—as by eggs, for instance.

Dr. Fowler, of Yarmouthport, Mass., obtained patents for its combination with vulcanite as applied to dentistry and other uses. It resists sulphur in the process of vulcanization in a manner which renders it an efficient and economical substitute for platinum or gold.

Aluminum is derived from the oxide alumina, which is the principal constituent of common clay. Lavoisier, a celebrated French chemist, first suggested the existence of the metallic bases of the earths and alkalis, which fact was demonstrated twenty years thereafter by Sir Humphry Davy, by eliminating potassium and sodium from their combinations; and afterward by the discovery of the metallic bases of baryta, strontium, and lime. The earth alumina resisting the action of the voltaic pile and the other agents then used to induce decomposition, twenty years more passed before the chloride was obtained by Oerstadt, by subjecting alumina to the action of potassium in a crucible heated over a spirit lamp. The discovery of aluminum was at last made by Wohler in 1827, who succeeded in 1846 in obtaining minute globules or beads of this metal by beating a mixture of chloride of alumina and sodium. Deville afterward conducted some experiments in obtaining this metal at the expense of Napoleon III., who subscribed £1,500, and was rewarded by the presentation of two bars of aluminum. The process of manufacture was afterward so simplified that in 1857 its price at Paris was about two dollars an ounce. It was at first manufactured from common clay, which contains about one-fourth its weight of aluminum, but in 1855 Rose announced to the scientific world that it could be obtained from a material called "cryolite," found in Greenland in large quantities, imported into Germany under the name of "mineral soda," and used as a washing soda and in the manufacture of soap. It consists of a double fluoride of aluminum, and only requires to be mixed with an excess of sodium and heated, when the mineral aluminum at once separates. Its cost of manufacture is given in this estimate for one pound of metal: 16 lb. of cryolite at 8 cents per pound, \$1.28; 2½ lb. metallic sodium at about 26 cents per pound, 70 cents; flux and cost of reduction, \$2.02; total, \$4.

Aluminum is used largely in the manufacture of cheap jewelry by making a hard, gold-colored alloy with copper, called aluminum bronze, consisting of 90 per cent. of copper and 10 per cent. of aluminum. Like iron, it does not amalgamate directly with mercury, nor is it readily alloyed with lead, but many alloys with other metals, as copper, iron, gold, etc., have been made with it and found to be valuable combinations. One part of it to 100 parts of gold gives a hard, malleable alloy of a greenish gold color, and an alloy of ¼ iron and ¼ aluminum does not oxidize when exposed to a moist atmosphere. It has also been used to form a metallic coating upon other metals, as copper, brass, and German silver, by the electro-galvanic process. Copper has also been deposited, by the same process, upon aluminum plates to facilitate their being rolled very thin; for unless the metal be pure, it requires to be annealed at each passage through the rolls, and it is found that its flexibility is greatly increased by rolling. To avoid the bluish white appearance, like zinc, Dr. Stevenson McAdam recommends immersing the article made from aluminum in a heated solution of potash, which will give a beautiful white frosted appearance, like that of frosted silver.

F. W. Gerhard obtained a patent in 1856, in England, for an improved means of obtaining aluminum metal, and the adaptation thereof to the manufacture of certain useful articles. Powdered fluoride of aluminum is placed alone or in combination with other fluorides in a closed furnace, heated to a red heat, and exposed to the action of hydrogen gas, which is used as a reagent in the place of sodium. A reverberating furnace is used by preference. The fluoride of aluminum is placed in shallow trays or dishes, each dish being surrounded by clean iron filings placed in suitable receptacles; dry hydrogen gas is forced in, and suitable entry and exit pipes and stop-cocks are provided. The hydrogen gas, combining with the fluoride, "forms hydrofluoric acid, which is taken up by the iron and is thereby converted into fluoride of iron." The resulting aluminum "remains in a metallic state in the bottom of the trays containing the fluoride," and may be used for a variety of manufacturing and ornamental purposes.

The most important alloy of aluminum is composed of aluminum 10, copper 90. It possesses a pale gold color, a hardness surpassing that of bronze, and is susceptible of taking a fine polish. This alloy has found a ready market, and, if less costly, would replace red and yellow brass. Its hardness and tenacity render it peculiarly adapted for journals and bearings. Its tensile strength is 100,000 lb., and when drawn into wire, 128,000 lb., and its elasticity is one-half that of wrought iron.

General Morin believes this alloy to be a perfect chemical combination, as it exhibits, unlike the gun metal, a most complete homogeneousness, its preparation being also attended by a great development of heat, not seen in the manufacture of most other alloys. The specific gravity of this alloy is 7.7. It is malleable and ductile, may be forged cold as well as hot, but is not susceptible of rolling; it may, however, be drawn into tubes. It is extremely tough and fibrous.

Aluminum bronze, when exposed to the air, tarnishes less quickly than either silver, brass, or common bronze, and less, of course, than iron or steel. The contact of fatty matters or the juice of fruits does not result in the production of any soluble metallic salt, an immunity which highly recommends it for various articles for table use.

The uses to which aluminum bronze is applicable are various. Spoons, forks, knives, candle-sticks, locks, knobs, door-handles, window fastenings, harness trimmings, and

pistols are made from it; also objects of art, such as busts, statuettes, vases, and groups. In France, aluminum bronze is used for the eagles or military standards, for armor, for the works of watches, as also watch chains and ornaments. For certain parts, such as journals of engines, lathe-head boxes, pinions, and running gear, it has proved itself superior to all other metals.

Hulot, director of the Imperial postage stamp manufactory in Paris, uses it in the construction of a punching machine. It is well known that the best edges of tempered steel become very generally blunted by paper. This is even more the case when the paper is coated with a solution of gum arabic and then dried, as in the instance of postage stamp sheets. The sheets are punched by a machine the upper part of which moves vertically and is armed with 300 needles of tempered steel, sharpened in a right angle. At every blow of the machine they pass through the holes in the lower fixed piece, which correspond with the needles, and perforate five sheets at every blow. Hulot now substitutes this piece by aluminum bronze. Each machine makes daily 120,000 blows, or 180,000,000 perforations, and it has been found that a cushion of the aluminum alloy was unaffected after some months' use, while one of brass is useless after one day.

Various formulæ are given for the production of alloys of aluminum, but they are too numerous and intricate to enter into here.

DETERMINATION OF POTASSA IN MANURES.

By M. E. DREYFUS.

THE method generally adopted for the determination of potassa in manures, *i. e.*, the direct incineration of the sample, may in certain cases occasion considerable errors in consequence of the volatilization of a portion of the potassium products.

To avoid this inconvenience, the author proposes a preliminary treatment of the manure with sulphuric acid at 1.845 sp. gr., to convert potassium nitrate and chloride into the fixed sulphate. The sulphuric acid attacks the manure energetically, and much facilitates the incineration, which may be effected at a dark red heat. The ignited portion (10 grms.) is exhausted with boiling distilled water acidulated with hydrochloric acid, and the filtrate, when cold, is made up to 500 c. c. Of this solution 50 c. c., representing 1 grm. of the sample, are taken, and, after being heated until close upon ebullition, baryta-water is added until a strong alkaline reaction is obtained. The sulphuric and phosphoric acids, alumina, magnesia, etc., are thus precipitated. The filtrate is heated to a boil, and mixed with ammonia and ammonium carbonate, to precipitate the excess of baryta in solution. The last traces of lime are eliminated by means of a few drops of ammonium oxalate. The filtrate is evaporated down on the water-bath, and the ammoniacal salts are expelled by carefully raising the temperature to dull redness. After having taken up the residue in distilled water it is treated with platinum chloride, and the potassium chloro-platinate obtained is reduced with oxalic acid. The quantity of potassa present in the manure can be calculated from the weight of platinum obtained.—*Bull. de la Soc. Chim. de Paris*.

THE ORIGIN AND RELATIONS OF THE CARBON MINERALS.*

By J. S. NEWBERRY.

WHAT are called the carbon minerals—peat, lignite, coal, graphite, asphalt, petroleum, etc.—are, properly speaking, not minerals at all, as they are organic substances, and have no definite chemical composition or crystalline forms. They are, in fact, chiefly the products or phases of a progressive and inevitable change in plant-tissue, which, like all organic matter, is an unstable compound and destined to decomposition.

In virtue of a mysterious and inscrutable force which resides in the microscopic embryo of the seed, a tree begins its growth. For a brief interval, this growth is maintained by the prepared food stored in the cotyledons, and this suffices to produce and to bring into functional activity some root-fibrils below and leaves above, with which the independent and self-sustained life of the individual begins. Henceforward, perhaps for a thousand years, this life goes on, active in summer and dormant in winter, absorbing the sunlight as a motive power which it controls and guides. Its instruments are the discriminating cells at the extremities of the root-fibrils, which search for, select, and absorb the crude aliment adapted to the needs of the plant to which they belong, and the chlorophyll cells—the lungs and stomach of the tree—in the leaves. During all the years of the growth of the plant, these organs are mainly occupied in breaking the strongly riveted bonds that unite oxygen and carbon in carbonic acid; appropriating the carbon and driving off most of the oxygen. In the end, if the tree is, *e. g.*, a *Sequoia*, some hundreds of tons of solid, organized tissue have been raised into a column hundreds of feet in height, in opposition to the force of gravitation and to the affinities of inorganic chemistry.

The time comes, however, sooner or later, when the power which has created and the life that has pervaded this wonderful structure abandon it. The affinities of inorganic chemistry immediately reassert themselves, in ordinary circumstances rapidly tearing down the ephemeral fabric.

The disintegration of organic tissue, when deserted by the force which has animated and preserved it, gives rise to the phenomena which form the theme of this paper.

Most animal-tissue decomposes with great rapidity, and plant tissue, when not protected, soon decays. This decay is essentially oxidation, since its final result is the restoration to the atmosphere of carbonic acid, which is broken up in plant-growth by the appropriation of its carbon. Hence it is a kind of combustion, although this term is more generally applied to very rapid oxidation, with the evolution of sensible light and heat. But, whether the process goes on rapidly or slowly, the same force is evolved that is absorbed in the growth of plant-tissue; and by accelerating and guiding its evolution, we are able to utilize this force in the production at will of heat, light, and their correlatives, chemical affinity, motive power, electricity, and magnetism. The decomposition of plants may, however, be more or less retarded, and it then takes the form of a destructive distillation, the constituents reacting upon each other, and forming temporary combinations, part of which are evolved, and part remain behind. Water is the great extinguisher of this as of the more rapid oxidation that we call combustion; and the decomposition of plant-tissue under water is extremely slow, from the partial exclusion of oxygen. Buried under thick and nearly impervious masses of clay, where the exclusion

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