CARBORUNDUM.

Carborundum, the new abradent, according to the inventor or discoverer, is the result of both invention and discovery. It was produced after long research and careful and intelligent experimentation, and in its production the inventor made the important discovery that carbon and silica would, under favorable conditions, combine to form a definite compound which was hitherto unknown.

Mr. E. G. Acheson, the fortunate inventor of the new abradent, made his first experiments in this direction in the laboratory of Mr. T. A. Edison, when that institution was located at Menlo Park, N. J. These experiments, which were productive of small results, were followed by others at Gosford, Pa., and again at a later date at Monongahela, Pa., where all the facilities of an electric lighting station were available for the work.

The first experiment in the latter place, which was made in 1891, consisted in mixing carbon and clay together and subjecting the mixture to a high temperature produced by electricity. An examination of the mass after cooling disclosed minute crystals of a dark blue color, which were very hard and of a bright luster. The experimenter, with considerable anxiety and some expectation, tested these small particles for hardness. In his tests nothing available escaped ; he even submitted a handsome diamond ring to the abrasive action of these crystals, thus spoiling the appearance of the stone. After this, many experiments in methods, mixtures and apparatus were made, and facilities were increased. About this time the inventor carried to New York the entire amount of material produced during two months, and this was all contained in a two ounce vial.

Early in the experiments it was found that the silica, and not the alumina of the clay, was the more important factor in the formation of the crystals. Sand was substituted for the clay—an experiment which resulted in a very much greater production from a given quantity of material. The color of the crystals was found to be a light green instead of blue, as was the case with the clay. Subsequently chloride of sodium was introduced into the mixture, not as essential to the manufacture, but as a cementive to cause the fine particles to adhere together, thus facilitating the removal of the crystals after they were cooled.

After having thus arrived at methods for producing a uniform product, and one which gave promise of fulfilling all the requirements of an abradent, the inventor entered into a thorough chemical investigation in order to increase the amount of production, so as to place the new material on the market. At this stage of the business a company was organized under the laws of Pennsylvania, entitled "The Carborundum Company." In the meantime efforts were made to introduce the carborundum into the diamond cutting industry. Some of the material was introduced among the diamond cutters of Amsterdam, Holland.

The crystals were found to be too brittle for charging a lap for the first cutting or roughing, but it proved as efficient as diamond powder for finishing. At this time the production had been increased to about three pounds per day. The carborundum first produced was placed at $10 per pound, but within a short time it was reduced to $4 per pound.

In 1892 the manufacture of wheels, hones and the many other forms in which emery and corundum are used, was undertaken. A vitrified bond was adopted as being the most suitable for holding together the carborundum particles. Hydraulic presses were procured for pressing the carborundum and binding material into the desired forms. A pottery kiln was built for vitrifying the goods.

The product being still quite small, it was used up in the manufacture of small wheels and points for dentists. Twelve thousand sample wheels, one-half inch in diameter and one-sixteenth of an inch thick, were mailed to the same number of dentists. The manner in which these wheels were received by the dentists, and the great superiority of carborundum for their uses, is told in the statement that in a period of one year about two hundred thousand wheels and points were disposed of to this trade alone. Large numbers of these wheels are used by the Westinghouse Electric and Manufacturing Company for the manufacture of the "ground stopper lamps." A dozen of these wheels were ordered by this company for a trial. As a result of this trial, the company, it is stated, have used these wheels to the exclusion of all others, and their orders up to January 4, 1894, amounted to over sixty-four thousand wheels.

Before March, 1893, the amount of carborundum produced was not sufficient to warrant active work on its introduction for machine and general metal work. The first wheels placed on the market were not turned or trued up ; on this account they did not prove entirely satisfactory in operation. As soon as this imperfection was noted, the manufacturers introduced apparatus for turning and truing the wheels.

The present plant consists of a 225 horse power Russel engine, 150 horse power Wheeler boiler, a 60 horse power Babcock & Wilcox boiler, and a 112,000 watt Westinghouse alternating dynamo, with the various special pieces of machinery necessary for working up the new material.

Our front page engraving illustrates the various steps in the manufacture of carborundum, and gives a faithful portrait of its persistent inventor.

Ordinary Connellsville coke is used, being crushed and ground in barrels to a fine powder. A good quality of glass sand and ordinary dairy salt are mixed with the coke, the proportions in some cases being: Coke, 20 parts; sand, 25; salt, 5 parts. This mixture is placed in the furnace and subjected to the intense heat produced in a central core of carbon by the passage of a current of electricity. This core, formed of broken coke, is placed in the furnace in the center of the carborundum mixture, which is in the form of a hollow cylinder, its size depending on the size of the furnace. In the furnace illustrated it is about eight inches in diameter. The electricity is introduced to the core by means of rods of carbon, two inches in diameter, nine in number, at each end.

From ten to fourteen hours are required to complete the operation of a furnace, the amperes being from 150 to 1,000 during the process. After cooling, the walls of the furnace are taken down, the top crust thrown off, and the carborundum removed. The illustration shows a furnace partly discharged. Surrounding the cylinder of carborundum crystals is a layer of loose white material, having the same composition as carborundum, but lacking in crystallization.

After removal from the furnace the carborundum is thrown into a grinding mill, where the crystals are separated by a crushing action. They are then thrown into a stream of water, passing through a series of tanks, of increasing sizes, where they are sized or graded. The graded crystals are mixed with an appropriate binding material, and moulded (as shown). After moulding, the prepared forms are placed in "saggers," and these again are placed in a potter's kiln and fired. The firing requires from four to six days, depending on the sizes of the wheels in the kiln. After removal from the kiln the larger wheels, intended for metal or machine work, are turned or trued up (see illustration). This turning up is performed either with one of the mechanical tools ordinarily used, and consisting of star-shaped wheels of steel, or with a diamond point ; in either case the principle is to tear the crystals from the binding material.

The quantity of carborundum manufactured during 1893 amounted to 15,200 pounds.

Mr. Acheson has recently sold his Austrian patent on carborundum to the Landerbank, of Vienna, and an engineer has been sent over to attend to the erection of works at Prague.

A New System of Fishing.

Mr. G. Trouve has recently published a paper in which he describes a new system of fishing of his invention which permits of taking fish automatically, and which, he claims, may be applied with the same success in lakes, rivers, canals, gulfs, on the coast and in the open sea. The arrangement is applicable to nearly every kind of net now in use, with slight modifications.

In Mr. Trouve's system of nets the foot rope is provided with a purse and is weighted with lead, as usual, and for the head rope there is substituted a flattened rubber tube cemented by a flexible rubber tube with a reservoir of compressed air or with a simple or double acting pump. This compressed air reservoir is placed, according to circumstances, either in a boat or upon the shore, or else is inclosed in a special buoy to be mentioned further along. If a pump is employed, it, too, may be installed in a boat or upon the shore.

Let us suppose that the arrangement is applied to a circular net. The latter, having been cast in the usual manner, sinks to the bottom under the action of its own weight, where it forms an immovable heap of relatively slight bulk, which, by reason of this very fact, will not attract the attention of the fish. The fish are afterward lured to the spot circumscribed by the net by means of bait of different kinds and by light, etc.

When the moment is deemed propitious for a good catch, the pump is set in motion and the cock placed upon the compressed air pipe is opened, so as to allow the air to enter the rubber tube that encircles the top of the net. As this tube becomes inflated, it describes a wide circle, and, rising toward the surface, carries the net along with it without any noise and without agitating the water. The attention of the fish is therefore not awakened and they are captured without knowing it, and before they have even attempted to make their escape.

After the catch has been taken from the net, the compressed air that fills the tube is allowed to escape, and the net again sinks and is ready for a second operation.

Mr. Trouve's buoys, mentioned above, contain electric apparatus in the form of batteries or accumulators and carry one or more incandescent lamps that are surmounted by a flattish reflector which sends the luminous rays over a very wide surface. They likewise contain a reservoir of compressed air, which is connected by a flexible tube with the tube that borders the top of the net. The flexible tube is provided with a three-way cock that puts the interior of the net tube in connection with the interior of the air reservoir, or with the external air, or prevents egress of the air. This cock is maneuvered by hand or by a clockwork movement started electrically and inclosed in the buoy. This clockwork movement may also be controlled from the shore or from a boat.

The bait employed (worms, frogs, small fish, etc.) is placed in a basket having several compartments and which is suspended from the luminous buoy.

Mr. Trouve has likewise devised a sort of balance, which is placed within the net, and by means of which can be approximately calculated the weight of the fish that may be taken by the apparatus lying at the bottom of the water.

Maintaining Streets Without and With Car Tracks.

In a paper read before a meeting of the Massachusetts Highway Association, by W. L. Dickinson, vice-president of the association and superintendent of streets in Springfield, Mass., he says:

We have been obliged to pave some of our streets with granite blocks, where there was a car track in the center, because it was impossible to keep the track in a safe condition with crushed stone. In fact, we have no streets with granite block paving without a street car track in the center, and there are several miles of gravel and macadamized streets with a track in the center that are costing a large sum for maintenance every year without good results, and it would be economy to pave them. If the car tracks were not in these streets, the traffic would be distributed over the entire roadway and the cost of maintenance would be small. It is generally acknowledged by men familiar with traffic and its injurious effects upon our streets, that when a street car track is laid in any ordinary width street it quickly increases the cost of maintenance and makes it impossible to keep the road in good condition for travel. Whatever road material you use, be it granite blocks, asphalt, brick or crushed stone, the poorest costs the most for maintenance. With the introduction of electricity as a motive power the mileage of street car tracks is increasing rapidly, and they will soon have the main arteries in our cities and towns girdled with electric railways. I have selected a few macadamized streets under various conditions of traffic in different parts of the city of which I can get a perfect record from the books of the highway department for the purpose of illustration and comparison.

From the figures we find that on residential streets with a moderate traffic and driveway of 30 feet from curb to curb, unincumbered with street car tracks, so that the traffic is distributed over the entire surface, it is possible to furnish the traveling public with a good surface of macadam pavement at an average annual cost of 0·013 per square yard for maintenance. On the other hand, when you put a track in the center and confine the traffic to a narrow space each side, the horses and wagons constantly traveling in the same place will, with the immense pressure per square inch brought to bear, grind the pavements into dust and mud. When you place a car track in the center of a street it occupies a position which was originally intended, when the pavements were first laid, to carry the bulk of the traffic.

Under these conditions it is not at all surprising that on a street which receives but a moderate traffic, the cost of maintenance with no car track in center is increased from 0·013 to 0·063 with the track in the center. These figures are the average for fourteen years. The average annual cost of maintenance per square yard on Dwight Street is 0·0134, on Water 0·021+. These streets have no car track in center, are in a business portion of the city, and receive a heavy traffic, yet the cost of maintenance is small compared with Maple and Central Streets, which are residential streets. These two streets have a car track in center and receive only a moderate traffic, but the average annual cost of maintenance is 0·063 per square yard, or $610 per mile.

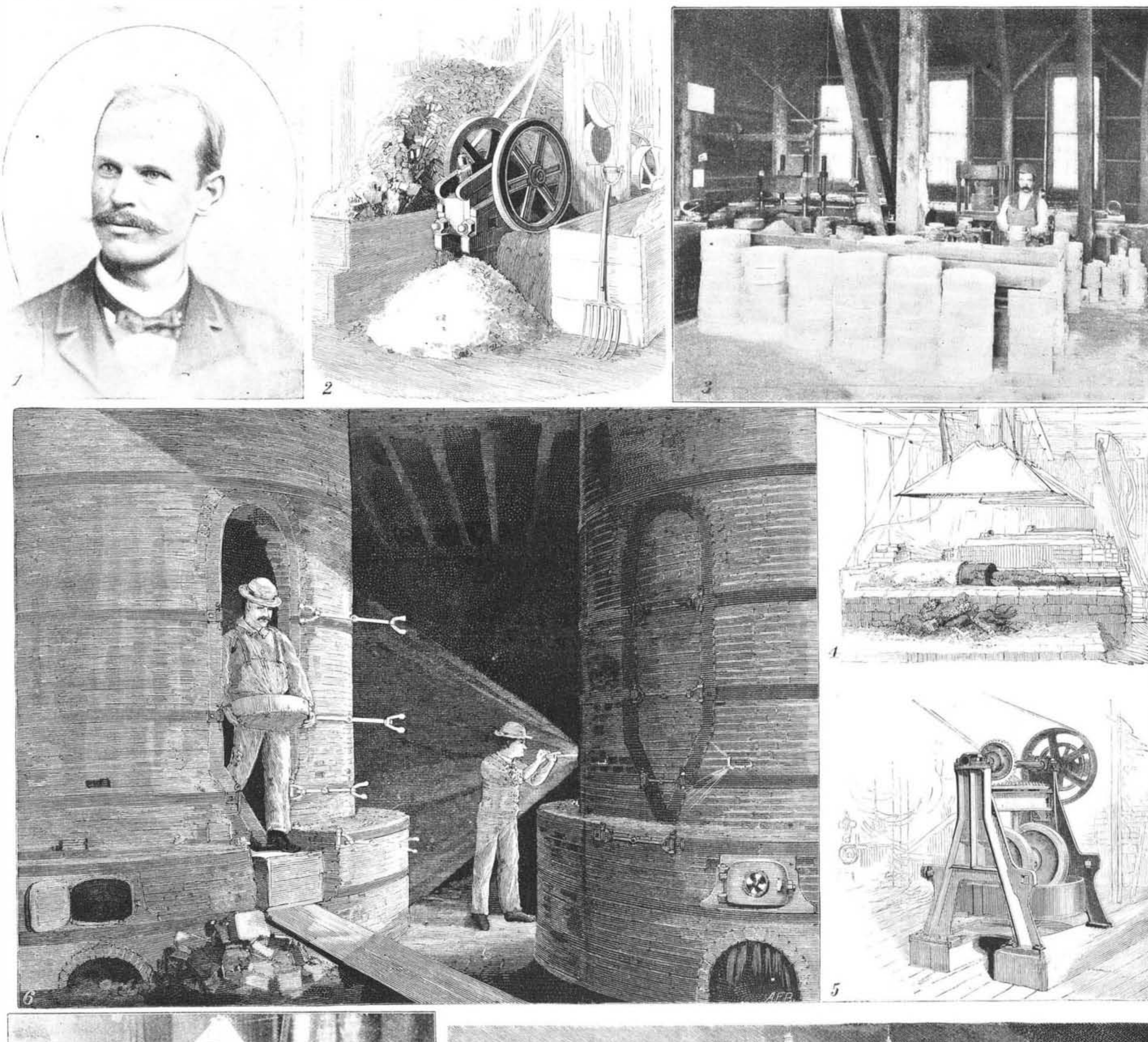
Summer Street is the approach to the New York and New England freight depot, was macadamized in the summer of 1892, and is subject to a very heavy travel, though the cost of maintenance annually is only 0·0055+ per square yard; while on St. James Avenue, macadamized the same year as Summer Street and one of the main arteries in the residential portion of the city, but receiving only an average traffic, has a street car track in center, and costs 0·141+ per square yard. Of course it must be understood that these results are obtained by the use of a fine quality of trap rock which comes from the quarries at Westfield, Mass., and Meriden, Conn., and is as good material for macadamizing streets as there is in the country. Undoubtedly with poorer material the cost of maintenance would be greatly increased, especially with the traffic confined to a narrow space each side of a car track.

SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class matter. Copyrighted, 1894, by Munn & Co.]

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LXX.—No. 14. ESTABLISHED 1845 | NEW YORK, APRIL 7, 1894. | $3.00 A YEAR. WEEKLY.



1. E. G. Acheson, inventor of carborundum. 2. Crushing coke. 3. Filling moulds, and pressing. 4. Carborundum furnace. 5. Mill. 6. The kilns. 7. Truing the wheels. 8. Moulding small carborundum wheels.

THE MANUFACTURE OF CARBORUNDUM—A NEW INDUSTRY.—[See page 215.]