PROTECTION OF PILES AGAINST THE TEREDO.

The February number of the *Transactions of the American Society of Civil Engineers* contains an interesting paper on this subject by R. Montfort, C.E., of the Louisville & Nashville Railroad Company, from which we make abstracts as follows:

The New Orleans division crosses a number of bays, bayous, and rivers, all of which are spanned by means of yellow pine creosoted pile trestles and iron bridges supported by creosoted pile piers.

The total number of linear feet of trestle is 21,407, and of iron bridging 6,459. It is no uncommon occurrence for the teredo to completely honeycomb an untreated yellow pine pile of from 12 to 15 inches diameter in less than six months, so as to render it unsafe for structural purposes. In 1871 a serious accident occurred from this cause at Biloxi Bay trestle, when a freight train went through the bridge, although the piles were only about ten months old. An examination showed that the piles were all eaten off close to the bottom of the water. When first built, Bay St. Louis trestle had hardly been completed when it was found the untreated piles were so badly attacked by the teredo that it was necessary to commence rebuilding at once. It 1872 resort was had to covering the piles with copper before driving, and this gave better results; but the protection was not found to be perfect. It was, therefore, decided in 1876 to construct creosote works, and they were built at a cost of $60,000.

In 1886 it was discovered the teredo had commenced its attacks on the creosoted piles. About the same time an inspection of the creosoted piles in the railroad company's wharves at Pensacola, Fla., which had been built in 1880, disclosed a similar condition of affairs.

In view of the vast amount of creosoted timber that existed in the structures on the New Orleans division, already referred to, and also at Pensacola, Fla., and on the Pensacola & Atlantic Railroad, which was built in 1882–83, and is owned by the Louisville & Nashville Railroad Company, the question of determining, if possible, on some further means of protecting the cresoted piles against the teredo was of vital importance. In connection with the late F. W. Vaughan, M. Am. Soc. C. E., consulting engineer, the writer was instructed to investigate, experiment, and report, with recommendations of what should be done. As a result, it was decided to adopt a thin coat of cement mortar or concrete, applied to the outside of the piles from the surface of the mud or sand at the bottom to the surface of high water at the top. In order to accomplish this, the work was conducted in the following manner: A shell of wrought iron, made in circular form, composed of several sections, each in two segments, so arranged as to be easily separated, was placed around the pile; the shell was clamped together above the water and lowered, one section after another, until it completely surrounded the pile from the surface of the water to a distance of from 6 inches to 2 feet below the bottom, varying with its hardness and the difficulty of forcing the shell down. A diver placed a pudding of "gumbo clay," inclosed in sacking, between the shell and the pile at the bottom before the shell was forced down, thus making the space between the pile and the shell almost watertight, where the depth of water did not exceed 12 feet; the water was then pumped out and the mortar or concrete poured in.

Where the depth of water exceeded 12 feet, it was found impracticable to keep the water out, and the attempt to do so was given up. In such case the mortar or concrete was passed down to the bottom of the shell through a galvanized iron pipe of special shape, so as to give as large an opening as possible without taking up too much space between the pile and the shell. A funnel or feeder was used at the top of the pipe to render it easy to fill. The pipe was gradually raised as the concrete filled up the space between the pile and shell; but the lower end of the pipe was kept constantly in the concrete, so as to prevent the concrete from falling through the water, which would separate its constituents, and, of course, ruin its adhesive power. The shell was allowed to remain three or four days, until the concrete had set, when the clamps were pulled off, and it was removed and placed on the next pile to be treated in a similar manner. Shells made of wood, held together with cast iron bands, were also used extensively on account of their relative cheapness as compared with the wrought iron shell. In this way 2,638 piles were protected in the wharves at Pensacola, 840 in Escambia Bay trestle, 413 in Biloxi Bay trestle, and 216 in Bay St. Louis trestle, making a total of 4,107 piles. It was only applied to piles that were found to be seriously attacked by the teredo, and that, if not protected, would soon be utterly destroyed. One important advantage which this means of protection possesses is that it can be accomplished without in any way disturbing the piles or the superstructure which rests on them, and this was especially important in the case of Pensacola wharves on which large storage sheds had been built. If the piles had to be replaced by new piles, the floors and roofs of these buildings would have greatly interfered.

It is now seven years since the work of protection, as described, was begun, and although some little trouble has been experienced from logs and rafts striking the protected piles in rough weather and abrading or cracking the concrete on a few of them, the expense of repairs has been small, and all of the piles which have been protected are still in use, and likely to continue so for a number of year; whereas, if they had not been protected, it would have long since become necessary to replace them by new piles. The engraving shows one of some piles broken off below the surface of the mud, and pulled up at Pensacola wharves three years after protection. They were found to be in good condition. Not only did the concrete completely cover the piles, and was itself covered with oysters, barnacles, etc., but the cement had found its way into the teredo holes, filling them even to the heart of the pile, and forming within it perfect casts of the teredo.

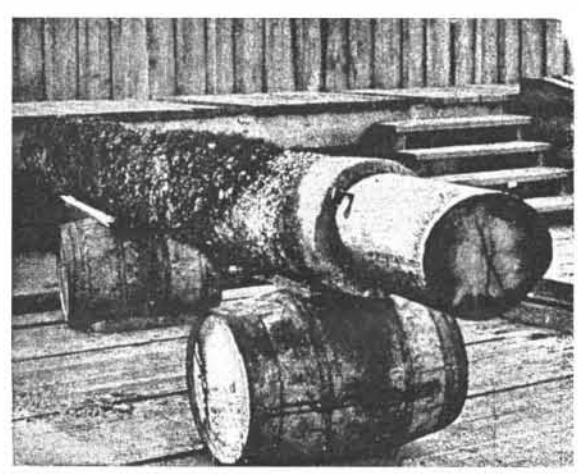
To remove the concrete required several heavy blows with an ax.

The piles were finally split up into small pieces, without finding a single living teredo.

The concrete was composed of sand, gravel, and "Alsen's" Portland cement, in the proportions of 1 of cement, 2 of sand, and 3 of gravel; sufficient water was used to render it thin enough to readily pass through the pipe. When the concrete was broken off, many of the fractures passed through the centers of the flinty gravel, showing the great strength with which the cement adhered.

The work of protection was first started at Pensacola, under the immediate charge of Superintendent E. O. Saltmarsh, to whom, as well as W. H. Courtenay, M. Am. Soc. C. E., Principal Assistant Engineer, a large part of the credit for the success of the undertaking belongs.

The cost of protecting piles in this way was found to vary from 80 cents per linear foot of concrete, measured



PENSACOLA WHARF—END VIEW OF PILE PROTECTED WITH CONCRETE, PILE REMOVED THREE YEARS AFTER PROTECTION.

on the pile, to $1.50 per linear foot, depending upon the length of the protection applied, the location of the pile, and the conditions of the weather; the average was about $1.25 per linear foot. But as the number of feet that required protection—viz., from high water mark to the surface of the bottom—was small compared with the total length of piles, the expense was much less than what it would have cost to have replaced the old piles with new creosoted piles.

Science Notes.

Artificial Whalebone.—Mr. Munck has invented a process for the manufacture of artificial whalebone that consists in first treating a raw hide with sulphide of sodium and then removing the hair. The hide is afterward immersed for twenty-four or thirty-six hours in a weak solution of double sulphate of potassa, and is then stretched upon a frame or table in order that it may not contract upon drying. The desiccation is allowed to proceed slowly in broad daylight, and the hide is then exposed to a temperature of from 50 to 60 degrees. The influence of the light, combined with the action of the double sulphate of potassa absorbed by the skin, renders the gelatin insoluble in water and prevents putrefaction, the moisture, moreover, being completely expelled.

Thus prepared, the skin is submitted to a strong pressure which gives it almost the hardness and elasticity of genuine whalebone. Before or after the desiccation, any color desired may be given it by means of a dye bath.

It can be rendered still further resistant to moisture by coating it with rubber, varnish, lac, or any other substance of the kind.

Calcium Carbide and Boride.—Mr. H. Moissan has recently obtained a crystalline compound of carbon and calcium, by employing the intense heat of his electric furnace, the temperature in which may approach 3,500° C. The crystals of this new body are described as reddish brown, opaque, and shining. They decompose in contact with water at the ordinary temperature into absolutely pure acetylene and oxide of calcium. The carbide, thrown into water, saturated with chlorine, disengages acetylene gas, which burns in contact with the excess of chlorine. It is attacked too by bromine, iodine and the vapor of sulphur. Hydrogen has no effect upon the new compound, nor has nitrogen. Iron and antimony are the only two metals found to react with the carbide. The most curious reaction, however, in which the new compound takes part is that which occurs when water is added to it. Pure acetylene is given off as soon as contact takes place, and the gas continues to be evolved until all the carbide is decomposed.

Mr. Moissan thinks that it is probable that in the first geological periods the carbon of the vegetable kingdom existed in the form of carbides. The great quantity of calcium distributed over the surface of the earth, its diffusion in all the deposits of recent or ancient formation, and the ease with which its carbide is decomposed in water may permit it to be believed that it has played a part in this immobilization of the carbon, under the form of a metallic compound.

Mr. Moissan has also, by means of his electric furnace, prepared carbon boride (first obtained by Joly) in sufficient quantity to permit of an examination of its properties. The compound, which forms brilliant black crystals of the density 2·51, is said to be very stable and extremely hard. In the latter respect it even exceeds the carbon silicide which is now offered in commerce as "carborundum," since the powder obtained by crushing it has proved to be capable of replacing diamond dust in the process of cutting diamonds. This is believed to be the first instance of a definite compound body being sufficiently hard to cut the diamond.

An Alloy of Gold and Aluminum.—During a series of experiments for the Royal Society's committee on researches upon alloys, Captain Hunt has made a discovery that will probably be utilized in the coinage of money. His alloy consists of 78 parts of gold to 22 of aluminum. These proportions, moreover, are the only ones in which these two metals alloy perfectly.

The product, it is said, is of a beautiful purple color, with ruby reflections, and cannot be imitated. Besides, as gold is 7·7 times heavier than aluminum, the same weight of the latter will be 7·7 times greater in bulk than the former.

Barometer of Great Sensitiveness.—The *Rivista Scientifica Industriale* gives the following description of a new barometer of extreme sensitiveness for use in coal mines. It consists of a vertical tube 20 millimeters in diameter internally, and about a meter in length, curved in the usual manner at the bottom. The free extremity is closed by a steel plug screwed into an iron collar fixed to the tube. Finally, a long capillary tube a millimeter in diameter is placed at right angles upon the large tube a short distance above the curved part, and terminates in an open receptacle.

The quantity of mercury is so regulated that the meniscus shall present itself toward the center of the capillary tube. The slightest variation in atmospheric pressure causes the mercury to rise and act upon the capillary column, in which the variations are augmented in the ratio of the sections of the tubes, that is to say, of 1 to 400, which permits of the reading of differences of one four-hundredth. When the changes of pressure become great enough to carry the meniscus outside of the capillary tube, the matter is remedied by acting upon the steel plug.

Internal Temperature of Trees.—The results of some experiments that Mr. W. Pring has been carrying on for the last nineteen years at Brussels present some interesting facts. These experiments demonstrate that the sap of trees contains quite a large quantity of gas, which escapes with a noise that is sometimes very marked and recalls the fizzing of freshly drawn aerated water. It takes place only toward the center of the line of the canal. The annual mean of the internal temperature of a tree is sensibly equal to the annual mean of the temperature of the air, but the monthly mean often varies from two to three degrees.

As a general thing it requires a day for a thermic fluctuation to be transmitted to the heart of a tree. On certain days, the difference between the internal temperature of a tree and that of the air may vary by 10 degrees, but ordinarily it is merely a few degrees. When the temperature of the air descends below zero, and continues to decrease, the internal temperature of the tree descends to a degree bordering on the point at which the water of vegetation freezes and remains stationary thereat. The water of vegetation freezes at a few tenths of a degree below zero. The absolute maximum of the internal temperature of a tree trunk may occur long before the absolute maximum of the surrounding air, because of the direct action of the spring sun and the air upon the leafless tree. During intense heat, in the course of the summer, the internal temperature of trees remains at about 15 degrees, with a variation of 3 degrees, at the most, even when the thermic variations of the air are exceptional. During ordinary years, a large tree is, on an average, warmer than the air in the cold months, and a little colder than the air in the hot ones.