Fully two hundred million of brick a year are being burned in the city of Chicago with crude oil fuel, and a clamp kiln containing one million brick can be burned with crude oil in Chicago at a labor cost of less than \$100, and at a total cost for labor and oil of about 40c. per thousand brick.

There are not, however, many places in the world where brick can be burned with oil at such a low cost as in the city of Chicago; the reason being that oil is not everywhere obtainable so cheaply as in this city, and because few clays in the world are so easily burned into brick as are the clays of Chicago. In Milwaukee, Wis., and in other places within a distance of 100 miles from Chicago, the time required to burn building brick with crude oil fuel averages from sixteen to twenty-one days, whereas the time of burning the Chicago clays averages only about five days, and splendid "burns" have been secured there with crude oil in three and one-half days. It is evident, therefore, that the advantages of using crude oil fuel for the burning of brick will vary in different parts of the United States.

Where circumstances and the nature of the clay permit of its use, crude oil is, next to fuel gas, the brick-makers' ideal fuel.—*The Brickmaker*.

INVESTIGATION OF A MOUND NEAR JEFFERSON CITY, MO.

By A. S. LOGAN.

RECENTLY, a party consisting of engineers and employees of the Missouri River Improvement Commission began an exploration of one of the mounds, a work of a prehistoric race, situated on the bluff, which overlooks the Missouri River from an elevation of one hundred and fifty feet, located about six miles below Jefferson City.

This mound is one of about twenty embraced in a circle one quarter of a mile in diameter.

The above party selected the mound in question apparently at haphazard; all the mounds presenting nearly a uniform outline, differing only in size and mostly circular in form, and from twenty to twenty-four feet at the base, rising to a height of eight feet and under. A trench was cut on a level with the natural soil, penetrating the mound about eight feet. A stone wall was encountered which was built very substantially, making access in that direction difficult, in consequence of which the earth was removed from the top for the purpose of entering from that direction. The earth was removed for a depth of four feet, when the top of the wall was exposed. Further excavation brought to light human bones, some of them fairly well preserved, especially the bones of the legs. On the removal of these and a layer of clay, another layer of bones was exposed, but presenting a different appearance than the first, having evidently been burned or charred, a considerable quantity of charcoal being mixed with the bones. In this tier were found portions of several skulls, lying close together, as if they had been interred without regard to order. They were, in all probability, detached from the body when buried.

The portions of the skulls found were those of the back of the head, no frontal bones being discovered. Some jaw bones with the teeth attached were among the remains, but only that portion of the jaw containing the molar teeth.

A few pieces of flint weapons were found in the upper layers, and nothing else of any significance.

At this juncture the diggers abandoned the search, and some days later the writer, desirous of seeing all that was to be seen, resumed the work and removed the earth and remains until the bottom of the vault was reached; several layers being thus removed. All of these had evidently been burned, as charcoal and ashes were mixed with the bones of each succeeding layer. The layers were about an inch in thickness, with from two to four inches of earth between, and small flat stones, about the size of a man's hand, spread on each different layer, as if to mark its division from the next above.

Between the bottom layers, mixed with charcoal, ashes and small portions of burned bones were found what gives value to the search, numbering about fifty tools and a smoking pipe.

The material of the tools is the same as the rock forming the vault, locally known as "cotton rock." I would consider it a species of sandstone.

Overlying the edge of "cotton rock" in the bluff is flint in great quantities, and in every conceivable shape, that these people could have resorted to had they been so disposed, and why they used the softer material I will leave to some archaeologist to determine. The tools themselves are made after no pattern, but selected for their cutting qualities, as they all have a more or less keen edge which could be used for cutting purposes, and were no doubt highly prized, as they were found all in a pile in one corner of the vault and on top of which was found a stone pipe. The pipe is made bowl and stem together, and it is curious that people of such crude ideas of tools and weapons should manufacture such a perfect specimen of a pipe. It is composed of a very heavy stone, the nature of which would be difficult to determine, as it is considerably burned.

A description of the vault will be found interesting to many. The wall of the vault rests upon the natural surface of the ground, about three feet high and eight and a half feet square, the inside corners being slightly rounded; it is built in layers about four inches in thickness and varying in length upward to three feet, neither cement nor mortar being used in the joints; the corners formed a sort of recess as they were drawn inward to the top, in which many of the stones were found. The stone for constructing the vault was brought from a distance of about a quarter of a mile, as there is none in sight nearer.

I assume from all these circumstances that these people lived in this neighborhood anterior to the age of flint tools, as the more recent interments indicate that they were then entering upon the flint industry, and it may be that the "cotton rock" had become obsolete.

These people buried their dead on the highest ground, covering and protecting them with these great mounds, when it would seem much easier to bury as at the present day; but instead, they, with great labor, carried the rock from a great distance, and it is reasonable to suppose, also, that the earth was brought

from a distance with which they are surrounded, and piled high above, as there is no trace of an immediate or local excavation.

In my view from the mounds and their surroundings I would unhesitatingly say the water, the foot hills of the glacier and the swamps left in its wake were but a short distance to the north of them, and during the summer months the melting ice would send a volume of water down this valley that the Missouri River of to-day is but a miniature of, and therefore the highest hills were the only land that could be used by that ancient race.

In this connection I would make the following suggestions that may lead to more important disclosures: My object is the hope of a more thorough investigation at some future time. Nearer to the top of the mound was found, certainly, the remains of a people of more recent date than those found in the vault, as their bones were larger, which would indicate a more stalwart tribe, and also their mode of burial was different, as there was no indication of fire being used, as was the case with the lower burials. I would pronounce the upper interments those of Indians of the present day; the tools found with these were weapons of the chase. On the other hand, those found in the vault were of a peaceful character, and their surroundings would readily comport, in my opinion, to the glacial period. The entire absence of flint in the bottom of the mound would show one of two things, either they were unacquainted with the use of flint or at that time there was no flint to be had. It is there now in great abundance, in such forms for cutting purposes that would render the "cotton rock" almost useless. The flint is found in a hill close to the river bank, about half a mile from the mound, and the upper portion of the ledge has the appearance, to me, of glacial action and probably forms a moraine, as it has, evidently, been pushed over the underlying ledge, and been ground and splintered in a manner that could not have been without great crushing force. It would be reasonable enough to suppose that the action of the river may have uncovered this flint by washing away the softer material since the occupation of the older race.

In relation to the Indian interment in the examined mound, I could not say distinctly whether the Indian burials had been such as to make them aware of former burials or not, but I think from the thickness of the clay between the two that they were ignorant of former burials. The mounds of the modern Indian, so far as my investigations are concerned, would indicate a more rudely formed structure which would appear to be an imitation of the older mounds, as they are not finished with like care nor have they the interior structures.—*The Scientist*.

ACTION OF CAUSTIC SODA ON WOOD.

By M. H. TAUSS.

THE researches of the author upon the action which water exerts upon wood at a high temperature have shown how much of the incrusting material can be removed without the aid of any reagent.

In connection with the manufacture of cellulose, it is also interesting to prosecute at the same time experiments with solutions of the caustic alkalies, in order to study the mode of action upon both wood and pure cellulose. The manufacture of cellulose has for many years been an industry, and yet little or nothing from a chemical point of view is known of the action of caustic soda upon vegetable fibers.

Braconnet, in 1820, obtained alumina by treating wood with an alkali, but the first application of wood to the manufacture of paper was due to Chaudard. By boiling vegetable fibers with caustic lyes, Collier and Pierré obtained cellulose. Again, in 1862, Barne and Blondel proposed to make cellulose in a similar way, but employed nitric acid in the place of soda.

The first cellulose made exclusively from wood and caustic soda was produced at the Manayunk Wood Pulp Works, in 1854, in the neighborhood of Philadelphia, by Burgess & Watt. The operation consisted in treating the wood for six hours at a pressure of from six to eight atmospheres, with a solution of caustic soda of 12° B.

Ungerer noticed that it was sufficient to limit the pressure from three to six atmospheres, according to the quality of the wood, and advised the use of solutions containing four to five per cent. of caustic soda. He employed a series of cylinders, arranged vertically, in which the wood was subjected to a methodical system of lixiviation. The same lye passed through many cylinders, so that when it made its exit at the end it was thoroughly exhausted, and the wood thus kept coming in contact with fresh alkaline solutions.

According to the account of Kieleaner, the disintegration of wood may be effected in the following four ways:

1. By heating direct in boilers at a pressure of 10 atmospheres. (See Dresel and Roscham.)
2. In vertical boilers heated direct or by steam, and kept at a pressure of from 10 to 14 atmospheres. (Sinclair, Nicol, and Behrend.)
3. In revolving boilers, maintained at a pressure of 12 atmospheres by direct steam.
4. By means of a series of small vessels communicating with each other, and through which a lye circulates at a pressure of six atmospheres. (Ungerer.)

This latter process is preferable to the others. Researches have also been made by the author in order to ascertain the loss which wood and cellulose suffer at different temperatures or in contact with varying quantities of alkali (NaHO).

The following is a *résumé* of the experiments, giving the loss in per cent. resulting from a "cooking" of three hours duration:

I. Ordinary pressure:	
10 grms. cellulose, with 580 c. c. of caustic soda solution, sp. gr. 1.09	21.99
10 grms. of soft wood, treated as above	49.19
10 " " hard " "	53.68
II. Pressure of five atmospheres:	
10 grms. cellulose, with 500 c. c. caustic soda solution of sp. gr. 1.099	58.02
10 grms. of soft wood, treated as above	75.85
10 " " hard " "	69.80

III. Pressure of ten atmospheres:	
10 grms. of cellulose	58.99
10 " soft wood	81.80
10 " hard "	70.39
IV. Ordinary pressure:	
10 grms. of cellulose, with 500 c. c. caustic soda solution of sp. gr. 1.162	21.88
10 grms. of soft wood	35.45
10 " hard "	46.43
V. Pressure of five atmospheres:	
10 grms. of cellulose, with 500 c. c. caustic soda solution of sp. gr. 1.162	77.33
10 grms. of soft wood	97.13
10 " hard "	91.48
VI. Ordinary pressure:	
10 grms. of cellulose, with 500 c. c. caustic soda solution of sp. gr. 1.043	12.07
10 grms. of soft wood	28.37
10 " hard "	30.25
VII. Pressure of five atmospheres:	
10 grms. of cellulose, with 500 c. c. of caustic soda solution of sp. gr. 1.043	15.36
10 grms. of soft wood	50.96
10 " hard "	55.66
VIII. Pressure of ten atmospheres:	
10 grms. of cellulose, with 200 c. c. caustic soda solution of sp. gr. 1.043	20.28
10 grms. of soft wood	70.31
10 " hard "	65.59

From this it is evident that by increasing the temperature and pressure the solvent action of the alkali is increased, but the strength of the lye exercises an influence which is even more marked. Thus, at a pressure of five atmospheres, the loss of cellulose was 0.75 with a caustic lye containing 14 per cent. of NaHO, while it was only 0.05 with a lye of 8 per cent. NaHO.

To further elucidate the action of the alkali under the conditions given above, the author has estimated the amount of precipitate which alcohol gives with the soda solutions, after boiling with the wood:

Specific gravity of NaHO solutions	1.043	1.09	1.162
Soft wood, ordinary pressure	1.043	traces	4.8
" " pressure of five atmospheres	1.043	20	26.8
" " ten "	1.043	1.7	-
Hard wood, ordinary pressure	1.110	27.40	36.80
" " pressure of five atmospheres	1.110	25.70	15.8
" " ten "	traces	5.20	15.8

The estimation of the precipitate, produced in the soda solutions employed in the experiments cited above, gives:

Soft wood, ordinary pressure	1.31	traces	2.0
" " pressure of five atmospheres	15.94	16.0	24.80
" " ten "	17.00	25.4	-
Hard wood, ordinary pressure	5.40	6	5.60
" " pressure of five atmospheres	9.40	15.40	33.60
" " ten "	14.00	18.40	33.60

As a general rule manufacturers employ a greater pressure than that which was found necessary by the author. As a result, it appears from these experiments that the wood not only loses incrusting matter, but that part of the cellulose enters into solution. As a matter of fact, the yield obtained in practical working from 100 parts of wood does not exceed 30 to 35 per cent.—*Le Bull. Fab. Pap.; Chemical Trade Journal*.

NEW BORON COMPOUNDS.

AN important paper is contributed by M. Moissan to the current number of the *Comptes Rendus*, describing two interesting new compounds containing boron, phosphorus, and iodine. A few months ago M. Moissan succeeded in preparing the iodide of boron, a beautiful substance of the composition B_2I_4 , crystallizing from solution in carbon bisulphide in pearly tables, which melt at 43° to a liquid which boils undecomposed at 210°. When this substance is brought in contact with fused phosphorus an intense action occurs, the whole mass inflames with evolution of violet vapor of iodine. Red phosphorus also reacts with incandescence when heated in the vapor of boron iodide. The reaction may, however, be moderated by employing solutions of phosphorus and boron iodide in dry carbon bisulphide. The two solutions are mixed in a tube closed at one end, a little phosphorus being in excess, and the tube is then sealed. No external application of heat is necessary. At first the liquid is quite clear, but in a few minutes a brown solid substance commences to separate, and in three hours the reaction is complete. The substance is freed from carbon bisulphide in a current of carbon dioxide, the last traces being removed by means of the Sprengel pump. The compound thus obtained is a deep red amorphous powder, readily capable of volatilization. It melts between 190° and 200°. When heated *in vacuo* it commences to volatilize about 170°, and the vapor condenses in the cooler portion of the tube in beautiful red crystals. Analyses of these crystals agree perfectly with the formula BPI_2 . Boron phospho-di-iodide is a very hygroscopic substance, moisture rapidly decomposing it. In contact with a large excess of water, yellow phosphorus is deposited, and hydriodic, boric, and phosphoric acids formed in the solution. A small quantity of phosphureted hydrogen also escapes. If a small quantity of water is used, a larger deposit of yellow phosphorus is formed, together with a considerable quantity of phosphonium iodide. Strong nitric acid oxidizes boron phospho-di-iodide with incandescence. Dilute nitric acid oxidizes it to phosphoric and boric acids. It burns spontaneously in chlorine, forming boron chloride, chloride of iodine, and pentachloride of phosphorus. When slightly warmed in oxygen it inflames, the combustion being rendered very beautiful by the fumes of boric and phosphoric anhydrides and the violet vapors of iodine. Heated in contact with sulphureted hydrogen, it forms sulphides of boron and phosphorus and hydriodic acid, without liberation of iodine. Metallic magnesium when slightly warmed reacts with it with incandescence. When thrown into vapor of mercury, boron phospho-di-iodide instantly takes fire.

The second phospho-iodide of boron obtained by M. Moissan is represented by the formula BPI . It is formed when sodium or magnesium in a fine state of division is allowed to act upon a solution of the di-iodide just described in carbon bisulphide; or when boron phospho-di-iodide is heated to 160° in a current of hydrogen. It is obtained in the form of a bright red powder, somewhat hygroscopic. It volatilizes *in*