SOME OF THE ANCIENT USES OF ASPHALTUM BY THE ABORIGINES OF CALIFORNIA.

ASPHALTUM was called chapopote by the Indians before the Spaniards entered California. This is the name also used in Mexico.

It was customary with the aborigines of California

to bury with their dead the implements and utensils used by them during their lives.

From the customs of to-day and from exhumations made in ancient burial places, the following described uses of asphalt by the Indians have been observed.

A basket without a bottom, made of closely woven grass, was cemented to a flat stone with asphaltum, as shown in Fig. 4. This was employed as a mortar. The Indians gathered acorns, hulled them, and then placed them in a bowl-shaped excavation in the ground. By the aid of water the tannin in the acorn was dissolved and removed by the water slowly percolating into the earth. The acorns were then dried and ground into flour in these mortars with a stone

pestle, and, like the practice of to-day, made into a dough and baked.

Baskets made of grass were made water tight by a coating of asphaltum. The asphaltum, together with hot stones, was placed in the basket and the basket was turned and caused to oscillate until an even coating was formed.

Baskets were made of tule in the form shown in Fig. 5. The tules were quilted with tarred fiber, asphaltum, with hot stones, was placed in the interior of the basket, and the basket rolled and turned until an interior coating was secured. These baskets were used for water jars.

Mortars were frequently hewn from solid sand-

stone. These were often accidentally broken and their repair was effected by sticking their fragments together with asphaltic cement, Fig. 10.

DETAILS OF BOAT CONSTRUCTION.

Tules were firmly and closely tied with fiber taken from different plants and tarred with asphaltum into bundles about four inches in diameter in the center and tapering to a point at the ends, and of the length of the intended boat.

Pliant sticks, which were intended to act as the ribs of the boat, were shoved through the bundles at in-

tervals in the manner indicated in Figs. 1 and 2. After a sufficient number of bundles of tules and pliant sticks were placed together, they were bent and secured in the form of the main body of the boat. The bow and stern of the boat were then made in the form and manner shown in Figs. 1 and 3. The tules were then quilted with the tarred fiber until they were firm and watertight, B B B, in Figs. 1 and 3.

The bent position of the ribs was maintained by seats. Further rigidity was given to the boat, if necessary, by fastening poles lengthways of the boat to the ribs. The outside of the boat was then smeared with liquid asphalt of the consistency of heavy tar, A A, Fig. 3.

This tar rises in the ocean and floats to the shore in the right state for this use. The surface of the asphalt was rubbed with dry powdered clay to remove its stickiness.

These boats, though cumbersome in appearance,

were very light, the main weight being the asphaltum and ribs.

Excursions were made in these boats to the islands, twenty-five miles distant from the mainland. Asphaltum was taken to these islands, where none exists, and steatite, from which their cooking utensils were constructed, was brought back. No steatite exists on the mainland, notwithstanding that it was in common use. These boats were also used for hunting and fishing.

Some of their fish hooks were made from sea lion teeth, Fig. 8. The tooth was notched, as shown in the figure, and bound to a piece of wood with sinew or gut. The sinew or gut was then coated with asphaltum, so that the water would not reach the sinew or gut and cause it to stretch.

The obsidian arrow heads and feathers were fastened to their arrows with sinew or gut, and protected from the action of moisture by asphaltum, Fig. 7. Spear heads were also fastened in this manner. These arrows and spears were poisoned in the following manner: A rattlesnake was provoked so that it would bite a deer's liver. The poisoned liver was then

placed in the sun until it became green and putrid. The arrows and spears were then dipped into this corrupted mass. This poison only acts when taken into the circulation of the blood, and, therefore, it did not injure the meat for eating.

Knife blades of obsidian were attached to wooden handles with asphaltum, Fig. 6. These knives were used for skinning animals.

Stems of pipes were fastened to serpentine bowls with a mixture of clay and asphaltum, Fig. 9.

Heads were made on wooden and bone pins with asphaltum, Fig. 11.

Asphaltum was stored and transported in bivalvular shells, like the clam and mussel.

The length of the column of air in their whistles, which were manufactured from a hollow bone taken from a pelican's wing, was regulated by an asphalt plug.

When the wood which they used for fuel was wet by winter rains, it was dipped into asphalt tar springs

to make it more combustible. Indian cooking utensils are found in the neighborhood of all bituminous springs.

These tar springs were the fire works of the Indian boys. When set on fire, huge convoluted columns of dense black smoke were seen by day, and the bright-

ness of their flame by night. All of these springs are coked by repeated fires.

Santa Barbara, Cal., January 4, 1894.

THE ARTIFICIAL PRODUCTION OF PETROLEUM.

By Dr. C. ENGLER.

SCIENTISTS have discussed very often in the last few years the question in which way petroleum, this source of wealth, with its special scientific interest for America, was formed by nature. According to one theory, it is generated from inorganic materials. Sokoloff thinks that petroleum was produced during the period of the formation of our planet out of cosmical hydrocarbons which, in the beginning dissolved in the soft mass, separated from it later on. Mendelejeff assumes that water entering by fissures and chasms the interior of the earth came in contact with melting carbide of iron and produced so in a simple manner oxide of iron and the hydrocarbons of petroleum. Strong objection cannot be made to these two theories from the chemical standpoint; but the composition of the different kinds of petroleum is against them, and geology considers them not free from objections.

For a series of years the idea that petroleum was produced from the remains of plants by a kind of distillation process was most generally adopted, especially by chemists. Chemical and geological reasons are against this theory. From the chemical standpoint it seems quite impossible that the substance of the plants could be split up by distillation into petroleum without leaving charcoal or coke. There would also be a genetic connection between coal and petroleum; but in occurrences of the ordinary kind, coal is nearly always absent. If this were really the case, then there ought to be with every oil occurrence in close connection a coal bank, which really seldom happens.

By a third theory the remains of animals form the raw material from which petroleum is formed in nature. There are many facts proving the decay of masses of animals which we find now in banks in the crust of the earth in the form of the remains of shells, fishes, saurians, etc. Prominent scientists, among them the Americans Wrigley, Whitney, Hunt, and others, and in Europe Hofer and Ochsenius, especially defend this

idea on geological grounds. But I will not enter into the geological discussion, preferring to try to give an answer to the question: How can the transmutation of animal remains into oil be imagined?

In order to answer this some thousands of salt water fishes and also shells have been distilled under strong pressure. The result was a liquid, containing mostly nitrogenous bases, such as pyridin, which was little or not at all similar to petroleum. I then recalled some experiments of Wetherill and Gregory, who found that the wax found in cadavers, the so-called "adipocere," was nothing else but the fatty residue, which remains after the putrefaction of all the other animal matter, especially of the nitrogenous constituents of the cadaver. It is also well known that even fossil bones frequently contain fat. The question now raised was this: Could not the process in nature have been a similar one; should not first of all the nitrogenated animal substance have been destroyed, leaving the fat, which was then transformed into oil? In order to prove chemically this possibility, I submitted animal fat (train oil) to distillation—first in a sealed glass tube, later on in a large iron vessel—under a pressure of twenty-five atmospheres at a moderate heat (300–400° C.), and to my great delight found that under favorable conditions seventy per cent. of the train oil was transformed into petroleum. This equals ninety per cent. of the theoretical output. Besides the oil some water and some combustible gas was always formed. The same behavior has been shown by other fats like butter, the fat of hogs, artificial fats, also the chemically pure glycerids of the fats like tri-olein, tri-stearin and the free fatty acids. All could be transformed into petroleum by distillation under pressure, when managed in the proper way.

I have here a liquid which is the distillate of the fish oil, and I have isolated from it almost all the hydrocarbons which have been discovered in the petroleum of Pennsylvania. The other products—the oil burning in this small lamp, too—are oils obtained from the crude material by purification.

But not only illuminating oils are produced. I separated also by distillation those lighter hydrocarbons which compose the gasoline, the ligroin, the benzine, etc. Recently I have succeeded in finding and separating paraffine wax and lubricating oils from those parts of the crude oil which show a high boiling point. This removes the objection of O. Ross to my theory of the formation of petroleum from animal remains. As a matter of fact, I found in the distillate obtained by decomposition of train oil nearly all the constituents which have been separated from the natural crude petroleum, and even the gases, which, like natural gas, consist essentially of marsh gas.

Very recently I have made close investigations on the mechanism or on the chemistry of the formation of the hydrocarbons of the petroleum produced by distillation of fat under pressure. These experiments prove that the simpler organic acids split up in the same way, yielding almost the theoretical quantity of the respective hydrocarbon. Thus phenylacetic acid yields toluene. For further details I am obliged to refer you to the actual experiments. I need only remark, that we have to assume that the acids with high molecular weights are decomposed with the production of a number of hydrocarbons.

To recapitulate, it is a geological fact that we find in nature the remains of antediluvian animals, as shells, fishes, saurians accumulated in masses. Whether these animals have been piled up in consequence of a natural super-production in special places in the ocean, or by currents, or in consequence of great revolutions of the earth, this must be decided by geology; but the remains exist.

Now in which manner do the organic substances of these animals become decomposed?

The animal substance consists essentially of nitrogenated material and fat. The former is easily decomposed, the latter is very stable—a fact which has been very well known for a long time, and has been shown again by exact investigations. Therefore we find the wax of cadavers in old graves, therefore the fat in the bones of mammals thousands of years old, therefore the fat on the bottom of the ocean recently found.

Whether and how far the fat was decomposed in this long period by the water splitting up glycerol and forming the free acid, for instance, the fat in the bones of mammals, cannot be answered. Both fat as well as the fatty acids form petroleum, when distilled under pressure.

We can imagine that such remains wrapped in mud and transported by the currents in the ocean easily accumulate, and later on under the pressure of sedimentary layers or strata, perhaps under the influence of heat, too, are transformed into petroleum. This is only one of the many possibilities by which the mechanical process of the transmutation of fat into petroleum may have happened.

Under any circumstances I think I have proved that from the chemical standpoint, the formation of petroleum from animal remains has the greatest probability, as we are able now to transform every animal fat into petroleum.—*Jour. Amer. Chem. Soc.*

CLOTH OILS IN REGARD TO FIRE RISKS. By W. MCD. MACKEY.

WHEN dealing with distilled oleins, both foreign and distilled from black oil and brown or Yorkshire grease, the chemist is seriously troubled by the mineral oil question, which assumes a fictitious importance owing to the insurance companies' practice of charging a high rate when an oil is classed as containing mineral oil. Thus black oil containing say, for the sake of simplicity, no unsaponifiable matter, may yield on distillation with superheated steam an olein containing a considerable quantity of unsaponifiable hydrocarbon oil, and the amount may be increased by repeated distillation.

Dr. Lewkowsch found a specimen of Yorkshire grease that he examined to yield, when distilled on the manufacturing scale, 34.54 per cent. of unsaponifiable hydrocarbons.

These hydrocarbons, the result of reduction during the distillation of fatty oils, are liable to be mistaken for added mineral oil. The nature of such hydrocarbons has not been exhaustively studied, but as far as insurance risks are concerned there seems to be little difference between them and mineral oil itself.

As a result of the new departure in insurance rating, the tendency is to depend on the flash point of an oil, the amount of unsaponifiable matter and a certificate of genuineness from the vender. This certificate in the case of recovered oils is usually valueless, as the oil manufacturer has seldom control over the oil finding its way into the seak (spent soap liquor) he buys. Though the flash point test is invaluable, the determination of the unsaponifiable matter gives data of little use as regards fire risk.

The fact that the tests ordinarily applied are inadequate is not owing to the difficulty of finding better, but to the fact that chemists are seldom asked to give their opinion as to the fire risks attending the use of oils submitted to them. The question usually is if the oil will fulfill the conditions of the schedule; and if the examination goes beyond the flash point and determination of unsaponifiable matter, it leads to questions of composition, sometimes incapable of satisfactory answer, and often of no interest whatever as regards actual fire risk.

Hence, also, the oil manufacturer, if he is so disposed,

maintaining as a residue in the stills. The second are distilled from this "tar" and the coke is left as perfectly dry residue.

For the first or crude process the apparatus used consists of a still, a condenser and a receiving house, with its accompanying paraphernalia. The crude stills are plain cylindrical vessels 13 feet in diameter and 30 feet long. The condenser tanks are 30 feet in diameter, one tank serving two stills. These are arranged in batteries as shown. The firemen are stationed between the stills, and the stillmen occupy the receiving houses. The stills are of $\frac{3}{8}$ inch riveted steel, plain cylindrical, with dialed heads, surmounted by a dome from which a vapor pipe leads. There is, besides, a filling pipe for crude oil and a tar pipe for pumping off the residue, and a manhole in each head for cleaning and repairing. Either in the top of the dome or at some point on the vapor pipe is a safety valve set to blow at a pound to one and a half pounds pressure. The setting is the simplest possible. There is no return flue. The still rests on brick work built up to the middle, the heating surface being about

STILL AND CONDENSER.

can, as far as insurance interests are concerned, practically sophisticate with impunity in certain directions.

Tests should be insisted on that would indicate the behavior of any particular oil under the conditions obtaining in its use, and there is no doubt that if there were some authority of the nature of Lloyds' in shipping, the testing of oils by rational methods would be undertaken, to the benefit of insurance interests and also those of the cloth and oil trades.—*Chem. Tr. Jour.*

THE REFINING OF PETROLEUM OIL.

IN spite of popular inveighing against monopolies and popular clamor for legislation against trusts, a thoughtful examination of the work and practice of the Standard Oil Company, the representative trust of them all, will show that they are not without their benefit to the public. The removal of what is often a ruinous competition has not only enriched the refineries, but has also cheapened their product to the public. Instead of religiously guarded trade secrets, we find the various superintendents conferring on what are the best methods of pursuing their occupation. Experiments are carried on by a common fund and the results given to all members of the trust, and in this way the best results are obtained at the very least outlay. The general practice of the various refineries is almost identical, excepting that those of more recent construction are a little improved in the mere detail. All dimensions given in this article refer to no particular establishment, but are merely average good practice.

The process of refining consists in the division and redi- vision of the crude oil into the various components and then purifying and refining the product. The petroleum products naturally divide themselves into three main groups; the light, nearly colorless, and highly volatile benzin- es and illuminating oils; the heavy more or less deeply colored paraffine oils and wax, and finally the residuary coke. The first are distilled directly from the crude oil, a heavy black "tar" re-

half the cylindrical area of the still. The upper half is often jacketed with corrugated iron, with about a nine inch air space.

Each condenser contains two square coils of pipe, one from each of a pair of stills, gradually reducing from the nine inch vapor pipe to the three inch pipe entering the running box in the receiving house. This is a small glass-fronted box, where the flow of the oil and its color can be constantly watched. From this box lead two pipes; one from the top, which carries the gas arising from the oil back to the grate to be burned, and the other from the bottom, which carries the oil to the "monitor." The object of this last apparatus is to distribute the oil into the several lines, whence it flows into the various tanks. The oil flows into a box inside the monitor which can be revolved by a handle, so as to bring a nozzle in the bottom of the box opposite the openings of the various pipe lines placed around the circumference of the bottom of the monitor. These lines are: Light benzine, heavy benzine, water white distillate, standard white distillate, etc., depending upon the number of grades of oil desired.

The stills are filled while cold with about six hundred barrels of crude oil and the fires started and continued with ever-increasing intensity for from fifty to sixty hours. At the last stages the bottom plates of the stills are red hot. When the oil begins to flow in the receiving house, the stillman draws off a sample into a cylinder glass and takes the gravity with a Baume hydrometer. The monitor is now set at the lightest "cut," say, for example, the "light benzine cut." He continues to take these samples from time to time, until the oil gets too heavy for "light benzine," when he turns the monitor lever so as to run the oil into the heavy benzine line. In this way he continues through all the various grades down the scale, there being a waste pipe running from the monitor, so that if at any time the oil should run bad, it can be switched into the

REFINING OF PETROLEUM OIL.