Source of the Oil	Geological Formation	PHYSICAL CHARACTERISTICS.							CHEMICAL COMPOSITION					INDUSTRIAL GRADES			
		Density at +15°	Natural Condition	Color	Odor	Evaporation in one month at +15°	Point of Ebulli- tion	Point of Solidifi- cation	C	H	O	N	Light Oils and Loss	Lamp Oils	Heavy Oils	Paraffine Oils	Mazout or Resi- due
Ain-Zeft.....	Helvetian	0.971	Pasty	Black	Slight	Slight	+162°	— 1.3°	78	7.1	14	0.9	3.50	13.50	32	29	22
Sidi-Brahim	Sahalian	1.016	"	Brownish black	"	"	+158°	— 1°	81	6	10.9	2.1	5.50	11	29.50	29	23
Bel-Hacel.....	"	0.989	"	"	"	"	"	— 4.4°	"	"	"	"	"	"	"	"	"
Medjilla (surface).....	Cartennian	0.835	Liquid	" green	Sulfurated	19%	+114°	— 13.5°	83	9.50	7.50	Traces	6	50.50	15	2.50	21
" (42 m.)	"	0.795	Very liquid	"	Not disagreeable	19	+ 94°	— 16°	82	11	7	"	7	53	13	3	24
" (56 m.)	"	0.794	"	Greenish	"	34	+ 81°	— 17.4°	80.5	13	6.5	"	9.50	56.50	7.50	3	23.50
Messilla (surface).....	"	0.842	Liquid	"	"	17.5	+110°	— 11°	84.05	9.50	6	"	5.50	48	16	4	26.50
" (98 m.)	"	0.830	"	Black	Strong and eth.	21	+ 93°	— 12°	82.50	12	5.50	"	5.50	54	12.50	4	24
Sidi Mohamed (surface).....	Nummulitic	0.811	"	Brownish green	Not disagreeable	"	"	"	"	"	"	"	"	"	"	"	"

account of its consistency, to be difficult of exploiting by boring. Its slight fluidity is an obstacle to its gushing, and even to pumping.

But this oil ought to be considered as a surface petroleum, oxidized and deprived of the greater part of its light constituents, having, so to say, undergone a complete distillation on its journey. In fact, oxidation in petroleum proceeds from a contact more or less prolonged with the atmosphere, or with the oxygenized products which it may meet with below the surface. Such are the resinous or asphaltic products (petroleum $C_{20}H_{32}$ and asphaltine $C_{30}H_{42}O_2$). It must be admitted that the proportion of oxygen in petroleum increases to a certain extent in consequence of its exposure to the air. There is a corresponding loss in the proportion of hydrogen, and even of carbon. This property explains why mineral oil, after a greater or less exposure to the air, loses a part of its caloric power.

The phenomenon that has been mentioned, of which an example is seen in the Dahra, I have had occasion to study at Sloboda, in Galicia. In a petroleum of this deposit and a sample of tarry petroleum from the same source, but oozing from fissures far from its origin, which may be considered as a simple asphaltic transformation of the first sample, the following elements have been found:

PETROLEUM OF SLOBODA.

Density (zero) 0.937.

Carbon	82.44 per cent
Hydrogen	6.21 per cent
Oxygen	11.35 per cent

TARRY PETROLEUM.

Density (zero) 0.881.

Carbon	84.98 per cent
Hydrogen	12.35 per cent
Oxygen	2.75 per cent

Laboratory experiments corroborate this view. Engler and Bock, on submitting neutralized and boiling petroleum to the action of a current of air, obtained a special oxidation, a resinous product containing butyric acid. Favored by the presence of an alkali, these reactions produce carbonic acid and water.

Drilling.—The work of drilling has not been generally well understood in Algeria. If imperfect prospecting had not been the initial cause of the want of success which has arrested the development of the petroleum industry, the lack of adequate instruments for reaching petroleum at great depths would have also occasioned disappointment. This might have been attributed to the sterility of the location, when in reality the petroliferous richness was apparent at the surface.

To appreciate the judgment necessary in the choice of the boring mechanism, it is sufficient to consider the nature of the lands. They contain to a great extent layers exceedingly adherent to the tools (clays and marls) necessitating frequent pipage, diminution in dimensions, which before the level is reached where the presence of petroleum can be anticipated, are so reduced that it is impossible to continue the work. This is the general cause that has led to the abandonment of all the borings undertaken in Algeria above 450 meters.

There are three remedies: (1) The employment of strong machines for rapid boring, allowing undertaking a well of large initial diameter, contending by the velocity of perforation against the clogging of the pipes, and not reducing the diameter except at the last extremity; (2) the employment of boring with water circulation, contending against the clogging by continual cleansing of the opening; (3) the employment of enlarging shears, and an elaborate system of pipes screwed together in sections.

PRECIOUS STONES IN THE UNITED STATES, 1901.

THE following synopsis of the precious stone industry of the United States for 1901, and the accompanying table, showing the production of precious stones in that year, have been sent to the Division of Mining and Mineral Resources of the United States Geological Survey, by Mr. George F. Kunz, Special Agent in charge of precious stones.

The principal items of interest concerning precious stones during the year 1901, are as follows:

The yield of sapphires in Fergus County, Montana, was greater this year than in 1900, and two companies are now mining in the region where the blue stones are found. Exploration for the many fancy-colored sapphires has been carried on still further in the Rock Creek region, Granite County, Montana.

The deposit of rhodolite garnet in the Cowee Valley, Macon County, North Carolina, was worked extensively. Mining for dark blue, green, and yellow beryls, for amethysts, and for emerald matrix was carried on in North Carolina.

The formaline deposits at Mesa Grande, San Diego County, California, were actively worked, and a new nearby deposit was discovered. The localities described in previous reports of this Survey as producing the golden green chrysoprase have been purchased, or a control of them for a stated period has been ac-

quired, and more or less mining for this mineral has been carried on.

Several new turquoise companies have been formed, so that seven companies are now actively engaged in mining that material, and are placing it on the market, accompanied by their respective trademarks as a guarantee that such stones as may change in color will be exchanged for others. New Mexico is the chief source of the turquoise supply.

The finding of one diamond in Lee County, Georgia, is of interest as coming from a new region.

Epidote crystals, magnificent as regards size and crystallization, have been found in Prince of Wales Island, Alaska.

Emeralds have increased greatly in public favor.

The diamond importation has been greater than in any previous year, and at no period have more fine and more very large stones been imported.

The presentation by Mr. Max Braverman of his collection of gems and minerals to the Golden Gate Museum, San Francisco, California, is worthy of note.

Within the last few years, more attention than ever has been paid to the quaint and fanciful cutting of all precious stones, the diamond included; and whereas, ten years ago, scarcely any other forms than the "brilliant" and the "rose" in diamonds were used, during the last year there has been a great demand for stones that are "pear-shaped," "marquise," "briolette;" also for table-cut stones in all forms—triangular, circular, hexagonal, and in the double rose form also; and a modification of the last form has been patented.

The following table gives the production of precious stones in the United States during 1901:

Diamond	\$100
Sapphire	90,000
Ruby	500
Topaz	"
Beryl (aquamarine, etc.).....	5,000
Emerald	1,000
Phenacite	"
Tourmaline	15,000
Peridot	500
Quartz, crystal	10,000
Smoky quartz	1,000
Rose quartz	150
Amethyst	500
Prase	"
Gold quartz	2,000
Rutilated quartz	50
Dumortierite in quartz.....	"
Tourmalinated quartz	1,000
Agate	1,000
Moss Agate	500
Chrysoprase	1,500
Silicified Wood (silicified and opalized)	7,000
Opal	"
Garnet (almandite)	100
Rhodolite	21,000
Garnet (pyrope)	1,000
Topazolite	"
Amazon Stone	200
Oligoclase	"
Moonstone	"
Turquoise	118,000
Uthallite (compact variscite).....	250
Chlorastrolite	3,000
Mesolite (thomsonite, so called).....	1,000
Prehnite	"
Diopside	"
Epidote	"
Pyrite	3,000
Malachite	100
Rutile	"
Anthraxite	2,000
Catlinite (pipestone)	2,000
Fossil Coral	100
Arrow points	500
Total	\$289,050

THE PEANUT CROP AND ITS USES.

By AMAZIAH WHITNEY.

THE American peanut is grown principally in Virginia, Georgia, Tennessee and North Carolina. These States produce annually about four millions of bushels, which retailed to the individual consumer aggregate a value of ten millions of dollars. Yet the peanut product is for the most part outside of any regular branch of manufacture, and has not yet formed the basis of any great industry. This is remarkable in view of the character of the plant, every part of which, except merely the tap-root, is capable of some economic use. While the plant itself has been known from the earliest times, as shown by its Sanscrit name Chinar Badam, it is only about fifty years since it attracted commercial notice. This was in the East Indian Presidency of Madras, where the growth of the peanut has increased until, during many years past, it has covered an annual aggregate which may be roughly estimated at two hundred thousand acres. As a plant of tropical or sub-tropical origin it has been commonly supposed to be capable of profitable culture only in

warm countries. The opposite seems to be the fact. The peanut will grow and ripen wherever there are five months consecutively free from frost. Reliable authorities say that in the United States it will flourish from New Jersey southward along the Atlantic coast, as far north as Wisconsin in the valley of the Mississippi, and anywhere on the Pacific coast south of the Columbia River. From this it appears that the crop is planted in only a small corner of the regions where climatic conditions are favorable to its production on a considerable scale. While not at present an important element in American agriculture or manufacture, it is by no means impossible that it may become so.

Scientists describe the peanut as a "diffuse, herbaceous annual with procumbent branches," and in the botanical system of Linnaeus it is called *Arachis hypogæa*. In popular phraseology in this country it is termed the peanut, perhaps because it is neither a pea nor a nut. It is, however, nearer the former than the latter, for it belongs to the leguminous order of plants, which includes peas, beans, clover, etc. The colored population of the Southern States refer to it as the "goober," while in other parts of the world it is known as earthnut and groundnut. By the Hindoos who cultivate it in large quantities it is called boni mug. A field of growing peanut plants very much resembles a field of clover, the growth shading the ground and choking the weeds. Like clover, it is believed to enrich the ground by assimilating nitrogen from the air and depositing it in the refuse left in the soil. This idea, however, is subject to some qualification. The peanut requires certain elements of fertility in the soil, without which it will not grow. Even very rich soils, if deficient in the requisite peculiarities, produce only vines and abortive shells, which latter are technically known as "pops."

The original habitat of the peanut is unknown. Some have claimed that it came from China through India. The better opinion seems to be that it originated in Brazil, passed to Africa, and then in a roundabout way to America. There are many varieties of the plant, and the products of the same variety very often differ materially according to the conditions under which they are grown. The East Indian plant is more stiff and somewhat more upright than its American congener. The typical American peanut is the Virginian, which sends its shoots sprawling along the ground in every direction. There is, however, a special variety of the Virginian known as the "bunch," in which the habit of growth is distinctly different. The nuts themselves have even greater divergencies in appearance and also in composition. There are in India two widely separate varieties. One of these has a light colored kernel which, contains very little oil, but is highly valued for eating; the other has a reddish color, and while its edible value is not great it is very rich in oil. The common peanut, as we all know, has usually two, and very seldom three, kernels in a shell. There is in Costa Rica a variety which has four and five kernels in a shell. The difference in the composition of the kernels is, qualitatively considered, very slight in the various kinds, but quantitatively the differences are great. Thus in one Tennessee crop the kernels were found to have had as low as 3.87 per cent of water, while one variety of Japanese has shown as high as 15.61 per cent. An Alabama product has given as much as 4.26 per cent of ash, while two varieties of the Japanese show, each, less than 2 per cent. Nitrogenous extracts are derived from Georgia peanuts to the extent of nearly 22 per cent, while those of Bombay afford only a trifle over 10 per cent. These figures, however, are misleading, as the strength of the extracts is manifestly not uniform, the absolute nitrogen in the Georgia kernels being only 4.88 per cent, while those of Bombay yielded 5.40 per cent. Similar differences exist in other parts of the plant. Peanut shucks, which are not the shells, but are the paper-like inner coverings of the kernels, have more ash in proportion to their weight than has peanut meal, about half the protein, and about the same amount of fiber. Of course, the meal referred to is that which is made from the cake which remains after the oil has been expressed from the crushed kernels. Considered in detail the chemistry of the peanut is complex, but presents little of interest from a practical viewpoint. Those curious concerning the subject should refer to an elaborate article by M. Mertens entitled "Recherches de l'Huile d'Arachide" in the *Moniteur Scientifique* of the year 1899. Analysis of the vines and shells of all varieties show heavy proportions of lime which explains why this mineral is so essential to soils devoted to the cultivation of the plant. In this connection it may be remarked that while it grows best on a calcareous sand, containing more or less decayed vegetation, it takes kindly to many soils in which natural deficiencies are made up by artificial additions of lime, potash, humus and phosphatic material. A clean soil which will not adhere to the nuts is also a requisite to the successful commercial exploitation of the product. Mechanically considered the one essential of the soil is a fine tilth four or five inches in depth, which is not to be wondered at when we consider the growth and structure of the plant. Under favorable circumstances on new

soils a yield of from fifty to one hundred bushels per acre has been obtained in the peanut-growing regions of the United States, but in the absence of a judicious rotation of crops, and perhaps by reason of somewhat neglectful tillage, an average of twenty bushels to the acre is as much as is ordinarily looked for. The methods of cultivation and harvesting are thus far primitive to a degree and *mutatis mutandis* very much the same as those of other farm crops. The nut-bearing vines are plowed out from the ground, stacked for two or three weeks to dry and ripen and the sound nuts are picked by women and children. This is the most expensive part of harvesting, and applies to the Virginian and similar varieties. In North Carolina a smaller variety is grown with which the kernels are separated from the haulm by a kind of threshing machine, but it is claimed by many that this method is not entirely satisfactory. Before reaching the consumer the nuts pass through the hands of middlemen, by whom they are winnowed, cleaned and polished, and separated into four grades; of these grades Nos. 1, 2 and 3 go to the street stands, and No. 4 to the "burnt almond" and peanut candy manufacturers. Aside from these uses a portion of the crop has been, from time to time, devoted to the manufacture of oil which finds a market as a substitute for olive oil, and as such comes in competition with the high grade of cottonseed oil. The production of peanut oil is not likely to meet with any great degree of financial success in this country until the supply of peanuts is very greatly increased. A mill having a business sufficient to compete with other oil products would require perhaps fifteen thousand tons of peanuts annually, and at this rate two mills would work up almost the entire yield of the United States. The oil cake has high feeding value for animals, and rivals English bean meal and American cottonseed meal for this purpose. The vines or haulm make a good hay, which, however, requires care in feeding, and the shells when ground with other feed materials have a high nutritive value for stock.

From what has been said it will naturally be inferred that the peanut crop and its uses constitute literally an infant industry. This is further exemplified by the very slight extent to which it has attracted the attention of inventors. The first patent relating to the industry in this country was issued to one S. Shepard in 1857 for a stemming and polishing apparatus. The next, in 1868, to J. C. Underwood for a picking machine. During forty-three years only sixty-four patents have been issued, and of these twenty-four have related to cleaners and nineteen to roasters. The latter, of course, have for the most part been comparatively trivial devices which run into coffee roasters on one hand and corn poppers on the other. Deducing these the peanut industry has produced only about one patent per year, and this, aside from cleaners, means only about twenty inventions, good, bad and indifferent, relating to other branches of the industry. These include diggers, pickers, shellers, stemmers, polishers, hullers, assorting apparatus, blanching processes, "warmers" for keeping hot the roasted edible, and also one "peanut vending machine" for insuring economical retail disposal to the public. This paucity of improvement seems to indicate a neglect of promising and increasing opportunities. It would appear as if the whole art, from planting the seed to finishing the product for market, needs overhauling to bring it abreast of the times.

CARBURETERS.

We propose to use the term "carbureter" in the present article in a wider sense than that which is generally given to it. Usually a carbureter is understood to be an apparatus by means of which atmospheric air is saturated more or less completely with the vapor of a volatile hydrocarbon which evaporates freely at the ordinary temperature of the air, the air thus carburized being converted into what is to all intents and purposes an inflammable gas. There are, however, a number of appliances in use on internal-combustion engines in which this process does not take place, at any rate outside the cylinder, and in which it probably is only completed during or toward the end of the compression stroke. There are also other appliances for enabling engines to be run with the heavier oils which are not volatile at ordinary atmospheric temperature. We propose to include all these forms of apparatus under the general heading of "carbureters," and to consider their characteristics and peculiarities as compared and contrasted with one another.

Where we have to deal with volatile hydrocarbons, of which an example is the gasoline usually employed in motor cars, the problem differs a good deal from that which is presented to us where we have to drive an engine with the heavier kinds of oils. The ether saturator invented many years ago for use with lime-light apparatus is in many ways the prototype of the gasoline engine carbureter. In this appliance ether, which is one of the most volatile combustible substances known, is poured on cotton wool arranged in one or more compartments in a box and oxygen under pressure is led through it. The oxygen takes up the ether vapor, and becomes to all intents and purposes a combustible gas, which may replace hydrogen for producing the oxy-hydrogen flame which is used for limelight purposes. What is a rather curious feature is that oxygen, fully saturated with ether, produces a higher temperature, and consequently a better light, than pure hydrogen.

The principles on which a large class of gasoline carbureters for explosion engines are constructed are mere application of the ether saturator, ether being replaced by gasoline and oxygen by atmospheric air. This applies to all those types in which carburized air is first fully saturated and then introduced with an additional charge of pure air into the working cylinder.

Carbureters may be divided into the following classes: (1) Wick carbureters; (2) Surface carbureters; (3) Spraying carbureters; (4) Vaporizing carbureters; and (5) Carbureters which involve a combination of two of these principles.

The wick carbureters are developments for motive power production of the ether saturator, that is to

say, they use the principles on which that appliance is based. In general, a somewhat more durable substance than cotton wool has been employed; for instance, finely divided copper gauze or porous asbestos has been used, arranged in such a way as to be always kept moist by the gasoline, the air to be carburized being passed over a considerable surface of the porous material so moistened. Often this arrangement is reduplicated in a number of separate partitions.

Fig. 1 shows a simple form of wick carbureter, in which the air entering through the vertical pipe, A, bubbles up through the gasoline and is still further saturated by passing through a flame covered with lamp wicking, B, which draws up the gasoline and is thus kept moist. The air to make the mixture is admitted to the gas through the valve on top, as the gas passes out of the carbureter on its way to the motor. The gasoline is kept at the required level by a float feed arrangement not shown.

The Sales and Braby carbureter shown in Fig. 2 is a more complicated example of the wick carbureter, and has a mechanical feed. The suction of the motor raises the valve, A, and draws in air through slots, aa, arranged around the circumference of the tube,

FIG. 1.—TYPICAL WICK CARBURETER.

B. Thence the air passes through slots, d, in the pipe, D, and is sucked upward through layers of fibrous material such as felt, m, interspersed with layers of wire gauze, n. The gasoline enters through the needle valve, G (which, by means of the rocker arm, C, and the stem, b, of valve, A, is opened every time A is raised) and falls upon the layers of wire gauze and felt, by which it is spread and absorbed. The air passing upward takes up the gasoline and forms gas. The air for the mixture is admitted through the valve, M. A pet cock, P, is placed at the bottom of the carbureter to drain any superfluous gasoline that might accidentally collect.

The earliest forms of surface carbureters were very simple appliances. They consisted, indeed, of little more than leading the air to be carburized through the gasoline tank, and relying upon the natural volatility of the gasoline to saturate the air. This arrangement is, of course, open to the objection that the volume of air in the receptacle increases as the gasoline decreases, with the result that the degree of carburization varies, and in consequence the driver of the engine has gradually to alter the feed of the mixture to the cylinder. A successful carbureter has been made on a development of this principle, in which the gasoline is kept by some special feed device at a

FIG. 2.—WICK CARBURETER WITH MECHANICAL FEED.

constant level in the carburizing chambers, and the carburizing chamber itself split up into a number of separate compartments. Sometimes the air was caused to bubble from one compartment into another, thus making the carbureter into a kind of Wolff's bottle, such as is familiar to every chemical student. Sometimes splashers were employed to effect an additional mixture of air and gasoline. But in all the principle was the same, viz., that of bringing the air into contact with as large a surface of the hydrocarbon as possible.

Phillips' carbureter, shown in Fig. 3, is a surface carbureter with spraying device in the form of paddles, PP, which are operated by the exhaust gases of the motor blowing on and turning a smaller windmill or paddle arrangement, pp, in a casing, c, in the upper chamber, G. The gasoline is warmed by the small pipe, e, from the exhaust, which passes along the bottom of the carbureter. Air enters through some small holes, aa, in the top of C, passes down through similar holes, bb, in the partition, and, after sweeping over the surface of the gasoline, makes its exit at the top through the valve (where air is mixed with the

gas to form an explosive mixture), then passing downward and out at the right, through the pipe leading to the motor.

The spraying carbureter is really a development of the splashing principle. The chamber in which the carburization is effected has the gasoline atomized in it by the use of a very fine orifice, through which the liquid is forced or sucked at a high velocity. This spray vaporizes the gasoline in exactly the same way as in the splashing carbureter, and the air sucks it up and keeps it, as it were, in solution.

The Abeille carbureter, shown in Fig. 4, is a combination of a float feed with a more or less perfect pulverizing device. The gasoline is kept at the level of the top of the small feed nozzle, G, by the float feed

FIG. 3.—SURFACE CARBURETER WITH SPLASHING DEVICE.

arranged in a neighboring chamber. The suction of the motor drawing air up past the nozzle causes the oil to spout out of the top of the latter and spray upon the perforated cone, C, above, through the small holes of which air introduced at the top at cc passes and forms an explosive mixture with the gasoline vapor on its way to the motor. The holes, cc, may be regulated by turning a screw cap.

The Longuemare carbureter, Fig. 5, is constructed similarly to the Abeille, but its spraying nozzle is larger and is closed at the top by a conical cap, A, in the lower tapered face of which are four or five fine grooves, through which the gasoline is drawn up in a like manner of fine jets that spray upon several sheets of wire gauze, B, set in the pipe above. The air for the mixture is introduced through the curved pipe shown, the air to form the gas being drawn in at O.

In the vaporizing carbureters which were originally designed for the utilization of the heavier oils, such as kerosene, the use of a heated surface or chamber is adopted, on to or into which the oil is sprayed, generally in as fine a condition as possible, through

FIG. 4.—ABEILLE ATOMIZING CARBURETER WITH FLOAT FEED.

a jet. By the use of heat it was hoped to obtain the same effect with the heavier oils as was obtained with the spraying carbureters using the lighter hydrocarbon at a lower temperature. In practice, however, this was only found to be true to a limited extent. As instances of this class we have the Hornsby and Priestman, together with a number of others, among stationary engines. Only the Roots and the Koch engines employ it for automobile purposes.

Grove's carbureter, Fig. 6, illustrates this type, inasmuch as it sprays into a kind of mixing chamber, A, which forms a recess just off the main cylinder, C, and has a channel, B, arranged for the inlet of the oil in the seat of the inlet valve. The spraying takes place between the seat and the edges of the valve. A constant quantity of air is drawn in and the flow of gasoline is regulated to get the mixture.

Deutz's carbureter, Fig. 7, is another example of the same type, which is said to have given good results with kerosene. In this arrangement the valve, e, is opened by the positive action of a cam upon a cam shaft and allows the oil to issue from the space between its spindle and the surrounding walls. As it