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# MISCELLANEOUS ANALYSES.

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# TEXAS AGRICULTURAL EXPERIMENT STATION.

# MISCELLANEOUS ANALYSES.

DUNCAN ADRIANCE, P. S. TILSON, AND H. H. HARRINGTON.

The work here presented is a part of that which accumulates from time to time from analyses made for the general public. Much of it has been done free of cost, and most of the remainder at a mere nominal price. Some of it will be of interest to the public, while other parts will have a local significance only.

## MINERAL WATERS.

Texas affords a very large number of these, and of almost every possible variety. Only a part of them have been developed or improved, and many are not accessible as summer or health resorts. But the few that are have a very liberal patronage, and especially from residents of the State. Wooten Wells, Mineral Wells, Manganic Wells, Lampasas Springs, and others, have a reputation even beyond the State. But there are many other waters in the State equal or superior in variety and abundance of mineral material to those mentioned above. Farmers and land owners who happen to control a mineral well or spring which is believed to carry great medicinal value, must bear in mind that judicious advertising, comfortable and luxurious surroundings, are factors in the healing properties of waters, as important as the character of the water itself. It is entirely unnecessary to send a water here for chemical analysis, unless one expects to expend a sufficient amount of capital and time on the water to invite and justify attendance in at least full proportion to the real value of the water. The locality should of course be easily accessible by rail to the public. The water may, indeed, be supplied by express to the various parts of the State. But such a demand is made, usually, only after the reputation of the water has been otherwise established. Aside from this, many waters lose a part of their medicinal value if shipped any distance. Any gas held in solution is either lost in part, or entirely; and in iron waters this constituent undergoes another form and is precipitated.

Mineral waters can not be easily duplicated by artificial means. It is an easy matter to find certain popularly known waters bottled and for sale in almost any drug store. But their compounding is not so skillfully done as when made in the earth's laboratory.

It would be impossible, as well as unnecessary, to give in a specific way the effect on the system of each ingredient of the waters submitted to analysis.

A common classification is: (1) Carbonated Waters, (2) Sulfur Waters, (3) and Saline Waters. The first class include those in which there is an excess of carbonic acid gas. The mineral ingredients are likely to include the carbonate of lime, magnesium, and iron, together with the presence of other substances in small quantities.

Sulfur waters are easily distinguished by their characteristic odor of sulfureted hydrogen; their ordinary mineral composition having no influence on their common name.

Saline waters are characterized more especially by the chlorides of sodium, calcium, and magnesium. If the ferrous salts of iron are present, the water is usually termed *chalybeate*. Alkaline Waters are very common in Texas. The alkalinity is due to the presence of the carbonate or bicarbonate of sodium; but this is nearly always accompanied with sodium chloride and sodium sulfate.

Table I gives analyses of mineral waters only; while following it, in Table II, are statements of several analyses made for some other specific purpose.

## *Mineral Water Analyses—Table I.*

Reported in grains to imperial gallon.

| | Rockdale, springs. | Marlin, artesian. | Belton, artesian. | Waxahachie, artesian. | Stafford, springs. | Huntsville, deep wells. | Palestine, springs. | Newark, artesian. | Alvin, deep wells. | Near Velasco, artesian. | Milford, springs. | Moores, springs. | Hearne, artesian. | Corsicana, artesian. | Rockwood, artesian. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total mineral matter | 127.2 | 530.6 | 145.4 | 130 | 43.3 | 32.86 | 276 | 107 | 154 | 228.4 | 495 | 480 | 149 | 363 | 4369 |
| Potassium chloride | 3.96 | | Trace. | | .32 | 3.04 | 1 | 2.26 | | | | | Trace. | | |
| Sodium chloride | 13.34 | 188.4 | 61.98 | 21.7 | 6.77 | 2.81 | 18 | 67.76 | 77.37 | 201.2 | 51.2 | 183.6 | 83 | 272 | 3491 |
| Magnesium chloride | 12.68 | | | | | | 5.55 | | | 4.6 | | 71.5 | | | 299 |
| Magnesium sulfate | 19.43 | 11.56 | 7.74 | Trace. | | | 155.2 | 1.12 | 24.09 | 2.8 | | | | | 2.6 |
| Calcium sulfate | 56.75 | 18.32 | | | | | 85.4 | | | | 41 | 154.4 | | | |
| Sodium sulfate | | 313.1 | 71.22 | 53.31 | 5.35 | 3.16 | | 10.14 | 14 | | 399 | | | | |
| Sodium carbonate | | | | 39 | 6.57 | 6.58 | | 23.38 | | | | | 64 | 83.4 | |
| Calcium carbonate | 3.2 | | 4.63 | Trace. | 7.52 | 12 | 104.6 | 1.39 | 32 | 12.7 | | 50.9 | | 5.1 | |
| Ferrous (iron) carbonate | 9.28 | .56 | Trace. | 9.98 | .29 | | | | | | 12.6 | | | | 2.10 |
| Magnesium carbonate | | 1.50 | | | 7 | | | | 5.07 | | | | | | |
| Silica and sand | | 2.85 | | 6.10 | | 6.12 | 1.3 | 1 | 1.53 | 1.70 | 1.24 | | | | |
| Calcium chloride | | | | | | | | | | | | 16 | | | 5.74 |

## *Water Analyses—Table II.*

| | Hockley, surface well. | Sugar Land, deep well. | Lysle, springs. | Angleton surface well. | Brenh'm deep well. | Ennis, artesian. | Lorena, artesian. |
|---|---|---|---|---|---|---|---|
| Total mineral matter | 18.04 | 10.4 | 156.3 | 17 | 26.4 | 148 | 145.4 |
| Organic and volatile | 7.2 | | | | 3 | | |
| Calcium carbonate | 5.53 | 4.16 | | 6.05 | 18.1 | 2.6 | .92 |
| Sodium chloride | 4.51 | | 77.5 | 5.45 | | 96.5 | 30 |
| Sodium carbonate | 6.50 | | | 6.02 | | 49.5 | 45.99 |
| Potassium sulfate | | | 4.36 | | | | 1.68 |
| Calcium sulfate | | | 38.8 | | | | *61.77 |
| Magnesium sulfate | | 4.86 | | | | | †1.41 |
| Calcium chloride | | | | | 5.30 | | |

* Sodium sulfate. † Magnesium carbonate.

The water from Marlin is from the deepest well in the State—about 3300 feet. It has a temperature of 142° Fahrenheit—also the warmest natural water in the State. It is remarkable for its large quantity of sodium sulfate (Glaubers salts). But the Milford springs contain an even larger amount of the sodium sulfate—larger than found in any other known water. The artesian water from Belton is marked by a large percentage of the same ingredient.

Inquiry has been made as to the use of the Waxahachie artesian water for irrigation and in boilers. It would not be suitable for the latter, but could be used for irrigating; especially if gypsum were occasionally applied to the soil to neutralize effects of sodium carbonate. Information was also wanted as to value of the water from "near Velasco" for irrigating. While not well adapted to that purpose, it could be used on certain plants. The grasses, alfalfa, and sorghum would probably do well under its use.

In general, the harmful ingredients in natural waters intended for irrigation, are the carbonate and the chloride of sodium. If one or both of these are present in large quantity, great care should be taken in use of the water. The carbonate can be removed usually with gypsum applied as a fertilizer. The chloride can be removed by growing special crops to extract it, or by flooding the field with a large amount of water, and in this way washing out the salt. In many parts of the State, where the rainfall is excessive in the winter and spring, but deficient in the summer, a water carrying a comparatively large amount of sodium chloride can be used in the summer drouth, since it is washed or leached out by the winter rains.

The water from Rockwood is very remarkable for its large amount of sodium chloride. It is at present being used for the manufacture of salt, of which there are nearly 9 ounces in every gallon. Sea water contains only about 1700 grains of salt to the gallon. While the waters of the Dead Sea contain about 6700 grains. This water was tested for bromine and iodine, but neither was detected.

In the Corsicana well oil was first struck at a depth of 1040 feet. The well was continued, and at a depth of 2400 feet water was found with a flow of 300,000 gallons a day, with a temperature of 120° Fahrenheit, and an initial pressure of about 56 pounds.

The water from Hockley, in Table II, was sent to be examined for its fitness in making a canaigre extract. It was tested carefully for iron, but none found. It is low in mineral matter, and well suited for the purpose intended.

The water from Lysle Springs is used to irrigate about 3000 acres of land, and has been in use about twenty years. The flow is reported to be about 7000 to 8000 cubic feet per minute. It is well adapted to the purpose for which it is used, except that the amount of sodium chloride is rather large.

The water from Sugar Land is used in a sugar refinery, and was tested particularly for chlorides; since the presence of these is known to hinder sugar from crystalizing. For this reason potassium chloride is not used as a fertilizer on sugar beets or sugar cane.

The water from Angleton was examined to test its value for railway locomotive boilers, for which it is well adapted.

The water from Brenham was analyzed to test its value as a drinking water (results of this not given in table), as a water for boilers and for irrigation. It is suitable for all these purposes.

In general, the purer a water from mineral matter, the safer it is for putting on cultivated land. This ceases to be true, of course, when only certain mineral constituents are present. But in Texas, at least, there is generally so much of the chloride or carbonate of soda present in spring and artesian water, as well as in some of the rivers, that we gladly turn to a pure water even for irrigation. This statement applies only to the mineral ingredients; whatever nitrogenous or organic material is present must be considered as a gain to the soil.

## SOILS.

A farmer's judgment and experience with a soil is perhaps worth more to the chemist in summing up the results of his analysis, than the chemist's unaided conclusions would be to the farmer. The appearance of a soil on the field, its color, texture, character of native growth, water-holding power, all taken together, go very far toward deciding the character of a soil, even before a crop is ever grown upon it, or before it is subjected to chemical analysis. Still, even a life-long farmer will sometimes be deceived in a soil. A soil that looks fertile to the eye, with apparently a good texture, will sometimes prove a great disappointment in practical work. In such cases a chemical analysis may prove beneficial. Again, one may have a poor soil—recognized as such—and the quickest and most economical means at command wanted to improve the soil to a greater or less extent. In such a case, the chemist and the farmer, aiding each other, can be of mutual benefit in the work. Lime, phosphoric acid, potash, and humus or organic matter are the most valuable constituents of a soil. The humus carries the nitrogen, besides greatly increasing the power of a soil to hold water, and thus resist drouth. Iron oxide perhaps ranks next to lime in importance in the soil; but very little of it is sufficient. But in many cases a farmer is inclined to attribute the cause of plant diseases to a poisonous principle in the soil, when the trouble does not really exist there, but is due to a fungus growth of some kind. Excluding "*alkali soils*," there is hardly anything in a soil in sufficient quantity at any time to act as a poison to plant life, if we except iron in the unoxidized condition and the metallic sulfides—a condition that could only exist in the subsoil, and that would soon disappear on exposure to air.

In table III, samples 1, 2, and 3 from Alvin, sent by Mr. H. Sampson, were supposed to contain some poisonous ingredients that caused the extremities of fruit trees (pears mainly) to die, and the tree, of course, to stop growing. No. 1 is surface soil, No. 2 is taken two feet below the surface, and No. 3 from three feet below the surface.

*Soil Analyses—Table III.*

| | Alvin, No. 1. | Alvin, No. 2. | Alvin, No. 3. | Lamarque, No. 1, black. | Lamarque, No. 2, white. | Harris county. | Hitchcock, No. 1. | Hitchcock, No. 2. | Hitchcock, No. 3. | Hitchcock, No. 4. | Mesa, east of El Paso. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Moisture at 212° F. | 2.23 | 2.91 | 2.82 | [*] | [*] | 2. | 8.77 | 4.23 | 3.15 | 1.34 | 3.65 |
| Organic and volatile matter | 5.48 | 5.02 | 9.91 | | | 5.82 | 5.43 | 4.46 | 3.24 | .95 | 4.06 |
| Silica and sand | 86.46 | 71.28 | 62.49 | | | 86.72 | 70.09 | 83.84 | 89.35 | 95.21 | 76.84 |
| Oxide of iron | .85 | 1.94 | 2.09 | | | .50 | 13.05† | 6.30† | 2.43† | 1.28† | 3.13 |
| Oxide of alumina | 2.43 | 4.03 | 3.60 | | | 1.45 | | | | | 5.95 |
| Phosphoric acid | .024 | .22 | .15 | | | .12 | .04 | .035 | .037 | .0195 | .074 |
| Calcium oxide | .958 | 6.33 | 8.17 | | | 1.62 | .21 | .165 | .40 | .66 | 3.56 |
| Sulfuric acid | .09 | .09 | .28 | | | .21 | .082 | .045 | .069 | Trace. | .055 |
| Magnesium oxide | .464 | 1.46 | 2.01 | ........ | ........ | ........ | .695 | Trace. | .08 | .122 | 1.06 |
| Potassium oxide | .093 | .46 | .56 | .07 | .098 | .17 | .61‡ | .51‡ | .52‡ | .29‡ | .397 |
| Sodium oxide | .175 | .56 | .57 | .92 | .751 | .35 | | | | | .218 |
| Manganese oxide | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ |
| Chlorine | .09 | ........ | ........ | .53 | .131 | ........ | ........ | ........ | ........ | ........ | ........ |
| Carbonic acid gas | .399 | 5.06 | 6.74 | .146 | 3.21 | .85 | ........ | ........ | ........ | ........ | 1.41 |
| Nitrogen | .18 | .03 | Trace. | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ |

[*] Undetermined.
† As oxides.
‡ As sulfurates.

Nos. 1 and 2 had a very slight acid reaction, just as a fertile soil should have, and No. 3 was decidedly acid. There were no unoxidized salts of iron in any of the samples. The lime is not excessive in the top soil, rather more in sample No. 2, and greatly increased in sample No. 3. The sulfuric acid, which might be derived from the presence of sulfides, is very low. Sodium is present in large amount, but not as the carbonate.

An extract from a letter sent Mr. Sampson in September, 1894, is as follows: "The lime increases rapidly as you go below the surface; and it may be that it is this which gives you the trouble. But I am inclined to believe that the difficulty exists in the mechanical or drainage condition of your soil, rather than in its chemical composition; if we assume that the trouble is really with the soil, and not caused by a fungus growth of some kind. But I lean to the opinion that such a growth will be found on the roots of the trees."

The following is an extract from Mr. Sampson's letter transmitting the soils. Referring to the trees, he says: "Some turn yellow in the nursery now; others will take root and make a growth of 6 to 12 inches after being transplanted, and the leaves then turn yellow, while the twigs turn black at the ends and continue to die down." "I have trees that made a growth of 7 feet during the year 1893, that were cut back in June, 1894, and made a growth of 3 to 5 feet before commencing to yellow up." In a letter of April 19, Mr. Sampson says: "There is no change in the condition of my orchard from what it was last summer, except, perhaps, the trees are yellowing up earlier." * * * "The stem or roots never die, it is only the new growth." Mr. Sampson now believes the cause of his trouble is "hard pan."

From Lamarque are samples of Black and White "Alkali," partial analyses only of which are made. The alkalinity in both cases due to carbonates of soda. This could be most easily reclaimed by application of gypsum. The samples from Hitchcock were sent by R. T. Wheeler, Esq., from his pear orchard and strawberry ground.

Samples 1 and 2 are respectively the surface and subsoil of a type locally known as "black waxy;" while Nos. 3 and 4 are the surface and subsoil of a type locally known as "sandy loam." These names will justify themselves when we glance at the percentage of sand and silica in the several samples, or when we notice the amount of organic and volatile matter. The amount of clay in the "black waxy" is shown by the content of alumina to be greater than that in the sandy loam.

The soil from El Paso was selected from a field intended for the growth of fruit trees.

## CLAYS.

The examination of these was made for a company that expected to extract the metal aluminum from clay. Complete analyses were made in only a few cases; since the alumina and lime were the two principal ingredients wanted, other substances except lime not interfering. As much alumina and as little lime as possible was the object desired.

Clay is a hydrated silicate of aluminum; it usually, if not always, contains besides this, small quantities of iron, lime, magnesia, and the alkalies. But the smaller the amount of these impurities the better the clay. The proportion of silica to the alumina varies through very wide limits. The purer varieties are perfectly white, and are then known usually as kaolin, the finer qualities of which are used in the manufacture of fine porcelain ware.

*Table of Clay Analyses.*

| Locality. | Alumina. | Oxide of iron. | Lime. | Silica. |
|---|---|---|---|---|
| Leaky | 37.08 | .......... | None. | .......... |
| San Diego | 16.32 | .......... | 6.42 | .......... |
| Bremond | 21 | .......... | 6.33 | .......... |
| Flatonia, No. 1 | 12.09 | 2.79 | None. | .......... |
| Flatonia, No. 2 | 9.51 | 2.17 | ... do.... | .......... |
| Flatonia, No. 3 | 15.47 | 3.07 | ... do.... | .......... |
| San Antonio, No. 1 | 16.93 | 2.83 | ... do.... | .......... |
| San Antonio, No. 2 | 19.94 | 2.94 | ... do.... | .......... |
| Elgin | 25.21 | 3.12 | ... do.... | 56.28 |
| Durango, Mexico | 14.2 | 1.54 | .93 | .......... |
| Bauxite, from Arkansas | 67.68 | None. | None. | 11.38 |
| Soapstone | 10 | 2.40 | ... do.... | 73.78 |
| Sanches, No. 2 | 17.84 | 7.12 | .......... | .......... |
| Sanches, No. 3 | 7.70 | 2.76 | .......... | .......... |
| Sanches, No. 4 | 16.01 | 5.27 | .......... | .......... |
| Cuero | 19.50 | 6.50 | .......... | .......... |
| Elmendorf | 12.21 | 6.19 | .......... | .......... |
| Calaveras | 7.06 | 3.10 | None. | .......... |

The Flatonia clay has attracted considerable attention, and it was expected that an analysis would justify its reputation. But such is not the case. Several samples were examined, and finally a complete analysis was made, which is here presented:

| | Per cent. |
|---|---|
| Moisture | 8.50 |
| Silica and sand | 72.22 |
| Alumina | 11.16 |
| Lime | 0.96 |
| Sodium oxide | 0.85 |
| Potassium oxide | 0.9 |
| Carbonic acid gas | 0.75 |
| Iron oxide | 1.08 |

The alkalies, lime and iron are too great to make the clay valuable as fire clay. Mixed with other material it might be used for porcelain ware.

## MARLS.

The term *Marl* is generally applied to calcareous material, with or without comminuted shells ("shelly marl"), that contains besides its principle constituent of lime carbonate, some phosphoric acid and potash. They are generally of little value except for farms in their immediate vicinity. Their mechanical effect on the soil is usually more important than their chemical effect. In Texas they would be found valuable on many of the coast clays, and the sandy uplands in the eastern part of the State. Lands in other parts of the State would probably derive little or no benefit from their use. In several counties of East Texas, the so-called Green Sand Marl is found in large beds. But so far as samples sent to this laboratory indicate it is of inferior quality, as compared to that of New Jersey. Still, it might be used locally to great advantage.

In the table below, No. 1 is a marl from Palestine, No. 2 from Pittsburg, and No. 3 from Rusk.

| | No. 1. | No. 2. | No. 3. |
|---|---|---|---|
| Calcium carbonate | 18.2 | Trace | ..... |
| Phosphoric acid | 0.3 | 0.15 | 0.58 |
| Potash | 0.6 | 0.69 | 1.00 |
| Sand and silica | .... | .... | 19.90 |

Nos. 2 and 3 are green sand marls.

## LIMESTONE

From Cline, Texas. Sent on by Mr. W. E. Giesecke, of the Litho-Carbon Rubber Company, to see if it could be used as a cement; and if not, what would be necessary to add to it for this purpose. The stone as sent was in broken nodules, which were coated on outside with carbonaceous matter. Some pieces seemed to contain much more of the carbonaceous material than was found in other samples. But a considerable quantity was taken for sampling, and it is thought an average quality obtained.

ANALYSIS.

| | Per cent. |
|---|---|
| Volatile and organic matter | 7.98 |
| Sand and silica | 0.30 |
| Ferric oxide of iron | 1.23 |
| Oxide of alumina | 1.07 |
| Calcium carbonate | 90.37 |

The limestone had been subjected to distillation in order to separate the "litho-carbon." Obviously it is not suitable for the purpose intended, unless mixed with a clay to furnish the necessary proportional parts of silica and alumina.

## IRON ORE.

From Clarksville.—One sample of little value, compared to other rich and purer ores in the State. Contains 45 per cent of the oxide of iron, 0.054 per cent of sulfur, and 0.183 per cent of phosphorous.

## BAT GUANO, AND BAT GUANO ASH.

Considerable quantities of Bat Guano and the Ash are to be found in caves in certain localities of West Texas. When free of earthy material, it is a most excellent fertilizer, containing nitrogen, phosphoric acid and potash in a soluble and very desirable form. But it should never be purchased by the farmer in any quantity, without having the very sample which he buys subjected to a chemical analysis. It is the only sure way he has to protect himself. Nos. 1 and 3 are samples of guano ash; Nos. 2 and 5, samples of guano from different localities. No. 4 is a mixture of ash and guano.

ANALYSIS.

| | No. 1. | No. 2. | No. 3. | No. 4. | No. 5. |
|---|---|---|---|---|---|
| Moisture | ..... | 12.63 | 14.91 | 23.39 | 13.41 |
| Phosphoric acid, total | 23.85 | 3.68 | 16.70 | 7.22 | 4.84 |
| Phosphoric acid, soluble | ..... | ..... | 0.46 | 0.14 | 0.30 |
| Phosphoric acid citrate, soluble | ..... | ..... | 11.23 | 4.94 | 3.15 |
| Phosphoric acid citrate, insoluble | ..... | ..... | 5.00 | 2.14 | 1.39 |
| Calcium oxide | 33.50 | ..... | 22.73 | ..... | ..... |
| Magnesium oxide | ..... | ..... | 2.69 | ..... | ..... |
| Potassium oxide | 0.90 | 2.03 | 0.64 | 0.96 | ..... |
| Total nitrogen | ..... | 11.91 | ..... | 1.66 | 10.04 |

## CACTUS AND FRUIT.

Some years ago analysis was made in this laboratory of the ordinary cactus, commonly known as prickly pear. It is sometimes used to a great extent on the western ranches for cattle feed. Last year analysis was made of the fruit of this cactus. The samples analyzed were sent by Mr. D. Flint, of Arcadia, Texas, who has this to say in regard to the same: "The cactus produces large crops of fruit, and I have always believed it to be of value. It is a fact that horses, cattle, deer, and hogs eat the fruit, and deer and hogs do well on it." For the sake of comparison the analysis of cactus is given again. No. 1 cactus, No. 2 the fruit in fresh state, No. 3 fruit dried free of water.

| | No. 1. | No. 2. | No. 3. |
|---|---|---|---|
| Moisture | 88.85 | 80.30 | ...... |
| Dry matter | 11.15 | 19.70 | 100.00 |
| Ash (mineral matter) | 1.94 | 1.76 | 8.91 |
| Ether extract (fats and oils) | 0.39 | 2.77 | 14.01 |
| Cellulose (woody fiber) | 1.26 | 5.28 | 26.82 |
| Albuminoids (nitrogenous substances) | 1.16 | 2.58 | 12.73 |
| Nitrogen free extract (starch, sugar, gums, etc.) | 6.39 | 6.97 | 37.53 |

## NATURAL GAS.

At many places in the Brazos bottom where artesian wells are sunk, gas either issues first or along with water. The gas is sometimes sufficient to burn with a strong steady flame. At Hearne, Texas, on the farm of Mr. H. R. Hearne, gas occurs in sufficient quantity for light and fuel, and is being used in the residence of Mr. Hearne for this purpose. A sample was sent here for chemical analysis and as examined found to have the following composition:

| | Per cent. |
|---|---|
| Carbonic acid gas | 0.21 |
| Carbon monoxide | 0.75 |
| Oxygen | 0.42 |
| Ethylene | 0.50 |
| Marsh gas | 31.50 |
| Hydrogen | 23.30 |
| Nitrogen | 40.15 |

The sample was sent in a rubber bag, and it was several days before an analysis could be made. Its composition leads to the belief that the gas diffused through the bag with the atmosphere, losing marsh gas for nitrogen. If so, it is really a better gas than the analysis would indicate. Mr. Hearne reports most satisfactory results in the practical use of the gas.

## CRUDE PETROLEUM.

At Corsicana, in sinking an artesian well, at a depth of 1040 feet petroleum oil was obtained; this oil was examined and its analysis shown below. Not satisfied with the volume of oil, and boring primarily for water, the well was continued, and at a depth of 2400 feet a fine flow of water was obtained, an analysis of which will be found under the head of "Water Analyses," this Bulletin. Mr. H. G. Johnston, who was the engineer charged with sinking the well, reports as follows: "The formation in which the oil is found is a sandy shale about 20 feet thick, located in the Blue Ponderosa Marl." The "marl" is reported as extending to a depth of 500 feet below the shale. Petroleum has been found in many places in the State; notably at Nacodoches and at Brownwood. But at both places the oil is of the heavy variety, suitable only for lubricating oil. But this appears to be a most excellent oil of the lighter type; furnishing the following separate distillates: One-half litre (or about one pint) was subjected to distillation and the following fractions obtained at the respective temperatures expressed in degrees of the centigrade scale:

Began to boil at 80 degrees.
Between 80° and 90° gave off 16.4 per cent of its volume.
Between 90° and 110° gave off 7.8 per cent of its volume.
Between 110° and 140° gave off 10.4 per cent of its volume.
Between 140° and 170° gave off 9.2 per cent of its volume.
Between 170° and 200° gave off 3.6 per cent of its volume.
Between 200° and 280° gave off 16.0 per cent of its volume.
Between 280° and 305° gave off 11.2 per cent of its volume.
Above 305° gave off 15.8 per cent of its volume.

Making the total volatile matter about 90 per cent, leaving a coke residue of about 10 per cent. Reported in a different way for the purpose of comparison, results are obtained as shown in the table below:

| Crude oil from— | Specific gravity at 17° C. | Began to boil at. | Came over under 150° C. | Between 150° and 300° C. | Over 305° C. |
|---|---|---|---|---|---|
| | | ° C. | Per ct. | Per ct. | Per ct. |
| Texas—Corsicana | .821 | 80 | 34.6 | 40 | 15.8 |
| Pennsylvania | .818 | 82 | 21 | 38 | 40.7 |
| Galicia | .824 | 90 | 26.5 | 47 | 26.5 |
| Baku | .859 | 91 | 23 | 38 | 39 |
| Alsace | .907 | 135 | 3 | 50 | 47 |
| Hanover | .899 | 170 | .......... | 32 | 68 |

It will be seen from this that the oil compares very favorably with Pennsylvania oil, which generally yields in practice from 60 to 75 per cent of burning oil of first and second quality.

The above figures, except for the Texas oil, are taken from Sadtler's Industrial Organic Chemistry, page 18.

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