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The gas fields of North Webster Parish, Louisiana

Joseph Maple Wilson

THE GAS FIELDS OF NORTH WEBSTER PARISH, LOUISIANA.

BY

JOSEPH M. WILSON

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THESIS

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Approved by C. L. Dake

Professor of Geology and Mineralogy.

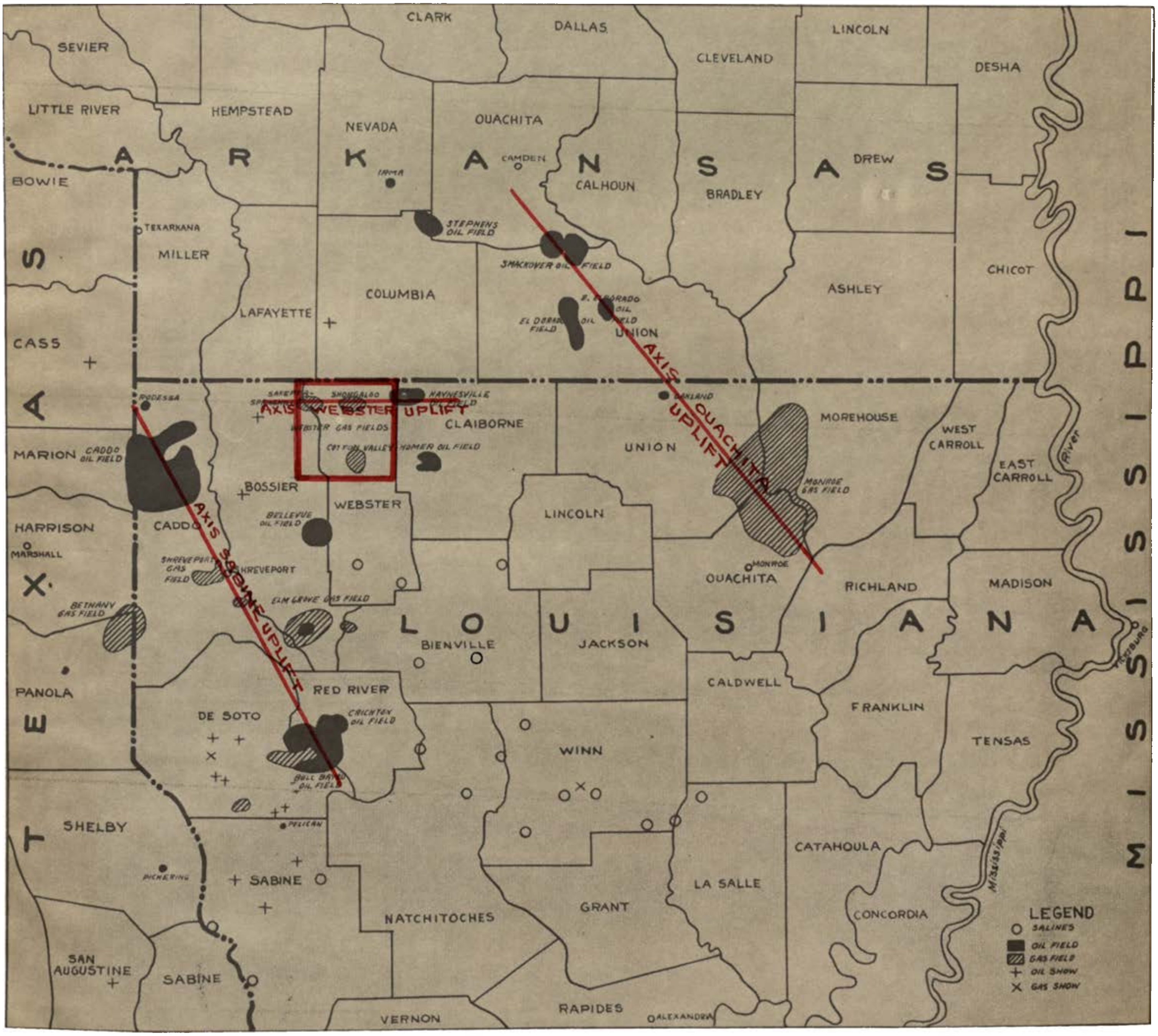
Table of Contents.

List of Illustrations.

I. LOCATION.

The gas fields of north Webster Parish, Louisiana, as discussed in this paper, are embraced in an area 9 townships or 324 square miles in extent including Township 21 North, Ranges 9, 10, and 11 West; Township 22 North, Ranges 9, 10, and 11 West; and Township 23 North, Ranges 9, 10, and 11 West in north Webster Parish and extreme northeast Bossier Parish, Louisiana. The area is outlined in red on the accompanying map, on Page 2, which shows the relation of the three gas fields in the area to the other oil and gas fields of north Louisiana, south Arkansas, and east Texas.

This area is about 25 miles northeast of Shreveport, Louisiana, the center of the oil and gas industry in the region. Cotton Valley, the principal town of the vicinity under discussion, may be entered from Shreveport on the Louisiana and Arkansas Railroad and several dirt roads also afford entrance during dry weather.



Map Showing the Oil and Gas Fields of North Louisiana, South Arkansas, and East Texas, with Relation to the Gas Fields of North Webster Parish, Louisiana.

II. TOPOGRAPHY.

Bodcaw Bayou, the boundary between Webster and Bossier Parishes, and Dorcheat Bayou in Webster Parish, the two principal streams of the area, are sluggish and meandering. Except for their broad flat and swampy valleys the country is rolling and in the southeastern part where the St. Maurice outcrops (See Areal Geological Map on Page 6) it is badly broken. The total relief is about 250 feet with 420 feet as the maximum elevation on the hills in T.21N., R.9W., and 170 feet the minimum in the bayou bottoms. The whole vicinity is well timbered with pine and hardwoods.

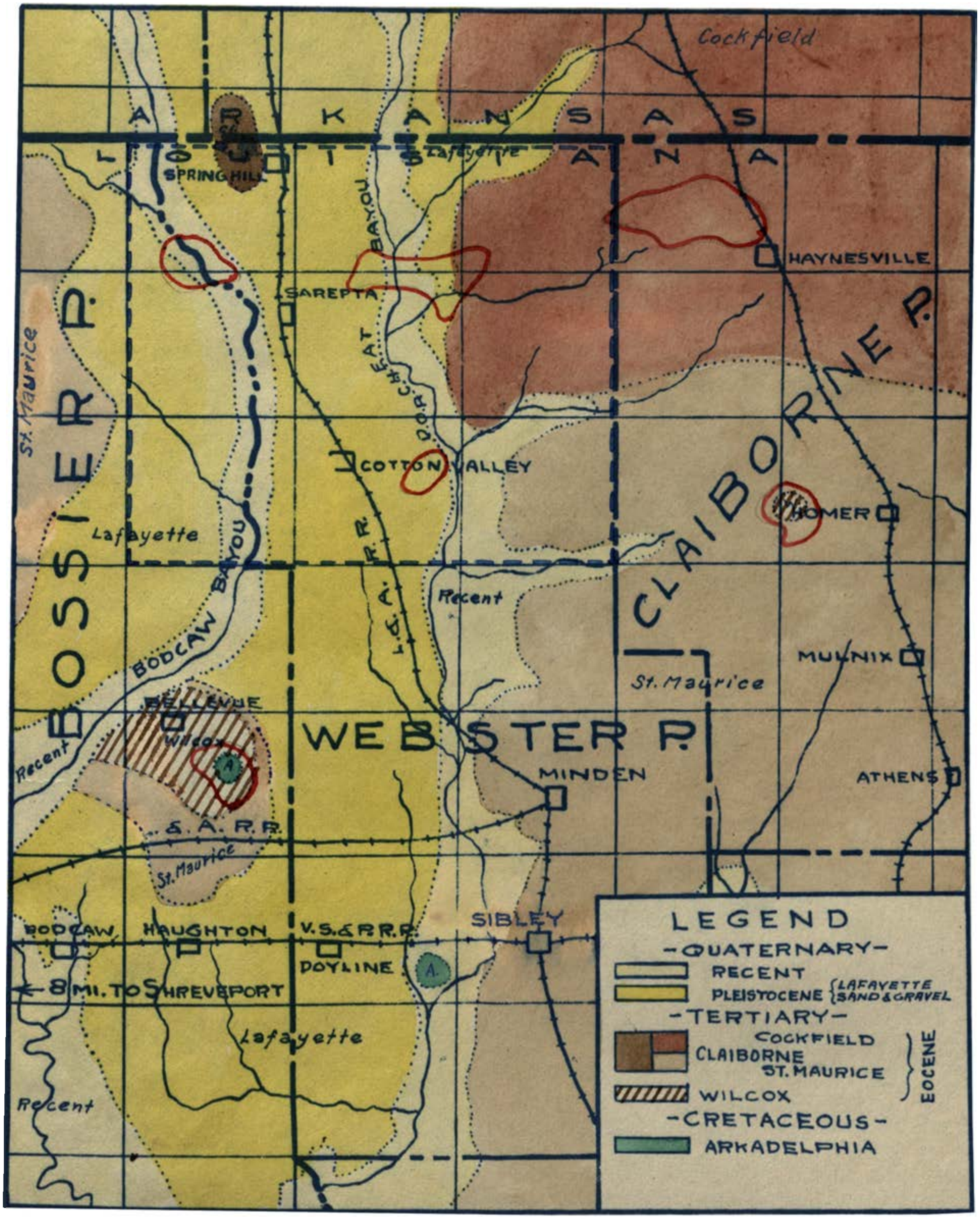
Relation of Topography to Sub-surface Structure. The unconsolidated nature of the sediments which are of Tertiary age and younger has made erosion easy and rapid so that with possibly one exception, sub-surface structure is not reflected in surface topography. The exception is in Dorcheat Bayou which has apparently abandoned its old course and turned out around the northeastern end of the Cotton Valley, or Webb structure, and followed the contour of the structure as shown in the accompanying U.S.G.S. topographic sheet (Between Pages 3 and 4) with sub-surface contours marked on it. There is a topographic high here shown best in sec. 14, T.21N., R.10W., but whether this feature is a reflection of sub-surface structure or a coincidence of erosion is a matter of question.

In the process of stream erosion extensive river bed deposits have been formed and in the flat country just west of Bodcaw Bayou on the Lloyd Harris structure, bedrock is sometimes not encountered in wells till a depth of 450 feet.

III. GEOLOGY.

Stratigraphy and General History of Sedimentation.

The oldest sediments penetrated in this locality are of Woodbine age and are believed to be the base of the Upper Cretaceous. The Woodbine is encountered at about 3300 feet and has been penetrated but 60 feet. Veatch says (U.S.G.S. Professional Paper No. 46) the thickness of this formation is about 500 feet but it is believed that he considered as Woodbine a part of what is now believed to be Eagleford. The actual maximum thickness of the Woodbine, as we now know it, is about 150 feet. It is here composed of loosely cemented and extremely porous sandstones and sandy clays or shales with plant remains probably indicating a a swampy or near shore condition. Only two wells in this locality are known to have penetrated the Woodbine: J. Y. Snyder's Sidney Estate No. 1 in sec. 16, T.21N., R.10W., and The Palmer Corporation's Miller No. 1, in sec. 29, T.21N., R.10W. The presence of red shales in both of these wells at the Woodbine horizon probably indicates a small unconformity at that time. The red shales in the Snyder well occur about 40 feet below the top of the Woodbine and apparently cut out the sand found in the Palmer Corporation's well which probably indicates the irregular surface of the old unconformity. In the Gilliland Oil Company's Waller No. C-7 in sec.11, T.23N., R.8W., on the northern edge of the Haynesville Field (See



Map showing the areal geology of North Webster Parish, Louisiana, and immediate vicinity.

cross-section between Pages 13 and 14) the Woodbine was penetrated about 10 feet and was composed of sandstone with no red shales. It showed salt water. The red shales mentioned are a general feature of the entire Gulf Coast Country and are not thoroughly understood.

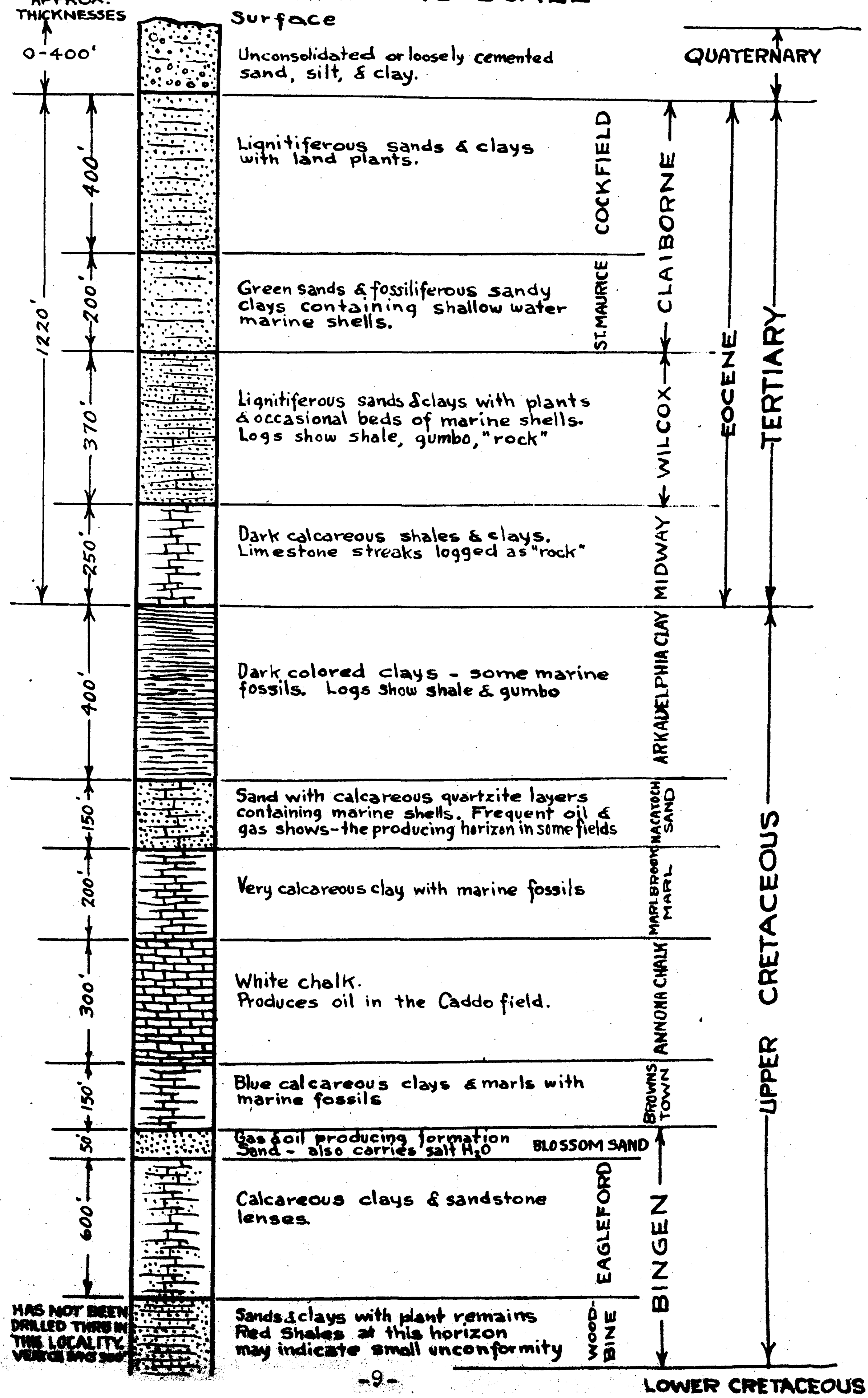
In this locality the Eagleford comprises about 600 feet of limy shales, or calcareous clays, with occasional sandstone lenses. It lies immediately below the Blossom Sand,, which some consider as the upper member of the Eagleford. The Woodbine, Eagleford, and Blossom comprise what is locally known as the Bingen group. Similar conditions of sedimentation probably obtained throughout the deposition of this group with the Blossom (here about 50 feet thick in hard and soft layers) as the best developed sand. The Blossom is the oil and gas producing horizon of this locality.

The Blossom grades into the Brownstown formation which probably represents a gradual submergence, as it is composed of 150 feet of calcareous clays and marls with fossil oysters and other marine fossils present. This in turn grades into the Annona chalk which seems to represent deeper sea conditions than any other period in the section. White chalk with marine fossils, chiefly oysters, composes most of the 300 feet of Annona here. The "chalk" produces oil in the Caddo Field where it is favorably fractured or crevassed so as to permit migration.

The Marlbrook marl represents the beginning of a period of gradual emergence. It is composed of calcareous clays and glauconitic marls with marine fossils. It grades into the Nacatoch sand, one of the chief oil and gas producing horizons of this region. The Nacatoch comprises about 150 feet of sand with calcareous quartzitic layers with marine shells. In the locality under discussion it gives occasional oil or gas shows but does not produce in commercial quantities. At Bellevue, 15 miles to the south, where it is pushed up to within 300 feet of the surface, it is the main producing horizon. The great lateral area of the Nacatoch sand must indicate either an advancing or retreating shore line but with what are apparently fairly deep water deposits both below and above it, it is difficult to arrive at a reasonable conclusion.

The Arkadelphia clay, the top of the Cretaceous, is composed of dark laminated clays, logged as shale and gumbo, with marine fossils present. The Arkadelphia grades very gradually into the Midway, the base of the Tertiary (which is here composed of Eocene formations only). The Midway, Wilcox, and lower part of the Claiborne (St. Maurice) all represent a gradual emergence.

GEOLOGIC SECTION
IN NORTH WEBSTER PARISH, LOUISIANA
NOT DRAWN TO SCALE



Formations in the Oil and Gas Fields of Northern Louisiana and Southern Arkansas

System, Series, Group, Formation	Principal Characteristics	Maximum Thickness in Feet	Productive Pools
Tertiary, Eocene, Claiborne, (1) Cockfield	Gray sand, some clay, shale, lignite, and quartzitic sandstone, non-marine.	450	
(2) St. Maurice	Limonitic clay, sand, calcareous glauconitic shales, marine	400	
(3) Wilcox	Sand, clay, shale, lignite, calcareous boulders, glauconitic.	600	
(4) Midway	Clay, limestone, chalk, some lignite, gypsum.	400	
Cretaceous, Gulf (5) Arkadelphia	Dark clay, shale, chalk near bottom, marine.	600	
(6) Nacatoch	Fossiliferous limestone, glauconitic sand	200	Gas at Caddo, Shreveport, Bethany, El Dorado and Smackover. Oil at Homer, El Dorado, Bellevue, ~~and~~ Smackover, Irma, & Elm Grove
(7) Marlbrook	Marl, chalk	350	
(8) Annona	Chalk	600	Gas at Monroe (?) Oil at Caddo
(9) Brownstown	Marl, chalk.	300	Oil at Elm Grove
Bingen, (10) Blossom	Calcareous, glauconitic sand.	150	Gas at Bethany and Webster. Oil at Homer, Haynesville, Smackover, and Stephens.
(11) Eagle Ford	Shale, calcareous and red in places. Sandy at bottom	600	Oil at Caddo and De Soto-Red River
(12) Woodbine	Sandy, lignitiferous	150(?) Doubtfully present	Gas at Bethany (?)
Cretaceous, Commanche, (13) Washita group	Limestones and clays.	300(?)	Gas at Bethany
(14) Fredericksburg group	Limestone	50 to 100 (?)	
Trinity group, (15) Glen Rose	Limestone	100 (?)	Oil at Caddo (Pine Island)

General geologic section for Northern Louisiana and Southern Arkansas after J. A. D. Hull in his paper "Notes on the Stratigraphy of Producing Sands in Northern Louisiana and Southern Arkansas", published in the Bulletin of the American Association of Petroleum Geologists, Vol. VII, No. 4, July-August, 1923.

Their members range from calcareous shales and limes in the Midway to green or glauconitic sands and sandy lignitiferous clays in the St. Maurice, and the fossils range from marine in the former to shallow water marine in the latter. The Cockfield, the upper member of the Claiborne, contains lignitiferous sands and clays with land plants. It is the top of the Tertiary as represented here.

In parts of the area (the nine townships as described in "Location") a veneer of Quaternary, largely river deposits, represents the surface. The Claiborne, which has in places been differentiated into its upper and lower members, is the only formation on the surface in place in the area (See Areal Geological Map on Page 6).

For purposes of comparison two geological sections are shown. The one on Page 9 represents the actual thicknesses of the formations in north Webster Parish, while the one on Page 10, compiled by J. P. D. Hull, shows their maximum thicknesses as found in North Louisiana and South Arkansas.

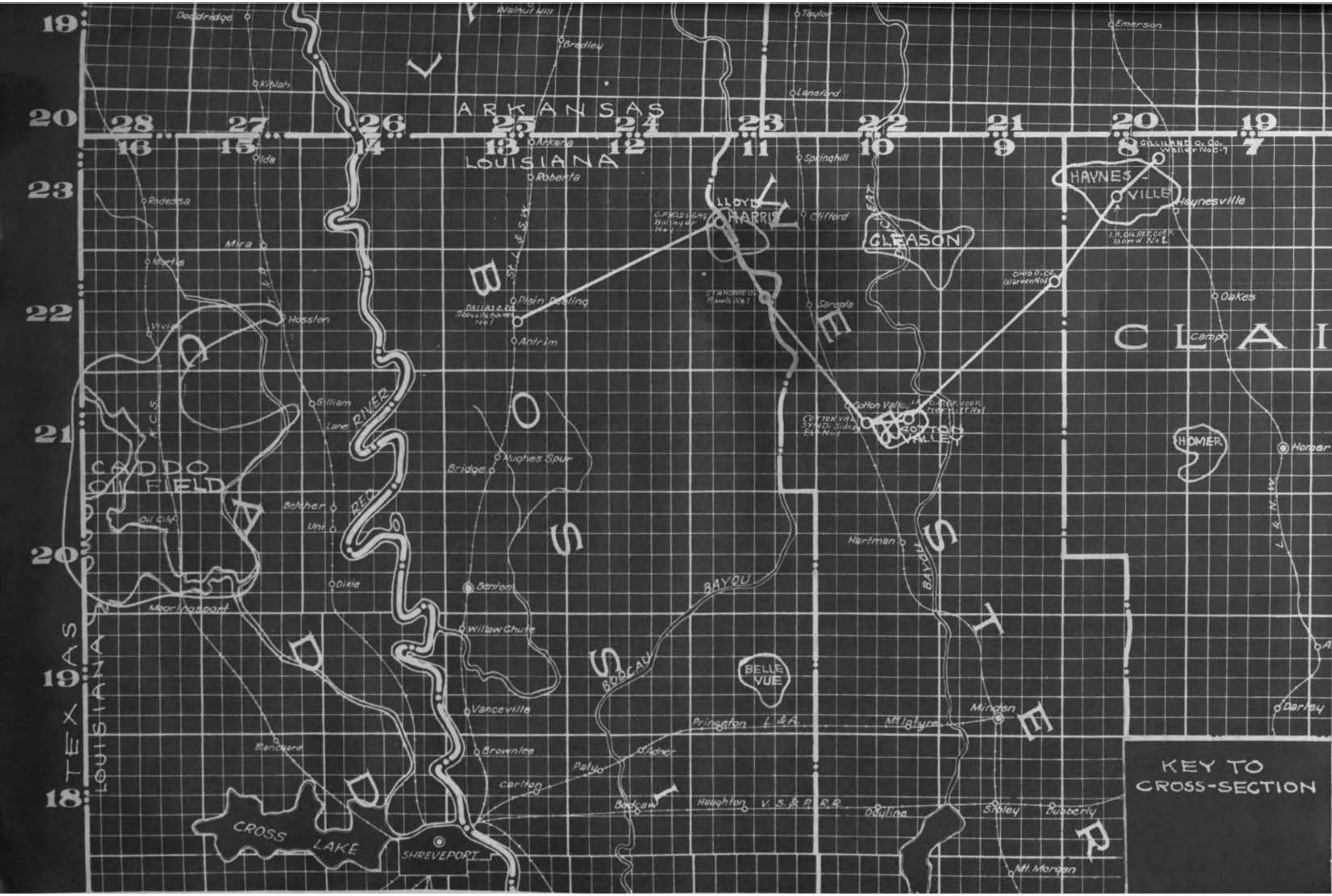
Folding

The Lower Cretaceous of this region is believed to have been deposited on an old irregular and possibly mountainous surface made up of Paleozoic rocks. On the old hill tops the Cretaceous bed was, of course, thinner than in the lower lying valleys and thus, being weaker, yielded at these points when lateral pressure was applied. The Sabine uplift and the Ouachita uplift, both of which were probably always positive elements, and other less general folds (See Map on Page 2) all apparently represent underlying Paleozoic hills.

The first of the two major periods of folding took place at the close of the lower Cretaceous because it is at this horizon that the red shales which occur throughout this region mark the old unconformity. Beds below the red shales are folded at different angles than beds above them. It was at this time when east-west pressure was developed to produce folds with general north-south axes, the two best examples of which are the Sabine and Ouachita uplifts.

The second of the two major periods of folding took place at a time well up in the Tertiary probably starting at the close of the Wilcox and continuing on up into the Claiborne and even into Post Eocene times (U.S.G.S. Bulletin 661-C, 1918, Page 119). That Wilcox sediments on the Sabine uplift are apparently surrounded by St. Maurice seems to indicate that folding had taken place at least before St. Maurice time. Had St. Maurice been deposited over the Sabine uplift, it would, of course, have been subjected to severe erosion, but even then a patch of it would probably have been left here and there. However, it is sometimes extremely difficult to positively identify the St. Maurice and some may yet be found. The difficulty of determining the age of the Sabine uplift is expressed by Sidney Powers in his paper "The Sabine Uplift, Louisiana", Bulletin A.A.P.G. Vol. 4, No. 2. This latter period of folding was developed by lateral pressure form the north producing folds with east-west axes. The Lloyd Harris, Gleason and Haynesville fold (in this paper called the Webster uplift) is an example of this type of folding. The unconsolidated nature of the Tertiary and Cretaceous sediments probably yielded to their tremendous weight, thus causing creep down the regional dip and creating sufficient movement from north to south to produce folding.

The western part of the cross section (between Pages 13 and 14) shows the sediments dipping away from the Sabine uplift. The Webster uplift, of which the cross section shows a part, possibly represents a buried Paleozoic



ARKANSAS
LOUISIANA
TEXAS
LOUISIANA
Doddridge
Walnut Hill
Bradley
Taylor
Emerson
Kiblah
Laneford
Ida
Arkana
Springhill
Roberta
Rodessa
HAYNESVILLE
Haynesville
LLOYD HARRIS
Clifford
GLEASON
Mira
Hosston
Vivian
Plain Dealing
Antrim
Sarepta
Oakes
Camp
CLAI
Gilliam
RED RIVER
Cotton Valley
COTTON VALLEY
HOMER
Homer
CADDO OIL FIELD
Oil City
Hughes Spur
Bridge
Belcher
Hartman
Dixie
Benton
Mooringsport
BAYOU
Willow Chute
BELLE VUE
BODCAU
Vanceville
Minden
Darley
Princeton
Brownlee
Blanchard
Carlton
Haughton
V. S. & P. R.R.
Doyline
Sibley
Dubberly
CROSS LAKE
SHREVEPORT
Mt. Morgan
KEY TO CROSS-SECTION

ridge. The Cotton Valley structure must denote a more or less isolated hill and both periods of folding are possibly responsible for its shape. Homer and Bellevue represent parallel cases. To the south are several non-productive salt domes. It is believed that Cotton Valley, Homer, and Haynesville are not salt domes.

In north Webster Parish there is as yet no positive evidence of faulting although Homer, nearby, is faulted, and faulting is not uncommon in other oil fields of north Louisiana.

Surface Indications of Folding.

There are no resistant beds here that can be mapped and detailed as in West Texas and Oklahoma. Surface dips may be found, but these must be taken with a grain of salt because of differential compacting and depositional effects such as cross-bedding (L. P. Teas, "Differential Compacting the Cause of Certain Claiborne Dips").

The Producing Horizon.

The gas and oil producing horizon, the Blossom sand, is encountered on the Gleason and Harris structures at approximately 2700 feet and on the Cotton Valley structure at approximately 2600 feet below the surface. It lies at the top of the Eagleford formation, well down into the Upper Cretaceous. The oil and gas in the Blossom sand are probably developed from bituminous matter in the Eagle-ford below and the Brownstown marl above it. The sand itself is distinguished by the presence of flakes of muscovite mica and by its greenish cast, due to the presence of glauconite. It is fine grained and ranges from a loose friable to a hard compact sandstone, the latter condition being due chiefly to the presence of calcareous or shaly material.

Although the total thickness of the Blossom formation is about 50 feet, the actual producing horizon is but a few feet thick as shown in the following table:

Gleason Structure:	Area, 28 square miles; thickness of sand, 5 feet; porosity, 33-1/3 per cent; initial rock pressure, 1100 pounds.
Harris Structure:	Area, 28 square miles; thickness of sand, 5 feet; porosity, 33-1/3 per cent; initial rock pressure, 1200 pounds.
Cotton Valley Structure:	Area, 10 square miles; thickness of sand, 10 feet; porosity, 33-1/3 per cent; initial rock pressure, 1080 pounds.

The relative numbers of gas wells producing on the different structures may be easily seen from the large scale map pasted to the back cover. In general the pressures on all of these structures seem to be great, but the volume of gas comparatively small because the wells when permitted to blow wide open soon drop down to very low pressures. The Merritt No. 1 of the Louisiana Oil Refining Corporation, on the Cotton Valley structure, when permitted to blow wide open went down from a rock pressure of 1010 pounds to 40 pounds in a day.

In regard to oil production from the Blossom sand in the area, the following may be said: On the Gleason structure the Louisiana Oil Refining Corporation's Gleason No. A-1 came in a big gasser spraying oil and salt water but cratered (See photograph on Page 21) and was lost. All other wells on that structure have proven to be only gassers.

On the Lloyd Harris structure several wells showed oil but only one, the Lloyd Harris et al's Pine Woods No. 3, ever made enough oil to attempt commercial production. During 1923 it made 10,000 barrels of 27° gravity fuel oil. It made this amount at the rate of about 50 barrels per day with lots of salt water and emulsion and about 10 million cubic feet of gas. In December, 1923, the well was shut down by the Department of Conservation on the ground that the gas wasted in producing the oil was of greater value that the oil itself.

On the Cotton Valley structure the Louisiana Oil Refining Corporation's Merritt No. 1 sprays 120 barrels of clean oil per day with about 10 million cubic feet of gas.

There is no salt water with it. It is 32-33 degrees Baume with very little gasoline content. This structure is looked upon with considerable favor as an oil producer and an active drilling campaign is being entered upon.

Other Possible Producing Horizons.

The Nacatoch sand encountered here at 1600 to 1800 feet has so far given nothing but salt water and small shows of gas. It is very limy, or calcareous, with little sand (See cross-section between Pages 13 and 14).

The Annona chalk does not seem to be sufficiently fractured and crevassed here to produce oil as at Caddo, and so far as known has never even given a show.

In the lower Eagleford there is one sand logged in J. Y. Snyder's (Cotton Valley Syndicate) Sidney Estate No. 1 as producing salt water (See cross-section). This sand encountered under favorable structural conditions might produce oil or gas.

The Woodbine is irregular in thickness and in places is probably not present at all, due to the irregular surface of the old unconformity as represented by the red shales. It is believed that this has prohibited migration of oil in the Woodbine and thus eliminated its accumulation.

No test has been made to the Trinity sand, which produces at Caddo. It would probably be encountered here at a depth of about 3600 feet and at this depth a good producer would be necessary to pay out. At Elm Grove, in southern Bossier Parish, a test to the Trinity drilled by the Gulf Refining Company produced a small amount of very high grade oil but it was abandoned.

IV. DEVELOPMENT.

The accompanying data sheet gives a list of completed wells in the area with the exception of a few in that part of the Haynesville Field which extends over into T.23N.,R.9W. From the big map, in the pocket on the back cover, it can be seen that considerable, but by no means complete, development has taken place.

The Gleason structure is being slowly developed and only for gas. The Gleason No. 1 of the Louisiana Oil Refining Corporation, in sec. 13, T.22N.,R.10W., the discovery well, blew in on February 4th, 1921, and was capped on February 14th, 1921. The Ohio Oil Company, The Fortuna Oil Company, the Oil Fields Gas Company and Belchic & Laskey have gas lines running from this Field into Haynesville.

The Lloyd Harris structure has not yet been defined to the northwest and it remains to be seen whether it is a big nose or a closed structure. It is certain that a good deal of gas may be expected from it, but its oil possibilities are doubtful. The discovery well in the Field, the Pine Woods No. 2 of Lloyd Harris et al in sec. 34, T.23N., 11W., was brought in on January 21, 1922. It was killed as it was feared it would crater.

The Palmer Corporation has a gas line from this Field running into Shreveport and the Ohio Oil Company and Belchic & Laskey have extensions here from their lines in the Gleason Field.

The Cotton Valley structure is the most recently developed of the three. The Merritt No. 1 drilled by Dr. Webb, in sec. 13, T.21N., R. 10W., is the discovery well, having been completed in September, 1922. This well made dry gas but early in the fall of 1923 the Fortuna Oil Company got a show of oil in their Merritt No. 1, in sec. 14, T.22N., R.10W., Later in the same year the Oil Fields Gas Company, drilling for gas on the Louisiana Oil Refining Corporation's lease brought in a 25 million cubic foot gasser in section 14 which sprayed considerable oil. It was taken over by the latter company and during the last few days of January, 1924, this well sprayed 120 barrels of oil per day with no salt water or emulsion. During December, 1923, and January, 1924, considerable activity developed in the field and several tests are now under way. The Palmer Corporation have run a branch from their gas line to Shreveport to the Field, and Belchic & Laskey have a line to Homer. The Texas Company's main oil line from Smackover runs within a quarter of a mile of the Merritt No. 1 of the Louisiana Oil Refining Corporation and arrangements are being made to handle the oil.

Drilling Methods Used.

The rotary system of drilling is used altogether in this area. It is common practise to set three strings of casing when drilling for the Blossom pay. From 200 to 400 feet of 10 inch surface casing is usually set and not less than 1200 feet of 8 inch. The 6 inch is set as near as possible to the top of the gas sand on the first suitable formation above it. The Nacatoch horizon at from 1600 to 1800 feet below the surface creates some water trouble but it is not serious.

The chief difficulty in drilling operations is in drilling into the pay. Unless drilling is stopped just after penetrating the sand, salt water is likely to come with the gas. Although a so-called "cap rock", or hard stratum, usually a shaly or calcareous sand, often marks the top of the pay sand, it is by no means a reliable key nor a uniform condition. When the critical depth is reached samples or cores are taken every foot or so and with their help, an experienced driller can tell when to

The crater of the Louisiana Oil Refining Corporation's Gleason No. A-1, in sec. 19, T.22N., R.9W., showing the derrick of the relief well, Gleason No. A-2. Gleason No. 1, the discovery well, was drilled too deep and abandoned.

stop.

Wells sometimes "blow themselves in" to salt water. The sand is in places extremely loose and the tremenduous gas pressure often works out the bottom of the hole so the well is deepened and penetrates to the salt water below.

The unconsolidated nature of the surface formations tend to make a well "crater" if the gas gets on the outside of the casing. The Gleason No. A-1 of the Louisiana Oil Refining Corporation met with this fate and since August, 1921, has wasted gas out of a large crater which consumed the derrick and equipment (See photograph, Page 21). The Pine Woods No. 2 of the Lloyd Harris et al, the discovery well in the Harris Field, threatened to crater, but was killed in time. Now, however, a more complete knowledge of underground conditions has enabled drillers to control these big gassers.

V. QUALITY OF GAS PRODUCED AND MARKET FOR SAME.

The open flow capacity of the three North Webster Parish Fields is approximately one billion cubic feet per day. They are second in importance in the State, being out ranked by the Monroe Gas Field in Northeast Louisiana, the largest gas field in the world, with an open flow capacity of three billion cubic feet per day.

The gas is dry and not suitable for casing head gasoline manufacture, as it contains but 45 to 47 gallons of gasoline per million cubic feet. It is being used for industrial and domestic purposes in Shreveport and vicinity and in the near future will possibly be the chief source of the localities now supplied by Bethany and Elm Grove.

VI. FUTURE POSSIBILITIES.

It is likely that there will be but little development in search of gas in the immediate future as it is at present almost a drug on the market. The summer of 1924 will, however, see considerable development in the north Webster vicinity in search of oil, which is in ever increasing demand. While development on the Cotton Valley structure to the south and east of the Merritt oil well will be interesting, it will not be in the nature of "wild catting", inasmuch as the structure is fairly well defined by dry holes. It is believed that the area presenting the most favorable outlook for the "wildcatters" lies to the north and west of the Lloyd Harris field. The structure is not yet defined in this direction and fairly cheap acreage is still available there. The contour lines on the large scale map show that T.21N., R.11W. is the largest unfavorable area yet untested.

Respectfully submitted,

Joseph M. Wilson

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The writer is also indebted to many other geologists and production men for advice and assistance.