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GEOLOGY
AND
UNDERGROUND WATER RESOURCES
OF
NORTHERN LOUISIANA AND SOUTHERN ARKANSAS

BY

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OUTLINE OF PAPER.

An attempt has been made to render each part of this report fairly complete within itself. Few people have time to plod patiently through a large volume in search of information on a single subject or a limited area. Books for reference purposes must partake more or less of the nature of a dictionary, in which the information desired can be quickly found without considering a vast amount of material not pertinent to the point or points at issue.

That the reader may more readily pick out the portion or portions suited to his particular needs the following brief outline is given

CHAPTER I. GEOLOGY.—This chapter contains a discussion of the geologic history and topographic development It includes a comprehensive statement of the manner in which this portion of the Coastal Plain was formed and of the broader geologic facts on which the conclusions embodied in the succeeding chapters are based A concise statement of the geologic history is given in table facing page 16.

CHAPTER II. GENERAL UNDERGROUND WATER CONDITIONS.—This chapter contains a discussion of the fundamental principles governing underground waters and of their application to this region. It is designed for the general student and for drillers and well owners who care for an idea of the whole field.

CHAPTER III. METHODS AND COST OF WELL MAKING

CHAPTER IV. UNDERGROUND WATER PROSPECTS, BY COUNTIES —In this chapter are given well predictions and a short discussion of the underground conditions in each county, so that concise information on any given area may be easily available.

CHAPTER V DETAILED WELL AND SPRING RECORDS.—This chapter contains data in regard to wells, arranged in tables, by counties, with notes giving sections, etc. It is, in fact, an alphabetical arrangement of all the well data collected, in which what is known of any given well or the wells in any region may be quickly found.

CHAPTER VI DICTIONARY OF ALTITUDES.—This chapter contains a comprehensive dictionary, arranged by counties, and based on the precise levels of the United States Engineers, United States Coast and Geodetic Survey, and United States Geological Survey To this net of precise levels the railroad levels have been connected and the corrections determined. Approximate elevations may be read from Pl. III (in pocket).

GEOLOGY AND UNDERGROUND WATER RESOURCES OF NORTHERN LOUISIANA AND SOUTHERN ARKANSAS.

By A. C. VEATCH.

INTRODUCTION.

FIELD WORK.

In the fall of 1902 arrangements were made with the Geological Survey of Louisiana for the writer to prepare a report on the geology and underground water resources of northern Louisiana. In the prosecution of this work it was found necessary, in order that the questions involved might be more thoroughly understood, to include that portion of the Coastal Plain in southern Arkansas southwest of Arkansas River, and the portion of northeastern Texas not discussed in Hill's exhaustive report on the artesian-water conditions of the Black and Grand prairies [a] After the Arkansas work was well in hand and before the Texas investigation had advanced beyond a few preliminary letters the writer was detailed to the Long Island, New York, investigation, which consumed the field and office time from February, 1903, to July, 1904.[b] The present report is thus based on the field work of the fall and winter of 1902 and 1903, supplemented by several years' field work with the Geological Survey of Louisiana and private work in eastern Texas. It covers southern Arkansas and northern Louisiana and small portions of adjacent areas in Mississippi and Texas.

LITERATURE.

The several geological surveys which have investigated portions of this area have, almost without exception, collected data regarding springs and wells in connection with their pioneer stratigraphic work. In only four instances have these data been published in a form which might be classed as a water report.

Peale, in his "Mineral springs of the United States," carefully compiled the references to springs in reports previous to 1886, with some additions from correspondence [c]

Later Branner collected the scattered references of Owen[d] and the observations and analyses of the Arkansas Geological Survey into a volume entitled "The mineral waters of Arkansas" [e]

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[a] Hill, R. T., Geography and geology of the Black and Grand prairies, Texas, with detailed descriptions of the Cretaceous formations and special reference to artesian waters Twenty-first Ann Rept U S. Geol Survey, pt 7, 1901.

[b] Prof. Paper U S. Geol Survey No 44, 1906

[c] Peale, A C., Mineral springs of the United States Bull U S Geol Survey No 32, 1886.

[d] Owen, D D, First Report of a Geological Reconnaissance of Arkansas, 1858, Second Report of a Geological Reconnaissance of Arkansas, 1860

[e] Branner, J. C., Ann. Rept Geol Survey Arkansas for 1891, vol. 1, 1892.

In 1902 Harris published an article entitled "The subterranean waters of Louisiana "[a] This is largely devoted to the waters of southern Louisiana, but gives a short description of the northern part of the State. It was republished with some additions in 1904 as Water-Supply Paper No 101, United States Geological Survey, under the title "Underground Waters of Southern Louisiana."

With these exceptions the works mentioned in the partial bibliography given below are important mainly because of their bearing on the stratigraphy

1860.

Owen, David Dale Second Report of a Geological Reconnaissance of the Middle and Southern Counties of Arkansas Philadelphia, 1860 8° 433 pp and chart

1870.

Hopkins, F V First annual report of the Louisiana State Geological Survey, 1869: Ann Rept Board of Supervisors Louisiana State Seminary of Learning and Military Academy for year ending December 31, 1869. New Orleans, 1870 Pp 77–109

1871.

Hopkins, F V Second annual report of the Geological Survey of Louisiana to the General Assembly: Ann Rept Board of Supervisors Louisiana State University for year ending December 31, 1870. New Orleans, 1871 Pp 35–80, map

1872.

Hopkins, F V. Third annual report of the Geological Survey of Louisiana Ann Rept. D. F Boyd, supt Louisiana State University, for 1871 New Orleans, 1872 Pp 163–206, map

1873.

Hilgard, Eugene W Supplementary and Final Report of a Geological Reconnaissance of Louisiana New Orleans, 1873 44 pp

1888.

Hill, Robert T The Mesozoic geology of southwestern Arkansas Ann. Rept. Geol. Survey Arkansas for 1888, vol 2 Little Rock, 1888 200 pp , map

1891.

Williams, J. Francis The igneous rocks of Arkansas. Ann Rept Geol Survey Arkansas for 1890, vol 2, 1891, 457 pp , 22 pls , 44 figs

1892.

Branner, John C The mineral waters of Arkansas Ann Rept Geol Survey Arkansas for 1891, vol. 1, 1892, 144 pp , map

Lerch, Otto A preliminary report upon the hills of Louisiana north of the Vicksburg, Shreveport and Pacific Railway Bull Louisiana State Experiment Station, Geology and Agriculture, pt 1, [1892], pp. 1–51, 7 figs

1893.

Lerch, Otto A preliminary report upon the hills of Louisiana south of the Vicksburg, Shreveport and Pacific Railway to Alexandria Bull Louisiana State Experiment Station, Geology and Agriculture, pt. 2, [1893], pp 52–160, 28 figs

1894.

Harris, Gilbert D The Tertiary geology of southern Arkansas· Ann. Rept. Geol Survey Arkansas for 1892, vol 2, 1894, 207 pp , 7 pls , 34 figs

Hill, Robert T Geology of parts of Texas, Indian Territory, and Arkansas adjacent to Red River. Bull. Geol Soc America, vol. 5, 1894, pp. 297–338, pls 12–13

1895.

Vaughan, T Wayland. The stratigraphy of northwestern Louisiana. Am. Geol., vol. 25, 1895, pp. 205–229, Bull U S Geol Survey No 142, 1896, 65 pp , 4 pls

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[a] Harris, G. D , Geol Survey Louisiana, Rept of 1902 [1902], pp 196–252

1900.

Harris, Gilbert D, and **Veatch, A C** A preliminary report on the geology of Louisiana· Geol Survey Louisiana, Rept for 1899, [1900], 354 pp , 62 pls , 7 figs

1901.

Hill, Robert T Geology and geography of the Black and Grand prairies, Texas, with detailed descriptions of the Cretaceous formations and special reference to artesian waters· Twenty-first Ann Rept U S. Geol Survey, pt 7, 1901, 651 pp , 71 pls , 80 figs

1902.

Harris, Gilbert D, and **Veatch, A C** A report on the geology of Louisiana Geol Survey Louisiana, Rept. of 1902, [1902], 288 pp , 44 pls , 27 figs

Taff, Joseph A Chalk of southwestern Arkansas Twenty-second Ann Rept U S Geol Survey, pt 3, 1902, pp 687–742, pls., 47–53, 57–69

1904.

Harris, Gilbert D. Underground waters of southern Louisiana Water-Sup and Irr Paper U. S. Geol. Survey No. 101, 1904, 98 pp , 11 pls , 15 figs

CHAPTER I.

GEOLOGY.

INTRODUCTION

OUTLINE OF MAJOR FEATURES OF PRESENT TOPOGRAPHY

Topographically northern Louisiana and southern Arkansas form an area which is divisible into two major provinces, the Ouachita Mountains and the Gulf Coastal Plain.

The Ouachita Mountains province is a region of relatively great and rugged relief, ranging from 500 to 2,000 feet above sea level and composed of roughly parallel ridges separated by deep, flat valleys It is underlain by a much folded, steeply inclined, deeply eroded series of Paleozoic sandstones, shales, and limestones, and has been developed from the slightly arched surface of an old peneplain by the erosion of the softer beds

The Gulf Coastal Plain is an area of low and rounded relief, extending in this region from 3 [a] to 600 feet above sea level (Pl III, in pocket). It is underlain by a series of relatively soft strata, dipping on the whole gently seaward, in which the present topography has been formed entirely by the profound dissection of an old plain level The surface of this old plain has now been almost completely destroyed (Pl. I, *C* and *D*), and the region presents two principal topographic divisions—(1) the hill lands and (2) the flood-plain and terrace areas (Pl I, *B*); the former representing the uplands formed of rolling hills, composed largely of the older beds of the Coastal Plain, and the latter the lowlands, flat or benchlike in character, composed of redeposited sediments of rather recent fluviatile origin

In the flood-plain region three features of very recent origin are to be noted—(1) the greater depth of Ouachita River Valley in southern Arkansas as compared with the Mississippi Valley at the same latitude (Pl I, *C*); (2) the shoals and rapids which are found in the midst of strips of mature topography on Angelina River near its mouth, along Sabine River from Pendleton to Burrs Ferry, particularly near Columbus (Pl. XXVIII, *B*, figs 14–16), on Red River near Alexandria (fig. 13), and on numerous small tributary and distributary channels in the Red River flood plain between latitude 32° and 33°, and on Ouachita River at Catahoula Shoals (figs. 10, 11), and (3) the lakes which occur or which formerly occurred in the lower part of each of the streams tributary to Red River between Alexandria and the

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[a] The elevation of extreme low water in the Mississippi at Red River Landing, November 14, 1895 (Ann Rept Chief of Engineers for 1900, pt. 4, 1900, pp 2543–2544). According to the maps of the Mississippi River Commission the beds of Red, Ouachita, and Mississippi rivers and of Bayou Macon and Boeuf and Tensas rivers often extend to considerable depths below sea level, thus the Mississippi at Vicksburg (Klineston) reaches a depth of 58 feet below sea level, at Fort Adams 112 feet, and at Miles Landing, 4 miles below the mouth of Red River, 127 feet.

Geologic history of northern Louisiana and southern Arkansas.

Geologic subdivisions.				Characteristic activities.					
				Deposition				Degradation.	Deformation.
				Thickness.		Character.			
Quaternary.	Recent.		Alluvium.	*Feet.* 0- 20+		Veneer of sand, silt, and clay on flood plains.		General degradation of the hill lands. Along Red River in Louisiana the resurrection of buried channels and the drainage of lakes produced by the "great raft." On the Sabine the partial wearing out of shoals produced by the recent movement of the Angelina-Caldwell flexure.	A slight upward movement at the west end of the Rockland-Vicksburg flexure is producing rapids on Sabine and Angelina rivers. A recent movement of 25 feet along the line of the Red River-Alabama Landing fault has resulted in the swamping of Ouachita River Valley to a point above the mouth of Bayou Moro in Arkansas.
				0- 25		Abnormal deposits of silt in Red River Valley resulting from the obstruction by the "great raft."			
	Pleistocene.					Formation of natural mounds.		Partial removal of valley fillings and production of present flood plains and principal terraces.	
			Port Hudson formation.	0- 200		Marine deposits on the coast and fluviatile deposits in the river valleys, partly filling the broad valleys developed in the preceding erosion cycle.			
						Rearrangement of surficial sands and gravels at new levels as erosion progressed.		Long and complex period of erosion, with the land 100 feet higher than to-day, in which the formations of the Coastal Plain were profoundly dissected and the major features of the present topography produced.	After the main development of the Angelina-Caldwell flexure the beds were faulted along a line extending from a point near Denison, Tex., through Alabama Landing. Union Parish, La. The downthrow of this fault is to the north and the break approximately 600 feet.
Tertiary.	Pliocene.		Lafayette formation.	[a]0- 50		A mantle of silt, sand, and gravel spread by combined marine and river action over the relatively even surface of the Coastal Plain and in the tributary valleys.			
	Miocene.							A period of erosion, probably composed of several stages, in which the Coastal Plain in this region was essentially base-leveled.	The low fold which extends from the vicinity of Angelina County, Tex., to a point north of Vicksburg, Miss., and which is now a line of weakness, began to develop in late Oligocene or early Miocene time. North of this line the older beds are now nearly horizontal; to the south they dip at a rate of from 35 to 150 feet per mile.
	Oligocene.		Fleming clay.	±260		Green calcareous clays, with a few brackish-water fossils.			
			Catahoula formation.	1,000-1,200		Near-shore deposits; sandstones occasionally quartzitic, and green clays, with fresh-water shells and land plants.			
			Vicksburg formation.	100- 200		Limestones and calcareous, somewhat lignitiferous, clays, containing marine shells.			The domes developed during late Cretaceous and early Eocene time show a slight movement in post-Claiborne time, but the amount is very small when compared with the initial movements.
	Eocene.[b]	Undifferentiated Eocene.[b]	Jackson formation.	200- 550		Highly fossiliferous shallow-water marine sandy calcareous clay.			
			Cockfield member of Claiborne.[c]	400- 500		Lignitiferous sands and clays, with land plants.	Landward these formations merge into lignitiferous sands and clays without distinctive marine fossils.		
			Claiborne formation.	200- 500		Fossiliferous sandy clay, containing shallow-water marine shells.			
			Sabine formation.	300- 900		Lignitiferous sands and clays, with plants and occasional beds of marine shells.			The great north-and-south fault of the Coastal Plain of Texas (the Balcones fault) developed late in the Cretaceous. In Louisiana peculiar domes or four-sided folds were produced and reached their major development in the late Cretaceous or early Eocene. About the same time masses of igneous rocks of limited area were intruded into the Paleozoic rocks and Coastal Plain beds in southern Arkansas. In central Texas similar occurrences took place as early as the Austin epoch. The Louisiana and northeastern Texas domes are thought to be due to the upthrust of similar igneous intrusions.
			Midway formation.	20- 260		Limestones and black calcareous clays.		Beds separated by a pronounced break in the fauna, which is, at present the only indication of a very serious break in sedimentation.	
Cretaceous.	Gulf series (upper Cretaceous).		Arkadelphia clay.	300- 600		Black laminated clays, with marine fossils in lower portions.			
			Nacatoch sand.	100- 160		Sand, with occasional calcareous quartzitic layers containing marine shells.			
			Marlbrook formation.	150- 750		Very calcareous clay, with marine fossils.			
			Annona chalk.	+100		White chalk.			
			Brownstown formation.	150- 500		Blue calcareous clay, with marine fossils.			
		Bingen formation.	Sub-Clarksville sand.[d]	50–100	40–700+	Water-bearing sand.	Lignitiferous sand and clays, with plant remains (Bingen formation).		
			Eagle Ford clay.[d]	0–600		Blue calcareous clay.			
			Woodbine formation.	+500		Lignitiferous sands and clays, with plant remains.			
	Comanche series (lower Cretaceous).		Washita group.	0- 400		Dark calcareous clays, with clayey limestone beds.		The Bingen and Woodbine sands indicate deposits very near shore and the fauna changes sharply at this point, but there is no evidence of a pronounced unconformity or a land period of great length.	
			Goodland limestone.	25- 30		Massive white limestone.			
			Trinity formation.	500- 600		Yellow, somewhat argillaceous pack sands, changing to the east to calcareous clays, with thin beds of limestone and gypsum.			
Pre-Cretaceous.	An immensely long period composed of the following principal stages in the order given: (1) Deposition, (2) profound folding and faulting, (3) long erosion, which essentially base-leveled these folds. On this planed-off surface the Cretaceous beds were deposited.								

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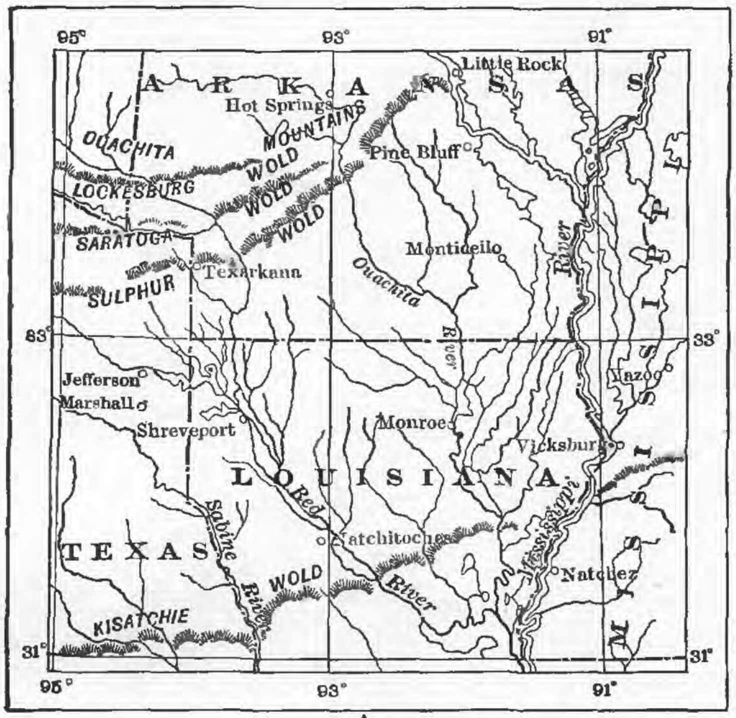
[a] Normal thickness in northern Louisiana and southern Arkansas not known because of the widespread and irregular deposition. In southern Louisiana these beds are much thicker than here given.

[b] The Jackson, Claiborne, and Sabine formations, which are fossiliferous and distinct in central Louisiana, grade into lignitiferous beds containing no distinct fossils as they go northward. In the region under discussion the fossiliferous Jackson limits this lignitiferous complex above. Still farther north, however, the Jackson also grows lignitiferous and merges with the rest. The Midway, likewise, in the upper embayment region shows a decidedly lignitiferous tendency and may in places merge with the lignitiferous time equivalents of the other Eocene beds.

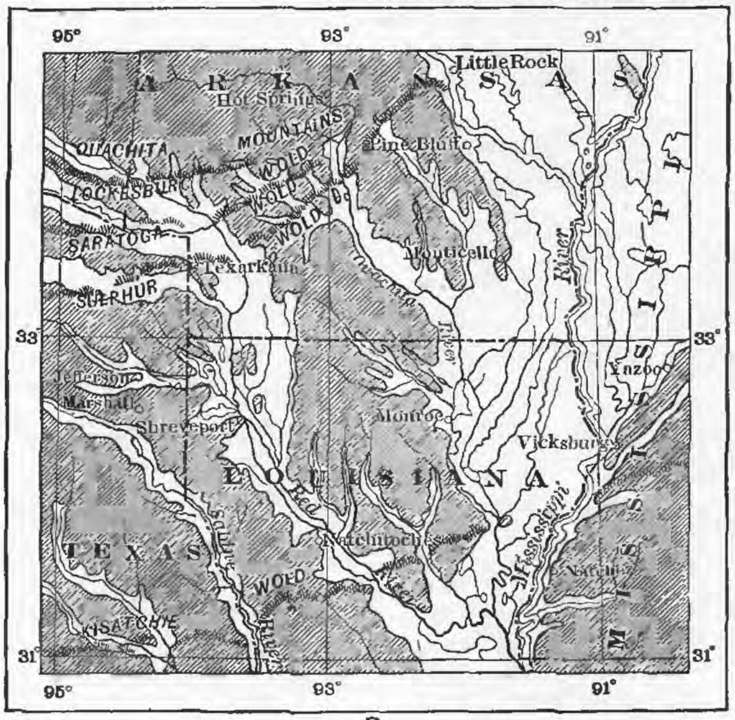
[c] A group without distinctive marine fossils, probably almost wholly of Claiborne age.

[d] These beds do not outcrop in the Arkansas area, except as they may be represented as littoral deposits in the upper part of the Bingen sand, and therefore need not be considered in wells drilled near the northern edge of the Brownstown formation; but they will be found farther south and must there be allowed for in well calculations.



A

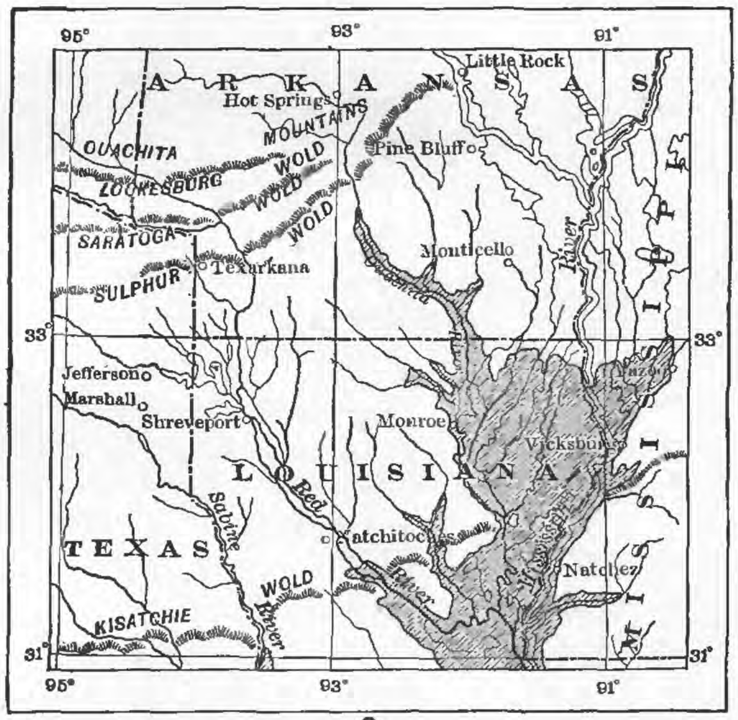
The Lockesburg, Saratoga, Sulphur, and Kisatchie wolds.



B

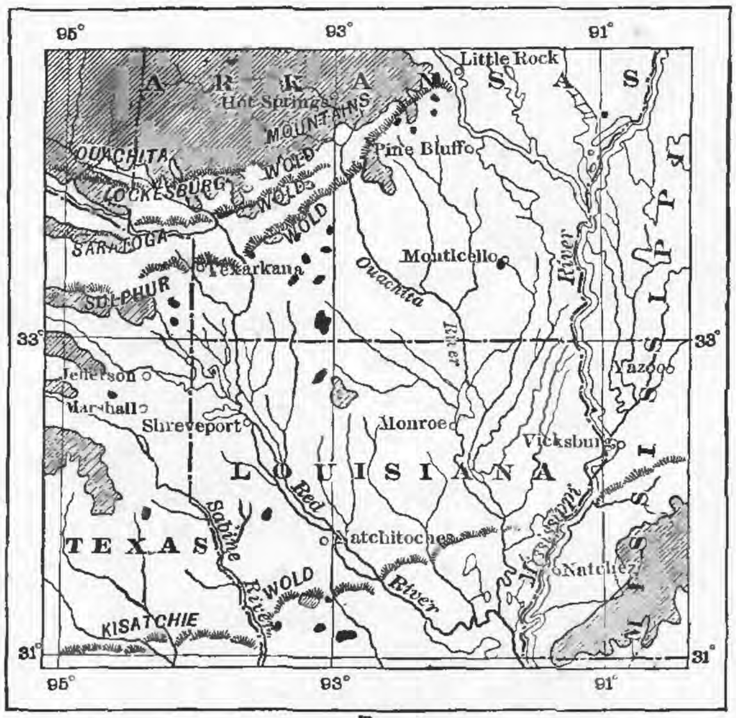
Hill lands.

Flood-plain and terrace areas.



C

Areas less than 100 feet above gulf level.



D

Areas more than 400 feet above gulf level.

SALIENT TOPOGRAPHIC FEATURES OF THE GULF COASTAL PLAIN IN NORTHERN LOUISIANA AND SOUTHERN ARKANSAS.

BY

A.C.VEATCH.

Scale

0 50 100 200 300 miles

1905

Arkansas-Louisiana State line (fig. 1). These lakes are the most important recent topographic features of this region, having been formed since the fifteenth century, but now the cause of their formation having passed, they are returning to their normal status as tributary streams. Several no longer exist, though still represented on maps because of the lack of recent detailed surveys (p. 61).

In the hill lands the general character of the topography is irregular and rolling, the hills rising 100 to 200 feet above the flat-bottomed stream channels which extend in every direction, but the unequal hardness of the underlying beds has given rise

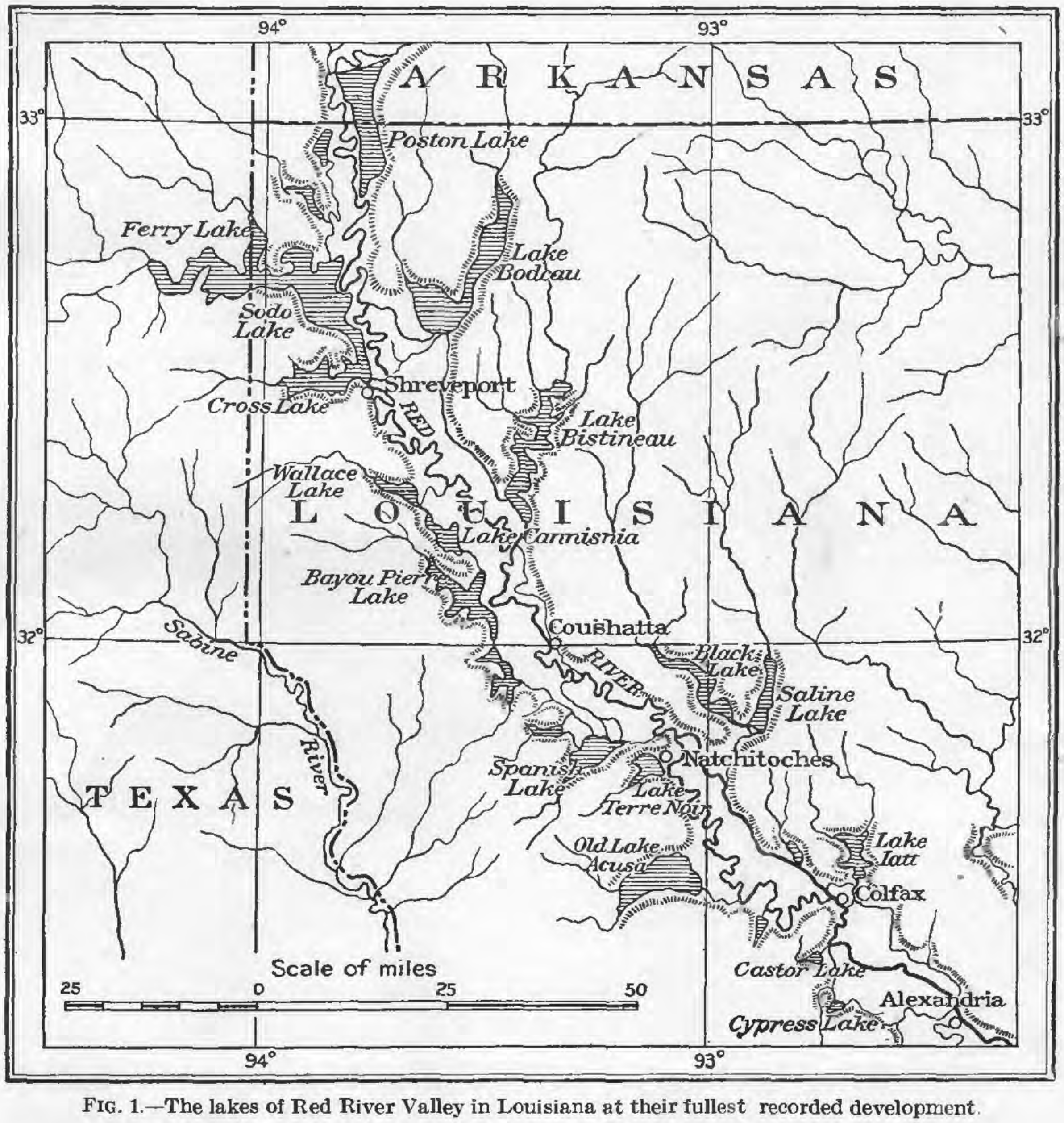


FIG. 1.—The lakes of Red River Valley in Louisiana at their fullest recorded development.

to several transverse ranges of hills, which are more or less persistent for many miles and follow the general strike of the formations producing them. Of these the Kisatchie Wold[a] (Pl. I, *A*), which is produced by the hard sandstone layers in the Catahoula (Grand Gulf) formation, is perhaps the most important. Others are the Sulphur Wold, formed by the sandy beds of the lower Eocene, and the Saratoga and Locksburg wolds, by Cretaceous formations. The transverse valley or vale[a] to

[a] For definition and derivation of the terms wold and vale see Prof. Paper U. S. Geol. Survey No. 44, 1906, p. 29.

the north of the Sulphur Wold, though not very well marked, has determined the location of the Iron Mountain Railway between Little Rock and Texarkana.

Over all the Coastal Plain, except in the steeper hill areas and the most recent flood plains, are low, circular, mound-like elevations that are in themselves of minor significance, but are relatively important because of their persistence and wide distribution. They are from 20 to 100 feet in diameter and attain a maximum elevation of 6 feet (Pl. XXVI, p. 54). They are particularly abundant in the terrace areas, where in wet weather they form low, sandy islands in the midst of a water-covered clay country. Their origin is one of the most interesting and perplexing problems of the region. (See p. 55.)

OUTLINE OF GEOLOGICAL HISTORY.

The geologic formations of this area may be classed in three groups—(1) the pre-Cretaceous rocks, (2) the Cretaceous, Eocene, and Oligocene beds, and (3) the surficial deposits. The first are composed of highly folded Paleozoic sediments, which outcrop on the northwestern side of the area discussed (Pl. III, pocket) and underlie all the Coastal Plain, forming the basement rocks on which the later sediments were laid down (fig. 2, p. 17). The Cretaceous, Eocene, and Oligocene deposits are composed largely of unconsolidated sands, clays, and marls, though limestones and sandstones are sometimes encountered. They dip coastward at a very low angle, are but slightly disturbed, and succeed one another in regular sequence, so that in passing from the coast to the mountains successively older beds are encountered. Thus while ascending topographically the traveler descends geologically.

Over this Coastal Plain series and along the coastward edge of the Paleozoic rocks is an irregular mantle of gravel, sand, and silt, which is relatively thin in the hill areas and thick beneath the larger flood plains and in the region south of the Catahoula and Fleming formations.

The table opposite gives a summary of the features that together make up the geologic history. It shows the succession of the strata, the age, name, thickness, and character of each formation, and the events of degradation and deformation. It is arranged in the order in which the formations were deposited—the youngest at the top and the oldest at the bottom—and should therefore be read from the bottom upward.

HISTORICAL GEOLOGY.

PRE-CRETACEOUS.

The beds exposed in the mountain regions of Arkansas and Indian Territory represent, for the most part, deposits laid down beneath the sea in periods extending back to a very early time in the earth's history. In Indian Territory Taff has found that the deposition was essentially continuous from the Cambrian to the upper Carboniferous, and that after a period of erosion, particularly well marked in the Arbuckle Mountains, sedimentation was again resumed. In western Indian Territory these beds grade up, without a break, into deposits with Permian and Triassic affinities.[a]

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[a] Hill, R. T., Twenty-first Ann. Rept. U. S. Geol. Survey, pt. 7, 1901, pp. 99-101.

The thickness of the Cambro-Silurian portion of these sediments in Indian Territory is estimated at 12,000 feet,[a] that of the Devonian at 600 feet,[b] and that of the Carboniferous at 24,500 feet;[c] the thickness of the latter in Arkansas is estimated at 23,780 feet.[d]

The land area from which the material for these immensely thick beds was derived lay to the south and southeast, and the relative position of the continental and oceanic areas was, therefore, at this time somewhat reversed—the ocean occupying the greater part of what is now the central and western United States and the land the Coastal Plain of the eastern and southern United States and portions of the Atlantic Ocean and Gulf of Mexico.

Near the close of the Carboniferous these beds were profoundly folded and faulted along the line of what is now the Appalachian Mountains. These folds extended across the present Mississippi Valley into Arkansas, Indian Territory, and Texas, and formed in this portion of their course a mountain range overlooking a sea that stretched westward and northwestward. The truncated bases of these folded and faulted strata show that they once extended many thousands of feet, even miles, above their present level (fig. 2)

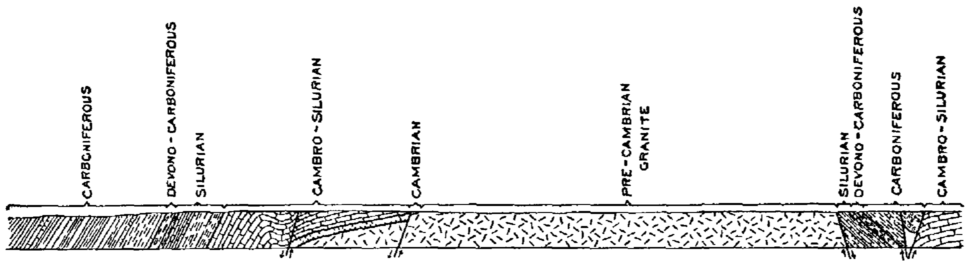

FIG 2—North-south section near Tishomingo, Ind T, showing in a general way the peneplained surface and the complex, highly disturbed character of the bed rock underlying the Cretaceous and Tertiary deposits of the Gulf Coastal Plain (After Taff) Length 6 5 miles, height 0 5 mile

The wearing away of these thousands and thousands of feet of hard Paleozoic rocks required a very long lapse of time; and when it is remembered that the extreme height indicated was not reached at one time, but was the result of more or less intermittent movements acting through long periods, and that the erosive agents did not at any time have the advantage of the extreme gradient which would result from so great an elevation, some idea of the length of the Triassic and Jurassic eons may be obtained

Whatever were the successive stages of this Triassic and Jurassic dissection, at the close of the Jurassic this region showed no very great irregularities, and when the land began to tilt gently southward as the result of a new adjustment of the earth's surface to the very complex group of factors affecting it, the sea transgressed northward over a relatively level plain in which there were no features indicating topographically the greatly disturbed and contorted character of the underlying rocks (fig. 2).

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[a] Taff, J A, Geologic Atlas U S, folio 79, U S Geol Survey, 1902

[b] Taff, J A, Geologic Atlas U S, folio 98, U S Geol Survey, 1903

[c] Drake, N F, Proc Am Philos Soc, vol 36, 1898, p 361, Twenty-first Ann Rept U S Geol Survey, pt 7, 1901, p 99.

[d] Branner, J C, Am Jour Sci, 4th ser, vol 4, 1897, p 358

CRETACEOUS.

CONDITIONS OF DEPOSITION.

The depression just mentioned marked the beginning of the Cretaceous, and in the ocean which then covered this part of North America (Pl. II, *A*) all the deposits which are now recognized as the main formations of this portion of the Coastal Plain were laid down in Cretaceous and Tertiary time. The alternations of sands, clays, marls, and limestones which now underlie this region indicate varying depths of ocean water on this old sea floor, and show that many changes took place in the relative elevation of the land and water, but the submergence beneath the sea was essentially continuous from early Cretaceous to late Oligocene time.

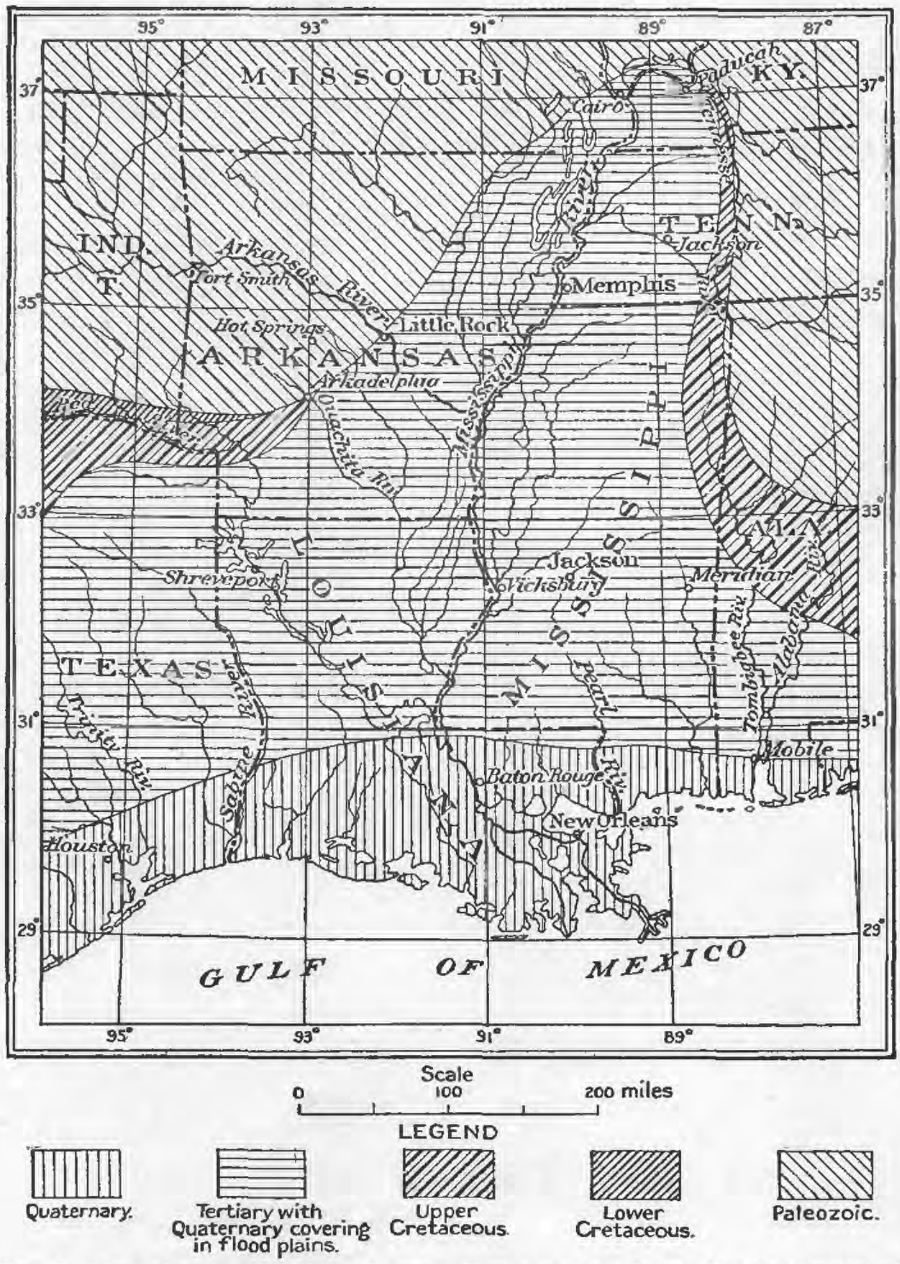
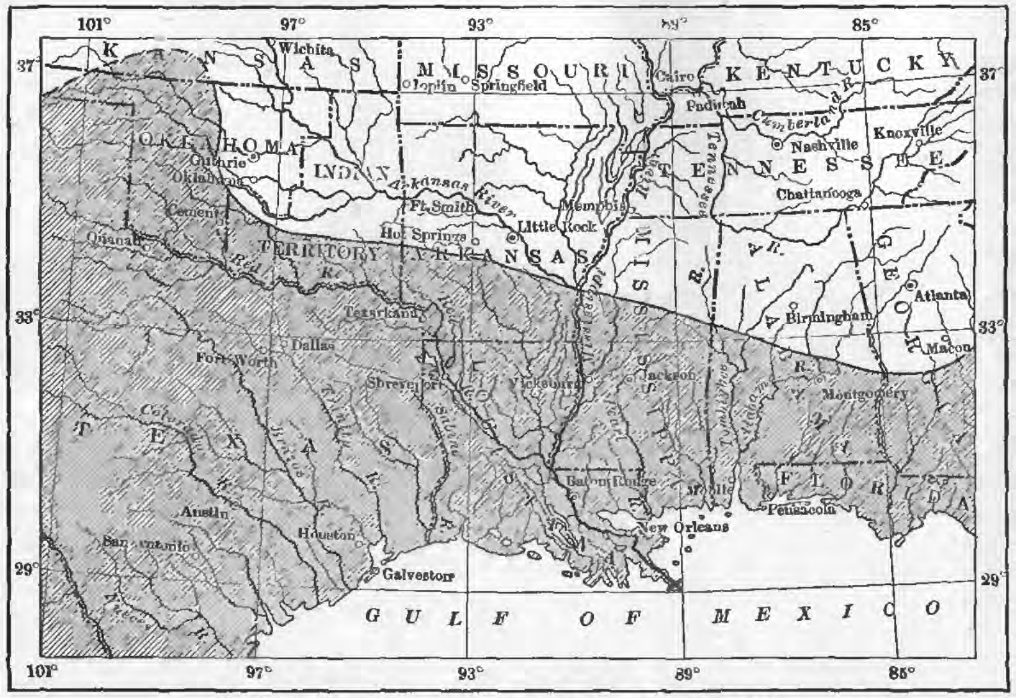


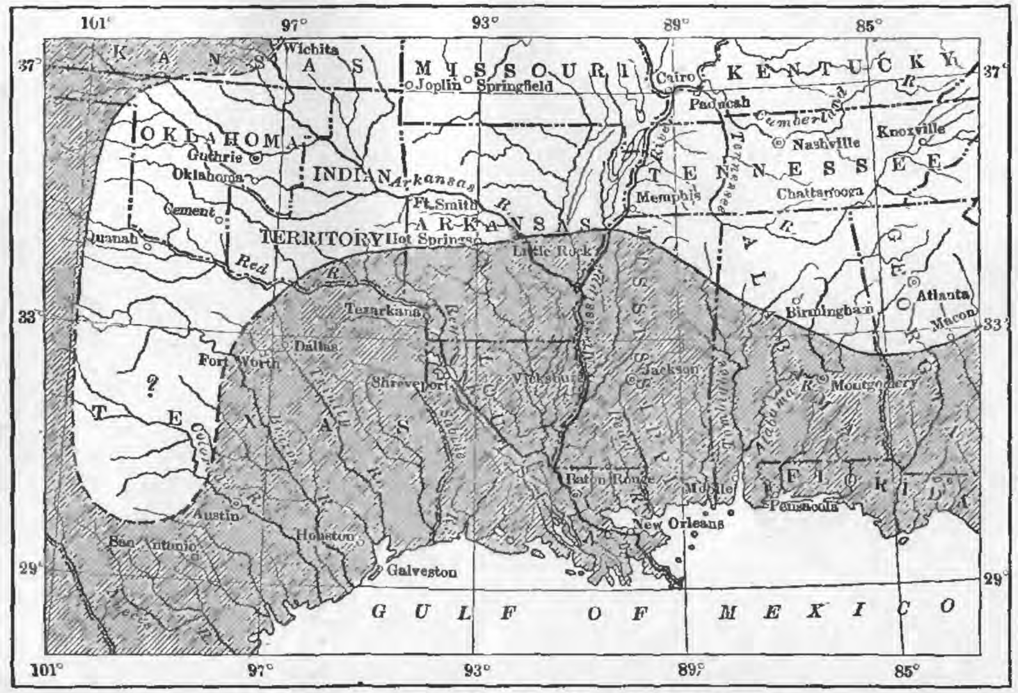
FIG. 3.—Map showing overlap of upper Cretaceous on lower Cretaceous and of Tertiary on Cretaceous in the Mississippi Valley.

The different formations recognized in this region represent periods of deposition during which the conditions were essentially the same and certain forms of life reached a peculiarly characteristic development. The progressive changes in the character of the animals inhabiting these waters make their remains—the fossil shells and bones so common over much of the region—of great value as indicators of the time at which the particular beds in which they occur were deposited and, therefore, the position of these beds in the general series of deposits.

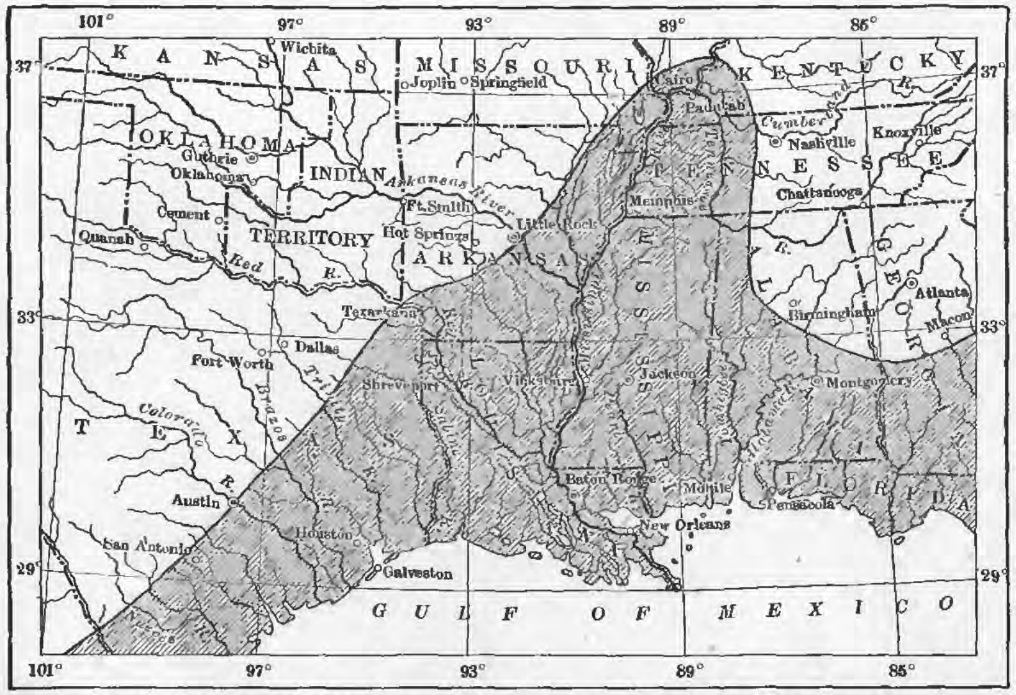
If these fluctuations in the relative elevation of the land and sea had occurred entirely in one plane, that is, if the land had been lifted and lowered without the shore line of one period cutting that of another, the present outcrops of the deposits would have been roughly parallel. Since, however, these movements were irregular and there was warping in a direction not entirely parallel to the first shore line, the



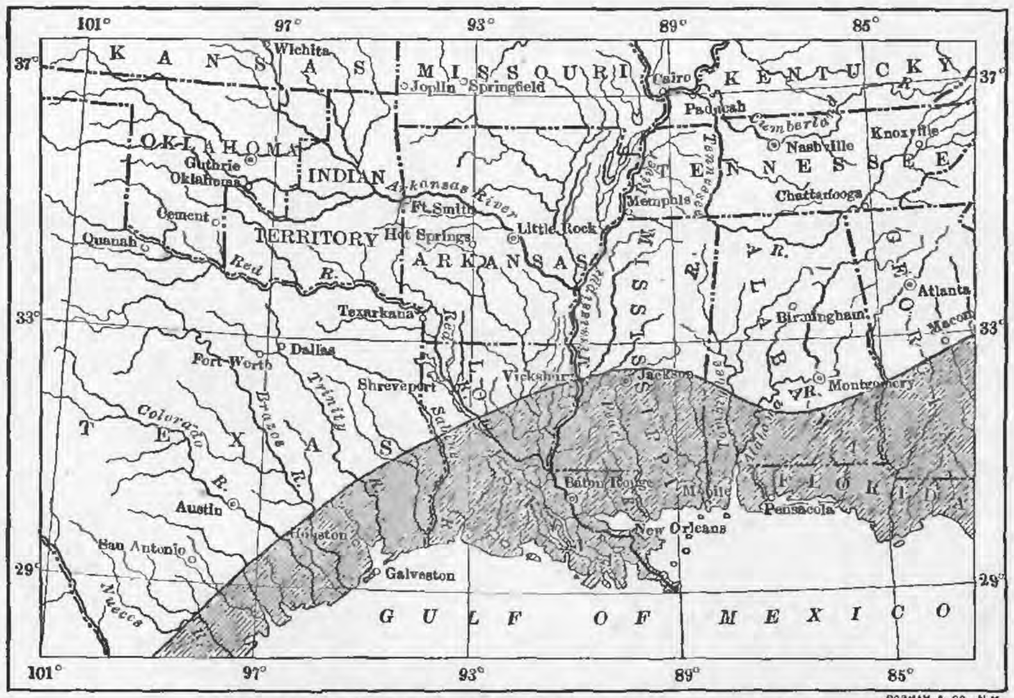
(A) EARLY LOWER CRETACEOUS



(B) EARLY UPPER CRETACEOUS



(C) LATE CRETACEOUS AND EARLY TERTIARY



(D) EARLY OLIGOCENE TERTIARY

BORMAY & CO., N.Y.

Scale
100 0 100 200 300 400 500 600 MILES

RELATIVE POSITIONS OF LAND AND WATER AREAS IN THE SOUTH CENTRAL UNITED STATES DURING THE CRETACEOUS AND TERTIARY EPOCHS.

Water, present Gulf of Mexico and all shaded areas; land, unshaded portion of present land.

new shore line cuts the old one obliquely and the present outcrops are wedge shaped, the point of the wedge being in the direction of the depression

This decrease in the area of outcrop of formations due to a progressive change in the direction of the shore line is well shown in southern Arkansas, where the lowest deposits of the Cretaceous, which occur along the base of the mountains, gradually taper out toward the east and are succeeded by the upper Cretaceous deposits, which are in turn overlapped by the Eocene (fig 3) Apparently the Mississippi embayment was but an insignificant feature of the shore line in the early Cretaceous (Pl II, *A*) and did not attain its maximum development until late Cretaceous and early Eocene time (Pl II, *C*) On account of this pivotal location of southwestern Arkansas the Cretaceous deposits, except possibly the uppermost, are less fully exposed and developed there than in central and eastern Texas. Many of the beds are entirely absent, or are so changed in general character that they have not yet been definitely recognized and frequent recourse is necessary to the Texas and Indian Territory areas for details lacking in this section.

MAJOR DIVISIONS

The major divisions recognized by Hill in the Texas region, together with the development in Arkansas and Indian Territory, are given in the following table

Major divisions of the Cretaceous in Texas, Arkansas, and Indian Territory

Texas classification (Hill[a])			Arkansas development	Indian Territory (Taff[b])
Series	Group	Formation	Formation	Formation
Gulf series (upper Cretaceous)	Montana	Navarro	Arkadelphia Nacatoch Marlbrook Annona	
	Colorado	Taylor	Brownstown	
		Austin [c]	Bingen sand [d]	
		Eagle Ford		
	Dakota	Woodbine		Silo sandstone
Comanche series (lower Cretaceous)	Washita	Buda	(Not differentiated)	Bennington limestone Bokchito formation
		Denison		
		Fort Worth		Caddo limestone
		Preston		Kiamichi formation
	Fredericksburg	Edwards	Goodland limestone	Goodland limestone
		Comanche Peak		
		Walnut		
	Trinity	Paluxy	Trinity sand	Trinity sand
		Glen Rose		
		Travers Peak		

[a] Hill, R T, Twenty-first Ann Rept U S Geol Survey, pt 7, 1901, pp 114-115

[b] Taff, J A, Geologic Atlas U S, folio 79, U S Geol Survey, 1902, folio 98, 1903

[c] Not found east of Paris, Tex

[d] The Bingen, while the lithological counterpart of the Woodbine, apparently contains littoral equivalents of the Austin and Eagle Ford (See p 24)

LOWER CRETACEOUS OR COMANCHE SERIES.

CONDITIONS OF DEPOSITION.

The lowest Cretaceous beds represent the near-shore deposits of the sea advancing over the old Jurassic peneplain and are, therefore, sandy and contain vegetable remains, as well as brackish-water shells These are succeeded by limestone and marls, indicating deeper water, and these in turn are limited above by the great sand beds that represent the extreme shallow-water conditions which marked the beginning of the upper Cretaceous

In Arkansas only the lowest of the series, the Trinity sand, is well developed, although near the Indian Territory line are good outcrops of the Goodland limestone, overlain by a series of marl and limestone beds, which, with the Goodland limestone, represent the other two grand divisions of the Comanche series, the Fredericksburg and the Washita

TRINITY SAND.

The Trinity sand, the oldest and lowest formation of the Coastal Plain series in this region, outcrops in a narrow band 6 to 12 miles wide, which extends westward along the base of the Ouachita and Arbuckle mountains from Wolf Creek in Pike County, Ark (Pl III), into Indian Territory to a point somewhat west of Ardmore, where it turns south toward Austin Because of its extensive development about the headwaters of Trinity River in Wise, Tarrant, and Parker counties, Tex , it has been called the Trinity sand or Trinity formation

South of Tishomingo and Atoka, in the Choctaw Nation, this formation consists of a fine yellowish pack sand, with irregular conglomerate beds at the base, and contains occasional lenticular masses of clays, the whole having an aggregate thickness of 200 to 400 feet [a] In this region it contains no fossils except occasional tree trunks, thought by Taff to be driftwood. Eastward these beds become more clayey in character and in southern Arkansas contain frequent thin layers of yellowish limestone, composed largely of the small oyster *Ostrea franklini* Coquand (Pl IV), together with other near-shore or brackish-water forms Occasional thin beds of gypsum, like that at the Plaster or Gypsum Bluff on Little Missouri River near Murfreesboro (Pl V, *A*), occur, and with the limestone beds indicate that the water obtained in the deep wells which penetrate this formation in southern Arkansas will not be of as good quality as that obtained farther west, where the sands are relatively purer.

Hill, in 1888, estimated the thickness of this formation in southern Arkansas at over 250 feet,[b] but a well (393)[c] drilled for Mr D J Sassamen 2 miles north of Centerpoint, which reached a depth of 500 feet without striking bed rock, indicates that the total thickness is over 600 feet and that the southward slope or dip of the strata is here over 100 feet per mile

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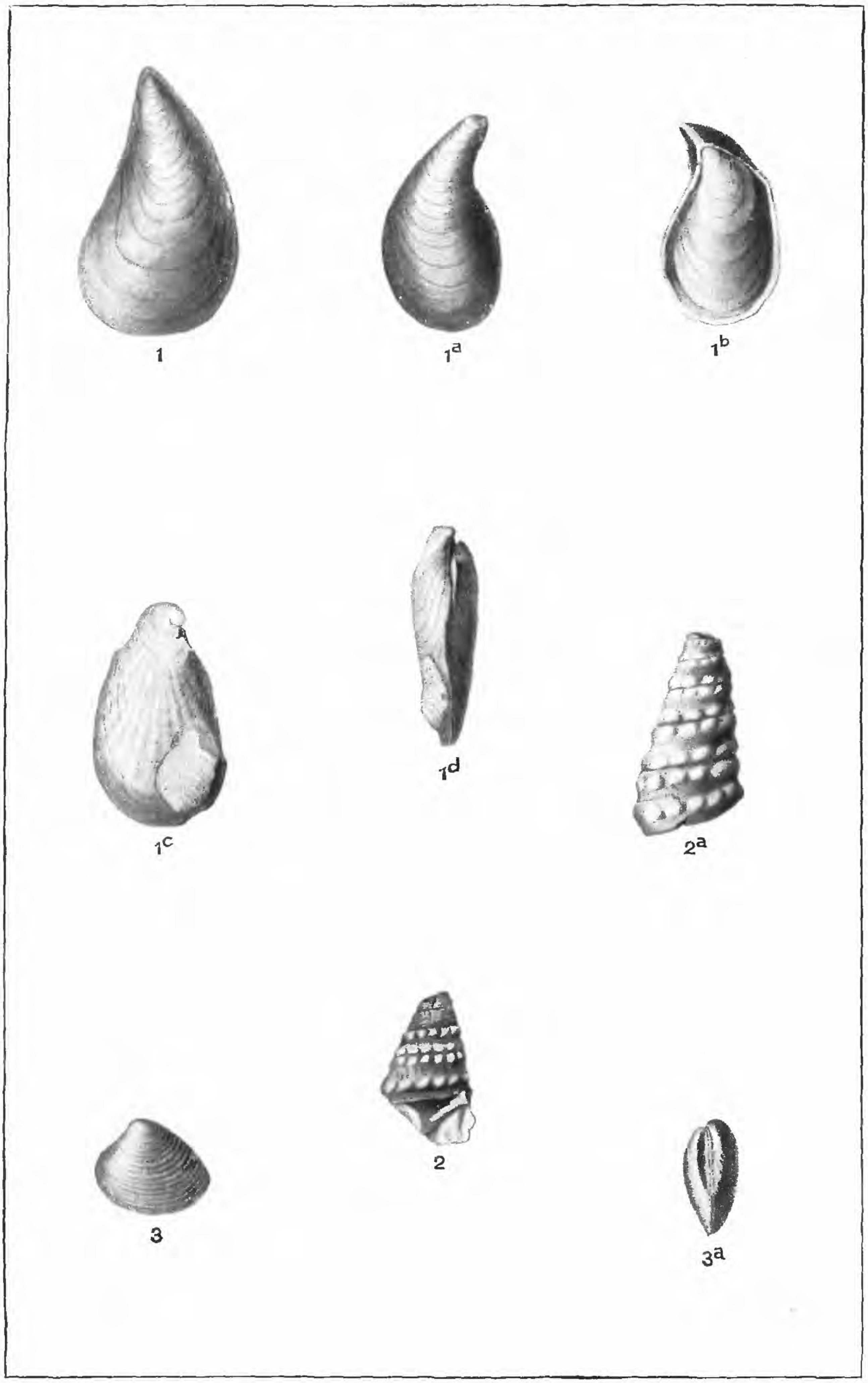
[a] Taff, J A , Geologic Atlas U S , folio 79, U S Geol Survey, 1902, folio 98, 1903

[b] Ann Rept Geol Survey Arkansas for 1888, vol 2, 1888, p 188

[c] The numbers in parentheses after references to wells correspond to those used in the table of well records in Chapter V



CHARACTERISTIC FOSSILS OF THE TRINITY FORMATION IN SOUTHERN ARKANSAS.

1, 1a, 1b, 1c, 1d. Ostrea franklini Coquand. 2, 2a. Glauconia branneri Hill. 3, 3a. Astarte? pikensis Hill.

A. GYPSUM BED AT PLASTER BLUFF, ON LITTLE MISSOURI RIVER, 3 MILES SOUTH OF MURFREESBORO, ARK.

An outcrop of the Trinity formation. Photograph by J. A. Taff.

B. TYPICAL LANDSLIP BENCH, SIDE OF ROCKY MOUNTAIN, 5 MILES EAST OF HOPE, ARK.

GOODLAND LIMESTONE.

Above the Trinity formation is a thin bed of chalky limestone 15 to 25 feet thick, which, because of its whiteness and firmness, contrasts sharply both with the Trinity sand and with the series of marls with thin limestone layers that overlie it. Because of these features it is easily traced from its type locality, 2 miles north of Goodland, on the St. Louis and San Francisco Railroad, in the Choctaw Nation, Indian Territory, both eastward to Cerro Gordo, on Little River, in Arkansas, and westward past Oakland and Marietta, in the Chickasaw Nation. It is everywhere in this region characterzied by the peculiar fossils shown in Pl. VI. South of Red River in Texas it increases gradually in thickness until it reaches a total of 700 feet on the Rio Grande,[a] where it is composed of two members which are called the Comanche Peak and Edwards formations.

WASHITA GROUP.

Above the Goodland limestone, near Cerro Gordo, Ark., is a series of calcareous clays, containing thin beds of limestone, and having a total thickness of over 250 feet.[b] These beds have not yet been carefully studied, but Hill's reconnaissance in 1888 has shown that they may be regarded as the representatives of the Preston, Fort Worth, and Denison formations of the Texas section[c] and of their equivalents in Indian Territory—the Kiamichi, Caddo, Bokchito, and Bennington formations of Taff.

This Indian Territory series along the line of the Missouri, Kansas and Texas Railway, south of Atoka, in the Choctaw Nation, is characterized by the fossils shown in Pl. VII, and shows the following lithologic units:

Section of the Washita group of the lower Cretaceous in Indian Territory in the southern part of the Atoka quadrangle (Taff).[d]

		Feet
	Silo (Woodbine) sandstone	
4	Bennington limestone. Blue shell limestone	10–15
3	Bokchito formation. Red and blue clay, with thin ferruginous limestone beds and lentils of friable sandstone	140
2	Caddo limestone. Yellow and white limestone, with thin marly beds	60
1	Kiamichi formation. Blue friable clay, with shell limestone beds in lower portions	150
	Goodland limestone	
	Total thickness of Washita division	365

The thickness of the Washita group in a well sunk 1 mile south of Denison, Tex., is given by Hill[e] as about 400 feet. In the deep wells at Paris, Tex., it is between 300 and 400 feet.[f]

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[a] Hill, R. T., Twenty-first Ann. Rept. U. S. Geol. Survey, pt. 7, 1901, p. 214.

[b] Ann. Rept. Geol. Survey Arkansas for 1888, vol. 2, 1888, pp. 110–111.

[c] See Pl. III, which, in so far as it relates to the Cretaceous in Indian Territory and Texas (except the boundary of the Trinity formation), has been compiled from Hill's report on the Black and Grand prairies. Twenty-first Ann. Rept. U. S. Geol. Survey, pt. 7, 1901, pp. 216, 223, 261, pl. 66.

[d] Geol. Atlas U. S., folio 79, U. S. Geol. Survey, 1902.

[e] Twenty-first Ann. Rept. U. S. Geol. Survey, pt. 7, 1901, pp. 618–619.

[f] Ibid., p. 629.

UPPER CRETACEOUS OR GULF SERIES.

CONDITIONS OF DEPOSITION.

At the close of the lower Cretaceous there was evidently a considerable change in the depth of the ocean waters in the Texas and Arkansas areas, since overlying the marine deposits of the Washita series are sands and clays containing lignite and other remains of land plants (Pl. VIII) of species very similar indeed to those of to-day, whose ancestors they probably were. In many places there is some evidence of slight erosion of the lower beds before these littoral deposits were laid down, and some portions of this area may have been dry land for a limited time.

The coast line was much nearer its present position than during the lower Cretaceous (Pl. II, p. 18), though the greater part of western North America, with the exception of the land along the older mountain chains of the Pacific coast, was one vast swampy area but little, if any, above ocean level. As the lowering of the land continued, deeper-water deposits succeeded these near-shore ones—at first dark-colored clays, then marls filled with marine shells, or even chalks, which, composed almost entirely of the microscopic remains of minute animals, represent deep water, though not abyssal conditions.

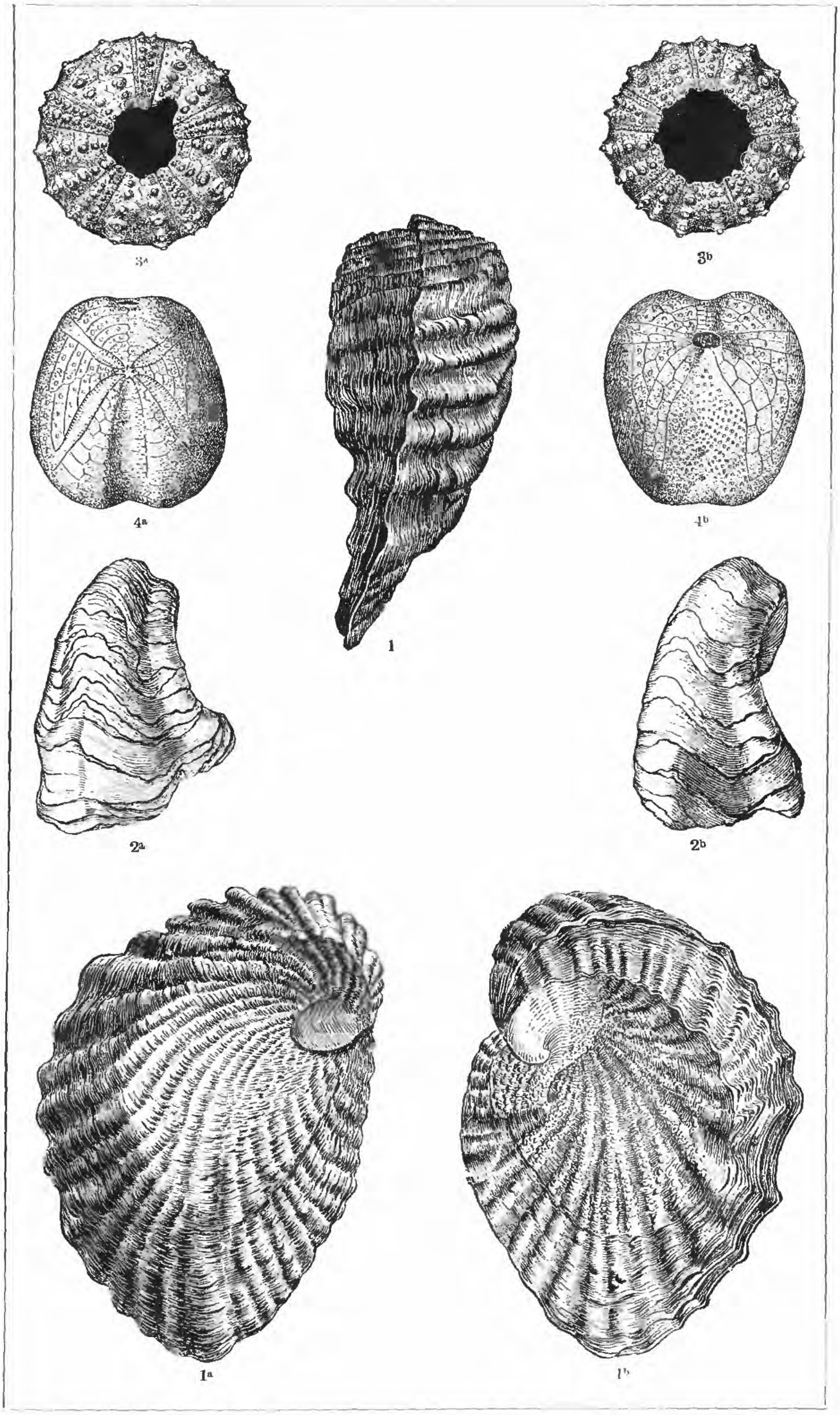
As a result of this submergence the low-lying area in western North America became a great mediterranean sea which connected the Gulf of Mexico and the Arctic Ocean. In the Texas-Arkansas area the depression was at first greatest to the southwest, but during the latter part of the Cretaceous the movement was reversed and the western region was gradually elevated as area near the Mississippi was depressed. This resulted finally in the development of the Mississippi embayment and in the severing of the connection between the Gulf and the interior sea, which was thus converted into a series of great inland lakes which persisted through much of the Tertiary. Because of this east-west and then west-east tilting the lower portion of the upper Cretaceous, which in central Texas is characterized by thick limestone and light-colored marl beds, is in Arkansas and Indian Territory composed entirely of near-shore sands with no marine fossils; while the upper portions, which in Texas are dark-colored calcareous clays, contain in Arkansas, Mississippi, and Alabama a large percentage of chalk and chalk marls.

Above, these beds pass through the limestone and marls of the lowest Eocene (Midway) into the lignitiferous near-shore deposits of the Sabine, which mark not only the return of the littoral conditions that initiated the upper Cretaceous, but also the completion of the cycle of deposition.

MAJOR DIVISIONS.

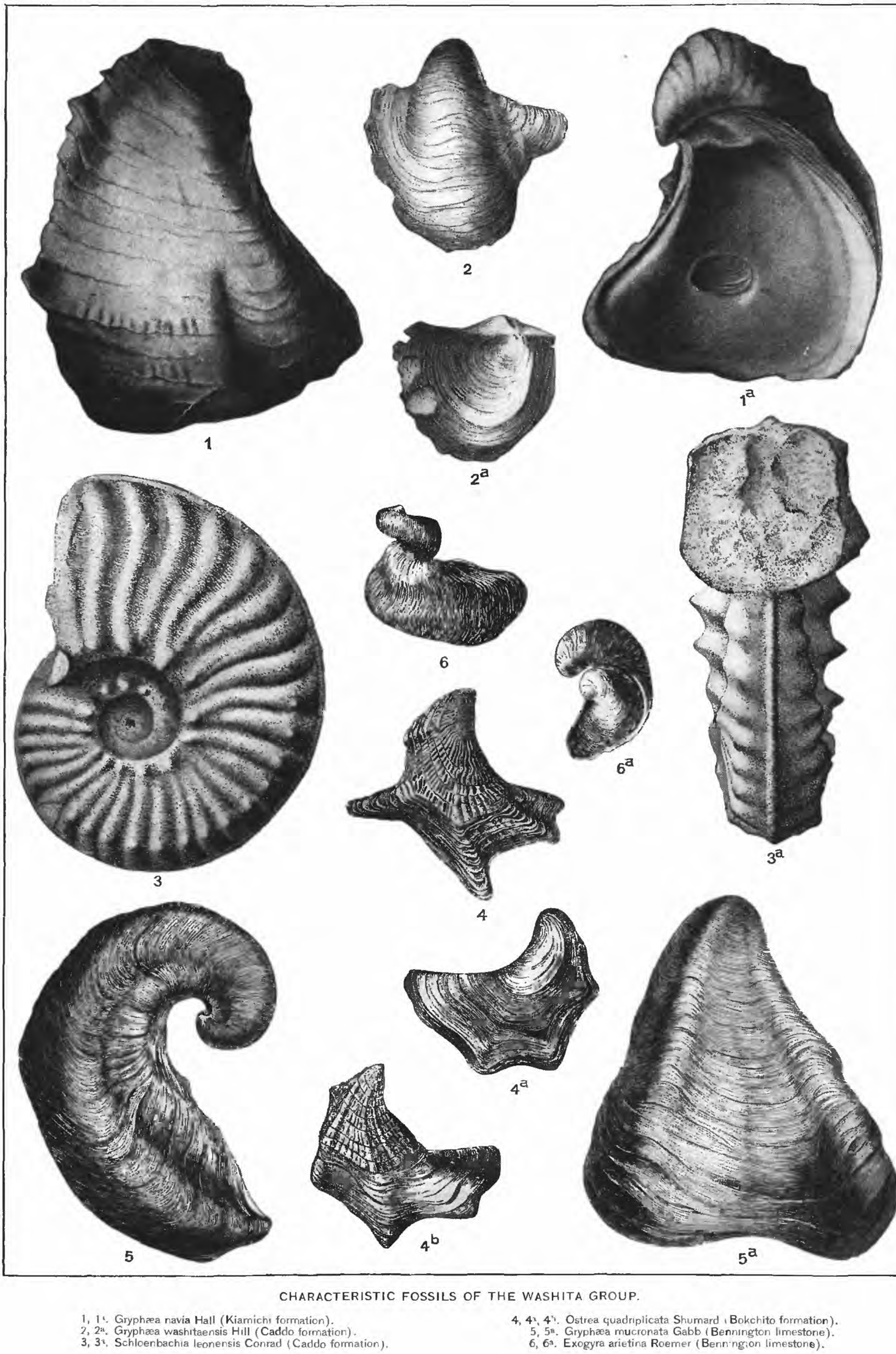
The upper Cretaceous of Arkansas is thus composed of the following members, beginning with the lowest:

1. Sands with bituminous, laminated clays containing leaf impressions (Pl. VIII) and lignite beds—the Bingen formation.
2. Blue calcareous clay with *Exogyra ponderosa* (Pl. IX)—the Brownstown formation.
3. White chalk—the Annona chalk.
4. Calcareous clay or clayey chalk, with considerable green sand—the Marlbrook formation.
5. Indurated sand, with thin calcareous and quartzitic layers locally called "water rocks" (Pl. XII, *B*, *C*), glauconitic in part—the Nacatoch sand.
6. Dark calcareous clays, fossiliferous below, which pass upward without a sharp break into the sandy, lignitiferous lower Eocene beds—the Arkadelphia clay.



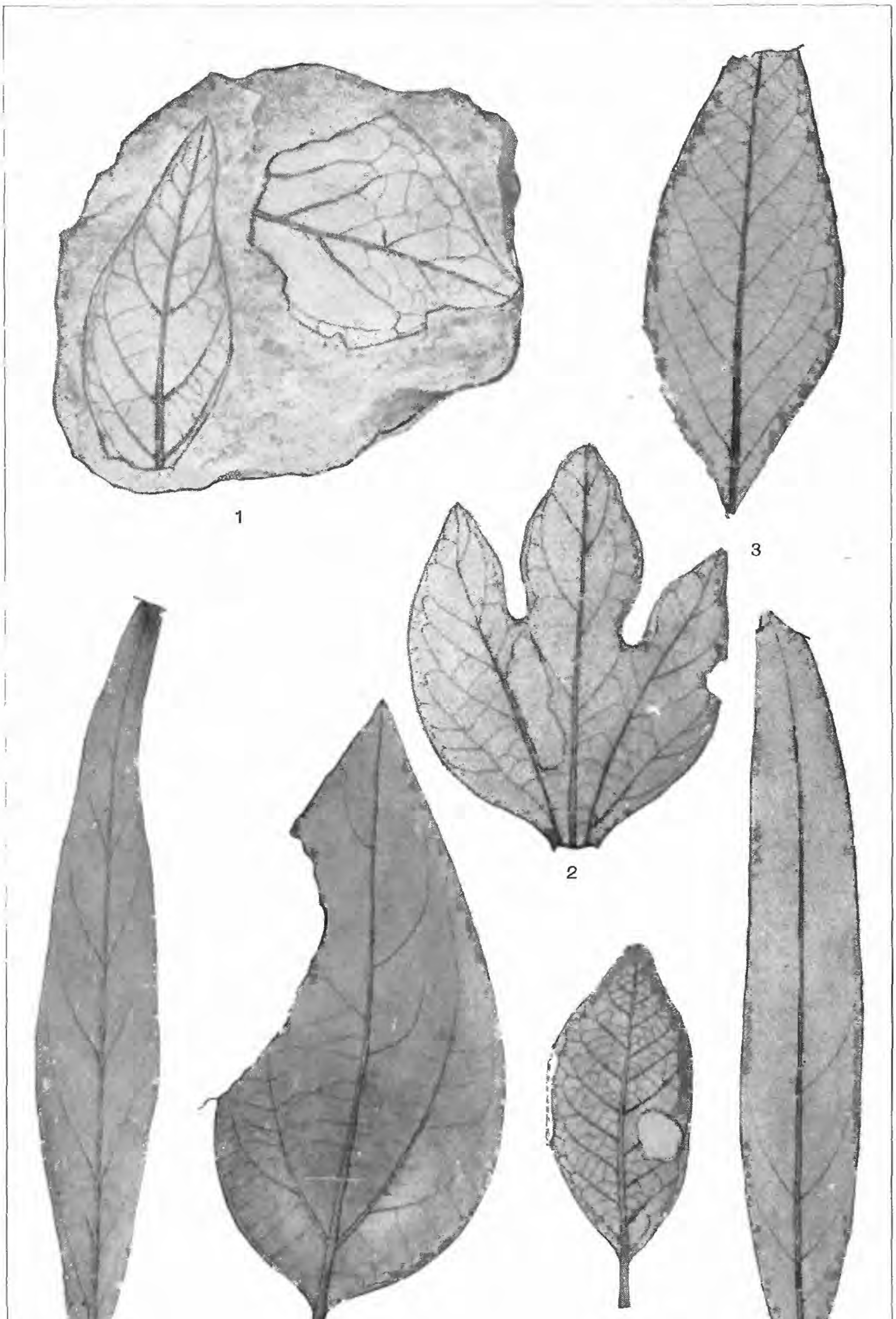
CHARACTERISTIC FOSSILS OF THE GOODLAND LIMESTONE.

1, 1a, 1b. Exogyra texana Roemer.
2a, 2b. Gryphæa marcoui Hill and Vaughan.
3a, 3b. Pseudodiadema texanum Roemer.
4a, 4b. Enallaster texanus Roemer.



CHARACTERISTIC FOSSILS OF THE WASHITA GROUP.

1, 1a. Gryphæa navia Hall (Kiamichi formation).
2, 2a. Gryphæa washitaensis Hill (Caddo formation).
3, 3a. Schloenbachia leonensis Conrad (Caddo formation).
4, 4a, 4b. Ostrea quadriplicata Shumard (Bokchito formation).
5, 5a. Gryphæa mucronata Gabb (Bennington limestone).
6, 6a. Exogyra arietina Roemer (Bennington limestone).



FOSSIL LEAVES FROM THE WOODBINE FORMATION.

1. Diospyros steenstrupi? Heer.
2. Lindera venusta Lesq.
3. Diospyros primæva Heer.
4. Andromeda pfaffiana Heer.
5. Cinnamomum heeri Lesq.
6. Salix hayei Lesq.
7. Myrica longa Heer.

BINGEN SAND

CHARACTERIZATION AND DISTRIBUTION

The near-shore character of the Bingen sand is in such contrast to the overlying and underlying Cretaceous marls and in the outcrop is so similar to the overlying sandy surficial deposits of the Late Tertiary that in Arkansas it has heretofore, with the exception of a limited outcrop near Morris Ferry, either been confused with the surficial deposits or been regarded as an outlier of the Lower Eocene beds, which it closely resembles lithologically.[a]

This formation consists of white or brown sands and clays containing some greensand and considerable lignite or ligniferous matter, in which respect it differs from the overlying formations. It forms, where best developed in Arkansas (Pl. III, in pocket), a sandy country with many springs. Its most easterly outcrop is on Ouachita River just below the mouth of De Roche Creek, where it is represented by a thin bed of lignite with accompanying sands.[b] Across Clark County there are many small outcrops along the edge of the Paleozoic rocks—notably at Big De Gray Creek (sec. 3, T. 7 S., R. 20 W.), near Hollywood, and at Clear Springs.[c] In Pike County it leaves the Paleozoic border (Pl. III) and is well developed about Bingen, from which locality Hill named the formation in 1888,[d] between Nashville and Centerpoint, around and north of Mineral Springs and north of Ben Lomond.

The section at the "Coal Shaft" near Ben Lomond (NW. ¼ SE. ¼ sec. 32, T. 10 S., R. 29 W.) is as follows.

Section at "Coal Shaft" near Ben Lomond, Ark.

		Feet
1	Hillside, covered	
2	Soft gray and brown, finely laminated sandstone with poor leaf impressions	8
3	"Coal"—impure sandy lignite of no commercial value	1 5
4	Irregularly bedded white sand, with some vegetable matter and thin plates of iron	4

Elevation of base of section is approximately 300 feet above sea level.

Half a mile south of this outcrop the Marlbrook beds, containing many typical fossil oysters, show in the hillsides, and these Coal Bluff beds must be regarded as very near the top of the Bingen formation. The character and thickness of the beds between this outcrop and the limited outcrop of greensands near Morris Ferry, described by Hill, which occur near the base of the Bingen formation, is largely a matter of conjecture. They have not yet been completely penetrated with a drill, and the outcrops thus far seen are too fragmentary and meager to indicate clearly their character. Mr. R. W. Smith, who has had an extensive experience in drilling wells, states (well 386[e]) that around Albrook below the "coal bed," which is encountered at the base of the marl, there are 100 feet of fine porous sandstone. This

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[a] Hill, R. T., Ann. Rept. Geol. Survey Arkansas for 1888, vol. 2, 1888, pp. 56-58; Bull. Geol. Soc. America, vol. 5, 1893, p. 309, pl. 12; Twenty-first Ann. Rept. U. S. Geol. Survey, pt. 7, 1901, p. 195, fig. 21.

[b] Hay, O. P. The northern limit of the Mesozoic rocks in Arkansas. Ann. Rept. Geol. Survey Arkansas for 1888, vol. 2, 1888, p. 265.

[c] Ibid., pp. 267-269, 272, 274-275.

[d] Ann. Rept. Geol. Survey Arkansas for 1888, vol. 2, 1888, pp. 56-58.

[e] See Chapter V.

probably does not represent the entire thickness of the formation, and additional water-bearing sands with intercalated clay layers are to be expected below At Ben Lomond (well No 717[a]) below the first water-bearing sandstone, which is 100 feet thick and stratigraphically below the lignite outcropping at the "Coal Shaft" above mentioned, a "blue rock and a white substance, like glass," are reported, below which water-bearing gravel is encountered The total thickness of the formation along the outcrop in southern Howard County, Ark , is over 500 feet (Pl. XXXVII, sec F, p. 70)

RELATION TO TEXAS AREA

To the west and south the beds below the Brownstown and Taylor marls thicken rapidly, and the various sand beds encountered together in southern Sevier and Howard counties, Ark , become greatly separated by layers of clay Thus the sand which is encountered in Arkansas immediately below the Brownstown marl, or 200 to 300 feet below the Annona chalk, is reached in wells at Clarksville, Tex., (1112, 1114[a]), 500 feet below the Annona chalk, or at about the base of the Taylor formation (fig 4) At this point, however, because of the interposition of the Eagle Ford formation—a black clay containing some selenite crystals and characterized by species of shells not yet found in the Arkansas region—the water-bearing bed is 500 feet above the uppermost Woodbine Similarly the pack sand encountered in the Paris, Tex , well[b] between 60 and 80 feet and apparently at the same horizon, is 600 to 700 feet above the top of the Woodbine and 1,100 to 1,300 feet above its base The Bingen sand, then, while the lithological counterpart of the Woodbine formation, is apparently the time equivalent of all the beds of the lower Cretaceous below the Brownstown and Taylor formations, a fact which indicates that during the early part of the upper Cretaceous this region was relatively stationary, while the country to the west was subjected to considerable oscillation.

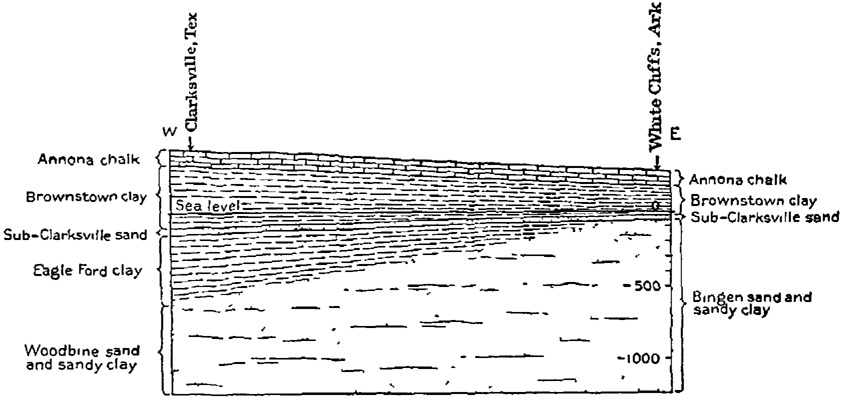

FIG 4 —Diagram showing the relation of upper Cretaceous beds, below the Annona chalk, in the sections at White Cliffs, Ark , and Clarksville, Tex

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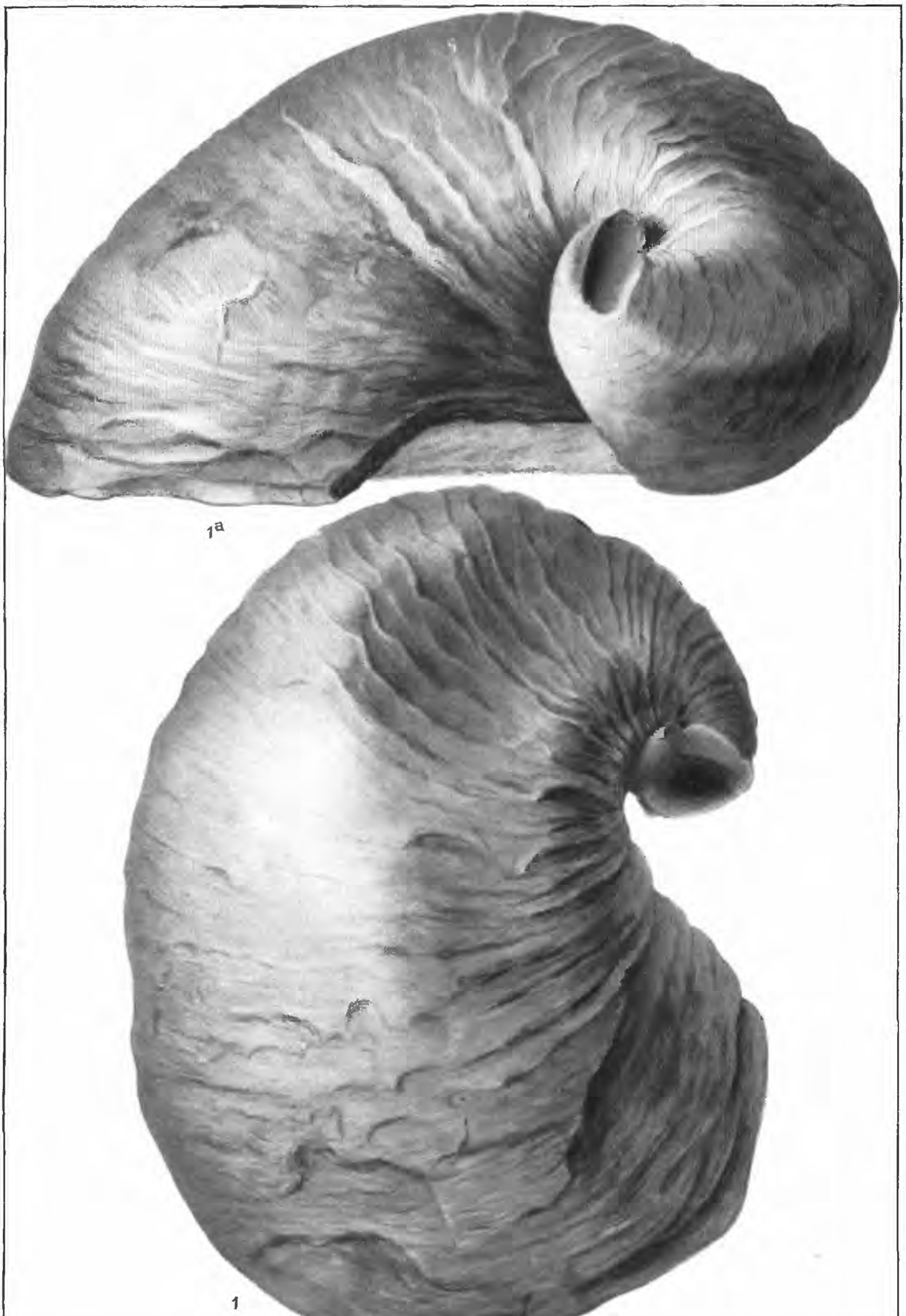
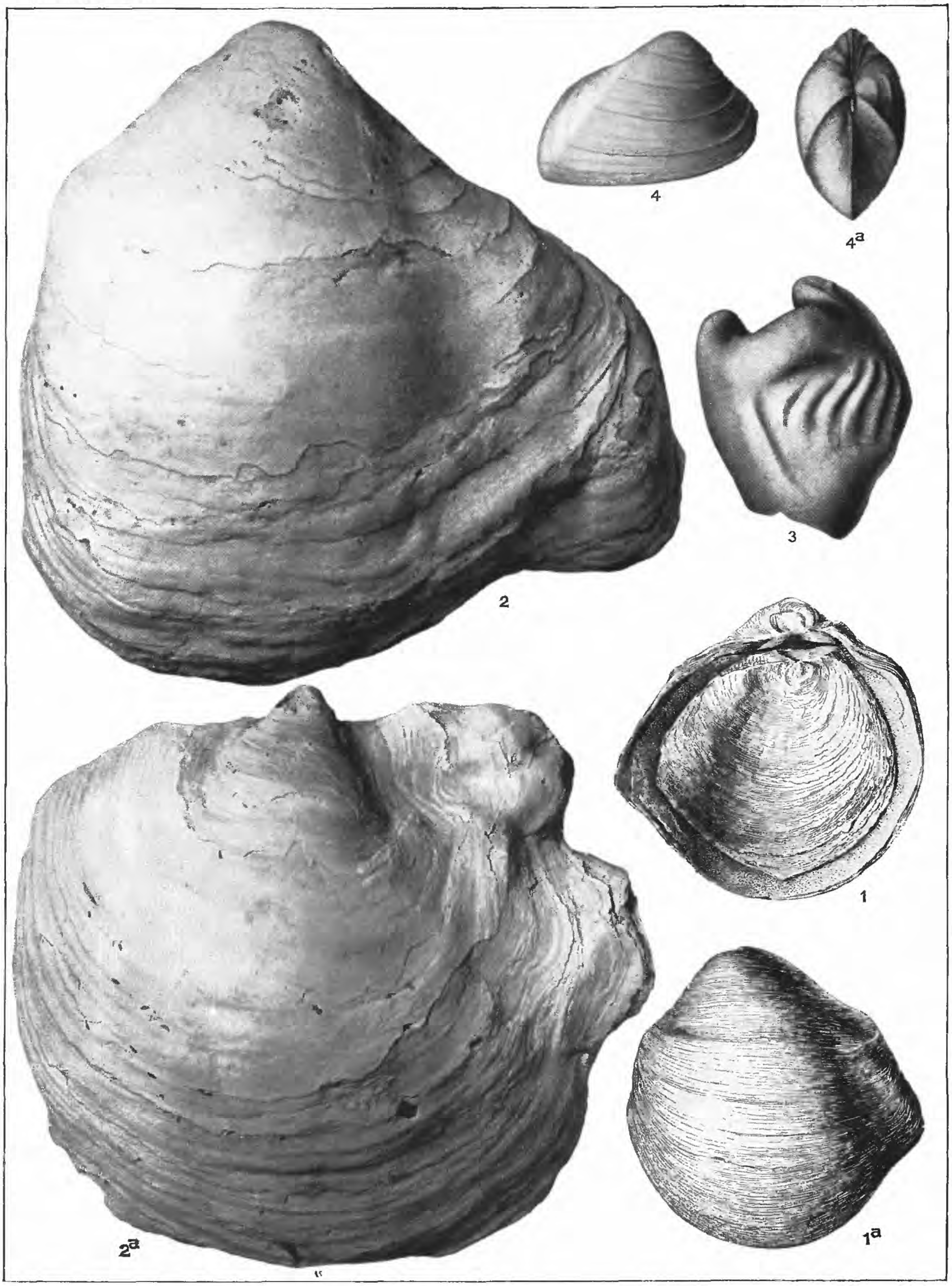
[a] See Chapter V

[b] Twenty-first Ann. Rept U S Geol Survey, pt 7, 1901, p 629



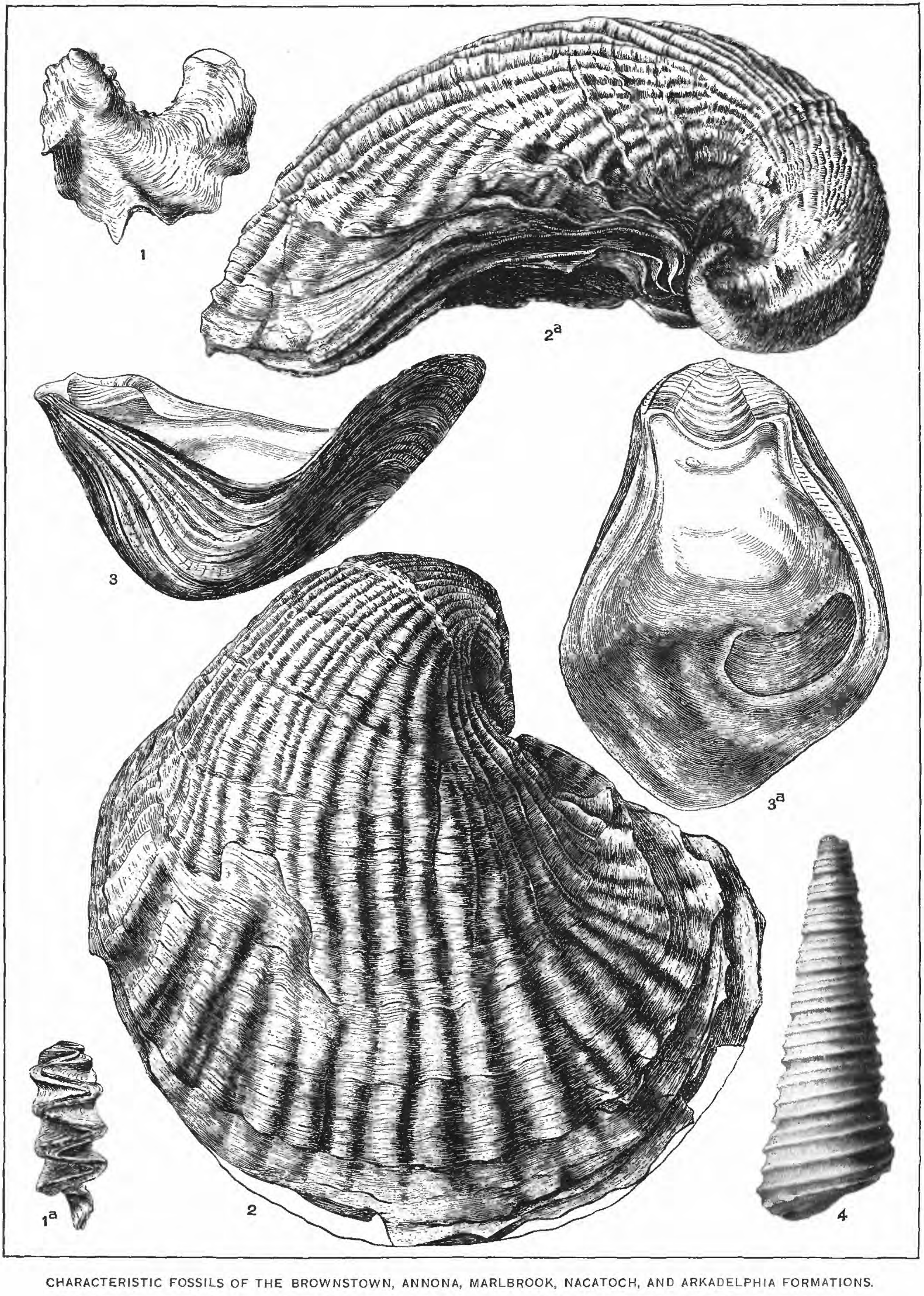
THE CHARACTERISTIC FOSSIL OF THE BROWNSTOWN FORMATION.

1, 1a. *Exogyra ponderosa* Roemer (× 5/6).



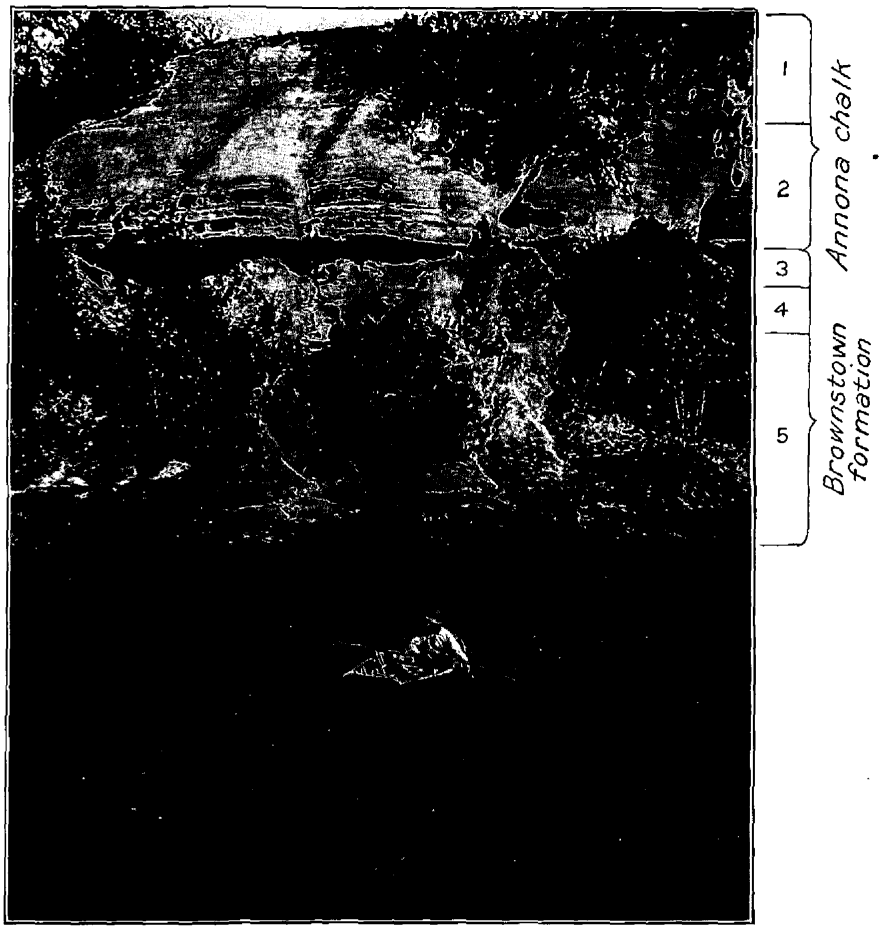
CHARACTERISTIC FOSSILS OF THE BROWNSTOWN, ANNONA, MARLBROOK, NACATOCH, AND ARKADELPHIA FORMATIONS.

1, 1a. Gryphæa vesicularis Lamarck. This small form is common in the upper part of the Brownstown formation, and the species is found in all the formations mentioned.
2, 2a. Gryphæa vesicularis. This large form is characteristic, in Arkansas, of the base of the Saratoga chalk or mid-Marlbrook formation.
3. Pugnellus densatus Conrad.
4, 4a. Veniella lineata (Shumard).



CHARACTERISTIC FOSSILS OF THE BROWNSTOWN, ANNONA, MARLBROOK, NACATOCH, AND ARKADELPHIA FORMATIONS.

1, 1a. Ostrea larva Lamarck (Brownstown, Marlbrook, Nacatoch, Arkadelphia formations).
2, 2a. Exogyra costata Say (Marlbrook, Nacatoch, and Arkadelphia formations).
3, 3a. Ostrea subspatulata Forbes (Nacatoch and Arkadelphia formations).
4. Turritella trilira Conrad.



A. BLUFF AT WHITE CLIFFS LANDING, ARK.

Showing contact between the Annona chalk and the Brownstown formation. Photograph by J. A. Taff.

B *C*

B, C. OUTCROPS OF NACATOCH SAND IN NACATOCH BLUFF, CLARK COUNTY, ARK.

The hard ledges, when encountered in wells, are called "water rocks," because water is commonly found beneath them.

OUTCROPS OF THE BROWNSTOWN, ANNONA, AND NACATOCH FORMATIONS.

SUB-CLARKSVILLE SAND

For convenience of reference the sand bed which in the Clarksville and Paris wells occurs near the base of the Brownstown (Taylor) formation and which to the east is found at the top of the Bingen sand (fig. 4) will be called the sub-Clarksville sand, from its typical development in the wells at Clarksville, Tex.

BROWNSTOWN FORMATION.

The Brownstown formation, into which the Bingen sand gradually grades, is well developed in the southern part of Sevier County, Ark., about Brownstown, from which place it takes its name. It is a blue or gray calcareous clay containing many fossil oysters and is characterized by the presence of the large oyster *Exogyra ponderosa* (Pl IX), whence it has sometimes been called the Exogyra ponderosa marl The soil derived from this formation, when not mixed with surficial deposits, is black and waxy, but the subsoil is yellow, and in most of its outcrops the bed is a yellow clay marl. It is limited above by the Annona chalk and has a total thickness of 150 feet in the eastern part of the area and 600 feet in the western

This name was first applied by Hill to marl beds typically developed at Brownstown, Ark , which at that time he thought were above the Annona (White Cliffs) chalk [a] In his report on the geology of part of Texas, Indian Territory, and Arkansas adjacent to Red River he used Brownstown to include all the beds between the Annona chalk and Washington (Nacatoch) beds.[b] Later, appreciating that the beds at Brownstown are below the Annona chalk, he gave them their right stratigraphic position, but included with them the marls which overlie the Annona chalk [c] The term is now defined to include the blue clay marls between the Bingen sand and the Annona chalk.

ANNONA CHALK.

This formation, which was first called the White Cliffs chalk[d] from the bluffs and village of that name on Little River, in the northeastern part of Little River County, Ark , was renamed the Annona chalk[e] from the town of Annona, Red River County, Tex , because it was found that White Cliffs as a formation name had been applied by Powell[f] to certain Juratrias beds in Utah It consists of white chalk, which at White Cliffs has a thickness of over 100 feet, but thins out rapidly to the east, disappearing entirely before reaching Okolona, where Taff has found only the chalky marl which, at the type locality, underlies it To the west outcrops are found at Rocky Comfort and across southern Red River and Lamar counties in Texas

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[a] Ann Rept Geol Survey Arkansas for 1888, vol 2, 1888, pp 86–87

[b] Bull Geol Soc America, vol 5, 1894, p 302, pl 12

[c] Twenty-first Ann. Rept U S Geol Survey, pt 7, 1901, p 340

[d] Hill, R T , Ann. Rept Geol Survey Arkansas for 1888, vol 2, 1888, pp 87–89

[e] Hill, R T , Bull Geol Soc America, vol 5, 1894, p 308, Twenty-first Ann Rept U S Geol Survey, pt 7, 1901, p 340 Hill's spelling Anona has been changed to Annona, the spelling used in the Postal Guide and on Hill's map of the Black and Grand prairies of Texas, 1899 (Twenty-first Ann Rept U S Geol Survey, pt 7, 1901, pl 65)

[f] Geology of Uinta Mountains U S Geog and Geol Survey Terr , 1876, pp 41, 51, 151

The section at White Cliffs Landing (Pl. XII, *A*, p 28) is as follows

Section at White Cliffs Landing, Little River County, Ark [a]

		Feet
1	Massive creamy-white chalk, in beds from 1 to 10 feet thick, separated by thin partings of very slightly laminated chalk	60
2	Massive, dull bluish-white siliceous chalk, slightly harder than the pure chalk of 1 This chalk is practically without indication of bedding, and because of its hardness it projects in a steep bench overhanging the less chalky and friable beds below	25
3	Massive, very siliceous, dull-blue argillaceous chalk marl This bed contains more than twice as much sand and nearly three times as much clay as the overlying bed The rock is very friable and weathers in recesses beneath the siliceous chalk	8
4.	Bluish, sandy, chalky marl, containing great numbers of the fossil shell *Gryphæa vesicularis* var Except for the abundant fossils this rock would be classed with 3, though it is probably slightly more sandy	7
5.	Bluish, sandy, chalky marl, gradually increasing in sandiness from the top downward to the level of the river This bed contains *Gryphæa vesicularis* var , but not in such abundance as 4, also many fossils of the large and heavy oyster *Exogyra ponderosa*, as well as others common to the upper Cretaceous marls	35

MARLBROOK FORMATION.[b]

The Annona chalk is succeeded by a series of blue, chalky, somewhat glauconitic marls, in places impure chalk The most extensive outcrops of this formation are along the ridge which extends from Marlbrook, the type locality in Hempstead County, to Saratoga, in southern Howard County (Pl III, in pocket). It forms a stiff black soil in which the skull-shaped oyster *Gryphæa vesicularis* (Pl. X) is very abundant About 200 to 300 feet above the base of this formation is a very chalky layer 20 to 50 feet thick, which has been called the Saratoga chalk marl or the Saratoga formation.[c] It is exposed in the Marlbrook-Saratoga region at the town of Okolona, where it is called "cistern rock,"at Dobyville, and on Little and Big Deciper creeks in Clark County It is reported in well borings at Gurdon (83), at Texarkana (480), and possibly at Frierson, La. (871) The thickness is 120 feet at Gurdon (probably including large amounts of chalky marl not properly referable to this horizon), 70 feet at Texarkana, and 25 feet at Frierson

The thickness of the Marlbrook formation ranges from 750 feet at Texarkana (well 480A) to 50 feet or less at Arkadelphia

NACATOCH SAND.

Above the Marlbrook marl is a series of sandy beds which are of vast economic importance to a strip of country along the Iron Mountain Railway between Arkadelphia and Texarkana, since they are the source of the main water supply of that region. Like the other sandy beds of the Cretaceous, at the outcrop they are distinguished with difficulty from the surficial sands that mantle the region However, the thousands of wells which have been sunk to this horizon (Pl. XXXVIII,

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[a] Taff, J A , Twenty-second Ann Rept U S Geol Survey, pt 3, 1902, pp 706-707

[b] Marlbrook chalk marls, Hill (Ann Rept Geol Survey Arkansas for 1888, vol 2, 1888, p 188)=Gryphæa vesicularis chalk marls, Hill (Ibid , pp 84, 188) =Marlbrook-Columbus chalk marls, Hill (Ibid , p 84) It is probable that the Marlbrook formation as here used contains in its upper portion beds which Hill classed with the Washington (Nacatoch) greensand. See p 27

[c] Branner, J C , Trans Am Inst Min Eng , 1897, pp 42-63, Taff, J A , Twenty-second Ann Rept. U S Geol Survey, pt 3, 1902, pp 714-723

in pocket) prove conclusively that the outcrop of this bed produces the belt of sandy land which begins on Yellow Creek south of Saratoga and extends, with interruptions of greater or less importance, along the main drainage channels, through Washington, De Ann, Garlandville, Nacatoch Bluff, and Keyton, and finally reaches Ouachita River at High Bluffs above Arkadelphia

The outcrop at Nacatoch Bluff, on Little Missouri River, in Clark County, is one of the most complete exposures occurring along this belt and shows the calcareous and quartzitic rocks which, when encountered in wells, are called "water rocks" (Pl. XII, *B*, *C*)

Section of Nacatoch Bluff on Little Missouri River, Clark County, Ark

		Feet	
1	Slope not well exposed, seems to be composed entirely of chert and quartz gravel	20	
2	Ledge of fossiliferous arenaceous limestone, containing many large fossil shells *Exogyra costata*, *Pectunculus* sp , and *Ostrea subspatulata*	1	
3	Sand	10	
4	Very impure sandy limestone or calcareous sandstone, with many imperfect fossils	0	1
5	Sand	4	
6	Hard fossiliferous calcareous sandstone	0	5
7.	Sand	5	
8	Slope on which landslip masses render positive determination difficult, seems to be composed of sand	25	
	Level of Little Missouri River		

Another exposure near the base of the formation occurs at Keyton. The lithological characters of this outcrop are such that, like parts of the Bingen, if it were not for the known slope of the rocks and the general structure of the country, one would be inclined to refer it to the Eocene, as has indeed been done.

Section of bluff at ford on Terre Noir Creek, at Keyton, Clark County, Ark

		Feet
1.	Fine white clayey sand, with occasional clay seams and clay pebbles, sand ranges from pure white to light yellow	30-35
2.	Laminated black clay, with white sand partings	12
	Low-water level of creek	

In the western part of this region the sands are rather light in color, although about Hope they are overlain by a very black sandy layer 3 to 15 feet thick, and have an aggregate thickness of about 100-160 feet (wells 244, 321, 322, 332, 356, 444, 478, 480, 480A) Toward Arkadelphia the sand grows darker and thinner. In the well of the Arkadelphia Ice and Fuel Company (27) it appears to extend from 100 to 160 feet, and is therefore about 60 feet thick

The beds described by Hill in 1888 as the "Washington greensand" or the "Washington or High Bluff greensand"[a] are doubtless very nearly equivalent to the Nacatoch sand as used in this report, and this older name would have been adopted here, but it was found to be preoccupied by the name "Washington County group," used by Stevenson in 1876[b] The term "Washington greensand" has never been very closely defined, but the writer is inclined to believe that it includes a portion of the greensand marls which in the present classification are included in the Marlbrook formation, the term "Nacatoch" being restricted to the sandy beds.

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[a] Ann Rept Geol Survey Arkansas for 1888, vol 2, 1888, pp 72-75, 188

[b] Second Geol Survey Pennsylvania, Rept K, 1876, pp 44-56

ARKADELPHIA CLAY.

The dark laminated clays which overlie the Nacatoch sand and form the "blue dirt" of the well drillers along the line of the Iron Mountain Railway from Arkadelphia to Texarkana were named by Hill in 1888 the Arkadelphia shales, from the outcrops at Arkadelphia, Clark County[a] These beds contain uppermost Cretaceous fossils for 100 to 200 feet above the Nacatoch sands, the fossil-bearing beds being well developed on Yellow Creek 3 to 4 miles northwest of Fulton, 5 to 6 miles north of Hope, north and northwest of Emmet, and at Arkadelphia (See Pl III) Thus far no fossils have been found in the upper portion of this formation, which extends without any apparent break to the Eocene sand beds forming the sandy hills (the *crest of the Sulphur Wold, Pl I, A, p 14) south of the Iron Mountain Railway* This absence of fossils, together with the fact that the Midway (Eocene) formation, though commonly characterized by limestones, contains dark-colored clays, makes the exact determination of the top of the Cretaceous in this section particularly difficult

In only four of the many wells which have penetrated the top of this formation[b] has any suggestion been found of a basis for division below the lower Eocene sand beds. At Uni, La , shell marl is reported in two wells (835, 836) at a point 150 feet below the sandy beds of the lower Eocene, and the writer is strongly inclined to believe that this shell marl is Midway (Eocene) (Pl XXXVII, sec F, p 70), as is likewise the marl reported in the wells at Furrh, La (802), and Waldo, Ark. (141), (Pl XXXVII, secs. H, I)

The total thickness of the Arkadelphia clay, excluding the beds which appear to be stratigraphically Eocene, is from 200 to 300 feet at Arkadelphia, 500 feet at Lanesburg, 500 to 600 feet at Hope and Spring Hill, and 500 feet at Texarkana and Shreveport.

IGNEOUS INTRUSIONS DURING THE UPPER CRETACEOUS.

At a number of points in Arkansas and Texas, near the old shore line of the upper Cretaceous sea, limited outcrops of igneous rocks have been found Some of these, like the eleolite-syenites[c] at Magnet Cove and Hot Springs, Garland County, Ark., are now entirely within the Paleozoic rocks; others as the peridotite dike[d] at Murfreesboro, Ark., and the several basaltic and phonolitic intrusions around and west of Austin, Tex ,[e] cut the Cretaceous deposits; and still another group, the eleolite-syenites (Fourche Mountain granite) occurring near Little Rock and Benton, Ark , is surrounded by lower Tertiary sediments.[c] (Pl III, in pocket) No lava flows or other effusive materials have been found associated with these igneous rocks, which it appears, represent cracks filled with molten matter rather than centers of volcanic activity

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[a] Ann Rept Geol Survey Arkansas for 1888, vol 2, 1888, pp 53-56

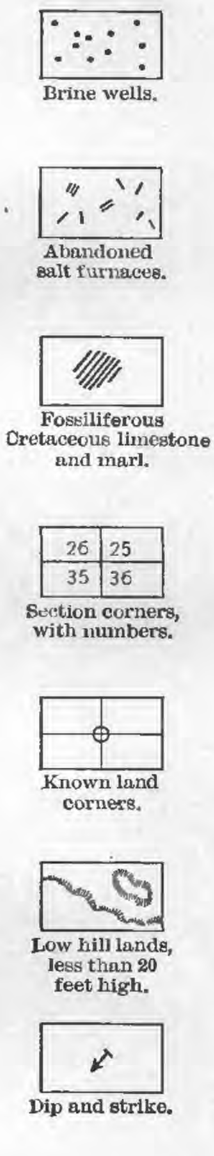
[b] For example, those about Lanesburg and Verde in southern Nevada County (563, 621, 625), about Hope (321), Spring Hill (344-353), and along Red River (196-202, 464), in southern Hempstead County, at Texarkana (478, 480, 480A), Dixie, La (799), Bossier City, La (785), Lake Point, La (788), Shreveport, La (806), and Frierson, La (871)

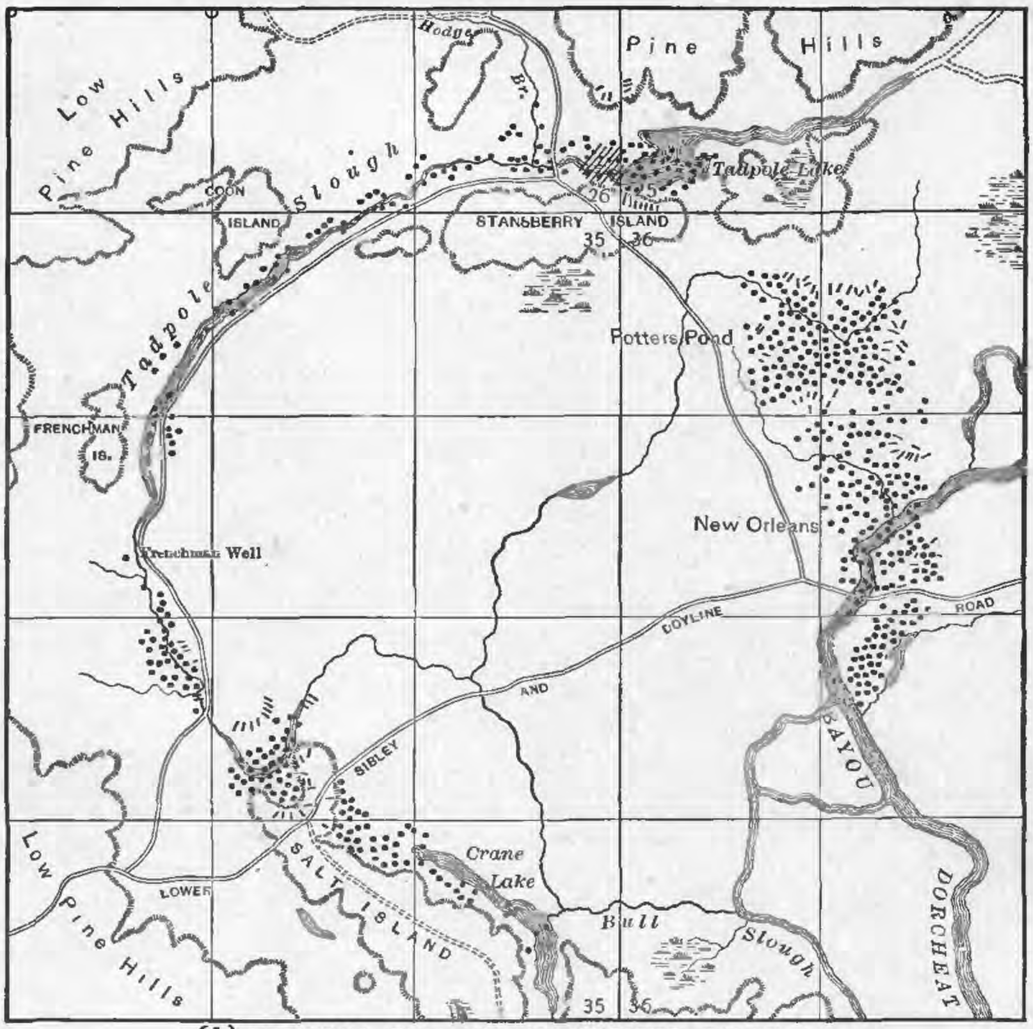
[c] Williams, J F , The igneous rocks of Arkansas Ann Rept Geol Survey Arkansas for 1890, vol 2, 1891, pp. 1, 2, 5.

[d] Ibid , pp 377-386

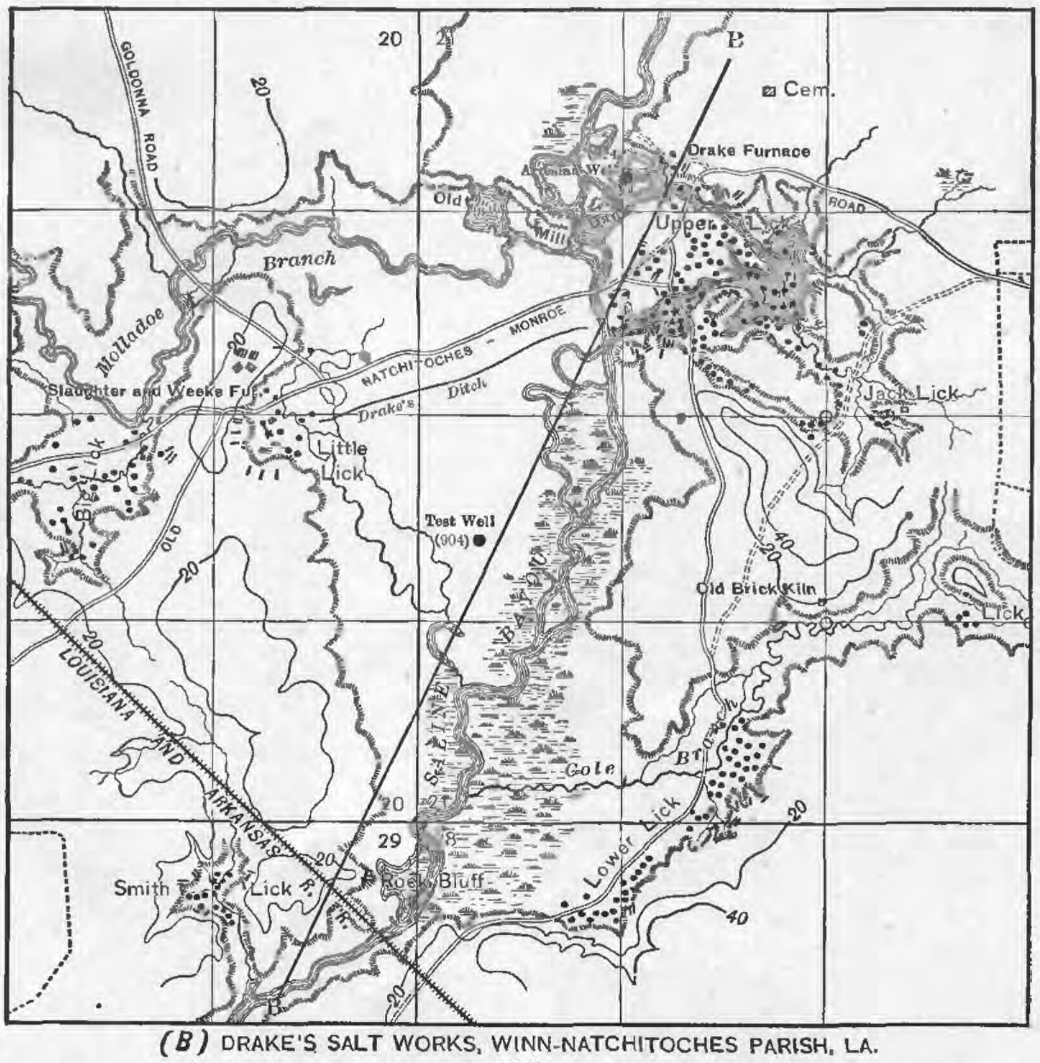
[e] Hill, R T , Eighteenth Ann Rept U S Geol Survey, pt 2, 1898, pp 256-257.

LEGEND





(A) BISTINEAU SALT WORKS, WEBSTER PARISH, LA.
1900.



(B) DRAKE'S SALT WORKS, WINN-NATCHITOCHES PARISH, LA.
1899.

MAPS SHOWING CHARACTERISTIC, SYMMETRICAL, CIRCULAR ARRANGEMENT OF SHALLOW BRINE WELLS AROUND THE TRUNCATED DOMES OF NORTHERN LOUISIANA.

BY A. C. VEATCH

Scale

0 ¼ ½ ¾ 1 mile

The exact time at which these intrusions took place has not been fixed definitely, but Williams is inclined to believe that these in Arkansas occurred near the end of the Cretaceous, certainly before the deposition of the Sabine sediments In the Texas region Hill has found evidence that some of the intrusions were made as early as the deposition of the Austin chalk

DEVELOPMENT OF DOME-LIKE FOLDS INLYING AREAS OF THE UPPER CRETACEOUS IN NORTHERN LOUISIANA AND EASTERN TEXAS

Other disturbances during the late Cretaceous or very early Eocene resulted in the formation of a number of steep domes or four-sided folds (quaquaversals) on the sea bottom in what is now northern Louisiana and eastern Texas (Pl XXXVII, p 70) Whether the forces producing these unique domes were in any way associated with those producing the intrusions just mentioned it is as yet impossible to say, but the irregularity of their distribution, the great symmetry of all the domes which have been carefully studied[a] (Pl XIII, fig 5), the difficulty of explaining this symmetry by any manner of folding not associated with igneous intrusions, and the suggestion which this symmetry carries of force applied at one point from below, just as a sharp-pointed little dome might be formed in a sheet of dough by pushing upward with a blunt pencil, indicate similar igneous intrusions beneath these great thicknesses of relatively plastic, recently deposited Cretaceous sediments as the cause of these domes[b]

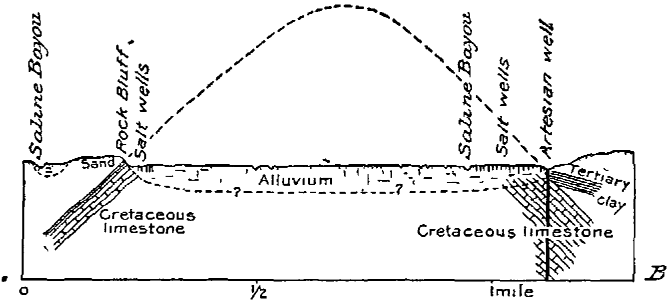


FIG 5—Cross section at Drakes Salt Works, Louisiana, along line B-B, Pl XIII, showing location of shallow brine wells and symmetrical truncated character of dome

Whatever their true origin, the sea floor showed, near the close of the Cretaceous, or in the early Tertiary, a series of steep-sided, more or less circular elevations These elevations would naturally modify the conditions existing in the portions of the sea where they were sufficiently contiguous to materially interrupt the oceanic circulation, and it is perhaps to such an interruption by the Texas group of domes that the salt deposits of Grand Saline, Tex , are due

These domes were entirely buried by the Eocene sediments, and as the twelve which have thus far been found in northern Louisiana and eastern Texas (Pl XXXVI, p 68) all occur in valleys (Pls. III, in pocket; XXXVII, sec F, p 70) flanked by hills of Tertiary strata and their exposure is due to more or less accidental conditions of erosion, it is quite probable that others will be encountered when the country is more thoroughly prospected. This probability introduces a decided element of uncertainty into the artesian-well prospects of this region.

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[a] See Veatch, A C The salines of northern Louisiana. Geol. Survey Louisiana, Rept. of 1902, pp. 41-100

[b] See footnote p 67.

In determining the amount of deformation represented it is necessary to ascertain with some degree of accuracy the age or stratigraphic position of the beds exposed in these domes. At the Anderson[a] and Brooks[b] salines in Texas and at the Bisteneau, Kings, and Rayburns salt works in Louisiana[c] fossil shells, such as *Exogyra costata*, *Gryphæa vesicularis*,[d] *Ostrea* larva, and other forms representing an uppermost Cretaceous fauna, have been found in limestone or chalk-marl deposits. These beds are the lithologic and paleontologic counterparts of the Marlbrook division of the Arkansas section, and may be tentatively referred to it. If of Marlbrook age the displacement to the present top of the dome is 1,100 feet (Pl. XXXVII, sec. D, p. 70). The original height of the top of the dome is not known, but the present truncated top is 1¼ miles in diameter (Pl. XIII), and the removed portion must have had a thickness of many hundred feet. The known displacement at Kings and Rayburns is about the same, but the total displacement was probably somewhat less, as is indicated by the smaller area of their truncated tops.

The beds exposed in the Winnfield dome are nonfossiliferous, light-colored, porous crystalline limestone in which the cavities are filled with sharp calcite crystals. Similar porous limestones of great thickness have been encountered in wells at Drakes (904, 994) and Cedar Lick, 2 miles south of Winnfield (999), and as the structure in all these cases is the same as that at the localities carrying Cretaceous fossils, and as the limestones are totally different from any of the Tertiary sediments in this region, they are regarded as Cretaceous deposits which have been altered by the pressure and heat produced in forming the domes. These marbles could not have been formed from any of the beds above the Marlbrook, and they are therefore regarded as Marlbrook or older. The deformation represented is therefore in the neighborhood of 2,000 feet (Pl. XXXVII, sec. C, p. 70).

At Coochie Brake and Drakes, and Prices salt works, very arenaceous limestones containing leaf impressions are found in the domed areas. These, if Cretaceous—and it is difficult to see how they may be Tertiary—represent either the Nacatoch or the Bingen. At Drakes the diameter of the truncated dome is about a mile, and the observed angle of slope on one side is 45°. This indicates that the strata removed may have had a thickness of as much as 2,000 feet and that the total deformation may be 3,000 or 4,000 feet.

The deformation at the Many dome, which is capped with Midway limestone, is almost the total thickness of the Sabine in this region, or between 800 and 1,000 feet.

The greater part of the movements represented in these domes took place in late Cretaceous or early Tertiary time, certainly before the deposition of the Sabine sediments, which show no signs of deformation of this magnitude. However, it seems probable that these points have been the loci of slight movements since that time, and that the relatively great dip of the Claiborne beds immediately surrounding the Winnfield dome is due to such a slight movement rather than entirely to deposition on a highly inclined surface.

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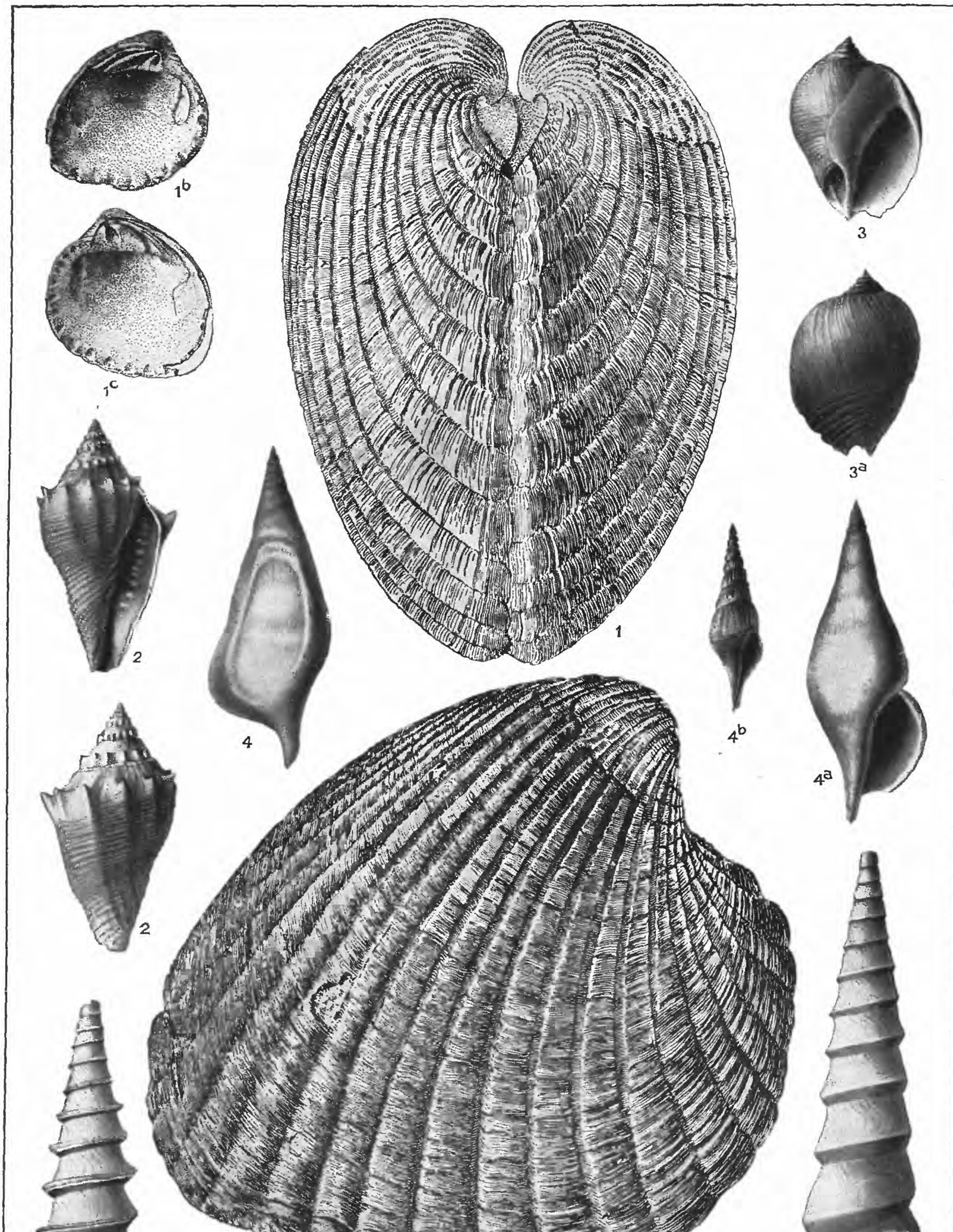
[a] Dumble, E. T., Second Ann. Rept. Geol. Survey Texas, 1891, pp. 304, 305.

[b] Herndon, J. H., Second Ann. Rept. Geol. Survey Texas, 1891, p. 223.

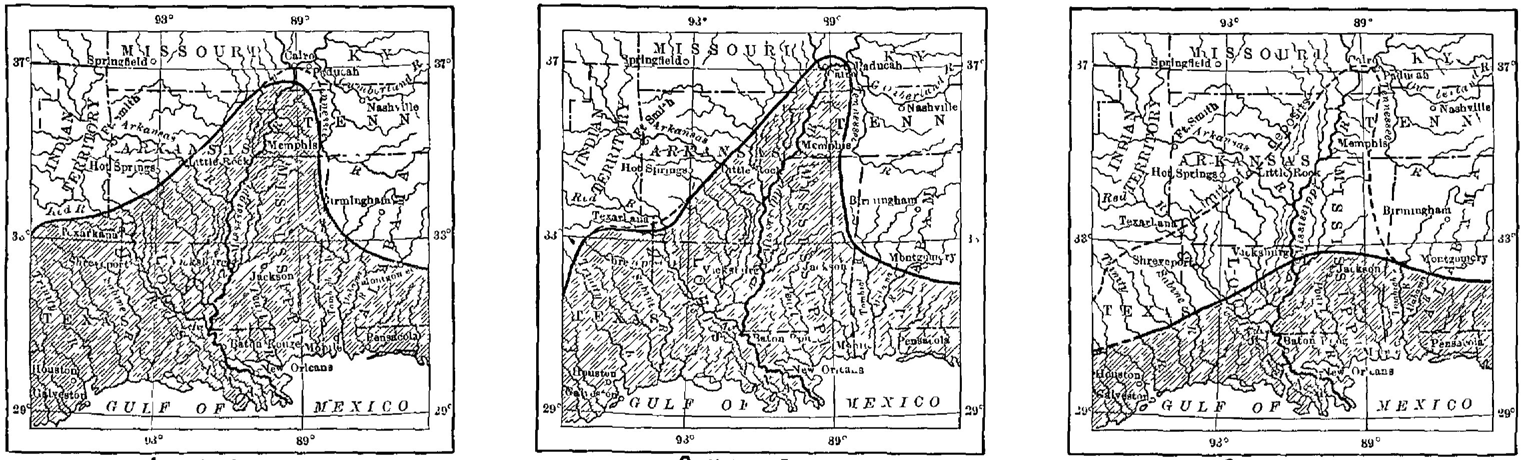
[c] Veatch, A. C., Geol. Survey Louisiana, Rept. of 1902 [1902], pp. 73, 74, 78, 86-87.

[d] The variety which Taff figures as characteristic, in Arkansas, of the base of the Saratoga or mid-Marlbrook formation: Twenty-second Ann. Rept. U. S. Geol. Survey, pt. 3, 1902, pls. 51, 52. (See Pl. X, 2, 2a, p. 26.)



CHARACTERISTIC FOSSILS OF THE EOCENE EPOCH.

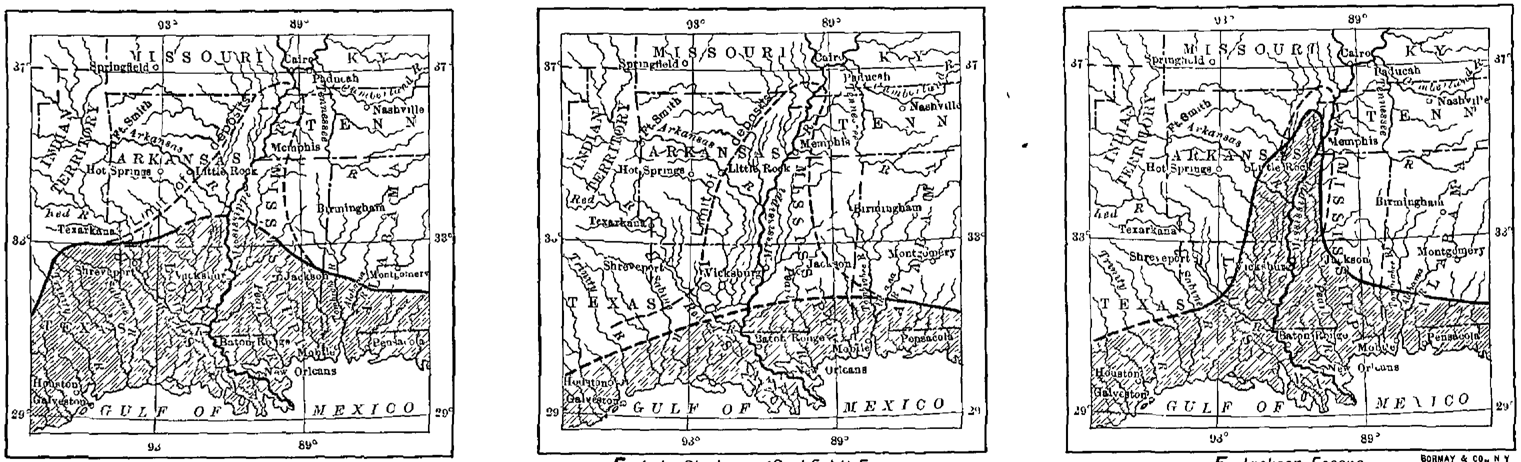
1, 1a, 1b, 1c. *Venericardia planicosta* Lamarck (Midway, Sabine, Claiborne, and Jackson formations).
2, 2a. *Volutilithes petrosus* Conrad (Sabine, Claiborne, and Jackson formations).
3, 3a. *Pseudoliva vetusta* Conrad (Midway, Sabine, Claiborne, and Jackson formations).
4, 4a, 4b. *Calyptraphorus velatus* Conrad (4b shows the *young* of this species; Midway, Sabine, Claiborne, and Jackson formations).
5, 5a. *Turritella mortoni* Conrad (Midway and Sabine formations).



A-Ripley Cretaceous

B-Midway Eocene

C-Sabine Eocene



D-Early Claiborne Eocene

E-Late Claiborne (Cockfield) Eocene

F-Jackson Eocene

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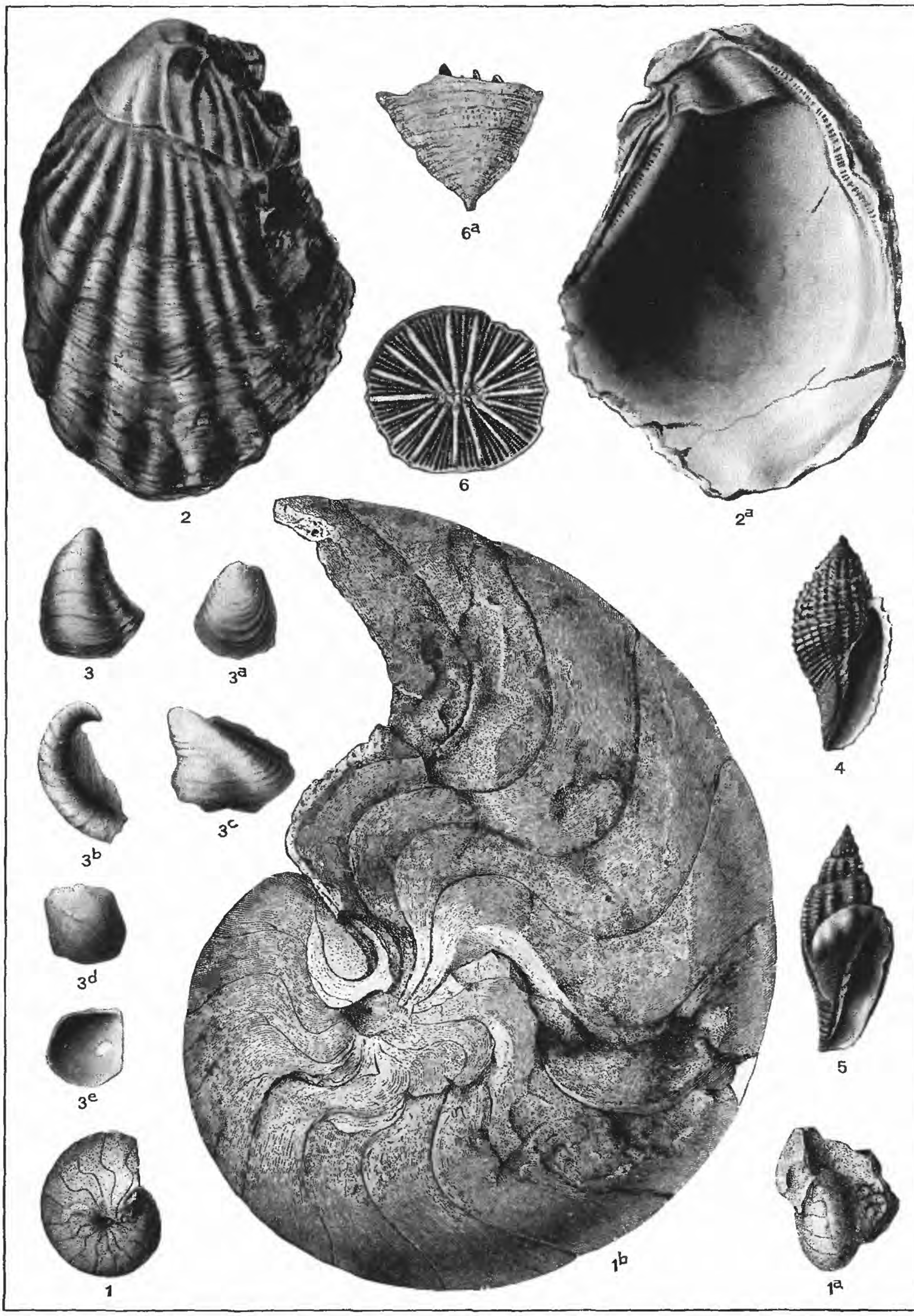
SKETCH MAPS SHOWING AREAS UNDERLAIN, IN WHOLE OR IN PART, BY BEDS CONTAINING MARINE MOLLUSKS OF THE RIPLEY CRETACEOUS AND EOCENE EPOCHS, AND INDICATING THE POSITIONS OF AREAS IN WHICH THE CONDITIONS WERE FAVORABLE FOR THE GROWTH OF MARINE FAUNAS.

BY A. C. VEATCH

Scale

100 0 100 200 300 400 500 600 miles

1904



CHARACTERISTIC FOSSILS OF THE MIDWAY FORMATION.

1, 1a, 1b. Enclimatoceras ulrichi White.
2, 2a. Ostrea crenulimarginata Gabb.
3, 3a, 3b, 3c, 3d, 3e. Ostrea pulaskensis Harris.
4. Volutilithes limopsis Conrad.
5. Volutilithes rugatus Conrad.
6, 6a. Flabellum conoideum Vaughan.

TERTIARY.

EOCENE

CONDITIONS OF DEPOSITION.

The change from the Cretaceous to the Tertiary in this region is much more of a paleontologic than a stratigraphic break, many of the genera and all of the species of mollusks inhabiting the Cretaceous sea disappeared at the close of the Cretaceous, as if by magic, to be replaced by the entirely new fauna which inhabited the Eocene ocean

No stratigraphic break at all commensurate with the paleontologic break has been discovered in this region, and the abrupt change in the animal life is, as Dana suggests,[a] perhaps due more to an alteration in the direction and character of the ocean currents, with the consequent change in temperature and food supply, and to the destructive effects of earthquake waves resulting from the gigantic disturbances which produced the Rocky Mountains, than to a time lapse.

Midway epoch—Certainly the earliest Eocene deposits, the Midway formation, are sediments indicating depths and distribution of water which are but the normal continuation of the Cretaceous conditions (compare *A* and *B*, Pl. XV), to which cycle of deposition (p 22) they seem more properly to belong This fact, with the presence of the Midway on the top of two of the domes, at Kings and Many, suggests that the domes were formed as late as the beginning of the Sabine.

The shore line of this early Eocene ocean was roughly parallel to that of the late Cretaceous sea, and the slight deepening of the water which permitted the formation of the Midway limestone, together with a slight warping, allowed the ocean to advance farther up the Mississippi embayment than before, and made possible the deposition of marine fossils in southern Illinois,[b] while marine Cretaceous fossils have not been found north of northern Tennessee.[c]

Sabine epoch—The Mississippi embayment at this time was relatively shallow and flat bottomed—its present depth of perhaps 3,000 feet at Memphis being the result of very gradual warping accompanied by a deposition which kept pace with the lowering and which extended through the whole Eocene—and a slight elevation was sufficient to convert it into a great low-lying swamp, or marsh, occasionally submerged by the ocean. The conditions were favorable for the growth of shallow-water marine mollusca (Pl XV, *C*) only as far north as Sabine Parish in Louisiana, about 30° north latitude, and in eastern Alabama about the latitude of Meridian, Miss., and even here there was an alternation of marine near-shore and swampy conditions These deposits constitute the Sabine formation. Above these swamps, or out of the shallow-water sea, the domes projected as a unique series of circular hills, and as the progressive subsidence continued they were gradually buried beneath the swamp, estuarine, and shallow-water marine

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[a] Manual of Geology, 4th ed, 1895, pp 877-878

[b] Worthen, Geol Survey Illinois, vol 1, 1866, pp 44-46, Loughridge, Geol Survey Kentucky, Rept on Jackson's Purchase Region, 1888, pp 41-52, Harris, Geol Survey Louisiana, Rept of 1902 [1902] p 9

[c] Loughridge, Geol Survey Kentucky, Rept on Jackson's Purchase Region, 1888, p 32

deposits, doubtless undergoing in the process more or less erosion from atmospheric agencies and ocean waves.

Claiborne epoch.—A slight depression, or perhaps it would be better to say a slight excess of the rate of depression over the rate of sedimentation, in eastern Texas and along the embayment caused the marine fauna to extend farther northward and to reach in the embayment region a point a little north of the thirty-third parallel (Pl XV, *D*). Still farther north, where the water was not deep enough, or river sediments prevented the growth of marine forms, the deposition of the lignitiferous sands and clays containing no marine fossils, which had begun at the close of the Midway, continued A slight elevation, greater in Louisiana and Texas than in Alabama, converted the shallow, flat sea bottom of the early portion of the Claiborne epoch into a coastal or estuarine marsh, and in western Mississippi, Louisiana, and Texas from 200 to 500 feet of lignitiferous clays and sands with no marine fossils were laid down before the gradual oscillation of this region or changes in climatic conditions again permitted a northward transgression of the marine fauna. This group of sediments is called the Cockfield member of the Claiborne

Jackson epoch.—Following the Cockfield deposition, conditions were favorable for the growth of marine forms to a point somewhat north of Memphis (Pl XV, *F*). This, the Jackson epoch, completed the main filling of the embayment area

In the succeeding Oligocene and Miocene time the shore line retreated gulfward, and there is no evidence that during these ages there was more than a gentle curve in the coast line in the region of the old Mississippi embayment (Pl. II, *D*, p. 18).

MAJOR DIVISIONS OF THE EOCENE.

The Eocene about latitude 31° 30′ north is composed of the following major paleontologic subdivisions (1) The Midway, characterized by fossiliferous limestone, but containing some blue clay, (2) the Sabine, composed of lignitiferous sands and clays, with marine fossils in the seaward or southern portions, (3) the Claiborne, composed of very fossiliferous calcareous clay in its lower portion and lignitiferous sands and clays, with no marine fossils, in its upper (Cockfield member), and (4) the Jackson, composed of fossiliferous calcareous clays. In the upper portion of the embayment all the beds become lignitiferous and lose to a greater or less extent their distinctive marine fossils This lignitiferous complex, which can be separated only on purely stratigraphic grounds, is discussed and mapped in this report as "undifferentiated Eocene" (p. 40).

MIDWAY FORMATION.[a]

This formation, which was named by Smith and Johnson in 1887 from a landing on the west side of the Alabama River in Wilcox County, Ala ,[b] and redefined by Harris[c] to include a paleontologic group bounded below by the Cretaceous and above by the Nanafalia beds of the Sabine (Lignitic), has been traced more or less intermittently along the southern edge of the Cretaceous outcrops—or where they are missing, as in the uppermost and western parts of the Mississippi embayment, along the Paleozoic rocks—from Georgia to Colorado River in Texas and perhaps to the Rio Grande

As already indicated, its lithologic characters are more similar to the underlying calcareous Cretaceous clays and marls than to the overlying lignitiferous beds of the Sabine Although this formation is composed of irregularly bedded dark-colored calcareous clays with more or less sand, it is generally characterized by the absence of the lignitic material so common in the overlying Sabine formation and by a bed or beds of impure white limestone 10 to 25 feet thick, which, because of its lithologic resemblance, was for a long time correlated with the Cretaceous In common with other beds of the Eocene, it contains *Venericardia planicosta*, *Pseudoliva vetusta*, and forms of *Calyptraphorus velatus* and *Turritella mortoni* (Pl XIV, p 32) Among other forms which are peculiar to this formation and which are, therefore, marks of identification are *Enclimotoceras ulrichi* White, *Ostrea crenulimarginata* Gabb, *Ostrea pulaskansis* Harris, and *Volutilithes limopsis* Conrad (Pl XVI).[d]

In Arkansas the Midway limestone outcrops along the edge of the Paleozoic rocks from Bayou Departe, Independence County, to below Rockport, on Ouachita River near Malvern, Hot Springs County (Pl III, in pocket). It is particularly well developed around and south of Little Rock, where the total thickness of the beds exposed is not known to be greater than 20 feet Between the outcrops near Malvern and southwestern Travis County, Tex , no exposures are known, but from the latter point southward to Brazos River the limestone and marls form a narrow belt having a maximum width of 13 miles near Wills Point[e] The total thickness

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[a] Synonymy of the Midway formation

≡Midway stage, Harris (Bull Am Pal , vol 1, 1896, pp 11–13)

≡Midwayan stage, Dall (Eighteenth Ann Rept U S Geol Survey, 1898, table opp p 334)

=Basal or Wills Point clays, Penrose (First Ann Rept Geol Survey Texas, 1890, pp 19–22)

≡Midway (or Clayton)+Sucarnochee or Black Bluff+Naheola or Matthews Landing, Smith et al (Bull U S Geol Survey No 43, 1887, p 18, Geology of the Coastal Plain of Alabama, Geol Survey Alabama, 1894, p 27)

>Porter Creek group, Safford (Am Jour Sci , 2d ser , vol 37, 1864, p 368)

>Flatwoods clays, Hilgard (Agriculture and Geology of Mississippi, 1860, pp 110, 111, Proc Am Assoc Adv Sci , vol 20, 1871, p 222, Am Jour Sci , 3d ser , vol 2, 1871, p 391)

=Middleton formation, Safford (Bull Geol Soc America, vol 3, 1892, pp 511, 512)

NOTE —In this and the several synonym tables following, the symbols used have the following meanings

≡Equal to in every respect

=Equal in a general way

>Less than

<Greater than

≠Not equal to

[b] Bull U S Geol Survey No 43, 1887, p 62

[c] Ann Rept Geol Survey Arkansas for 1892, vol 2, 1894, pp 8, 9, 22, Bull Am Pal , vol 1, 1896, pp 11–13

[d] For a detailed discussion of the paleontology of the Midway formation see Harris, G D , The Midway stage: Bull. Am. Pal , vol 1, 1896, pp 117–270

[e] Kennedy, William, Proc Philadelphia Acad Nat Sci for 1895, 1896, pp 144-149

in this section is estimated by Kennedy at 260 feet,[a] which is but a little greater than that found in this formation in western Alabama by Harris (210 feet).[b] It therefore seems probable that the thickness of the Midway beds underlying Louisiana is about 200 feet.

In Louisiana limited outcrops of the Midway have been found in connection with two of the domes, Many and Kings (Pls. III, in pocket; XXXVI, p. 68), and the report of "*Nautilus dekayi* Morton" (probably *Enclimotoceras ulrichi* White) between Hendersons Mills and Albany, in Caddo Parish,[c] together with the irregularity of the section of a well (801) sunk near the mouth of Cottonwood Bayou, which obtained brine, suggests that there may be another dome area in this region (Pl. XXXVII, sec. F, p. 70). None of the fossils have been examined, but it seems probable from the structure of the region that the shell marls reported in wells at Uni (835, 836) and at Furrh, La. (802), are Midway, as are likewise the shells found in the well at Waldo, Ark. (141), (Pl. XXXVII, secs. F, H, I).

SABINE FORMATION.[d]

Overlying the Midway limestones and calcareous clays is a series of dark, finely laminated sands and clays containing much vegetable matter, either scattered through the mass or accumulated in lignite beds, and occasional layers containing marine shells. It commonly differs from the underlying Midway in the presence of lignitic material and fossil leaves (Pl. XVII) and when containing marine fossils (Pl. XVIII) is readily distinguished from both the Midway and the overlying Claiborne. Toward the coast, where it is overlain by the very calcareous, argillaceous, fossiliferous lower Claiborne beds, its upper limit can be fixed with exactness, but farther inland, where estuarine and swamp conditions persisted until Jackson time, no separation is possible except on a purely stratigraphic basis. (See Pl. XXXVII, p. 70.)

On the whole, the formation is predominantly sandy, and while the sand beds are not so regular or so coarse as some of the beds in the Cretaceous, they are the

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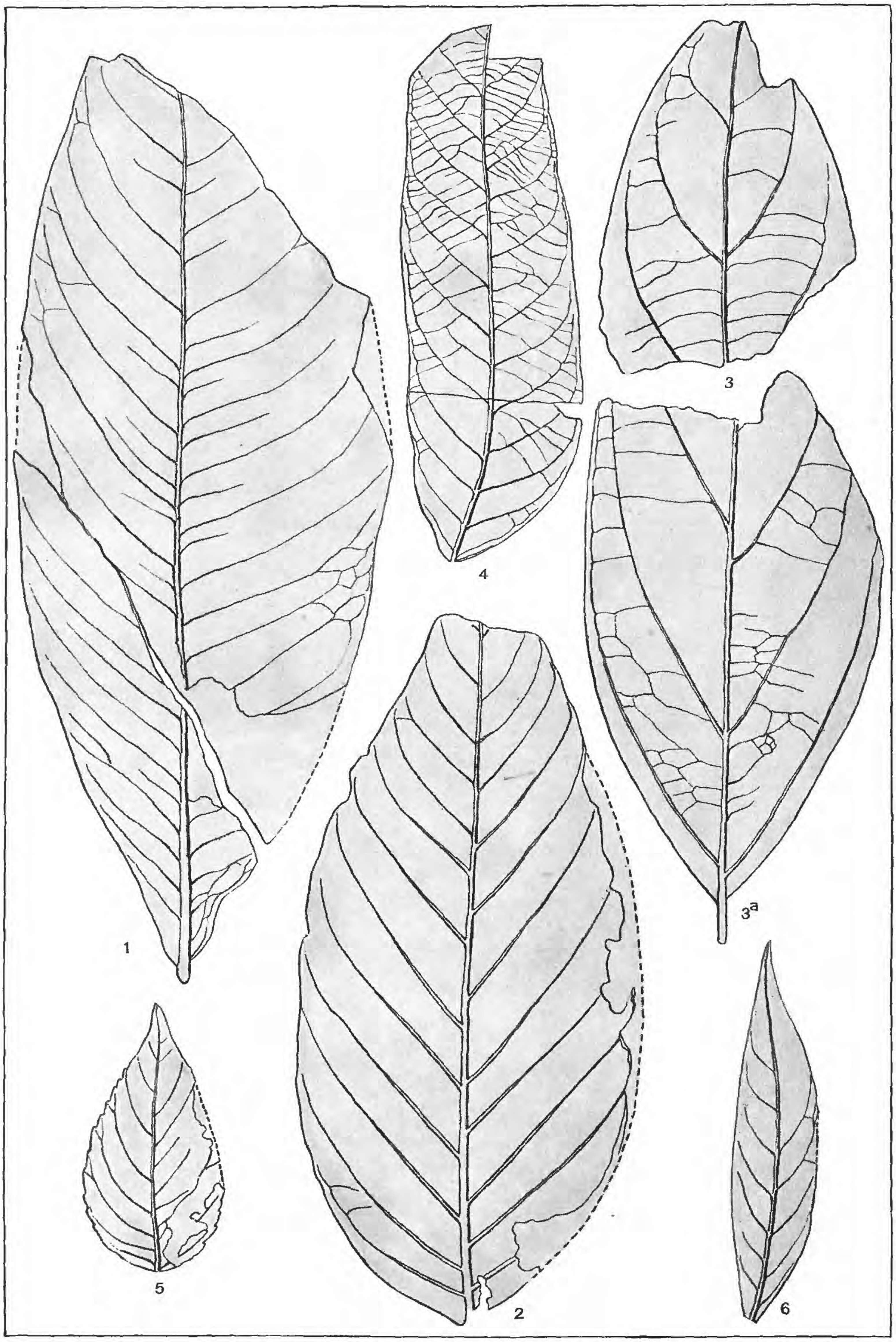
[a] Third Ann. Rept. Geol. Survey Texas, 1892, p. 49.

[b] Harris, G. D., Bull. Am. Pal., vol. 1, 1896, p. 145.

[c] Collins, H. C., Ann. Rept. Chief of Engineers for 1873, vol. 1, 1873, pp. 651-654; also House Ex. Doc., 43 Cong., 1st sess., vol. 2, pt. 2, 1873, pp. 651-664. A careful examination of this locality by the writer failed to confirm this report. Collins's statement, however, bears so many earmarks of careful observations, faithfully recorded, that the results of this examination are not felt to be conclusive

[d] Synonymy of the Sabine formation:

≡Lignitic stage, Harris (Am. Jour. Sci., 3d ser., vol. 47, 1894, p. 304; Bull. Am. Pal., vol. 2, No. 9, 1897).
≡Chickasawan stage, Dall (not Hilgard) (Eighteenth Ann. Rept. U. S. Geol. Survey, pt. 2, 1898, table opp. p. 334).
<Lignitic, Smith et al (Bull. U. S. Geol. Survey No. 43, 1887, pp. 18, 38; Geol. Survey Alabama, Bull. No. 2, 1892, p. 47; Geology of Coastal Plain of Alabama, Alabama Geol. Survey, 1894, pp. 147, 198, 488), which includes the Midway.
>Mansfield group, Hilgard (Am Jour. Sci., 2d ser., vol. 48, 1869, p. 340), which includes all the Sabine formation except the fossiliferous beds.
<Mansfield group, Hopkins (First Ann. Rept. Geol. Survey Louisiana, 1869, 1870, pp. 78, 83), which includes the nonfossiliferous portion of the Sabine and the Claiborne (Cockfield)
<Camden series, Hill (Geol. Survey Arkansas, Rept. for 1888, vol. 2, 1888, pp. 49-53), which includes fossiliferous Jackson, the Lagrange, and a portion of the Cretaceous.
>Lignitic, Kennedy (Third Ann. Rept. Geol. Survey Texas, 1892, p. 50; Proc. Philadelphia Acad. Sci. for 1895, 1896, p. 92), which includes all the Sabine except the fossiliferous beds.
<Lagrange group, Safford (Am. Jour. Sci., 2d ser., vol. 37, 1864, pp 369-370; Rept. Memphis Waterworks for 1898), which includes portions of all the Eocene beds above the Midway.
<Timber belt or Sabine River beds, Penrose (First Ann. Rept. Geol. Survey Texas, 1890, pp. 22-47, 117), which in eastern Texas included also the lower Claiborne, Cockfield, and Jackson.



FOSSIL LEAVES FROM THE SABINE FORMATION.

1. Magnolia hilgardiana Lesquereux.
2. Andromeda eolignitica Hollick.
3, 3a. Tetranthera præcursoria Lesquereux.
4. Juglans schimperi Lesquereux.
5. Ulmus tenuinervis Lesquereux.
6. Sapindus angustifolius Lesquereux.

most important water-bearing strata in Louisiana and Arkansas north of the outcrop of the Catahoula formation (Pl. III, in pocket) and south of the Eocene-Cretaceous boundary.

In Alabama this formation, which has long been called the Lignitic, contains several fossiliferous horizons that are closely related from a paleontologic standpoint, but show faunal differences which have led to the recognition of four substages, named as follows, beginning with the lowest: (1) Nanafalia, (2) Bells and Greggs landings (Tuscahoma), (3) Woods Bluff, and (4) Hatchetigbee. The first two are sometimes collectively called the Bells Landing substage and the second two the Bashi substage.[a] No distinctive marine fossils have yet been found in the lignitiferous time equivalents of this formation in Mississippi, Arkansas, and the upper embayment region, but along Sabine River in Louisiana and Texas, in the same position relative to the embayment as the Alabama deposits, are developed fossiliferous beds showing the same facies. *Ostrea thirsæ* (Pl. XVIII), an oyster common in the Nanafalia horizon in Alabama, occurs in abundance at Marthaville, La., and the fossils from Pendleton and Sabinetown bluffs on Sabine River, in Sabine County, Tex., show very close affinities to the Greggs Landing and Woods Bluff horizons of Alabama.[b] These beds are limited above by a well-preserved and abundant lower Claiborne fauna, and below by the Midway (Wills Point) fossiliferous clays and limestones.

The name Lignitic formation, derived from the lithologic character of the beds, is not in accordance with the rules of geologic nomenclature, and it is therefore necessary to give to this formation the name of some locality at or near which the beds are typically exposed. As the name Chickasaw formation[c] or stage, which has been used by Dall as an exact synonym for Lignitic, is neither stratigraphically nor historically appropriate in this sense, and as the name Lagrange (Safford, 1864) has been applied to the lignitiferous complex above the Midway, and as the doubtful definition and the lack of marine fossils at the type localities of the Mansfield group (Hilgard, 1873) and Camden formation (Hill, 1888) make them unavailable, the name Sabine has been suggested and adopted, from the typical development of the formation along Sabine River in Sabine County, Tex., and Sabine Parish, La., and from noteworthy exposures at Sabinetown Bluff.

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[a] Smith, E. A., and Johnson, L. C., Bull. U. S. Geol. Survey No. 43, 1887, p. 18; Smith, E. A., Johnson, L. C., and Langdon, D. W., Geology of the Coastal Plain of Alabama, Geol. Survey Alabama, 1894, p. 27; Harris, G. D., Bull. Am. Pal., vol. 2, 1897, p. 196.

[b] Harris, G. D., Geol. Survey Louisiana, Rept. for 1899 [1900], pp. 65-72, 299-309; Geol. Survey Louisiana, Rept. of 1902, pp. 123-125.

[c] This name was suggested by Hilgard as an appropriate equivalent for his Northern Lignitic (which is defined in Geology of Mississippi, 1860, pp. 110-123; Am. Jour. Sci., 3d ser., vol. 2, 1871, pp. 394-396), for the very sufficient reason that the "entire Northern Lignitic is within the Chickasaw Purchase, and its most characteristic and conspicuous outcrops are on the four Chickasaw bluffs, of which the Memphis bluff is the last" (Eighteenth Ann. Rept. U. S. Geol. Survey, pt. 2, 1898, pp. 344-345). Dall, however, assumed that Hilgard's Northern Lignitic was the exact equivalent of the Lignitic defined by paleontologic criteria in the Alabama section, and so used it. As a matter of fact the Northern Lignitic is a lignitiferous complex, containing representatives of all the beds between the Midway and the Jackson (see p. 40), and therefore represents the swamp and estuarine deposits of the Sabine, Claiborne, and Jackson epochs. The strata exposed in the Chickasaw bluff, the type locality (see Pl. XXXVII, *A*, p. 70), are stratigraphically either Jackson or the underlying Cockfield, which is uppermost Claiborne. In the whole of the Chickasaw Purchase (about 20,000 square miles) no locality of the Sabine (Lignitic) containing typical marine fossils has been found, and it is necessary to go 100 miles from its border for such a locality. It therefore appears necessary either to use the name Chickasaw formation in the sense in which Hilgard defined it or to abandon it.

The Sabine formation and its equivalent beds in the undifferentiated Eocene underlie the whole of Louisiana, except the limited areas occupied by the outcrops of the Cretaceous and Midway domes, and all of Arkansas south and east of the Cretaceous and Midway outcrops (Pl III, in pocket) Its thickness, as shown by carefully constructed sections in which local irregularities are reduced to their proper minor importance, ranges from 300 feet in northern Bossier Parish to from 800 to 900 feet near Natchitoches and on Sabine River (Pl XXXVII, p. 70).

CLAIBORNE FORMATION [a]

This formation, which overlies the Sabine, contains the most persistent and widely developed marine beds of the Coastal Plain, and is known to extend from Maryland to the Rio Grande. Its extremely fossiliferous character early attracted attention, and it was from collections from Claiborne Bluff, on Alabama River, in Alabama, that the presence of beds of Eocene age in the Gulf States was first proved by Conrad [b] He named it the Claiborne formation and, with Lea,[c] described and figured many of the fossils found in a relatively thin sand bed which outcrops in the bluff at Claiborne Landing, Ala Subsequent work has shown that this bed, which is generally referred to as the Claiborne sand, is but a very local development, paleontologically, of one of the larger divisions of the Eocene. It is to this large division that the name Claiborne formation or Claiborne group is now applied (See synonymy)

In central Louisiana the Claiborne formation is divisible into a lower fossiliferous member, which has been called the "Lower Claiborne" in this area, and an upper lignitiferous member, called the Cockfield, which contains no marine fossils The lower portion is much more calcareous, glauconitic, and clayey than the underlying Sabine beds, and where typically developed contains no lignitic nor lignitiferous matter, though to the north it changes to lignitiferous sands and clays and merges into the undifferentiated Eocene group Thus, while across San Augustine and Sabine counties, Tex., and on Sabine River it is extremely

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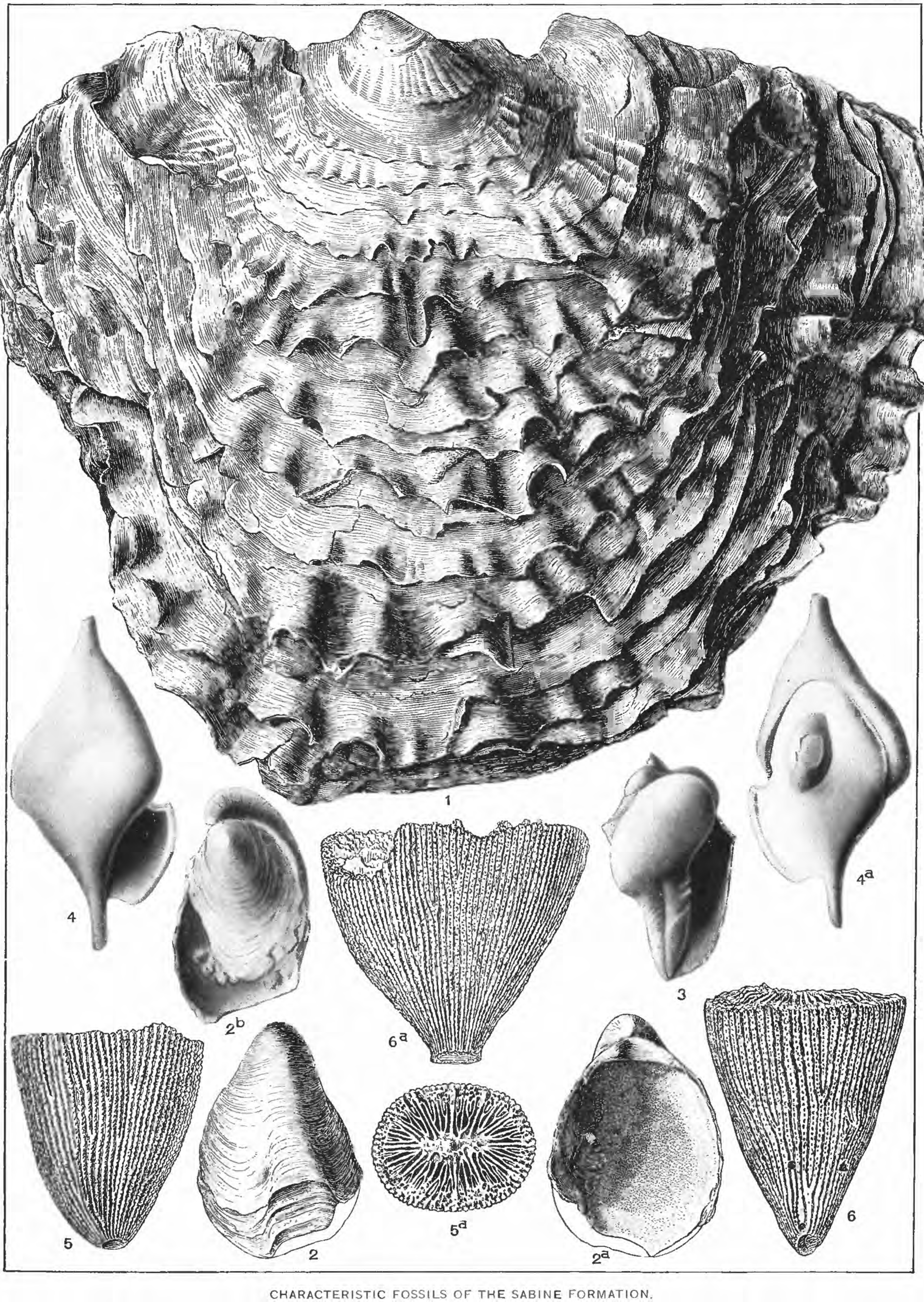
[a] Synonymy of the Claiborne formation
=Claibornian stage, Dall (Eighteenth Ann Rept U S Geol Survey pt 2, 1898, pp 342-343), except the White Bluff beds
=Claiborne (sand)+Lower Claiborne, Harris (Am Jour Sci ,3d ser ,vol 47, 1894, p 304), except the White Bluff beds
≡Claiborne sand + Ostrea sellæformis beds+Lisbon beds+Buhrstone, Harris (Am Jour Sci , 3d ser , vol 47, 1894, p 304)
≡Claiborne (sand)+Buhrstone, Smith and Johnson (Bull U S Geol Survey No 43, 1887, p 18)
≡Claiborne proper (including the Claiborne sand and Ostrea sellæformis beds)+Buhrstone, Smith, Johnson, and Langdon (Geology of the Coastal Plain of Alabama, Geol Survey Alabama, 1894, pp 27, 122, 124, geologic map of Alabama, 1894)
>or=Claiborne stage or Claiborne group (siliceous Claiborne+calcareous Claiborne) Hilgard (Geology of Mississippi, 1860, pp 108, 123-128)
>Claibornian, Heilprin (Proc Philadelphia Acad Nat Sci , 1882, p 184, Contributions to Tertiary geology and paleontology of the United States, Philadelphia, 1884, p 30), which is exactly equivalent to Claiborne sand
<Lower Claiborne, Kennedy (Proc Philadelphia Acad Nat Sci for 1895, 1896, p 92), which includes portions of Jackson and basal Oligocene beds
<and>Cooks Mountain beds+Mount Selman beds (Marine deposits or Marine beds), Kennedy (Third Ann Rept Geol Survey Texas, 1892, p 45, Bull U S Geol Survey No 212, pl 2, 1903), which include also the portion of the Sabine which contains marine fossils
=Lower Claiborne+Cockfield Ferry beds, Vaughan (Bull U S Geol Survey No 142, 1896, p 21)
=Lower Claiborne, Harris and Veatch (Geol Survey Louisiana, Rept for 1899 [1900], pp 73-89, geologic map)
=Lower Claiborne+Cockfield, Harris (Geol Survey Louisiana, Rept of 1902 [1902], pp 17-21)

[b] Conrad, T A , Eocene fossils of the Claiborne, with observations on this formation in the United States Fossil Shells of the Tertiary Formation of North America, vol 1, No 3, 1835, pp 29-36 (See Harris's republication of Conrad's Fossil Shells, 1893, pp 75-84)

[c] Lea, Isaac, Tertiary formation of Alabama Contributions to Geology, Philadelphia, 1833, pp 9-209 pls 1-6



CHARACTERISTIC FOSSILS OF THE SABINE FORMATION.

1. Ostrea compresserostra Say.
2, 2a, 2b. Ostrea thirsae Gabb
3. Volutilithes petrosus var toumeyi Conrad.
4, 4a. Calyptraphorus trinodiferus Conrad.
5, 5a. Eupsammia elaborata (Conrad).
6, 6a. Balanophyllia haleana (M. Ed. and H.).

calcareous and fossiliferous and is sharply limited both above and below by the lignitiferous beds of the Cockfield and the Sabine, and while it maintains this calcareous, fossiliferous character northward in Louisiana to about the Vicksburg, Shreveport and Pacific Railway (Pl III, in pocket), yet north of that line the beds are pronouncedly lignitiferous in character. A few small, poorly preserved Claiborne fossils have been found in northern Bossier Parish,[a] and stratigraphic relations suggest that the fossils found in the wells at Buckner, Ark (134), and Dubach, La (889), and at Walnut Bluff, below Camden, on Ouachita River,[b] are also Claiborne, but the general character of the beds in this region indicates near-shore or swamp conditions very different from the deeper water conditions farther south

In Louisiana and Texas the commonest and most readily recognized fossils of this formation are *Ostrea sellæformis* and *Anomia ephippoides* The oysters are particularly abundant, often forming "oyster prairies," which are bald spots covered with oysters These shells, together with some of the other common and characteristic forms, are shown in Pl. XIX.

The thickness of this lower fossiliferous portion of the Claiborne formation is 250 to 300 feet in the region about Monroe, but increases to over 500 feet at Winnfield On Sabine River the thickness, calculated from dip observations, is 550 feet,[c] and the section of a well recently put down near Robinsons Ferry, Texas (1120), which obtained fossils at a depth of 1,250 feet, that Dr W H Dall regards as Claiborne, indicates that it is as much as 700 feet

COCKFIELD MEMBER OF THE CLAIBORNE[d]

The lignitiferous sands and clays which occur in central Louisiana between the marine portions of the Claiborne and Jackson formations are extremely similar in lithologic character to the Sabine beds, and were at first confused with them They contain no marine mollusks and are characterized by thin, impure lignite beds and clays, often containing plant remains in an excellent state of preservation They are identical in appearance with the lignitiferous complex to the north (undifferen-

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[a] Harris, G D, Ann Rept Geol Survey Arkansas for 1892, vol 2, 1894, pp 178-180

[b] Ibid, pp 141-142

[c] Geol Survey Louisiana, Rept of 1902, p 120

[d] Synonymy of the Cockfield member

= Upper Lignitic beds, Lerch (Preliminary report on the hills of Louisiana south of the Vicksburg, Shreveport and Pacific Railway to Alexandria, 1893 pp 82-85)

≡Cocksfield Ferry beds, Vaughan (Am Geol, vol 15, 1895, p 220, Bull U S Geol Survey No 142, 1896, p 21)

<Lower Claiborne, Harris and Veatch (Geol Survey Louisiana, Rept for 1899 [1900], pp 80-82), which includes also the fossiliferous portion of the Claiborne in Louisiana

≡Cocksfield beds, Harris (Geol Survey Louisiana, Rept of 1902 [1902], p 21

≡Cocksfield Ferry beds or Cocksfield, Veatch (Geol Survey Louisiana, Rept of 1902, pp 120, 130-131, 141, 158, 160-163)

=? Yégua, Dumble (Report on Brown Coal, Geol Survey Texas, 1892, pp 148-154, Science, new ser, vol 16, 1902, pp 670-671)

<Yégua clays, Kennedy (Proc Philadelphia Acad Nat Sci, vol 47, 1895, p 92), which includes part of the fossiliferous marine Jackson

<Lufkin or Angelina County beds, Kennedy (Third Ann Rept Geol Survey Texas, 1892, pp 45 58-60) which includes part of the fossiliferous marine Jackson

<Mansfield group, Hopkins (First Ann Rept Geol Survey Louisiana, 1869, 1870, pp 78-83), which includes the unfossiliferous Sabine

<Northern Lignitic, Hilgard (Geology of Mississippi, 1860, pp 110-123, Am Jour Sci, 3d ser, vol 2, 1871, pp 394-396), which includes also lignitiferous portions of the Sabine and lower Claiborne

tiated Eocene) of which they form a part, and can be definitely differentiated only when fixed between fossiliferous Claiborne and Jackson beds or by structural data.

They were first definitely separated from the other Eocene nonmarine strata by Lerch, who called them the upper Lignitic in distinction from the lower Lignitic (Sabine) which occurred below the lower Claiborne formation. Later Vaughan found these beds typically exposed at Cockfield Ferry,[a] on Red River, halfway between the very fossiliferous Claiborne beds at St. Maurice and the Jackson beds at Montgomery, and named them the "Cocksfield Ferry beds."

At Jackson, Miss., the Cockfield beds have a thickness of about 400 feet.[b] In Louisiana the thickness ranges from 400 to 500 feet. (See Pl. XXXVII, p. 70.)

The sandy, near-shore character of these beds makes them of greater importance as water carriers than the Claiborne and Jackson. In central Louisiana they commonly contain great amounts of soluble salts and the water is generally not so good as that from the Sabine. In Arkansas and Mississippi a sand bed at about the same stratigraphic position as the basal Cockfield water horizon yields good potable water (p. 85).

Regarding the relation of the Cockfield to the Jackson and Claiborne time divisions the data at hand, as has been pointed out by Vaughan,[c] indicate that they are late Claiborne rather than early Jackson. In central Louisiana they are limited below, at St. Maurice, by fossils which belong low in the Claiborne, and above, at Montgomery, by fossils which, while not basal Jackson, are low in the Jackson; and while the Cockfield may contain a small amount of the Jackson, it is to be regarded as almost wholly of Claiborne age. In southern Arkansas, where basal Jackson fossils are developed, the Cockfield is clearly of Claiborne age. In central Texas, as pointed out by Dumble,[d] the Yégua of Dumble (not Kennedy) presents many points of resemblance to the Cockfield, and is here clearly a portion of the Claiborne.

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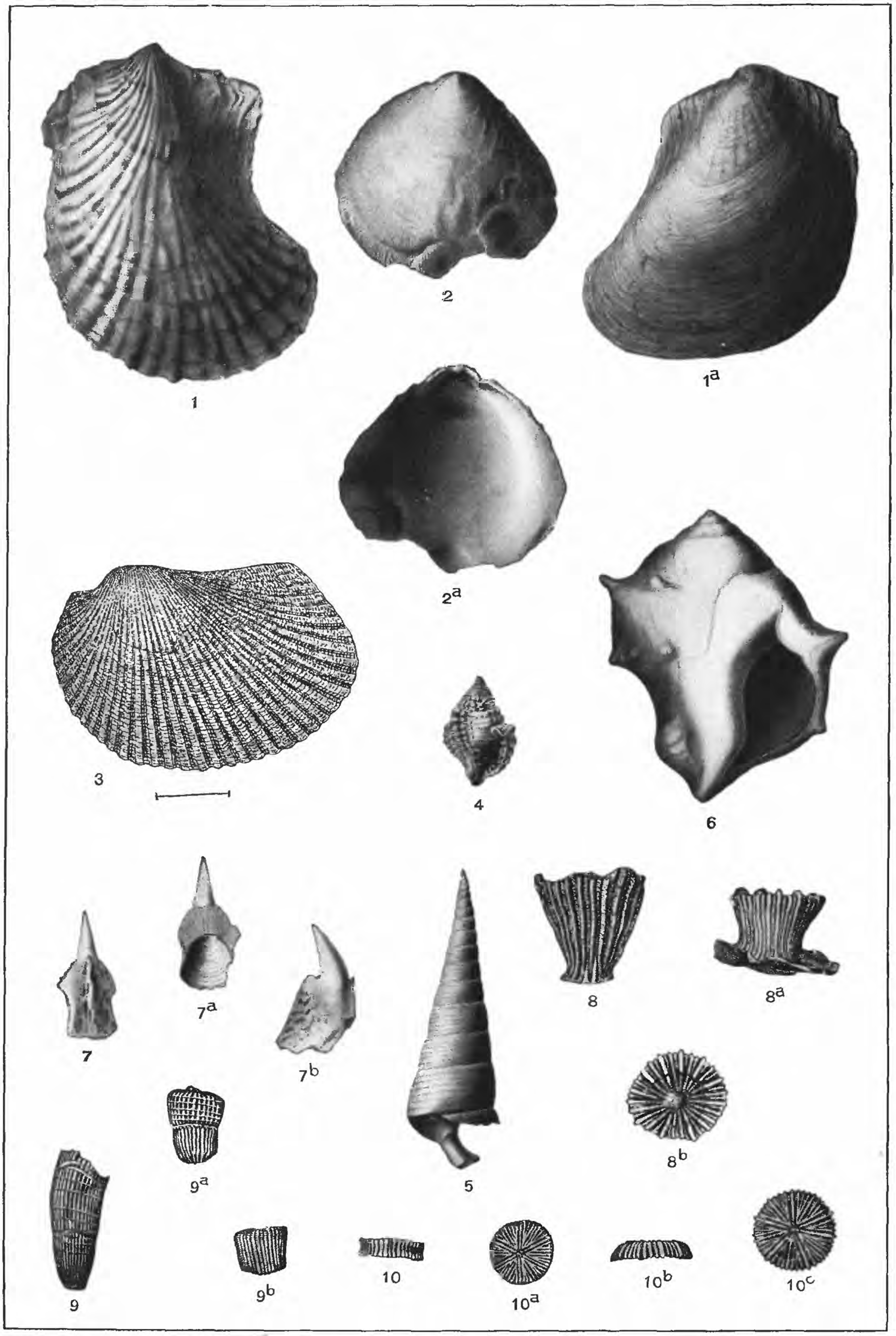
[a] This was spelled by Vaughan "Cocksfield Ferry." The maps of the Red River Survey (MS. sheet No. 37, Red River Survey, U. S. Engrs., 1889–1890, scale 1: 10,000) gave two plantations at this point belonging to "A. P. Cockfield" and "W. J. Cockfield." The ferry name should naturally be spelled in the same way as the name of the owners. The section at "Cocksfield Ferry," published by Vaughan (Am. Geol., vol. 15, 1895, pl. 9; Bull. U. S. Geol. Survey No. 142, 1896, pl. 1), is really a section of Petite Ecore, or, as it has been improperly anglicized, "Petite Ecore Bluff."

[b] Based on well section given in Geology and Agriculture of Mississippi, 1860, p. 191.

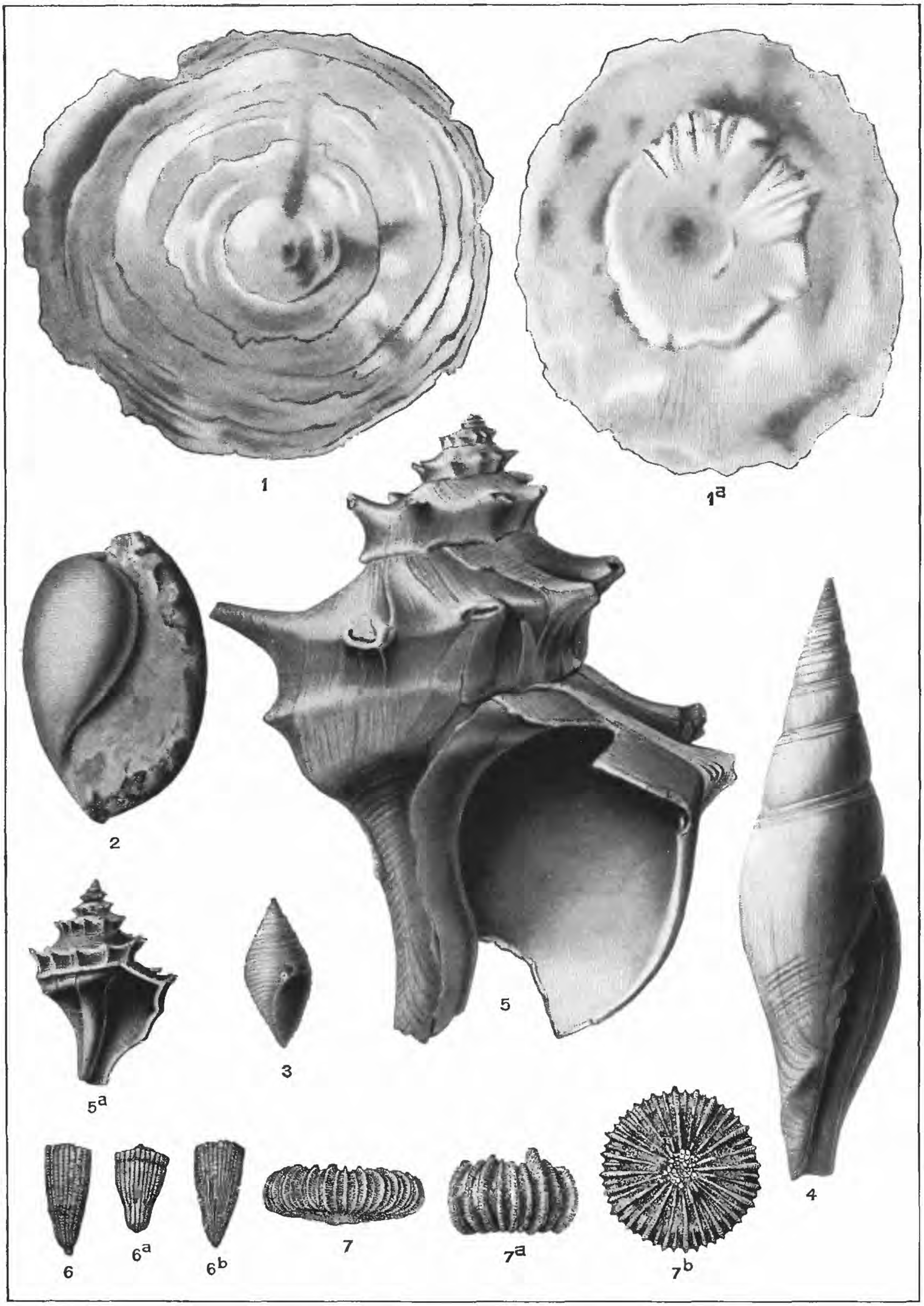
[c] Bull. U. S. Geol. Survey No. 142, 1896, p. 22.

[d] Science, new ser., vol. 16, 1902, pp. 670–671.



CHARACTERISTIC FOSSILS OF THE CLAIBORNE FORMATION.

1, 1a. Ostrea sellæformis Conrad.
2, 2a. Anomia ephippoides Gabb.
3. Arca vaughani Casey.
4. Pirsonella sepdentata Gabb.
5. Mesalia claibornensis Conrad.
6. Cornulina armigera Conrad.
7, 7a, 7b. Belosepia ungula Gabb.
8, 8a, 8b. Paracyathus alternatus Vaughan.
9. 9a, 9b. Paracyathus bellus Vaughan.
10, 10a, 10b, 10c. Discotrochus orbignianus M. Edw. and H.



CHARACTERISTIC FOSSILS OF THE JACKSON FORMATION.

1, 1a. Umbrella planulata Conrad.
2. Haminea grandis Aldrich.
3. Conorbis alatoides Aldrich.
4. Mitra millingtoni Conrad.
5, 5a. Levifusus branneri Harris $\frac{4}{5}$.
6, 6a, 6b. Aldrichiella elegans Vaughan.
7, 7a, 7b. Trochocyathus lunulitiformis var. montgomeriensis Vaughan.

JACKSON FORMATION.[a]

The Jackson group was named by Conrad[b] in 1856, from Jackson, the capital of Mississippi, where the beds are typically exposed. It consists of a series of fossiliferous, somewhat gypseous, calcareous clays which have been traced from eastern Alabama to eastern Texas It extends farther up the Mississippi embayment than any other of the Tertiary beds containing marine fossils except the Midway (Pl. XV, p. 32), having been found in wells at Hays Landing, La. (872), near Arkansas City, Ark. (144), and at Helena, Ark (644) It is exposed at Crowleys Ridge, west of Memphis, and, south of Arkansas River in Arkansas, extends from near Little Rock to Hamburg (See Pls III, in pocket, and XXXVII, sec. A, p. 70) At Crowleys Ridge it shows a marked tendency to change into lignitiferous clays—a tendency which is quite like that of the Claiborne and the Sabine farther south.

In this region it is the most fossiliferous marine bed of the Eocene, with the possible exception of the Claiborne in Louisiana and the Midway in Arkansas, from both of which it may be distinguished by its characteristic fossils (Pls XX, XXI) and stratigraphic position. One of the noted outcrops in Louisiana is shown in Pl XXII, *A* (p 40)

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[a] Synonymy of the Jackson formation

≡Jacksonian stage, Dall (Eighteenth Ann Rept U S Geol Survey pt 2, 1898 p 342

≡Jackson stage, Harris and Veatch (Geol Survey Louisiana Rept for 1899 [1900] pp 89-93, Geol Survey Louisiana, Rept of 1902, pp 22-23, 131-132, 141, 158, 164-167)

<Jackson group, Hopkins (Second Ann Rept Geol Survey Louisiana, 1871, pp 7-15, map), which includes the Sabine, Cockfield, lower Claiborne, and a part of the Jackson, the remainder of the Jackson is included in his Vicksburg group

<White limestone, Johnson (Report on the iron region of northern Louisiana and eastern Texas, House Ex Doc, 50th Cong 1st sess, No 195, 1888, map, pp 14-15), which includes lower Claiborne (in part), Cockfield, Jackson, and Vicksburg (?)

<Yégua clays, Kennedy (Proc Philadelphia Acad Nat Sci, vol 47, 1895, p 92), which includes the Cockfield

≠Yégua, Dumble (Report on Brown Coal, Geol Survey Texas, 1892, pp 148-154, Science, new ser, vol 16, 1902, pp 670, 671), which is regarded as a portion of the Claiborne

<White limestone, Smith (Geology of the Coastal Plain of Alabama, Geol Survey Alabama, 1894, pp 107, 232, 376, 492, 495, see also Casey, Proc Philadelphia Acad Nat Sci for 1901, 1901, pp 513-518)

<Fayette sands, Kennedy (Proc Philadelphia Acad Nat Sci for 1895, 1896, pp 92, 95-99, Bull U S Geol Survey No 212, 1903, p 20, pl 2) These, as defined by Kennedy, are largely Catahoula (Grand Gulf), but include, near the base, Jackson fossils (See Harris, Geol Survey Louisiana, Rept of 1902, p 25, Veatch, ibid, p 133)

<Vicksburg, Hilgard (Am Jour Sci, 2d ser, vol 48, 1869, pp 340-341, Supplement and Final Report of a Geological Reconnaissance of Louisiana, New Orleans, 1873, pp 18-19), which includes all the Jackson and Claiborne beds in Louisiana along Sabine River and a number of Jackson localities in eastern Louisiana

≠Jackson group, Lerch (The hills of Louisiana south of the Vicksburg, Shreveport and Pacific Railway [1893] pp 88-91), which includes only a portion of the lower Claiborne

[b] Conrad, T. A, Proc Philadelphia Acad Nat Sci, vol 7, 1856, p 257

UNDIFFERENTIATED EOCENE [a]

The Eocene beds, which in central Louisiana, Mississippi, and Alabama are fossiliferous, all become lignitiferous in the upper portion of the embayment The marine fossils of the Sabine, lower Claiborne, and Jackson epochs each extend farther northward than those of the preceding epochs (Pl XV, p 32), but in each case the beds bearing marine fossils grade into lignitiferous clays and sands containing no distinctive marine fossils

The first name given to this lignitiferous group, which can not be separated except on structural grounds, was the Lagrange This included all the Eocene beds in Tennessee above the Midway, and was afterwards quite logically extended by its author, Prof J M. Safford, State geologist of Tennessee, to include the lignitiferous sands and clays of Crowleys Ridge,[b] which are of lower Jackson age and are the stratigraphic equivalents of the beds in the upper Chickasaw Bluffs This formation grows more sandy to the north, where at Memphis essentially continuous sand beds 800 feet thick have been penetrated.[c]

OLIGOCENE.

CONDITIONS OF DEPOSITION.

The change from the Eocene to the Oligocene in this area is, like the change from the Cretaceous to the Eocene, much more a paleontologic than a stratigraphic break, and while beds of lignitiferous strata separate the Jackson from the basal Oligocene or Vicksburg beds, they are of no greater importance as an indication of a time break than half a dozen beds within the Eocene No pronounced unconformity or discordance of the strata has been observed However, such characteristic and abundant Eocene forms as *Venericardia*, *Pseudoliva*, *Volutilithes*, and *Calyptraphorus* (Pl XIV, p 32) abruptly terminate in the Jackson, and are replaced in the basal Oligocene by a distinctly different fauna Of the 122 species known in the basal Oligocene, but 10 are found in the Claiborne and Jackson [d]

The lowest Oligocene beds in the Mississippi Valley, like the basal Eocene, are lithologically more like the topmost beds of the preceding series than the succeeding beds of the larger time division which they initiate. They represent conditions of

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[a] Synonymy of the undifferentiated Eocene
=Northern lignitic, Hilgard (Geology of Mississippi, 1860 pp 110–123, Am Jour Sci, 3d ser, vol 2, 1871, pp 394–396), except the Flatwoods clays, which are Midway
≡Lagrange, including Bluff lignite, Safford (Am Jour Sci, 2d ser, vol 37, 1864, pp 369–370)
≡Lagrange + Bluff lignite, Safford (Geology of Tennessee, 1869, pp 424–428)
≡Lagrange, Safford (Agricultural and Geological Map of Tennessee, 1874, Taintor Brothers, New York, publishers).
≡Lagrange, Safford (Agricultural and Geological Map of Tennessee, Tavel, Eastman & Howell, Nashville, Tenn., 1875)
≡Lagrange, Safford and Killebrew (Elementary Geology of Tennessee, Nashville, 1876, pp 165–166).
≡Lagrange, Safford (Agricultural and Geological Map of Tennessee, 1888, 1896, 1899)
≡Lagrange Safford (Rept Memphis Water Works, 1898, p 16)
≡Lagrange, Safford (Elements of the Geology of Tennessee, Nashville, 1900, pp 104, 160–161)
<Camden series, Hill (Ann Rept Geol Survey Arkansas for 1888, vol 2, 1888, pp 188–189), which includes the Jackson and a portion of the Cretaceous
=(?) or >Camden beds, Hill (Ann Rept Geol Survey Arkansas for 1888, vol 2, 1888, pp 188–189)
>Chickasawan stage, Dall (Eighteenth Ann Rept U S Geol Survey, pt 2, 1898, pp 344–345), which is restricted to the Lignitic (Harris, 1894) or Sabine formation

[b] In report of John Lundie "On Waterworks System of Memphis, Tenn, 1898 p 16

[c] Safford, J M, Bulletin State Board of Health, vol 5, pt 7, Feb 20, 1890, pp 98–106, Ann. Rept Geol Survey Arkansas for 1889, vol 2, 1891, pp 28–29

[d] Dall, W H, Trans Wagner Free Inst Sci, vol 3, pt 6, 1903, p 1553

1. Skull restored from specimens collected by Charles Schuchert in Alabama. Length 47.5 inches. The name Zeuglodon (yoke tooth) is taken from the shape of the molar teeth. Original in United States National Museum.

2. Water-worn vertebra of the type commonly found in the Jackson strata. Length 13 inches.

3. More perfect vertebra, showing processes. Length 14.75 inches.

ZEUGLODON (*BASILOSAURUS*) *CETOIDES* OWEN.

A COMMON AND CHARACTERISTIC JACKSON EOCENE WHALE-LIKE MAMMAL.

A. NOTED FOSSILIFEROUS JACKSON OUTCROP AT MONTGOMERY, LA.

Showing low southward dip of the Eocene beds. This locality is in the "steeply" dipping portion of the Caldwell-Angelina flexure and indicates the very low character of that structural feature. Photograph by G. D. Harris.

B. LOWER FALLS, MINT SPRING BAYOU, VICKSBURG, MISS.

Showing bedded limestone in the Vicksburg formation. Note unconsolidated shell marl above and below the limestone. Photograph by G. D. Harris.

NOTED OUTCROPS OF THE JACKSON AND VICKSBURG FORMATIONS.

deposition and distribution of ocean water which are but the continuation of those of the previous period, while the succeeding beds are indicative of more or less radical changes. The basal Oligocene beds, the Vicksburg formation, are overlain by near-shore deposits consisting of coarse sandstones interstratified with greenish-gray clays very different from the underlying calcareous and lignitiferous strata and entirely devoid of marine remains, though containing land plants and fresh-water shells. This group of beds, which is called the Catahoula formation, is in turn overlain by greenish calcareous clays, containing a very few brackish-water shells and called the Fleming formation Indeed, if physical rather than biological changes were made the basis of the broader geologic divisions, the dividing lines between the Cretaceous and Eocene and the Eocene and Oligocene in this region would be drawn above the base of the deposits of these larger time units

During the Eocene the Mississippi embayment was almost, if not completely, filled, and in the Oligocene, except possibly in early Vicksburg time, the coast line was a simple broad curve reaching from eastern Georgia to Mexico with no pronounced indentations (Pl. II, *D*, p 18)

VICKSBURG FORMATION [a]

The Vicksburg formation, which was named by Conrad in 1846[b] from its very fossiliferous exposure in the bluffs at Vicksburg, Miss (Pl XXII, *B*), where it has a total thickness of 120 feet,[c] is the lithological counterpart of the underlying Jackson, from which it can be distinguished by the absence of such characteristic and adundant Eocene fossils as those shown in Pl XIV (p 32) Characteristic Vicksburg fossils are shown in Pl XXIII. The known extent of the typical Vicksburg is very limited West of Mississippi River it has been definitely proved to occur only in a limited region in northern Catahoula Parish, La[d] (Pl III, in pocket), though it may extend westward to the vicinity of Little River. To the east certain beds in eastern Mississippi and Alabama, particularly the great Orbitoidal limestone of the Florida peninsula, have been correlated with this formation, but the recent work of Dall[e] renders this correlation somewhat doubtful, and Casey has suggested that the true Vicksburg beds represent but a local development in a remnant of the old Mississippi embayment[f]

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[a] Synonymy of the Vicksburg formation

≡Vicksburg, Dall (Trans Wagner Free Inst Sci, vol 3, pt 6, 1903, p 1553)

≠Vicksburg, Hilgard (Am Jour Sci, 2d ser, vol 48, 1869, pp 340–341, Supplemental and Final Report of a Geological Reconnaissance of Louisiana, New Orleans, 1873, pp 18–19) All the localities at which Hilgard reported Vicksburg in Louisiana have proved to be Claiborne or Jackson

<Vicksburg group, Hopkins (First Ann Rept Geol Survey Louisiana, 1869, 1870, pp 94–98, Second Ann Rept Geol Survey Louisiana, 1870, 1871, pp 15–18) Includes portions of the Claiborne and Jackson

≮White limestone, Johnson (Iron Region of Northern Louisiana and Eastern Texas, 1888, pp 14–16) As described, this includes only Jackson and Claiborne fossils

<St Stephens White limestone, Smith (Geology of the Coastal Plain of Alabama, Geol Survey Alabama, 1894, pp 107, 232, 376, 492, 495), which includes the Jackson According to Casey, it has not yet been definitely proved that the White limestones contain any true Vicksburg (Proc Philadelphia Acad Nat Sci for 1901, pp 513–518)

[b] Conrad, T A, Proc Philadelphia Acad Nat Sci, vol 3, 1846, pp 280–281

[c] Hilgard, E W, Am Jour Sci, 3d ser, vol 2, 1871, map facing p 391

[d] The outcrops of the Vicksburg beds 3 miles south of Rosefield were first described by Hopkins, who correctly referred them to the Vicksburg (First Ann Rept Geol Survey Louisiana for 1869, 1870, p 97, Second Ann Rept Geol Survey Louisiana for 1870, 1871 p 16) They were, however, first definitely proved to belong to this stage by Vaughan (Bull U S Geol Survey No 142, 1896, p 52)

[e] Dall, W H, Trans Wagner Free Inst Sci, vol 3, pt 6, 1903, p 1553

[f] Casey, T L, On the probable age of the Alabama White limestone, Proc Philadelphia Acad Nat Sci for 1901, pp. 513–518

CATAHOULA FORMATION.[a]

Overlying the fossiliferous Vicksburg clays and limestones is a series of sandstones and greenish clays which are generally quite different, lithologically, from any of the older beds of the Tertiary series in Louisiana and Arkansas The sandstones which are the characteristic feature of this formation range in thickness from a few inches to 50 or 60 feet (Pl. XXIV, wells 859, 938, 939), and thicknesses of as much as 140 feet (well 855) have been reported[b] These sand beds are often cemented by silica into very hard quartzites, but such occurrences are essentially local, and the quartzitic beds pass laterally in very short distances into soft sandstones or even unconsolidated sands These sandstones and quartzitic layers have resisted erosion more than the underlying clays and unconsolidated sands of the Eocene and so have formed a line of rocky hills, the Kisatchie Wold (Pl I, p 14) extending across Louisiana, into Texas on the one hand and into Mississippi on the other.

These beds contain no indications of marine life, but land plants are abundant and fresh-water shells have been found in several places. The change from the conditions existing in the Vicksburg is very marked and indicates an elevation during which the region where the oceanic conditions were favorable for the growth of marine life was considerably south of the present outcrop of the formation (See Pl III, in pocket)

These beds were observed at Grand Gulf, on Mississippi River, in Claiborne County, Miss , by Wailes, the first State geologist of Mississippi, who referred to them as the "Grand Gulf sandstones."[c] Later Hilgard[d] used the name "Grand Gulf group" to include the beds exposed in southern Mississippi between the Vicksburg and the relatively recent coastal clays (Port Hudson), and the name has been used with varying shades of meaning by different authors since that time.[e]

In view of this confusion and in order to furnish a name not likely to be misunderstood, the name Catahoula formation is used in this paper as a synonym for the "typical Grand Gulf" or the "Grand Gulf proper." This new name is from Cata-

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[a] Synonymy of the Catahoula formation

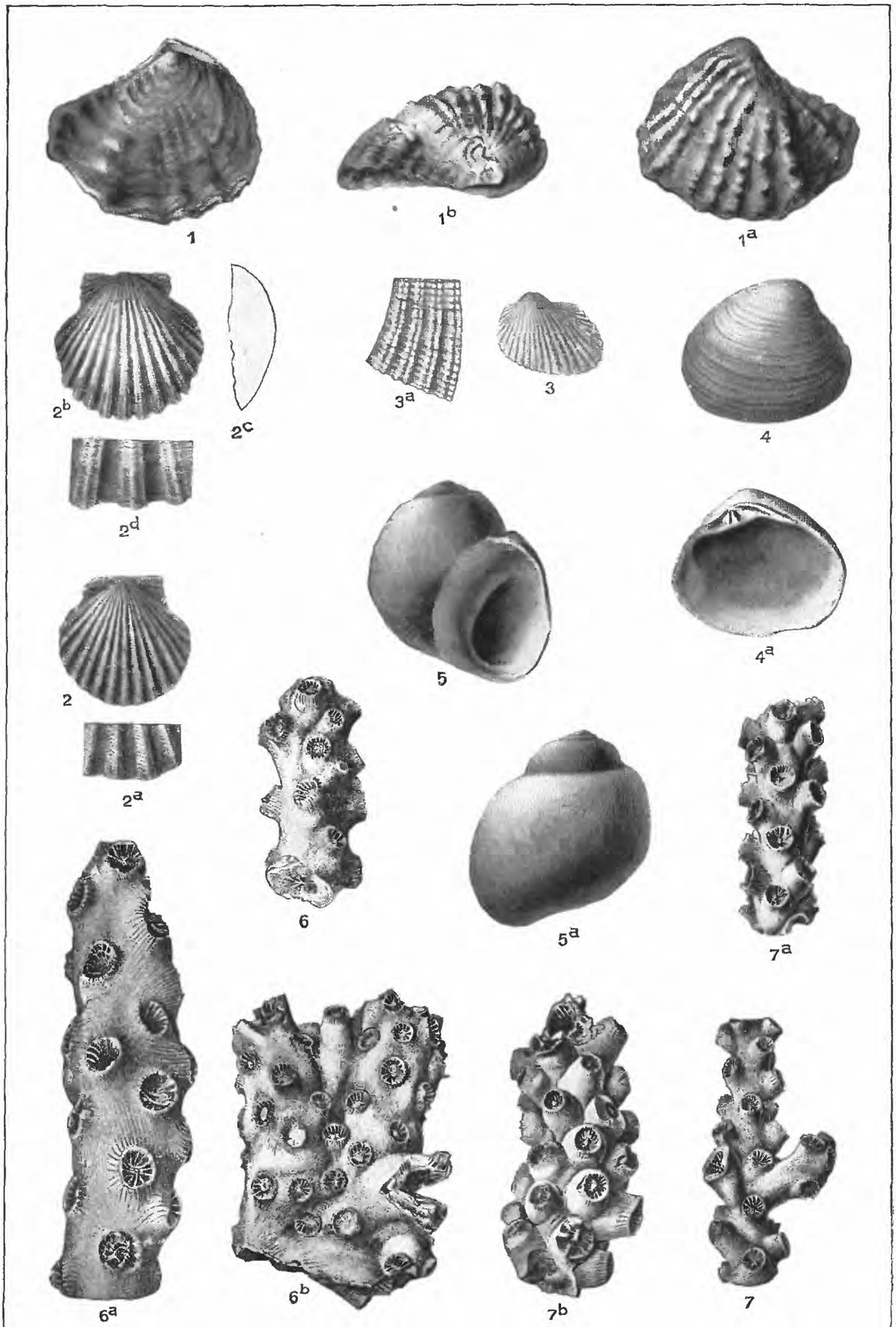
- <Grand Gulf sandstone, Wailes (Agriculture and Geology of Mississippi, 1857, pp 216–219) Includes typical Grand Gulf sandstone and (erroneously) some consolidated Claiborne and Lafayette
- <Grand Gulf group, Hilgard (Report on Geology and Agriculture of Mississippi, 1860, pp 147–154), which includes the Catahoula, Fleming, and Pascagoula formations
- =Typical Grand Gulf, Dall (Eighteenth Ann Rept U S Geol Survey, pt 2, 1898, table facing p 334).
- ≡Grand Gulf proper, Harris (Geol Survey Louisiana, Rept of 1902, p 28)
- <Grand Gulf beds, Harris (ibid)
- ≡Grand Gulf, Veatch (Geol Survey Louisiana, Rept of 1902, pp 120, 132–135)
- <Fayette beds, Penrose (First Ann Rept Geol Survey Texas, 1890, pp 47–58), which are a composite including Claiborne beds in their type locality and Catahoula and Fleming beds in east Texas
- ≮Fayette beds, Dumble (Jour Geol , vol 2, 1894, pp 552–554, Science, new ser , vol 16, 1902, p 671), which are Claiborne
- <Fayette sands, Kennedy (Third Ann Rept Geol Survey Texas, 1892, pp 60–62, Bull U S Geol Survey No 212, 1903, pp 20, 21–22), which includes a portion of the Jackson (See Geol Survey Louisiana, Rept of 1902, pp 25, 132, 133)
- =Oakville, Dumble (Science, new ser , vol 16, 1902, pp 670–671) This correlation, while suggestive, needs further evidence to verify it

[b] Kennedy, William, Third Ann Rept Geol Survey Texas, 1892, p 63

[c] Wailes, B C L , Agriculture and Geology of Mississippi, 1857, pp 216–219

[d] Hilgard, E W , Rept on Agriculture and Geology of Mississippi, 1860, pp 147–154

[e] In this connection see the following Smith, E A , and Aldrich, T H , Science, new ser , vol 16, 1902, pp 835–837, Idem, vol 18, 1903, pp 20–26, Dall, W H , Science, new ser , vol 16, 1902, pp 946–947, Idem, vol 18, 1903, pp 83–85, Hilgard, E W., Science, new ser , vol 18, 1903, pp. 180–182.



CHARACTERISTIC FOSSILS OF THE VICKSBURG FORMATION.

1, 1a, 1b. Ostrea vicksburgensis Conrad.
2, 2a, 2b, 2c, 2d. Pecten poulsoni Morton.
3, 3a. Scapharca lesueuri Dall.
4, 4a. Macrocallista (Chionella) sobrina Conrad.
5, 5a. Ampullinopsis mississippiensis (Conrad).
6, 6a, 6b. Oculina vicksburgensis (Conrad).
7, 7a, 7b. Oculina mississippiensis (Conrad).

A. QUARRY ON CONN LEAGUE, JASPER COUNTY, TEX., NORTHEAST OF ROCKLAND.

Opened for stone for Sabine Pass jetties.

B. ON TEXAS AND PACIFIC RAILWAY, NEAR LENA, LA.

Photograph by G. D. Harris.

OUTCROPS OF THE CATAHOULA FORMATION.

houla Parish, La.,[a] which is directly across the Mississippi Valley from Grand Gulf and where there are many outcrops which are lithologically and stratigraphically counterparts of the beds of the old type locality. From this place the beds have been traced eastward through Mississippi into Alabama, where they apparently grade into a series of fossiliferous sands and calcareous clays known as the "Chattahoochee group." To the west they extend in a very pronounced line across Louisiana into eastern Texas, and, according to Dumble, are continued across that State in his Oakville beds.[b] The thickness of this formation, as shown by comparative cross sections based on wells at Alexandria (933, 939) and Boyce (944) and on dip observations on Sabine River,[c] is about 1,100 feet (Pl. XXXVII, p. 70).

The country in which this formation outcrops is, as a rule, poor in everything but long-leaf pine. The sand beds are, however, important water carriers, and in places (as near Harrisonburg, Lena, and Christie, La., and about Rockland, Tex.) the quartzitic layers have been quarried for riprap work and ballast (Pl. XXIV).

FLEMING CLAY.[d]

The Fleming clay, which was so named by Kennedy in 1892[e] from Fleming siding on the Missouri, Kansas and Texas Railway near the line between Tyler and Polk counties, Tex., consists of green or bluish green calcareous clays, differing from the underlying Catahoula beds in the presence of numerous small white calcareous nodules and the absence of the characteristic Catahoula sandstone layers. Near its base it often contains a bed of bright-red clay, which forms a convenient line of parting.[f] These beds produce a stiff, heavy soil that is often black and resembles the soils of the Cretaceous prairies. Except where deeply covered with the surficial sands and gravels, these are commonly quite distinct from the coarse, sandy soils of the Catahoula formation.

Although these deposits represent less truly littoral sediments than the Catahoula beds, extended search has failed to reveal any marine remains except near Burkville, Newton County, Tex., where a brackish-water Oligocene fauna[g] has been found in a local development of limestone 3 to 4 inches thick. These beds are

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[a] It may be of historic interest to note that one of the first mentions of the outcrops of this formation refers to the exposures at Catahoula Shoals, in Catahoula Parish, which were even at that early day correctly correlated with the exposures east of the Mississippi. (See Darby, William, A Geological Description of the State of Louisiana, Philadelphia, 1816, pp. 45–46.

[b] Science, new ser., vol. 16, 1902, pp. 670–671.

[c] Geol. Survey Louisiana, Rept. of 1902, pp. 120, 132–135, pl. 37.

[d] Synonymy of Fleming clay:
=Fleming beds, Kennedy (Third Ann. Rept. Geol. Survey Texas, 1891, pp. 62–63).
≠Frio clays, Dumble (Jour. Geol., vol. 2, 1894, pp. 554–555; Science, new ser., vol. 16, 1902, pp. 670–671), which are regarded as Claiborne.
≡Frio clays, Kennedy (Proc. Acad. Nat. Sci. Philadelphia for 1895 1896, pp. 93–95; Bull, U. S. Geol Survey No. 212, 1903, pp. 20, 22–23, pl. 2).
≡Frio clays, Veatch (Geol. Survey Louisiana, Rept. of 1902, pp. 120, 135–137, 141–144, pl. 37).
≡Frio clays, Harris (Geol. Survey Louisiana, Rept. of 1902, pp. 28–32).
≡Frio clays, Maury (Bull. Am. Pal., vol. 3, 1902, pp. 353, 390, pl. 25).

[e] Kennedy, W., Third Ann. Rept. Geol. Survey Texas, 1892, pp. 62–63.

[f] Ibid., p. 63; Harris, G. D., Geol Survey Louisiana, Rept. of 1902, p. 31.

[g] Geol. Survey Louisiana, Rept. of 1902, p. 136; Bull Am. Pal., No. 15, vol. 3, 1902, p. 80. Kennedy (Bull. U. S. Geol. Survey No. 212, 1903, p. 53) reports a number of lower Claiborne (Eocene) species from this locality, but the collection made by the writer in 1902, which was by far the largest made at this point, showed none of the species listed by Kennedy. Dr. T. W. Vaughan later visited the outcrop and states that the fragmentary material which he was able to obtain was regarded by both himself and Dr. W. H. Dall as having a decidedly Oligocene aspect.

particularly well developed on Neches River in the vicinity of Townbluff and extend east and west from that point in a belt 5 to 15 miles wide

The thickness of the Fleming beds is not well known, though it has been estimated by Kennedy at 260 feet and by Veatch at 200+ feet.[a]

Along Sabine River the dip of the Fleming formation is much less than that of the basal Catahoula beds, though it is apparently the same as that of the uppermost Catahoula, which is from 25 to 35 feet per mile.

MIOCENE AND EARLY PLIOCENE.

After the deposition of the Fleming beds a general elevation of this region, accentuated locally by the further development of the low Angelina-Caldwell monoclinal flexure (see p 68; Pl XXXVI, p 70), caused the sea to retreat southward to a point between the present outcrop of the Catahoula and Fleming formations and the Gulf shore. This retreat was but one of the steps in the gradual growth of this portion of the American continent, which, with minor retrogressions, such as occurred in the late Pliocene, has resulted in moving the shore line of the southern sea, now the Gulf of Mexico, from a line, as yet unfixed, north of the southern edge of the Ouachita Mountains to the present coast

The effect of this late Oligocene, Miocene, and early Pliocene uplift and the very slow and gradual tilting which accompanied it was to permit the formation in the coast region of Louisiana of very thick post-Oligocene deposits, which, with the beds that were formed in the late Pliocene and Quaternary, have a thickness in that region of much more than 3,000 feet.[b] The region north of this shore line was by this elevation subjected to more or less profound erosion, by which this new Coastal Plain, underlain by Oligocene, Eocene, and Cretaceous sediments. was reduced to a level, in Louisiana and Arkansas, of from 500 to 700 feet above the present sea level. North of this Coastal Plain, in the region of the older rocks, where erosion had been active since the first arching and tilting of the great Jurassic peneplain in the early Cretaceous, the erosion of the Miocene and early Pliocene completed the formation of a plain lying below the level of the old Jurassic peneplain and containing many protruding remnants of the older surface This lower, partially developed Tertiary peneplain was essentially continuous with the eroded Coastal Plain

LATE PLIOCENE

LAFAYETTE FORMATION.

CONDITIONS OF DEPOSITION

In the late Pliocene a considerable change in elevation occurred, which caused the sea to advance from its position a little north of the present Gulf coast and to cover much of the eroded Coastal Plain and in places to extend over the bordering rocks. The sea, in its advance and retreat, spread over this plain a sheet of littoral deposits, and the rivers flowing into it filled up the valleys with similar materials.

This great blanket of silts, sands, and gravels of near-shore and fluviatile

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[a] Geol Survey Louisiana, Rept of 1902, p 120

[b] The Galveston, Tex , well at a depth of 2,920 feet reached only the upper part of the Miocene (Harris, Fourth Ann. Rept Geol. Survey Texas for 1892, 1893, p 118, Twenty-first Ann. Rept U S Geol. Survey, pt 7, 1901, pp. 402-406)

origin, which, from its exposures in Lafayette County, Miss., has been named the Lafayette formation by Hilgard,[a] and which has been described at length by McGee,[b] was, in northern Louisiana and southern Arkansas, largely worn away and redeposited in the succeeding periods of erosion Its remnants or redeposited remnants are, however, very common throughout the Coastal Plain in Arkansas and Louisiana (Pl XXV, *A*), though the exact relation of the different deposits and the succession of events involved in their redeposition can be exactly determined only by a very detailed study after large-scale topographic maps have been prepared

PRESENT DISTRIBUTION

South of the Catahoula and Fleming formations these sands and gravels form the surface for miles and then pass southward beneath the more recent clays of the Quaternary (fig. 6), forming there the water-bearing beds which furnish a portion of the waters used in the irrigation of that region. North of the Catahoula sandstone their occurrence is essentially fragmentary, and they appear and disappear in an extremely irregular manner As shown by wells, they are commonly thickest in the large valleys, where they have been concentrated by erosion subsequent to their original deposition, but they do not normally outcrop on the surface of the present river flood plains and on the adjoining terraces, though they are frequently exposed in the base of the river banks at low water and are generally abundant where the terraces grade into the adjacent hills

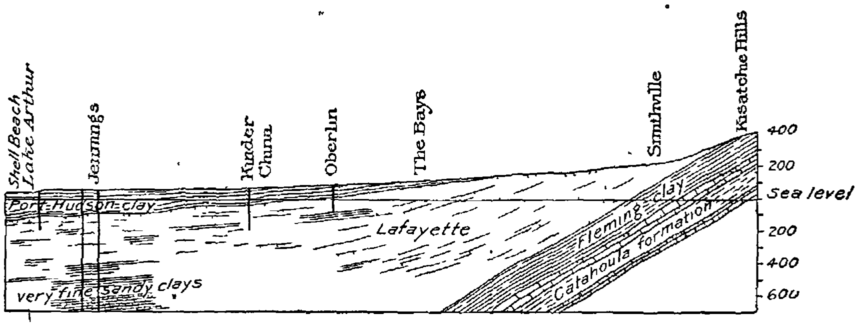

FIG 6 —North-south section showing Lafayette and younger gravels passing beneath the clays of the Port Hudson and supplying artesian wells in southern Louisiana

They are notably absent in regions of very calcareous clays, as in the Jackson area in Louisiana and the regions underlain by the more calcareous beds of the Cretaceous,[c] a peculiarity of distribution due to two factors. (1) The clayey layers of a gently sloping unconsolidated Coastal Plain series are generally more easily eroded than the sandy beds, and the surficial beds are therefore really more completely removed along the outcrops of the clay layers; (2) it is not always possible to state positively that these Lafayette and younger beds are absent from the weathered outcrops of the sandy layers of the older Coastal Plain series, and it often happens, because of the absence of pronounced lithologic differences, that the

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[a] Hilgard, E W , Am Geol , vol. 8, 1891, p 130

[b] McGee, W J, The Lafayette formation, Twelfth Ann Rept U S Geol Survey, pt 1, 1891, pp 347-521

[c] Also observed in Mississippi and Alabama (Geology of the Coastal Plain of Alabama, Geol Survey Alabama, 1894, p 68, Agriculture and Geology of Mississippi, 1860, p 5, Geol Survey Louisiana, Rept for 1899 [1900], pp 105-106)

Lafayette beds are assumed to be present in great thickness, when in fact they are almost or entirely absent. Thus, in Arkansas, portions of the weathered outcrops of the Bingen and Nacatoch sands[a] have been mistaken for these surficial beds. Outcrops of a bed of littoral sediments, probably Cretaceous, lying below the Midway at Little Rock,[b] and ferruginous deposits in Louisiana belonging to the lower Claiborne[c] have also been improperly classed as Lafayette

The gravel deposits are particularly abundant along Ouachita and Little Missouri rivers, and on the eastern side of the old course of Red River, along Bayou Dorcheat and Black Bayou The bowlders along this line are often of extreme size, thus at Bisteneau Salt Works large masses of quartzite, containing 8 to 10 cubic feet, were observed in 1899 and were then thought to be local,[d] but similar bowlders have subsequently been found at many points to the north between this locality and the novaculite outcrops in the Ouachita Mountains (Pl. XXV). Similar bowlders have been found on Ouachita River near Monroe,[e] and it is difficult, in the absence of any known glacial action, to imagine how they could have been transported 100 to 150 miles from their source, unless it were by floating ice. Call, however, has made the suggestion that somewhat similar bowlders on Crowleys Ridge were carried by roots of floating trees[f] This, while possible in some cases, is not believed to be the true explanation of all the occurrences observed in southern Arkansas and northern Louisiana. These large gravel deposits belong more properly to the period of erosion and readjustment which followed the Lafayette than to the Lafayette submergence itself

QUATERNARY

PLEISTOCENE.

LATE TERTIARY AND EARLY QUATERNARY EROSION.

A gradual elevation marked the close of the Lafayette epoch and the sea retreated southward over the deposits laid down in its former advance, reassorted them, and carried back into the ocean some of the finer materials of the upper layers. The streams following the sea across this newly emerged coastal plain, in courses determined by its slight irregularities, began at once to trench its surface and incidentally to form the major topographic features of to-day. As this slow elevation continued the streams cut deeper and deeper into the underlying beds and, while at first the valleys were deep and narrow and the major streams were separated by large flat-topped areas representing the old plain level, the tributary streams gradually wore back into these level regions, divided them, and carved them into hills. When at last the land came to rest, at a height of about 100 feet above the present level, the streams, unable to cut below the very low slopes necessary to carry their waters seaward, began to cut from side to side and in time made

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[a] Ann Rept Geol Survey Arkansas for 1888, vol. 2, 1888, pp 28–42, map, Twenty-second Ann. Rept U S Geol Survey, pt 3, 1902, pl 47

[b] Twelfth Ann Rept U S Geol Survey, pt 1, 1891, p 470, Ann Rept Geol Survey Arkansas for 1892, vol 2, 1894, p 7

[c] Second Ann Rept Geol Survey Louisiana for 1870, 1871, pp 22–23, Bull Louisiana State Exper Sta , Preliminary report on the hills of Louisiana north of the Vicksburg, Shreveport and Pacific Railway, 1893, pp 24–26, Bul U. S Geol Survey No 142, 1896, pp 20–22, Geol Survey Louisiana, Rept for 1899 [1900], pp 100–101

[d] Geol Survey Louisiana, Rept of 1902, p 88

[e] Ibid , p 169

[f] Call, R. E., Ann Rept Geol Survey Arkansas for 1889, vol 2

A

B

LAFAYETTE GRAVEL, 5 MILES EAST OF PRESCOTT, ARK.

A. Typical exposure. *B*. Large quartzitic bowlders.

C

ESCARPMENT ON THE SOUTHERN EDGE OF THE MARKSVILLE HILLS.

A Port Hudson terrace in Avoyelles Parish, La.

OUTCROPS OF LAFAYETTE AND PORT HUDSON FORMATIONS.

broad valleys somewhat larger than the present flood plains, which occupy the depressions produced by these older rivers, but which are now restricted by the unremoved portions of the Port Hudson deposits forming terraces. The bottom lands along the larger streams, the ancient Mississippi, Arkansas, Ouachita, and Red rivers, were about 100 feet below the present flood plains (see bottom of gravel layer, Pl. XXXVII, p 70), and like the latter were trenched still deeper by the streams traversing them (see stream cuts in present destructional flood plains, shown in fig 9, p 51) Thus the bed of the Mississippi of to-day has an extreme depth of 150 feet below its banks at Vicksburg, 165 feet at Fort Adams, and 175 feet 4 miles below the mouth of Red River,[a] and the abnormal depths of the redeposited Lafayette and Quaternary materials encountered in some of the wells given in the following tables are, in part, thought to be due to such occurrences, though they may be the effect of a slight uplift toward the close of this erosion period

Table showing thickness of Port Hudson and redeposited Lafayette and Quaternary beds in the Red River Valley, and indicating the position of the old land surface

Well No [b]	Location	Thickness of deposits
	ARKANSAS	
	Little River County	*Feet*
448	Lanesport	70
	Miller County	
468	Fulton	80
478	Homan	108
	Hempstead County	
198	Fulton	80
203	Fulton	60
-	Lafayette County	
419	Frostville	85
420	New Lewisville (2 miles west of)	79
421	New Lewisville	79+
	LOUISIANA	
	Bossier Parish	
788	Lake Point	120
783	Bossier City (3 miles north of)	130
784	Bossier City (2½ miles north of)	76
785	Bossier City	80
786	Bossier City	195?
794	Pool	111?
	Caddo Parish	
803	Missionary	130
796	Belcher	96
797	Belcher (3 miles northeast of)	125
799	Dixie	60
800	Dixie (2½ miles east of)	85
801	Dixie (3 miles southwest of)	121
835	Uni	70
804	Below Shreveport	69-110
805	Robson	106
832	Bayou Pierre	70
	Natchitoches Parish	
906	Luella	300?
908	Montrose	180

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[a] Mississippi River Comm, Survey of Mississippi River, charts Nos 48, 60, and 61.

[b] Numbers correspond to those used in Chapter V.

Table showing thickness of Port Hudson and redeposited Lafayette and Quaternary beds in the Red River Valley, and indicating the position of the old land surface—Continued.

Well No.[a]	Location.	Thickness of deposits.
	LOUISIANA—continued.	
	Grant Parish:	*Feet.*
877	Colfax	130
	Rapides Parish:	
953	Rapides (average of 5 wells)	108
937	Alexandria	90
938	Alexandria	155 ?
940	Alexandria	110+
950	Pineville	200 ?
950	Pineville	230 ?
947	Lamothe	105+

Table showing thickness of Port Hudson and redeposited Lafayette beds in the Mississippi Valley, and indicating the position of the old land surface.

Well No.[a]	Location.	Thickness of deposits.
	TENNESSEE.	*Feet.*
	Memphis (on bluff)[b]	139.3
	Memphis (9 feet above high water)[c]	160
	ARKANSAS.	
644	Helena (bottom land)	162.3
644	Helena (on bluff)	171.3
4	Stuttgart	115+
707	Baring Cross	87
708	East Little Rock	66
411	Pine Bluff	42
412	Pine Bluff	110
415	Pine Bluff	100
1415A	Pine Bluff	87
24	Dermott	100
25	Dermott	150 ?
145	Arkansas City	105
144	Arkansas City (Choctaw Bar)	151
	MISSISSIPPI.	
1039	Greenville	200
1041	Greenville	90
1047	Yazoo City	150 ?
1033	Valley Park	100+
1016	Mayerville	118
	LOUISIANA.	
873	Lake Providence	248 ?
872	Hays Landing	109
894	*Mound*	135+
922	Monroe	95
923	Monroe	80
867	Fish Pond	145+

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[a] Numbers correspond to those used in Chapter V.

[b] Ann. Rept. Mississippi River Comm. for 1883, 48th Cong., 1st sess., House Ex. Doc. No. 37, 1884, p. 483.

[c] Safford, J. M., Rept. State Board of Health, vol. 5, No. 7, 1890, pp. 98-106; Ann. Rept. Geol. Survey Arkansas for 1889, vol. 2, 1891, p. 28.

In the area between the main streams the tributaries formed in time an interlocking drainage very little different from that of to-day, and at the close of this long period of erosion almost all of the old plain level had been destroyed (Pl. I, p. 14) and the major topographic features of northern Louisiana and southern

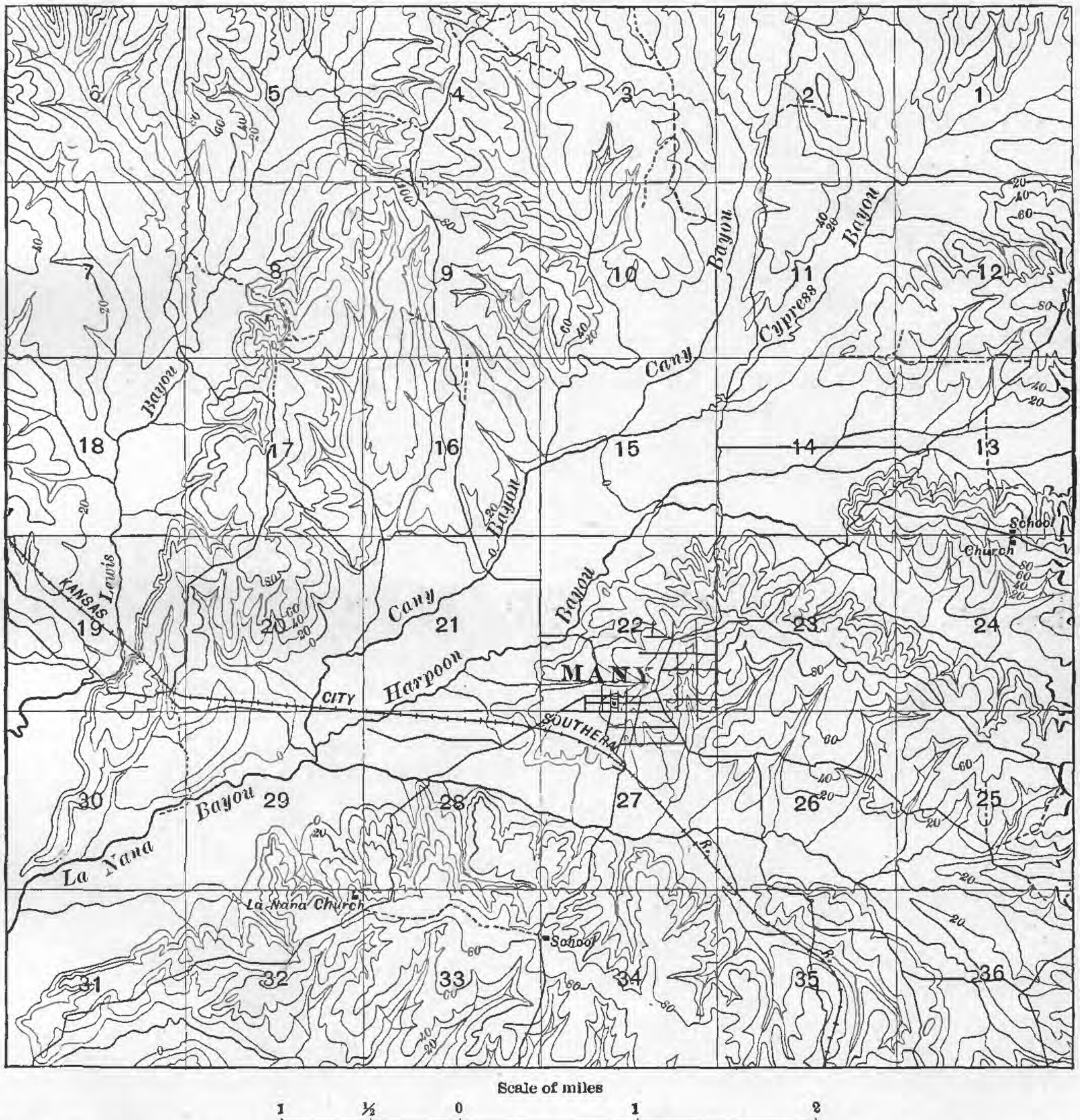

FIG. 7.—Sketch topographic map near Many, Sabine Parish, La., showing the characteristic flat-bottomed, steep-sided, small stream valleys of northern Louisiana and southern Arkansas, by A. C. Veatch, 1899.

Arkansas produced. Indeed, the only great difference between the topography of that day and this was that the principal valleys were 100 to 150 feet deeper, and the Port Hudson terraces (Pl. III, in pocket) were entirely absent. The valleys of the small streams did not then show their present anomalous, steep-sided, flat-bottomed, filled character (fig. 7), but the hill slopes passed in curves of gradually lessening gradient to the streams between them (fig. 8).

The topographic features of to-day are but the features developed in that period, slightly modified by the partial filling of the valleys in the succeeding period of low level and the incomplete reexcavation of this filling which has taken place since that time.

PORT HUDSON DEPOSITION.

CONDITIONS OF DEPOSITION.

During the long preceding period, which in its results was essentially one of erosion, though there were doubtless many stages that have not yet been interpreted, the mantle of Lafayette sands and gravels was largely worn away and redeposited. The gravel was concentrated at many points by stream action and toward the close of the period, when perhaps the land stood slightly higher than before, and when the Mississippi may have been augmented by glacial flood waters, many of the valley bottoms were covered with sand and gravel.

With the slow subsidence which then began the carrying power of the streams was diminished and the gravels were covered with fine sands and, in time, with silts and clays. The bottom lands were converted into great low-lying swamps and, mingled with the deposits formed at this time in the valleys north of Baton Rouge, are fresh-water shells[a] and many swamp-loving trees, as well as driftwood washed in from the higher lands.

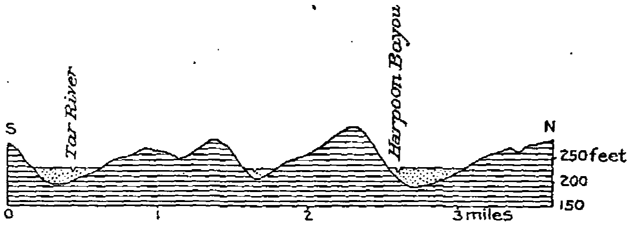

FIG. 8.—Section near Many, La., showing typical flat-bottomed, filled character of small stream valleys in northern Louisiana and southern Arkansas; also showing typical steeper gradient of north-facing than of south-facing hill slopes.

These swamp deposits and their accompanying blue clays are succeeded by silty or sandy, somewhat calcareous clays, which reflect the general character of the sediments of the rivers along which they are found. Thus, on the Mississippi they are yellow or grayish yellow and contain numerous ferruginous and a few calcareous concretions, while on Red River they are bright red and contain many lime nodules not vastly different from those found in the loess and known as "loesskindchen."

These deposits are to-day best exposed in the riverward edges of the terraces. Along the Mississippi excellent exposures are found in the railroad cuts near Hamburg and in the Morehouse and Avoyelles hills (Pl. XXV, *C*, p. 46), while on Red River notable outcrops are found at St. Andres Bluff, near Colfax; at Campti; at Red Bluff, east of Frierson; on the Kansas City Southern Railway, north of Wallace, Cross, and Ferry lakes; in Caddo Parish; at Red Bluff, near Bodcau; at Hurricane Bluffs, in Bossier Parish;[b] and at Fulton and Mandeville, on the St. Louis, Iron Mountain and Southern Railway, in Arkansas (Pl. III, in pocket).

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[a] Third Ann. Rept. Geol. Survey Louisiana for 1871, 1872, p. 177; Geol. Survey Louisiana, Rept for 1899 [1900], pp. 190-191.

[b] See Geol. Survey Louisiana, Rept. for 1899 [1900], pp. 113-114, 189-192; Third Ann. Rept. Geol. Survey Louisiana, for 1871, 1872, pp. 185-190.

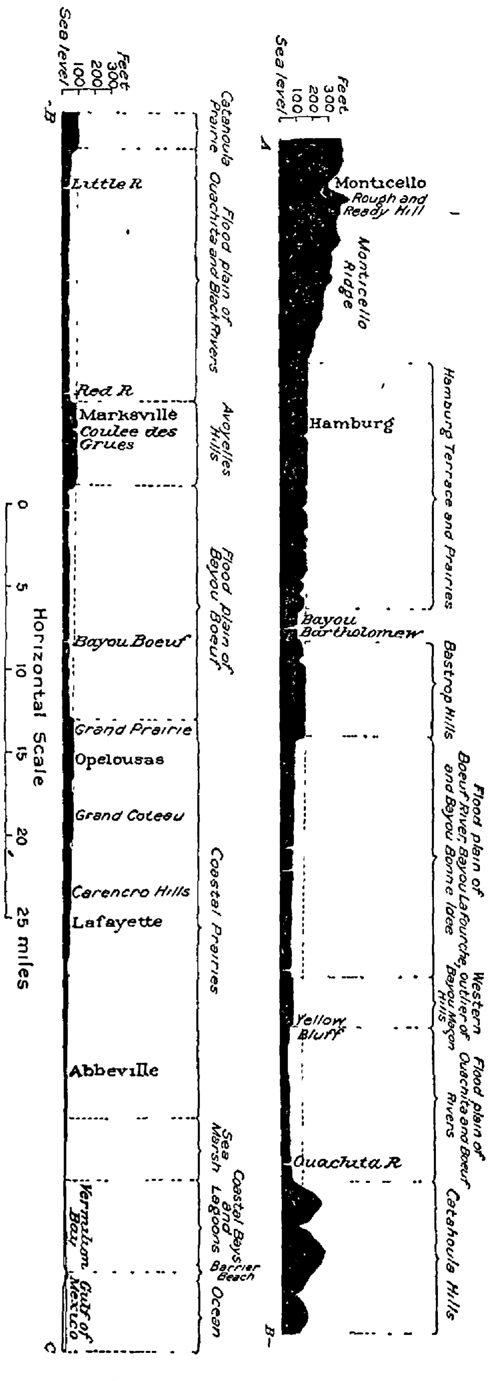

FIG 9.—Section from Monticello, Ark., to the Gulf of Mexico, near Abbeville, La., showing the relation of the Hamburg terrace, Bastrop Hills, Catahoula Prairie, and Avoyelles Hills to the coastal prairies.

Occasionally some of the large animals which then lived in this portion of the country wandered into these marshes and became mired. Among the bones preserved in this way are species of the *Mastodon* and *Elephas*, of the *Mylodon*, *Megalonyx*, *Megatherium*, and *Glyptodon*, large animals akin to the sloths, and armadillos, now found in South America, a camel, a large elk, and a prehistoric horse but little different from the domestic horse of to-day

These deposits are all essentially fluviatile or estuarine in origin, and the present level tops of their remnants, which form terraces along the sides of the principal valleys (fig 9), indicate that this depression was not over 100 feet below the present level On Red River the height of the terraces is seldom over 60 feet above the present bottom lands, and in the Mississippi Valley, near the Arkansas-Louisiana State line, it ranges from 60 to 80 feet To the north the terraces become lower, and in southeastern Missouri they have an elevation of but 20 to 30 feet,[a] a variation which is perhaps due to recent movements either along the line of the Angelina-Caldwell flexure, the Red River-Alabama Landing fault, or both (Pl. XXXVI, p 68)

These clay terrace deposits are continued southward in the pine meadows of eastern Louisiana and the prairie and pine flats of southwestern Louisiana, which are doubtless of the same age. The hills which border the Bayou Teche, the Grand Coteau des Opelousas, and the Cote Gelee, represent the eastern scarp of this prairie region where it has been cut by the Mississippi They are but the southern representatives of the isolated terrace remnant, the Avoyelles Hills, which is the connecting link between them and the Mississippi and Red River terraces (fig. 9). With the exception of the present sea marsh and the inconsiderable alluvial deposits of the present Mis-

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[a] Marbut, C. F., Univ of Missouri Studies, vol. 1, No 3, 1902, p. 16

sissippi flood plain, these coastal prairies are the most recent deposits of southern Louisiana above sea level.

DEPOSITION OF THE LOESS

Near the close of this low-level period great floods of water from the glaciers to the north brought down large quantities of very fine yellow rock meal. This is now found capping the highest hills east of the Mississippi as far south as the Mississippi-Louisiana State line and west of the Mississippi, in Arkansas and Louisiana, only on Crowleys Ridge, and at Sicily Island. It was early recognized at Vicksburg by Lyell and by him correlated with similar deposits in the Rhine Valley called "loess."[a] By some it is thought to represent the natural levees of an immensely swollen Mississippi, but the hypothesis best supported by the known facts is that it was deposited by glacial flood waters over the Mississippi plain and formed great mud flats, from which, after drying, it was conveyed to its present position by the wind.[b]

EROSION OF THE PORT HUDSON DEPOSITS.

With the elevation that followed the Port Hudson period of low level the main streams began to cut out the deposits which partially filled their valleys. This erosion, which was the last of the major stages in the formation of the present topography, has resulted in the partial removal of the Port Hudson deposits, which in northern Louisiana and southern Arkansas are now found as terraces along the sides and underlying the present flood plains at no very great depths.[c] The nearness of the Port Hudson sediments to the surface and the relative thinness of the present alluvial deposits indicate that the flood plains of all the larger rivers of this area, except, perhaps, the Mississippi plain below Donaldsonville and New Orleans, are to be regarded, on the whole, as destructional rather than constructional plains.

The amount of erosion accomplished in post-Port Hudson time is very small when compared with that accomplished in the long and complex late Tertiary and early Quaternary period of erosion, when the main topographic features of this region were produced.

To the south the plain, which was continuous with the Opelousas Hills and low bluffs along the Mississippi near Baton Rouge and which formed an integral part of the prairies and pine flats of Louisiana, was broadly trenched, leaving these bluffs on either side to indicate its former height and extent. In central Louisiana the Avoyelles Hills were separated, on the one hand, from the Opelousas Hills by a broad valley, formerly the flood plain of Red River, but now occupied by Bayou Boeuf (fig. 9), and, on the other hand, from the terraces to the northwest, whose edge is represented by Grimes and Innes bluffs, by the more recent Red River bottoms. In the Red River valley the "upland flats" were made into

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[a] Lyell, Charles, Second visit to the United States, 1849, vol. 2, pp. 194-195.

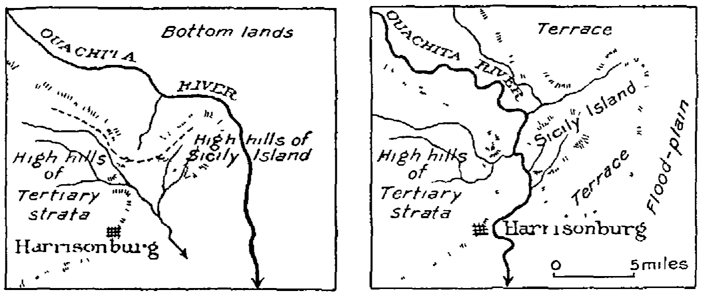
[b] For an excellent summary of this question see Chamberlin, T. C., Jour. Geol., vol. 5, 1897, pp. 795-802.

[c] Hilgard, E. W., On the geological history of the Gulf of Mexico: Proc. Am. Assoc. Adv. Sci., 1871, pp. 230-236; Am. Jour. Sci., 3d ser., vol. 2, 1871, pp. 398-404; 48th Cong., 1st sess., House Ex. Doc. No. 37, vol. 19, 1884, pp. 480-481; Geol. Survey Louisiana, Rept. for 1899 [1900], pp. 118, 175-176; Geol. Survey Louisiana, Rept. of 1902, pp. 138, 169.

terrace benches at this time by the trenching of the Port Hudson deposits. To-day these "upland flats" form a notable minor feature of the topography and are particularly well developed in Lafayette County, Ark, and Bossier Parish, La, along what is perhaps the old course of Red River, which, after the filling of the valleys, was abandoned for a more westerly course following the smaller valley of Sulphur Fork through eastern Caddo Parish (Pls I, *A*, III, in pocket)

In parts of the Mississippi Valley where the erosion has been somewhat irregular these Port Hudson deposits have not been completely worn down to the level of the surrounding gradational plains, and these remnants, though much below the height of the main terraces, are still noteworthy because of their peculiar soil, their relief above the bottoms, and the fact that the banks of the waterways traversing them are lower than the surrounding lands—like true upland creeks—while in the recent flood plains the banks are typically higher and form more or less pronounced natural levees To this class belong the Bayou Macon Hills (fig 9, p 51, Pl III, in pocket) and the hardly noticeable elevation just above high water extending from the high Bastrop Hills northward toward Dermot, Ark

On the small tributary streams in the hill-land areas, especially toward the headwaters, the cutting has been less, and the present flood plains of these minor streams are often essentially the unaltered surface of the old Port Hudson deposits Along Sabine River, though the Port Hudson deposits form occasional low bluffs and rise slightly above the restricted plain of the present river, they are much more a part of the bottoms, with which they are commonly classed, than are the terraces along the flood plains of the present Red and Mississippi rivers, which are commonly regarded as hill lands



A, Drainage in early Quaternary time *B*, Present drainage

FIG 10 —Change in Ouachita River drainage near Harrisonburg, La

In the erosion of the relatively level Port Hudson constructional valley plains several peculiar topographic features have been produced Among these are the gorge-like passage of Ouachita River, between Sicily Island Hills and the main uplands, in Catahoula Parish, La, the transverse cutting of the high terrace remnants by Bayou Bartholomew, Boeuf River, and Deer Creek, and the lower level of the land immediately bordering the Ouachita than of that bordering the Mississippi at the Arkansas-Louisiana State line (Pls I, III, in pocket).

DIVERSION OF THE OUACHITA RIVER NEAR HARRISONBURG, LA

Because of the hardness of the Catahoula formation, a notable contraction has been produced in the Mississippi Valley where these beds cross it (Pls. I, *B*; III in pocket); in the period of high level preceding the Port Hudson deposition the group of hills forming the present Sicily Island hill mass was but a promontory on the main Catahoula hill mass and Ouachita River flowed to the east of it (fig. 10 *A*)

When the main valley region was partially filled during the succeeding low-level period, the low divide between the two minor stream valleys, which partially separated this hill mass from the hills to the west, was buried with fluviatile sediments which extended 60 feet above the present bottoms (figs. 9, 11). The Sicily Island hill group was thus entirely separated from the main hill mass by a relatively flat fluviatile plain which was but a portion of the larger constructional plain occupying the whole Mississippi Valley (fig. 11). This plain was doubtless slightly higher in the main valley, where the Mississippi brought down large quantities of sediments and the Ouachita naturally occupied the lower ground, and so passed to the west of the Sicily Island hill mass (fig. 10, *B*). In the succeeding period, when the streams cut out a portion of this filling and formed the terraces, the Ouachita cut down and became superimposed on the old rocky divide between the former north and south flowing creeks, and thus formed the present Catahoula Shoals (fig. 11).

TRANSVERSE CHANNELS OF BAYOU BARTHOLOMEW, BOEUF RIVER, AND DEER CREEK.

When the slight uplift following the Port Hudson low level caused the streams to commence trenching the Port Hudson Valley plains, Ouachita River, which then joined the main flood plain at about its present juncture with Saline River in southern Arkansas (Pl. I, *B*, p. 14), early gained the ascendency over the other streams of the valley. This is evidenced by the courses of the tributary streams—the Bartholomew, the Boeuf, and Deer Creek—which pass through the intervening terrace remnants in more or less pronounced gorges to join it (Pl. III, in pocket). The cause of this ascendency is, primarily, that the greater amount of sediment carried by the Mississippi tended to produce a relatively greater depression along the present course of the Ouachita, both in building up and cutting out the Port Hudson plain. In the period of low level the Port Hudson plain was built up more rapidly along the greater silt-carrying Mississippi, while in the succeeding periods of erosion the Ouachita, being less burdened with sediment, more nearly attained a perfect base-level. In the beginning of this period of erosion the streams of the valley, therefore, drained southwest into the Ouachita, and, as the latter has maintained its greater depth, they have continued to do so. In this process the streams have become intrenched in the Port Hudson deposits and, as a result of this and of the irregular removal of the beds by the complex system of drainage in the Mississippi bottoms, a stream sometimes leaves a broad flood plain and deliberately flows through a range of hills to join another flood plain beyond. Thus Bayou Bartholomew follows the eastern edge of a well-marked terrace escarpment 40 to 60 feet high

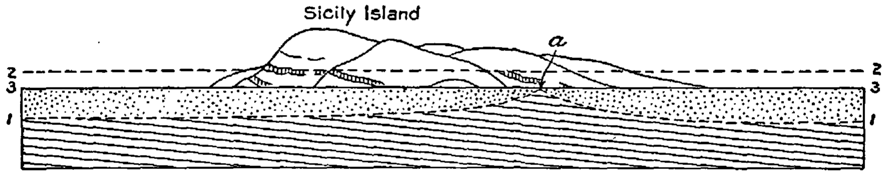


FIG. 11.—Diagram illustrating the deflection of Ouachita River and the cause of the formation of the Catahoula Shoals near Harrisonburg, La. *a*. Catahoula Shoals; old divide between north and south flowing drainage. 1-1. Beds of north and south flowing minor streams (first stage). 2-2. Original level of valley filling (second stage). 3-3. Present Ouachita flood plain (third stage).

A. ON FLAT FORK CREEK, 3 MILES FROM TENEHA, TEX.

Showing tree-covered top and barren surrounding country. Substructure: Sabine Eocene.

B. ON FLAT FORK CREEK, 3 MILES FROM TENEHA, TEX.

Symmetrical form partially destroyed by stream erosion. Substructure: Sabine Eocene.

C. AT PRESCOTT, ARK.

Substructure; Arkadelphia Cretaceous.

D. ON PINE FLATS, NEAR TARBINGTON, TEX.

Substructure: Port Hudson (Quaternary). Photograph by Vernon Bailey.

NATURAL MOUNDS.

through Lincoln, Drew, and Ashley counties, Ark , and, though separated from the present flood plain of the Mississippi in this part of its course by a low, almost imperceptible swell, may topographically be regarded as occupying the very western edge of the Mississippi bottoms (Pl III, in pocket) In northern Louisiana it turns to the southwest, leaves this broad plain, and passes, in a steep-sided valley but a mile or two wide, through the escarpment which is continued southward in the eastern face of the Bastrop hills

Similarly, though in by no means so striking a manner, Bayou Boeuf leaves the Mississippi flood plain and passes through a valley between the Bastrop and Bayou Macon hills to the Ouachita flood plain beyond (Pl. III)

Farther to the south Deer Creek cuts obliquely across the Bayou Macon hills and separates them from the terraces flanking the Sicily Island hill mass.

DIFFERENCE IN LEVEL BETWEEN THE OUACHITA AND MISSISSIPPI FLOOD PLAINS AT THE LOUISIANA-ARKANSAS STATE LINE

The difference in the height of the banks of the Mississippi and those of the Ouachita in the latitude of the Arkansas-Louisiana State line is very striking, the top of the former being 112 feet above sea level and that of the latter but 63 feet. The difference is, however, somewhat exaggerated by a small, very recent fault which cuts across the valley near Alabama Landing, La (p 65), and which if it continues across the Mississippi flood plain has been completely obliterated by the great amount of sediment carried by that river The true ratio, with the recent displacement of this fault allowed for, is about 112 to 88—still a striking difference in the elevation of the main stream of the valley and one of its tributaries.

FORMATION OF NATURAL MOUNDS.

GENERAL CHARACTER AND THEORIES OF ORIGIN

Some time after the formation of the Port Hudson plains a vast number of low mounds, rudely circular, 20 to 100 feet in diameter and 3 to 5 feet high, were formed (Pl. XXVI) These mounds have an extremely wide distribution They are well developed on the prairies and pine flats of the Port Hudson deposits along the coast of Louisiana and Texas, where they form the now well-known "pimple prairies," and are popularly associated with the oil deposits, with which, however, they are in no way genetically connected. They occur irregularly throughout the Coastal Plain in northern Louisiana, northeastern Texas, Arkansas, and southeastern Missouri, except in the present flood plains. They are best developed on the Port Hudson terraces, but extend also over the hill lands They are not restricted to any geologic formation or any range of elevation The material of which they are composed is commonly a very fine loam, which is reported by the agriculturists to be coarser than and quite distinct from the surrounding soil, which is commonly clay Oil-well drillers in southern Louisiana and southeastern Texas report the material in these mounds to be entirely different from the surrounding soil and exactly the same as the fine sand found beneath the 50 to 100 feet of surface clay The apparent difference in composition is, however, not so great as it seems at first sight and is in part due to the greater elevation and consequent better drainage of the mounds. Careful mechanical analyses will be necessary to determine the true character and degree of this difference.

Mr. J. A. Taff, of this Survey, reports that similar mounds are very abundant through Indian Territory, where they are best developed on the plains formed during the Tertiary by the erosion of the highly inclined Carboniferous shales and sandstones. They are there, as throughout the Coastal Plain, composed of somewhat coarser materials than that of the surrounding lands, which are commonly flat and water-soaked, while the mounds stand out as somewhat sandy islands. Mr. M. K. Shaler, field assistant, who during the season of 1904 worked with Mr. Taff in Indian Territory, reports that identical mounds occur in southeastern Kansas.

The question of the origin of these mounds is one of the most perplexing problems of this region and can not yet be said to be satisfactorily solved, though the range of possibility has been somewhat narrowed by recent work. The theories which have thus far been advanced may be grouped as follows:

- 1. Human[a]
  - a. Garden beds.
  - b. Tepee or wigwam sites.
  - c. Burial mounds.
- 2. Animal[b]
  - a. Ant hills.
  - b. Mounds of burrowing animals.
- 3. Water erosion[c]
  - a. Great currents of floods.
  - b. Slow erosion at low level.
- 4. Eruptions[d]
  - a. Springs or "aqueous" volcanoes due to artesian pressure.
  - b. Gas vents.
  - c. Eruptions due to the unequal weight of an uneven clay layer on a water-logged sand bed.
- 5. Wind[e]
  - a. Low dunes collected by scanty vegetation in a semiarid region of variable winds.
  - b. "Root wads." Masses of earth lifted by the uprooting of trees in storms, which have perhaps been enlarged or modified by burrowing animals.

Of these theories those deserving the most careful attention are (1) the spring and gas-vent theory, (2) the dune theory, and (3) the ant-hill theory.

SPRING AND GAS-VENT THEORY.

The spring and gas-vent theory has, until the last year, seemed the most probable of the several hypotheses advanced. The argument in this case is that throughout the Coastal Plain strata there are large amounts of vegetable matter from which gas has been slowly generating. This gas, with the associated artesian water, on escaping has brought to the surface fine sands and built up low cones. In substantiation of this hypothesis two lines of evidence were adduced. First, there are at widely separated points—namely, near Sulphur City, La., and near Tenaha,

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[a] Nadaillac, Marquis de, prehistoric America, translated by N. D'Anvers, New York, 1895, p. 182. Lockett, S. H., First Ann. Rept. Topog. Survey Louisiana for 1869, 1870, pp. 66-67. Geol. Survey Louisiana, Rept. for 1899 [1900], p. 194.

[b] Hilgard, E. W., supplemental and final report of a Geological Reconnoissance of Louisiana, 1873, p. 11.

[c] Owen, D. D., Second Report of a Geological Reconnoissance of part of the State of Arkansas, Philadelphia, 1860, p. 144. Lerch, Otto, a preliminary report on the hills of Louisiana south of the Vicksburg, Shreveport and Pacific Railway: Bull. Louisiana State Exper. Sta., Geology and Agriculture, pt. 2, 1893, p. 106.

[d] Memorial and explorations of the Hon. J. B. Robertson in relation to the agriculture, mineral, and manufacturing resources of the State (Louisiana), with the report of the joint committee: Doc. 2d sess., 2d Legis., Rept. No. 23, 1867, also separate, New Orleans, 1867, pp. 14-15. Hopkins, F. V., First Ann. Rept. Geol. Survey Louisiana, 1869, 1870, pp. 80-82. Clendenin, W. W., a preliminary report upon the Florida parishes of east Louisiana and the bluff, prairie, and hill lands of southwest Louisiana: Bull. Louisiana State Exp. Sta., Geology and Agriculture, pt. 3, 1896, pp. 179-183. Geol. Survey Louisiana, Rept. for 1899 [1900], pp. 193-194.

[e] Featherman, A., Third Ann. Rept. Botanical Survey of Southwest and Northwest Louisiana, 1871, 1872, pp. 106-107. Clendenin, W. W., op. cit., p. 180.

A

B

SMALL SAND CONES FORMING OVER GAS AND WATER VENT ON FLAT FORK CREEK, 3 MILES SOUTH OF TENEHA, SHELBY COUNTY, TEX.

C

MUD CONES NEAR DOUGLASTOWN, LONG ISLAND, N. Y.

Formed by pressure of underlying artesian water.

SAND AND MUD CONES.

in northwestern Texas, in regions covered with mounds, a number of low cones a few inches in height and a few feet in diameter in the course of formation (Pl. XXVII). In both cases the very fine sand composing the cones was being brought up by the flow of gas and water in the center of the cone. Second, it is commonly reported by the oil-well drillers in southern Louisiana and southeastern Texas, though the statement could not be satisfactorily verified, that wells sunk on the mounds yield more gas than those in the intermound spaces. In these cases it has been assumed that the gas was of slightly more importance than the artesian water. It is, however, probable that the water was the principal cause and the gas but an accessory. Shepard[a] has described low spring cones in southeastern Missouri, which are clearly of the same character as those just described. The region in which these occur is likewise covered with natural mounds. A number of cones and irregular "sand sloughs" were produced by water and gas eruptions or by water alone during the New Madrid earthquake of 1811–12, and these have naturally led to the classification of all the mounds in this section as of similar origin. From an examination of some of the mounds in southeastern Missouri along the line of the St. Louis, Iron Mountain and Southern Railway, the writer is inclined to doubt this generalization and to regard the greater number of them as identical with the same phenomena to the south and west, and not of the same origin as the low spring cones or the eruptions of the New Madrid earthquake. This locality is, however, the best argument for a water and gas origin. On Long Island, New York, there are a number of low mud cones which, while not entirely identical with the mounds, are of interest as examples of cones produced by artesian pressure (Pl. XXVII).

DUNE THEORY.

A wind origin was suggested for these southern mounds by Featherman in 1872[b] and by Clendenin in 1896.[c] Recently Dr. C. W. Hayes, after having examined the mounds in southeastern Texas, observed very similar low mounds clearly due to wind action 15 or 20 miles southwest of Green River city, in southwestern Wyoming, and concluded that the Coastal Plain mounds were of the same origin. The objection to this theory, which is regarded as more probable than that just discussed, is the very great irregularity of wind-made features and the fact that these natural mounds of the south-central United States, over an area at least 300 miles wide and 500 miles long, are notably uniform in size and exactly resemble one another. It would seem that in so large an area a wind origin would involve a greater variation in size than has been observed and would necessitate the presence of occasional dunes or lines of dunes of noteworthy size whose origin could not in any way be doubted. This hypothesis, moreover, requires an arid or semiarid climate in this region at a very recent time, of which there is no other evidence and which, in the present state of the investigation, can hardly be considered as conclusively proved.

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[a] Shepard, E. M., The New Madrid earthquake: Jour. Geol., vol. 13, 1905, pp. 45–62.

[b] Third Ann. Rept. Botanical Survey of Southwest and Northwest Louisiana, 1871, 1872, pp. 106–107.

[c] Preliminary report upon the Florida parishes of east Louisiana and the bluff, prairie, and hill lands of southwest Louisiana: Bull. Louisiana State Exp. Sta., Geology and Agriculture, pt. 3, 1896, p. 180.

ANT-HILL THEORY.

In considering the ant-hill hypothesis it must be conceded at the outset that in size and distribution these mounds exceed the work of any mound-building insects in this country. They are, however, approximated in size by some of the mounds of the leaf-cutting ants, the Atta. These are reported by Dr. W. M. Wheeler, formerly professor of zoology in the State University of Texas and an authority on ants, to reach a diameter in Texas of 40 to 50 feet and a height of 1 to 2 feet. He states that the hills are very stable and persist after the colony has migrated or become extinct. Mr. E. A. Schwarz, of the National Museum, reports that in Cuba the Atta hills often reach a height of 10 to 12 feet, with a diameter several times as great, and in places completely overrun the cane fields. These occurrences greatly reenforce the theory of an ant origin.

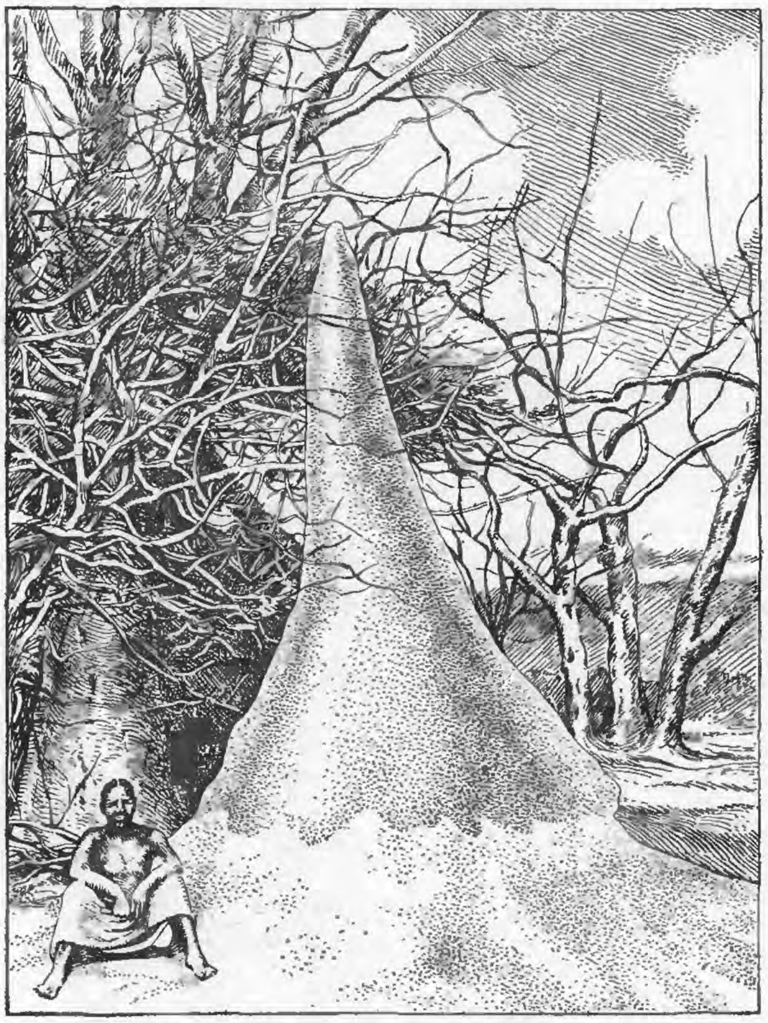

FIG. 12.—An African termite hill. (Drawing from photograph by Sir H. H. Johnston.[b]) Note the broad, low mound, on which the central spire rests, produced by wash of the central hill.

An alternative "ant theory" is that these mounds are the work of mound-building varieties of the so-called "white ants" (termites), which are notably developed in the tropical parts of South America and Africa and in Australia.[a] The immense hills of certain varieties of these termites, notably *Termes bellicosus*, which form a very important minor topographic feature over wide areas in Africa, are the nearest approach of any insect work to these natural mounds, both in size and bulk of material represented. These structures have a conical, sugar-loaf, or bee-hive shape and range from 6 to 20 feet in height and 50 or more feet in diameter (fig. 12). They are composed of mud in which more or less vegetable matter is mixed, and so, like the mounds, are best developed in clay regions. Should these cones be deserted by the termites, they would weather down into broad, low mounds which, because of their greater height and of the vegetable matter mixed with them, would have a looser character than the surrounding soil.

[a] For a discussion of termites see Encyclopædia Britannica, 10th ed., vol. 33, 1902, pp. 255-256, and the references there given.

[b] British Central Africa, New York, 1897, p. 371.

Regarded as the work of termites, these mounds suggest a warmer and moister climate, though modifications such as those which enabled large elephants, camels, and animals of the sloth and armadillo families (p 51) to live in this region would also have enablėd these now similarly restricted mound-building termites to do the same, and the causes which resulted in the extinction of the larger animals would in like manner, though at a later date, have destroyed the termites.

Opposed to the termite theory and pointing to a rodent origin is the fact that in exceptional cases in southern Arkansas these mounds are covered with gravel This is more probably due to subsequent work of burrowing animals

In conclusion it may be said that these mounds are clearly due to causes not now in operation in this region, and no theory of origin yet suggested is entirely satisfactory The dune and ant-hill theories are, perhaps, the best supported. On either of these hypotheses the mounds are indications of important climatic changes in recent time, and so offer a line of investigation which may develop very important and far-reaching results.[a]

RECENT

In Recent time, which may be defined more or less arbitrarily as that since the extinction of the mastodon and associated animals, and in this region more particularly as that since the completion of the main erosion of the Port Hudson deposits in the larger valleys, the topographic and geologic changes have been very slight With the exception of irregular benches on the hillsides produced by landslips (Pl V, p. 20), which, as their formation began in early Quaternary time, are only in part Recent, the effects of these changes are noteworthy only in the bottoms Aside from such local results as the destruction of river banks, the building of bars, and the formation of cut-offs, all produced by the wandering of the principal rivers in their flood plains and the building up of the front lands above the back lands by the deposition of sediment in overflows, the most important of these changes are (1) the formation and destruction of the lakes of Red River Valley (fig 1, p 15, Pls XXXII, p 62, XXXIII, p 62), (2) the deflection of Red River through a narrow gap in the terrace deposits near Marksville (fig 14, p 64), (3) the production of the "Rapides" near Alexandria, (4) the development of small rapids on Sabine and Angelina rivers and the production of a low swampy area in the latter above the rapids, and (5) a slight movement along the Red River fault line near Alabama Landing, La (p 65), with the resultant extreme swamping of the bottoms from that point to above the mouth of Bayou Moro, in Arkansas

Of these, the formation and destruction of the lakes of Red River Valley is by far the most important, and, happening, as it has, in historic and semihistoric times, is of peculiar interest as an example of geology in the making

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[a] Since the above was written the following short articles, discussing the general subject of natural mounds, have appeared in Science Branner, John C, Science n s, vol 21, 1905, pp 514-515, Hilgard, E W, id, pp 551-552, Spillman, W J, id, p 632, Purdue, A H, id, pp 823-824, and Piper, C V, id, pp 824 825 Branner and Purdue suggest that these mounds may represent immense concretionary formations Spillman refers certain mounds in southwest Missouri to unequal weathering of limestone containing large chert masses Branner gives many references to the mounds of the Pacific coast, for which he states the following theories have been advanced (1) Surface erosion, (2) glacial origin, (3) æolian origin, (4) human origin, (5) burrowing animals, including ants, and (6) fish nests exposed by elevation Bushnell, D I, jr, Science, n s, vol 22 1905, pp 712-714, has suggested the human origin theory, and this phase of the matter has been discussed by the writer in Science n s, vol 23, 1906, pp 34-36

FORMATION AND DESTRUCTION OF THE LAKES OF RED RIVER VALLEY.[a]

The "Great Raft"[b] commenced to form on the old course of Red River along Bayous Boeuf and Teche (fig. 13, p. 63), and its head reached a point in the flood plain near Alexandria in the latter part of the fifteenth century. This "Great Raft" (Pls. XXIX and XXX), which was more properly a complex series of log jams, each completely filling the river, started with a more or less accidental jamming of floating trees and driftwood. The effect of this initial jam was to pond the water immediately above it and force the river to form a new outlet in a low place in the bank above the jam and flow off through the adjoining timbered bottom lands. Driftwood quickly accumulated about this new outlet and formed another jam, separated from the older by a greater or less space, and in this manner the great raft gradually moved up the river. After a time, which, to judge from the total length of the raft and the average rate of advance, must have been about two hundred years, the lower portion had so decayed that it was carried down the partly blocked channel. Thus the raft moved up the river as a great, irregular accumulation of log jams and open water about 160 miles in length.[c] Its average rate of advance in the period between 1820 and 1872 was four-fifths of a mile per year, though in two instances accumulations of over 5 miles are recorded during extreme freshets.[d]

As the raft advanced, it blocked the outlets of the tributary streams and the channels draining the lowlands between the higher front lands and the bordering hills, and by preventing the discharge of the water from them at a level equal to the original low water of the main channel (Pl. XXXI) produced a series of lakes (fig. 1, p. 15; Pl. XXXII). The timber in these flooded areas soon died (Pl. XXX, *B*, *C*) and the exposed portions decayed, leaving the stumps as silent witnesses of their former condition (Pl. XXXIV, *A*, *B*).

Of the formation of these lakes in the lower part of the valley there is naturally no historic account, for the foot of the raft, at the time of the early settlements, was near the present site of Natchitoches,[e] and was one of the important factors in determining the location of that town, which was thus placed at the head of ordinary navigation. The successive dates of the formation of these lakes can, however, be closely approximated by the known rate of growth of the raft. Of the formation of the lakes in the upper part of the valley there are, however, more or less complete records. The group near Shreveport—Cross, Ferry, and Sodo lakes in Caddo Parish and Lake Bodcau in Bossier Parish (fig 1, p. 15), which were formed near the close of the eighteenth century—are described in a number of reports

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[a] For additional details and references see Veatch, A. C., The Shreveport area: Geol. Survey Louisiana, Rept. for 1899 1900], pp. 160–174, 181–188.

[b] The term "raft" is used here, as in the early history of this region, to apply to the jams formed of timber naturally thrown into the river by the caving of the banks. The branches on such trees greatly aided the formation of jams. Such a raft is quite different from the common raft made of logs cut in lengths, trimmed of their branches, and fastened together so that they can be floated down the river.

[c] Geol. Survey Louisiana, Rept for 1899, 1900, p. 164. See also Capt. H. M. Shreve's reports: 23d Cong., 1st sess., House Ex. Doc., vol. 3, No. 98, 1834; 24th Cong., 1st sess., House Ex. Doc., vol. 3, No. 197, 1836, p. 2; 25th Cong., 2d sess., Senate Doc. vol. 1, No. 1, p. 351.

[d] Shreve, H. M., 24th Cong., 1st sess., Senate Doc., vol. 3, No. 197, 1836, p. 2; Ann. Rept. Chief of Engrs. for 1879, vol. 2, 1879, p. 952.

[e] Paxton, Joseph, 20th Cong., 2d sess., Senate Doc., vol. 1, No. 78, 1829, p. 5; map of Natchitoches by J. F. Broutin, 1722, published in Thomassy's Géologie pratique de la Louisiane, 1860, opp. p. 227.

A. LOW CIRCULAR DUNES IN WHITE VALLEY, WESTERN UTAH.

Produced by sand or dust lodging about low desert vegetation. Photograph by G. K. Gilbert.

B. GOODWIN RAPIDS ON SABINE RIVER, NEAR COLUMBUS, LA.

One of the group of low shoals produced by recent upward movement along the Angelina-Caldwell flexure.

A. STEAMER "AID" REMOVING A PORTION OF THE GREAT RED RIVER RAFT IN 1873.

Note powerful lifting cranes and inclined platform bow, on which logs were hauled up for cutting with steam and hand saws. Location: 1 mile above Cedar Bluffs, La.; sec. 22, T. 21 N., R. 14 W. Photograph by R. B. Talfor.

B. ONE OF THE SEVERAL TIMBER JAMS COMPOSING THE GREAT RED RIVER RAFT.

In the region of slack water produced by these jams silt accumulated very rapidly and effectually filled the channel of the river (Pl. XXXI). Location: Channel of Red River, 5 miles below the Arkansas-Louisiana State line; sec. 29, T. 23 N., R. 14 W. Photograph by R. B. Talfor.

GREAT RED RIVER RAFT.

A. OPEN WATER AT FOOT OF ONE OF THE SEVERAL RAFTS WHICH MADE UP THE GREAT RED RIVER RAFT.

Timber jams and open water alternated throughout the length of the Great Raft, the open water being one-half to two-thirds of the whole. Location: One-half mile above head of Red Bayou, La., opposite Millers Bluff; sec. 16, T. 22 N., R. 14 W. Photograph by R. B. Talfor.

B. TIMBER DEADENED IN SHALLOW LAKE, PRODUCED BY THE RAFT.

Location: Sec. 33, T. 23 N., R. 14 W., Caddo Parish, La. Photograph by R. B. Talfor.

C. TIMBER DEADENED IN TEMPORARY RAFT LAKE WHICH WAS DRAINED BY THE REMOVAL OF THE RAFT.

Location: Head of McWillie Lake, sec. 16, T. 22 N., R. 14 W., Bossier Parish, La. Photograph by R. B. Talfor.

GREAT RED RIVER RAFT.

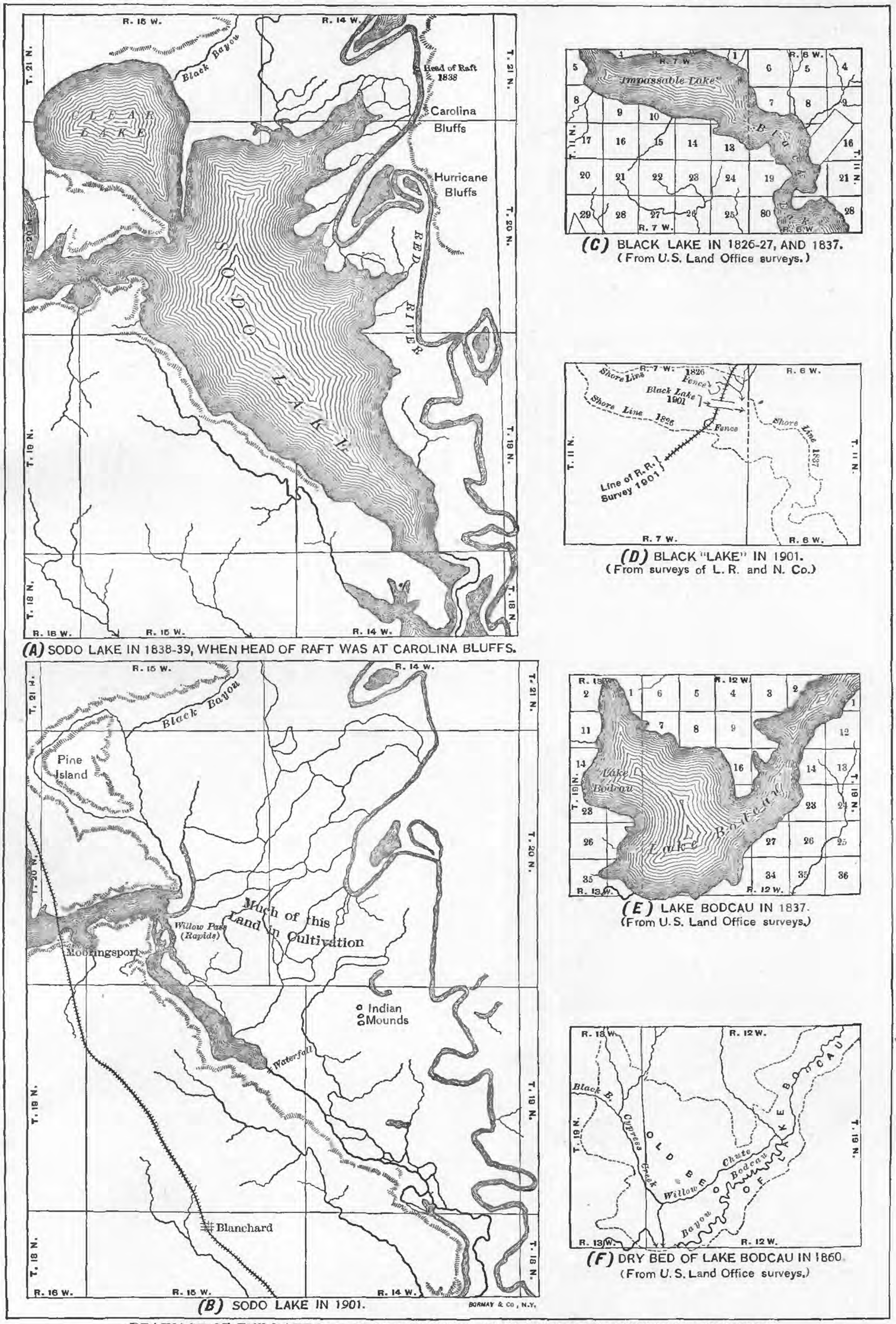
A

B

MAIN CHANNEL OF RED RIVER IMMEDIATELY AFTER REMOVAL OF GREAT RAFT IN 1873.

Showing silt accumulated during raft period. Location: Between Wild Lucia and Dooley's Bayou, La.; T. 21 N., R. 14 W. Photograph by R. B. Talfor.

GREAT RED RIVER RAFT.



(A) SODO LAKE IN 1838-39, WHEN HEAD OF RAFT WAS AT CAROLINA BLUFFS.

(B) SODO LAKE IN 1901.

(C) BLACK LAKE IN 1826-27, AND 1837.
(From U.S. Land Office surveys.)

(D) BLACK "LAKE" IN 1901.
(From surveys of L. R. and N. Co.)

(E) LAKE BODCAU IN 1837.
(From U. S. Land Office surveys.)

(F) DRY BED OF LAKE BODCAU IN 1860.
(From U. S. Land Office surveys.)

DRAINAGE OF THE RAFT LAKES OF RED RIVER VALLEY IN NORTHWESTERN LOUISIANA.
BY A. C. VEATCH.

Scale
0 5 10 miles

from various sources as prairies or bottom lands which were suddenly covered with water [a]

Before the final removal of the raft, in 1873, its head advanced from Carolina Bluffs, where Shreve found it in 1838, to a point within 3 miles of the Arkansas-Louisiana State line (Pls. XXXII, *B*, XXXIII, *A*), and in this advance it blocked the outlet of a bayou draining a large area of bottom land on the east side of Red River just above Millers Bluff and produced the last of the Red River lakes—Poston Lake—through which, for a time, steamboats passed on their way to upper Red River[b] (Pl XXXII)

Since the removal of the raft and the adoption of measures to prevent its re-formation this region has been gradually returning to its former condition (Pls XXXII, XXXIII) Maj J H Willard, of the United States Engineers, reports, from careful leveling, that the river lowered its bed between 1873 and 1892 over 15 feet at a point 15 miles above Shreveport and 3 feet at Shreveport, and that a similar reduction has been going on in the river below that place[c] The lake areas are rapidly draining[d] and, in many places, land which in the early part of the last century was a part of one of these lakes is now under cultivation (Pls. XXXII, *A*, *C*, XXXIII, *A*, *B*) The complete return of this region to pre-raft conditions has been considerably retarded by a number of causes, among which are the following (1) The deposits of the raft period (Pl XXXI, p 60) have in some cases entirely filled the old channels of the tributaries, and the streams thus superimposed on projecting spurs of the old Tertiary beds have been forced to cut entirely new channels Small rapids and waterfalls have been developed, which are wearing back and gradually draining the lakes (2) Even without such hindrances the reestablishment of a perfect base-level in a silt-laden stream like Red River is doubtless very slow

A theoretical consideration of maps, together with the well-known silt-laden character of Red River, has led to the natural, though erroneous, explanation that these lakes are the result of excessive deposition in the normal régime of the river According to this hypothesis Red River, overloaded with silt because of the excessive erosion in its headwaters, is building up its flood plain more rapidly than the minor clearer tributary streams, the lower portions of which are therefore converted into lakes, and these lakes have been referred to as the type examples of lakes of this class[e] It should be pointed out in this connection that (1) the lakes of Red River did not extend above the upper limit of the raft, though the valley above is quite as mature and should, under the conditions assumed, receive the same amount of sediment, (2) the uppermost of the lakes are known to have been formed by the raft, (3) since the removal of the raft all the lakes have materially decreased in size and where not completely drained are still decreasing, (4) the flood plain of Red

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[a] 20th Cong, 2d sess Senate Doc, vol 1, No 78, 1829, p 10, 43d Cong, 1st sess, House Ex Doc, vol 2 pt 2, 1873, pp 658-659, also published as Ann Rept Chief of Engrs for 1873, pp 658-659, Geol Survey Louisiana, Rept for 1899 [1900], pp 185-186

[b] MS map by Lieut E A Woodruff, in the archives of the War Department

[c] Ann Rept Chief of Engrs for 1893, pp 1909-1910

[d] Lockett, S H, Second Ann Rept Topog Survey of Louisiana, 1870, 1871, pp 44, 46, Woodruff, E A, Ann Rept Chief of Engrs for 1873, p 650

[e] Davis, W M, Science, vol 10, 1887, p 142, Davis, W M, and Snyder, W H, Physical geography, Boston, 1898 pp 279-280, Chamberlin, T C, and Salisbury, R D, Geology, vol 1, 1904, p 179

River in the region of the lakes, instead of rapidly building up, is at present the site of a unique destruction and presents, in the midst of a well-defined river flood plain, waterfalls and rapids. Indeed, it is very safe to assume that had there been no raft there would have been no large lake in Red River Valley, and that any classification of lakes by origin must regard these temporary bodies of water as unique. The presence of these lakes on the maps of to-day is in many cases due not to their existence but to the fact that all these maps are based on the old Land Office surveys, made in the early part of the last century (see Pls XXXII, XXXIII)

Another theory which has been suggested for the origin of these lakes is that they were produced by earthquakes in a way similar to the sunk lands of the St. Francis basin and Reelfoot Lake, near New Madrid, Mo , which were formed during the earthquake of 1811-12 This theory was first advanced by Lyell[a] and has recently been restated by Shepard[b] The resemblance between the two phenomena is, however, restricted to the fact that in both cases bottom-land trees have been killed by being flooded with water The lands submerged by the New Madrid earthquake are irregular areas entirely in the Mississippi flood plain. The Red River lakes, which are now largely drained, had a regular shape dependent on topography existing before their formation They occur regularly in every large valley tributary to Red River from Alexandria to the Louisiana-Arkansas State line, and in the low portions of the bottoms between the higher land along the main river channel and the bordering hills (fig 1, p 15) It must be confessed that it would be a most singular earthquake or series of earthquakes which would produce lakes with this peculiar regularity and without any evidence of faulting The lakes have, moreover, either completely drained, or are still draining, a fact which, when the character of the draining is considered, is entirely incompatible with any theory of origin involving a sinking of land, such as has occurred in the vicinity of New Madrid

A recent movement along the Red River-Alabama Landing fault, which passes north of all these lakes (Pl XXXVI, p 68) and in which the downthrow is, moreover, to the north, has produced a well-defined break of 25 feet in the Ouachita River bottoms near Alabama Landing (Pl XXXV, p 66) There is no evidence, however, that this faulting produced a lake It represents a number of insignificant movements rather than a single break (p 65)

DEFLECTION OF RED RIVER BELOW ALEXANDRIA, LA.

Another effect of the raft, and because of its favorable situation a more permanent one, was the diversion of Red River below Alexandria Here, as the raft advanced up the old channel of Red River along Bayou Boeuf (fig 13) and the water was ponded in the low areas between the main channel and the bounding hills, the lake on the north side of the valley below Alexandria found an outlet through a low place in the Avoyelles and Point Maigre hills (fig. 13), even as the flood waters of to-day pass through a break in the Avoyelles Hills, the Coulée des Grues, just south of Marksville, and join the Ouachita-Black River drainage and

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[a] Lyell, Charles, Principles of geology, 11th ed , vol 1, p 452

[b] Jour Geol , vol 13, 1905, pp 60-61

ultimately the Mississippi. After the passage of the raft up the river this new course was so well established that it has remained the main channel of the river to this day.

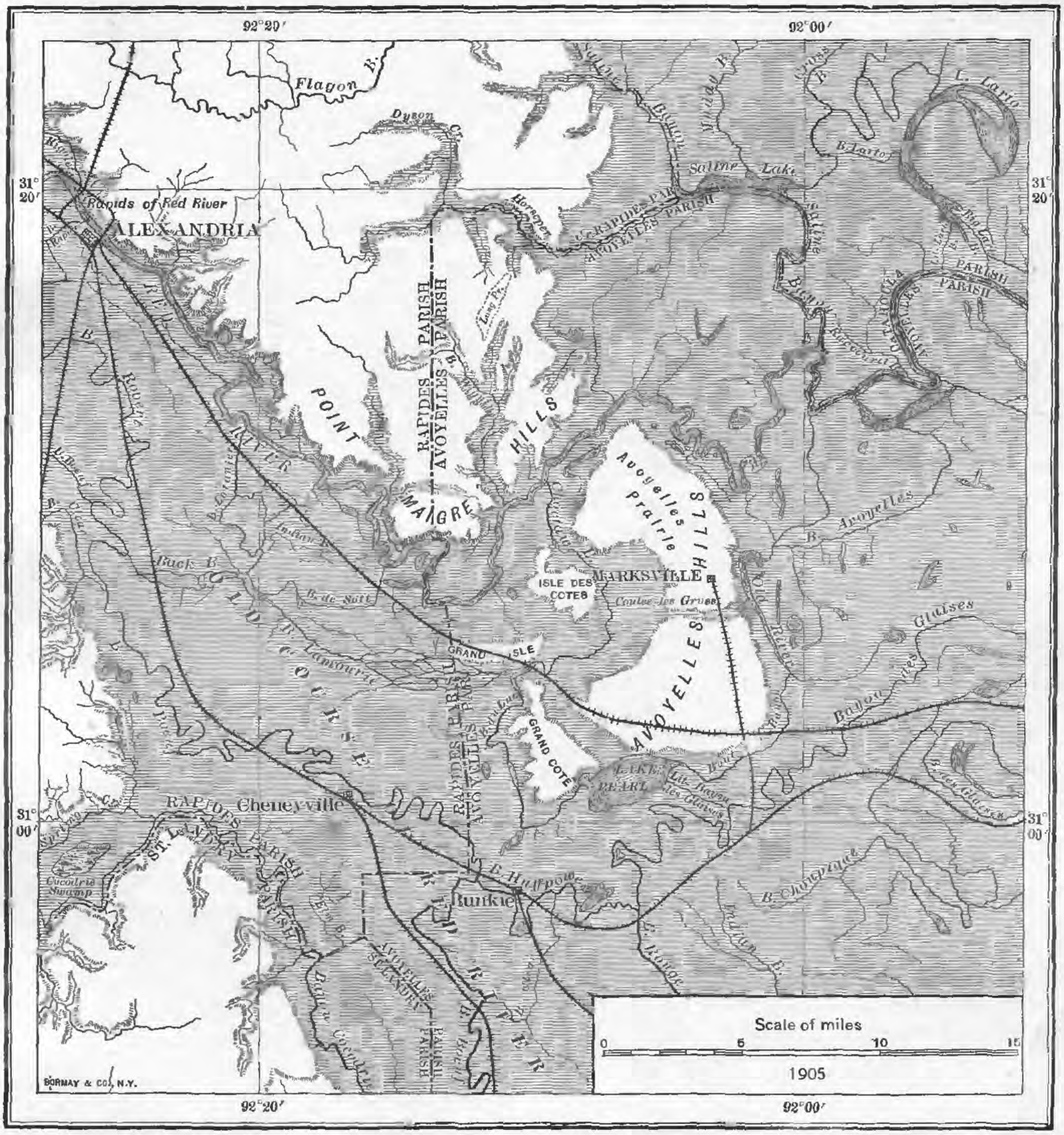

FIG. 13.—Map showing diversion of Red River below Alexandria, La., and location of the rapids. Shaded areas are land subject to overflow; white areas, terraces and hill lands.

PRODUCTION OF THE "RAPIDES" NEAR ALEXANDRIA, LA.

Near Alexandria the choking and building up of the old channel of Red River during the raft period and the free outlet afforded by the low place between the Avoyelles and Point Maigre hills caused the development of a new channel along the north side of the valley. When the river, in adjusting itself to its new course, cut out the alluvial deposits it became, in one place, superimposed upon projecting spurs of Catahoula sandstone, and these harder beds produced small rapids, which, because of their extremely recent formation, have not yet been cut out by the river

DEVELOPMENT OF SMALL RAPIDS ON SABINE AND ANGELINA RIVERS

The shoals and low rapids which occur along Sabine River for a distance of 60 miles between the mouth of La Nana Bayou and a point 6 miles below the mouth of Bayou Toro, and which attain their maximum development at the mouth of Bayou Negreet and near Columbus (figs 14, 15), are, like the rapids of Red River at Alexandria and Catahoula shoals on Ouachita River, due in part to the superposition of the river on the underlying country rocks by the silting up of the valley during the Port Hudson submergence and the subsequent irregular cutting out of these deposits There is, however, this important difference between the Sabine River rapids and those of Red River and Catahoula shoals, namely, that the latter are isolated occurrences associated with near-by bluffs of Tertiary strata, while the Sabine River rapids represent a series extending for a distance of 60 miles, attaining a maximum development near the center, and, except at Columbus and Sabinetown, not associated with the bluffs of the country rock (fig. 16)

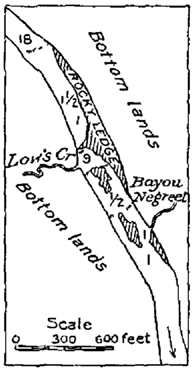

FIG 14 —Sketch map of McClinahan Shoals, Sabine River between Sabinetown, Tex , and Columbus, La (Polhemus 1878) Shaded areas represent rocky ledges exposed at low water, figures give depths of water in feet

Along Angelina and Neches rivers in Texas, which form the first important drainage system west of the Sabine, a somewhat analogous and in itself more conclusive phenomenon has been observed Near the headwaters of the Angelina at the Rusk-Nacogdoches county line the river banks are from 8 to 10 feet high They rapidly decrease in height to a point 6 or 7 miles above the Houston, East and West Texas Railroad bridge, where they are almost at water level Below this point many outlet sloughs leave the river, which has the aspect of a stream at or below its base-level, and just beyond the railroad bridge the river divides into many branches—narrow, tortuous, tree-choked channels, which wander aimlessly through a great swamp and finally unite, several miles below, to form a low-banked river The banks then gradually increase in height and low, flat-topped bluffs, 4 to 6 feet high, composed of brightly colored sands, appear at intervals. Between the mouth of Ayrish Bayou and old Bevilport the banks of the river are from 15 to 20 feet high, and the appearance of these bottom lands perched high above the river is in marked contrast to the flat swamp land at water level in the valley above The current in this portion of the river is quite swift and reaches its maximum velocity in the great southward loop 2 or 3 miles

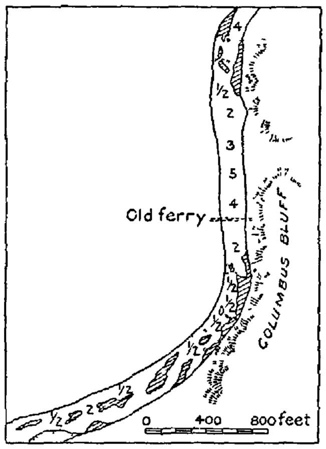

FIG 15 —Sketch map of Goodwin Shoals, Sabine River, near Columbus, La (Polhemus 1878) Shaded areas represent rocky ledges exposed at low water, dotted areas, sand bars, figures give depths of water in feet

A. FERRY LAKE NEAR MOORINGSPORT, CADDO PARISH, LA.

Showing stumps of pine, oak, and cypress killed by flooding during raft period, and now exposed by partial drainage of lake.

B. WAVE-FORMED BLUFF ON SOUTH SHORE OF FERRY LAKE.

Partial drainage of lake by removal of raft has left the bluff 15 feet above water level. Note trees growing on old beach.

FERRY LAKE, A PARTIALLY DRAINED RAFT LAKE.

above Lewis Ferry. From Bevilport to the Gulf the height of the banks of the river gradually decreases. The relation of these two occurrences was such as to lead to the suggestion in 1902 that the phenomenon observed was due to a slight folding along an axis extending obliquely across the two rivers, and further work has shown the presence of a low monoclinal flexure extending eastward through Louisiana and striking Mississippi River north of Vicksburg (p. 68, Pls. XXXVI, XXXVII). This flexure began to develop in the Oligocene and has been moving intermittently since that time. The rapids indicate a very recent movement along this portion of the flexure, which is perhaps still developing.

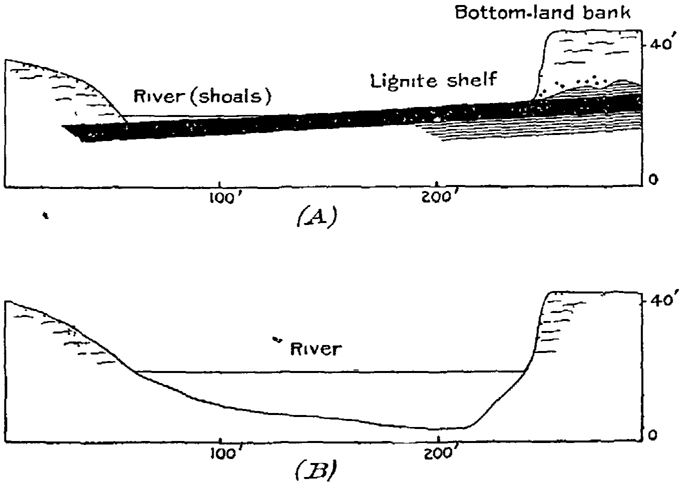

Fig. 16.—Cross sections illustrating character of a typical rocky shoal on Sabine River showing its relation to the flood plain or bottoms. *A*, Section at "Stone Coal Bluff," between Sabinetown and Pendleton, Tex.; *B*, section 1 000 feet above *A* at same stage of water.

FAULT ON OUACHITA RIVER NEAR ALABAMA LANDING, LA.

Another recent crustal movement has resulted in a rather important change in the Ouachita River bottoms near the Arkansas-Louisiana State line. This consists in a slight movement of the large Red River-Alabama Landing fault (p. 68). As revealed by the careful surveys of Ouachita River by the United States engineers, this has amounted to 25 feet, and the movement is so recent that, although occurring in the flood plain of a large river, it has not been perceptibly obliterated by sedimentation (Pl. XXXV). A break of this size, if produced at one time, must have resulted in an earthquake of very considerable magnitude,[a] and it must be considered either to have been formed before the important earthquakes of the early part of the last century, or to represent a great number of very slight movements, none of which was large enough to produce an important quake. In either case the persistence of this break must be regarded as an extreme illustration of the small amount of sediment carried by Ouachita River, by reason of which this river has been able to attain and maintain a more perfect base-level than the silt-laden Mississippi (Pl. I, p. 14).

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[a] The faulting accompanying the great Bengal-Assam earthquake of June 12, 1897, which is regarded by R. D. Oldham, of the India Geological Survey, as the most powerful and widespread earthquake of which there is historical account, is not known to exceed 30 feet. The faulting that produced the great Japanese earthquake of October 28, 1891, averaged 3½ meters, although it attained in places a maximum of 6 meters. The severe earthquake which occurred in the Mexican State of Sonora, south of Arizona, on May 3, 1887, was produced by a faulting of but 11 feet. The severe shocks in Chile in the early part of this century were accompanied by displacements of from 3 to 8 feet, and the dislocation of the New Madrid earthquake of 1811–1812 is given as only a few feet (Lyell, Principles of Geology, vol. II, 12th ed., 1875, pp. 106–110). See Dutton, C. E., Earthquakes, New York, 1904, pp. 52–60.

The effect of this fault is to render the bottom lands between it and the mouth of Smackover Creek, in Arkansas, particularly subject to severe and prolonged inundations and to greatly decrease and in some cases largely destroy the value of these lands for cultivation.

The Red River lakes are south of this fault line and in no way connected with it The downthrow is, moreover, to the north and the Red River lakes, therefore, on the upthrow side There is no evidence of a lake in the Ouachita bottoms above the fault, which is an additional reason for believing it due to a number of slight movements rather than one large break

LANDSLIP BENCHES.

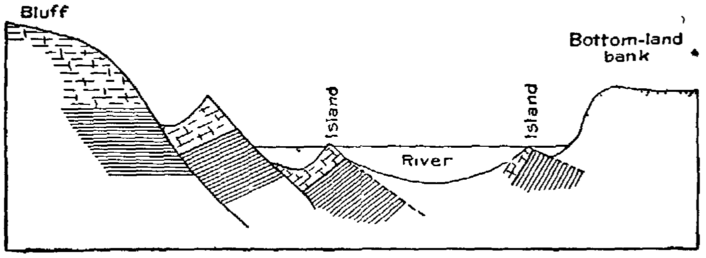


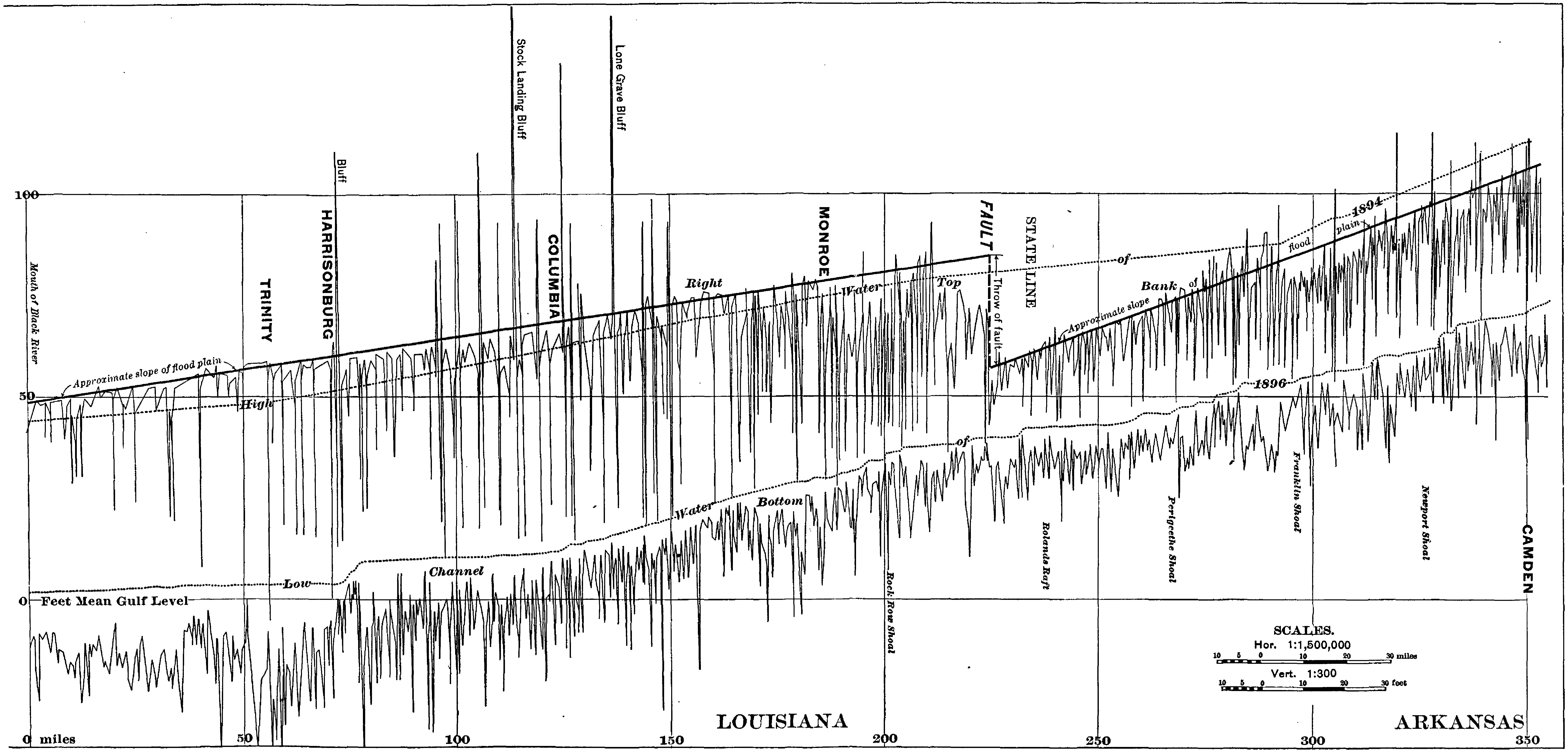
FIG 17 —Section of Bunker Hill Bluff, Catahoula Parish, La . showing manner of formation of the landslip or "hogback" islands common along Ouachita River

Besides the definite terrace levels due to erosion, there are on all steep hillsides many irregular, limited benches (Pl. V, p 20) that form a minor feature about as important topograhpically in some places as the mounds on the flat lands These occurrences, which represent arrested landslips produced by undercutting or by the action of underground waters or earthquakes are frequently regarded as old fortifications, "treasure holes," old mine dumps, and the like. Along Ouachita River landslips of this character, produced during the profound erosion of the early Quaternary (p 46) and then buried beneath the Port Hudson deposits, are now being resurrected by the river and form in its channel in many places peculiar low "hogback" islands of steeply inclined strata, at some places associated with bluffs (fig 17) and at others entirely removed from the bluff line

STRUCTURE

BROADER STRUCTURAL FEATURES RESULTING FROM CAUSES ASSOCIATED WITH CONDITIONS OF DEPOSITION

As has been explained in the foregoing discussion of the historical geology, the flat Jurassic land surface or peneplain was, in this region, very gradually warped in two principal directions. It was gently tilted southward in the direction of the present Gulf coast, and later, while the gulfward tilting was still continuing, a broad trough was developed southwest along the axis of the present Mississippi Valley, which, indeed, owes its origin to this fold. The general effect of this tilting was to give to all the beds deposited by the ocean on this old land surface a very gentle slope toward the Gulf, and, after a time, toward the Mississippi Valley The relative intensity of these two slopes depended on the location, near the Mississippi Valley the slope toward the trough was more important, while to the east and west the gulfward slope increased in value until it became the principal element. The effect of this very slow progressive tilting and the usual wedge or lens shape of



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RECENT FAULT CROSSING THE OUACHITA RIVER BOTTOMS NEAR ALABAMA LANDING, LA.

Inferred from "Profile of bottom of channel and right bank of the Ouachita and Black rivers from Red River, Louisiana, to Camden, Ark., by the U. S. Engineers."

marine deposits, which are thin toward the land and thicker seaward, was to give to the lowest beds a greater slope than the succeeding ones [a] (Pls III, XXXVII, secs B, D, E, F, G, H, I, p 70)

Thus the older Cretaceous beds—the Trinity, Goodland (Fredericksburg,) and Washita formations (pp 20–21)—which attain great thickness in central Texas, grow thinner in passing eastward along the outcrop, and finally disappear in southwestern Arkansas (See Pl III, in pocket, compare secs F, D, E, B, Pl XXXVII, p 70) The lowest formation of the upper Cretaceous in Arkansas, the Bingen, likewise thins out rapidly to the east, while to the west it grades into a very thick series, which ultimately becomes two or three distinct formations (p 24, fig 4; compare secs E, D, H, Pl. XXXVII) In the latter part of the Cretaceous, with the development of the Mississippi embayment, the deep water shifted eastward, and the clays of this period, which are dark and calcareous in Texas, contain, in the Arkansas and Mississippi regions, large amounts of chalk and chalk marls.

In the Tertiary strata somewhat similar causes have resulted in the entire absence of the Vicksburg beds west of Catahoula Parish, La (Pl III.)

Besides these variations in thickness and lithological characters, due to conditions intimately connected with deposition, and the initial dips due to the gentle tilting of the surface of the old Triassic peneplain, notable variations in the structure have been produced in several other ways (1) By the domes, (2) by the Angelina-Caldwell flexure, (3) by the Red River-Alabama Landing fault

CHANGES BY SUBSEQUENT OROGRAPHIC MOVEMENTS

DOMES

The domes, twelve of which are now known in northern Louisiana and eastern Texas (Pl XXXVII), the presence of a thirteenth being suspected, are by far the most unique structural feature in this region They are very symmetrical, four-sided folds or quaquaversals of Cretaceous strata, about a mile in diameter, that represent deformations of from 1,000 to 4,000 feet (Pl. XIII) They penetrate the Eocene beds without materially disturbing them, except, perhaps, the Midway, and though their major development and partial truncation by erosion occurred during the late Cretaceous and early Tertiary, the Winnfield dome is known to have moved in post-Claiborne time, and the Belle Isle, one of a series of closely related domes in southern Louisiana, shows movements in Quaternary time.[b] In point of origin it is thought that these domes were perhaps produced by the upward pressure of intrusions of igneous rocks of limited area (see p 29), and so may be termed bysmalithic[c] domes or bysmalithic quaquaversals[d]

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[a] Still farther seaward the beds again grow thinner, but no such thinning has been observed in this area, and it is presumed that the point where these beds thin out is beyond the area under discussion

[b] Geol Survey Louisiana, Rept for 1899, [1900], pp 228–229, Geol Survey Louisiana, Rept of 1902, pp 99–100

[c] Iddings, Jour Geol, vol 6, 1898, pp 705–706

[d] Since the above was written I have found that Lee Hager (Eng and Min Jour, vol 78, 1904, pp 137–139, 180–183) has suggested a hypothesis which explains the origin of these and very similar domes in southern Louisiana and southeastern Texas by the upthrust of an igneous plug His theory is in the most essential particulars parallel to the one here advanced The fact that two workers in this field have independently arrived at the same hypothesis as the only one at all in accordance with the known facts greatly adds to its probable value Mr Hager's suggestion that the wonderful salt, sulphur, and gypsum deposits of this southern region are not of normal marine origin, but were concentrated and redeposited by the heated waters circulating around these igneous intrusions, and that these deposits are to be regarded as essentially the product of

ANGELINA-CALDWELL FLEXURE.

The low Angelina-Caldwell monoclinal flexure is known to extend from Angelina County, Tex , through Louisiana north of Natchitoches, Winnfield, and Columbia to Mississippi River north of Vicksburg (Pls XXXVI, XXXVII, secs A, B, C, D, F) It began to develop in Tertiary time, perhaps as early as the Oligocene, and is still a line of weakness Recent movement along its west end has resulted in the formation of a series of shoals on Sabine River and in the swamping of a part of the Angelina River Valley in Angelina and Nacogdoches counties, Tex (See p 64) It has almost entirely destroyed the southern element of the dip of the beds between its northern edge and a point about 60 miles south of the Paleozoic border Along the line of the flexure the dip of the Claiborne beds ranges from 46 feet at Vicksburg to 150 feet on Sabine River Still farther south the dip becomes less, though this change of the dip has as yet been actually observed only on Sabine River, where, between Hattens Ferry and Burrs Ferry, it changes from 150 feet to about 30 feet per mile (Pl III, sec F)

It should be noted that the Nacogdoches oil field occurs near the upper bend of this monocline, and that the oil springs reported in Sabine Parish, La., occur in the same relation to this fold.

RED RIVER-ALABAMA LANDING FAULT

The Red River-Alabama Landing fault extends across northern Louisiana and southern Arkansas into northeastern Texas, approximately in the position shown on Pl. XXXVI, though in a much more irregular manner Like the Angelina-Caldwell flexure, it is of late Tertiary age and has been the site of movement in the present time The total displacement or "throw" of this fault along the Little Rock-Marksville section (Pl XXXVII, sec B), where the data regarding it are most complete, is in the neighborhood of 600 feet, with the downthrow to the north

The throw of the Red River fault, of which this seems to be the continuation, is given by Hill as about 626 feet at Preston and 617 feet north of Denison, Tex. The close agreement of these figures is very surprising when the distance between the places of measurement—about 275 miles—is considered, as such uniformity of fault structure is unusual

Evidence of recent movement along this line is found on the Ouachita River just above Alabama Landing, where the displacement revealed by the careful levels of the United States engineers is 25 feet (Pl. XXXV, p 66) This movement, which is so recent that the river has not yet perceptibly filled the depression, has resulted in the production of an extremely low, swampy area extending almost to the mouth of Smackover Creek in Arkansas.

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the change in conditions produced by these intrusions, appeals to me as the most probable theory that has yet been advanced The stratigraphic and structural relations of the salt deposits of Grand Saline, Tex , are not well known, but the beds here do not indicate a dome, and the salt beds have therefore been referred to ordinary salt-pan action The brines of the various northern Louisiana salines are in part clearly derived from water-bearing Cretaceous beds which have been brought up by this extreme folding, but the brines may be in part derived from salt beds formed about the center of the uplift and as yet unexposed

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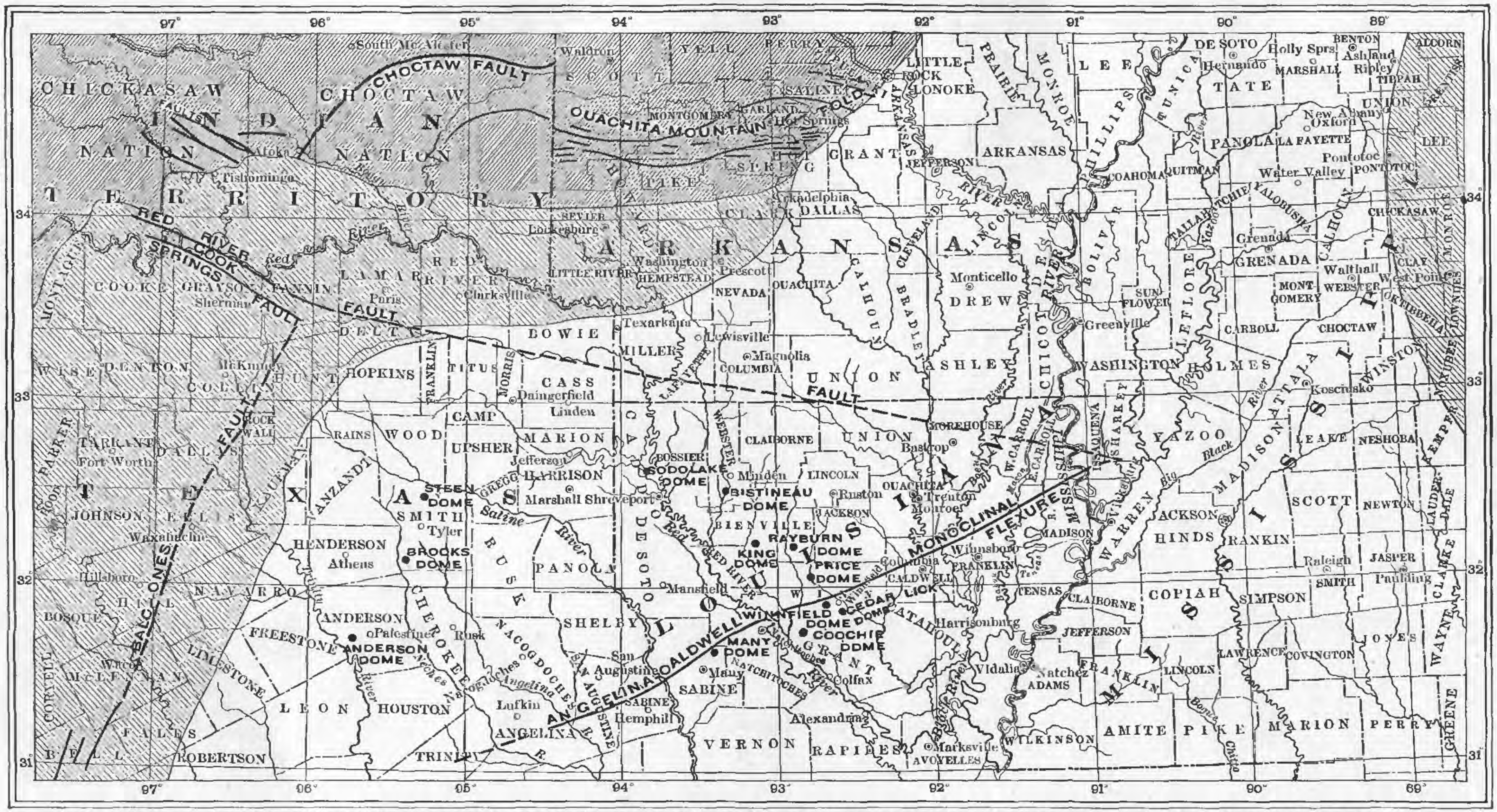

PRINCIPAL STRUCTURAL FEATURES OF THE COASTAL PLAIN IN NORTHERN LOUISIANA AND SOUTHERN ARKANSAS WITH SOME OF THE STRUCTURAL FEATURES OF ADJOINING AREAS.

Scale

40 0 40 80 120 miles

1905

LEGEND

Tertiary with Quarternary Covering in places.

Cretaceous.

Archean and Paleozoic.

LOCAL STRUCTURAL FEATURES

Besides these broader structural features, there are in every locality many minor examples of faults and folds on a minute scale that have no bearing on the general structure of the region, but are of importance to the teacher and student as examples of the larger and much more obscure occurrences. These little structural phenomena are generally the result of the readjustment of the strata resulting from erosion, and in some cases to slight readjustments produced by earthquakes.

DIP OF STRATA

The direction and character of the dip of the strata is shown on the structural (Pl III) and hydrologic sections (Pl. XXXVII) and may be inferred from the contours shown on the underground-water maps (Pls. XXXVIII, XLI-XLIV) However, the following values may be of interest

The slope of the old Triassic land surface, or the "bed rock," is from 100 to 125 feet per mile all along the Cretaceous-Paleozoic contact in southern Arkansas from Arkadelphia westward Northeast of Arkadelphia nothing is definitely known regarding its slope, and there is some indication that it may be faulted.

The dip of the upper part of the Bingen formation (the sub-Clarksville sand) is 70 feet per mile about Gurdon and 80 feet per mile at Texarkana.

The Nacatoch sands have a dip of 56 feet at Gurdon, 65 feet at Hope, 80 feet at Fulton, and 73 feet at Texarkana (See Pl XXXVIII, pocket)

The southward element of the dip of the base of the Jackson north of the Red River-Alabama Landing fault along the line of the sections from Vicksburg to Marked Tree (Memphis) (Pl. XXXVII, sec. A), and from Monroe to Little Rock (Pl XXXVII, sec B) is about 1 7 feet per mile

The southward element of the dip of the base of the Claiborne along the Angelina-Caldwell flexure is 46 feet per mile at Vicksburg, 48 feet at Columbia, 50 feet at Colfax, and 150 feet on Sabine River.

The dips toward the Mississippi trough range from 8 to 16 feet per mile.

CHAPTER II.

GENERAL UNDERGROUND WATER CONDITIONS.

INTRODUCTION.

SOURCE OF UNDERGROUND WATER.

Of the 40 to 50 inches of rain which commonly fall during each year in northern Louisiana and southern Arkansas (fig 18) a considerable portion immediately flows off the surface in streams and ultimately reaches the sea. Another portion passes into the ground and, after a longer or shorter journey, returns to the surface in the form of springs either on the land or under bodies of water. In both of these cases a part is lost by evaporation, and a certain amount, though a comparatively small percentage, is consumed by living organisms and in chemical work

The portion which passes into the earth furnishes the entire supply of well water both in surface and deep wells. Its availability for this purpose at any point and the permanency and quality of the supply, as well as the height to which the water will rise above the bed in which it is encountered, depend on the relative position, elevation, and permeability of the different strata in that region Its potability, or mineral character, depends on the soluble minerals contained in the beds through which it passes

The percentage of the rainfall which sinks into the earth is determined by (1) the character of the rains, whether of a slow and steady or a torrential nature, (2) the topography of the country, whether flat or with many steep slopes, (3) the character of the vegetation covering the surface, and (4) the porosity of the soil and the physical character and state of saturation of the underlying beds

NATURE OF MOVEMENT OF UNDERGROUND WATER

Except in thick limestone beds containing caverns, underground waters very rarely travel through channels or conduits of appreciable size, or in any way resemble surface streams; and seldom can the underground water system of any area be said to even remotely "resemble the veins of the human body." The true cavern streams furnish an extremely small percentage of the world's water supply derived from wells, and well waters on the whole are to be regarded as coming from the saturated portions of porous beds, through which the water moves in the small spaces between the particles as the sand of a sand bed or sandstone, or the gravel of a gravel bed or congolmerate. This motion is to be described as a slow seeping, in which the water moves at the rate of a few feet per day, rather than a few miles, as in surface streams

The manner and character of this flow may be artificially and somewhat arbitrarily shown by taking a sand pile of considerable size, placed on a relatively hard or impervious material, and spraying its center with water. When the lower portion of the pile has become saturated, little streams will begin to trickle from one or more points at the base, the number depending on the shape of the ground where the pile is situated. These little rivulets represent springs and it will be found that the water will flow for some time after the cessation of the spraying, the length of

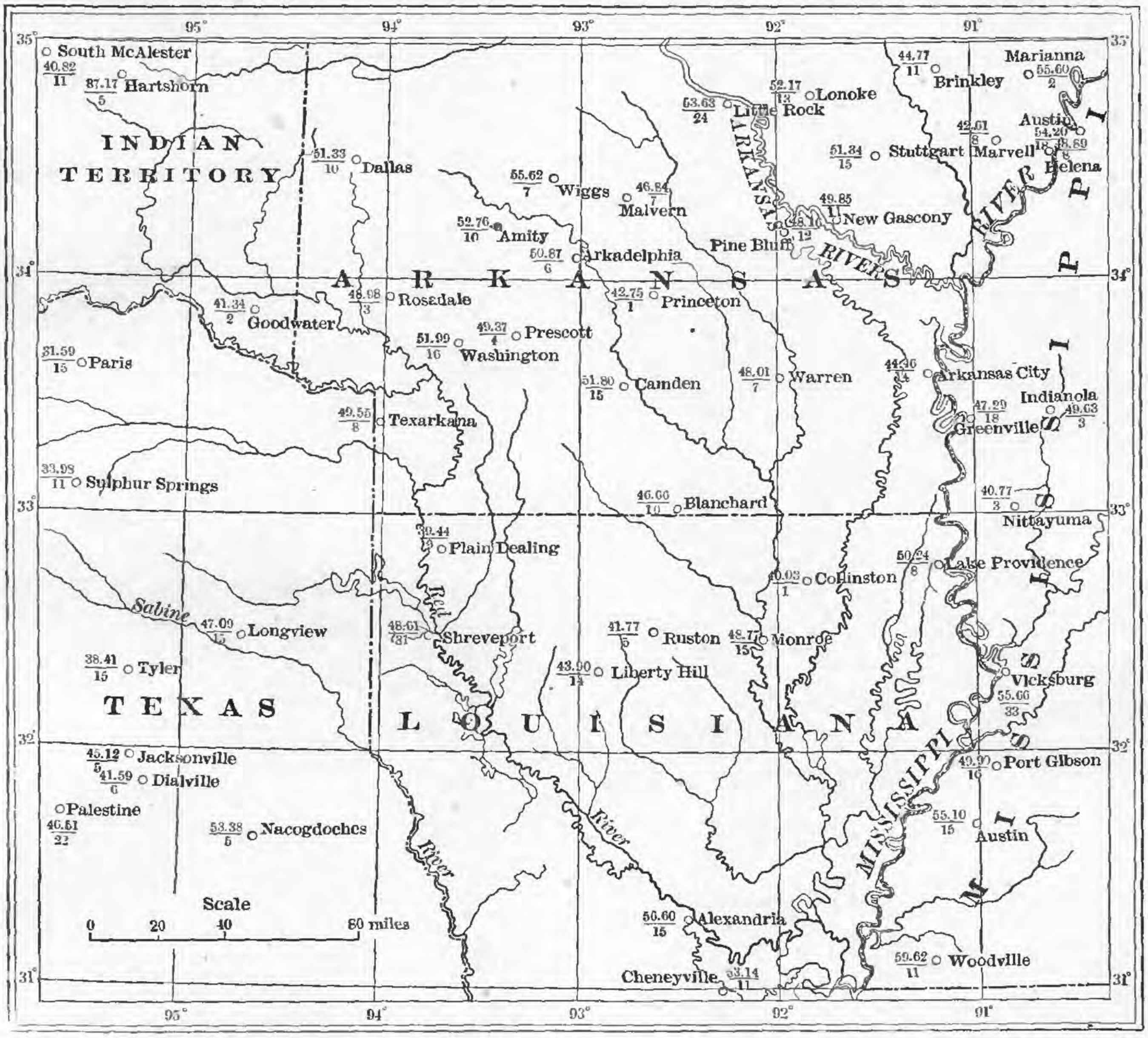

FIG. 18.—Annual rainfall in northern Louisiana and southern Arkansas, compiled from reports of the United States Weather Bureau for the years 1902 and 1903. Lower figures represent period of years; upper figures, average rainfall for period given.

time depending on the size of the pile and the coarseness of the particles composing it. Imagine this sand pile increased to many feet in thickness and covering the top of a hill or group of hills which is underlain by clay beds, and an idea will be had of the character and cause of many of the springs in northern Louisiana and southern Arkansas.[a]

[a] For another type of springs see p. 76.

ZONES OF SATURATION

The effect of this constant influx of water into the earth is to completely saturate the rocks between an upper limit, whose position depends largely on the amount of rainfall and the relief of the country, and a lower limit, fixed by the point below which the enormous pressure of the upper layers of rocks prevents the existence of spaces of any character between the rock particles The position of this zone of no pores has been estimated by Van Hise[a] to be about 6 miles from the surface

MAIN GROUND-WATER TABLE

The upper limit of this zone of complete saturation is known as the main ground-water table In regions of heavy rainfall it is relatively near the surface, while in areas of light precipitation it is deep in the ground. The possibility of obtaining water below this main ground-water table depends on the location of the coarse beds, such as sand and gravel, which will yield their contained water readily. Clay beds in this zone, though also completely saturated, release the water extremely slowly if at all, and have, therefore, no water-bearing value.

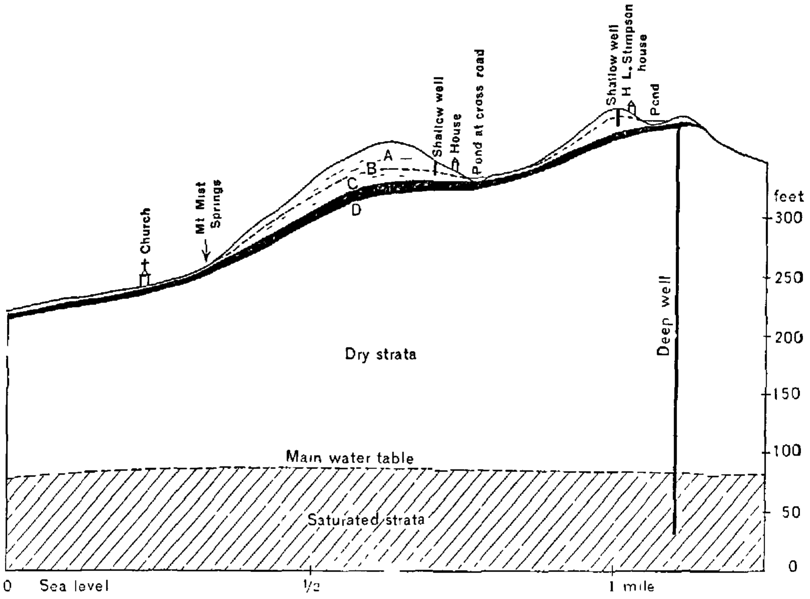

FIG 19 —Cross section on Long Island, New York, showing the relation of a perched water table to the main water table and the production of springs dependent on a perched water table

PERCHED GROUND-WATER TABLES

Above this zone of complete saturation and separated from it by nonsaturated strata, there are, in regions containing irregular clay or relatively impervious beds, more or less elevated, limited, and disconnected zones of saturation which may be termed "perched water tables" They supply local shallow wells, and when cut by valleys produce springs of greater or less importance (fig 19). Wells dependent

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[a] Sixteenth Ann Rept U S Geol Survey, pt 1, 1896, p 593

on perched water tables are in general much less satisfactory than those which pass below the main water table, as they derive their supply from more or less limited bodies of saturated strata which are quickly affected by periods of drought.

VARIATIONS OF PRESSURE OR HEAD

The water pressures in the main zone of saturation are very unequal The differences in the coarseness of the strata, the leakage through springs, and the constant additions from rainfall prevent their ready equalization. They vary greatly in different layers in the same region, and in the same layer in different regions The extent and cause of this variation is indicated by the character of the factors in the following equation

Pressure head at a given point in any stratum, expressed in feet above sea level=elevation of ground-water table at source—loss by resistance—loss by leakage

All the members on the right-hand side of this equation are irregular variables. The first, the elevation of the ground-water table at the outcrop or source, depends on the elevation of the surface, which changes at different points (See p 78.)

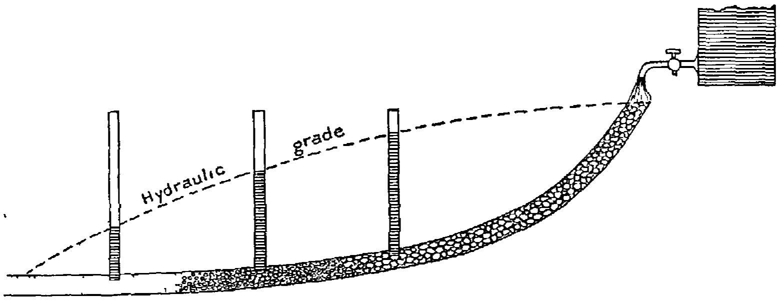

FIG 20 —Experimental illustration of loss of head by resistance and leakage (After David, 1893)

The second depends on the size of the spaces between the grains, which in even the most uniform beds is a constantly changing quantity and in beds such as those of the Lower Eocene is extremely variable The third varies with any change in the coarseness of the adjacent beds, which are never constant, and is affected by faults, joints, and other natural breaks

This variation may be artificially shown in the manner indicated in fig. 20 In this experiment a tube is filled with sand, coarse shot, and marbles, representing beds of different coarseness, and the lower end of the tube is closed with a brick to prevent the materials from running out When water is allowed to flow in from above, it rises to different heights in the small tubes, representing wells.

CAUSES PRODUCING ARTESIAN OR FLOWING WELLS

It is these variations in the pressure or head that make flowing or artesian wells possible under certain conditions. These may be briefly stated as follows.

1 There should be relatively porous beds suitably situated to collect and transmit the water
2 There should be less porous or relatively impervious layers so placed that they may confine the water collected
3 The level of the ground-water table at the source should be enough higher than the surface at the point where the well is drilled to compensate for the loss of head due to resistance and leakage

In order that the well may be permanently artesian it is also necessary that there be sufficient rainfall and that the demand be not greater than the rate at which the water can flow through the porous stratum or strata.

The arrangement of the factors which produce a flow is by no means constant. They vary considerably from point to point and relatively new combinations are to be continually expected. Possibly the most usual combination is that shown in the accompanying diagram (fig. 21) Here the confining beds are clay and the porous bed is a sand which dips regularly in the direction in which the surface slopes. Water falling in the region marked "catchment area" sinks into the sand and supplies the artesian wells drilled on lower ground. Most of the artesian wells of this region have this arrangement of factors. which may be taken as typical of a large class of artesian wells, being, perhaps, the one most commonly expounded and understood, but a radical rearrangement of factors will produce results depending on the same general principles [a]

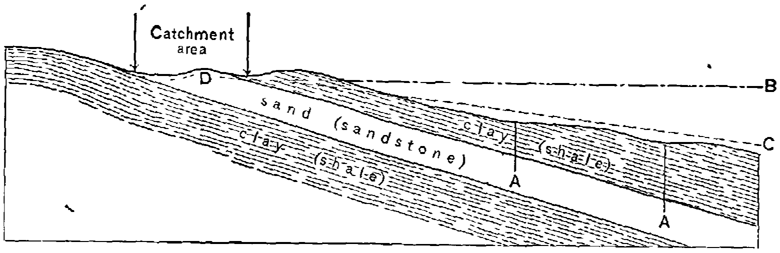

FIG 21—Diagram showing the common arrangement of factors producing artesian wells *A*, Artesian wells, *B*, head of water if there were no loss by resistance or leakage, *C*, actual head or hydraulic gradient, *D*, ground-water table at outcrop

PRINCIPAL WATER-BEARING HORIZONS.

The water-bearing value of the geologic formations of northern Louisiana and southern Arkansas and their relations to one another are briefly outlined in the table opposite and graphically shown on Pl. XXXVII

LOWER CRETACEOUS HORIZONS

TRINITY FORMATION

This formation, which is a very important water-bearing horizon in Texas, is of much less importance in Arkansas, where it contains considerable clay, gypsum, and limestone and lacks the coarse sandy beds characteristic of it farther west. Only one deep well has been tried in this area, that of D. J. Sassamen (393) near Centerpoint (Pl XXXVII, sec F), which is 500 feet deep and obtained a hard chalybeate water. A second well (742) 200 feet deep, sunk 4 miles south of Lockesburg, was abandoned without obtaining water It was too far north to draw on any of the horizons of the Bingen sand (Pl XXXVII, sec. F), and would have

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[a] For such exceptions, other than those described on pp 81-82, see Prof Paper U S Geol Survey No 44, 1906, pp 68-72

Water-bearing value of geologic formations of northern Louisiana and southern Arkansas [a]

Geologic subdivisions				Character of deposits	Water-bearing value
Quaternary	Recent	Alluvium		Veneer of sand, silt, and clay on flood plains	Seldom of value except in connection with the underlying Port Hudson deposits
	Pleistocene	Port Hudson formation		Clays and silts underlain by gravel beds, which occur beneath all the river valleys and as terraces along their sides	The sand and gravel beds of this formation beneath the river valleys, and generally beneath the terraces, yield inexhaustible supplies of water, often hard and alkaline
Tertiary	Pliocene	Lafayette formation		Silt, sand, and gravel, forming a very irregular mantle over the older beds	Of very little value, except in extreme southern portion of this region. Supplies occasional shallow wells, though these generally depend on the older formations
	Oligocene	Fleming clay		Green calcareous clay	None. Shallow wells in the area of the outcrop of this formation depend entirely on covering of surficial sand and gravel (Lafayette)
		Catahoula formation		Green clays, with layer of white sand and sandstone	Contains several important horizons in central Louisiana. (See Pl. XXXVII, p. 70.)
		Vicksburg formation		Limestones and calcareous clays, somewhat lignitiferous	None
	Eocene	Jackson formation		Highly fossiliferous calcareous clays	Serves in central Louisiana to retain water in underlying beds
		Claiborne formation	Cockfield member	Lignitiferous sands and clays	One of the two important water-bearing formations of the Eocene. Water-bearing sands irregularly throughout, with the coarser and more prolific beds at the base
				Calcareous clays, changing to the north into lignitiferous sands and clays	Where typically developed, in central Louisiana, has small water-bearing value, to the north it contains several minor water-bearing horizons [b]
		Sabine formation		Lignitiferous sands and clays	The most important water-bearing formation of the Eocene in this section, contains several horizons
		Midway formation		Limestones and marly clays	None
Cretaceous	Upper Cretaceous or Gulf series	Arkadelphia clay		Black laminated calcareous clays	Retains water in Nacatoch sand
		Nacatoch sand		Sand, with occasional very hard calcareous or quartzitic layers, locally called "water rocks"	An important horizon in southern Arkansas. Yields soft alkaline water near outcrop and impotable water from 2 to 15 miles from outcrop
		Marlbrook formation		Very calcareous clays	None
		Annona chalk		White chalk	Where porous, contains very hard water
		Brownstown formation		Blue calcareous clay	Very little. Minor water-bearing horizon 200 to 300 feet from base
		Bingen sand [c]		Lignitiferous sands and clays	Several well-developed water horizons
	Lower Cretaceous, or Comanche series	Washita group		Dark calcareous clays and clayey limestones	None
		Goodland limestone		Massive white limestone	None
		Trinity formation		Calcareous clays, with thin beds of sand, gypsum, and limestones	An important water-bearing formation in Texas. Of doubtful importance in southern Arkansas
Pre-Cretaceous				Greatly folded, steeply inclined Paleozoic sandstones and shales	Water bearing, but horizons can not be predicted because of highly disturbed character of beds

[a] See table of geologic history, facing p. 16.

[b] The water-bearing sands reported in this formation in Alabama and eastern Mississippi seem to be represented in this region in the water-bearing beds of the basal portion of the Cockfield, which is a part of the Claiborne.

[c] Including sub-Clarksville and Woodbine sands.

had to be drilled to a depth of 1,100 or 1,200 feet to reach the base of the Trinity, the horizon reached in the Sassamen well.

On the whole, the best water and most prolific yield from this formation is to be expected near its base, and a deep well should not be undertaken in the area north of the Bingen outcrop and south of the Paleozoic rocks (Pl. III, in pocket) without planning to push it to bed rock. The depth at which bed rock will be encountered may be roughly found by multiplying the distance in miles between the Paleozoic-Trinity border (Pl. III) and the point where the well is to be sunk by the average rate of slope, 100 to 125 feet per mile. A well at Lockesburg would have to be sunk about 800 to 900 feet, and one at Morris Ferry about 1,200 feet to reach the bottom of the Trinity and fully determine its water possibilities; at Texarkana a depth of 4,000 to 5,000 feet would have to be reached, though in this case several water-bearing horizons would be passed through before penetrating the Trinity.

UPPER CRETACEOUS HORIZONS

BINGEN WATER SANDS.

The Bingen formation is a complex of sands and clays containing several water-bearing horizons. (See Pl. XXXVII, secs. D, E, F, H.) Because of the dense and impervious character of the clays both above and below it, rain water can enter only at its outcrop. In this respect it is like the other Cretaceous horizons of Arkansas, but unlike some of the lower Tertiary beds. In the area of outcrop (Pl. III), which is a sandy belt of country whose character has been determined by the underlying sandy Cretaceous beds, there is generally no difficulty in obtaining abundant supplies of soft water at shallow depths, in which respect it contrasts sharply with the clay areas on both sides, where only hard water can be obtained in shallow wells, and that with difficulty.

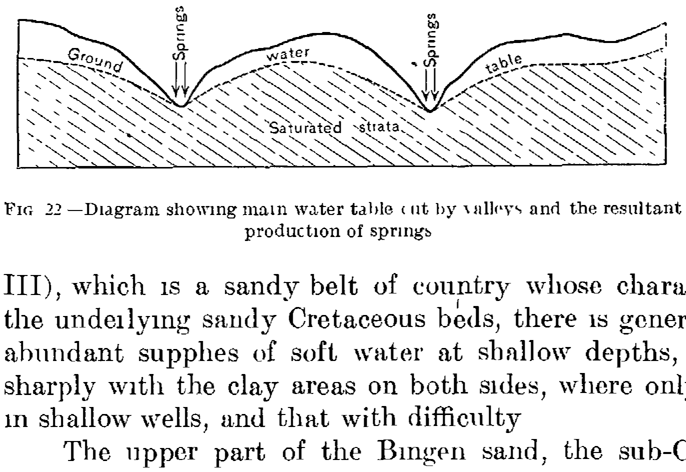

FIG. 22.—Diagram showing main water table cut by valleys and the resultant production of springs.

The upper part of the Bingen sand, the sub-Clarksville sand, furnishes the natural and, it may be added, the most desirable water supply for all the calcareous-clay regions in southern Arkansas between the Bingen and Nacatoch outcrops (Pls. III, XXXVIII). It dips regularly southeastward, and its occurrence may be confidently expected at points south of the outcrop.

Although this uppermost layer is the only one which has thus far been extensively developed, the presence of lower sands in the same series has been shown in wells at Nashville (398), Ben Lomond (717, 723, Pl. XXXVII, sec. F), Clarksville (1111-1114), and Paris, Tex. (Pl. XXXVII, sec. H). Toward Arkadelphia, where this formation is thin, all these water-bearing horizons merge, but to the west they are separated by many feet of clay.

Springs.—The deep sand beds along the outcrop furnish the reservoir for numerous springs. Many of these depend on the main ground-water table rather than on perched water tables, and so differ from the type previously explained (p 72, fig 19) The essential difference between springs dependent on perched water tables and those dependent on the main water table is that in the first case the springs represent the leakage along the edge of the impervious layer which produces the perched water table, while in the second case they represent the leakage from the top of the zone of saturation and are in no way intimately connected with impervious layers (fig 22)

Pressure —The elevation of the outcrop of the Bingen sand in southern Arkansas ranges from less than 200 to about 500 feet above sea level, the average elevation being about 400 feet The pressure head ranges from 201 feet near Arkadelphia to 370 feet near the elevated outcrop in southern Pike and northern Hempstead counties (Pl XXXIX) In the transverse valleys south of the high outcrops flowing wells are common, and the area in which flowing water can be obtained (Pl XXXVIII, pocket) probably extends well down the Arkansas, Little Missouri, and Ouachita valleys Two notable cases of decrease in pressure are reported (378, 384), but they may be due to the rotting of the casing and the leakage of the water into the surficial beds

Quality —In southern Pike, Howard, and Sevier counties, where this horizon has been most extensively developed, the water is generally soft and alkaline and greatly superior to the hard, highly mineral surface water It tends to foam in boilers, but does not commonly form hard scale. In nonflowing wells, which are not cased to the water-bearing strata, the water stands in contact with the overlying very calcareous clays and becomes quite hard In every instance the quality of the water can be vastly improved by casing the wells to the bottom

Availability —The only failures reported in the area underlain by the Bingen sands, as at Washington (356) and in Little River County (445-448), have clearly been due to a lack of sufficient depth, the wells in several cases having been abandoned just short of the water-bearing horizon

The potability of the water in the several Bingen sand horizons in the region south and southeast of the outcrop of the Nacatoch sand (Pl XXXVIII) is as yet problematic, though the probable depth can be indicated with a fair degree of accuracy The saline character of the water found at Arkadelphia (27, 73) in this horizon (Pl XXXVII, sec G, p 70) and the brackishness observed in the wells at Saline Landing (404), in the southeast corner of Howard County, are regarded as rather unfavorable signs, and suggest the conditions prevailing in the Nacatoch sands, where fresh water is found near the outcrop and salty water at a distance of a few miles south (pp. 80–81) At Clarksville, Tex (1112, 1114A), the uppermost horizon of the Bingen formation, the sub-Clarksville sand, has, however, yielded satisfactory results, and it is therefore regarded as a horizon of possible importance as a source of potable water to the southeast, where it should be encountered at a depth of from 1,000 to 1,500 feet below the Nacatoch. The uppermost Woodbine sand, which in northeastern Texas is 500 feet below the sub-Clarksville, yields very salty water, but the basal Woodbine sands, 500 feet lower still, offer better possibilities, though they are also likely to yield mineral water. The basal Woodbine horizon is reported to have yielded fresh water at Clarksville, Tex (1114, Pl XXXVII, sec. H, p. 70). The well at Paris, Tex , penetrated all the Woodbine sands without developing a satisfactory horizon, but Hill[a] has suggested that sufficient precautions were not taken to case off the salty water in the upper Woodbine sands, and that the quality of the water in the lower sands was, therefore, not satisfactorily determined.

BROWNSTOWN FORMATION.

In the Brownstown formation a stratum yielding very hard and in some cases bitter water is sometimes encountered at a point 100 to 200 feet above the Bingen sand (fig 29, p 116) The supply is limited, and wells, as a rule, should be continued to the Bingen sand

NACATOCH SAND.

This has been the most extensively exploited water horizon in southern Arkansas It outcrops but a few miles north of the Iron Mountain Railway (Pl. XXXVIII, pocket), and furnishes the most satisfactory supply for the calcareous-clay lands between the Nacatoch outcrop and the sandy hills at the base of the Eocene (Pl III, in pocket). Its extensive development has been due, not only to the fertility of the soil overlying it, but to the ease and cheapness with which wells could be completed The blue clay (Arkadelphia formation) overlying it does not cave and is easily worked. Below the weathered surface or cover of surficial deposit, which is 10 to 20 feet thick in the hills and may reach 100 feet in the main river bottoms, it will stand without casing and it is always possible to dispense with this item of cost, though to obtain the best results wells should be cased to the bottom Completed wells, 3 to 4 inches in diameter, cased through the surface or "caving dirt" with pine boards, cost but 18 to 50 cents per foot, and so are within the reach of everyone. Difficulty in sinking wells in this region has been experienced only in some wells in the Little Missouri and Red River bottoms, where the gravel filling the old river valley (pp 86-87) has proved troublesome

One result of the cheapness and ease with which water can be obtained in this area, and the fact that it will flow over wide areas (Pl XXXVIII, in pocket), has been to encourage a very wasteful development. Wells have been bored and abandoned and the water allowed to run to waste. The result of this has been that the demand has exceeded the supply and over wide areas the water head is lowering (582) North of Prescott this loss in head has amounted to 7 feet in seventeen years (574), and, it will constantly increase One effect of this will be to materially lessen the areas in which flowing water can be obtained. (Pl. XXXVIII.) The only remedy is the prevention of needless waste and a greater economy in the matter of wells

Springs—Along the outcrop of the Nacatoch sand springs are more numerous than in the clay region on either side, because of the greater depth of the sand beds which supply them

Pressure—As has been explained (p 73), the pressure in the water-bearing sand depends on the height of the ground-water table at the outcrop less the losses by resistance and leakage. The height of the outcrop of the Nacatoch sand is 153 feet in the bed of Ouachita River at Arkadelphia, 178 feet in the bed of Little Missouri River near Boughton, 217 feet in the beds of Little and Red rivers near

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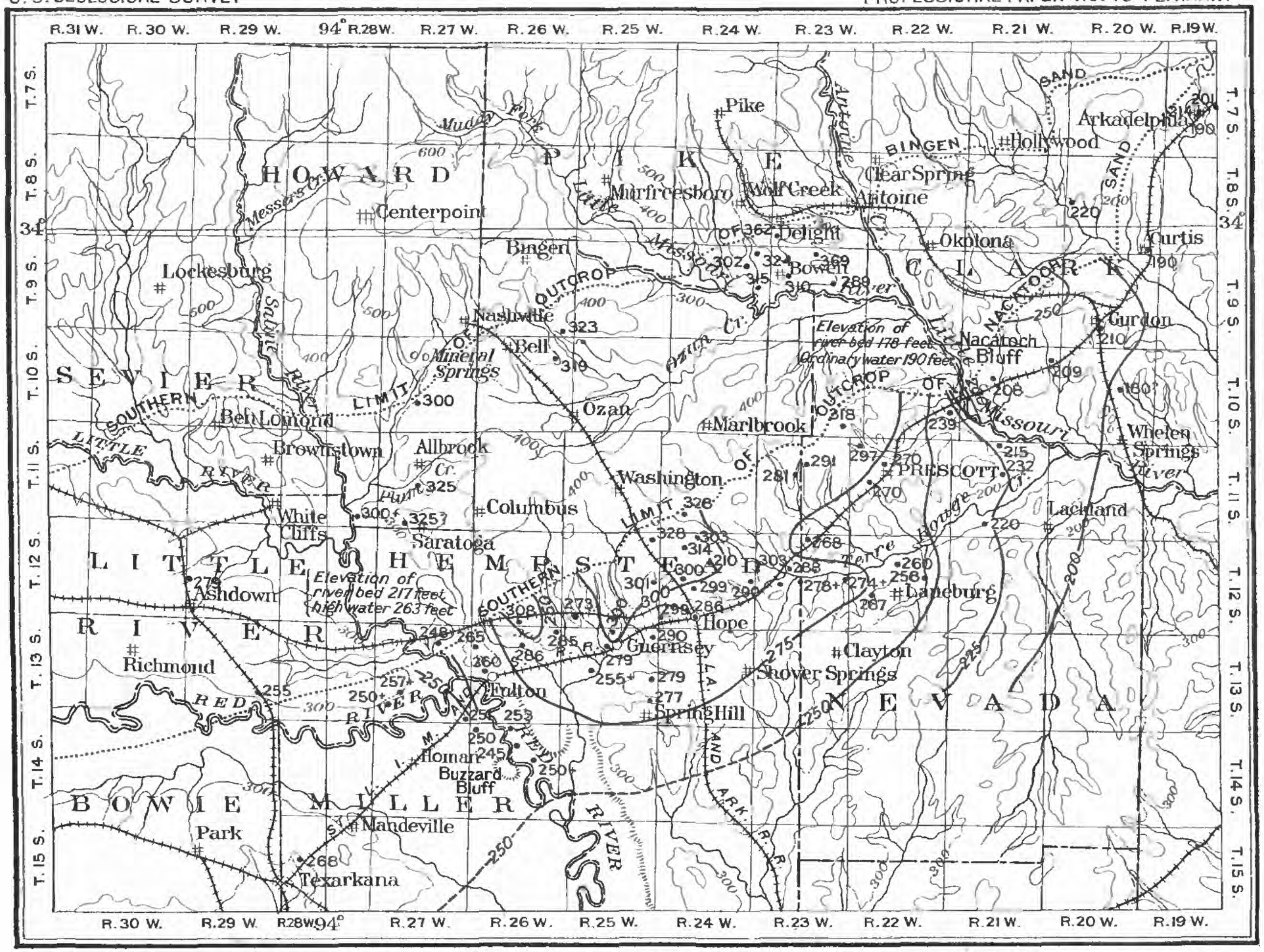
[a] Twenty-first Ann Rept U S Geol Survey, pt 7, 1901, p 630



LEGEND

•325 Water level in feet above sea level in Bingen sand wells

•286 Water level in feet above sea level in Nacatoch sand wells

250 Lines of equal head in Nacatoch sand

MAP OF SOUTHERN ARKANSAS SHOWING VARIATIONS IN HEAD OF WATER IN NACATOCH AND UPPER BINGEN SANDS

By A.C.Veatch

Surveyed in 1902

Scale

0 10 20 30 miles

CONTOUR INTERVAL 100 FEET

1905

JULIUS BIEN & CO.N.Y.

Fulton, Ark., over 400 feet on the divide between Red and Little Missouri rivers, and 300 feet north of Gurdon. (Pl. XXXVIII.) The effect of these varying elevations in the source is to give rise to greatly differing heads in wells not far apart. Thus water in the Nacatoch sand will rise to over 300 feet near the high outcrops between Little Missouri River and Terre Rouge Creek and between Terre Rouge Creek and Red River, but near the low points in the outcrops along these streams it will stand at a much lower level. Water that falls on these high places along the outcrop moves not only down the dip southward, but laterally toward the low cuts along the streams, where a portion of the water goes to increase the stream flow. This change in head parallel to the outcrop is shown by the following table giving the elevations to which water from the Nacatoch sand will rise along the Iron Mountain Railway.

Variation in pressure head of water from the Nacatoch sand along the Iron Mountain Railway.

	Elevation above sea level to which water will rise (feet).
Texarkana	268
Clipper Spur	251
Fulton	260
Guernsey	290
Hope	286
Emmet	268
Prescott	275
Boughton	233
Britts	208+
Beirne	209
Gurdon	210
Curtis	190
Arkadelphia	190

Besides these variations due to the differences in the heights of the outcrops, there is also, in passing down the dip, or southward, a loss of head, due to the fineness of the spaces between the sand grains through which the water moves. This is indicated in a north-south line just west of Hope, where the pressure head decreases from 328 to 277 feet in 10 miles. Three miles north of Prescott a head of 328 feet is attained, while 10 miles south at Lanesburg the head is only 258 feet. The fundamental principle of artesian flow is rather clearly understood by the people throughout this region, but few have appreciated the cause of these changes in head. In general, the popular statement is that "as water will rise to its source, therefore the water throughout this region from the same bed will rise to the same elevation." It is apparently not appreciated that the elevation of the "source" of this water varies with the elevation of the land, and is therefore a changing quantity, and while the elevation of the outcrop on a divide may be 400 feet, in a near-by stream it may be only 200 feet above sea level.

An interesting case of extreme variation in the hydraulic pressuere is found along Garland Creek near Prescott, Ark. This creek valley begins near the outcrop of the Nacatoch sand at an elevation of 350 to 400 feet above sea level, and after a southward bend turns toward the point where the outcrop crosses the Little Missouri bottoms at an elevation of less than 200 feet above sea level. The pressure, therefore, decreases from 317 feet above sea level at the Nelson well to 233 feet at Boughton (fig. 23). The decrease of pressure and the rate of fall of the creek are not exactly the same, and the irregular variation of these two curves gives rise to several disconnected artesian areas.

Wells near the points where the outcrop of the Nacatoch sand crosses the larger rivers fluctuate with the stage of the river. (See well 203.) In some cases this is due to the fact that the height of the point of discharge for the water moving laterally from the high points in the outcrop along the divide changes with any

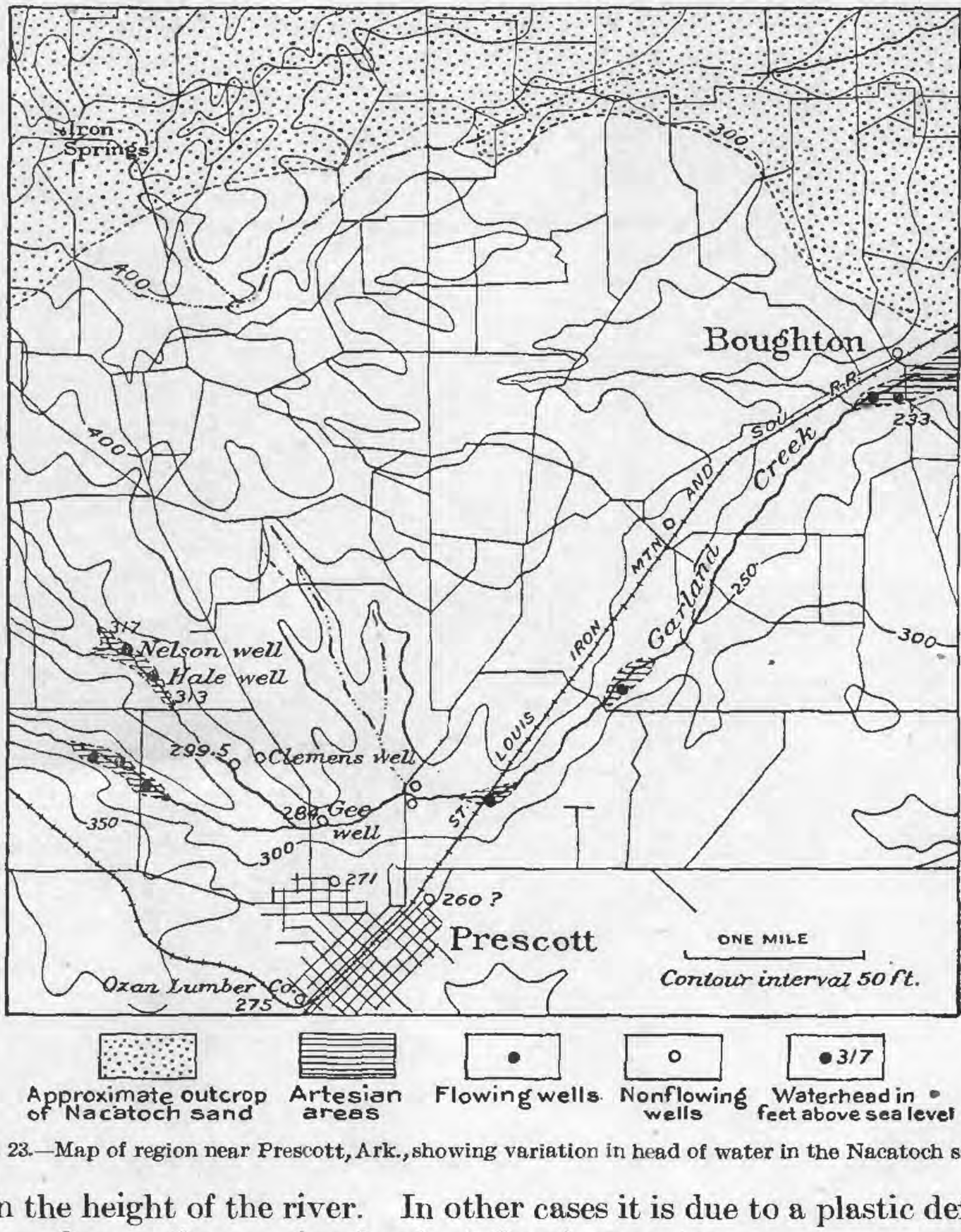


FIG. 23.—Map of region near Prescott, Ark., showing variation in head of water in the Nacatoch sand.

variation in the height of the river. In other cases it is due to a plastic deformation of the strata, due to the varying head of the river waters.

Quality.—The Nacatoch sand, like the sub-Clarksville sand, yields a soft alkaline water whose total mineral content varies considerably from place to place. Where allowed to stand in contact with the overlying blue clays, as it does in the majority of nonflowing domestic wells, which are cased only through the layer of "caving dirt," generally 30 or 40 feet thick, it becomes quite hard; but in freely flowing wells and in wells which are cased to the bottom it is soft. It has been used with success for locomotive boilers at Guernsey (244), but at Gurdon was unsatisfactory because of its pronounced tendency to foam (84). The Gurdon water has, however, been successfully used in the boilers of the large mill at that place. South of an irregular line 2 to 15 miles from the outcrop it becomes too salty to use. Apparently the soluble salts have been dissolved and carried down by the continual inflow of rain water, and so the beds have been leached near the outcrop and the salts concentrated at a greater or less distance from it. The line between fresh and salt water is often very sharp, as in the Monkern wells at Curtis (54) where, from the same horizon, fresh water is obtained in one well and salt water in another not 200 feet away.

Availability.—This increase in the saltiness destroys the economic value of a very widely developed and persistent sand, except in the limited region relatively near the outcrop. This horizon has yielded impotable salty water at Texarkana (478) and artesian salt water at Shreveport (806) and Frierson (871). It is believed to be the source of the salt water in the numerous salines in northern Louisiana (Pls. III, in pocket; XXXVII, sec. E, p. 70) and some of the salt water found in the lower Eocene strata (p. 83). Wells in the region of the Tertiary strata must therefore obtain their supply from the superficial or Tertiary water sands, or pass through the Nacatoch in an attempt to develop the sub-Clarksville, Woodbine, or lower Cretaceous horizons. (Pl. XXXVII, sec. H.)

EOCENE HORIZONS.

The underground water conditions in the Eocene beds in southern Arkansas and northern Louisiana are in some respects quite different from those in the Cretaceous. The sandy water-bearing beds in the Cretaceous are fixed between two impervious strata; thus the Nacatoch sand is overlain by the very dense Arkadelphia clay and underlain by the Marlbrook, and water can enter only at the outcrop of the sand. This condition is shown in fig. 21, p. 74. These clay beds are firm and do not cave readily, and so are easy material in which to sink wells. On the other hand, in the Eocene beds below the Jackson and north of the region in central Louisiana, where the lower part of the Claiborne formation is a relatively impervious calcareous clay, there are no well-defined persistent clay layers. The whole series is predominantly sandy, and rain water is relatively free to penetrate the beds at any point. This condition is of great economic importance, because it greatly increases the catchment area, and thus makes possible a much more extensive development of the Eocene water sands in southern and southwestern Arkansas, northern and northwestern Louisiana, and northeastern Texas than would otherwise be feasible. It is of economic importance in another way, in that the beds cave more readily than the Cretaceous beds, and so make the sinking of wells more difficult and uncertain and therefore more expensive.

The head in this case depends ultimately not on the height of the ground-water table at the outcrop, but on the height near the well (fig. 24), and is thus controlled more by the immediate topography than by that at some more distant outcrop. An extreme and conclusive example of this condition is shown by the height of the water in the deep wells at Bolinger (782) and Antrim, La. (776), 269 and 249 feet, respectively (Pl. XL). The water-bearing sands developed in these wells outcrop 35 or 40 miles north in Arkansas and 100 miles west in Texas, though the Arkansas outcrop probably should not be considered, because it is separated from the wells by a fault Between the wells and the Texas outcrops is a string of wells developing the same horizon, along Red River Valley, in which the water rises to heights ranging from 170 to 206 feet above sea level. Clearly the head can not come from that direction. Between these wells and the Arkansas outcrops is a well at Frostville in which the water rises to 219 feet and one at Taylor where the head is 230 feet. At no point to the east or south does the water from the Sabine sands rise as high as in the Bolinger and Antrim wells. This is clearly an isolated area of greater head in the Sabine sand, which is due to the greater height of the water table in the isolated hill mass in which it is situated Another effect of this dependence of the head on the height of the ground-water table in the immediate vicinity is that the head decreases with depth. This is due to loss in transmission downward through the very fine sands, and in this respect is identical with the conditions on Long Island, New York[a] Thus the heads of the water in the different sands encountered in the well of the Red River Lumber Company near New Lewisville are 244, 232, 230, and 222 feet; in the Frostville well, 219, 215, and 200 feet; in the Spring Hill well, 221 and 207 feet, and in the Minden wells, 182 and 164 feet

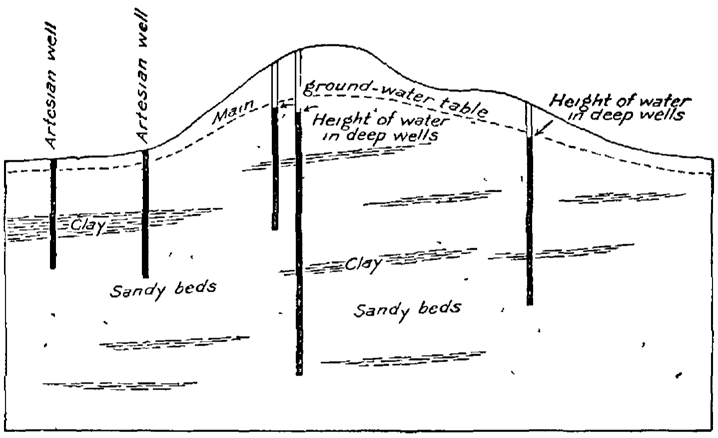


FIG 24 —Diagram showing water conditions in the lower Eocene strata in northwestern Louisiana and southern Arkansas. The beds are predominantly sandy, with irregular discontinuous clay masses, water is relatively free to pass to any part of the beds, and the hydraulic head depends on the local position of the ground-water table rather than on its position at the outcrop of the water-bearing beds

It sometimes happens that local clay layers permit the transmission of a high pressure from a hill-land area underneath a lower region and so produce conditions favorable for flowing wells. In such cases it is possible to have a flowing well without any inclination of the beds and with a lower elevation at the outcrop of the water-bearing strata than at the point where the flowing well is obtained. (See well at left of fig. 24) Such artesian wells are developed at Missionary (803) and Boleyn, La. (901), and the artesian wells of the Eocene present all gradations from this type to a close approximation to those of the Cretaceous region (pp. 73–74; fig. 21).

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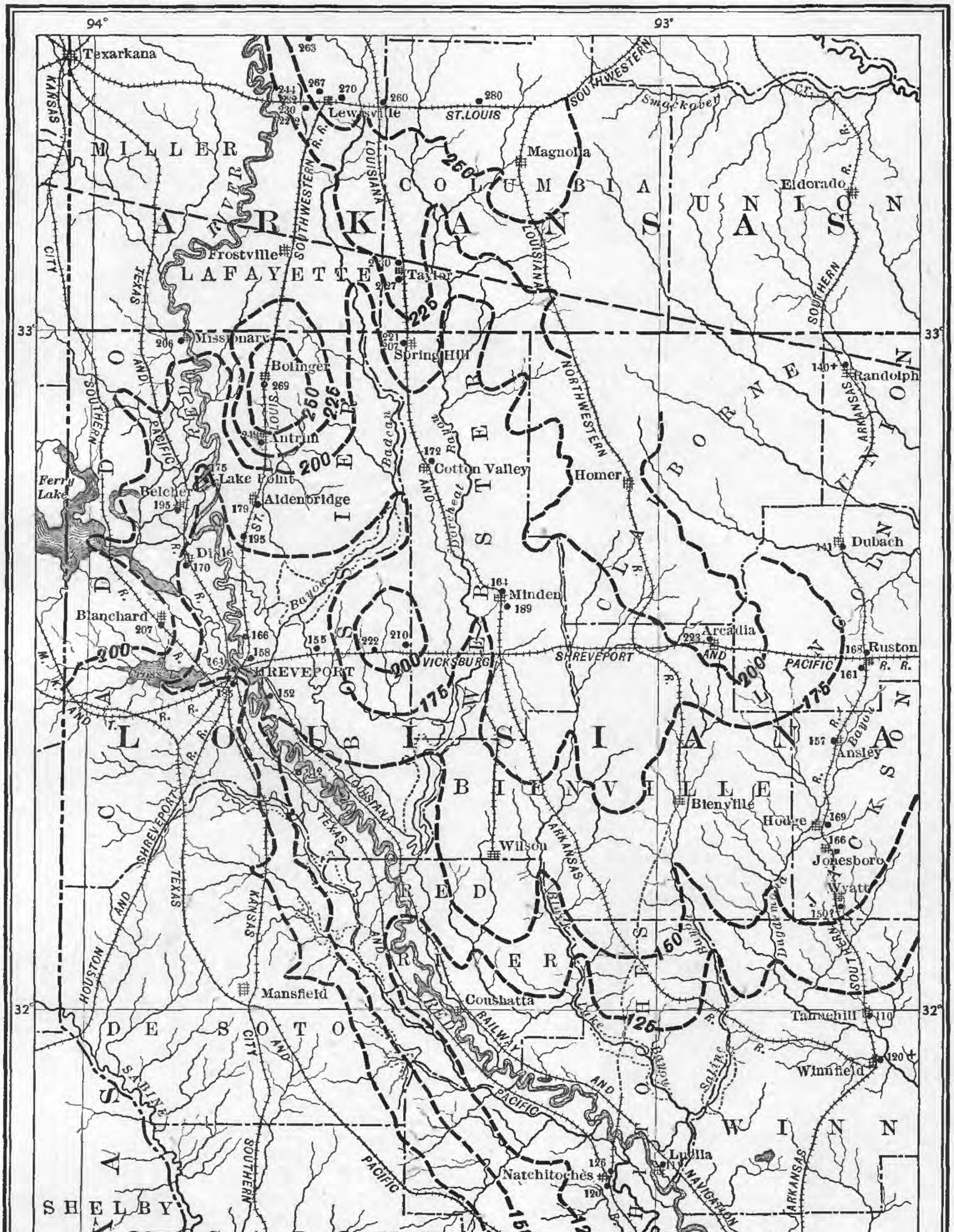
[a] Prof Paper U S Geol Survey No 44, 1906, pp 67–68



●191 Elevation to which water will rise, in feet above sea level.

200 Approximate lines of equal head.

MAP SHOWING VARIATION IN HEAD OF WATER IN THE SABINE SANDS IN NORTHWESTERN LOUISIANA AND SOUTHWESTERN ARKANSAS.

By A. C. Veatch, 1903.

In general, in the water-logged beds of the Eocene the successful development of a well depends on finding a bed coarse enough to act as a large natural horizontal strainer and so aid in removing the water in the adjoining finer beds. The sandy beds in the Eocene change greatly in thickness and physical character in short distances, but the development has clearly shown that sand beds of economic importance for well purposes are more likely to be encountered in certain positions than in others, and that while such beds may be encountered at any point in the Eocene strata the chances of developing a satisfactory well are much greater along certain fairly well-defined horizons. It is these lines of greater probability that form the Eocene water horizons, and it is on them that predictions are based.

The most important of these horizons are those occurring (1) in the Sabine and, farther north, near the base of the undifferentiated Eocene into which it grades, and (2) near the base of the Cockfield and in the upper part of the undifferentiated Eocene into which it also merges. Where the beds between the Midway and Jackson become very sandy in the upper Mississippi embayment, as shown in the Memphis well (Pl. XXXVII, sec. A, p. 70), these horizons merge, but farther south the clay layers increase in importance and separate them widely.

SABINE WATER SANDS.

The main Sabine water horizons, as developed in northern Louisiana (Pl. XXXVII, secs. B, C, D, E, F, p. 70), occur from 100 to 200 feet below the lower Claiborne. To the south, where the formation thickens considerably, the water-bearing sands increase in number and are fairly uniformly distributed throughout the Sabine (Pl. XXXVII, secs. E, F). In Arkansas a group of horizons is found in the Sabine at New Lewisville and Stamps, though only the upper ones, near the Claiborne, are generally developed. This horizon continues in the Mississippi Valley, where it has been successfully developed in many wells.

Pressure.—As has been explained above (p. 82), the pressure in the Sabine sands in the area in which this formation outcrops, and where it is covered by but a thin layer of the Claiborne formation, varies almost directly with the local topography or the local position of the main ground-water table. Here artesian wells are of local and more or less accidental occurrence. To the south and east, where these sands become embedded beneath the more impervious beds of the lower Claiborne, artesian conditions are developed which are uniform over considerable areas (Pl. XLI, in pocket). Along the Mississippi flood plain the head is greater on the east than on the west, as the hill land in northern Mississippi is uniformly higher than that in Arkansas and northern Louisiana, which is deeply trenched by Ouachita and Red rivers.

Quality.—Water from the Sabine horizons is commonly soft and somewhat alkaline. Like some of the Cretaceous waters, it tends to collect soluble salts and is more highly mineral in deep than in shallow wells. In Sabine Parish (966, 969) the deep waters are somewhat mineral. At Natchitoches (909, 911) and Luella (906) they are so highly charged with salt that they can not be used. This is due perhaps to brine which has leaked from the Cretaceous domes to the north. The area in which the water in the Sabine sands has been rendered impotable in this way has not been determined, but it probably includes southwest Bienville, eastern Red River, Natchitoches, with the possible exception of the west central portion, southern Winn, and central and western Grant parishes. At Monroe the water is so mineral that it is only occasionally used in the city waterworks, though extensively employed for industrial purposes At Delhi and Vicksburg the water, though artesian, is very alkaline, and this condition probably affects a large part of the Mississippi Valley in Louisiana east of Ouachita River. Brine has been obtained in this horizon at Crossett, Ark (well 6, Pl. XXXVII, sec. B), but all other developments in Arkansas and northwestern Mississippi, as at Wilmar (151) and Pine Bluff, Ark (410–415), and Indianola (1030), Ittabena (1022), Greenwood (1018, 1020, 1021), O'Reilly (1005), Cleveland (1003–1004), Tchula (1012–1015), and Yazoo City, Miss. (1048), have yielded potable water

Availability—In the area which is underlain by the Sabine and the corresponding undifferentiated Eocene horizons (Pl XLI) these water-bearing sands may, in general, be said to be available at any point. Wells at Waldo (141) and near Bearden (628), while both developing water at the proper depths, are regarded as failures, the first because the supply did not seem sufficient and the second because the sand was so very fine that it easily passed through the strainers The water was, moreover, very alkaline It is felt, however, because of the great irregularity of the Eocene beds that these occurrences are essentially local and do not prove that a good well could not be developed at the same horizon 10 or 20 miles away. The only factor greatly restricting the development of these horizons is that imposed by the quality of the water in the areas near the domes

WATER-BEARING VALUE OF CLAIBORNE (LOWER) FORMATION.

In central Louisiana the fossiliferous Claiborne is a calcareous clay having no water-bearing value To the north, however, it merges into lignitiferous sands and clays, and occasionally water-bearing strata are developed, as at Ruston and Arcadia, La. (Pl XXXVII, sec. I, p. 70) Along Mississippi River in Arkansas and Mississippi occasional horizons are developed in the undifferentiated Eocene in beds which are the stratigraphic equivalents of this part of the Claiborne (Pl. XXXVII, secs A, H), but the more important and persistent horizons are in the overlying Cockfield, which is of Claiborne age, though separated in central Louisiana because of lithologic differences.

In the regions marked fossiliferous Claiborne on the geologic map (Pl III, in pocket) it will generally be advisable to continue wells to the Sabine water sands.

COCKFIELD WATER SANDS.

In central Louisiana the basal layers of the Cockfield member of the Claiborne are sandy, and where penetrated, except at Delhi, La , and Vicksburg, Miss , have yielded water (Pl. XLII, in pocket) As a rule, the water in the deeper wells, as at Leland (855), Rochelle (881), Olla (856–857), Tullos (861), and Colfax (877), is impotable, though an exception is to be noted in the case of the deep well at Robinsons Ferry, on Sabine River (1120), in which a soft, pleasant-tasting water is reported at a depth of 1,010 to 1,030 feet Near the outcrop successful wells have been finished at Clarks (Pl XXXVII, sec. B) and at Weaver

Spur (Pl. XXXVII, sec. E), and a successful well could doubtless be finished at Montrose, Natchitoches Parish, by going about 100 feet deeper than the well abandoned (Pl. XXXVII, sec. E).

In southern Arkansas and Mississippi, north of the Red River-Alabama Landing fault, a water horizon in the upper part of the undifferentiated Eocene, in about the same stratigraphic position as the basal Cockfield horizon, is very widely and extensively developed (Pls. XXXVII, secs. A, B, G, H, K; XLII). Between it and the base of the Jackson a number of water sands have been developed in different wells, but they show little regularity, and the better wells have almost without exception been finished in the main horizon.

Pressure.—The outcrops of the Cockfield and corresponding undifferentiated Eocene water sands in Arkansas and Louisiana are all relatively low, and the water will generally not rise much over 100 feet above sea level, except in elevated regions where the head is dependent on the local height of the ground-water table. Flowing wells from this horizon will be obtained along the main stream channels in central Louisiana (Pl. XLII). In Arkansas and northwestern Mississippi the artesian area is near the eastern side of the flood plain, where a relatively higher head is possible because of the greater average height of the Mississippi hill lands. Water from these horizons will rise very near the surface over all the flood plain, but in Arkansas it is regarded as quite improbable that flowing wells will be obtained.

Quality.—In central Louisiana the water of this horizon is generally impotable except near the outcrop. West of Red River, as indicated by the Robinsons Ferry well (1120), water of good quality may be expected much deeper in the embed. Indeed, it is believed that in the section west of Red River the quality of the deep water will generally be better in this horizon than in the underlying Sabine.

In southern Arkansas and northwestern Mississippi no impotable water has been reported at this horizon in any wells except at Crossett, Ark. (6). As a rule the water from the basal layers is soft and more or less alkaline. At Empire (26) the water is so alkaline that it can not be used in boilers; but at Blissville (145), Greenville (1039), Arkansas City (143), Monticello (148–150), and Wilmar (153) good boiler water has been obtained. The water from the beds just below the Jackson, as at Warren (14–19), is generally hard, and better water can be obtained by deepening the wells.

Availability.—The water sands of the basal Cockfield are relatively very persistent. They may be confidently expected in eastern Arkansas and northwestern Mississippi at depths not greatly exceeding those indicated on Pl. XLII (in pocket). Failures have been relatively few, those at Rison (133) and Thornton (23) being the most noteworthy; but these are entirely surrounded by successful wells and so represent only local variations. The area affected by the impotable sulphur water encountered at this horizon in the Crossett well (6, Pl. XXXVII, sec. B) is probably not large, as is indicated by successful wells at Warren (19), Monticello (148–150), Dermott (24), Blissville (145), and Greenville (1039).

In Louisiana the development of this horizon is probably limited to wells near the outcrop and west of Ouachita River (Pls. III, XLII). On Sabine River the dip of the strata will make the depth prohibitive at any great distance from the outcrop Between Red and Ouachita rivers development is restricted by the mineral water in the embed, and east of Ouachita River the absence of this horizon in the Delhi and Vicksburg wells suggests that it is of minor importance in that section

OLIGOCENE HORIZONS

CATAHOULA WATER SANDS.

The sand and sandstone beds occurring through the Catahoula formation form a very important group of horizons which have been developed in central Louisiana at Ferriday, Harrisonburg, Pollock, Alexandria, Boyce, and Zimmerman (Pls. XXXVII, secs A, B, C, E, XLIII)

Pressure —The head in the Catahoula sand, except possibly in the unexplored region in Vernon Parish, is seldom over 100 feet above sea level Flowing wells may be developed in the flood plain southeast of the high hills in Catahoula Parish and along Little, Red, and Sabine rivers (Pl XLIII)

Quality.—In central Louisiana the water is commonly soft and slightly alkaline and is, perhaps, the best of the Tertiary waters In the basal layers, however, the water is in two cases salty—at Boyce (943) and at Ferriday (867) Whether these occurrences are due to soluble salts in the strata themselves or to brine which has leaked from near-by Cretaceous domes is not known, but it is probably the latter.

Availability —Successful wells may be expected in most of the regions south of the Catahoula outcrop (Pl XLIII), and wells should not be abandoned until they have reached the depth indicated Thus the Pickering well (981) is believed to have been a failure because it did not go deep enough, the chances of developing a successful well at that point at a depth of 1,200 feet or less below sea level are regarded as extremely good

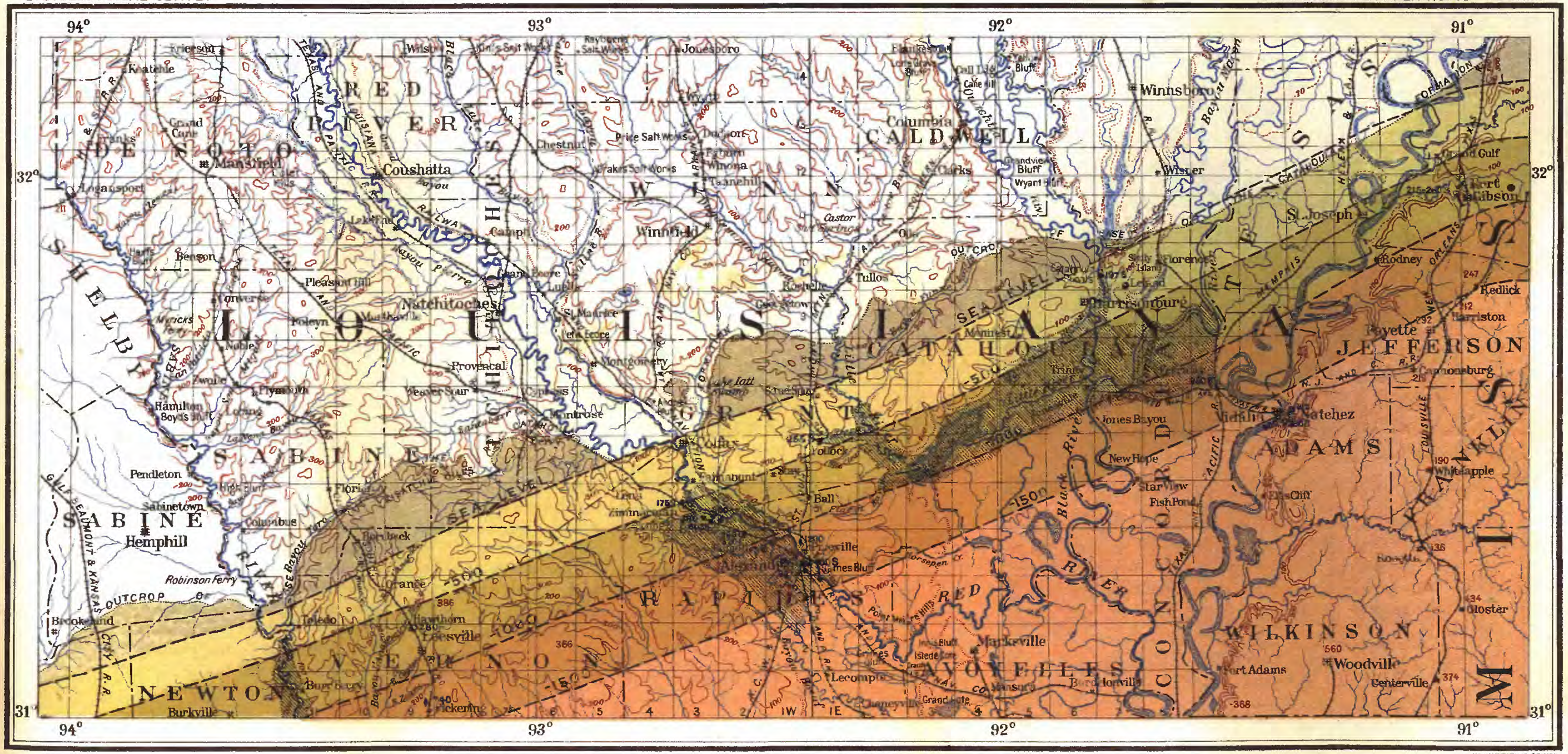
WATERS IN THE SURFICIAL SANDS AND GRAVELS

LAFAYETTE AND PORT HUDSON

The irregular beds of late Tertiary and Quaternary sands and gravels which cover the older Tertiary and Cretaceous beds throughout this region are of varying value as water carriers. As a rule, however, the surficial deposits are in the hills of relatively limited and local importance, while under the large river valleys and portions of the accompanying terraces they contain very large supplies

The deposits in the hill lands often produce perched water tables (p 72), which supply domestic wells and sometimes springs This supply is generally small and readily exhausted, and the most successful wells and the larger springs depend on the sandy Tertiary and Cretaceous beds rather than on these surficial deposits

Along the main river valleys, however, where these sands and gravels were concentrated in early Quaternary and Port Hudson time, large quantities of water can generally be obtained (Pl XLIV, in pocket) In the flood plains limited supplies can be obtained from driven wells (p 94) of no great depth, but where large supplies are needed wells should be pushed to the main gravel beds which



LEGEND

- Area not underlain by Catahoula sands

DEPTHS OF BASE OF CATAHOULA FORMATION

- Above sea level
- 0-500 feet below sea level
- 500-1000 feet below sea level
- 1000-1500 feet below sea level
- Over 1500 feet below sea level

- Area of flowing wells
- ● Flowing wells
- ○ Nonflowing wells
- ♦ Failures

Figures give depths from the surface, in feet, of water-bearing strata or bottom of wells

Letters give quality of water
B Brine
S Soft

Note: Depths given by shading and contours refer to basal layers. Wells can generally be completed at less depths. In the area underlain by the Catahoula formations it is not advisable to continue wells below the depths indicated. See Chapter IV for a discussion of conditions in each locality

JULIUS BIEN & CO. N.Y.

MAP OF THE CATAHOULA ARTESIAN RESERVOIRS IN CENTRAL LOUISIANA
BY A.C. VEATCH

Surveyed in 1902

Scale

10 5 0 10 20 30 40 50 miles

1905

overlie the older Tertiary and Cretaceous strata These can be reached at depths of from 75 to 150 feet

Pressure.—The water head of these beds varies directly with the topography and the height of the water in the adjoining waterways. Flowing wells are not to be expected, but the water in the bottom lands will in all cases rise relatively near the surface and, because of the large supply and the coarseness of the water-bearing beds, will not be lowered readily by pumping

Quality—Where large supplies can be obtained the water is mineral in character; in regions where the older deposits are very calcareous, as in the greater part of the Cretaceous and parts of the Claiborne and Jackson beds, the water is of very little value, but where the underlying beds contain less mineral matter the water is of better quality and affords the most available supply over wide areas In general the mineral content is higher in the water from these gravels than in the neighboring surface streams, but the percentage of sediment is much less

MINERAL SPRINGS AND MINERAL WATERS.

The rain water in passing through the ground tends to dissolve a portion of the soluble salts contained in the strata through which it passes Thus all spring and well waters contain a greater or less amount of mineral matter in solution Sometimes the dissolved minerals have a medicinal value, or the water is of so great relative purity that its use is recommended and the springs or wells are developed commercially

Throughout Louisiana and the Coastal Plain of southern Arkansas there are many "mineral" springs and wells Some contain a very great amount of mineral matter in solution, and such waters should be used with great caution and only on the prescription of a competent physician The water from all these springs is of local origin It represents rain water which has fallen within a mile, or at most 4 or 5 miles, of the spring, and the greatest care must therefore be taken to see that the water is not polluted with harmful organic waste. Springs in large towns or other places so situated that they may receive either directly or indirectly the drainage of houses, barns, and outhouses should be carefully avoided, for if not polluted they are likely to be polluted at any time In general, water from springs in any town or community of some size in this region is to be regarded with suspicion

At several points in northern Louisiana and in the Coastal Plain of southern Arkansas attempts have been made to develop the spring waters From many springs the waters are used locally and in a few cases, notably that of the Arkansas Lithia Spring near Hope, water has been shipped for some distance The yield of the Coastal Plain springs is usually quite small, and this has been an important factor in restricting their development Indeed, it is felt that if any large mineral-water developments are to be made in the Coastal Plain portion of this section, they will have to depend on well rather than spring waters

The following table shows some of the springs which have been partially developed, arranged alphabetically by counties

Partial list of mineral springs in the Coastal Plain strata of southern Arkansas and northern Louisiana

ARKANSAS

No [a]	County	Location and name	Character of water	Remarks
1	Arkansas	La Grue Springs		Noted for medicinal properties
2	do	Cold Spring		
12	Bradley	"Sulphur Springs"	Alkaline, sulphur	Used locally
13	do	Leag's Mineral Springs	Magnesia	
20A	Calhoun	Near Hopewell	Sulphur, iron	Used commercially prior to the war.
22	do	Little Bay, Double Mineral Spring.	Soft, pure	
51	Clark	Clear Springs	Iron, sulphur, lithia.	Local resort Camp ground
	do	Curtis	Sulphureted, saline.	Many mineral wells
72	do	Daleville, Salt Springs	Brine	
105	do	Hollywood	Saline	Local resort Camp ground.
126A	Cleveland	Gum Springs	Sulphureted	Local resort
136	Columbia	Macedonia		
138	do	Milner, Magnesia Springs		
142A	Dallas	Princeton, Mattocks Springs.	Saline, sulphureted	
164	Hempstead	Dotson, Long Spring	Magnesia	
254A	do	Hickory Creek, Sulphur Springs	Sulphureted	
340	do	Hope, Arkansas Lithia Springs Co	Iron, lithia.	Local resort Small improvements. Limited amount of water shipped
	do	Hope, Lithia well		Limited amount of water shipped.
343	do	Shover Springs		Noted for medicinal qualities.
394	Howard	Mineral Springs	Alkaline, iron.	Many large springs
415B	Jefferson	Pine Bluff, Lees Springs		Local resort
415C	do	White Sulphur Springs		Do
435	Little River	Cerro Gordo, Salt Springs	Salt	
441	do	Coleboro, Salt Springs	do	
459	Miller	Crank, Magnesia Springs		
	do [b]	Texarkana, Ghio Springs	Soft, pure	Water sold locally for drinking purposes (See p 263)
491	Nevada.	Clayton		"Sour spring"
695	Pike	Murfreesboro	Saline, chalybeate	
712-713	Sevier	Ben Lomond, north of, Salt Springs	Saline	
741	do	Chapel Hill, Salt Springs	Saline	
745B	Union	Blanchard Springs.	Saline, sulphureted.	

[a] See Chapter V

[b] Springs are in Bowie County, Tex

LOUISIANA

771	Bienville	Kings Salt Works, Salt Springs	Brine	
772	do	Rayburn Salt Works, Salt Spring	do	
814	Caddo	Shreveport, Currie Springs	Soft	Sold locally for drinking purposes.
	do	Shreveport, Mineral Wells.		Sold locally for medicinal purposes.
861	Catahoula	Tullos, Castor Salt Springs.	Saline	
862	do	White Sulphur Springs		Local resort, largely patronized before the war
863	Claiborne	Lisbon, 6 miles east of		Local resort
871A	De Soto	Grand Cane Mineral Springs		Local resort, with improvements.
888	Lincoln	Ruston, Louisiana Chautauqua	Iron	
900	Natchitoches	Allen	do	

Partial list of mineral springs in the Coastal Plain strata of southern Arkansas and northern Louisiana—Cont'd.

LOUISIANA—Continued

No [a]	County	Location and name	Character of water	Remarks
912	Natchitoches	Natchitoches, Fourth of July Spring		Local resort
913	do.	Natchitoches, Iron Springs	Iron	
914	do	Natchitoches, Breazeale Springs.		
915	do	Natchitoches, Sulphur Springs.		
916	do.	Sans Souci		Do
958	Red River	Coushatta, 10 miles east of.	Saline	
972	Sabine.	Pleasant Hill, Ferrell's Mineral Spring		Local resort, with small improvements
	do	Negreet Salt Springs	Brine	
982	Webster.	Bisteneau Salt Works	do	
984	do	Dubberly, Valentine Springs	Sulphureted.	Noted locality for medicinal purposes
984A	do.	Minden, Long Springs.	Iron.	Local resort
994	Winn	Drakes Salt Works, Salt Springs	Brine.	
995	do	Prices Salt Works, Salt Springs	do.	

[a] See Chapter V

HYGIENIC VALUE OF DEEP-WELL WATERS.

The relatively porous character of the Tertiary beds in northern Louisiana and southern Arkansas and the irregularity of these beds render surface wells particularly liable to pollution. Even in thinly settled regions the domestic wells are always near the house and barns and the drainage from the barn lot and outhouses goes more or less directly into them. It is extremely essential in shallow wells that there be an impervious cover to divert this refuse, and from the very nature of most of the shallow wells in this region such a covering is seldom present. When the houses are in groups, as in towns and villages, the danger increases at a very rapid rate. As a rule deep-well waters, where the mineral content is not excessive, are much to be preferred to water from shallow surface wells. An exact quantitative statement of the relative value is particularly difficult because of the impossibility of obtaining complete information. However, in order to obtain some idea of the effect of the use of deep-well waters a circular letter was sent to persons at points where deep wells had been used for some time. This letter asked the following questions: "What was the relative amount of sickness before and after the use of deep-well water? In your town how does the general health of the people who use deep-well water compare with that of those who do not? How does the general health of your community compare with other places similarly situated, but where the people use shallow-well water?"

Definite replies to this letter were received from Pine Bluff, Ark , and Ruston, Spring Hill, Zimmerman, and Boyce, La

Pine Bluff, Ark.—The data at this point refer to the effect of the water from wells 800 to 900 feet deep, supplied by the Sabine water sand (Pl. XXXVII, sec. B, p 70), on the employees of the St Louis Southwestern Railway in the Pine Bluff shops Previous to the sinking of the wells in 1897 and 1899 (410-411) the water supply was from shallow wells. Mr. R. M. Galbraith, formerly general master mechanic of the Pine Bluff shops and now president of the Cotton Belt Trust and Savings Company at Pine Bluff, made the following statement in October, 1902.

> Before the deep wells were completed 40 to 50 of the 437 men employed in the shop were on the sick list during the summer After the deep-well water was used there was practically none on the sick list

Ruston, La—City waterworks were installed in this place in 1900–1901 The supply is from a well (890) 425 feet deep, which obtains its supply from the Sabine sands and from a thin bed in the lower Claiborne (Pl. XXXVII, secs C, I) Dr. R F Harrell reports under date of November 17, 1902·

> There has been a very noticeable decrease in the number of cases of malarial sickness where the people confine themselves to the use of hydrant water Of the 3,500 people in Ruston it is estimated that 945 are using deep-well water We had 51 cases of typhoid fever here this year, and not one has occurred in families where the people have used deep-well water altogether

Spring Hill, La—The supply here is from the Sabine sands from a depth of 228 to 270 feet (989) The local manager of the Pine Woods Lumber Company writes

> The general health of our people has been immensely improved since we have used the deep-well water entirely for drinking purposes in the mills If we could compel our employees to universally use it we could further decrease the sickness The percentage of sickness here is much less than in the surrounding camps and farms

Zimmerman, La—Drinking water for the large mill at this point is supplied by a flowing well 175 feet deep, which is supplied by one of the Catahoula sands (956). The mill is situated on an old cut-off lake of Red River into which the sawdust and waste is dumped, and on the whole the conditions are not very inviting Mr. J. A. Bentley, president of the J A. Bentley Lumber Company, which operates this mill, reported November 10, 1902

> Before we had the artesian well the sickness among our people at Zimmerman was quite discouraging, but since we have put in the well chills and fevers have almost entirely disappeared The comparative amount of sickness before the well was put down was ten sick to one now

Dr J. H Reagan, resident physician for the Bentley Lumber Company, both before and after the well was sunk, reports

> Before the well was put down malaria was very prevalent There was much more sickness in Zimmerman than in the high pine-covered hills to the south After the well was put down we had at least 30 or 40 per cent less sickness than previously I had no typhoid and very few cases of continual fever among the people at Zimmerman, and almost my entire practice was in the neighboring hill region, where the people depended on surface water My conversation with neighboring physicians and people from adjoining towns elicited the fact that much fever existed when Zimmerman was comparatively immune

Boyce, La.—The water for the town and shops of the Texas and Pacific Railway at this point is supplied from a number of artesian wells (942–946), generally about 300 feet deep, which obtain their supply from the Catahoula beds (Pl. XXXVII, sec C) Mr H A Boyce reports regarding this locality

> To my certain knowledge the health of Boyce has been greatly benefited by the use of artesian water Referring your letter to our two physicians, Doctor Sewell and Doctor Texada, both stated the same They have been practicing here only since the wells were bored, but from information from former physicians have no hesitancy in saying that sickness has decreased at least 50 per cent Formerly there was considerable typhoid fever, now there is rarely a case Doctor Sewell, who has been here three years, says he has had four cases of typhoid fever in Boyce during that time All four cases were in one family, who used only cistern

water Doctor Texada, who has been here about the same time, has had three cases—two at a house where cistern water was used, not certain about the other They both agree that while there has been very little sickness in Boyce this year, and no typhoid fever, there has been considerable sickness, and many cases of typhoid fever in the surrounding country where cistern and surface waters are used They attribute the health of the town to the use of artesian water, for sanitary regulations are no better now than formerly There has been no sickness among railroad employees this year

HISTORY OF DEVELOPMENT.

The pioneer development of the deep-well waters in northern Louisiana and southern Arkansas was in the Cretaceous region of southwestern Arkansas Here in the fertile black lands there was no other available supply and the geologic conditions were such that deep wells could be easily and cheaply sunk Many such wells were completed before the war, and since that time necessity and low cost have combined to make the development very active

In the Tertiary region, on the other hand, where water could generally be obtained in shallow wells at any point, the necessity of developing the deep supply was not evident Moreover, the difficulty of sinking such wells was greater than in the Cretaceous region and the cost therefore higher In the Tertiary hill country the low value of the land and the absence of large industries prohibited very great expenditures for wells, and in the alluvial regions, where land values were higher, abundant water supplies could be obtained from the Port Hudson sands and gravels at depths ranging from a few to 150 feet (pp 86-87) Within the last fifteen years, however, many factors have combined to change this condition The wealth of the country, which has been slowly accumulating since the civil war, has become sufficient to justify expenditures for deep wells at plantations and cotton gins in many and widely separated places, ice factories have been established at many points, and compresses, cotton-oil mills, and cotton factories requiring large quantities of water have been erected In the towns the rapid development has increased the fire risk and started the demand for waterworks, and the education of the people regarding the relation of water and drainage to health has aroused a demand for pure water Of the waterworks thus far established, five in northern Louisiana and six in southern Arkansas depend entirely on underground water, and one in northern Louisiana and two in southern Arkansas depend in part on underground water, as shown in the table below Finally, with the great extension of the railroads, the rapid exhaustion of white-pine lumber in the Northern States, and the greater demand for building materials from all sources, large mills have been erected at many points throughout this region These mills, demanding an abundant and steady water supply, have been a most important factor in the development of the deep-well waters in the Tertiary beds of Louisiana and Arkansas

Waterworks of northern Louisiana and southern Arkansas, 1904

Number of well [a]	Name of town	Ownership	Source of supply
934-935	Alexandria, La.	Municipal	Deep wells
948	Lecompte, La	do	Shallow wells
988	Minden, La	do	Deep wells
923	Monroe, La.	do	Ouachita River, deep wells
....	Natchitoches, La.	do	Springs
890	Ruston, La.	do	Deep wells
....	Shreveport, La	Private	Cypress and Crow bayous.
...	West Monroe, La.	Municipal	Ouachita River
.	Arkadelphia, Ark	do	Do
...	Camden, Ark	do	Do
24	Dermott, Ark	do	Deep well
321-322	Hope, Ark.	do	Do
...	Hot Springs, Ark.	do	Springs and surface water
....	Little Rock, Ark	Private	Arkansas River
148	Monticello, Ark	Municipal	Deep wells
412	Pine Bluff, Ark.	Private	Do
580	Prescott, Ark.	Municipal	Do
478-479	Texarkana, Ark.	Private	Shallow wells and surface water

[a] These numbers correspond to those used in Chapter V, where additional data will be found

CHAPTER III.

METHODS AND COST OF WELL MAKING.

METHODS

In wells of small diameter the three following processes are employed to break the material into pieces small enough to be readily removed from the hole: (1) Grinding or cutting with a rotary motion, (2) pounding or shattering by percussion, (3) washing or separating the particles by means of water currents The first is illustrated in the well auger and diamond drill which cut or abrade by the rotary motion of a harder on a softer material. The second is illustrated in the cable rig, or common drop drill, which in its essential features is but a very heavy bar drill, with suitable appliances for lifting, which pounds and shatters the rock into pieces In many applications of the grinding and pounding processes, which are used in varying combinations, water under pressure is an important accessory, and in the jetting and rotary process, used in unconsolidated sands and clays, it is of greater importance as an abrading agent than the other two

After the material is loosened it is necessary to remove it before the drilling can proceed, and it is in the removal or disposition of this material that the different methods of well making show the sharpest distinctions. On this basis wells may be divided as follows

A Material from well hole not elevated to the surface
  I Removal automatic
    a Driven wells
B. Material from well hole elevated to the surface
  I Removal involving a cessation of the drilling or boring
    a Dug wells
    b Wells made with a dirt or clay auger ("bored wells")
    c Wells made with a well punch ("punched wells")
    d Wells made with a simple percussion drill and sand pump (cable rig)
  II Removal automatic, without a cessation of the drilling or boring
    a Well made with "self-cleaning" drills,[a] or automatic sand-pumping outfit
    b Wells made by hydraulic process
      1 Jet process
      2 Rotary process
  III Removal only in part automatic [b]
    a Wells made with core drills
      1 Diamond drills
      2 Chilled-shot drills
      3 Hollow steel bit coring machines

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[a] Sometimes improperly called "hydraulic process" It is no more a hydraulic process than is the cable rig, from which it differs essentially only in the automatic removal of the drillings

[b] All drillings are automatically elevated by a water jet in all types of core drills, but the removal of the core proper involves a cessation of drilling

DRIVEN WELLS

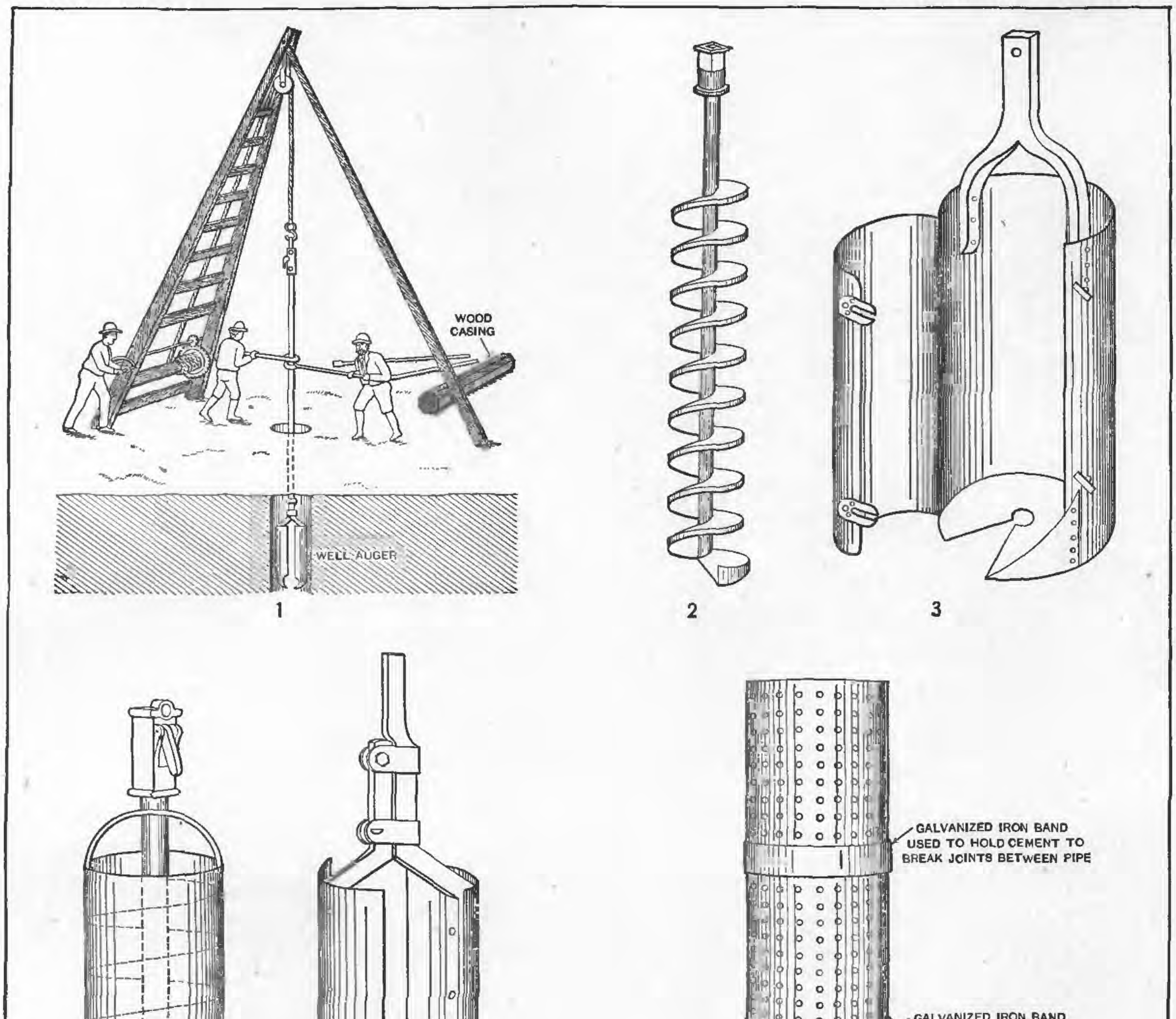
In regions of unconsolidated strata, where the ground water is relatively near the surface (within the suction limit, or about 30 feet) and the water-bearing beds are relatively coarse, the cheapest and simplest method of obtaining a small water supply is by placing a strainer on a piece of pipe of the same size and driving it into the ground with a sledge or maul. Extra pieces of pipe are added after the first length is driven into the ground, and the well is thus made the desired depth. Unless the depth at which the best water supply can be obtained is already known, tests are made from time to time by screwing a small suction or "pitcher" pump on the top of the casing. When a desirable stratum has been located, the well should be pumped continuously for some time to free the strainer and remove the finer particles from the stratum in the immediate vicinity of the screen and so form a natural strainer of greater or less extent about the well (fig 28) This is the commonest type of well in the river-bottom lands, but in the hill lands, though it is occasionally used, better results can usually be obtained by other methods

BORED WELLS.

The principle involved in the carpenter's auger was early extended to boring holes in unconsolidated sands and clays, and it still remains one of the simplest and cheapest methods of making wells of small diameter and of a few hundred feet depth. Various types of augers are employed, some of which are shown in Pl. XLV, 2, 3, 4, 5 Forms Nos 2 and 5 are adapted for use in clay and Nos. 3 and 4 for sand and sandy clay where it is desirable to have some sort of containing vessel to hold the cuttings When small bowlders are encountered which can not be taken up by the auger, grabs of various kinds are used to remove them (see "ram's horn grab," Pl XLVI, 1, 6), but if the bowlders or masses of rock are larger than the hole the well must be abandoned or some other form of tools employed. When the rock is thin it may be shattered by substituting a bar drill for the auger and raising and lowering, as in the cable rig.

The drill rods are of iron or wood, sometimes square (Pl XLV, 1), so that wrenches or other suitable turning devices can be attached, but more often round, when they are turned by a clamp or wrench (Pl. XLVII, *A*). When the auger is filled with earth it is lifted to the surface with a windlass and emptied and the boring resumed. Bored wells are in some instances cased with hollow trees, but more commonly with boards, sheet-iron pipe, iron casing, or tile of some sort (Pl XLV, 7). Of the several forms of casing tile properly put in is perhaps the most ideal.

Bored wells are found throughout this region. In the Tertiary strata they are generally very shallow, but wells 100 to 300 feet can be sunk by this method On Long Island, New York, where there is a very gravelly, sandy soil, with irregular clay masses. somewhat similar to that in northern Louisiana and southern Arkansas, the well auger is still successfully used in making wells to depths of 250 feet, notwithstanding the nearness of New York City and the ease with which improved drilling tools may be obtained. In that region the cost of wells made with the well auger and finished with tile is less than half that of wells made with improved tools, and this will probably be the cheapest method of developing domestic wells in many parts of the Tertiary strata of northern Louisiana and southern Arkansas.



WELL-BORING AND WELL-PUNCHING TOOLS.

1. Ordinary well-boring outfit.
2, 3, 4, 5. Well-boring augers.
6. Self-fastening couplings used on Challenge well-auger poles.
7. 18-inch perforated straight tile, used as a strainer in Elliott tile wells. Note also Elliott patent iron shoe.
8. Well punch.

WELL MAKING.

ARKANSAS CLAY AUGER

In the Cretaceous region, where there are thick beds of blue clay, which do not cave, experience has developed a clay auger radically different from those shown in Pl. XLV, though somewhat resembling a "pod auger" With this holes are very easily bored to depths of 300 to 400 feet at a cost of 12½ to 40 cents a foot, and holes 700 feet deep have been drilled under favorable conditions.

The auger is 15 feet long[a] (Pl. XLVI, 14). It consists of an auger barrel 4 feet long, which is made of cast steel and resembles a 3-inch pipe sawed vertically in half. This is fastened by a flat piece of iron to a second auger barrel, 1½ to 2 feet long; above this is a second piece of flat iron, square at the top and cut with threads for fastening to the wooden poles (Pl. XLVI, 11, 17). At the bottom of the auger barrel, on the right-hand side, is riveted a steel cutting edge of the shape shown in Pl. XLVI, 15. This is commonly called the cutting bit and projects inward 1¼ inches. On the opposite side and slightly above is the "auger lip," which helps to hold the dirt in the auger barrel when the tools are lifted In operation, the auger is fastened to a short 10-foot pole (Pl. XLVI, 11) known as the auger pole, and this to the regulation 26-foot pole The tools are turned with a clamp, and when the bit begins to choke, the tools are lifted and dropped by means of a windlass (Pl. XLVII, *A*). This operation jumps the dirt up in the bit, and so frees

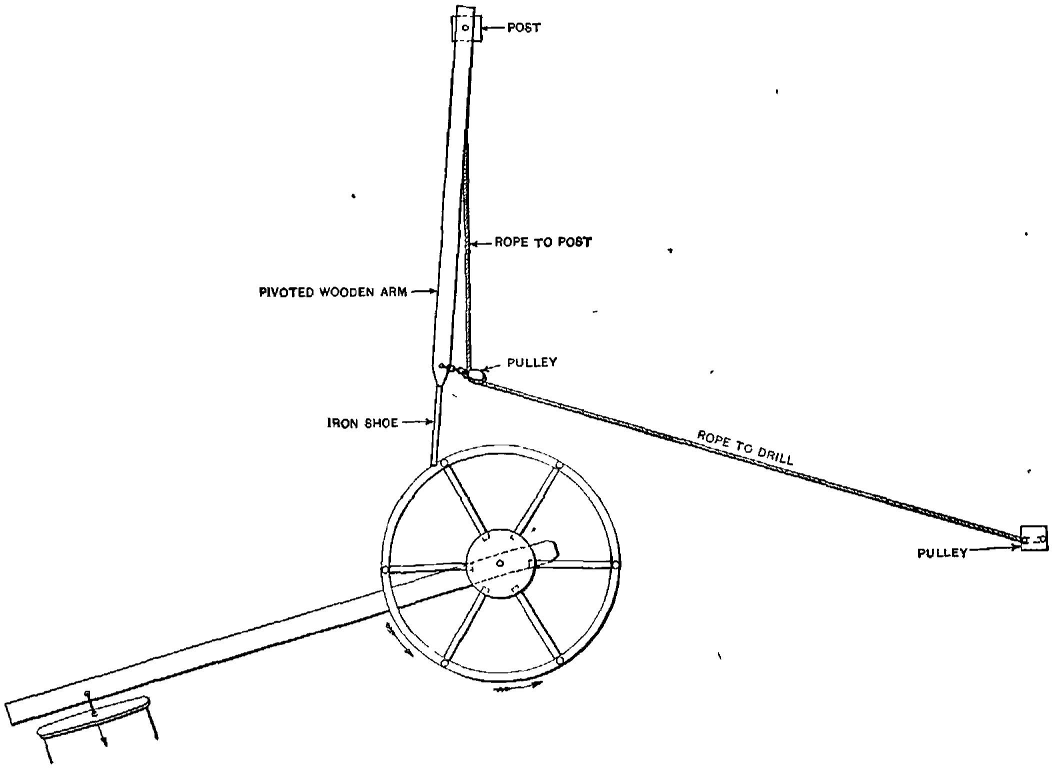


FIG 25—Method of jumping rock drill in Arkansas well rig Compare with Pls XLVI and XLVII

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[a] In Pl XLVI this is foreshortened because of the angle at which the auger is placed

PLATE XLVI.

TOOLS OF AN ARKANSAS WELL-BORING OUTFIT BELONGING TO MR. G. B. HIPP, OF GARLANDVILLE, ARK.

1. 9-inch "twister," or "ram's horn grab." Used for removing large stones and old wooden curbs.
2. 3½-inch bar drill, with solid iron bar attached ("drill stem"), used in drilling through the "water rock."
3. Wrench for tightening wooden poles.

4, 5. Stilson wrenches.

6. 3½-inch "twister," or "ram's horn grab." Used for removing stones, fishing for lost tools, and cleaning out old wells.
7. Pipe tongs.
8. Sand pump made of section of iron pipe. Used in removing sandy and clayey material which will not hold on the regular clay auger (No. 14).
9. 5-inch reamer or cutting bit for enlarging hole made with No. 14. It is used on same guide shown with No. 12.
10. Taper pin. Used in "fishing" for lost piping.
11. 10-foot wooden pole. Used just above the clay auger.
12. 9-inch reamer or cutting bit for enlarging hole.
13. 9-inch rock drill.
14. 3½-inch Arkansas clay auger.
15. Extra cutting edge or "cutting bit" for 3½-inch Arkansas auger.
16. Key for holding poles while unscrewing.
17. Regular 26-foot wooden pole, showing detail of lower connection.
18. Iron drill rod, sometimes used instead of wooden pole in drilling through the "water rock."

TOOLS OF AN ARKANSAS WELL-BORING OUTFIT.

WELL MAKING.

the lower end; it is termed "making a slip." If the clay is very dry a little water is added, and with the very sticky Cretaceous clay this process can be continued until the whole length of the auger is filled with a cylinder of mud. This 15 feet of mud represents about 10 feet in depth. Usually, however, the auger is filled for only about 10 feet, representing 7 feet of depth, before lifting the tools.

When rock is encountered a bar drill is used (Pl. XLVI, 2). This is sometimes attached directly to the wooden poles and sometimes to iron poles. The drill shown is fastened to a solid piece of iron weighing about 100 pounds, which in a rough way corresponds to the drill bar of the regular cable tools (Pl. XLVIII).

In the outfit shown in Pl. XLVIII, 2, the drill is jumped by means of an auxiliary wheel on the windlass (fig. 25). The drill rope passes through a pulley in a post near the driller and a second pulley on a pivoted arm, and is held in the supporting post by a wooden wedge. This wedge is removed and redriven when it becomes necessary to lengthen the drill rope.

When sandy layers are encountered, which will not hold in the auger, the sand pump is used or enough clay is dumped in the hole to make the sand stick together.

In cases where wells of larger diameter are desired, or where it is necessary to enlarge the upper part of the hole for wooden casing, the 3- or 3½-inch hole made with the Arkansas clay auger is enlarged with a reamer (Pl. XLVI, 10, 12).

PUNCHED WELLS.

In regions where there are uniform clay beds without rocks or bowlders wells are often made with a well punch. This consists of a cylinder of steel or iron 1 to 2 feet long split along one side and slightly spread (Pl. XLV, 8). The lower portion is very slightly expanded, sharpened, and tempered into a cutting edge. In use it is attached to a rope or wooden poles and lifted and dropped in the hole by means of a rope given a few turns around a windlass or drum. By this process the material is forced up into the bit, slightly springs it, and so is held. When the bit is filled it is raised to the surface and emptied. When working in very dry clay water is sometimes added to aid the bit in "picking up" the material. Thin sand layers are passed by throwing clay into the well and mixing it with the sand until the bit will take it up.

This process is not very extensively used in this region, and is not so practicable as the Arkansas clay auger.

SIMPLE DROP DRILL OR CABLE RIG.

It was early learned that the raising and dropping on stone of a metal bar with a horizontal cutting edge would, if the bar was turned slightly with each stroke, produce a circular hole. This primitive device in the form of a hand drill bar is used to-day in many stone quarries. As applied to well drilling the bar was at first attached to the end of a "spring pole" made by firmly fastening the small end of a sapling in the ground and fixing a support near the base so that it inclined upward at an angle of 30° or more. The hole was drilled by the "spring of the pole," the driller keeping it in motion by pulling down on the drill rope.

PLATE XLVII.

WELL-BORING OUTFIT OF MR. G. B. HIPP, OF GARLANDVILLE, ARK.

A. Boring with clay auger (Pl. XLVI, 14) and wooden poles. The drill poles, with auger attached, are turned with clamp as shown, and when the auger begins to choke it is lifted and dropped by the boy turning back on the windlass and letting go. This jumps the dirt up in the bit and so frees the lower end. This process is repeated until the bit is full, when it is lifted to the surface and emptied. By this method from 7 to 10 feet can be bored without emptying.

B. Drilling with iron poles and rock drill (Pl. XLIV, 2, 18). Drill is jumped by means of pivoted arm, which is pushed outward and then freed from the cogs on the upper wheel of the windlass (fig. 25, p. 95).

A

B

WELL-BORING OUTFIT OF MR. G. B. HIPP, OF GARLANDVILLE, ARK.

WELL MAKING.

As the hole deepened the rope was paid out and the limit of depth was determined by the elasticity of the pole and the ability of the men to raise the tools out of the well when it was necessary to remove the accumulated drillings with a sand bucket or sand pump (Pl XLVIII, 5, 6) In time the lifting of the tools was done by horsepower and then by steam; the spring pole was supplemented by a walking beam (Pl XLVIII, 3), whose motion depended not on its elasticity but on power transmitted from an engine by means of a crank shaft. This enabled much heavier tools to be jumped, and with improved lifting devices greatly increased the possible depth of wells

A complete "string of tools," as used in the cable rig, is shown in Pl. XLVIII, 1, and the method of operation and construction of the derrick is illustrated in Pl. XLVIII, 3-7

For the successful operation of the cable rig, or drop-drill process, it is necessary that the material be relatively hard and brittle, and firm enough to stand up without casing In regions where hard rock is at the surface or covered with but a relatively small amount of unconsolidated material, which must be penetrated with a casing before the drilling of the well proper begins, the cable or walking-beam rig is the cheapest and most commonly used method of sinking deep wells, but in regions of unconsolidated strata, such as the Tertiary and Quaternary beds of the Atlantic and Gulf States, drilling with cable tools is impracticable, and for large wells either the jet or rotary process should be used

In some of the Cretaceous beds where the material is solid enough to stand up without casing the cable rig has been successfully used, as at Texarkana, Ark (480), but even in this material better results can usually be obtained with the rotary process Cable tools were tried at Gurdon, Ark., in the same strata geologically as at Texarkana, but here the material caved badly, and after two attempts the well was abandoned It could have been finished to the desired depth with the proper rotary outfit

AUTOMATIC SAND-PUMPING OUTFIT.

Drilling a well with a cable rig involves two principal operations—(1) a pounding up of the rock and (2) a removal of the drillings with a sand pump A combination of these two operations has resulted in a process which is of great value in regions of unconsolidated strata where the ordinary cable-rig process can not be used with advantage, and which is often more practicable than any other for wells of small diameter and comparatively shallow depths in rock regions

The tools may be described, in the aggregate, as a sand pump fitted with a drill having one or two perforations through which the drillings can enter the sand-pump barrel, which is composed of sections of pipe having a total length slightly greater than the depth of the well (Pl. XLIX, 1) When this "string of tools" is "jumped" by a spring pole or walking beam, or other suitable device, such as shown in Pl. XLIX, 4, 5, the drill loosens the material, which, as in the ordinary sand pump, passes through the valve into the drill rods In drilling in dry material enough water must be added to make a rather thin mud of the drillings in order to enable them to pass the drill valve The continuous jumping of the tools pumps

PLATE XLVIII.

CABLE RIG OR DROP-DRILL OUTFIT.

1 A complete "string of tools" for a cable rig The auger stem or drill stem is used to add weight to the drill and increase its force of impact The jars are composed of two linked pieces of extra-quality steel having a slack or endwise motion of 6 to 9 inches (No 2). they enable a sharp, quick, upward blow to be delivered which "jars" the tools loose when they become fast The sinker or sinker bar is used occasionally where the well is filled with water to help sink the cable rapidly, unless placed between the jars and the bit it adds little or no force or weight to the drill

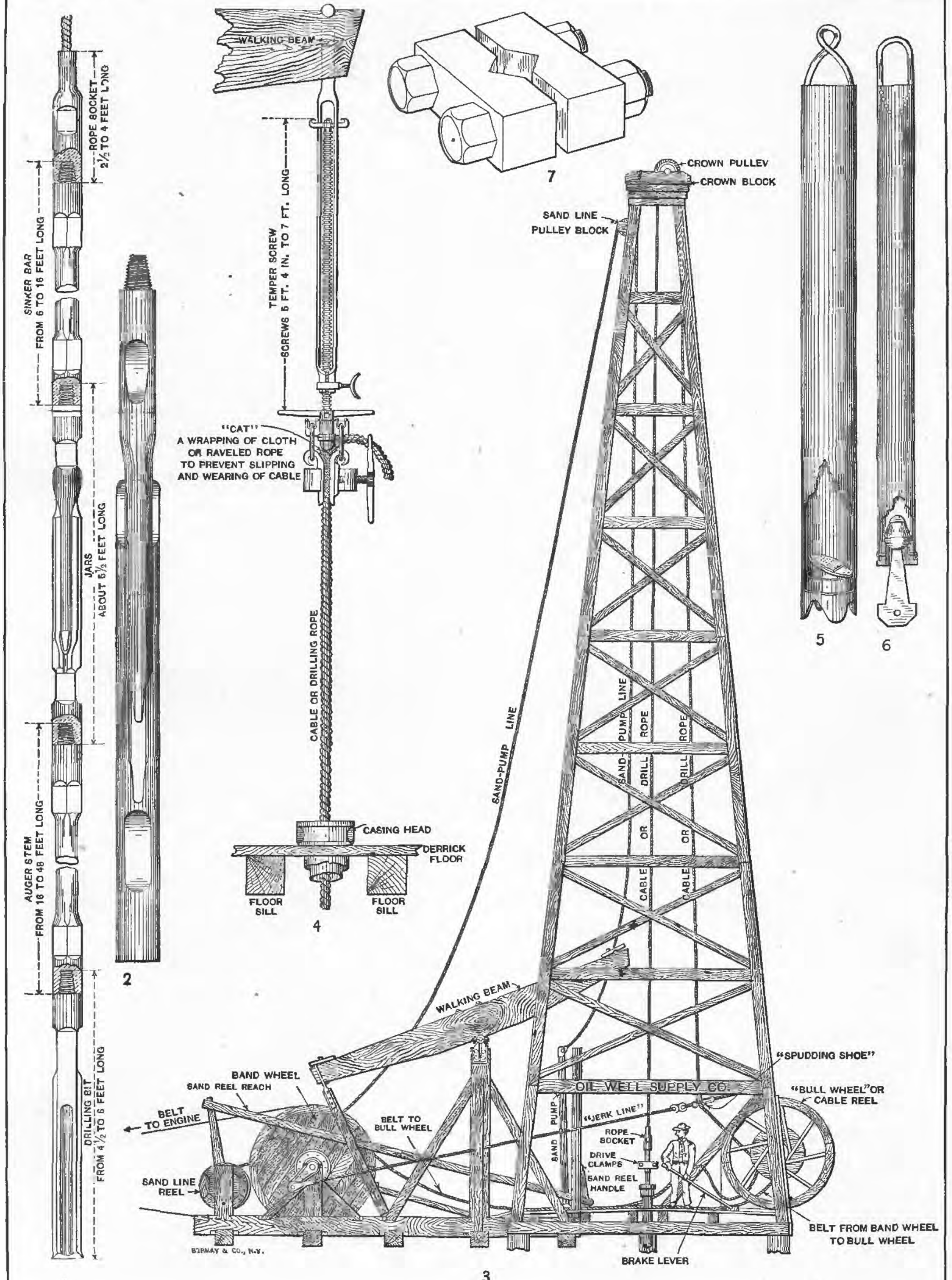
2 "Jars," open

3 Standard rig arranged for starting the hole or "spudding" The "string of tools" is jumped by means of a "jerk line" attached to the crank of the band wheel As the drilling progresses the tools are lowered by gradually unreeling the cable from the "bull wheel" The casing or pipe is "driven in" with driving clamps (No 7), attached as shown

4 Temper screw, with cable attached After the hole has been sunk for some depth below the derrick floor the walking beam and temper screw are used The string of tools is jumped by means of the walking beam, and the tools are lowered as the drilling progresses by means of the temper screw

5, 6 Sand pumps or bailers, 5, Common form with steel-flap valve, 6, form with dart valve When the accumulations of the drilling in the well impede the progress of the drill, the tools are lifted by reeling up the cable on the bull wheel and the drillings are removed with the sand pump The temper screw is then wound up or "elevated," the tools lowered, and the drilling resumed

7 Driving blocks



CABLE RIG OR DROP-DRILL OUTFIT.

WELL MAKING.

the drillings through the drill rods without regard to the depth of the well, and finally throws them out at the surface

The principle which makes the elevation of drillings in this manner possible may be briefly explained as follows [a]

The drill is so shaped that when it falls it tends to compress the water and air in the lower part of the hole, and, in properly shaped tools, this force is suddenly brought to a culmination by a curved surface and thus pops the valve open and allows the ingress of the water and drillings In a way it is somewhat analogous to the sudden development of pressure in the hydraulic ram, by which water is elevated to considerable heights, only here the power is developed not by the fall of a column of water, but by the gravity drop of a string of tools

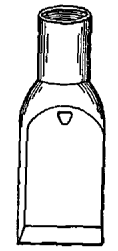


Fig 26.—A well-shaped self-cleaning drill Shoulder is circular and almost completely fills the drill hole, blade is flat and suddenly curves at the top, thus developing the maximum force in the space where it is most needed to pop open the drill valve

The theory of action is so intimately connected with the efficiency of the drill that it may be well to call attention to some of the features of a well-made self-cleaning drill It should be circular at the upper end and have a diameter very slightly less than the width of the cutting edge The blade should be flat and suddenly curve at the top in order to obtain the effect of a conical compression in a very short space (compare figs 26, 27). If this curved area were slightly coned toward the opening (not so much that large fragments or pebbles would be likely to jam) a further increase in force would be gained, and the maximum amount of lifting power would be developed with the least expenditure of energy In practice additional valves opening upward, called drill rods or blind valves (Pl XLIX, 2, 3), are added in the drill stock They relieve the bottom or drill valve of some of the downward thrust of the drillings, and so increase the efficiency of the outfit.

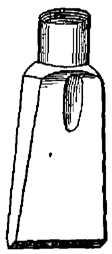


Fig 27—A badly shaped self-cleaning drill Shoulder does not fill the hole, and drillings rush past the opening without lifting valve with maximum force This is, however, a very good shape for a jetting outfit

The continuous sand pumping and the method of drilling and driving the casing at the same time, by clamping the drive block to the drill rods, make it possible to pass through beds of relatively caving material which can not be handled with the ordinary cable rig

The important feature of this rig from a water standpoint, and the one which makes it of peculiar utility for sinking water wells in the Coastal Plain region, is that it is impossible to pass a water-bearing stratum, no matter how small, without being aware of its presence In the jet process it is very easy to pass a water-bearing stratum, and with the rotary process, in which very muddy water is used that commonly plasters up any small sand beds encountered, the determination of water horizons, unless they are very large, is comparatively impossible.

This type of rig has been used at a number of points, notably about Shreveport, and combined with a small jetting outfit it is now supplanting the boring outfits in the deep wells in the Cretaceous region It is peculiarly adapted for work in the Eocene beds, and will doubtless become one of the commonest forms used in the development of this section.

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[a] I am indebted to Dr Arthur L Day, physicist, of the United States Geological Survey, for suggestions in this matter.

PLATE XLIX.

AUTOMATIC SAND-PUMPING PROCESS

1 A "string of tools" for automatic sand-pumping outfit The drill varies somewhat in size, length, and shape, but is characterized by the presence of a leather valve which allows the drillings to enter and prevents their egress, as in the sand pump (Pl XLVIII, 5, 6) The "drill stock" or drill rods are commonly 1 to 1½ inch pipe, though in wells 3 to 4 inches in diameter a short length of 2½-inch pipe is sometimes placed above the drill

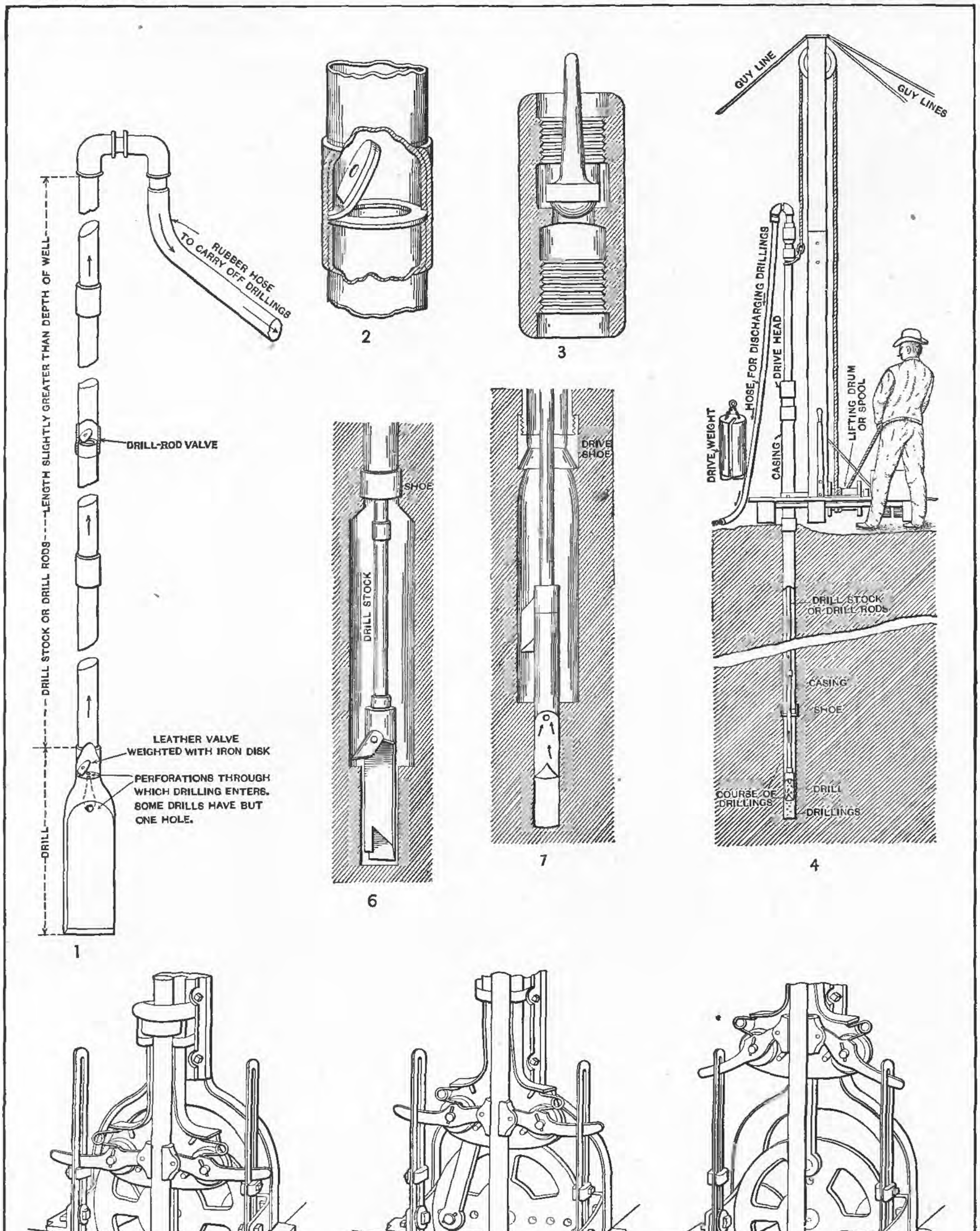
2, 3 Drill rod or blind valves 2, Leather drill-rod valve, with large opening, 3, metal drill-rod valve, with small opening One or two drill-rod valves are inserted in the drill rods, the number depending on the character of the material being drilled They distribute the weight of the column of drillings along the drill rods in the downward thrust, and allow pumping to continue if anything happens to the drill valve.

4 Common device for "jumping" or "churning" the tools The rope is given a few turns around the lifting spool or drum, and the drill pipe alternately raised and lowered by tightening and loosening the rope This "churning" drills the hole, as in the cable rig (Pl XLVIII), and by means of the valves (1) automatically elevates the drillings through the hollow drill rods The casing, armed with a driving shoe (Pl L, 5), is driven in the hole made by the drill with some form of drive weight This is lifted and dropped in the same manner as the drill rods Sometimes the drive block is bolted to the drill rods and the whole weight of the tools thus utilized in driving the pipe

5 a, b, c Improved device, used on the "Ohio tubular well-drilling machine," for rapidly and regularly lifting the drill rods

6 Automatic sand pumping, enlarging "paddy" or expansion bit, for use in unconsolidated materials

7 Automatic sand pumping, enlarging shoulder bit, for use in rock



AUTOMATIC SAND-PUMPING PROCESS.

WELL MAKING.

JETTING PROCESS.

In the jetting process the material is loosened and the drillings are elevated to the surface by means of water under pressure Its use is entirely restricted to unconsolidated materials The water is conducted into the well by means of pipes of relatively small diameter, called wash pipes, jet pipes, or drill pipes, and is directed downward near the bottom of the well by means of a suitable bit (Pl L, 3, 4; fig 27) The drill is turned from time to time by means of a clamp or wrench, and so keeps the hole true and aids the water in wearing away more resistant masses of clay or like substances When local hardened strata are encountered the drill is lifted and dropped, as in the drop drill or cable rig and the automatic sand-pump outfit If there are many "shells of rock" which require to be drilled in this manner it is often advisable to insert in the drill rods a blind valve (Pl XLIX, 3), upside down, with a spring to keep the valve pressed up against the valve seat in order to prevent the drillings from entering the drill and choking it when the tools are dropped

The casing is usually driven, but in some instances it is possible to use a paddy or expansion drill (Pl L, 2, 4), which makes the hole larger than the casing and enables it to settle of its own weight when moved with a pipe wrench from side to side (Pl L, 1)

This process is better suited for drilling wells of large diameter than the automatic sand-pumping process, and is admirably adapted for use in the unconsolidated materials of the Coastal Plain.

ROTARY PROCESS.

The rotary process is but a development of the jetting process, from which it differs mainly in that the more or less irregular turning of the drill rods by hand in the jetting process is here replaced by regular and rapid turning by a revolving table or rotary moved by machinery When the character of the material is such that the ordinary fishtail bit can be used (Pl LI, 3) the rotary process is very little different from the jetting process, except that the larger machinery, pumps, and derrick commonly used in rotary outfits permit larger holes to be drilled. The fishtail bit is used when the material does not cave readily and when the water pressure and the plastering of the sides with the mud in the wash water will make it stand up Under favorable conditions holes may be drilled many hundred feet in this manner without casing, the bit then removed, and all the casing inserted at one time

The constant rotation and the high water pressure used enables the rotary to be employed in a manner entirely different from any other outfit and makes the process peculiarly fitted for penetrating very caving, unconsolidated materials. In such instances the casing, armed with a toothed cutting shoe (Pl LI, 4), is itself used for the wash pipe and the water and drillings returned to the surface between it and the wall of the hole. In practice the wash water is mixed with fine clay, and this very muddy water tends to plaster up any sand beds encountered and so prevent any loss of water and consequent reduction of head Constant motion and water pressure are required, and in order to facilitate the addition of drilling pipe two water swivels are employed. When the hole has been drilled to such a depth that

PLATE L.

JETTING PROCESS.

1 Jetting process Water enters drill pipe or jetting pipe by hose from force pump and emerges from the two holes in the drill as jets directed downward or toward the bottom of the well The drillings loosened by the jet and the drill, which is occasionally turned by a clamp or wrench, are carried to the surface with the upward current of water between the drill pipe and casing If the hole is not large enough to allow the pipe to settle of its own weight when turned with a pipe wrench, it is driven with a drive block Sometimes a solid drive head is used on top of the casing, sometimes a drive plate, and sometimes only an extra heavy tee or specially constructed drive head or tee

2 Paddy or expansion drill in operation This enables a hole larger than the casing pipe to be drilled, and in favorable material makes driving unnecessary

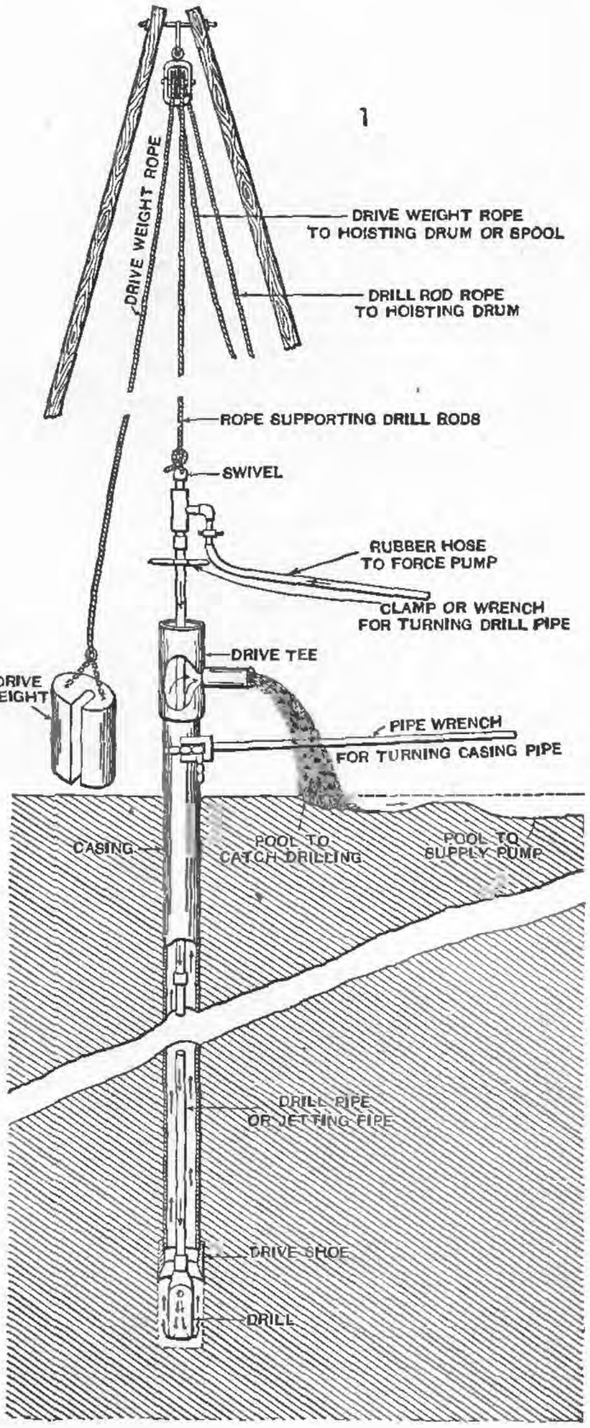
3 Paddy or expansion drill, closed for lifting or lowering in the hole

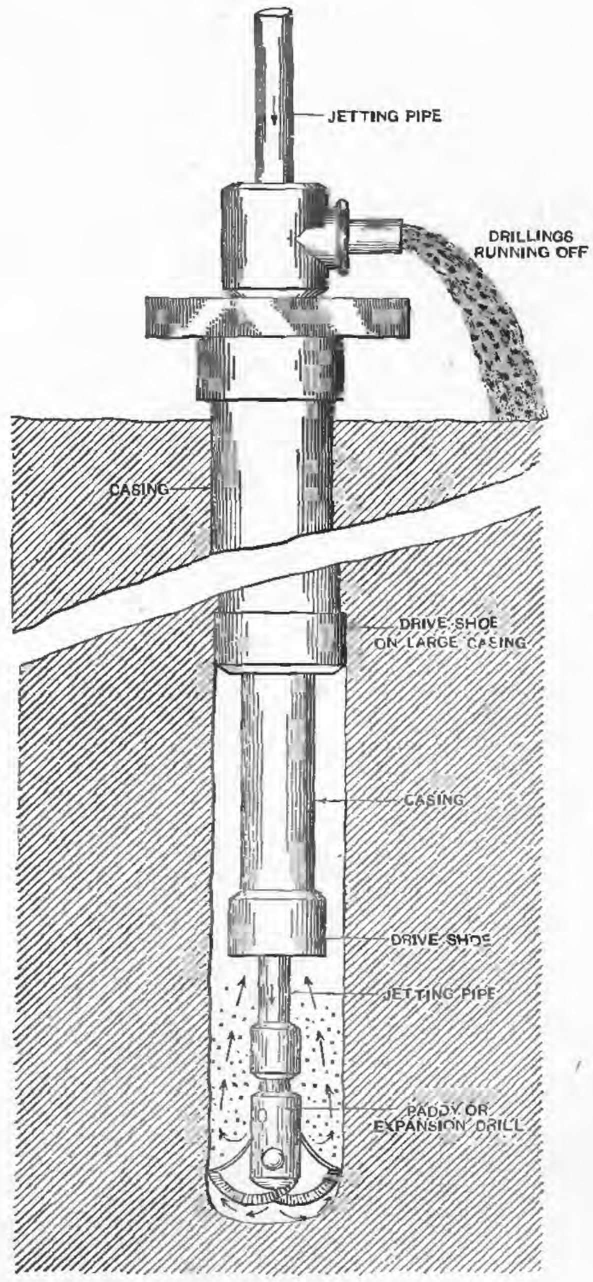
4 Common jetting drill This shape, with the attachment of a valve, is often used in the automatic sand-pumping outfit, but for best results the shape should be modified. (See p 101)

5 Drive shoe Tempered steel or iron, with cutting edge, for use on end of casing pipe

6 A simple jetting outfit Designed and used by Roy S Barker in drilling test holes on Long Island, New York In this the drive weight is lifted by two men standing on a wooden platform clamped to the casing, and the weight of the men aids in sinking the casing.

1





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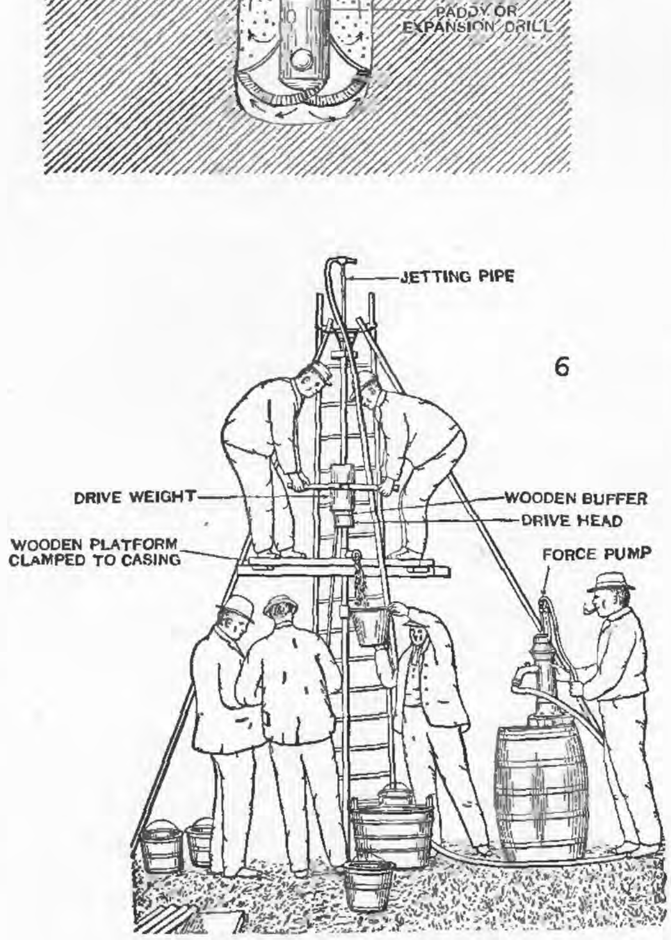

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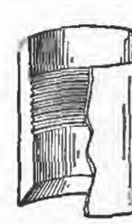
4



5

JETTING PROCESS.

WELL MAKING.

the top of the pipe is near the revolving table a length of pipe is attached to the second water swivel and elevated by means of the lifting drum into position for coupling, the rotary is then reversed and the first water swivel unscrewed, the new length of pipe is coupled on, and the pumps are switched to the hose connected with it This operation with skillful men requires but a few seconds, and drilling proceeds with scarcely an interruption To prevent the drenching of the men when the water swivel is unscrewed "back-pressure valves" are sometimes inserted between the pipe couplings (Pl LI, 5) To guard against accident to the pumps and the consequent "sticking" of the pipe, all large outfits have two force pumps so connected that should one fail the other can be immediately used Wells are usually started with large casing, which is pushed down as far as possible; smaller casing is then inserted, and so on to the bottom of the well The well at Galveston, Tex , which is the deepest well ever sunk in unconsolidated materials, has 22-inch casing from 0 to 60 feet, 15-inch from 60 to 928 feet, 12-inch from 928 to 1,500 feet, 9-inch from 1,500 to 2,363 feet, and 5-inch from 2,363 to 3,067 feet.

This process is by far the quickest method known for sinking wells of large diameter in unconsolidated material Wells over 1,000 feet deep have in several cases been sunk in less than a day and a half As a means of developing water wells it is not entirely satisfactory unless the exact point at which the water-bearing beds occur is already known

CORE DRILLS.

In the various types of core drills, all of which are intended for use in consolidated material or hard rock, there is a combination of a revolving and a hydraulic process Hollow bits with some cutting or abrasive device are revolved by suitable machinery, and wear out a hole with a core standing in the center The drillings are removed by a jet of water, and from time to time lengths of the core are broken off and brought to the surface either by lifting the drill, which in some cases automatically breaks the core and clamps it, or by a separate "core lifter "

In the diamond drill a hollow bit is used in which eight diamonds (either carbons or borts) are inserted—four near the outer edge and projecting slightly outward, and four near the inner edge and projecting slightly inward

In the chilled-shot drill a hollow wrought-iron shoe is used in connection with chilled-steel shot or other loose abrasive The constant rotation causes the shot to wear away the rock. This method can not be used in fissured or porous rocks where the shot can run out of the drilled hole, nor can it be used on bowlders or other irregular surfaces surrounded by clay, as the shot slide off and become embedded without accomplishing any work

The toothed steel bit is similar to the ordinary rotary shoe or bit (Pl LI, 4). The rotary bit does not yield a good core because of the softness of the material worked and the rapid washing away of the core by the water current Indeed, in most work the toothed rotary bit is fitted with a central crosscutting edge which prevents the formation of any core whatever This method of coring is well adapted for work in relatively soft, uniform rocks

On account of the unconsolidated character of the material ordinary core drills can seldom be used in the Coastal Plain of Arkansas and Louisiana Exceptional

PLATE LI.

ROTARY PROCESS

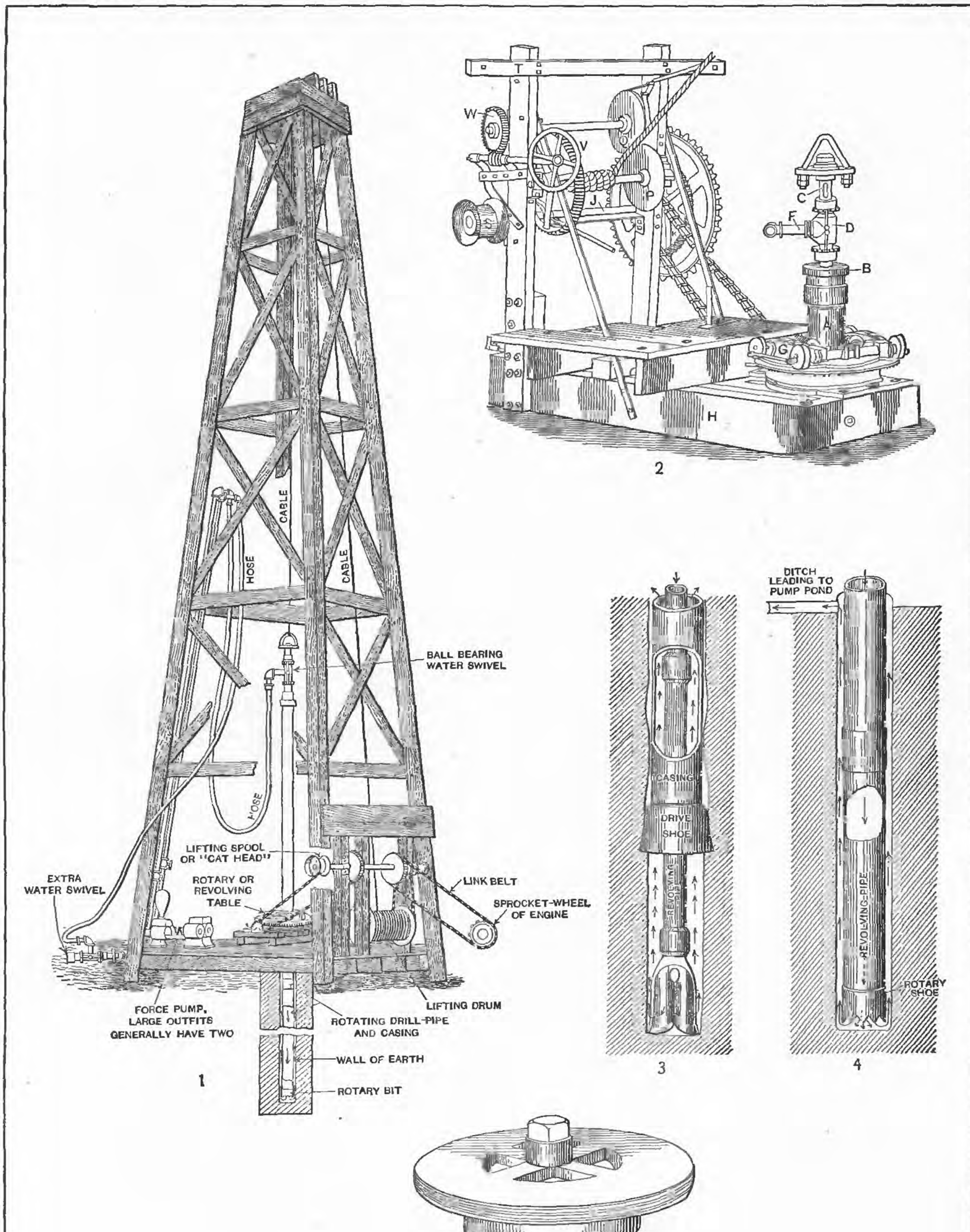
1 Rotary outfit Water is forced from pump through water swivel and down casing or drill pipe and returns to surface as shown (Nos 3, 4) The pipe, which is armed with a rotary shoe (No 4) or a fishtail bit (No 3), is constantly rotated by means of a rotary or revolving table (No 2) The drillings loosened by the water and the drilling bit are brought to the surface by the return current outside the drilling pipe or casing

2 Revolving table, hoisting machinery, and water swivel of Chapman's rotary

3 Fishtail bit

4 Toothed or rotary bit

5 Back-pressure valve occasionally used between couplings to keep drillings from entering wash pipe and to prevent a "back flow" when the water swivel is unscrewed to allow new lengths of pipe to be added



ROTARY PROCESS.

WELL MAKING.

cases are found in the hard rocks encountered in some of the Cretaceous domes in northern Louisiana and in the salt and the sulphur deposits of southern Louisiana. In the latter, diamond drills have already been used.

FINISHING A WATER WELL.

When the water sand is consolidated or hard enough to stand up in the hole, as in some of the Cretaceous beds, the finishing of a well offers no very great difficulty; but where not consolidated, as in the Tertiary and Quaternary beds, some sort of screen must be used. It is on the selection and setting of this screen that much of the success of the well depends. The screens commonly used are of two general types. One is made of pipe with round perforations covered with wire, wire gauze, or perforated metal gauze of some sort. The other is made of brass tubing with rows of horizontal slits increasing in size inward. The latter is perhaps the simpler, but is the more expensive type.

After the screen has been placed, which in most of the wells in this section is done after the drilling is completed, it is very desirable that the well be pumped heavily for several days or until the water clears. The point of this is to remove the finer particles immediately about the screen and thus to surround it with a natural strainer of coarser particles (fig. 28). During this initial cleaning out of the well the pump should not be stopped when it commences to draw sand. In many cases where this has been done not only has the well not been properly cleaned out or finished, but the pump valves and rods have been firmly fastened by the rapidly settling sediment and great difficulty has been experienced in their removal. In very fine sands, where there are no particles coarse enough to form a good natural screen, it is often practicable to introduce gravel from the surface and with it develop a strainer about the screen.

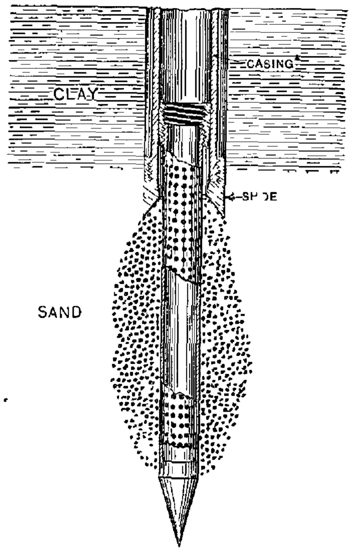


FIG. 28.—Diagram showing natural strainer of coarse material formed about the screen by pumping out the finer sand.

COST OF DEEP WELLS.

The cost of wells naturally varies with the complexity of the tools needed, the skill of the driller, the character of the material drilled, the transportation facilities, and the amount of competition. If water is guaranteed it varies with the known water probabilities, and is always higher, except where the water conditions are thoroughly understood, than for a mere hole in the ground.

In the Cretaceous region of southwestern Arkansas, where the conditions are such that deep-well water is the only supply over large areas and where very favorable geologic conditions exist, a very ingenious adaptation of the well-boring process has been developed (p. 95). By this method the drillers, who are almost without exception local planters, can afford to make 3½-inch wells for from 12½ to 40 cents a foot. When machine rigs of the jetting and automatic sand-pumping types were introduced in this region, as they have been within the last ten years, the "machine men" had to meet the competition of the "hand-tool men" and so prices have been kept down It should be added in explanation of these prices that it is usually understood that the board for the drillers, and horse feed, will be furnished by the persons for whom the well is being drilled, who will also furnish the casing As this is generally made of a few rough yellow-pine boards, which can be obtained at a near-by mill, it is not a very important item of cost

In the Tertiary regions, where water can generally be obtained in shallow dug and driven wells, the demand for deep wells has not been so great However, with the rapid development of this section in the last fifteen years, large and permanent water supplies have been demanded for manufacturing purposes and deep wells have been put down at many points. The first of these wells were put down by well drillers from other sections of the country The cost was necessarily high, and the prices have been pretty well maintained to this time. The usual charges range from $1 to $4 a foot without casing, and while very large compared with the cost of wells in the Cretaceous region they are but slightly higher than those on Long Island, New York The development is now largely restricted to wells for mills, ice factories, and waterworks, but conditions are very favorable for extensive developments for domestic and plantation purposes Small jetting, automatic sand-pumping, and hand-boring outfits[a] are well adapted for such developments, and for ordinary wells 200 to 400 feet deep they should almost entirely supplant the larger rigs The following example illustrates the difference in cost Wells put down in Avoyelles Parish 100 to 150 feet deep into the Port Hudson gravels by professional well drillers cost $2 to $3 per foot Judge Morrow, of Rapides, Rapides Parish, has put down three wells 102 feet deep in the same material with a jetting machine at an average cost of 39 cents per foot

Statistics regarding the cost of wells in this region are given in the following tables, which are based on reports from various sources In some instances it is probable that the total cost given does not include the cost of casing, and that the amount given under "Average per foot" should be transferred to the column "Average per foot without casing."

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[a] The bits shown in Pl XLV are much better adapted for work in the Tertiary strata than the specialized clay bit used in the Cretaceous strata (Pl XLVI 14).

Cost of deep wells in the Cretaceous strata in southwestern Arkansas

Well No	Location		Total depth	Diameter	Size and length of casing		Cost			Year drilled	Remarks
	County	Town					Total	Average per foot	Average per foot, without casing		
			Feet	*Inches*	*Inches*	*Feet*					
28	Clark	Arkadelphia	321	6-4					[a]$2 00 [a]1 25 [a]1 00	1901	Jetting outfit
29	do	Beirne	187	6		[b]30	$50 00	$0 27		1893	Hand boring tools
30	do	do	175	3¼		[b]16	35 00	20		1896	Do
32	do	do	177	3¼	4	[b]47	35 00	20	20	1902	Do
36	do	do	235½	3¼	4	[b]31	46 00	+ 19		1902	Do
46	do	Bradshaw	325	3¼		30	60 00	18		1897	Do
47	do	do	175	4			80 00	46		1901	Do
53	do	Curtis	146	4			25 00	17			Do
58	do	do	115	4			25 00	22		1902	Do
65	do	do	150	4	4	20-40	30 00	20		1902	Do
71	do	Daleville	410	4					1 00	1893	Jetting rig
80	do	Gurdon	143	3¼			40 00	28		1903	Hand boring tools
88	do	do	222	3¼		[b]30	50 00	22		1903	Do
91	do	do	358	3¼		[b]40	125 00	35	35	1901	Do
99	do	do	315	4		[b]54	80 00	25	25	1881	Do
106	do	Hollywood	89	5			35 00		25	1901	Do
114	do	Okolona	280	3	3	280	300 00	1 07		1885	Do
156	Hempstead	Bell	135	4					44		Do
159	do	do	180	4					40		Do
160	do	do	230	4					54		Do
	do	Fulton							[c] 40- 50	1902	Do
	do	do	175	2			100 00	57			Do
212	do	do	173	3	3	60			50	1896	Do
215	do	do	192	2	2	[b]57	23 40	[d] 12		1893	Do
216	do	do	170	2	2	16			25	1898	Do
217	do	Fulton (Sprudel)	235	4	4	50	200 00	85			
219	do	Fulton	296	3	3	30	96 00	32		1893	Do
	do	Garlandville	100-300	3¼					25	1904	Do
252	do	Guernsey	232	3	3	[b]30	75 00	32			
322	do	Hope	500	9-6	9	390	1,400 00	2 80			
	do	do	400	2-3					30- 50	1902	Domestic wells
347	do	Spring Hill	434	4	4	[b]60	130 00	30		1902	Automatic sand-pumping outfit
348	do	do	500	1½	2	94	231 85	46		1901	Do
352	do	do	500	2	4	30	150 00	30		1902	Do
357	do	Washington	245	1½					40		
365	Howard	Allbrook	347½	2	2	30	113 25		30	1901	"Machine well"
366	do	do	230	4			125 00	54		1886	Do
374	do	do	496	4-3	4	42	200 00	40		1900	Do
375	do	do	430	3-2	3	40	100 00	23		1898	Do
380	do	do	320	2			100 00	31			Do
393	do	Centerpoint	500	2	2	110	250 00	50		1901	Do
402	do	Saratoga	788	3-2-1	3-2-1	720	500 00	63	[e] 30	1902	Do
433	Little River	Arkinda	290	4					1 00	1899	Do
447	do	Rocky Comfort	500	4-3-2	4	30	250 00	50			Do
448	do	do	560	2	2	72	+350 00	62		1902	Do

[a] $2 per foot, 0-100 feet $1 25 per foot, 100-200 feet; $1 per foot, 200-321 feet Statement of J M Phillips, well driller

[b] Casing of pine boards

[c] General statement of Chas D Hudson, well driller, 40 cents per foot down to 250 feet, 50 cents per foot below 250 feet

[d] Probably does not include labor of owner

[e] Does not include moving rig, extra help, board, horse feed, etc.

Cost of deep wells in the Cretaceous strata in southwestern Arkansas—Continued

Well No	Location		Total depth	Diameter	Size and length of casing		Cost			Year drilled	Remarks
	County	Town					Total	Average per foot	Average per foot, without casing		
			Feet	*Inches*	*Inches*	*Feet*					
492	Nevada	Emmet	172	4	4	[a] 30	$50 00	$0 29		1890	"Machine well"
517	do	Lanesburg	465	2	2	425	300 00	64	$0 35		Do
518	do	do	568	3	3	[a] 30	100 00	18	18	1894	Do
519	do	do	540	3-2	3	[a] 32	150 00	28	28	1892	Do
563	do	Prescott	375	3¼	4	[a] 47	75 00	20		1901	Hand boring tools
565	do	do	433	3¼			80 00	18		1901	Do
	do	do	100-400	3					25	1902	Do
579	do	do	170	6	6	170	100 00	59		1901	Do
582	do	do	170	3			35 00		21	1902	Do
615	do	Verde	428	4	4	30	140 00	33		1888	Machine tools
619	do	do	380	2	2	36	85 00	22		1900	Do
620	do	do	359	2	2½	40	110 00	31		1894	Do
621	do	do	390	2	3	45	100 00	26		1902	Do
623	do	do	419	1½	3	30	130 00	31		1891	Do
624	do	do	473	3	3	26	100 00	21		1898	Do
	Pike	Bowen	100-350	3				[b] 12½ [b] 25 [b] 50	[b] 12½ [b] 25 [b] 50	1902	Hand boring tools

[a] Casing of pine boards

[b] Wells not over 200 feet deep, $25, every additional foot to 300 feet, 25 cents per foot, every additional foot over 300 feet, 50 cents per foot Statement of J B Dillon, well driller

Cost of deep wells in the Tertiary and Quaternary strata in southern Arkansas

Well No	Location		Total depth	Diameter	Size and length of casing		Cost			Year drilled	Remarks
	County	Town					Total	Average per foot	Average per foot, without casing		
			Feet	*Inches*	*Inches*	*Feet*					
15	Bradley	Warren	196	4	4	196	$400	$2 04		1902	
19	do	do	648	2½	2½	(?)648	1 200	1 85		1902	
24	Chicot	Dermott	750	4	4	650	1,500	2 00		1902	
125	Cleveland	Cho (Anderson)	432	2½	2½	432	1 000	2 31		1890	
126	do	Draughon	117	4	4	117	100	85		1898 1901	4 wells put down by mill company
127	do	Kedron (Kendalls)	457	3	3	450	1,000	2 19		1901	
128	do	Kingsland	247	2½			210	85	$0 61	1901	"Punched well"
129	do	do	200	3			100	50		1901	Jetting process
130	do	do	376	2½			276	73		1900	Do
139	Columbia	Taylor	305	4	4	305	700	2 30		1902	
142	Dallas	Fordyce	502	4			1,800	3 05		1901	
143	Desha	Arkansas City	550	6			(?) 1,000	1 82		1894	
148	Drew	Monticello	750	8			3,000	4 00		1899	
412	Jefferson	Pine Bluff	905	8-6	8-6	905	3,500	3 87		1898	
419	Lafayette	Frostville	156	4	4	156			4 00	1895	
			156	6	6	156			4 00	1902	
427	do	Stamps	415	8	8	345	2,200	5 30	[a] 3 50	1902	Rotary
458	Miller	Boggy	250	4-2½	4	150	500	2 00			
628	Ouachita	Bearden	1,001	6	6	901	2,600	2 60		1898	Rotary process
630	do	Camden	135	2	2	135			1 50	1885	

[a] Owner furnished pipe and steam to run machines

Cost of deep wells in the Tertiary and Quaternary strata in northern Louisiana

Well No	Location		Total depth	Diameter	Size and length of casing		Cost			Year drilled	Remarks
	County	Town					Total	Average per foot	Average per foot, without casing		
			Feet	*Inches*	*Inches*	*Feet*					
757	Avoyelles	Bunkie	125	4			$250 00	$2 00		1901	
758	do	do	158	4			522 00	3 30		1897	
759	do	do	140	4			400 00	2 86		1902	
763	do	Mansura	110	6			500 00	4 54		1902	
767	do	Marksville	[a] 800	6-4			1,400 00	1 75			
768	Bienville	Arcadia	540	8¼-6	Not cased		1,500 00	2 77	$2 77	1901	
768A	do	do	535	5-3½		480			2 75	1893	
773	Bossier	Antrim	286	4	4	286		4 00		1896	
774	do	do	233	6	6	233		4 00		1902	
775	do	Allentown	110	5	5	110	250 00	2 27		1899	Jetting machine
776	do	Antrim	300	5	5	275	1,000 00	3 33		1898	
778	do	Benton	350	2½	2½	225			2 00		Automatic sand-pumping rig
779	do	do	196	3	3	196	600 00	3 06			Do
781	do	do	170	2½					2 00		Do
782	do	Bolinger	235	4	4	170			2 00	1897	
784	do	Bossier City	350	2½	2½	80	380 00	1 09		1898	Automatic sand-pumping rig
786	do	do	195	6-2	6 2	70 98	[b]550 00	2 82			Do
789	do	Curtis	197	2½	2½	100	300 00	1 52		1897	Do
791	do	Foster	210	3	3	150	300 00	1 43		1898	Do
794	do	Poole	300	4-2				1 65			Do
798	Caddo	Blanchard	185	3	3	100			1 25	1897	Do
803	do	Missionary	290	3-2	3 2	132 158	392 65	1 35		1900	Do
805	do	Robson	225	4					(?)1 00	1898	
807	do	Shreveport	996	4	4	(?)996	8,000 00	8 03		1891	Rotary process
808	do	do	280	4-2½	4 2½	83 69	500 00	1 79		1901	Automatic sand-pumping rig
811	do	do	338	6-4	6 4	96 60	[c]1,117 50	3 30		1902	Do.
823	do	do	225	2½-1½	2½ 1½	82 76	290 00	1 30		1901	Do
820	do	do	338	6-4					[d]1 50 2 00	1901	Do
829	do	do	201	2½			300 00	1 50		1893	Do
812	do	do	324	4-2½	4 2½	80 69	700 00	2 16		1901	Do
817	do	do	150 180 290	6-4 6-4 6-4			650 00 650 00 650 00	4 20 3 61 2 24		1902 1902 1902	Do
828	do	do	210	2½	2½	80	250 00	1 19		1897	Do
864	Claiborne	Stateline	285	3-2			365 00	1 28		1900	Do
877	Grant	Colfax	1,103		2½	900	2,500 00	2 26		1899	Rotary outfit
880	do	Pollock	910	8-6-4			1,700 00	1 87		1896	
881	do	Rochelle	[e]555				4,300 00	7 75	[f]1 00		

[a] Depth paid for

[b] Amount paid drillers

[c] Contract price with certain stipulations as to yield

[d] First 100 feet $1 50 per foot below 100 feet $2 per foot

[e] Statement of driller

[f] Contract price for drilling, owners to furnish everything but the drills

Cost of deep wells in the Tertiary and Quaternary strata in northern Louisiana—Continued

Well No	Location		Total depth	Diameter	Size and length of casing		Cost			Year drilled	Remarks
	County	Town					Total	Average per foot	Average per foot, without casing		
			Feet	*Inches*	*Inches*	*Feet*					
885	Jackson	Hodge	330	6	6	330	$1,300 00	$3 94		1900	
886	do	Jonesboro	545	6	5	534	2,500 00	4 58		1901	
887	do	Wyatt	302	4	4	302	634 00	2 10		1902	
890	Lincoln	Ruston	430	8-6	8 6	200 230	1,800 00	4 19		1901	
891	do	do	450	4	4	450	1,200 00	2 68		1901	
911	Natchitoches	Natchitoches	726	6-4-2½	6	160	1,250 00	1 72		1900	Rotary outfit
917	do	Weaver Spur	308	4-2	4	124	418 90	1 36			Automatic sand-pumping rig
921	Ouachita	Monroe	360	3½	3½	360			$3 00	1892	Jetting process
923	do	do	385	5					3 50	1892	Do
925	do	do	375	5	5	375	875 00	2 33		1901	Do
944	Rapides	Boyce	302	8			1,200 00	4 00		1900	Rotary process
946	do	do	279	3½	3½	180	400 00	1 43		1899	
952	do	Rapides	102	2	2	102	40 00	0 39		1900	Drilled by owner with jet machine
956	do	Zimmerman	175	4	4	175	185 00	1 05		1897	Drilled by owner
960	Red River	Lake End	287½	4-2½	4 2½	85 80	[a] 530 00	1 84		1900	Automatic sand-pumping rig
966	Sabine	Loring	704	6					3 25	1901	Rotary
973	do	Plymouth	521	4					2 25	1901	Do
979	Union	Randolph	206	3½	3½	206	500 00	2 43		1901	
985	Webster	Minden	317	6	6	317	1,000 00	3 15		1901	
989	do	Spring Hill	368	3	3	(?) 368	661 85		1 80	1899	
997	Winn	Tannehill	270	4	4	(?) 270	500 00	1 85		1902	

[a] Contract price, well not accepted because of salty water

CHAPTER IV.

UNDERGROUND WATER PROSPECTS, BY COUNTIES.

SOUTHERN ARKANSAS.

ARKANSAS COUNTY

In Arkansas County no attempt has been made to develop any but the gravel beds which occur near the base of the Port Hudson deposits, 75 to 150 feet from the surface, although the deep-well prospects are very favorable. The water sands corresponding to the Cockfield horizon will be encountered at depths of from 250 to 300 feet below sea level. This is the horizon developed at Helena (642B, 643),[a] Rosedale (1006), Arkansas City (143), and Dermott (24), and encountered in the Pine Bluff and Redfield wells (Pl XXXVII, secs A, B, G).

The Sabine horizon will be found at depths from 700 to 800 feet below sea level. This is the horizon developed at Pine Bluff (410, 415), Jonestown (1010), Eaglenest (1009), Lyon (1011), and Cleveland (1003, 1004)

The water will rise very near the surface from both of these horizons, but probably will not flow

ASHLEY COUNTY

Ashley County, with the exception of its north-central portion (Pl III), is underlain by the gravels at the base of the Port Hudson (Quaternary) deposits. These outcrop on the southern prolongation of the Monticello Ridge, but through the rest of the county are buried by the silts and clays of the upper part of the Port Hudson, which in the southern and southwestern part attain a thickness of from 50 to 100 feet. These gravel beds furnish the most available water supply for this region (Pl. XLIV). At Crossett the yield from three 8-inch wells is 200 gallons per minute (7) The coarser gravels are generally just above the "black dirt," or Tertiary beds, and in order to obtain the largest amount of water the wells should be drilled until this black dirt is encountered, then the casing should be pulled back a few feet

The only deep well (7) which has been sunk in this county obtained impotable water from the Eocene water sands (Pl XXXVII, secs A, B, H), but wells in adjoining counties have yielded better results, and the conditions in the northern and eastern part, as indicated by the wells at Warren (19), Monticello (148–150), Dermott (24), Blissville (145), and Greenville (1039) are more favorable. These wells obtain water from the Cockfield water sands (p 84), and indicate that the best water-bearing sands in this group are to be expected in the eastern

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[a] Numbers in parentheses refer to corresponding numbers used in table in Chapter V

part of the county at depths not exceeding 400 to 450 feet below sea level, or 500 to 600 feet from the surface (Pl XXXVII, sec A) The unsatisfactory character of the Portland and Empire wells is believed to be due to their shallowness; better water could probably be obtained by deepening them to 500 feet The water from this horizon will not flow, but in the bottom lands will rise almost to the surface

Wells should not be drilled deeper than 300 feet below sea level in the western part of the county and 450 feet in the eastern part, unless it is desired to reach the Sabine horizon This will be encountered at depths of from 800 feet below sea level in the western part to 1,000 feet in the eastern part Along Ouachita River and east of Overflow Creek and Bayou Bartholomew it will probably furnish flowing water, though the head will not be great (Pl. XLII) The water from this lower horizon will probably be brackish (Compare results at Crossett (7) and Yazoo City (1046–1049))

Water sands may be found for several hundred feet below this horizon, but these occurrences are not probable, and wells of greater depth are likely to prove unprofitable Below these lie the nonwater-bearing clays of the Midway and uppermost Cretaceous, and the next water horizon, which is reached 1,000 to 1,500 feet below, will probably yield very salty artesian water.

BRADLEY COUNTY

The gravels underlying the terrace deposits are of possible importance as water carriers only in the southern and western parts of this county (Pl XLIV). Here the buried gravel beds will be encountered at depths of from 20 to 100 feet Wells intended to yield large supplies should be drilled until the Tertiary beds, or "black dirt," is encountered, and the screen should be set a few feet above it in the coarse gravels

In the northern and northeastern parts of the county, around Warren, only the Tertiary water sands are of importance At Warren a number of wells (14–19) obtain hard water just below the Jackson (Pl XXXVII, secs B, H) This supply, on account of the dip, is probably not available in the western part of the county. A better quality of water can be obtained by deepening these wells to the main Cockfield horizon, which underlies the whole county, and will be encountered at depths ranging from 200 feet below sea level in the western part to 300 feet (Pl XLII) in the eastern The depth of the well of the Warren Stave Company, 1 mile east of Warren (19), is believed to be excessive, the records of all the surrounding wells and the geologic structure show no reason why this well should be deeper than 500 feet (Pl XXXVII, secs B, H). The water obtained from this horizon is soft and alkaline, and in the southern part of the county, as suggested by the Crossett well (6), may be impotable

The lower Eocene or Sabine horizon, though not yet developed, will be encountered at depths ranging from 700 feet below sea level in the extreme northwestern part of the county to 800 feet in the southeastern part (Pl XLI). At Bearden (628), and Crossett (7) water from this horizon has proved unsatisfactory, and while this layer has yielded good water in other places, its development is not recommended here unless the upper sands fail.

CALHOUN COUNTY

In Calhoun County the surface gravels are relatively thin except in the southern and southwestern portions, where the Port Hudson terraces, or "flat lands," are well developed (Pls III, XLIV, in pocket) These gravels have been developed in a 25-foot well, sunk by the Little Bay Lumber Company at Little Bay (21), and supply the domestic wells in the southern and western parts of the county (Pl XXXVII, sec H)

The upper Eocene or Cockfield water sands are relatively near the surface throughout the whole county, the base of this series ranges from near sea level in the western part of the county to slightly over 200 feet above sea level in the eastern part. Wells should not be drilled much deeper unless it is intended to go to the Sabine horizon Water-bearing sands in the Cockfield have been encountered in the Bearden well (628), just on the county line, between 300 and 312 feet below the surface (Pl XXXVII, sec K). The Thornton (23) and the Fordyce (142) wells likewise encountered water sands in this horizon, which have been successfully developed in the latter The sand is relatively fine, and great care must be taken in properly selecting and setting the screen The Thornton well was probably not deep enough and was not properly finished It was abandoned after a time because of the fine sand This could perhaps have been avoided by pumping the well thoroughly when first completed, or introducing coarse sand and gravel as described above (p 107) Water from this horizon will rise to within 10 to 100 feet of the surface, depending on the elevation of the ground

The Sabine horizon will be encountered at a depth of about 700 feet below sea level It is not likely to yield as good results as the upper horizon, and should not be drilled for until the upper sands have been thoroughly tested The water from this horizon may flow in the southern part of the county in the Ouachita and Bayou Moro bottoms (Pl. XLI).

CHICOT COUNTY

Throughout Chicot County the Eocene strata are everywhere buried by 70 to 150 feet of Quaternary sands, gravels, and silts (Pl XXXVII, secs A, H) These surficial beds are coarser near the base and will yield very large supplies of somewhat chalybeate water This water is used for locomotive purposes on the Iron Mountain Railway (10, 25), and in the adjacent portions of Mississippi on the Yazoo and Mississippi Valley Railroad (1007, 1040, 1042), and by the cotton-oil mill and other factories at Greenville, Miss It is the source of water for local gin and plantation purposes, except where cisterns are used

Water of better quality can be obtained from the underlying Eocene beds at depths of 400 to 500 and 900 to 1,000 feet below sea level (Pl XXXVII, secs A, H). Several minor horizons are encountered above the 400-foot stratum, as shown in the Blissville (145) and Empire (26) wells, but better water and more prolific yields are obtained from the main Cockfield horizon developed in the wells at Arkansas City (143), Dermott (24), Blissville (145), and Greenville (1039) Water from this horizon will not flow, but will everywhere rise to within a few feet of the surface. It is in every way the best water horizon available in this county

The Sabine horizon, which will be encountered at depths of from 900 to 1,000 feet, will furnish flowing water, except perhaps on the Bayou Macon Hills (Pls. III, XLI) The quality of this water can be determined only by drilling. At Crossett, Ashley County (6), it is quite salty, but across the river in Mississippi, at Cleveland (1003–1004), O'Reilly (1005), Indianola (1030), and Moorhead (1031), artesian water of satisfactory quality has been obtained

In no case will it be desirable at drill much below this Sabine horizon. The underlying uppermost Cretaceous water sands lie 1,000 to 1,500 feet below, and others in the same series occur at depths of 3,000 to 5,000 feet. The water from these Cretaceous horizons will probably be artesian, but it is likely to be highly mineral

CLARK COUNTY

Both topographically and geologically Clark County shows two major divisions—to the northeast is a hilly, rocky country representing a portion of the Ouachita Mountains, and to the southwest is a lower, dirt country, which is a part of the Coastal Plain

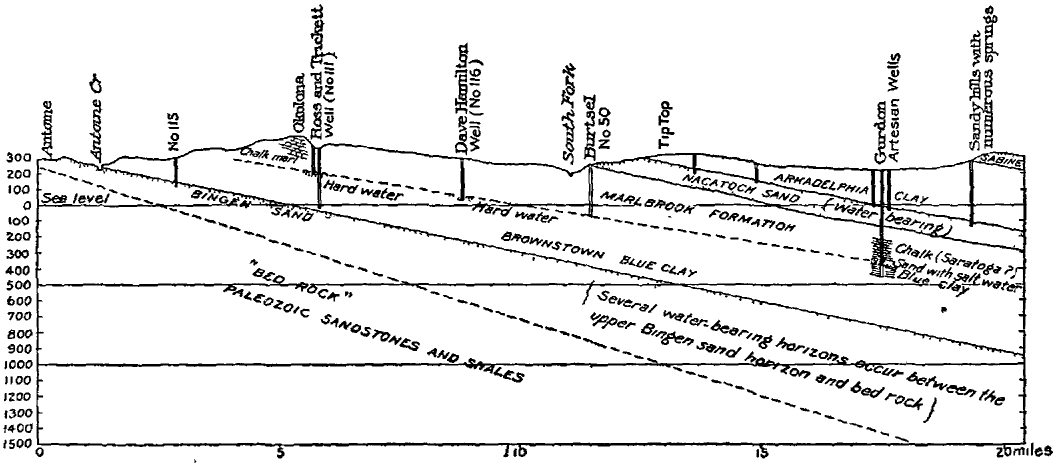

FIG 29 —Section from Antoine to Gurdon, Ark , showing water-bearing horizons

In the mountain region the water supply is very irregular. It occurs in local gravel beds of no great extent or continuity, in the alluvial fillings in the creek bottoms, and very irregularly through the bed rock itself. Deep wells must depend on the supply from the bed rock, and, while water-bearing sandstones occur throughout, it is not possible at this time to make any definite predictions Wells may obtain satisfactory supplies within a few hundred feet, and it is quite possible to drill 1,000 feet or more without obtaining a good supply

In the Coastal Plain portion of this county there are three groups of sands—the Bingen, Nacatoch and Sabine—which outcrop in northeast-southwest belts and slope southeasterly in a very regular manner. The lowest of there, the Bingen sand, outcrops in a very narrow and somewhat disconnected band along the border of the Paleozoic rocks (Pls III, XXXVIII, in pocket). It underlies the whole county southeast of the outcrop, and its upper portion will be encountered at the depths shown on Pls. XXXVII (sec. G) and XXXVIII and fig. 29.

It will furnish flowing water along Ouachita River, Terre Noire Creek, Antoine Creek, and Little Missouri River At Daleville and Arkadelphia it furnishes artesian salt water, in the Ross well, near Bradshaw (46), artesian brackish water; and in the Gaither well (47) soft water Near Okolona and in southwestern Pike County the water is usually soft and alkaline.

The well of Ross & Trickett at the town of Okolona (111) was abandoned just before the Bingen horizon was reached It should have been about 50 feet deeper (fig. 29) The well of the Burtsell Lumber Company at Burtsell (50) was started near the base of the Nacatoch sand, and to reach the Bingen must have penetrated both the Marlbrook and Brownstown formations To obtain the best results a well at this point should be slightly over 600 feet deep (fig 29). The test well of the Grayson-McLeod Lumber Company at Gurdon (83) did not reach this horizon by about 300 feet Above the Bingen horizon there is a thin stratum containing very hard water, which is of some value for local domestic wells near and south of Okolona. It has been encountered at Okolona in the Ross & Trickett well (111), the old Academy well (112), and perhaps the Cargill well (113). It also furnishes the supply in the Hamilton well (116), 3 miles southeast of Okolona. The depth and position of the Burtsell test well indicate either that this horizon is locally absent or that it would have been encountered within a few feet At Gurdon this horizon yields a very small flow of artesian salt water.

From 200 to 500 feet above the Bingen sand the outcropping from 4 to 10 miles south of it is the Nacatoch sand (Pls. III, XXXVIII and fig 29) This is the source of all the water along the Iron Mountain Railway, and will be encountered in any part of the county southeast of the railroad by going to the proper depth. A restriction on the development of this layer is, however, imposed by the fact that 2 to 10 miles south of the outcrop the water becomes quite salty (p 80). Flowing wells from this horizon are possible over considerable areas.

If potable well water is to be developed at Arkadelphia it can be obtained only in the uppermost layer of the Nacatoch (see well 27), and even in this case there is danger that pumping will bring in salt water The lower sands between bed rock and the Nacatoch, as shown by the wells at the ice factory (27) and Daleville (71, 73), will yield only rather salty water

Five or 6 miles south of the Nacatoch outcrop are the basal sandy beds of the Sabine (Eocene), which supply numerous springs and in which shallow wells can easily be finished at almost any point

Besides these upper Cretaceous and Eocene horizons, large gravel deposits, partially filling the old valleys (p 86), occur along the main stream channels, as Ouachita, Terre Noire, Antoine, and Little Missouri rivers In the Little Missouri bottoms in southern Pike County these gravels are encountered at depths of 80 to 100 feet Everywhere they furnish large supplies of water of very poor quality

CLEVELAND COUNTY.

With the exception of the gravel deposits, 10 to 30 feet thick, in the Saline Bayou and Bayou Moro bottoms, which yield water of poor quality, important water supplies can be obtained in this county only from the Eocene strata

The beds of the Cockfield water-sand group range from sea level at the northwest corner of the county to almost 300 feet below sea level in the southeast corner (Pl XLII) Along the line of the Iron Mountain Railway it is about 200 feet below sea level (Pl XXXVII, sec K). This horizon has been developed in the Fordyce (142), Clio or Anderson (125), and Kedron or Kendalls (127) wells. It was encountered in the Pine Bluff wells (412, 415A), but these wells were continued to the Sabine horizon. Above the main Cockfield sand, which is very persistent, there are several irregular horizons which have been developed at Kingsland (128–129), Draughon (126), and Rison (132) (Pl XXXVII, sec. K) Similar occurrences are to be expected throughout the county

Wells should not be continued below the base of the Cockfield sands unless they are to go to the Sabine horizon, which will be found at depths ranging from 650 to 750 feet below sea level (Pls XXXVII, secs B, H, K, XLI) Between the base of the Cockfield sands and the Sabine sands no water has been encountered in this region. The Sabine horizon has been developed at Pine Bluff (410–415) where it yields excellent water, and at Bearden (628), with less satisfactory results

Only one failure has been reported in this county, the Porter Lumber Company well at Rison (133). This did not succeed in developing the Cockfield sands, which are reported in all the surrounding wells, and it did not go deep enough to reach the Sabine sands. It is believed that successful wells can be developed at Rison in both these horizons.

COLUMBIA COUNTY.

Wells from which large yields of good water are desired must, in Columbia County, be finished in the Eocene beds At any point above the Midway and Cretaceous deposits water-bearing beds are likely to be encountered Below the Midway no good water is to be expected unless it is found in the sub-Clarksville sand, 2,000 to 2,500 feet below the basal Sabine. The extreme depth to which it is advisable to sink wells in the region north of the Red River fault line (Pl XLI) ranges from 100 feet below sea level in the extreme northwestern part of the county to 600 feet in the southeastern part, and in all cases water is to be expected above this extreme depth South of the fault line it is not advisable to go deeper than 200 feet below sea level (Pls. XXXVII, secs E, H; XLI). Many successful wells have been finished in the Sabine sands at New Lewisville and Stamps, Lafayette County, and similar developments are to be expected here In the Waldo well (141) water was encountered at the proper depth, but the supply was not deemed sufficient, and the well was deepened without results This failure is not believed to affect the probabilities over a very wide area, as it is clearly due to essentially local conditions.

Flowing water has been developed from a shallow well in the Eocene sands at Fomby (135), in the southeastern part of the county, and flowing wells may possibly be developed on the headwaters of Smackover and Dorcheat creeks

DALLAS COUNTY

In Dallas County the whole of the Eocene water sands are available, and there should be no difficulty in developing a good horizon at any place The depth of profitable development ranges from near the surface in the northwestern part of the county to about 700 feet below sea level in the southeastern part (Pls XXXVII, secs G, K, XLI, XLII). Flowing water is not to be expected over wide areas, but may occur locally under conditions similar to those described on page 82.

But one deep well has been finished in this county, that of the Fordyce Lumber Company, at Fordyce (142), which is supplied by the Cockfield sands

In the "flat lands" in the southwestern portion of the county, along Ouachita River, extensive gravel beds underlie the surface deposits, and will yield more or less satisfactory supplies at depths ranging from 25 to 100 feet.

DESHA COUNTY.

The beds outcropping in Desha County are entirely Quaternary silts, sands, and gravels These beds are from 70 to 150 feet thick, are commonly coarser near the base (Pls. XXXVII, secs A, G, H; XLIV), and contain abundant water supplies. Wells to yield large supplies, as for railroad and gin purposes, should be finished in these coarser layers Ordinary drive wells are practicable in any part of the county, and range in depth from 25 to 75 feet. Water from these beds is used at Dermott (25), and at Greenville (1040), and Shaw, Miss (1007), for locomotive purposes.

Water of better quality can be obtained in any part of the county from the older Tertiary beds underlying these surficial sands and gravels The base of the Cockfield water sands will be encountered at depths ranging from 300 to 400 feet below sea level (Pls. XXXVII, sec. A; XLII). The successful wells at Rosedale (1006), Arkansas City (143), and Dermott (24) are finished in this horizon. Flowing water is reported from the Rosedale well, and artesian wells of very weak pressure may be expected over a portion of the northeastern part of the county. In the western and southern portions the water will not flow, but it will come very near the surface.

The Sabine horizon, which is the one developed in the wells at Pine Bluff (410–415), Jonestown (1010), Lyon (1011), Cleveland (1003–1004), O'Reilly (1005) Dockery (1028), Doddsville (1029), Ruleville (1032), and Moorhead (1031), will be encountered in this county at depths ranging from 750 to 900 feet below sea level. It will yield flowing water in the eastern part of the county (Pl. XLI).

DREW COUNTY.

In Drew County the best water supply is obtained from the Cockfield water sands (Pl. XXXVII, secs A, H) In developing these water sands, wells seldom need be sunk over 300 feet below sea level in the western part of the county and 400 in the eastern part; and in many cases they can be finished at less depths Deeper wells are reported at Monticello, but unless the development of the sands at that place is of a very peculiar and local character, there is no reason for the wells going more than 450 feet below sea level (see well 148, p. 244; Pl. XXXVII, sec. H). At Wilmar a higher horizon is encountered, which corresponds, more or less, to the stratum developed in the shallow wells about Warren (14–18), where it yields hard water. At Blissville (145) several sands in the same series are found below the surficial gravel.

No wells have as yet developed the Sabine horizon in this county, and there seems to be little reason why they should This horizon was reached in the Gates Lumber Company test well at Wilmar (151), but because of the large yield of the upper strata it was not developed It is to be expected throughout the county at depths ranging from 700 to 750 feet in the western part to 900 feet on the eastern side

The surficial sands and gravels occurring at the base of the terraces flanking the Monticello Ridge are developed in a number of minor wells. Along the east side of Bayou Bartholomew these gravels yield, as throughout the Mississippi bottom, large supplies of water For waterworks purposes, wells should, however, be finished in the underlying Eocene sands.

GRANT COUNTY

No deep wells have as yet been sunk in this county, but the general conditions can be rather confidently outlined from the geologic structure and the data furnished by wells in the surrounding counties

The sand beds forming the sandy hills in the northwestern part of the county dip regularly under it, and at the southeast corner are about 600 to 700 feet below sea level This is the horizon developed in the Pine Bluff wells (Pl XXXVII, sec G), and at Sheridan it will probably be encountered at about 200 feet below sea level (Pl XLI). Other sands in the Eocene occur above this one. The Cockfield group of water sands, which has been encountered in the wells at Redfield (416; Pl. XXXVII, sec B) and Pine Bluff (412, 415A), and which has been developed at Kedron, Clio, and Fordyce (Pl XXXVII, sec K) may be profitably developed in the eastern part of the county (Pl. XLII) At Sheridan this horizon will be encountered at a depth slightly above sea level, and in the southeast corner of the county will be found at something over 200 feet below sea level

HEMPSTEAD COUNTY

In Hempstead County there are three belts of sandy land in which springs are common and where soft water can ordinarily be obtained at any point in shallow surface wells These three belts are the outcrops of the Bingen, Nacatoch, and Sabine water sands (Pls. III; XXXVII, secs. D, E). Each of these sands dips regularly southward at a rate of 60 to 80 feet per mile, and may be reached at any point south of the outcrops by going to the proper depths (Pls. XXXVIII, XLI)

The Bingen sand outcrops in the northwest corner of the county in the vicinity of Bingen (Pl. XXXVIII), from which place it takes its name, and is the natural source of underground water supply in the calcareous clay lands of the Brownstown and Marlbrook formations (Pl. III) It has been extensively developed in southern Pike and Howard counties, where it generally yields excellent soft alkaline water In Hempstead County it has been developed only about Bell (156-160) and Ozan (342). Failures are reported at Dotson (165), Columbus (162), Washington (356), and Yancey (362) In each of these cases there is no doubt that if the wells were deepened slightly they would yield water. The first three wells have not gone deep enough by from 50 to 150 feet to reach the uppermost Bingen or sub-Clarksville sand (p 76) The Yancey well, however, must have passed this horizon, and so is the only well reported in southern Arkansas which has been sunk deep enough to reach the sub-Clarksville sand, yet has not succeeded in obtaining water from it In this case, however, there are several lower horizons (Pl XXXVII, sec E), but it would not be advisable under any circumstances to sink the well deeper than 1,000 feet At Washington a contract should be made for a well 1,000 feet deep, with the privilege of stopping if water is encountered above this point. Water can confidently be guaranteed at Washington in some one of the Bingen horizons. Where the Bingen sands underlie the Nacatoch the head in the upper beds will probably be greater than in the lower, and the attempt to get flowing water at Hope (321) was therefore a misguided venture. The upper Bingen sand will be encountered here at a depth of about 1,100 feet below sea level (Pl XXXVII, sec. D), but the water will not flow and will probably be more highly mineral than that in the Nacatoch sand already developed.

The Nacatoch sand which forms the sandy belt of country just south of Saratoga, Columbus, and Washington, like its continuation eastward in Nevada and Clark counties, has been extensively developed along the Iron Mountain Railway (p 78) It has a thickness of from 75 to 150 feet, can be confidently expected at any point south of the outcrop, and over wide areas will furnish flowing water (Pl XXXVIII). For variations in the pressure head, see page 78

The Sabine sands supply all the water used in the southern part of the county, and while no deep wells have been sunk in this area the well of the Lewisville Lumber Company (426), just across the line in Lafayette County, indicates the possibilities in the extreme southern and southeastern portions of Hempstead County In no case will it be desirable to go below sea level in attempting to develop these sands (Pls XXXVII, secs D, E; XLI).

Under the Red River flood plain are extensive deposits of gravel at depths of about 80 feet (198), which will yield large supplies of very poor water (Pl XLIV).

In the Cretaceous and Tertiary beds it is not always necessary to case the wells below the surface "caving dirt," but better results can be obtained by so doing.

HOT SPRING COUNTY.

Hot Spring County is roughly divided by Ouachita River and the Iron Mountain Railway into two sections—a hilly, rocky area to the west, which is a portion of the Ouachita Mountains, and a rolling dirt country to the east, which is a part of the Coastal Plain. In only the southeastern part of the county are the underground-water prospects very favorable

In the mountain region large underground supplies can be obtained only by drilling blindly into the rock and continuing the hole until enough "water veins" are encountered to furnish the desired amount This, on the whole, is a very uncertain proceeding, and while water of a satisfactory quality and quantity may be obtained at a depth of a few hundred feet, wells may be drilled to 1,000 feet or more without satisfactory results. In the valley of Ouachita River there are gravel deposits 20 to 50 feet thick which in places will yield good supplies, but generally wells must be continued into bed rock, as near Malvern (362A). On the whole, in the case of the town of Malvern, it will probably be more feasible either to make a reservoir in the mountains or to develop a spring supply from the high sandy hills south and southeast of the town than to obtain water from a series of wells The Sabine sands which outcrop along this line of hills dip southeastward and in the southeastern part of the county will be found at depths not below sea level. In this portion of the county there is no reason for drilling wells deeper than the basal Sabine water sands (Pl XLI).

HOWARD COUNTY

South of the mountains in Howard County the two most important water-bearing formations are the Trinity and the Bingen.

The Trinity is here of minor importance The beds are quite clayey, somewhat calcareous and gypseous, and the best water-bearing beds are probably just above bed rock There is therefore no reason for abandoning wells until bed rock is encountered, but before a well is started care should be taken to roughly estimate the depth required and determine whether or not the cost is prohibitive and whether the well tools are sufficient The depth to bed rock may be roughly estimated by multiplying the slope of the surface of the bed rock, which is about 125 feet per mile, by the distance in a north-south direction between the point at which bed rock outcrops and that at which the well is to be sunk But one deep well has has been drilled in this area—that of D J Sassamen (393) north of Centerpoint (Pl. XXXVII, sec F). This is finished in the lower layer of the Trinity

South of Centerpoint and extending to Mine Creek is the outcrop of the Bingen formation (Pls. IV, XXXVIII) This forms a sandy country in which shallow wells can easily be finished In the Bingen formation there are several water-bearing sands, and near the line between it and the overlying Brownstown formation wells can either develop the upper layers or be drilled for 400 to 500 feet into the basal layers, passing through several different horizons in the operation.

The uppermost layer of this series is the one most commonly developed in the southern part of Howard County, where it supplies many deep and artesian wells (Pl. XXXVIII) These wells are commonly finished with but a few feet of iron or wood casing, which passes through only the upper or "caving dirt" The water is turbid, however, when the wells are not cased to the top of the water-bearing strata, and casing is recommended for all wells (See well 386, p 253.) The head is lowering in this region, indicating that the development has already exceeded the rate of supply, and care must be exercised to prevent needless waste and leakage into the upper or "caving dirt" (p 78).

JEFFERSON COUNTY.

In Jefferson County the Quaternary gravels, which underlie the terrace deposits and the river bottoms, afford the most usual source of underground supply east of Bayou Bartholomew and Arkansas River (Pl XLIV). Driven wells are common, but for large supplies wells should be sunk to the coarser gravels which overlie the older Eocene deposits. These will be encountered at depths ranging from 50 to 125 feet. These surficial gravels supply the water used in the ice factory and stave company's plant at Pine Bluff (409B, 415), and formerly supplied the waterworks (412).

Water of much better quality can, however, be obtained at any point in the county from the underlying Eocene water sands (Pl. XXXVII, secs. B, G). The Cockfield horizon is found from very near sea level in the northwestern part of the county to about 250 feet below sea level in the southeastern part (Pl. XLII). This horizon has been encountered at Redfield (416) and in the deeper wells at Pine Bluff (412, 415A), but it was not developed because the yield did not seem sufficient. It is, however, a very good horizon and in most wells should be carefully tested to see if it will not yield the desired amount. This horizon has been developed in at least one well at Pine Bluff (409A) and supplies the large mills at Clio and Kedron (Pl. XXXVII, sec. K).

The Sabine water horizon is developed in many wells at Pine Bluff, where it is encountered at about 700 feet below sea level. It is available throughout the whole county at depths ranging from 200 feet below sea level in the northwestern part to 800 feet in the extreme southeastern part (Pls. XXXVII, secs. B, G; XLI). Water will rise very near the surface in the bottom lands from both the Cockfield and Sabine horizons, but will probably not flow over any considerable area.

LAFAYETTE COUNTY.

In Lafayette County there are two principal sources of underground-water supply—(1) the Quaternary gravels and sands under the terraces and river bottoms and (2) the sands in the Sabine formation.

The first are available in the flat lands along the St. Louis Southwestern Railway from New Lewisville to near the State line at depths less than 150 feet (Pls. XXXVII, secs. D, H; XLIV). They supply water for many local wells and also for the large mills at Bolinger or Kress City (417; Pl. XXXVII, sec. D).

The Sabine sands have been developed in the following wells: Lewisville Lumber Company (426), Sunny South Lumber Company (423), Red River Lumber Company (420), court-house (424), and Moore (425), near New Lewisville, and at Stamps (427–429) and Frostville (419). Flowing water has been developed along Bayou Bodcau (Pl. XLI), and it is possible that it may be obtained along Red River from near the Cotton Belt Railway bridge southward. The head is, however, very variable (pp. 81–82) and no definite predictions of flowing wells are possible. The best water is usually developed in the upper of the group of water sands, and in no case would it be advisable to go below the depths indicated on Pl. XLI.

LINCOLN COUNTY.

No deep wells have yet been sunk in Lincoln County, though the underground-water prospects are very favorable. The Cockfield sands will be encountered at a depth of about 300 feet below sea level in the whole county. This horizon is developed at the following places: Rosedale (1006), Arkansas City (143), Dermott (24), Monticello (148–150), Warren (151–153), Wilmar (19), Kedron (127), and Clio (125). It is also encountered in the wells at Pine Bluff (Pls. XXXVII, secs. B, G; XLII). The Sabine or main Pine Bluff horizon will be found at depths of about 750 to 800 feet below sea level (Pl. XLI). It is not probable that water from either of these horizons or groups of horizons will flow, but in the bottom lands it will rise to within a few feet of the surface. Near and east of Bayou Bartholomew (Pl. XLIV) abundant supplies can be obtained in the Quaternary gravels at depths not exceeding 150 feet, but the water in the Lagrange sands is generally of better quality.

LITTLE RIVER COUNTY.

Little River County is almost completely buried beneath the surficial deposits of the Lafayette and Port Hudson (Pl. III). These range in thickness from a few to 80 feet (434, 440, 443, 444, 448). The gravel beds in the thicker sections are covered with layers of clay and sand, as in the terrace deposits farther south, and will commonly yield large supplies of water. Beneath these beds water can be obtained from the upper Cretaceous beds in all parts of the county except the northwest corner. In the region north of the outcrop of the Bingen formation (Pl. III) the only horizon of importance is the basal Trinity. Its depth in this portion of the county is from 1,000 to 1,500 feet (p. 76).

Along the Bingen outcrop shallow wells can often be finished in one of the several water-bearing Bingen sands, and will yield soft water. The Bingen group dips regularly beneath the county, and water can be confidently expected in it in the southern and southwestern portions, although no wells have as yet been successfully completed. In southern Sevier County many wells have been completed to different horizons of the Bingen which are from 300 to 900 feet below the Annona chalks (Pl. XXXVII, sec. F). In northeastern Texas the several Bingen horizons are more widely separated. The uppermost, the sub-Clarksville sand, occurs 500 feet below the Annona, and the Woodbine, or lower Bingen, occurs at depths of from 1,000 to 1,500 feet (Pl. XXXVII, sec. H). The extensive development of these horizons in both Howard and Sevier counties (Pl. XXXVIII) and their occurrence in the wells at Clarksville and Paris, Tex., clearly indicate that they will be found in Little River County.

Of the deep wells sunk in the southern and southwestern parts of the county, only the one at Hudson (443) has developed an adequate water supply. This is a very hard water and is derived from a cavernous place in the Annona chalk (Pl. XXXVII, sec. F). The upper Bingen or sub-Clarksville sand is at this place about 300 feet deeper. Wells at Rocky Comfort (445, 448) have all been abandoned without results. Of these only the Walker gin well was at all near the proper depth. This appears to have about reached the upper Bingen, and it is suggested that it be pushed 100 feet deeper. If no results are obtained at that point, it will be necessary to go to the lower Bingen or Woodbine horizons (Pl. XXXVII, secs. H, F). However, the sub-Clarksville sand is expected to yield results. In the case of the DeLong well on Red River (448) it will be necessary to go to a depth of at least 1,000 feet (Pl. XXXVIII).

In the southeast corner of the county the Nacatoch sand is available. Its northern edge was encountered in the Hudson well (443; Pl. XXXVII, sec. F), and it has been developed at several points along Red River (436-440). In quality the water from the Nacatoch sands varies from soft to very salty alkaline. This horizon is encountered in the deep wells at Texarkana, where the water is quite brackish. It may be developed at any point south of a line about 2 miles north of the upper outcrop shown on Pl. XXXVIII and at the depths indicated.

MILLER COUNTY.

The irregular mantle of gravels and sands which covers the older Tertiary and Cretaceous beds in this region is thicker in the valleys, and it is such a local development that furnishes much of the present water supply of Texarkana (479). The demand here has already exceeded the supply. Along the Red River flood plain and the main terraces accompanying it these gravel deposits are thicker and more uniform and yield inexhaustible supplies (Pl. XLIV); here the coarser gravel beds may generally be reached at depths of from 80 to 100 feet (198, 464, 468).

Of the Cretaceous water-bearing sands only the uppermost (Nacatoch) has thus far been developed. It underlies the whole of the county, but its development is restricted by the fact that at a varying distance south of the outcrop the water is so salty that it can not be used The position of the top of this horizon varies from 150 feet above sea level in the extreme northeastern part of the county to from 1,400 to 1,700 feet at the Red River-Alabama Landing fault line (Pls. XXXVII, sec. F; XXXVIII); south of the fault it is horizontal and about 800 feet below sea level This horizon has been developed along Red River as far south as Dooleys Ferry, and furnishes artesian water of good quality (196-202, 463-468; Pl XXXVIII). A well about a mile south of Dooleys Ferry (462) was abandoned just before reaching the requisite depth. South of this point along Red River this horizon probably contains salty water At Garland it would be encountered at about 1,200 feet, and might furnish flowing water with a very low pressure.

West and south of Red River nearly all the wells yield salty water (473-476, 478-480A), and it is important to consider the depths and probable water value of the underlying Cretaceous sand. The uppermost horizon of the Bingen formation, the sub-Clarksville sand (p 76), is extensively developed in southern Sevier and Howard counties, where it furnishes artesian water. The water at Saline Landing (404) is brackish, and this fact suggests that deeper in the embed all the water will be brackish. However, at Clarksville, Tex. (Pl XXXVII, sec. H) this horizon has yielded satisfactory water, and is therefore regarded as of possible importance as a source of supply in this region, where it will be found about 1,500 feet below the Nacatoch. The uppermost Woodbine sand, which in northeastern Texas is 500 feet below the sub-Clarksville, yields very salty water, but the basal Woodbine sands, 500 feet still lower, offer better possibilities, though they are likewise likely to yield mineral water. The basal Woodbine horizon is reported to have yielded fresh water at Clarksville, Tex. (1114; Pl. XXXVII, sec. H). The Paris, Tex , well penetrated all the Woodbine sands without developing a satisfactory horizon, but Hill[a] has suggested that sufficient precautions were not taken to case off the salty water in the upper Woodbine sands and that the quality of the water was therefore not satisfactorily determined.

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[a] Twenty-first Ann Rept U S. Geol Survey, pt 7, 1901, p 630

In southern Miller County the best results are to be expected from the Sabine sands, these outcrop about as shown on Pl. XLI, and may be expected at depths not greater than those indicated. This horizon has been developed in shallow wells at Texarkana (1067–1068), Boggy (456–458), and Fort Lynn (461). The flowing well at Missionary, La (803) and the wells at Frostville (419) and around New Lewisville (423–429) develop members of this group of horizons (Pl. XXXVII, secs. D, H). This is the most promising source of water along the Red River Valley from about 5 miles north of Garland southward. At Garland water-bearing sands of this group should be found at depths not exceeding 300 to 400 feet, from which the water will rise very near the surface, if it does not flow over in a feeble stream.

NEVADA COUNTY.

Besides the sands and gravels of late Tertiary and Quaternary age which cover much of the county and attain thicknesses of from 40 to 80 feet in the main river bottoms, where they yield large supplies of water of poor quality, there are in Nevada County three principal water-bearing formations—the Bingen (p 76), the Nacatoch (p 78), and the Sabine (p. 83).

The Bingen formation outcrops in Pike and Clark counties (Pls III, XXXVIII) and dips regularly southeastward beneath Nevada County. Many wells have been developed in this horizon in southern Pike County, and it will in time be extensively developed in Nevada County, north of the sandy outcrop of the Nacatoch formation (Pl. III), where it will be encountered at the depths indicated on Pl. XXXVIII But one deep well has been attempted in this region, that of J. T. Williamson on Black Creek (537). It was abandoned at a depth of 285 feet; the depth of the Bingen at this point is about 600 feet.

The Nacatoch sand forms a sandy belt of land extending from Garlandsville northeastward across the county (Pls. III, XXXVIII). In the region south of the outcrop this water horizon is everywhere available, and has been very widely and extensively developed. Along all the main stream valleys it will furnish artesian water, though the head varies greatly because of the differences in elevation of the outcrop, losses by leakage, and resistance (p. 78). Throughout the whole region the demand has exceeded the supply and the pressure is everywhere decreasing. The effect of this decrease will be felt first near the outcrop and will gradually affect the region to the south.

The Sabine beds form the sandy lands south of the Arkadelphia clay belt (Pl. III) In this region good springs are numerous and little difficulty is experienced in finishing shallow wells. Deep wells may be completed in this formation in the central and southern parts of the county, the lower limit of profitable development being about 500 feet below sea level in the extreme southeastern part of the county (Pl. XLI). The pressure head in the Sabine sand in this region will vary almost directly with the local elevation (pp. 81–82).

OUACHITA COUNTY.

In Ouachita County the surficial gravels, where developed along the St. Louis Southwestern Railway, have not yielded very satisfactory results. Supplies have been developed at Little Bay (21), across the line in Calhoun County, and at Bearden

(628A), Eagle Mills (634), and Millville (635), but in all cases the supply is likely to fail in dry weather In the main flood plain of the Ouachita, especially on the eastern side, the supply from this source will generally be quite abundant and in the terrace lands will usually be sufficient for ordinary purposes. Deep wells can be developed throughout the county in the underlying Eocene beds. The Cockfield horizon (Pl. XXXVII, sec K) is available in shallow wells just west of Ouachita River and in deep wells east of it. This horizon has been encountered in the Millville (635) and Bearden (628) wells at depths of 153 to 170 and 300 to 310 feet, respectively. In neither was it developed, in the first case the failure was due to lack of a proper screen, and in the second to a desire to develop a thicker horizon, which the driller's experience at Pine Bluff had taught him might be expected. With proper screens and exhaustive pumping (p. 107) this horizon can be expected to yield good results. Indeed, it is regarded as the most promising east of Ouachita River.

The Sabine horizon, which has been developed in the Bearden well (628), Pl. XXXVII, sec. K), where it furnishes a highly alkaline water, containing much fine sand, occurs at depths ranging from sea level in the northwestern part of the county to 700 feet below sea level in the extreme southeastern part (Pl. XLI). This is not to be regarded as a very promising horizon, but it is worth drilling for if the other supplies can not be obtained. At Waldo (141), Bearden (628), and Crossett (6), the three nearest wells developing this horizon, the results have been unsatisfactory

In no case is it advisable to go much below the depth indicated on Pl. XLI.

PIKE COUNTY.

The Coastal Plain strata underlie only the extreme southeastern part of Pike County The remainder is a very rocky, hilly region, in which the hard Paleozoic rocks are very near the surface, and the obtaining of a large water supply in bed rock is merely a matter of chance. Wells may develop a good supply within a few hundred feet of the surface or may go 1,000 feet or more without results

In the region of the Trinity outcrop (Pl III) the water is wholly from shallow wells, which obtain their supply from the surficial gravel overlying the Cretaceous clays. The Trinity formation is here a calcareous clay of practically no water-bearing value (687, 693, 694, Pl XXXVII, sec E).

Only along and south of the Bingen outcrop, in the extreme southeastern part of the county, are deep wells practicable. The sand beds in the Bingen formation dip regularly southward and have been encountered at many points (Pl. XXXVIII). Flowing water is obtained along Little Missouri Valley and some of the streams tributary to it. The water is soft and alkaline in freely flowing wells, but in other wells, which are cased only through the upper "caving dirt," it stands in contact with the overlying calcareous clays and becomes quite hard. The wells in southern Pike County, with the exception of the Key well at Delight (688), develop the uppermost Bingen horizon It is quite likely that other sands will be encountered at intervals for 100 or 200 feet below this horizon (Pl. XXXVII, sec. E).

Besides the mantle of gravel found all over this region, there are thick deposits in the river valleys which contain abundant supplies of very poor water. In the southeastern part of the county these gravel beds often prove very troublesome to the driller, and care must always be taken to fasten the casing firmly into the clay to prevent the leakage of the Bingen water.

PULASKI COUNTY.

In the mountainous parts of Pulaski County, or roughly the region northwest of the main line of the Iron Mountain Railway, the only underground water supply of known importance is that contained in the gravels which underlie the main flood plain and terraces of Arkansas River. These beds have been developed at Baring Cross (707) and East Little Rock (708), and are apparently the most important underground supply in the immediate vicinity of Little Rock They follow Arkansas River into the Coastal Plain region, southeast of the main line of the Iron Mountain Railway, and are available along the river near the southeastern part of the county (Pl. XLIV) at depths not exceeding 150 feet

The sandy beds of the Eocene outcrop in the triangular area south of Little Rock, between the main line and the Alexandria branch of the Iron Mountain Railway (Pl. III). These beds dip southeast, and in the extreme southeastern part of the county, in the lowlands along Arkansas River, the conditions are very favorable for flowing water, which has already been reported in a well at Sweet Home (709). The depth to the lower Eocene sands varies from sea level near Wrightsville to 500 feet below sea level in the extreme southeastern part of the county (Pl XLI), and other horizons are to be expected above this one (Pl. XXXVII, sec. B; XLII).

SALINE COUNTY.

Saline County is roughly divided by the Iron Mountain Railway into a hilly, rocky portion, which is a part of the Ouachita Mountains, and a rolling dirt country, which is a part of the Coastal Plain (Pl. III).

In the Ouachita Mountains portion the deep-water conditions are very irregular, and no definite predictions can be made The water supply is almost wholly from surface wells, and the chances of obtaining water in deep wells are very uncertain East of the railroad are the sandy hills of the basal Sabine formation. These dip southeastward (Pls XLI, XLII), and the conditions are favorable for deep wells in the eastern part of the county. The chances for flowing water along and east of the Iron Mountain Railway are very good In no case will it be advisable to go deeper than shown on Pl XLI, or about 250 feet below sea level in the extreme southeastern part of the county (Pl. XXXVII, sec. B)

Along Arkansas River there are thick gravel beds which will be reached at depths not exceeding 150 feet. These will yield large supplies.

SEVIER COUNTY.

In the portion of Sevier County south of the rocky, mountain lands there are three principal water-bearing formations—the Trinity, the Bingen, and the surficial deposits.

The Trinity formation, which occurs along the edge of the Paleozoic rocks (Pl. III), is here predominantly clayey and of much less importance than in northeastern Texas. On the whole, the best water and the most prolific yield in this formation is to be expected near its base, and a deep well should not be undertaken in the area north of the Bingen outcrop and south of the Paleozoic rocks without planning to push it to bed rock. The depth at which bed rock will be encountered will be roughly found by multiplying the distance in miles between the Paleozoic-Trinity border and the point where the well is to be sunk by the average rate of slope, 100 to 125 feet per mile. A well at Lockesburg would have to be sunk about 800 or 900 feet, and one at Morris Ferry about 1,200 feet to reach the base of the Trinity and fully determine the water possibilities of that formation at that point. Only one deep well has been tried in this area, that of D J Sassamen, near Centerpoint (Pl XXXVII, sec. F), which is 500 feet deep and obtains a hard chalybeate water (393). A second well, 200 feet deep, sunk 4 miles south of Lockesburg (742), was abandoned without results. It was too far north to draw on any of the horizons of the Bingen sand (Pl XXXVII, sec F), and would have had to be drilled to a depth of about 1,100 or 1,200 feet to reach the base of the Trinity, the horizon reached in the Sassamen well

The Bingen formation contains the most important water horizons in this county, but it is available only in the southeastern portion (Pls. III, XXXVII, sec. F, XXXVIII), where about Ben Lomond it supplies many artesian wells. In this formation, which is here from 400 to 500 feet thick, there are several water-bearing strata, and wells have been finished in nearly all of them, though most commonly in the topmost. The water is soft and somewhat alkaline, though 100 to 200 feet above the uppermost Bingen sand, and probably in the Brownstown formation there is a thin stratum which yields a hard, bitter water (735–740). A better water can always be obtained by deepening the wells. Salty water is reported in wells south of White Cliffs (450). Perhaps better results could be obtained by casing off this horizon and deepening the well

The surficial sands and gravels are well developed both in the uplands, where they are often confused with the outcrops of the Bingen formation, and in the valleys They supply many local wells, and beneath the large valleys contain inexhaustible supplies of very poor water (Pl. XLIV).

UNION COUNTY.

The most important water horizons in Union County are those of the Cockfield (Pl XXXVII, secs. C, H.), which have been developed at Fomby, Columbia County (135), Eldorado (746A, 746B), Upland (753, 754), and Blanchard Springs (745A) The base of this group of water sands ranges from sea level slightly west of the Arkansas Southern Railroad to about 300 feet below sea level in the eastern part of the county (Pl. XLII). The water near Ouachita River may be impotable, as indicated by the well at Crossett (6), which obtained sulphur water from this horizon at a depth of 450 feet (Pl XXXVII, secs B, H) The shallow artesian wells at Fomby and Blanchard Springs are essentially local occurrences depending on conditions similar to those explained on page 82 Similar occurrences are possible, however, in any of the valley bottoms in this region.

The Sabine horizon will be encountered at depths ranging from 600 feet below sea level in the northwestern part of the county to 800 feet in the southeastern part The wells at Bearden (628) and Crossett (6), however, which have obtained unsatisfactory results from this horizon, suggest that an attempt should not be made to develop it until the upper horizons have been thoroughly tried This horizon will furnish artesian water along Ouachita River, where it will probably be mineral in character (Pl. XLI).

NORTHERN LOUISIANA.

AVOYELLES PARISH.

Avoyelles Parish is almost wholly dependent for its underground-water supply on the sands and gravels of the Port Hudson and redeposited Lafayette These deposits underlie the whole parish (Pls XXXVII, sec B, XLIV), and while in the bottom lands shallow driven wells are nearly always successful, the best water can be obtained in the coarser gravels between 65 and 200 feet (756–767). This supply is practically inexhaustible; and while the water is hard, a chemical and bacteriological examination by Professor Metz, of New Orleans, of the water from this horizon at Lecompte (948), where city waterworks are contemplated, has resulted in a very favorable report

The water-bearing sands developed in the Alexandria wells are, on account of the dip, very deep under most of this parish (Pl. XXXVII, sec B), and it wil generally be inexpedient to try to develop them. The deep wells of the Natchez and Marksville Oil Company found no important horizon below the upper gravels which supply the municipal well at Marksville (767).

BIENVILLE PARISH.

Throughout all of Bienville Parish, with the exception of limited areas immediately surrounding the Cretaceous domes at Kings and Rayburns Salt Works (Pls. III; XXXVII, secs E, I), deep-well water can be obtained in the Sabine sands. The lower limit of profitable development ranges from 150 feet below sea level in the northeastern part of the parish to about 300 feet in the southeastern part (Pl. XLI). Water sands will generally be found above this extreme depth, but in case they are locally absent at any point it will not be advisable to go deeper The clays of the Midway and Arkadelphia formations, which underlie the Sabine, contain no water, and that of the next horizon, which is 600 or 700 feet below the Sabine, is very salty and is the source of the brine of the old salt works (Pl XXXVII, sec. E). This brine, in many cases, leaks into the Eocene sand beds and renders the water impotable The prospects south of the domes are, therefore, not so good as those north (p 83)

The pressure head will vary somewhat with the local topography (p. 82, Pl. XL), and flowing wells are to be expected only locally and in deep valleys near high hill masses.

BOSSIER PARISH.

The best water in Bossier Parish is obtained from the Sabine sands at depths not exceeding 100 to 150 feet below sea level (Pls XXXVII, secs D, F, I, XLI). The many wells in northern Bossier Parish have thoroughly demonstrated the possibilities there, and the well at Robson (805), in Caddo Parish, shows that good results can be expected at least that far down the river. Water-bearing sands will be found in the Sabine in the extreme south end of the parish at the depths indicated by the wells at Curtis (789), Robson (805), and Frierson (871), but the quality can be determined only by drilling.

The water head in this region varies almost directly with the local topography (p 82, Pl. XL). Flowing wells are therefore not to be expected, except locally, and if obtained will probably have a short life (778, 779, 784).

Under the Red River flood plain and the terraces accompanying it are considerable gravel deposits which yield abundant supplies of water of poor quality This is the source of most of the water used in the bottom lands In sinking deep wells the common practice in this region is to penetrate these gravels with a 3-inch casing, which is firmly seated in the underlying blue clay, a hole an inch or two in diameter is then drilled, which is cased but a few feet (fig 38) In general it is felt that it would be better to case the wells the entire depth, using a still larger casing to penetrate the upper gravels, and to place screens opposite each of the water-bearing sands The greatest care must be taken to cut out the water in the surficial gravels, or it will seriously impair the quality of the water obtained in the Sabine sands (797).

CADDO PARISH.

The principal water-bearing horizons in Caddo Parish are (1) the Quaternary, or Port Hudson, gravels and sands, and (2) the sands in the Sabine formation (Pl. XXXVII, secs D, E, I)

The Quaternary, or Port Hudson, gravels and sands underlie the Red River flood plain at depths of 75 to 130 feet (782–785, 788, 796, 799, 800, 804, 805) They supply the shallow wells in this region, and will yield very large amounts when the wells are properly finished in the gravels near the base The water is, however, hard, chalybeate, and alkaline, and a better quality can usually be obtained in the underlying sands

The Sabine formation underlies all of Caddo Parish, except possibly a limited region near Sodo Lake, to a depth of 100 to 150 feet below sea level. In it there are several sand beds, some occurring in fairly well-defined horizons These beds vary somewhat in thickness from place to place, but in general may be said to be available at any point in the parish Failures are reported at Furrh (802), Uni (835, 836), and Dixie (801), but all of these represent essentially local variations. That the Furrh well represents only a local absence of the Sabine water sands is shown by the successful wells at Shreveport, Blanchard, and Marshall (Pl XXXVII, sec I) At Uni a sand bed was encountered in the proper stratigraphic position (Pl. XXXVII, sec F), but yielded no water, though successful wells have been finished all about it. The well 3 miles south of Dixie, at the mouth of Cottonwood

Bayou (801), has apparently struck one of the peculiar Cretaceous domes which occur irregularly throughout Louisiana, and which yield impotable salt water. To judge from other cases, the area affected by this disturbance is not great (pp 29, 67.) The conditions everywhere in Caddo Parish warrant sinking wells to depths of 100 to 150 feet below sea level, if water is not encountered above that point, but it is useless to continue them deeper Below this point are the Midway and Arkadelphia clays, which contain no water, and below them is the Nacatoch sand, which contains artesian salt water (806, 871) Several deeper wells have been drilled throughout the parish, and it is popularly, though incorrectly, supposed that good water has been obtained at greater depths. At Shreveport there are several water-bearing horizons (fig 30), the best one being about 50 feet below sea level The water head varies almost directly with the local topography, and flowing wells are essentially of local occurrence (see p. 82) Nearly all the wells in this region are cased only part of the way to the bottom. It is believed to be desirable to case them the entire distance and to place proper screens opposite each horizon

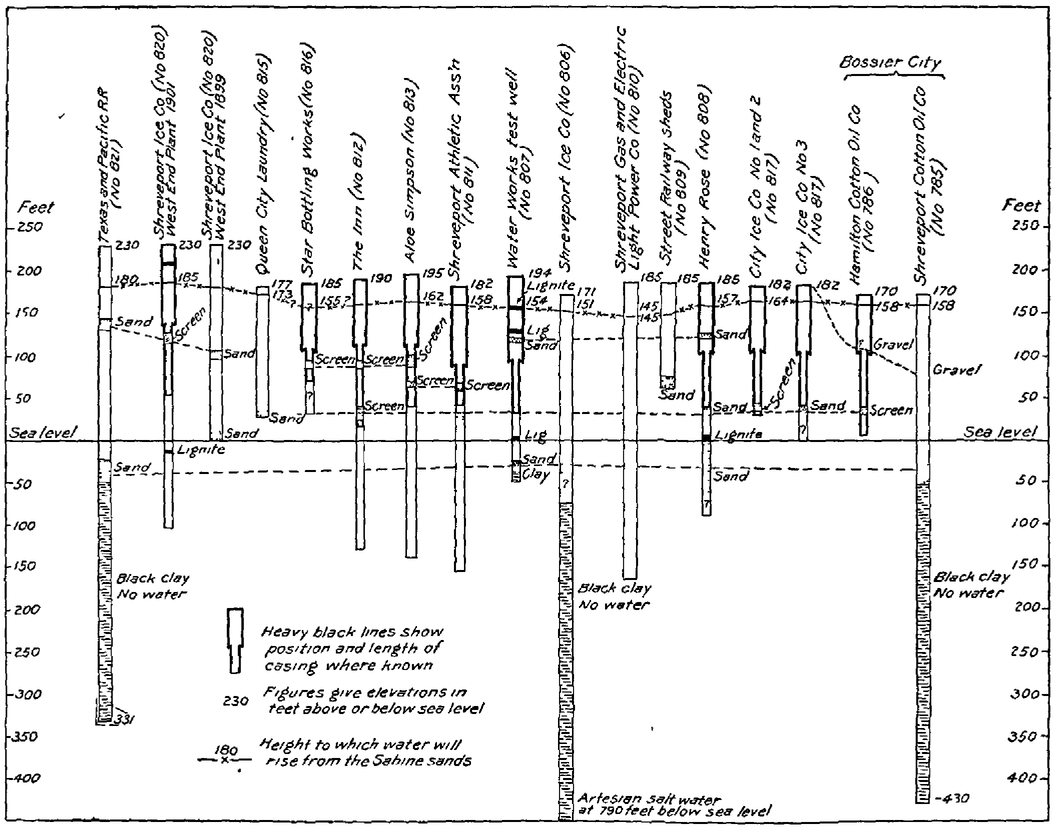

FIG 30 —Wells in the vicinity of Shreveport, Caddo Parish, La

On the question of the water possibilities below the Nacatoch sand see page 139; on springs see page 87.

CALDWELL PARISH

In Caldwell Parish large water supplies can commonly be obtained in the Quaternary sands and gravels which underlie the flood plain of Ouachita and Boeuf rivers at depths of from 25 to 100 feet (Pls. XXXVII, sec. B, XLIV) In the hill lands shallow wells can be finished at almost any point, though in the southern and southeastern parts of the parish, in the region of the calcareous Jackson clays, the water is very hard and the yield not always good

Of the deep waters the best results are to be obtained in the Sabine water sands The top of this group will be encountered at depths ranging from 200 feet below sea level in the northwestern part to 900 feet in the southeastern part. This is the horizon developed in the Columbia well (841), at a depth of 358 to 438 feet below sea level, and in the many wells about Monroe (Pl. XXXVII, sec B) Over all the eastern part of the parish it will furnish flowing water. This is the most promising horizon along the Iron Mountain Railway south of Columbia; it will be encountered at depths ranging from 400 feet below sea level at Columbia to 800 feet at the Caldwell-Catahoula parish line. In no case would it be advisable to go much deeper than indicated on Pl. XLI.

At a distance of 400 to 500 feet above the Sabine water sand is the basal Cockfield horizon (p 84; Pl XXXVII, sec B) This may be reached by surface wells in the northern part of the parish, and by deep wells in the southeastern part It has been found in wells at Clark Spur (838–840), Olla (856–857), Rochelle (881), and Leland (855). In all the deeper wells it furnishes impotable water, and it is not regarded as a horizon of much economic importance Wells, except those north of the outcrop of the Jackson formation (Pl. III), must be continued to the Sabine sands

CATAHOULA PARISH.

The chief underground-water supplies of Catahoula Parish are contained in (1) the Quaternary, or Port Hudson, deposits, (2) the Catahoula, (3) the Cockfield, and (4) the Sabine formations (Pl XXXVII, sec B)

The Port Hudson deposits are best developed in the lowlands along Little and Ouachita rivers and south of Catahoula Lake and Brushley Bayou (Pls. III; XXXVII, sec B) These beds contain large supplies and are the ones most commonly developed. Shallow driven wells yield sufficient water for ordinary purposes, and when large supplies are needed they can be obtained in the main gravel beds at depths ranging from 50 to 150 feet

The Catahoula beds form the high sandy hills northwest of Catahoula Lake and Brushley Bayou (Pl. III) Here shallow wells generally yield good soft water. These sandy beds dip regularly southeastward, and are found under the parish south of the outcrop at depths less than those shown on Pl. XLIII This is the natural source for water at Harrisonburg, and in the region along and north of Little River and Catahoula Lake, where in the lowlands flowing water will probably be obtained. There is some probability, as indicated by the Ferriday well (866), that in the extreme southern part of the parish salt water will be encountered. In the central portion, however, no trouble is anticipated In the neighboring parishes the Catahoula beds supply the water at Pollock, Alexandria, Boyce, and Zimmerman (p 86). If a well does not obtain water in the Catahoula formation, it is believed to be inadvisable to sink deeper.

The next group of water sands occurs about 1,000 feet below the Catahoula (Pl XXXVII, sec B) in the Cockfield formation These have been encountered in wells at Leland, (855), Colfax (871), Olla (856-857), and Rochelle (881), and in all these cases have yielded unsatisfactory water

Below the basal Cockfield occur the Sabine sands, and in the northwestern part of the parish, beyond Bayou Funne Louis, where the Catahoula sands are not available (Pls. III, XLIII), this is regarded as the most promising horizon. Successful wells have been finished in these beds at Columbia and along the Arkansas Southern Railroad from Winnfield northward (Pl XXXVII, secs B, C) Its upper limit should be encountered at depths ranging from 800 feet at Olla to 1,000 feet at Georgetown or Rochelle. In no case will it be advisable to go deeper than 1,500 feet (Pl XLI) One unfavorable feature of the outlook here is the salt springs on Bayou Castor. If they represent brine leaking from one of the Cretaceous domes, it is possible that even the lowest horizon will be impregnated with salty water In view of this, wells are more likely to succeed near the Catahoula-Caldwell parish line than farther south

CLAIBORNE PARISH

The conditions for deep water supplies in Claiborne Parish are very favorable. The Sabine water sands are everywhere available at depths not exceeding 200 feet below sea level (Pl XLI). Should the water sands in any case be locally absent, it is not advisable to continue wells deeper; the underlying Midway and Arkadelphia clays contain no water, and the Nacatoch sand, which lies 700 feet below the basal Sabine, furnishes salty water (Pl XXXVII, secs. C, E, I). The head of the water from the Sabine sands will vary almost directly with the local topography (p 82, Pl XL), but flowing wells are likely to be developed in the bottom lands along Bayou D'Arbonne and Middle Fork.

CONCORDIA PARISH.

Concordia Parish lies wholly within the flood plain of the Mississippi, and the usual supply is from the surficial gravel beds encountered at depths less than 150 feet These yield very large supplies of somewhat chalybeate water suitable for boiler purposes

The deep-well prospects are not very favorable, of the several early Tertiary formations, the Catahoula would be expected to yield the best water. In a number of wells at Natchez and Vidalia, horizons have been developed in the upper part of this formation at depths of 300 to 500 feet These horizons will be encountered to the south at depths which will increase about 50 feet per mile.

A deep test well put down by the Texas and Pacific Railway at Ferriday (866) obtained flowing salt water from the basal Catahoula beds at about the same horizon developed in the deepest wells at Alexandria (Pl. XXXVII, secs. A, B), Below the Catahoula the water sands in the Cockfield and Sabine probably contain highly mineral water at this point, and it is hardly worth while to drill to them.

DE SOTO PARISH.

Although but one deep well has been sunk in De Soto Parish (871), the wells in the surrounding parishes and the general geologic structure indicate very favorable conditions. Satisfactory water sands may be expected throughout the parish at depths ranging from less than 100 feet below sea level in the northwestern part to 200 feet in the southeastern part (Pls XXXVII, sec. F; XLI). The height to which the water will rise depends somewhat on the local topography, but throughout the parish will commonly be over 175 feet above sea level (Pl XL). At Mansfield it is quite likely that the height will be over 200 feet. Flowing wells may be expected locally in deep valleys flanked by high hills (p 82), the most promising region for such wells is the east-central portion of the parish, along the western edge of the Red River flood plain and in the very deep valleys tributary to it. The water will usually be soft and alkaline and the yield abundant. The town of Mansfield should have no difficulty in developing a water supply from deep wells.

In case satisfactory water is not developed at any point at a depth less than those given above, it will not be advisable to continue the well deeper. Below the basal Sabine sands are the clays of the Midway and Arkadelphia formations, and below these the Nacatoch sand, which yields artesian salt water at Shreveport (806) and Ferriday (871). For the prospects below the Nacatoch see page 139

EAST CARROLL PARISH.

The Port Hudson silts, sands, and gravels underlie all of East Carroll Parish to depths of from 100 to 150 feet and will yield very large supplies of rather chalybeate water Wells to yield the greatest amount should be finished in the gravel beds which lie near the base of these surficial deposits (Pl. XXXVII, sec A)

The Eocene water-bearing sands can be reached at any point by drilling to the requisite depth (Pls. XXXVII, sec A, XLI, XLII) The quality of the water is, however, very uncertain. On the one hand, there is a highly mineral water developed in the wells at Crossett (6), Delhi (962), and Vicksburg (1,037), which comes from the Sabine sands (Pl XXXVII, secs A, B, I) On the other hand, there is good water in the wells at Satartia (1,045), Yazoo City (1,046–1,049), Greenville (1,039), and Blissville (145) The deep well at Lake Providence developed the same horizon found in the Empire well (26) Better water might be obtained in the Cockfield horizon at an additional depth of 200 or 300 feet (Pl XXXVII, sec. A). Flowing water would doubtless be obtained at this point from the Sabine sands at a depth of about 100 feet below sea level The water from this horizon at Yazoo City is good, at Crossett bad. and the quality at Lake Providence can be determined only by boring.

FRANKLIN PARISH.

The most important water-bearing formation in Franklin Parish is the Port Hudson. This underlies the whole parish, and the coarser beds, which can commonly be developed at depths ranging from 75 to 150 feet, will furnish very large supplies of fairly good boiler water

Of the Eocene horizons, the only one of probable importance is the Sabine. The uppermost Sabine horizon, or that encountered in the Monroe (921–925), Columbia (841), and Delhi (962) wells, will be found in this parish at depths ranging from 500 feet below sea level in the western part to 1,000 feet in the southeastern part It will probably furnish mineral water of a character varying from potable water at Monroe and Columbia to the impotable water at Delhi This horizon at Winnsboro will be found at 700 to 800 feet below sea level and will perhaps furnish feebly flowing water In no case will it be advisable to go deeper than indicated on Pl. XLI, unless a test well several thousand feet deep is contemplated.

GRANT PARISH

The principal water-bearing beds underlying Grant Parish are (1) the surficial gravels, (2) the Catahoula sands and sandstones, (3) the Cockfield sands, and (4) the Sabine sands.

The Port Hudson gravels are of importance only in the Red River flood plain, where they will furnish large supplies at depths of from 70 to 130 feet. Less important sands are encountered above these basal gravels, in which driven wells can often be finished, but for large yields the wells should be completed in the lower gravels Over much of the hill land there are irregular deposits of gravel, which supply local wells with very pure water. A very important development of this sort is found near Sand Spur, where a number of wells have been completed for the St Louis, Iron Mountain and Southern Railway (882)

The Catahoula beds form the high sandy hills in the southeastern part of the parish and wherever developed yield excellent water Several different horizons occur in this group, as shown by the wells at Zimmerman, Boyce, and Alexandria, and in no case will it be advisable to go deeper than shown on Pl. XLIII. Flowing water will be encountered along Red River Valley in the southwestern part of the parish, 10 miles south of Colfax, and along Little River

The Cockfield member, which outcrops in southern Winn Parish (Pls. III; XXXVII, sec D), contains several horizons which are of doubtful value in this parish The most important occurs near the base, or about 1,000 feet below the Catahoula This has been developed at Colfax (877) and at Rochelle (881), and in each case has furnished artesian salty water At Rochelle better results may be obtained in the underlying Sabine sands, which will be encountered at depths over a thousand feet below sea level, but the presence of a Cretaceous dome at Cedar Lick and the suggested presence of one at Castor Salt Springs indicate that the probabilities are against such a development, though potable water has been obtained in this Sabine horizon at Winnfield (998)

The Sabine sands yield very salty water at Luella (906) and Natchitoches (909, 911), in Natchitoches Parish, and as these are believed to be due in large part to salt water from the Cretaceous domes no better results can be hoped for in western and southern Grant. On the whole, in Grant Parish surface wells are the only source of underground supply, except in the region of the Catahoula formation.

The chances of getting water at Colfax by going deeper are not very promising, except at very great depths The first Cretaceous sand, the Nacatoch, if it is present in this region, occurs about 2,000 feet below the basal Cockfield, or, roughly, 3,000 feet from the surface. This yields artesian salt water at Shreveport (806) and Frierson (871) and will doubtless yield salt water here. In northeastern

Texas, about 1,000 feet below this, is the sub-Clarksville sand, which will probably also yield salty water (Pl XXXVII, sec. H) One thousand feet deeper are the basal Woodbine horizons, which yield somewhat mineral water The most promising horizons are the Paluxy and Trinity, which, at Corsicana, Tex , according to Hill,[a] are, roughly, 500 and 2,400 feet below the Woodbine According to this estimate, which is necessarily a very rough one, the Paluxy sand is 5,500 feet below the surface at Colfax and the base of the Trinity 7,500 feet The cost of so deep a well would be almost prohibitive, yet it is hardly worth while starting to drill at Colfax unless some such depth is planned for

JACKSON PARISH

The deep-well prospects throughout Jackson Parish are very promising No circumstances are known which would introduce unfavorable conditions. Wherever wells have been drilled they have yielded satisfactory results, both in this parish, as at Ansley, Hodge, Jonesboro, and Wyatt (Pl. XXXVII, sec C), and in adjoining parishes, as at Ruston (890–891), Monroe (921–925), Columbia (841), Winnfield (998), Tannehill (997), and Pyburn (996) (See Pls. XXXVII, secs B, C, I, XLI)

The depth of profitable development ranges from nearly 200 feet below sea level in the western part of the parish to 500 feet in the extreme southeastern part. At Vernon a good water-bearing stratum will probably be developed at a depth of 100 feet below sea level

LINCOLN PARISH

Abundant supplies of water may be expected throughout Lincoln Parish at depths ranging from not over 200 feet below sea level in the western part of the parish to 400 feet in the eastern part (Pl. XLI). Several water-bearing horizons will be encountered above this extreme depth. Where all the sands are locally absent, it will not be advisable to go much deeper than indicated The principal horizon developed in the Dubach and Ruston wells, and in the adjoining parishes in the Ansley, Arcadia, and Monroe wells (Pl XXXVII, secs. C, I), occurs at depths ranging from 100 feet below sea level in the western part of the parish to 200 feet in the eastern part The Sabine sands will furnish flowing water along Bayou D'Arbonne and Middle Fork (Pl XLI).

MADISON PARISH.

Madison is one of the alluvial parishes, in which the most available water supply is in the Port Hudson gravels These extend to depths of over 100 feet (Pl XXXVII, sec I; wells 892–894) and will everywhere furnish large supplies of water suitable for boiler use. The deep-well prospects are very unfavorable. Artesian water can be obtained throughout the parish from the upper Sabine sands at depths ranging from 800 to 1,000 feet below sea level, but this, as indicated by the wells at Delhi (962) and Vicksburg (1037), is too highly mineral to be of use. There is little chance that the deeper water horizons will yield better results. Accord-

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[a] Twenty-first Ann Rept U S. Geol Survey, pt 7, 1901, pls 69–71

ing to the best information obtainable the well at Delta (893) should have obtained artesian salt water at 1,000 feet below sea level. The depth reported for this well is believed to be rather excessive.

MOREHOUSE PARISH.

At no place in Morehouse Parish do the Eocene beds outcrop The Port Hudson deposits, with a thin covering of alluvium in some places, form the whole surface of the parish and underlie it to depths of from 50 to 200 feet. These beds are coarser in their lower portions and will furnish very large supplies of slightly hard, chalybeate water, which is fairly good for boiler use (896–899).

No wells have yet been sunk in this parish below these surficial beds, but water may be developed in the underlying Eocene sands in all parts of the parish. South of the Alabama Landing fault line (p. 68) water can be developed in the same horizon that is found at Monroe and Delhi (Pl. XXXVII, secs. B, I) at depths ranging from 200 to 400 feet below sea level in the western part of the parish to 700 to 900 feet in the southeastern part. The quality of the water will be between that at Monroe (921–924) and Delhi (962) and will flow over most of the bottom lands. North of the Alabama Landing fault line the basal Cockfield horizon will be encountered at depths between 300 to 400 feet below sea level. This horizon furnishes sulphur water at Crossett (6) and good water at Blissville (145), Dermott (24), and Greenville (1039). Its quality in northern Morehouse Parish could be determined only by drilling, but it will probably be mineral A lower horizon can be reached in this portion of the parish at depths between 800 and 1,000 feet. This is the stratum which furnishes salty water at Crossett (Pl. XXXVII, sec. B), and there is no reason to hope for better results here.

NATCHITOCHES PARISH

Natchitoches Parish presents in surface outcrops a very singular combination of five of the six most important water-bearing formations of northern Louisiana and southern Arkansas; nevertheless it is a region in which good water can be obtained only with difficulty.

The Port Hudson gravels are well developed under the Red River flood plain, where they extend to depths of about 150 feet When the underlying beds are not calcareous, as in the portion of the valley about St. Maurice, the water is a fairly good chalybeate water, but to the south, where the underlying clays belong to the calcareous Claiborne and Jackson groups, the water is very hard and cisterns are commonly used

The Catahoula formation outcrops in the southern part of the parish (Pls. III, XLIII) and near the Vernon Parish line will be available in deep wells This group of sands has been developed in the adjoining parish of Rapides at Zimmerman, Boyce, and Alexandria (Pl. XXXVII, sec E). As yet no deep wells have been sunk in this formation in Natchitoches Parish.

The Cockfield member outcrops in a narrow belt in T. 7 N., Rs. 8 and 9 W. (Pl. III). It furnishes good water where developed at Weaver Spur (917) near the outcrop, and it is the most promising horizon at Montrose, where it will be encountered at a depth of about 600 feet (Pl. XXXVII, sec. E) This horizon dips southeastward and is encountered at a depth of 1,100 feet at Colfax, where it furnishes artesian salt water (Pl XLII)

The underlying Sabine sands (Pl. XXXVII, sec. E) are of value only in the extreme west-central portion of the parish, beyond the area of contamination from the salt water that leaks from the Cretaceous domes at Drakes, Prices, Rayburns, and Kings (Pls III, XXXVII, sec. E; XLI) Near Natchitoches there is a layer in the very uppermost part of the Sabine, just below the Claiborne, which is of local importance It outcrops in the hills just south of Grande Ecore on Red River, and supplies the numerous springs north of Natchitoches, as Camp Salubrity Spring, Breazeale Spring, Iron Spring, and Fourth of July Spring. It is the horizon developed in the shallow wells at the waterworks (910), and encountered between 98 and 108 feet in the normal school well (911) The lower horizons, which are not interrupted by Red River (Pl. XXXVII, sec. E), yield very salty water, which will flow in Red River Valley. These have been developed at Luella (906) and Natchitoches (909, 911), and in the adjoining Red River Parish at Lake End (960). Only in the extreme west-central portion of the parish about Marthaville and Robeline are the conditions in the Sabine sands regarded as favorable Here, on account of the high land in northern Sabine and De Soto parishes, the direction of deep underflow is toward Red River Valley, and the head is so much higher that it prevents the inflow of the salt water from the north Artesian water of good quality is reported at Boleyn (901) at a depth of 412 feet, and similar developments are to be expected in the same region

At Drakes Salt Works, in the northern part of the parish, and at the salt works in the adjacent parishes of Winn and Bienville, the uppermost water horizon of the Cretaceous series, the Nacatoch sand is exposed and furnishes salt water (Pl XXXVII, sec E). The brine escaping from these domes is, in part, responsible for the salinity of the water in the Sabine sands, and the prospects in northern Natchitoches for good wells in these sands are not very favorable, water-bearing beds will, however, be encountered at about the depths shown on Pl. XXXVII, sec. E

The poor quality of the deep-well water in the greater part of this parish makes it desirable to ascertain what can be found in the underlying Cretaceous deposits. At Natchitoches, according to the best data at hand, the Nacatoch sand is 1,500 to 2,000 feet from the surface This yields artesian salty water at Shreveport (806) and Frierson (871) In northeastern Texas about 1,000 feet below the Nacatoch is the sub-Clarksville sand, which will probably yield salty water One thousand feet deeper are the basal Woodbine horizons (p 24), which will yield somewhat mineral water. The most promising horizons are the Paluxy and Trinity, which, at Corsicana, Tex , according to Hill,[a] are, roughly, 500 and 2,400 feet below the Woodbine. According to this estimate, which is necessarily a very rough one, the base of the Trinity at Natchitoches is about 6,000 feet from the surface, and the Paluxy 4,000 feet. The cost of so deep a well would be very great, yet it is hardly worth while starting to drill at Natchitoches unless some such depth is planned for.

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[a] Twenty-first Ann. Rept U S Geol Survey, pt 7, 1901, pls 69-71

Such a deep test well might be undertaken by the cooperation of the State, the parish, the town, and the railroads of that section, for all would be benefited by the results obtained

OUACHITA PARISH

Ouachita Parish is half hill land and half alluvial land. In the hills shallow wells yielding sufficient water for domestic and small plantation uses can be finished at almost any point. In the bottom lands inexhaustible supplies of slightly hard chalybeate water are to be obtained from the surficial Port Hudson gravels, which underlie this section of the parish, at depths of 100 to 150 feet

The Sabine sands underlie the whole parish and will be encountered at depths of from 200 to 400 feet below sea level (Pls XXXVII, sec. B, I, XLI) In all the alluvial land and in some of the larger valleys of the hill land this water will flow. It has been extensively developed about Monroe (921, 924), where it furnishes a soft alkaline water which is extensively used by the industries at that place and by the large plantations The water will probably be less mineral in the western portion of the parish than in the eastern

RAPIDES PARISH

The principal sources of underground-water supply in Rapides Parish are (1) the Port Hudson gravels, (2) the very late Tertiary gravels, and (3) the Catahoula formation

The Port Hudson gravels are well developed under the Red River flood plain and some of the terraces along it (Pl. XXXVII, sec. B, XLIV) The coarser beds are reached at depths of 100 to 150 feet (937, 940, 947, 948, 952), though shallower wells can often be finished. This horizon yields good boiler water, and the tests at Lecompte (948) indicate that it is a very satisfactory quality for municipal purposes. Much of the hill land is covered with late Tertiary gravels, and in the southern part of the parish these are sometimes of sufficient thickness to be of considerable importance as sources of water

The Catahoula formation is the source of the deep water developed at Zimmerman (956), Boyce (942–946), and Alexandria (933–939, Pl. XLIII, secs B, C). In all the northern part of the parish except in the immediate vicinity of Colfax, where they are absent, these beds will furnish the best water obtainable. The principal horizons are encountered from 400 to 500 feet above the base, and the ordinary depth of wells will be about 500 feet less than that given on Pl XLIII, which refers to the base of the formation. It will not be advisable in any case to go below the Catahoula Flowing water is to be expected in Red River Valley and in the extreme northeastern portion of the parish about Catahoula Lake.

RED RIVER PARISH

In the hill lands of Red River Parish there has as yet been no demand for very large water supplies, and surface wells have furnished all the water needed. In the more thickly settled region, along Red River Valley, large supplies have been easily obtained from the Port Hudson sands and gravels, which underlie the whole flood plain and furnish, from the lower, coarser beds, at a depth of about 100 feet, unlimited supplies of hard water which is fairly good for boiler use

The water-bearing sands of the Sabine, which underlie the whole of the parish, have been developed at only one point, Lake End (960), where they have yielded salty water. The quality of the water in these beds in other portions of the parish can be determined only by drilling In the northeastern and eastern portions, in the direction of the Cretaceous domes (Pl XLI), they are likely to yield salty water, but in the northwestern and western portions the chances are somewhat better because, west of Red River, the greater head (Pl XL, p 82) will prevent an inflow of salt water from the fractured Cretaceous beds brought up in the domes north of Red River. The Many dome is probably not a disturbing factor. Wells near the western side of the valley, or in the steep creek valleys tributary to it, may furnish artesian water.

In developing these beds it is not advisable to go deeper than 100 to 200 feet below sea level (Pl. XLI), unless it is planned to sink a very deep test well The prospects along this line have been discussed under Natchitoches Parish (pp 139–140). At Coushatta the lower beds will be reached at a depth of about 700 feet less than at Natchitoches

RICHLAND PARISH

In Richland Parish, as in the other parishes east of Ouachita River, large supplies can be obtained in the surficial and Port Hudson deposits, which underlie the whole region Wells can commonly be finished at depths of from 25 to 50 feet, but where large supplies are desired it is generally advisable to go to the coarse gravels which overlie the older Tertiary beds These beds are commonly encountered at a depth of 100 to 150 feet

Artesian water from the Sabine sands may be obtained in any part of the parish by going to the requisite depth, which will usually be from 400 to 500 feet below sea level in the western and southwestern portions of the parish and 700 feet in the extreme eastern portion This horizon is developed at Monroe (921–924), Columbia (841), and Delhi (962, Pl XXXVII, secs B, I) The quality of the water at any point may be roughly predicted by its position relative to these three localities Along Bayou Lafourche and Boeuf River, in the west-central and southwestern portions of the parish, the chances are sufficiently good to warrant sinking deep wells In no case will it be advisable to go below the depths given on Pl XLI, unless a test well 4,000 to 6,000 feet deep is planned

SABINE PARISH.

In Sabine Parish, in the region north of the Cockfield member (Pls XLI, XLII), the best water horizons are in the Sabine sands These have been developed at Noble, Zwolle, Plymouth, Loring, and Negreet (Pl. XXXVII, sec. F) With the possible exception of the Negreet well, the water obtained in each of the above cases is to be recommended rather than the surface water, which is commonly used about the mill towns It is certainly less likely to be contaminated, and the mineral matter does not appear to be greater than in other wells where good results have been obtained These sand beds vary considerably from point to point, but may be said, in general, to be available at any locality

Flowing water has been obtained from this group of horizons at Boleyn (901), on Bayou Negreet (969), and at Robinsons Ferry (1120), and is likely to be developed in deep wells in the northeastern part of the parish and along Sabine River Deep in the embed and south of the Bayou Negreet Salt Springs the water is highly mineral, but in the whole southern part of the parish where this occurs water can be obtained from the Cockfield member or in the upper part of the Claiborne These beds cross the parish in a narrow belt just south of Many (Pl. III), and dip southward. At Robinsons Ferry a soft artesian water has been obtained at a depth of 1,010 to 1,030 feet (Pl XXXVII, sec. F) This is regarded as a horizon of probable importance in southern Sabine Parish (Pl XLII)

TENSAS PARISH.

This is an alluvial parish in which the best water is obtained in the Port Hudson gravels These are commonly encountered at depths varying from 100 to 150 feet, and yield large supplies of chalybeate water No deep wells have been sunk, though the conditions are favorable in the area shown on Pl. XLIII, in which the base of the Catahoula is from 0 to 500 feet below sea level, and in wells not over 400 feet deep along Mississippi River below this belt In the first case it is hoped to develop the lower Catahoula sands found in the Catahoula Shoals and Leland wells (Pl XXXVII, sec B), and in the second to develop the upper Catahoula sands found in the Port Gibson and Natchez wells (Pl XXXVII, sec A), which are supplied by a lateral westward flow from the Mississippi region. Deep wells in the southern part of the parish, as indicated by the Ferriday well (866), will probably obtain salt water

UNION PARISH

The deep-well prospects are very favorable throughout Union Parish Two successful wells have been developed at Randolph (979), and the wells in the adjoining parishes at Dubach (889), Ruston (890–891), and about Monroe (921–927) clearly indicate the conditions to be expected (Pl XXXVII, secs. B, C, I) South of the Red River-Alabama Landing fault line water will be encountered at depths ranging from 100 to 300 feet below sea level, and in no case will it be advisable to go deeper than shown on Pl. XLI, or 200 feet below sea level in the western part of the parish and 500 feet below in the eastern part Flowing water is to be expected along Bayous D'Arbonne, Cornie, and L'Outre and their principal tributaries. At Farmerville the horizon developed at Randolph, Dubach, Ruston, and Monroe will be encountered at about 200 feet below sea level North of the fault, water can be obtained in the upper Eocene or Cockfield sands at 0–300 feet below sea level, but it will not be advisable to try to develop the lower sands, as the wells at Crossett (6) and Bearden (628) obtained very unsatisfactory water from this horizon (Pl XXXVII, secs. *B*, *C*).

VERNON PARISH

With the exception of that obtained in the surficial gravels, the underground water supply of Vernon Parish is to be obtained from the Catahoula beds (p 86) This formation yields good results at Zimmerman, Boyce, and Alexandria, in Rapides Parish, and near Rockland, Tex.

In Vernon Parish but two deep wells have been sunk; that at Hawthorn (980) is reported as successful and that at Pickering (981) as unsuccessful It will be seen from the dip shown on Pl. L that the Pickering well lacked about 100 feet of reaching the horizon developed at Hawthorn. Between the Hawthorn horizon and the extreme depth shown on Pl XLIII several water-bearing sands are to be expected which will yield good soft water. In the hill lands along the Kansas City Southern Railway water will not flow, but on Sabine River below Bayou Toro flowing wells are to be expected. It is believed to be inadvisable to go deeper than shown on Pl. XLIII, as the water in the underlying Cockfield and Sabine sands will probably be salty.

WEBSTER PARISH.

In Webster Parish, except in the limited area around and south of the Cretaceous dome at the Bisteneau Salt Works (Pls. XXXVII, secs C, I; XLI), very good water can be obtained from the Sabine sands at depths less than 200 feet below sea level. The main water horizon, as developed in the wells at Taylor (139–140), Spring Hill (989), Cotton Valley (938), Minden (985–987), and near Shreveport, is about 100 feet below sea level throughout the parish. Above this sand a minor horizon has been developed at Allentown (775) and in the ice factory and cotton-oil mill well at Minden (988). The failure at Yellow Pine is due to the disturbance of the Bisteneau dome, which directly affects only a small area. Good water can probably be obtained at Lanesville and Dubberly at the depths indicated by the Minden well

WEST CARROLL PARISH

Throughout West Carroll Parish the Port Hudson deposits are very near the surface. They form the Bayou Macon hills and in the bottom lands are overlain by but a thin covering of alluvium. These beds are from 100 to 150 feet thick, and the coarser beds near the base will yield very large supplies of somewhat hard chalybeate water

No wells have as yet been sunk below these gravels, but in every part of the parish water can be obtained in the underlying Eocene beds South of the Alabama Landing fault line water can be had in the horizon developed at Monroe (921–927), Delhi (962), and Vicksburg (1037), at depths between 300 and 500 feet below sea level (Pl. XXXVII, secs A, B, I) This water will probably flow, but, as indicated by the Delhi and Vicksburg wells, will be highly mineral Other horizons may be developed for several hundred feet below this one, and will probably also yield mineral water.

North of the fault line the basal Cockfield, or upper Eocene water sands, will be encountered at depths between 400 and 500 feet below sea level. This horizon furnishes sulphur water at Crossett (6; Pl. XXXVII, sec. B), and good water at Blissville (145), Dermott (24), and Greenville (1039; Pl. XXXVII, sec. A). Its quality in northern West Carroll Parish can be determined only by drilling. Two hundred feet below this horizon is that developed in the Empire and Lake Providence wells (Pl. XXXVII, sec. A). A lower horizon can be reached in this portion of the parish at depths between 800 and 1,000 feet. This is the stratum which furnishes salty water at Crossett (Pl. XXXVII, sec. B), and there is little reason to hope for better results here.

WINN PARISH.

The three important water-bearing formations available in Winn Parish are (1) the Nacatoch, (2) the Sabine, and (3) the Cockfield. The Nacatoch is commonly from 1,000 to 2,000 feet below sea level in this region, but is folded up in the Cretaceous domes (Pl. XXXVII, secs. C, I). It yields salty water, which, leaking from the fractured and truncated domes, fills the Sabine sands to the southwest.

The Sabine formation, which occurs about 700 feet above the Nacatoch, and is from 500 to 900 feet thick, likewise underlies the whole parish (Pls. XXXVII, sec. C; XLI). In the region north and east of the domes the sands in this formation yield good fresh water, which at Winnfield (998) is artesian. South and southwest of the Cretaceous domes these sands are present, but, as shown at Luella (906) and Natchitoches (909–911; Pl. XXXVII, sec. E), they will probably yield salty water, though the exact limit of the brine-impregnated areas can be determined only by drilling.

The Cockfield member outcrops in a belt extending across the parish south of St. Maurice and Winnfield (Pls. III, XLII). Along the outcrop these beds will probably yield potable water at depths varying from a few feet at the northern edge to 500 feet near the Cockfield-Jackson contact (Pl. XXXVII, sec. C). In the embed, as shown at Rochelle (881) and Colfax (871), this horizon will yield salty water.

CHAPTER V.

DETAILED WELL AND SPRING RECORDS.

INTRODUCTION.

All the well and spring data collected regarding northern Louisiana and southern Arkansas and the adjacent portions of Mississippi and Texas are presented in the following tables, arranged under each State alphabetically by counties, and under the county headings alphabetically by towns. This plan groups the data into small geographic units, and enables any one interested in a particular region to quickly find the information regarding it.

The desirability of bringing all this detailed material into a chapter of well records is more or less evident. In the first place, it makes all the data readily and equally available for reference. It also relieves the discussion, or text proper, from a vast and wearisome amount of detail, and yet by means of arbitrary numbers enables that detail to be easily found whenever desired.

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Smith, R. Walter, well driller, Allbrook, Ark.
Stoer & Backus, well drillers, Shreveport, La.
Strong, W. A., well driller, Monroe, La.
Touzet, H. P., well driller, 3629 Iberville street, New Orleans, La.
Turner, W. A., well driller, Columbus, La.[a]
Wade, H. W., well borer, Prescott, Ark.
Wells, J. M., sr., well borer, Gurdon, Ark.
Williams, L. B., well borer, Gurdon, Ark.
Winters, C. H., well driller, Harrisonburg, Ark.
Yocom, James, well driller, Spring Hill, Ark.

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[a] Temporary address

Wells and springs in southern Arkansas, northern

ARKANSAS

No	Location	Township	Range	Section	Owner	Driller.	Authority
	ARKANSAS COUNTY						
*1	Dewitt, 10 miles southeast of	5 S.	2 W.	35.	"LaGrue springs"		W Maxwell[a]
2	Dewitt, 10 miles east of	5 S.	2 W.	1.	"Cold Spring".		do.
*3	Stuttgart				General		A H Solkland, postmaster
*4	do.				do.		Gunter Bros.
	ASHLEY COUNTY						
5	Crossett	18 S.	8 W.	19?	Crossett Lumber Co	Hart Well Co.	L B Clifford.
*6	do	18 S	8 W.	19?	do	L B Clifford Well Co	do.
7	do.	18 S	8 W.	19?	do	do.	do
*8	Hamburg				Court-house		G D Harris[c]
	Ouachita River				U S Eng test borings		
*9	Pineprairie				General.		G D Harris[c]
10	Portland.				St Louis, Iron Mountain and Southern Rwy		M M Munson, pump repairer
11	do				Portland Cotton Oil Co		C T Baker, bookkeeper
	BRADLEY COUNTY						
	Ouachita River				U S Eng test borings		
*12	Sumpter.	14 S	9 W.	34.	"Sulphur springs"		G D Harris[d]
*13	Warren, 6 miles from				Leag's Mineral Springs		David Dale Owen[e]
14	Warren, 1 mile west of				Arkansas Lumber Co	Hart Well Co	Arkansas Lumber Co
15	Warren	12 S	10 W.	36.	Southern Lumber Co	do.	N H Clapp, manager
16	do.	12 S	10 W.	36.	do	do	do
*17	do	13 S	9 W	6	Bradley Lumber Co	do.	M Forsythe, manager
18	do.	13 S	9 W.	6.	do.	do	do
19	Warren, 1 mile east of	13 S	9 W.	6	Warren Stave Co	do.	Warren Stave Co.

* For additional data see "Descriptive notes" following this table

[a] County surveyor

[b] Combined yield of three wells

[c] Ann. Rept Geol Survey Arkansas for 1892, 1894, pp. 130-131

Louisiana, and adjacent portions of Mississippi and Texas

(SOUTHERN)

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
	Spring				Large				Noted for medicinal properties	1
	do				do					2
2	100±	160				Large	Quaternary.	Slightly hard	Water in gravel	3
2	65–115	160				do	do		do	4
	450								Abandoned	5
8–6	976	160	−74	80–110			Quaternary.	Good	Completed in 1902	6
			−36	450		22	Cockfield	Sulphur		
			−28	913–976		70	Sabine	Salty		
8	110	160	−74	80–110		[b]200	Quaternary.	Good.		7
	60						do		Water in gravel beds	8
									See under Union County	
										9
	100±	125					Quaternary	Iron		10
6	400±	125	−30				Eocene	Alkaline	Drilled in 1899 Postmaster reports no water	11
									See under Union County	
	Spring							Alkaline, sulphur		12
	Springs							Magnesia		13
6	192	209	−56	162–192		[f]20	Cockfield	Hard	Wells sunk in 1900 and 1902 White sand at 162–192 feet	14
4	196	232	−62			20	do	do	Scales badly in boilers	15
4	194	230	−58			20	do	do		16
4	150	218	−50			20	do	do	Well near track, completed in 1902	17
4	150	208	−29			35	do	do	Well at sawmill, completed in 1902	18
2½	648	175	−36				do	Soft		19

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[d] Op. cit, p 124

[e] Second Report of a Geological Reconnaissance of Arkansas, 1860, p. 142

[f] Each well

Wells and springs in southern Arkansas, northern

ARKANSAS

No.	Location.	Township.	Range.	Section.	Owner.	Driller.	Authority.
	CALHOUN COUNTY.						
*20	Hampton				William Thompson.		David Dale Owen[a]
20A	Hopewell, 1 mile from.				Sulphur and chalybeate spring.		A. C. Peale
21	Little Bay				Little Bay Lumber Co.		Little Bay Lumber Co.
22	Little Bay, 3 miles north of.	11 S.	14 W.	4	J. I. Holdernis		David Dale Owen[b]
	Ouachita River				U. S. Eng. test borings.		
*23	Thornton	11 S.	14 W.	11	Knapp, Stout & Co.		Knapp, Stout & Co.
	CHICOT COUNTY.						
24	Dermott				Corporation of Dermott.	Hart Well Co.	James Bennett, marshal.
25	do				St. Louis, Iron Mountain and Southern Rwy.		M. M. Munson[c]
26	Empire				Empire Lumber Co.		
	CLARK COUNTY.						
*27	Arkadelphia /	7 S.	19 W.		Arkadelphia Ice and Fuel Co.	J. M. Phillips	J. M. Phillips
*28	Beirne	10 S.	21 W.	12	General	L. B. Williams	L. B. Williams
29	do	10 S.	21 W.	12	J. D. Robinson		J. D. Robinson
30	do	10 S.	21 W.	12	R. C. Biggadike		R. C. Biggadike
31	do	10 S.	21 W.	12	Dr. A. F. F. Kerstan.	Dr. A. F. F. Kerstan.	Dr. A. F. F. Kerstan.
*32	do	10 S.	21 W.	12	James C. Clark	Henderson Nelson	Henderson Nelson
33	do	10 S.	21 W.	12	W. M. Yager	L. B. Williams	L. B. Williams
34	do	10 S.	20 W.	18, NW¼	L. B. Williams	do	do
35	do	10 S.	20 W.	do	J. G. Clark		do
36	do	10 S.	20 W.	7, NE¼ SW¼	P. W. Wood	Henderson Nelson	Henderson Nelson
37	do	10 S.	21 W.	10, NW¼	Sam Dotson	L. B. Williams	L. B. Williams
38	do	9 S.	21 W.	33, NW¼ SE¼	—— Smith	Henderson Nelson	Henderson Nelson
39	do	9 S.	21 W.	35	Mrs. A. Daniels	do	do
*40	do	9 S.	21 W.	35, NE¼ NE¼	Mrs. Y. G. Thomas	do	do
41	do	9 S.	21 W.	26	J. G. Clark	do	do
42	do	9 S.	21 W.	27	Mrs. E. Collett	do	do
43	do	9 S.	21 W.	23	Fisher place	do	do
44	do	9 S.	21 W.	24, NW¼ SE¼	Jas. Jones (col.)	J. M. Wells, sr.	J. M. Wells, sr.
45	do	9 S.	21 W.	24, NW¼ SW¼	Pete Bond (col.)	do	do
46	Bradshaw	8 S.	20 W.	18, SW¼	Maj. J. A. Ross		Maj. J. A. Ross

* For additional data see "Descriptive notes," following this table.

[a] Second Report of a Geological Reconnaissance of Arkansas, 1860. p. 139.

[b] Op. cit., p. 138.

[c] Well pulled back to 650 feet.

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(SOUTHERN)—Continued

Diameter of well	Depth of well.	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality.	Remarks	No
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
..	23	....	.	...		..	.	...	Lignite ..	20
.. ..	Spring	.			.		.	...	Used commercially prior to the war	20A
96	25	..	..		..	Large	Quaternary.	Good .	.....	21
..	Spring	..	...	..	..	...	..	Soft, pure	"Double mineral spring"	22
..	..	....	...	..	..	.	...	..	See Ouachita and Union counties	
6	385	310	..	.		..	Cockfield..	Sandy, hard	Completed in 1888. .	23
2½	c 750	144	−11	60–100 650	. .	Large d 75	Quaternary Cockfield .	Hard, iron Soft .	Gravel between 60 and 100 feet	24
..	150	....	...	..	..	.	Quaternary	Hard iron	......	25
3½	357	120	−11½	357	.	..	Cockfield .	Alkaline..	Used in sawmill	26
6–4	321	190	Flows +24	100 321	Small . 35	.. ..	Nacatoch . Bingen .	Fresh . Brine .	Completed in September, 1901	27
..	...	...	....	167–170	...	...	Nacatoch.	...	..	28
6	187	.	+ 4	187	0 5	.	. do ..	Soft....	Cost, $50, casing, 30 feet	29
3	175		+ 2		1 5	...	.do. ..	do...	Cost, $35, casing, 16 feet.	30
4	176		Flows	172–176		.	.do ..	Soft alkaline	.... ..	31
3¼	177	225	−16	170–177	.		. do	Soft.. ..	Supplies sawmill Casing, 37 feet	32
3¼	172		Flows	..	.	.	. do	..	.....	33
3¼	218	.	do				do	..	211 feet to water rock	34
3¼	211	...	.do		.		. do.		205 feet to water rock .	35
3¼	235	..	−50	233–235			do	.	....	36
3¼	100		Flows	.		.	do .		...	37
3¼	g 35	240	.		..		do ...	..	..	38
3¼	g 115	..	−15		...	..	do.	.	..	39
3½	110	.	−25	..		..	.do		Casing, 30 feet	40
3¼	g 90	240	−15	..	.		do ...	..	.....	41
3¼	g 111	320	.	...	.	.	.. do ...	..	.	42
3¼	g 114	300	...	..	.	.	.do.	.	...	43
3¼	120	.	−20	..		.	. do ..	Soft ..	Water rock 16 inches thick	44 45
3¼	116	......	−20	...	.	.	.do ..	.....	.....	
3	325	220?	Flows.	325	Small		Bingen .	Brackish..	Cost, $60, casing, 30 feet, used for stock	46

[d] Estimated
[e] Pump repairer
[f] See also Daleville (71–73)
[g] To water rock.

Wells and springs in southern Arkansas, northern

ARKANSAS

No.	Location.	Township.	Range.	Section.	Owner.	Driller.	Authority.
	CLARK COUNTY—continued.						
47	Bradshaw	7 S.	21 W.	36, SW¼ SW¼	W. J. Gaither	 J. M. Wells, sr.	W. J. Gaither J. M. Wells, sr.
*48	Britt's Switch	10 S.	21 W.	16, NE¼	J. G. Clark	Henderson Nelson	Henderson Nelson
49	do				T. J. Stewart		T. J. Stewart
*50	Burtsel	9 S.	21 W.	18	Burtsel Lumber Co.	H. W. Wade	H. W. Wade
*51	Clear Springs	8 S.	22 W.	7	Christian Church		Z. L. Kirkman
*52	Curtis				General		T. M. Ewing
52A	do	8 S.	20 W.	36[a]	G. L. Hamlin		G. L. Hamlin
53	do	8 S.	20 W.	36[a]	J. L. Stroup		J. L. Stroup
*54	do	8 S.	20 W.	36[a]	J. A. Monkern	J. M. Wells, sr.	J. M. Wells, sr.
55	do	8 S.	20 W.	25, NW¼	Jack Banks		T. M. Ewing
56	do	8 S.	20 W.	36, SW¼ SW¼	Evans's place		do
57	do	8 S.	19 W.	17, NW¼ SW¼ [c]	M. V. Smoker		
58	do	8 S.	19 W.	19, SE¼ NW¼ [c]	Judge A. F. Deaton.		Judge A. F. Deaton.
59	do	8 S.	19 W.	19, SW¼ NE¼ [c]	do		do
60	do	8 S.	19 W.	19, SW¼ SW¼ [c]	A. M. Crow		A. M. Crow
61	do	8 S.	19 W.	20, NE¼ SW¼ [c]	Jabez Osborn		T. M. Ewing
62	do	8 S.	19 W.	21	G. & S. Studdard		do
63	do	8 S.	19 W.	29	W. B. Ewing		do
64	do	8 S.	19 W.	31, NW¼ SE¼ [c]	T. A. Hollingshead		do
65	do	8 S.	19 W.	31, NW¼	T. M. Ewing		do
66	do	9[b] S.	19 W.	6 NW¼	W. B. Ewing		T. M. Ewing
*67	do	9 S.	19 W.	5, SW¼ SE¼	Parabe Thomas		T. A. Thomas
68	Curtis, 3 miles northeast of.	8 S.	19 W.		W. Hollingshead	J. M. Wells, sr.	J. M. Wells, sr.
69	Curtis, 3 miles east of.	8 S.	19 W.		M. Deaton	do	do
70	Curtis, 2 miles northeast of.	8 S.	19 W.		Jos. Neal	do	do
*71	Daleville	7 S.	19 W.	16, SE¼ NE¼	A. M. Crow		A. M. Crow
*72	do	7 S.	19 W.	do	do		do
73	do	7 S.	19 W.	16, SW¼	Wm. Grayson, president.	L. B. Clifford	L. B. Clifford
73A	do	8 S.	19 W.	13	Mrs. Anderson		David Dale Owen[e]
*74	Degray	7 S.	20 W.	5?	General		J. J. Dunlop, postmaster.

*For additional data see "Descriptive notes," following this table.

[a] In town of Curtis.

[b] Used in boiler at gin.

Louisiana, and adjacent portions of Mississippi and Texas—Continued.

(SOUTHERN)—Continued.

Diameter of well.	Depth of well.	Approximate elevation of surface.	Height of water above (+) or below (−) the ground.	Depths of principal water-bearing strata.	Yield per minute.		Geologic horizon of water-bearing strata.	Quality.	Remarks.	No.
					Flow.	Pump.				
Inches.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Galls.*	*Galls.*				
4	175	300±	−75	100			Bingen	Soft	Cost, $80; completed in 1901.	47
	178		−35				do	Good	Water rock 4 feet thick	
3¼	90	198	+10		5		Nacatoch		84 feet to water rock; casing, 23 feet.	48
4	104	198	+ 9	90-104	5		do		Bored in 1889; casing, 100 feet.	49
3½	365	260	− 8	50					Abandoned	50
	Springs.						Bingen	Iron; sulphur; lithia.	Group of 20 or 30 springs.	51
4	150		Flows.				Nacatoch			52
5	150	190±	do				do	Soft		52A
	(?) 325		do				do	do		53
	140	190	do				do	Salty[b]		54
	145	193	+ 0				do	Good		
			Flows.				do	Soft		55
			No flow				do	do		56
	160						do	Sulphur	Smells of H_2S	57
4	115		Flows.				do	Hard		58
4	115		− 8				do	do		59
	±200						do	Soft		60
							do	Sulphur		61
	180		Flows.				do	Salty	Too salty to use	62
	180		do				do	do	Used for watering stock.	63
	140		+ 1				do	Good	200 yards south of this is a salty artesian well.	64
	150		Flows.		1-2		do	Soft	Four flowing wells	65
			do				do	Salty		66
6	313	175	do				do	do	Used in boiler; casing, 40 feet.	67
	154		do				do	Good		68
	207		−10				do	Fine	Water rock 4 feet thick	69
	105		Flows.				do	do	Water rock 1½ feet thick.	70
6-4	410	185	+26	330	Large.		Bingen	Brine		71
	30-40						Quaternary[d]		Old salt wells	72
	551	185	Flows	150	Small.		Nacatoch	Brine	Bed rock at 550 feet	73
			do	450	Large.		Bingen	do		
	100		−20							73A
	30						Bingen	Soft		74

[c] Locations by T. M. Ewing.

[d] Brine derived from underlying Cretaceous beds.

[e] Second Report of a Geological Reconnaissance of Arkansas. 1860, p. 122.

Wells and springs in southern Arkansas, northern

ARKANSAS

No.	Location	Township	Range	Section	Owner	Driller	Authority
	CLARK COUNTY—continued						
75	Gurdon	9 S	20 W	19, SW¼	Wm Clark	L B Williams	L B Williams
76	do	9 S	20 W	19, SW¼	Mrs Bettie Wells	do	do
77	do	9 S	20 W	29, NE¼ SE¼	Chas O Neal	do	do
*78	do	9 S	20 W	28, SW¼ NW¼	T B McLaughlin	Henderson Nelson	Henderson Nelson
79	do	9 S	20 W	29, NE¼ NE¼	F D Brown	L B Williams	L B Williams
80	do	9 S	20 W	29, SW¼ NW¼	Frank La Croix	Henderson Nelson	Henderson Nelson
81	do	9 S	20 W	28, NE¼ SW¼	Mrs Waldo	L B Williams	L B Williams
*82	do	9 S	20 W	(a)	General		
*83	do	9 S	20 W	28[a]	Grayson, McLeod Lumber Co		Grayson, McLeod Lumber Co
*84	do	9 S	20 W	28[a]	do		Capt Thos Gage
*85	do	9 S	20 W	28[a]	St Louis, Iron Mountain and Southern Rwy	C H Winters	C H Winters
*86	do	9 S	20 W	33[a]	Dr M A Harper	Henderson Nelson	Henderson Nelson
*87	do	9 S	20 W	33[a]	William Weatherspoon	do	do
88	do	9 S	20 W	33[a]	Hunter Lipscomb	do	do
89	do	9 S	20 W	(a)	Robert Pennington	do	do
90	do	9 S	20 W	(a)	John Holman	do	do
91	do	9 S	20 W	35, NW¼	W Cheatham	L B Williams	W Cheatham
92	do	9 S	20 W	35, SW¼	Capt Thos Gage		L B Williams
*93	do	9 S	20 W	35, SE¼	John Rawles	James C Lowdermilk	James C Lowdermilk
94	do	10 S	20 W	4, NW¼	S M Cates	L B Williams	L B Williams
95	do	10 S	20 W	3, NW¼	W J Seahorn		W J Seahorn
96	do	10 S	20 W	4, NE¼	—— Schofin	L B Williams	L B Williams
96A	do	10 S	20 W	4, SE¼	Henry Bowers	do	do
97	do	10 S	20 W	9, NE¼ NW¼	J B Randle		J B Randle
98	do	10 S	20 W	4?	—— Josslin	James C Lowdermilk	James C Lowdermilk
*99	do	10 S	20 W	9, NE¼ NE¼	Alvin Pry[d]	L B Williams	L B Williams
100	do	10 S	20 W	9	Alvin Pry[f]	James C Lowdermilk	James C Lowdermilk
101	do	10 S	20 W	10, NW¼	—— White	do	do

* For additional data see "Descriptive notes," following this table

[a] In the town of Gurdon

[b] See p. 78

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(SOUTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks.	No
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
3¼	112	...	−43	...	...	...	Nacatoch	...	...	75
3¼	105	...	...	...	...	...	do	...	...	76
3¼	171	...	− 0	...	...	...	do	...	...	77
3¼	174	...	− 8	170 5	...	...	do	Soft and sulphur	Casing, 42 feet	78
3¼	160	...	−10	...	...	...	do	...	Asphalt, below water rock	79
3¼	143	...	−25	...	...	...	do	...	Cost, $40	80
3¼	187	...	Flows	...	...	...	do	...	...	81
3¼	200-240	...	...	...	...	...	do	...	...	82
10-6	760	198	+12	200-225	...	...	Nacatoch	Soft, alkaline	Temperature of water from 200 to 225 feet is 70° F	83
	710	198	Flows	600±	...	...	Brownstown [b]	Salty		
4-6	[c] 198	...	do	...	...	50	...	...	Several wells, lowers 20 feet when pumping	84
...	225	...	...	200-225	...	Small	Nacatoch	...	...	85
3¼	240	...	No flow	235	...	...	do	...	...	86
3¼	210	...	−10	208	...	...	do	Soft	Completed in April 1903, cost, $60	87
3¼	222	...	− 7 5	220	...	...	do	do	Completed in 1903, cost, $50, casing, 30 feet	88
3¼	206 5	...	− 8	204	...	...	do	Soft and sulphur	Completed in April, 1904, 203 feet to water rock	89
3¼	210	...	− 6	...	...	...	do	Hard and sulphur	Cost, $50, casing, 36 feet	90
3¼	358	260?	−50	300-358	...	Small	do	Salty	Cost, $125, casing, 40 feet, 300 feet to water rock	91
3¼	366 5	250	−40	...	...	...	do	...	...	92
3¼	342	250	...	...	...	None	...		Incomplete	93
3¼	272	...	...	...	...	...	Nacatoch		...	94
3¼	325	230?	−20	...	...	...	do	Good	Salty water at 225 feet	95
3¼	[c] 270	225	−15?	...	...	...	do	...	...	96
3¼	[c] 267	225	...	...	...	...	do	...	...	96A
3¼	356	250	...	...	...	...	do	...	...	97
3¼	355	...	...	...	...	...	do	...	...	98
3¼	[c] 315+	260	[e] −18	315-	...	...	do	...	Cost, $80, casing, 54 feet, sawmill well	99
3¼	360	...	−40	...	...	...	do	...	...	100
3¼	332+	...	−60	332-	...	...	do	...	...	101

[c] Depth to water rock

[d] R B F Key sawmill well

[e] In 1881

[f] R B. F Key, house well.

Wells and springs in southern Arkansas, northern

ARKANSAS

No	Location	Township	Range	Section.	Owner.	Driller.	Authority.
	CLARK COUNTY—continued						
102	Gurdon	10 S	20 W.	15, NE¼	Empire Mill (E A Whitmore)	James C Lowdermilk	James C Lowdermilk
103	do	10 S	20 W.	17, SE¼ SE¼	Geo Barfield	do	do
104	Hebron	9 S	19 W	36	General		John B Langley
105	Hollywood	8 S	21 W.	6, NE¼ NE¼	Terre Noire Methodist camp ground		R T Hill[a]
106	do	8 S.	21 W	4	Tobe Little		Tobe Little
107	do				do	J B Dillon	J B Dillon
108	do				—— Minifee	do	do
109	Keyton	9 S.	21 W	11, SW¼	General		Postmaster
110	do	9 S.	21 W	11?	Old Benedict Mill place		Nick Peters
111	Okolona	9 S.	22 W	3[b]	Ross & Trickett		Chas Trickett
112	do	9 S.	22 W	3[b]	Old Academy		do
*113	Okolona, near				—— Cargill		David Dale Owen[d]
*114	Okolona	8 S.	22 W	28, SW¼ SW¼	Capt T M East		Capt T M East
115	do	8 S.	22 W	30, SE¼ SE¼	W B East		do
*116	do	9 S.	22 W	12, SE¼ SW¼	Dave Hamilton		Geo W Hines
117	Smithton	9 S.	20 W	17	Thos Coxe	L B Williams	L B Williams
118	do	9 S.	20 W.	16.	J R Perry		do
119	do	9 S	20 W	22.	General		
120	Smithton, 1 mile southeast of	9 S	20 W.		(f)		Capt T M Gage
121	Smithton, 2 miles east of	9 S.	20 W		(f)		—— Norman
122	Smithton, 3 miles east of	9 S.	19 W	19?	(f)	John Lowdermilk	John Lowdermilk.
123	Whelen Springs						Capt Thos Gage.
	CLAY COUNTY						
*124	Knobel				St Louis, Iron Mountain and Southern Rwy	C H Winters	C H Winters
	CLEVELAND COUNTY						
125	Clio (Anderson)	8 S.	11 W	24	Bluff City Lumber Co		Bluff City Lumber Co
*126	Draughon	10 S	11 W	5	Saline River Lumber Co		S. E Emmert, secretary

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* For additional data, see "Descriptive notes," following this table

[a] Annual Report Geol Survey Arkansas for 1888, vol 2, 1888, p 258

[b] In the town of Okolona

[c] See p 78, fig 116

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(SOUTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks.	No.
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
3¼	402	240	− 60	....	....	....	Nacatoch	....	....	102
3¼	301	....	Flows	295-301	2	....	do	....	295 feet to water rock	103
....	40	....	....	....	....	....	Sabine	Soft	Supply generally from springs	104
Spring	....	....	....	....	....	....	....	Saline	....	105
5	89	....	− 18	80	....	....	Bingen	Hard	Not cased, completed in 1901	106
4	120	....	− 40	....	....	Small	do	....	Not much water	107
4	100	....	....	....	....	do	do	....	Completed in 1892	108
....	18-40	....	....	....	....	....	Nacatoch	Soft	Ample supply	109
....	30+	....	....	....	....	....	do	do	30 feet to water rock	110
....	386	363 5	....	150	....	Small	Brownstown [c]	Hard	....	111
....	200±	380	....	....	....	do	do	do	Well sunk in 1857-58	112
....	308	....	....	300	....	....	do	....	Water-sand caved and well was abandoned	113
3	280	349	− 15 −115	....	....	....	Bingen	Slightly hard	Casing, 280 feet, used for mill	114
3	200	300+	− 40	....	....	....	do	....	....	115
3	250	290	− 38	....	....	....	Brownstown [c]	Hard	Drilled about 1882	116
3¼	[e] 100+	225	....	....	....	....	Nacatoch	....	....	117
3¼	122	225±	− 30	....	....	....	do	....	....	118
3¼	200-220	210	+ 1 −5	....	....	....	do	Soft, alkaline	Water either flows or is very near the surface	119
....	....	....	Flows	....	....	....	do	Salty	....	120
....	....	....	do	....	....	....	do	do	....	121
3¼	300	....	do	....	....	....	do	....	Strong flow of chalybeate water	122
....	15-20	....	....	....	....	....	Sabine	Soft	Many springs	123
8	56	....	....	....	....	....	....	....	Strainer 15 feet long	124
2½	432	210	− 32	400-432	....	42	Cockfield	Soft	Completed in 1890, used for family and mill supply	125
4	117	209	[g] − 16	95-117	....	183	do	....	Reasonably soft and pure	126
2½	117	209	− 16	....	....	34	do	....		

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[d] Second Report Geological Reconnaisance of Arkansas 1860, pp 123-124

[e] Depth to water-rock

[f] Drilled for the old Smith Lumber Co

[g] When pumping, −30

Wells and springs in southern Arkansas, northern

ARKANSAS

No	Location	Township	Range	Section	Owner	Driller	Authority
	CLEVELAND COUNTY—continued						
126A	Gum Springs						A. C. Peale[a]
127	Kedron	8 S.	10 W.	18.	Frank Kendall Lumber Co		Frank Kendall Lumber Co
128	Kingsland				Leah Pressed and Fire Brick Co		Superintendent
*129	do	10 S.	12 W.	11.	H C Newton		H C Newton
130	Kingsland, 10 miles northwest of	9 S.	13 W.	11.	do		do.
131	Kingsland, 13 miles northwest of	8 S.	13 W.	28.	do.		do.
132	Rison				Morris & Brewster	J P Clifford	J P Clifford
133	do				J P Porter Lumber Co		J P Porter Lumber Co
	COLUMBIA COUNTY						
134	Buckner.				Public well		J G Beasley
135	Fomby				Bodcau Lumber Co	L B Clifford Well Co	L B Clifford.
136	Macedonia				J J Smith		County clerk.
*137	Magnolia, 2 miles northeast of				J V Butler.		David Dale Owen[b]
138	Milner				Dr C D Milner		
*139	Taylor, 1 mile north of				Louisiana and Arkansas Rwy	L B Clifford Well Co	L B Clifford.
*140	Taylor, ½ mile north of				Calvin Powell	do	do.
*141	Waldo.				Neimeyer Lumber Co	do.	do.
	DALLAS COUNTY						
*142	Fordyce				Fordyce Lumber Co		Fordyce Lumber Co
142A	Princeton, 8 miles west of				Mattocks Spring		A C Peale
	DESHA COUNTY						
*143	Arkansas City.				Desha Lumber Co		Desha Lumber Co.
*144	Arkansas City (Choctaw Bar).				Test boring		E W Hilgard[c].
	DREW COUNTY.						
*145	Blissville	15 S.	4 W.	13.	Chicot Lumber Co		Chicot Lumber Co

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*For additional data, see "Descriptive notes," following this table

[a] Bull. U. S Geol Survey No. 32, 1886, p. 120

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(SOUTHERN)—Continued.

Diameter of well	Depth of well	Approximate elevation of surface.	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata.	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks.	No.
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls.*	*Galls*				
	Spring				0 5			Sulphureted	Local resort	126A
3	457	225±	−50	450–457			Cockfield	Soft, sulphur	Completed in 1901, casing, 450 feet	127
2½	247	209?	−80	217–247			do	Hard	Completed in 1901	128
3	200	209?	−20				do	Soft	Used for sawmill	129
2½	376		−10				Eocene	Hard	Poor for domestic use	130
2½	200		−20				do	Hard, bad		131
3	225	225					do	Soft	Fossil shells are reported at 200 feet	132
	(?)700	225							No water, ground sandy, no stone or coal	133
	104	290					Eocene	Sulphur	Fossil shells at 104 feet	134
	126		Flows				do	Good	Put down for logging camp	135
	Spring				Large					136
	do							Iron		137
	do								Magnesia springs	138
4	305	253	−26	217–305		65		Soft	Completed in 1902	139
2	275	250	−20	210–275		4		do	Casing, 200 feet	140
5–4	1,038	350	−70	520–540			Sabine		Well abandoned	141
4	502	270	−22 −70 −70	22 425–450 460–502		 59	Pliocene? Cockfield do	 Soft	Temperature, 72 5° F, completed in 1901	142
	Spring							Sulphureted saline		142A
6	552	140	−12	550		66	Cockfield	Soft	Temperature, 72° F, supplies mill and town	143
	185 2								Mississippi River Commission test boring	144
10–4	490	126	−11	30 80 200 400 490		 Large	Quaternary? do Cockfield do do	Seep water Soft and pure	Waterworks for village and mills	145

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[b] Second Report of a Geological Reconnaissance of Arkansas, 1860, p 135

[c] Rept Miss River Com for 1883 48th Cong, 1st sess, House Ex Doc No 37, 1884, pp 489-490

Wells and springs in southern Arkansas, northern

ARKANSAS

No	Location.	Township	Range	Section	Owner.	Driller	Authority.
	DREW COUNTY—continued						
146	Constance				Postmaster		Postmaster.
*147	Monticello				Corporation of Monticello		David Dale Owen[a]
*148	do				do		D A Trammer[b]
149	do				Monticello Ice Works	Hart Well Co	D A Trammer
150	do				Monticello Cotton Mills	do	Hart Well Co
*151	Wilmar				Gates Lumber Co.		Gates Lumber Co
152	do				do		do
153	do				do	Hart Well Co	do
	FAULKNER COUNTY						
*154	Conway				St Louis, Iron Mountain and Southern Rwy		E Fisher, engineer of bridges and buildings.
	GARLAND COUNTY						
*154A	Hot Springs				H M Rector		H M Rector
	HEMPSTEAD COUNTY						
155	Arcadia	10 S	23 W	25.	General		Postmaster
*156	Bell	9 S.	26 W	36, SW¼ SW¼	J B. Ball	J B Dillon	J B Dillon
157	do	10 S.	26 W	1, NE¼ NW¼	Joseph Ball	do	do
158	do	10 S.	26 W	11, SW¼ NW¼	Thos Sampson.	do	do
*159	do	10 S	26 W.	11, NW¼ NE¼	W. H Robbins	do	do
*160	do	10 S.	26 W	12, NW¼ SW¼	Harrison Robbins	do	do
161	Belton				General		Postmaster
162	Columbus[g]	11 S	26 W	29, NW¼ NW¼	Town of Columbus	Walter Smith	
163	De Ann	11 S.	24 W	22.	General		Postmaster
*164	Dotson	9 S.	24 W.	19.	Long Spring		John C Branner[h]
165	do	9 S.	24 W.	27?	J W Boyd.		J. W Boyd
166	Emmet[i]	11 S.	23 W	21, NW¼ SW¼	Gus Lane	G B Hipp	G B Hipp
167	do	11 S.	23 W	21, NW¼ SE¼	Russell Arnold	do	do
168	do	11 S.	23 W	28, NE¼ NW¼	W A Townsend	C B Moore	C B Moore
169	do	11 S	23 W.	28, SE¼ NW¼	L T Matthews.		
170	do	11 S.	23 W	28, NE¼ SW¼	W A Landers		

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* For additional data see "Descriptive notes," following this table.

[a] Second Report of a Geological Reconnaissance of Arkansas, 1860, p 143

[b] Superintendent of waterworks

[c] Also given 604 feet.

[d] Estimated capacity, 200

[e] Estimated.

Louisiana, and adjacent portions of Mississippi and Texas—Continued.

(SOUTHERN)—Continued.

Diameter of well.	Depth of well.	Approximate elevation of surface.	Height of water above (+) or below (−) the ground.	Depths of principal water-bearing strata.	Yield per minute.		Geologic horizon of water-bearing strata.	Quality.	Remarks.	No.
					Flow.	Pump.				
Inches.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Galls.*	*Galls.*				
	65			43 65			Quaternary. do	Poor Good	Used for sawmill	146
	160									147
8	[c]750	265	−126	555–750		[d]110	Eocene		Completed in 1899; temperature, 79° F.	148
6–2½	800	283	−145	720?			do	Soft	No boiler scale	149
6–2½	810	280	−144	734–810?		[e]52	do	do	Completed in 1901	150
4–2½	800	145		184–194 313–333 400–500 800			do		Test well	151
5	194	145		184–194			do	Soft	Temperature, 65.3° F.; well at planer.	152
4–2½	455		− 2	400–455		380	do	do	Temperature, 71.8° F.; well at sawmill.	153
11½–7	389			50–57		Small.	Paleozoic			154
6	860			40		12–14	do		Abandoned	154A
	30						Nacatoch?	Soft	Used for domestic supply only.	155
4	135	341.5	−17	135			Bingen	do	Cost, $60; casing, 135 feet.	156
4	155	351	−40?	155			do			157
4	240	445	[f]−90				do			158
4	180	391	−35?			Large.	do	Hard	Casing, 166 feet	159
4	230	389	−70				do		Lignite between 200 and 208 feet.	160
	15						do	Soft		161
3	730					None.			Abandoned; drilled in 1901.	162
	35						Nacatoch	Soft		163
	Spring.						Nacatoch?	Magnesia		164
	210					None.				165
	112		− 27				Nacatoch			166
4	± 40		Flows.		2		do	Soft		167
	128		− 35				do			168
	110		− 20				do			169
	100		Flows.		2		do			170

[f] Approximate; well had been abandoned when visited in January, 1902.
[g] See also Allbrook and Saratoga, under Howard County.
[h] Ann. Rept. Geol. Survey Arkansas for 1891, vol. 1, 1892, p. 110.
[i] For wells near Emmet, but in Nevada County, see under Nevada County.

Wells and springs in southern Arkansas, northern

ARKANSAS

No.	Location	Township	Range	Section.	Owner.	Driller	Authority
	HEMPSTEAD COUNTY—continued						
171	Emmet	11 S.	23 W.	28, NE¼SE¼	John Boyd	G B Hipp	G B Hipp
172	do	11 S.	23 W.	28, SE¼SE¼	J D Boyd	do	do
173	do	11 S.	23 W.	29, NE¼NW¼	Henry Dickie.	do	do
174	do	11 S.	23 W.	29, NW¼SW¼	Mrs. Fannie Williams	C B Moore	C B Moore
175	do	11 S.	23 W.	32, NW¼NW¼	Jas Williams	do	do
*176	do	11 S.	23 W.	33, NE¼	Mrs Alice Landers	G B Hipp	do
177	do	11 S.	23 W.	33, SE¼	B L Landers.		do
178	do	11 S.	23 W.	33, NW¼	Robert Hannah.		Robert Hannah
179	do	12 S.	23 W	17	Capt Rich Jones	Hudson & Cornelius	Hudson & Cornelius
180	do	12 S.	23 W.	17, SW¼SE¼	E S Greening, jr	J M Phillips	J M Phillips
181	do	12 S.	23 W.	17, SE¼SW¼	do	do	do
182	do	12 S.	23 W.	17, SW¼SW¼	—— Morgan	do	do
183	do	12 S.	23 W.	17, NW¼SW¼	do	do	do
184	do	12 S.	23 W.	17, SE¼NE¼	John Crosnoe	do	do
185	do	12 S	23 W.	18, SW¼	John Turnemaker	do	do
186	do	12 S.	23 W.	18, NW¼SW¼	Providence Church	do	do
187	do	12 S.	23 W.	18, SW¼SW¼	Dick Campbell.	do	do
188	do	12 S.	23 W.	19, NW¼NW¼	Albert Betts	do	do
190	do	12 S	23 W.	19, NE¼NE¼	Elgin Greening	J M Phillips	J M Phillips
191	do	12 S.	23 W	19, SE¼NE¼	Asbury Dudley.	do	do.
*192	do	12 S	23 W	21, NW¼NW¼	Mon Phillips	do	do.
193	do	12 S.	23 W.	21, NW¼SE¼.	Wash Alexander	Hudson & Cornelius	Hudson & Cornelius
*194	do	12 S.	23 W.	21, SW¼NE¼	Dug McSwain	J M Phillips	J M Phillips
195	do	12 S.	23 W.	21, SE¼NE¼	do	Hudson & Cornelius	Hudson & Cornelius
196	Fulton (Red River)	14 S.	26 W.	14	Wm Temple	S R Meredith	S R Meredith
197	do	14 S.	26 W.	10	Alfred Cribbin (Smith place)	Geo Johnson.	J M Phillips. Dr B Shirs
*198	do	14 S	26 W.	4	Albert Moore	C D Hudson	C D Hudson
199	do	14 S.	26 W.	4	Jones place.	do	Dr B Shirs.
200	do	14 S.	26 W.	4	do	S R Meredith	S R Meredith
*201	do	13 S	26 W.	28.	J. B. Shultz	Hudson & Cornelius	C D Hudson
*202	do	13 S.	26 W.	28.	Jesse Ogden	do	do
*203	Fulton	13 S.	26 W.	20 [c]	General	J M Phillips. Hudson & Cornelius	J M. Phillips Hudson & Cornelius
204	do	13 S.	26 W.	20 [c]	Creamery Package Co.	C D Hudson	Creamery Package Co

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* For additional data see "Descriptive notes," following this table

[a] Original

[b] Original Present depth to water is reported as 40 feet, but as well has caved badly this does not necessarily represent the level of the water from the Nacatoch sand

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(SOUTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface.	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
	145		− 1				Nacatoch.			171
	130		− 5				do			172
	82		+ 8		2		do			173
	98		−25				do			174
	120		−15				do		92 feet to water rock.	175
	130		Flows				do			176
	116 190		− 5 Flows				do			177
5	235		do		1		do	Soft	Casing, 35 feet	178
	265		do				do			179
2	280	261	do				do		260 feet to water rock	180
2	260	253 4	[a] +32		2		do		255 feet to water rock	181
4	265	271	Flows		½		do			182
2	258	302	−18				do			183
4	240	304	−16				do		227 feet to water rock	184
4	240		[b] −23				do			185
4	240	329 5	(?) −25				do			186
	248	291	(?) −16				do			187
4	250	283 6	+ 2		½		do			188
2	280	270	+ 2		½		do		Cost, $68 50, 260 feet to water rock.	190
2	290		Flows		½		do			191
2	372	268 3	+12				do		First water rock at 350 feet	192
2	374	274 4	Flows				do			193
2	378	263 9	+20		2		do		First water rock at 355 feet	194
2	367	273 6	+ 4		2		do			195
2	700	250	Flows	660–700			do	Good	Well caved because not cased	196
	480	245	do.	470–480	±5		do	do.		197
	480	250	+ 3				do	do		198
2	374	250	Flows				do	do		199
3	360	250	+12				do	do	Casing, 60 feet	200
2	280	250	Flows				do	do	Very strong flow	201
2	240	250	do				do	do		202
2-3 2-3	180 160-180	255-265	([d])				do	Soft	Pressure decreasing	203
2	196	257	Flows				do		Used for boiler and domestic purposes	204

[c] In the town of Fulton.

[d] Formerly all flowing wells, now only flow in lowest places

Wells and springs in southern Arkansas, northern

ARKANSAS

No.	Location	Township.	Range	Section.	Owner	Driller	Authority.
	HEMPSTEAD COUNTY—continued						
205	Fulton	13 S.	26 W.	20[a]	Geo. Rosenburg	S R Meredith	S. R Meredith
*206	do			(a)			John C. Branner[b]
207	Fulton (Lodi Ferry).	13 S.	27 W.	9, SW¼ NE¼	Captain Wheeler	C D Hudson	C D Hudson
*208	do	13 S.	27 W.	3 ?	Chas McNabb	do	do
209	Fulton (Yellow Creek)	13 S.	27 W.	12, SW¼ NW¼	Hubbard Jones	do	do
210	do	13 S.	26 W.	7	Spates Bros	do	do
211	Fulton (Bridge Creek)	13 S.	26 W.	8, SE¼ NE¼	Dan Harkness		Dan Harkness
*212	do	13 S.	26 W	10, NW¼ NE¼	do	C D Hudson	C. D Hudson
*213	do	13 S.	26 W.	2, SW¼	do	do	do
*214	do	13 S.	26 W.	11, NW¼ NE¼	do	do	do
215	do	13 S.	26 W.	11, SE¼ SW¼	Wm Mayfield	do	Wm Mayfield
216	do	13 S.	26 W.	12	Sam Colter		Sam Colter
217	Fulton (Sprudel)	13 S.	26 W.	14, NE¼ SW¼	E G. Porterfield	J J Byers	E G. Porterfield.
218	Fulton (Weaver Spur)	13 S.	26 W.	15, NW¼ SW¼			C D Hudson
219	Fulton	13 S.	26 W.	1, NE¼ SW¼	Will Logan	Hudson & Cornelius	do
*220	do	13 S.	26 W.	1, NE¼ SW¼	Orange Smith	do	do
221	do	13 S.	26 W.	1, SW¼ NW¼	Oliver Nash	do	do
222	Fulton (Bois d'Arc Prairie)	12 S.	26 W.	34, SW¼	John Gilbert.	C B Moore J M Phillips Hudson & Cornelius	C B Moore J M Phillips C D Hudson
223	do	12 S.	26 W.	33, NW¼ SE¼	Tony Cooper	J M Phillips	John Gilbert
*224	do	12 S	26 W.	26, NE¼ NW¼	Will Gilbert	Hudson & Cornelius	C D Hudson
*225	do	12 S.	26 W.	23, SW¼ SE¼	John Gilbert	do	do
*226	do	12 S.	26 W.	24, NE¼ SW¼	Liberty schoolhouse	do	do
*227	Fulton (Sandy Bois d'Arc Creek)	12 S.	26 W.	24, SW¼ SW¼	John Gilbert	do	do
228	do	12 S.	26 W.	25, NW¼ NE¼	R Stringfellow.		do
229	do	12 S	26 W.	25, NE¼ SW¼	—— Morgan		do
230	do	12 S.	26 W.	25, SE¼ NE¼	Eb Gilbert.	Hudson & Cornelius	do
231	do	12 S.	26 W.	36 ?	Tom Tompkins	do	do
232	Garlandville[c]	11 S	22 W.	16, NW¼	Ed Steward.	G B Hipp	G. B Hipp.

* For additional data see "Descriptive notes," following this table

[a] In the town of Fulton

[b] Ann Rept Geol. Survey, Arkansas for 1891, vol 1, 1892, p 137.

[c] Original head, will now rise only 12 feet

Louisiana, and adjacent portions of Mississippi and Texas—Continued.

(SOUTHERN)—Continued

Diameter of well	Depth of well.	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality.	Remarks	No.
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
3	200						Nacatoch..		Passed through three "water rocks"	205
										206
2	138	255	− 7				Nacatoch.			207
2	96	260	− 7				.do.....			208
	137	272 5	− 7				..do.....		44 feet to water rock...	209
	130		−80				...do.....			210
	160		− 2							211
5-3	130	285 5	+ 1	127-130	1		Nacatoch	Hard..	Casing, 60 feet	212
2	133		− 2				...do			213
3	175		Flows				.do			214
2	192		..do..	187-192			.. do	Alkaline.	Supplies gin, casing, 57 feet	215
2	170		..do..		3		...do....		Casing, 16 feet	216
4	235	255	c +25		d 30		.do ...	Soft, alkaline	Cost, $200, casing, 50 feet	217
3		278?					.. do ...		Formerly flowed.. .. .	218
3	296	349	e −52	290-296			... .do ...	Soft......	Cost, $96, casing, 93 feet.	219
2	285	347	−45	280-285			...do....	...do..		220
3	263	312	f −27	257-263			..do....	...do...		221
4	53	296	+12		± 5		.. do. ..	do..	48 feet to water rock.	222
2	53	299	+ 7		± 5		..do ...	. do....		
2	52	292	+12	47-52	10		...do....	do..		
2	57		− 3				. do.			223
2	97		−15				...do...	Soft	51 feet to water rock..	224
2	67		− 6				..do . ..	.do...	Blue clay entirely absent	225
2	54		− 7				.. do.. ..	...do...	47 feet to water rock....	226
2	53		− 7				do...	...do...		227
	81		Flows				...do.. ..		2 flowing wells Water just below the water rock	228
	168		...do..				do...		Cost $65	229
	137		−14				. . do.....		117 feet to water rock.	230
2	253		Flows				...do... ..			231
3	28	292	−11				...do. .	Hard.....	Water rock 8 feet thick..	232

[d] Flow in 1890 present flow 5 gallons

[e] In 1893, December 29, 1901, the depth to water was 59 feet

[f] In 1897

[g] For wells near Garlandville, but in Nevada County, see under Nevada County

Wells and springs in southern Arkansas, northern

ARKANSAS

No.	Location.	Township.	Range	Section.	Owner	Driller.	Authority
	HEMPSTEAD COUNTY—continued						
233	Garlandville	11 S.	22 W.	16, NE¼ NW¼	John Vickers	Geo W Hines	Geo W Hines
234	do	11 S.	22 W.	16	Albert Hubbard		G B Hipp
235	Guernsey (Sheppard)	13 S.	25 W.	18, SW¼	Geo Hutchins	Hudson & Cornelius	Hudson & Cornelius
236	do	13 S.	25 W.	18, NE¼	J H Bryant	do	do
237	do	13 S.	25 W.	17, NE¼ NW¼	John Finley	do	do
238	do	13 S.	25 W.	16, NW¼ SW¼	J W Baker	Jas Yocom	Jas Yocom
239	Guernsey (Sandy Bois d'Arc Creek)	13 S.	25 W.	6, SW¼	Reed Brothers	Hudson & Cornelius	Hudson & Cornelius.
240	do	13 S.	25 W.	8, NE¼ NW¼	John Finley	do	do
241	do	13 S.	25 W.	8, NW¼ NE¼	Dr J P. McIver.	do	do
242	do	13 S.	25 W.	9, NW¼ SW¼	John Finley	S R Meredith	S R Meredith.
243	Guernsey	13 S.	25 W.	9, SW¼ NW¼	C B Ambler	Hudson & Cornelius	Hudson & Cornelius
*244	do	13 S.	25 W.	3, SE¼ SE¼	St Louis, Iron Mountain and Southern Rwy		E Fisher[b]
245	do	13 S.	25 W.	3, NE¼ SW¼	Guernsey School	Hudson & Cornelius	Hudson & Cornelius
*246	do	13 S.	25 W.	2, SW¼ NW¼	Frank Jett	do	D E Cornelius
247	do	13 S.	25 W.	4, SE¼ NE¼	J Y McIver	do	C D Hudson
248	do	13 S.	25 W.	5, SE¼ NW¼	Henry's Chapel	do	Hudson & Cornelius
249	do	13 S.	25 W.	5, NE¼ NE¼	A W McIver	do	do
250	do	12 S.	25 W	32, SW¼ NE¼	F P Keel	do	do
251	do	12 S	25 W	33 SW¼ NW¼	Lawrence White		C D Hudson
252	do	12 S	25 W	33, SE¼ SW¼	C C Hopson	C C Hopson	C C Hopson.
253	do	12 S.	25 W.	33, SW¼ SE¼	W A Rhodes	Hudson & Cornelius	Hudson & Cornelius
254	do	12 S.	25 W.	34, SW¼ SW¼	J K Shelly	do	do
254A	Hickory Creek				Hickory Creek sulphur spring		A C Peale[c]
255	Hope	12 S.	25 W.	35, SW¼ NW¼	D E Cornelius	D E Cornelius	D E Cornelius
256	do	12 S	25 W.	35, SE¼ NW¼	Henry Coleman.	do	do
257	do	12 S	25 W.	35, SW¼ NE¼	Swan Anderson	do	do
258	do	12 S.	25 W.	35, NW¼ NE¼	A R Jones		do
259	do	12 S.	25 W.	35, NW¼ NE¼	Swan Anderson		do
260	do	12 S	25 W.	25, SE¼ SE¼	Gordon Cook.	J M Phillips.	J M Phillips.
*261	do	12 S	25 W.	25.	(A Hannegan)		David Dale Owen[h]
262	do	12 S	25 W.	25, NE¼ SE¼	Nelson White.	J M Phillips	J M Phillips
263	do	12 S	25 W.	25, NE¼ NE¼	Tom Washington.	do	do

* For additional data see "Descriptive notes," following this table.

[a] Flowing at 4 feet above the ground

[b] Engineer of bridges and buildings, Missouri Pacific System.

[c] When not pumping

[d] Formerly a flowing well, but has now ceased.

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(SOUTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface.	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No
					Flow	Pump.				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
3½	36	304.5	−26				Nacatoch		26 feet to water rock, 9.5 feet thick	233
36	25		Flows				do.		20 feet to water rock	234
3	387	280	− 2				do.			235
3	339	280	− 2				do			236
3	351	280.1	− 2				do			237
2	400	255	Flows				do.			238
2	250±		do				do		Three wells	239
	317		do				do.			240
	340-350		do				do.			241
3½	360	262.5	+16				do.			242
3	370	274.5	+10		[a]5		do.	Good	Used to supply sawmill, first water rock at 310 feet	243
6	460	290	[c]Flows	316-460		58	do	Soft	Completed December 26, 1901, casing, 255 feet	244
	357	302	+ 1				do	do.	First water rock at 320 feet	245
	327		Flows				do	do		246
	348	292.5	(d)	316			do		First water rock at 292 feet	247
2	265		Flows				do			248
	270	286.6	do		3		do			249
2	200	273	do		2		do			250
	195		+ 8		2		do		First water rock at 180 feet	251
3	232	280	Flows	220-230	2.5		do	Soft	Cost, $75, casing, 30 feet.	252
2	274		do				do		254 feet to water rock	253
	290		− 3				do			254
	Spring							Sulphureted		254A
2	270		+18		2		Nacatoch	Soft		255
	285		Flows		1		do	do		256
	300		+10		2		do	do		257
	297		+10		2		do	do		258
3	290		+18		2		do	do		259
4	[f]300	292.7	[g]−0.3				do	do		260
		276	+ 2				do			261
4	290	296.5	[g]− 1				do			262
4	280	306.3	− 8				do			263

[e] Bull U S Geol Survey No 32, 1886, p 120

[f] To water rock.

[g] Formerly a flowing well

[h] Second Report of a Geological Reconnaissance of Arkansas, 1860, p 118

Wells and springs in southern Arkansas, northern

ARKANSAS

No	Location	Township	Range	Section.	Owner.	Driller.	Authority
	HEMPSTEAD COUNTY—continued						
264	Hope	12 S	25 W	24, NE¼ SE¼	Lewis Moore	J M Phillips	J M Phillips
265	do	12 S	25 W	24	Jas M Hannegan	S R Meredith	S R Meredith
266	do	12 S	25 W	13, NE¼ SW¼	Joseph Taylor	Hudson & Cornelius	Hudson & Cornelius
267	do	12 S	25 W	13, SE¼ NW¼	Geo Allen		J M Phillips
268	do	12 S	25 W	13, SE¼ NW¼	do		do
269	do	12 S	25 W	12	Jas White	J M Phillips	do
270	do	12 S	25 W	12, NE¼ NW¼	—— Coxe		do
271	do	12 S	25 W	2, SE¼	E T Porterfield	J M Phillips	do
272	do	12 S	25 W	1, NW¼	Judge A H Carrigan		Judge A. H Carrigan
273	do	11 S	25 W	36	Steve Carrigan	J M Phillips	J M Phillips
274	do	11 S	24 W	29, SW¼ SE¼	Wm Rhodes	do	do
275	do	11 S	24 W	32, NE¼ NW¼	A P Delony	do	do
276	do	11 S	24 W	32, NW¼	do	do	do
277	do	11 S	24 W	32, NW¼ NE¼	Glenn Fredrick	do	do
278	do	11 S	24 W	32, NE¼ SE¼	Willis Phillips	do	do
279	do	12 S	24 W	3, NW¼ NW¼	E D Andrews	do	do
280	do	12 S	24 W	3, SW¼ NW¼	do	do	do
281	do	12 S	24 W	4, SE¼ NE¼	John Allen	do	do
282	do	12 S	24 W	4, NW¼ SW¼	do	do	do
283	do	12 S	24 W	4, SW¼ NW¼	P C Fredrick	do	do
284	do	12 S	24 W	5, NW¼ SE¼	Sam Bradley	do	do
285	do	12 S	24 W	5, NW¼ NW¼	W N Forshee	do	do
286	do	12 S	24 W	6, NW¼ SW¼	Judge A H Carrigan	do	do
287	do	12 S	24 W	7, NE¼ SE¼	Dr Robert Wilson	do	do
288	do	12 S	24 W	9, SE¼ SE¼	Hopewell School (white)	do	do
289	do	12 S	24 W	11, SW¼ NE¼	Mrs A Hutchinson	do	do
290	do	12 S	24 W	11, SE¼ NE¼	Allen Coxe	do	do
291	do	12 S	24 W	12, SW¼ NW¼	Jas Jones	do	do
292	do	12 S	24 W	12, NW¼ SW¼	Elmore Jones	do	do
293	do	12 S	24 W	13, NE¼ NW¼	Mrs A Grissom	do	do
294	do	12 S	24 W	13, SE¼ NE¼	Berry Acker		do
295	do	12 S	24 W	13, NE¼ NE¼		J M Phillips	do
296	do	12 S	24 W	13, NE¼ SW¼	Providence schoolhouse	do	do
297	do	12 S	24 W	13, NE¼ SW¼	Wm Stevens	do	do
298	do	12 S	24 W	13, SW¼ SE¼	Mrs Browning	do	do
299	do	12 S	24 W	13, SW¼ SW¼	Calvin Phillips	do	do
300	do	12 S	24 W	14, SE¼ SE¼	Ed Phillips	do	do
301	do	12 S	24 W	14, SW¼ SE¼	Geo Palmer	do	do
302	do	12 S	24 W	14, NE¼ SW¼	Ellis Green	do	do

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[a] Formerly a flowing well

[b] Original level 33 feet

Louisiana, and adjacent portions of Mississippi and Texas—Continued.

(SOUTHERN)—Continued.

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No.
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet.*	*Feet*	*Galls*	*Galls*				
4	248	300.9	[a] 0	...	...	...	Nacatoch.	...	...	264
3	...	306	− 6	...	...	...	..do.....	...	...	265
...	234	...	−23	...	...	...	.... do...	...	...	265
4	190	...	−18	...	...	...	...do....	...	160 feet to water rock...	267
...	...	...	Flows	...	...	...	.do....	...	...	268
...	139	...	−55	...	...	...	.do.....	...	109 feet to water rock..	269
	165	...	...	...	...	...	..do...	...	...	
...	120	...	Flows	...	...	...	..do ...	...	...	270
...	90	...	−60	...	...	...	.....do...	...	70 feet to water rock	271
4	48	340	−12	...	...	...	..do....	Hard. ...	...	272
4	75	?390	−60	...	...	...	..do.....	...	60 feet to water rock. .	273
4	102	411	−76	...	...	...	.... do ...	...	68 feet to water rock.. .	274
..	78	388.2	−62.5		...	...	....do.....	...	. . do.....	275
4	102	390	−68	...	...	...	.. do . .	...	75 feet to water rock ...	276
...	96	399.5	−75	...	...	...	....do.....	...	Water does not come above first water rock	277
4	100	390.5	−70?	...	...	...	..do....	...	...	278
...	90	...	Flows		...	...	...do....	Soft ...	...	279
...	130	350	−45	...	...	...	do.. .	Hard.. ..	110 feet to water rock .	280
4	130	352	−49	...	...	...	.do ...	. .do. .	...	281
4	160	369.5	−55	140–160	...	...	...do.....	..do ...	Well at residence of John Allen	282
4	147	383.2	−65±	...	...	...	. . do ...	.. .do...	...	283
4	140	...	−40	...	...	...	...do....	. .do...	...	284
4	68	...	−12	...	...	...	. . do....	...	...	285
4	139	...	[b] −40	...	...		. do . .	Hard.....	109 feet to water rock .	286
4	130	...	−20	...	...	...	. . do . . .	...	120 feet to water rock ..	287
4	238	366	−60	...	...	...	.do . . .	...	220 feet to water rock.	288
...	140	...	[c]	...	...	...	...do . . .	...	...	289
...	+115	...	Flows							
4	127	...	−20	...	...	...	. ..do.....	...	...	290
4	128	...	Flows	...	...	...	...do	...	...	291
...	148	...	.do..	...	...	...	. .do....	...	...	292
4	190	...	−12	...	...	...	. ..do....	...	...	293
...	200	...	−12	...	...	...	. .do.. .	...	...	294
4	190	309.6	− 6	...	...	...	. do....	...	...	295
4	204	300	− 4	...	...	...	. .do.. .	...	...	296
4	220	316	−20	...	...	...	. .do .	...	...	297
4	250	...	−15	...	...	...	... do . .	...	220 feet to water rock..	298
4	258	...	−40	...	...	...	. .do ..	...	...	299
4	250	...	−50	...	...	...	..do....	...	...	310
4	248	...	−40	...	...	...	. . .do....	...	200 feet to water rock..	300
...	250	...	−55	...	...	...	. .do....	...	238 feet to water rock ..	302

[c] "Very near surface"

Wells and springs in southern Arkansas, northern

ARKANSAS

No	Location	Township	Range	Section	Owner	Driller	Authority.
	HEMPSTEAD COUNTY—continued						
303	Hope	12 S	24 W	15, SW¼ SE¼	Allen Rolls	J M Phillips	J M Phillips
304	do	12 S	24 W	16, SE¼ SE¼	Hopewell School (colored)	do	do
305	do	12 S	24 W	16, NE¼ NE¼	Henderson Allen		do
306	do	12 S	24 W	16, SW¼ SW¼	J M Phillips	J M Phillips	do
307	do	12 S	24 W	18, NE¼ NE¼	Albert Ames	do	do
308	do	12 S	24 W	20, NE¼ NE¼	Parny Ames	do	do
309	do	12 S	24 W	21, SW¼ NW¼	Capt Bridwell	do	do
310	do	12 S	24 W	21, NE¼ NE¼	James Taylor	do	do
311	do	12 S	24 W	22, NW¼ NW¼	Colonel Job	Hudson & Cornelius	Hudson & Cornelius
312	do	12 S	24 W	22, SW¼ NE¼	J M Miller		J M Phillips
313	do	12 S	24 W	22, NE¼ SE¼	Mrs Ed McFadden	Hudson & Cornelius	Hudson & Cornelius
314	do	12 S	24 W	22, SE¼ NE¼	Aaron Smith	do	do
315	do	12 S	24 W	23, NW¼ NW¼	Charles Phillips	J M Phillips	J M Phillips
316	do	12 S	24 W	23, SE¼ SE¼	Calvin Phillips	do	do
317	do	12 S	24 W	24, SE¼ NW¼	do	do	do
318	do	12 S	24 W	24, NW¼ NE¼	Tom Neighbors	do	do
319	do	12 S	24 W	24, NE¼ NE¼	John Malone	do	do
320	do	12 S	24 W	28, SE¼ SE¼	Dr J W Andrews	do	do
*321	do	12 S	24 W	28, SE¼ SW¼	Corporation of Hope	George Johnson	do
*322	do	12 S	24 W	28, SE¼ SW¼	Corporation of Hope (waterworks)		John T Barr[b]
323	do	12 S	24 W	28, SW¼ SE¼	Hope Ice Co	Hudson & Cornelius	J M Phillips
324	do	12 S	24 W	28	Hope Cotton Oil Co	J M Phillips	do
325	do	12 S	24 W	28	J M Phillips	do	do
326	do	12 S	24 W	29, SE¼ SE¼	B Furgeson	D E Cornelius	D E Cornelius
327	do	12 S	24 W	29, SE¼ SE¼	R M Lagrone	do	do
328	do	12 S	24 W	29, SE¼ NW¼	D E Cornelius	do	do
329	do	12 S	24 W	30, SE¼ SE¼	T M Battle	do	do
330	do	12 S	24 W	30, SW¼ SW¼	—— Grissom	J M Phillips	J M Phillips
331	do	12 S	24 W	30, NW¼ NW¼	Melrose schoolhouse	D E Cornelius	D E Cornelius
*332	do	12 S	24 W	30, NW¼ NW¼	Jas Hennigan	do	do
333	do	12 S	24 W	31, SW¼ NW¼	Mrs M Furgeson	J M Phillips	J M Phillips
334	do	12 S	24 W	34 ?	Dudley & Black	C B Moore	C B Moore
335	do	13 S	25 W	1, NE¼ NE¼	George Bowden	do	do
336	do	13 S	24 W	6, SW¼ NW¼	James Bowden	do	do
337	do	13 S	24 W	6, SE¼	A A Gibson		J M Phillips
338	do	13 S	24 W	7, SW¼ NE¼	do		do

* For additional data see "Descriptive notes," following this table

[a] Water level originally 47 feet

[b] Chairman water and light committee

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(SOUTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No.
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
4	250		−55			Small	Nacatoch.			303
4	280	335.5	−50?				do.		250 feet to water rock.	304
4	245	365	−55				do.			305
	285		−52				do.		265 feet to water rock, casing, 54 feet	306
2	190		−17				do.		140 feet to water rock.	307
4	316	360	−60				do.		285 feet to water rock.	308
4	285	352	−53				do.		280 feet to water rock	309
4	245	322	−35				do.			310
4	263	330	−32				do.			311
	280		[a] −60				do.			312
	320		−30				do.			313
	300		−32				do.			314
4	280		−58				do.			315
4	300		−12				do.			316
4	260?		−16				do.			317
4	240	318	−22				do.			318
4	250	310	−20				do.			319
2	404	350.5	−70?				do.		372 feet to water rock.	320
5-4	950	355		375–445			do.		Test well sunk about 1882	321
9-6	500	352.5	−66			150	do.	Soft, alkaline	390 feet to water rock, casing, 390 feet	322
4	428	344	−58			[c] 15	do.			323
	426.5	347	[d] −62				do.			324
4	400	347	−47				do.			325
2	396		−54				do.			326
2	390		−54				do.			327
4	280		− 8				do.			328
2	340		−12				do.			329
	330	280	+ 8		10		do.	Soft	300 feet to water rock.	330
4	280	303	[e] −1.5				do.		260 feet to water rock.	331
4	400		− 2				do.		do.	332
4	325	299.8	0				do.	Soft		333
4	458						do.		Incomplete.	334
	410	320	−30				do.		400 feet to water rock.	335
	395		−18				do.			336
	406		−15				do.			337
	420		−18				do.			338

[c] Engineer states that water is readily lowered
[d] Originally 57 feet
[e] Formerly a flowing well

Wells and springs in southern Arkansas, northern

ARKANSAS

No	Location	Township	Range	Section	Owner	Driller	Authority
	HEMPSTEAD COUNTY—continued						
339	Hope	13 S.	24 W.	7, NE¼ NE¼	Gibson schoolhouse		J M Phillips
*340	do	13 S	24 W.	19	Arkansas Lithia Springs Co		James R Henry, manager
*341	Ozan	10 S	25 W.	30 ?	Hugh King		
*342	Ozan, 5 miles east of	10 S.	25 W.	25	J D Morrisett		David Dale Owen.
343	Shover Springs				Thomas Haines.		Postmaster[a]
344	Spring Hill	13 S	25 W	24, NW¼ SE¼	James Yocom	James Yocom	James Yocom
345	do	13 S	25 W.	23, SW¼ SE¼	Robert Jones.	Hudson & Cornelius	Hudson & Cornelius
346	Spring Hill, 1½ miles northwest of	13 S.	25 W.	23?	Claude Duggar	S R Meredith	S R Meredith.
347	do	13 S	25 W.	22, NE¼ SW¼	J W Moses	James Yocom	James Yocom
348	do	13 S.	25 W	21, SE¼ SE¼	David Morgan	do	do
349	do	13 S	25 W	20	E G Porterfield		C D Hudson
350	do	13 S	25 W.	15, NE¼.	Capt T A Collins.	James Yocom	James Yocom
*351	do	13 S	25 W	14, NE¼	J W Byram	Hudson & Cornelius	Hudson & Cornelius
352	do	13 S	25 W.	11, SE¼	S S Moses	James Yocom	James Yocom
353	do	13 S	25 W.	12, SE¼ SE¼	Wash Moore	Hudson & Cornelius	Hudson & Cornelius
354	Wallaceburg	10 S	24 W.		J M Hendrix		Postmaster.
355	do	10 S	24 W	(b)	Prescott Lumber Co	John Lowdermilk	John Lowdermilk.
*356	Washington	11 S	25 W	22[b]	Town of Washington	S R Meredith	S R Meredith.
*357	do	11 S	25 W	(c)	C E Royston		C E. Royston.
*358	do	11 S.	25 W.	(c)			David Dale Owen
359	Washington, 6 miles north of	11 S	26 W.	23, NE¼.	W C Myers		Superintendent
360	Washington, 2 miles west of				—— McFadden.		David Dale Owen[d]
*361	Washington, 3 miles south of				E Merrick		do.
*362	Yancey.	11 S	26 W	4, SE¼	Geo Taylor Commission Co[e]	S R Meredith	S R Meredith.
	HOT SPRINGS COUNTY						
*362A	Malvern, 1 mile south of				Wisconsin-Arkansas Lumber Co	L B Clifford Well Co	G S Smith[f]
*362B	Malvern.	4 S.	17 W.	15	Wm Kilpatrick		A H Purdue[g]
362C	Witherspoon, 3½ miles east of				"Brown s Springs"		G W Howard, postmaster

*For additional data see "Descriptive notes," following this table

[a] At Clayton, Ark

[b] Well near bridge over Ozan Creek, on Prescott and Northwestern Railroad.

[c] In town of Washington

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(SOUTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
	427		−26				Nacatoch.		401 feet to water rock	339
	Spring				1		Sabine			340
4	480	378	−60				Bingen			341
								Magnesia		342
	Spring						Sabine.		Noted for medicinal qualities	343
2	580	307	−30				Nacatoch		568 feet to water rock	344
2	555		−20				do		Casing, 35 feet.	345
2½	500		−25±				do		Casing, 30 feet	346
4	434		Flows				do	Soft	Cost, $130, casing, 60 feet	347
2	541		−16				do	do	Cost, $231 85, casing, 94 feet	348
	408	250	Flows				do	do		349
2	434	255	+18				do	do.		350
2	427	265	+ 6	407–427			do			351
4–2	500		− 9				do		Cost, $150, casing, 30 feet.	352
	498	316 4	−37	484–498			do		480 feet to water rock	353
	280					None				354
3¼	275						Bingen?			355
3	750	390	−35	90		None			Casing, 75 feet.	356
1½	245		−28					Soft.	Cost, 40 cents per foot.	357
	Shallow									358
	500					None				359
	450					None				360
	Spring						Nacatoch.	Saline		361
3	700					None			Casing, 30 feet	362
	478					50	Carboniferous		Water from fissures in rock	362A
10	250		+ 0	100?					Bored for oil, not finished.	362B
	Spring								Used medicinally	362C

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[d] Second Report of a Geological Reconnaissance of Arkansas, 1860, p 118
[e] "Walker Farm"
[f] Foreman for L B Clifford Well Co
[g] Water-Sup and Irr Paper U S Geol Survey No 102, 1904, pp 378–379

Wells and springs in southern Arkansas, northern

ARKANSAS

No	Location	Township	Range	Section	Owner	Driller	Authority
	HOWARD COUNTY						
363	Allbrook	11 S.	27 W.	2, SW¼ SW¼	Wm Blackwood	S R Meredith	S R Meredith
364	do	11 S	27 W.	4, NE¼ NE¼	W H Cowling	do	do
365	do	11 S	27 W	5	Joe Crofton	do	do
366	do	11 S	27 W.	5	H C Crofton		H C Crofton
367	do	11 S	27 W	5	H L Crofton		H L Crofton
368	do	11 S	27 W.	7			S R Meredith
369	do	11 S	27 W	9, NE¼ SW¼	Howard Turner	S R Meredith	do
*370	do	11 S	27 W	9, NE¼ SE¼	W A Coleman & Bro	do	do
371	do	11 S	27 W	9, NE¼ SE¼	—— McKee	do	do
372	do	11 S	27 W.	10, SW¼ NE¼	W A Coleman & Bro	R W Smith & Bro	W A Coleman
373	do	11 S	27 W.	10, NE¼ NW¼	do		do
*374	do	11 S	27 W	12, NE¼ SW¼	W W Johnson	R W Smith & Bro	
*375	do	11 S	27 W.	15, NE¼ SE¼	Wilson & Walker	S R Meredith	S R Meredith
376	do	11 S	27 W	16, SE¼ SE¼	T R Shirley	do	do
377	do	11 S	27 W.	16, SE¼	do	R W Smith & Bro	
*378	do	11 S.	27 W.	17, NE¼ SE¼	Allen Rose	S R Meredith	Allen Rose
379	do	11 S	27 W	17, NW¼ NE¼	R S Bell	do	S R Meredith.
380	do	11 S	27 W.	17, SW¼ NE¼	W L Bell	R W Smith & Bro	W L Bell
381	do	11 S	27 W.	17	A L Stewart		A L Stewart.
*382	do	11 S	27 W.	19, SE¼	W H Cowling[h]	S R Meredith	S R Meredith
383	do	11 S	27 W	19	do.[i]	do	do
*384	do	11 S	27 W.	20, NE¼	Willaby Smith	do	do
385	do	11 S	27 W.	20, NW¼ SE¼	Joe Crofton	R W Smith & Bro	Joe Crofton
*386	do	11 S	27 W	20	R W Smith	R W Smith	R W Smith.
387	Buckrange[j]	10 S.	27 W.	23, NE¼	John Cowling	D R Shuptine	D R Shuptine.
388	do.	10 S.	27 W	24, NW¼	S C Cowling	do	do
389	do	10 S	27 W.	26, SE¼	S G Goodlett	do	do
390	do.	10 S.	27 W	35 ?.	Wm Ingram	S R Meredith.	S R Meredith
391	do.	10 S	27 W.	36 ?	Aaron Calvin[k]	D R Shuptine	D R Shuptine
392	do	10 S	27 W	36 ?	W T Whitmore	do	do.

* For additional data see "Descriptive notes," following this table

[a] Water was soft when well was first completed, but became hard later

[b] Cleared after being used for a few years.

[c] Flow originally 4 to 5 gallons

[d] Flow February 11, 1903, 4 gallons

[e] Original head

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(SOUTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
3	340		− 30	300–340			Bingen		Casing 60 feet	363
3	480		− 80	380			do	Soft	Used in gin boiler, casing 25 feet	364
3	360		− 30	350			do			365
4	230		− 60	230			do	Soft[a]	Cost $125, casing 30 feet, drilled in 1886	366
2	283		− 20				do	Soft	Completed in 1898, cost, $100	367
3	?100		Flows							368
3	460		− 30	450			Bingen			369
3	500	350?	− 18	460–465 481–500			do	Turbid		370
3	460		− 13				do	Milky[b]		371
3	460	310?	+ 3	420	[c] ½		do	Soft	Casing 36 feet	372
3	434		No flow					Turbid		373
4-3	496	360?	− 22	400			Bingen	Turbid, soft	Cost $200, casing 42 feet.	374
2	430	320?	0 + 17	380 430	[d] 6		do	Soft		375
3	360	300?	[e] + 25	350	[f] 10		do	do	Water becomes turbid when pumped	376
	370		− 10	360			do	do		377
2	340		− 8	320		3	do	do	Casing 23 feet Well flowed from 1897 to 1900	378
3	444		(g)	410			do			379
2	320		− 18	300			do		Cost $100, drilled in 1900	380
2	300		Flows	250	8		do	Soft	Drilled in 1902, casing 20 feet	381
3	360		+ 30	340			do	do		382
6	330		Flows	300			do	do		383
3	466		− 1				do	do	Temperature 65° F, formerly a flowing well	384
2	347 5		Flows	347	4		do	do	Completed in 1901, flow has decreased, casing 30 feet	385
3	400		do	360			do	do	Casing 20 feet	386
3	50		− 15				do			387
3	130		− 20				do	Turbid		388
3	200		− 60				do			389
	360		−100	±300			do			390
	400		− 80				do	Very turbid	Drilled in 1883.	391
	380		−100				do	Hard		392

[f] Original flow, present flow ½ gallon

[g] Flowed when first completed

[h] Old Reeder place, house well

[i] Old Reeder place, farm well

[j] See also under Mineral Springs and Allbrook

[k] Bill Carter place

Wells and springs in southern Arkansas, northern

ARKANSAS

No	Location	Township	Range	Section	Owner	Driller	Authority.
	HOWARD COUNTY—continued						
393	Centerpoint.	8 S	28 W	14.	D J Sassamen	R W Smith.	D J Sassamen
* 394	Mineral Springs.	10 S	27 W.	19.			
395	do.	10 S	27 W	28, NW¼	W K Cowling	D R Shuptine	D R Shuptine
396	do.	10 S	27 W	32 ?, NE¼ ?	do	do	do.
397	do.	10 S	27 W	32, SE¼.	F Potter.		W H Cowling
* 398	Nashville	9 S	27 W	(a)	Capt D P Terry	S R Meredith	S R Meredith
399	Saratoga	11 S	27 W	29, NW¼ NE¼	Frank Smith	Frank Smith	Frank Smith.
400	do	11 S	27 W	29.	do		do.
* 401	do	11 S	27 W	29, NW¼ SE¼	Ed McJenkins	Frank Smith	do
* 402	do	11 S	27 W.	35, NE¼ NE¼	Thos L Jones.	R W Smith.	Thos L Jones
* 403	do	11 S	27 W.	33 [b]	Spates & Frick	R W Smith & Bro	do.
* 404	do	11 S	28 W	35	Conway & Williams	S R Meredith	S R Meredith.
* 405	do	11 S	28 W	35	do	do	do
406	do	11 S	28 W	35	do	do	do.
407	do	11 S	28 W.	36 ?	do	do	do.
	JEFFERSON COUNTY						
* 409	Dexter.						Postmaster
409A	Pine Bluff				Capt S Geirreiter		John J Martin, county surveyor
409B	do.				St Louis Stave and Lumber Co		St Louis Stave and Lumber Co
410	do				St Louis Southwestern Ry		J S Berry, superintendent water service
* 411	do				do.	W B Sharpe & Bro	R M Galbraith, general master mechanic
* 412	do				Pine Bluff Water and Light Co	do	F G Bridges, president [d]
413	do.				do		Superintendent
414	do				Sawyer-Austin Lumber Co	W B Sharpe.	Sawyer-Austin Lumber Co
* 415	do				Pine Bluff Ice Co		Jeff Hicks.
* 415A	do				Arkansas Cotton Oil Co	Johnson & Fleming	Arkansas Cotton Oil Co
415B	Pine Bluff, 10 miles from				Lees Springs		A C Peale [g]
415C	Pine Bluff, 8 miles southwest of				White Sulphur Springs		do [g]
* 416	Redfield				St Louis, Iron Mountain and Southern Rwy	C H Winters	C H Winters

* For additional data see "Descriptive notes," following this table

[a] In town

[b] Near post-office

[c] Depth February, 1903.

Louisiana, and adjacent portions of Mississippi and Texas—Continued.

(SOUTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks.	No
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
2	500		−98				Trinity	Hard, iron	Casing, 110 feet, drilled in 1901	393
	Springs				15		Bingen	Alkaline, iron	Many large springs	394
3	78	+300	Flows	78			do			395
3	160		−60				do			396
3	370±		−60				do			397
3	132	375	−35	120–132			do			398
3	600	310	− 8	±400			do			399
3	396		Flows				do			400
3	[c] 440								Incomplete	401
3½–2	787 6	385	−50?	750			Bingen	Soft	Casing, 720 feet	402
2–1	602	385	−60			Large	do	do		403
2½	455	290	+12		½		do	Brackish		404
	365		Flows				do			405
	355		do				do			406
	465		−16				do			407
	86	279	−36							409
	300									409A
3	92		−18	37–92			Quaternary	Sulphur		409B
10–5½	840	216	−20	840			Sabine	Very good, soft	Completed in 1897	410
10–8	890	216	−22			650	do	do	Strainer 60 feet, completed in 1899, temperature 64° F	411
8–6	905 915		[e] −31	864–915		[f] 600	do		Completed in 1898.	412
	70–90						Quaternary	Hard, iron	Abandoned	413
8	915		−47				Sabine	Soft, slight amount of iron	Forms soft red scale, completed in 1899	414
10	300		−26	26–100			Quaternary	Hard, iron	Temperature 64° F	415
4	826	±215	−28	806–826		+30	Sabine	Soft	Completed September, 1904	415A
	Spring				3–5				Resort	415B
	do				8			Sulphureted	do	415C
6	545	300	−60	404–412		20	Sabine			416

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[d] Letter, July 6, 1899

[e] In 1899 Level in 1902 was −46

[f] Two wells

[g] Bull U S Geol Survey No 32, 1886, pp 120, 121

Wells and springs in southern Arkansas, northern

ARKANSAS

No	Location	Township	Range	Section	Owner	Driller	Authority
	LAFAYETTE COUNTY						
417	Bolinger (Kress City)	17 S	24 W.	9[b]	Kress City Lumber Co	L B Clifford	L B Clifford.
*418	Bradley				H Smith.		G D Harris[a]
*419	Frostville.	18 S	25 W.		Red River Lumber Co	L B Clifford.	L B Clifford.
*420	New Lewisville, 2 miles west of	16 S	24 W.	18	do.	do.	do.
*421	New Lewisville.	16 S	24 W	14[d]	L B Clifford.	do	do
*422	New Lewisville, 2 miles south of	16 S	24 W.		Sam Owen	do.	do.
423	New Lewisville, 1 mile east of	16 S	24 W.		Sunny South Lumber Co		
*424	New Lewisville	16 S.	24 W.	(d)	Court-house	L B Clifford	L B Clifford
425	do.	16 S	24 W.	(d)	R R Moore.	J P Clifford	R R Moore.
*426	New Lewisville, 5 miles north of	16 S	24 W.	15	Lewisville Lumber Co	J M Phillips.	J M Phillips
*427	Stamps.				Bodcau Lumber Co	L B Clifford.	L B Clifford
428	do				do.	do.	do
429	do				do	do.	do.
	LINCOLN COUNTY						
430	[illegible]				General.		County clerk.
	LITTLE RIVER COUNTY						
431	Alleene	11 S	31 W.	36[d]	R L Johnson		R L Johnson.
432	do.	11 S	31 W.	25	H C Kingston		H C Kingston
*433	Arkinda.	11 S	33 W.	26.	J A Reinhardt[c]		J A Reinhardt.
*434	Ashdown	12 S	29 W.	32[d]	J R Bowles.		J R Bowles.
435	Cerro Gordo.	9 S	33 W.	36	State Salt Springs		D F Shall[f]
*436	Coleboro (Red River)	13 S	27 W.	27, SE¼ NE¼.	Geo W Orton		Geo W Orton.
437	do.	13 S	27 W.	29, SE¼ NE¼.	do.		do.
438	Coleboro (Lake Fulton)	13 S	27 W	31, NE¼ NE¼	A B Phillips.		do.

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* For additional data see "Descriptive notes," following this table

[a] Ann Rept Geol Survey Arkansas for 1892, 1894, p 83

[b] From 4-inch wells

[c] From 6-inch well

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(SOUTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
3 4 5	140	267		80–140	.	.	Quaternary	Good ...	Water in white sand and gravel, wells sunk in 1892, 1896, 1898	417
. .	37		.				. .do ..			418
4 6	156 364	255 255	−36 −36 −54	112–120 140–160 364	. .	*b* 35 *c* 52 Not used	Sabine.. . do. .	Alkaline Impotable	Used for town supply and boilers	419
6	502	262	−20 −30 −32 −44	75–79 204–234 300–320 468–482	. . . . ..	. .. .	Quaternary Sabine .do . . . do .	Alkaline. Good . . . .. Sulphur .	. .. .	420
. ..	79	.	−18	75–79			Quaternary?	.	.. . .	421
.	44		−20	36–44	. . .	. .	do	. .	. . . .	422
. .	232	270	Flows.	232	1	50	Sabine.	Sulphur, iron, magnesia	Completed in 1892.. ...	423
2	240	301	−35	223–240	. ...	. .	. . do. ..	.. .	Completed in 1902 .	424
2	250	307	−40	. .. ..	. .	..	.. do. .		.. . .	425
2	200	263 6	+ 1	150–200	½	25	. ..do . .	...	Completed in 1901.. .	426
8	415	260	+ 0	233–345 370–415	. . ...	600	. ..do . .. do.	Soft .... Sulphur	Water taken entirely from 233 to 345 feet, temperature 66° F	427
3	306	255	Flows	233–306	5	200	..do .	. . .	Completed in 1892 . . .	428
3	329	255	.do .	233–329	5	200	. do . .	.	Completed in 1893.	429
. . . .	18–30	....	. .. .	.... .			. . . ..	.. .	Water generally bad, rather soft	430
10	66	320	−56	56–66			Quaternary?	Hard ..	. . . .	431
8	75	330	−65	65–75			do .	. do....	. . . .	432
4	290	. . . .	.	. . . .	. ..	None			Drilled in 1899. .	433
96–4	70	....	19	19–25–70	.	Large	Quaternary?	Salty ...	Well 8 feet square, 25 feet deep, supplies gin	434
.	Spring	. . .	.	. . . .	. .	..	..	.	Salt springs	435
3	146	265	No flow		.	.	Nacatoch.	Salty ..	.. . .	436
3	160	265	− 8	. . .. ..	.		.do ..	Good	... ...	437
. .. ..	190	270	−11	. ... . .	.	. ..	.do ..	Soft	.. . . . .	438

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d In town
e Well started for camp of C C C C Co , but camp was transferred before well was completed
f Colton's map of Arkansas, 1857

Wells and springs in southern Arkansas, northern

ARKANSAS

No	Location	Township	Range	Section	Owner	Driller	Authority.
	LITTLE RIVER COUNTY—continued						
439	Coleboro (Red River)	14 S.	28 W.	2, SE¼ NE¼	Ed Moss		Geo W Orton.
*440	do	14 S	28 W.	2?	Frank Harkness	S R Meredith.	S R Meredith.
441	do	13 S	28 W.	2.	State salt springs.		D F Shall[a]
	Foreman						
*443	Hudson	13 S.	29 W.	15.	Hudson River Lumber Co	L B Clifford.	L B Clifford.
*444	Ogden	13 S.	29 W	36[b]	Judge M W Bates	S R Meredith.	S R Meredith.
*445	Rocky Comfort	12 S.	32 W	18, SE ¼	J T Holman		J C Branner[c]
446	do	12 S	32 W	28, NE¼ NE¼	Col A D Hawkins.		P B Williams, county surveyor
*447	do	12 S	32 W.	36.	C S Walker		C S Walker
*448	Rocky Comfort (Red River)	13 S	32 W	32.	Jesse L De Long.		Jesse L De Long.
449	White Cliffs[d]	11 S	29 W.	36 ?.	White Cliffs Portland cement works		S R Meredith.
450	White Cliffs, one mile south of						do
450A	Wilton	12 S.	30 W.	1, NE¼	P Kinsworthy		P Kinsworthy
450B	Winthrop	11 S	31 W	7	W A Black		P B Williams.
450C	do	12 S	31 W	7	King-Rider Lumber Co		do
	LONOKE COUNTY						
451					General[e]	J P Clifford	J P Clifford
*452	Austin				St Louis, Iron Mountain and Southern Rwy		E Fisher, chief engineer, bridges and buildings
453	Cabot.						Pump repairer, St Louis, Iron Mountain and Southern Rwy
454	Carlisle				—— Hemingway	J P Clifford	J P Clifford
455	Carlisle, 1½ miles from				—— Brady	do	do
	MILLER COUNTY						
456	Boggy	27 S	17 W.	34.	Lumber Company.	L B Clifford.	L B Clifford.
457	do	27 S	17 W.	34	do	Cook Well Co.	J P Clifford
458	do	27 S.	17 W	34.	do	J P Clifford.	do
459	Crank				J W Crank		J M *Montgomery*, county clerk
460	do.				A P Littleton.		do

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* For additional data see Descriptive notes,' following this table.

[a] Colton's map of Arkansas, 1857.

[b] In town

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(SOUTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No.
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
	190	270	−10				Nacatoch.	Good		439
3	300	270	−10	200-300			do	do	Casing, 60 feet	440
	Spring								Salt springs.	441
									See under Rocky Comfort	
4	830	319	−40	830			Annona			443
2½	224	300	−45	100-224			Nacatoch	Soft	Casing, 80 feet	444
	308					None			Abandoned	445
						do			Several hundred feet deep	446
4-2	500		−30			Small		Hard	Well abandoned, drilled in 1901	447
2	560	300				None				448
	325		Flows				Bingen	Hard.		449
	300-400		do				do	Salty		450
6	45-56		−35	45-56			Quaternary	Lime, iron	Water in gravel	450A
	Spring						Bingen?		"Big Springs".	450B
	do						do		Supplies sawmill	450C
2½-2	100						Quaternary		Water in gravel	451
8	394					28			Rock below 275 feet.	452
	137		−20						Many fossil shells at 14 feet.	453
2	160						Quaternary		Water in gravel	454
	±100						do		Blowing well	455
	310			270 310			Sabine do	Impotable Good		456
6	160		−15	160		50	do			457
4-2½	250		− 5	150 250			Sabine	Brackish Soft.	Casing, 150 feet Water associated with lignite bed	458
	Spring				Large		do		Magnesia spring	459
	do						do	Freestone		460

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[c] Trans Am Inst Min Eng for 1897, vol 27, 1898, p 48
[d] See also under Brownstown, Sevier County
[e] For southern portion

Wells and springs in southern Arkansas, northern

ARKANSAS

No	Location.	Township	Range	Section	Owner	Driller	Authority
	MILLER COUNTY—continued						
*461	Fort Lynn.				Fouke sawmill	J P Clifford	J P Clifford
462	Homan (Red River)	15 S	26 W.	2	J W Hervey	George Johnson	J M Phillips
463	do	14 S	26 W.	9.	Fuquay place	C D Hudson	Dr B Shirs
*464	do	14 S	26 W.	8	Bryant and B'Shirs	Hudson & Cornelius	C D Hudson
465	do	14 S	26 W.	5	Wilson place		W H McMuster
466	Homan (Scott Lake)	13 S	26 W	31 ?	Joe Richards	Hudson & Cornelius	C D Hudson
467	do	13 S	27 W.	36 ?	J Shultz	do	do
*468	Homan (Clipper Spur)	13 S	27 W.	36 ?	do	do	do
469	Homan (opp Fulton)	13 S	26 W.	20	do	do	do
470	do	13 S.	26 W.	19.	Captain Wheeler.	do	do
471	Homan (Red River)	13 S.	27 W.	24 ?	Jas Shultz	do	do
472	do	13 S	27 W.	26 ?	do	do	do
473	do	13 S	27 W.	32	Mrs Cloud (Augburn place)		W H McMuster
474	do	13 S	27 W.		Opposite Phillips place	George Johnson	J M Phillips
475	do	13 S	27 W.		Avery (Kinsworthy place)	James Yocom	C D Hudson
*476	do	13 S	27 W.	18-19	Joe Winters	Hudson & Cornelius	do
477	Mandeville				General		Postmaster
*478	Texarkana[a]	15 S	28 W.	29, SW¼ SW¼	Waterworks Co of Texarkana		R A Munson, superintendent
*479	do	15 S.	28 W	29, SW¼ SW¼.	do		do
*480	do	15 S	28 W	29, NE¼ NE¼	Oil company.		do
*480A	do				Home Ice Co	American Well & Prospecting Co	American Well & Prospecting Co
	NEVADA COUNTY						
481	Boughton[c]	10 S	22 W.	25.	Josiah Frisby heirs	Geo W Hines	Geo W Hines
482	do	10 S	22 W.	26, NE¼	John De Laughter	do	do
483	do	10 S	22 W.	26[d].	E De Laughter	do	do
484	do	10 S.	22 W	26[d]	do	do	do
485	do	10 S	22 W.	26[d]	—— Steward	do	do
486	do	10 S	22 W.	26[d]	St Louis Iron Mountain and Southern Rwy		do
487	do	10 S	22 W	27, SE¼ NE¼	W L Hines	Geo W Hines	do
488	do	10 S	22 W.	27 SE¼ NW¼	Geo W Hines	do	do
489	do	10 S	22 W	27 SE¼ SW¼.	Claud Buchanan	do	do
490	do	10 S.	22 W	27, NW¼ SW¼	do	do	do
491	Clayton	13 S.	23 W.	12.	J A Cafield		Postmaster

* For additional data see "Descriptive notes," following this table.

[a] See also 1067-1069 under Bowie County, Tex

[b] Whole system

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(SOUTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (–) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No
					Flow	Pump				
Inches	*Feet.*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
	190				Large		Sabine	Soft.	Water in coarse sand	461
	700-800	245					Nacatoch		Abandoned.	462
	492	250	Flows				do	Soft		463
	486	250	do	470-486			do	do		464
2			do				do	do		465
	300	250	– 0	290-300			do	do	Water rock, 2 feet thick.	466
	300		– 0				do	do		467
	270	255	– 4				do			468
2	140	254	Flows				do			469
	150	260	– 2				do		Water rock, 8 feet thick	470
	137	[a] 260	– 8				do	Good		471
	180	? 265	–13	170-180						472
			Flows				Nacatoch	Salty		473
	205		do do	180 205	Small Large			Fresh. Salty		474
	340		–13				Nacatoch.	do.		475
2	408	268	– 8				do.	do.		476
	25						Quaternary	Soft	Many large springs	477
360-5	45	295	–10	15-45		[b] 500	Lafayette ?	do.	Group of 52 wells	478
12-6	930	295	–28	825-925		187	Nacatoch	Salty	Drilled in 1897	479
12-6	1,390	297	–30	800-900			do		No oil, abandoned	480
	1,900		–15 – 5	880-900 911-941			do do	Brackish do		480A
	80-85		Flows				do		Flow has decreased greatly	481
	61		do				do			482
3¼	31	236 3	– 3				do			483
3¼	27	231 3	+ 1				do			484
	55	232 9	Flows	28-55			do			485
	18		+ 2				do		Well in bed of Garland Creek	486
3	72		–35				do	Hard.		487
3	63		–30				do	do		488
3¼	68		– 3				do			489
3¼	100		–50				do			490
Spring							Sabine		Sour spring, noted for medicinal properties	491

[c] See also under Prescott
[a] In village of Bougnton

Wells and springs in southern Arkansas, northern

ARKANSAS

No	Location	Township	Range	Section	Owner	Driller	Authority
	NEVADA COUNTY—continued						
492	Emmet[a]	11 S	23 W	22	Geo Wake	G B Hipp	G B Hipp
493	do	11 S	23 W	22	Sam Cowhorn	do	do
494	do	11 S	23 W	22, NW¼	Jas Prather	do	do
495	do	11 S	23 W	27	Chas Blagg	do	do
496	do	11 S	23 W	34, SW¼ SE¼	J M Holton	C B Moore	C B Moore
497	do	11 S	23 W	35, SW¼ SW¼	Ed Hood	do	do
498	do	11 S	23 W	35, NE¼ NE¼	R. A Landers		do
499	do	11 S	23 W	36, NW¼ SW¼	do	C B Moore	do
500	do	12 S	23 W	2, NW¼ NW¼	P McGroury	do	do
501	do	12 S	23 W	3, NE¼ NE¼	J A Hood	do	J A Hood
*502	do	12 S	23 W	3, NE¼ NW¼	C B Moore	do	C B Moore
503	do	12 S	23 W	3	Chas Lee		
504	do	12 S	23 W	3	Doctor Garner	C D Hudson	C D Hudson
505	do	12 S	23 W	3	J M Thompson	C B Moore	C B Moore
506		12 S	23 W	3, NE¼ SW¼	Village of Emmet	do	do
507		12 S	23 W	3, NE¼ SW¼	Robert Burns	do	do
508		12 S	23 W	12, NE¼	J A Calloway		J A Calloway
509	Garlandville[c]	11 S	22 W	3, SW¼	Mrs Gordon	G B Hipp	G B Hipp
510	do	11 S	22 W	10, SW¼	Mat Duncan	do	do
511	do	11 S	22 W	10, SW¼	H L Griffin	do	do
512	do	11 S	22 W	10, SW¼ SW¼	D T Milam	do	do
513	do	11 S	22 W	15, NW¼ NW¼	do	Geo W Hines	Geo W Hines
514	do	11 S	22 W	15, SE¼	Wiley Hatley	do	do
515	do	11 S	22 W	15, NE¼ NE¼	Sullivan place	G B Hipp	G B Hipp
	Lackland						
*516	Lanesburg	12 S	21 W	8			County surveyor
517	do	12 S	22 W	10, SE¼ SW¼	E Matthews		E Matthews
518	do	12 S	22 W	14, NE¼ SW¼	J A Alsobrook	Hudson & Cornelius	Hudson & Cornelius
519	do	12 S	22 W	14, NW¼	J A Nelson		C D Hudson
520	do	12 S	22 W	15, NW¼	W J Martin	J J Byers	do
521	do	12 S	22 W	16, NW¼ NE¼	J Matthews	do	do
522	do	12 S	22 W	16, SW¼ SW¼			D P Hazzard
523	do	12 S	22 W	17, SW¼ SE¼	G W Hudson	Hudson & Cornelius	Hudson & Cornelius
524	do	12 S	22 W	17, SE¼ SW¼	L Whitton	J J Byers	C D Hudson
*525	do	12 S	22 W	20, NW¼ NW¼	John Crain	Hudson & Cornelius	Hudson & Cornelius
526	do	12 S	22 W	20, SW¼	Pisgah School		C D Hudson
527	do	12 S	22 W	20, NE¼ SW¼	H C Bright	Hudson & Cornelius	Hudson & Cornelius
528	do	12 S	22 W	20, NE¼ NE¼	D P Hazzard		C D Hudson
529	Prescott	10 S	21 W	30, SW¼ SW¼	John Smith	Geo W Hines	Geo W Hines
530	do	10 S	21 W	30, SE¼ SW¼	John Hooks	do	do
531	do	10 S	21 W	30, SW¼ SE¼	Jas Mitchell	do	do

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* For additional data see "Descriptive notes," following this table

[a] For wells near Emmet, but in Hempstead County, see under Hempstead County

[b] Flow has decreased.

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(SOUTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No.
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
	± 80		− 8				Nacatoch.			492
	80		−15				do			493
	82		−10				do			494
4	130		Flows				do			495
	190		do		1½		do			496
	225		do				do.	Soft		497
4	172		do		3		do	do	Casing, 30 feet	498
4	202		do		3		do	do		499
	±250		do		½		do	do		500
3½	208.5	266.5	+ 1.5	200-208.5	1		do	do	199 feet to water rock, casing, 35 feet	501
3	206	270	− 2	192-206			do	do	Casing, 32 feet	502
	237						do		230 feet to water rock	503
3	293		−12				do		240 feet to water rock, supplied sawmill	504
3	228	292.5	−22				do	Hard		505
3	283	320.2	−50				do	do	265 feet to water rock	506
3	268		−20				do	do.	248 feet to water rock	507
3	328	±265	Flows		[b]1		do	Soft.	308 feet to water rock	508
3	50		−25				do			509
3	80		−60				do	Hard		510
3	30		−15				do			511
3	65	337.5	−40.6				do			512
3	60	333.5	−38.5				do			513
3	100		−35				do			514
3	82		−25				do			515
									See Prescott	
	225					None	Nacatoch		Abandoned	516
2	465	249.2	+11		3		do	Soft	Cost $300, casing 425 feet.	517
3	568	262.6	− 4	530-568			do	do	Cost $100, casing 30 feet.	518
3-2	542	284.4	−27				do		490 feet to water rock	519
	463	258.4	+ 0.5	420-463			do			520
	419	244.2	[d]Flows				do			521
	430	274.7	−11				do			522
	480	255.4	+ 3	466-480	0.2		do	Soft		523
	469	251	Flows		0.5		do	do		524
	456	266.8	− 0.8	400-456			do			525
		269					do		Formerly a flowing well.	526
	520	299	[e]−32	500-520			do			527
	436	261.2	Flows	400-436	0.2		do	Soft		528
3¼	165		−20				do	Hard		529
3¼	145		+10		½		do	Soft		530
3¼	155		− 0				do			531

[c] For wells near Garlandville, but in Hempstead County, see under Hempstead County

[d] Mr F Matthews states that water would rise 32 feet when well was completed in 1890

[e] Original level, present level lower

Wells and springs in southern Arkansas, northern

ARKANSAS

No	Location	Township	Range	Section	Owner	Driller	Authority
	NEVADA COUNTY—continued						
532	Prescott	10 S	21 W	31	Dave Defoe	Geo W Hines	Geo W Hines
533	do	10 S	21 W	31, NE¼ SW¼	Robt McNeely	do	do
534	do	10 S	21 W	32	Jas Breedlove	G B Hipp	
535	do	10 S	21 W	32	Ruff Andrews	Geo W Hines	Geo W Hines
536	do	10 S	21 W	33	Wm Hunt	do	do
*537	do	10 S	22 W	4	T J Williamson	do	do
*538	do	10 S	22 W	20	Smith Briley	do	do
539	do	10 S	22 W	20	Joe Arnett	do	do
540	do	10 S	22 W	28, SW¼	O M Billingsly	do	do
541	do	10 S	22 W	28, SW¼ NW¼	Avey Ward	do	do
542	do	10 S	22 W	29, SE¼ NE¼	do	do	do
543	do	10 S	22 W	29	Mrs J B Shanks	do	do
544	do	10 S	22 W	29, NW¼	do	do	do
545	do	10 S	22 W	30, NE¼	Jas Mitchell	do	do
546	do	10 S	22 W	31, SW¼ NW¼	—— Hale		
547	do	10 S	22 W	31, NE¼ SW¼	Mrs Ida Nelson	H W Wade	H W Wade
548	do	10 S	22 W	31, SW¼ SE¼	John Hale	J C Lowdermilk	J C Lowdermilk
549	do	10 S	22 W	31, SW¼ SW¼	John Matthews	Geo W Hines	Geo W Hines
550	do	10 S	22 W	34	Robert Hawkins	do	do
551	do	10 S	22 W	34	A Hawkins	do	do
552	do	10 S	22 W	34	I Hawkins	do	do
*553	do	10 S	23 W	13	Iron Springs		David Dale Owen[b]
554	do	10 S	23 W	35, SE¼	Dr E Hale	Geo W Hines	Geo W Hines
555	do	10 S	23 W	35	Geo McKain	do	do
556	do	10 S	23 W	35	Wm Britt	do	do
557	do	10 S	23 W	36, SW¼	J M Neal	do	do
558	do	10 S	23 W	36, SE¼	Chas E Clarke	do	do
559	Prescott (Wrye)	11 S	21 W	4, NE¼	James Andrews		do
560	do	11 S	21 W	7, SW¼	Parson Pheps	Geo W Hines	do
561	do	11 S	21 W	7, NE¼ SE¼	Geo Gatlin		Jas Lowdermilk
562	do	11 S	21 W	8, SW¼		Jas Lowdermilk	do
*563	do	11 S	21 W	15, NW¼	A J Bolls	Geo W Hines	Geo W Hines
564	do	11 S	21 W	18, NE¼	Jas Gibson	Jas Lowdermilk	Jas Lowdermilk
564A	do	11 S	21 W	18, NE¼	Jas Cummings	do	do
565	Prescott (Lackland)	11 S	21 W	28	J N Beane	Geo W Hines	J N Beane
566	Prescott	11 S	22 W	1, NE¼ NE¼	L Raines	do	Geo W Hines
567	do	11 S	22 W	1, SE¼	L H Hitt		do
568	do	11 S	22 W	2, SE¼ SE¼	Robt Barham	Geo W Hines	do
569	do	11 S	22 W	3, SE¼	Burnet Steele	do	do
570	do	11 S	22 W	4, NE¼	R M Walker		do
571	do	11 S	22 W	4, SE¼	Geo Gatlin		do
572	do	11 S	22 W	4, SW¼	Wm Gee	Geo W Hines	do

* For additional data see "Descriptive notes," following this table

[a] February, 1902

[b] Second Report of a Geological Reconnaissance of Arkansas, 1860, p 117

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(SOUTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
3¼	215		− 5				Nacatoch			532
3¼	192		− 3				do	Hard		533
	230		Flows		2		do			534
3¼	245		do				do	Soft		535
3¼	245		do		1		do	do		536
3¼	285				None		do		Abandoned	537
3¼	72	375	[a]− 53 5				do	Soft		538
3¼	47	345 2	− 25				do			539
3¼	120		− 20				do			540
3¼	66		− 28				do			541
3¼	72		− 35				do			542
3¼	76						do			543
3¼	165		−100				do		100 feet to water rock	544
3¼	70+		− 63	63-70			do	Slightly hard	Casing, 50 feet	545
			Flows				do			546
3	55	316	+ 1				do		2 flowing wells	547
3	80	313 6	Flows		½		do		60 feet to water rock	548
3	78		− 35				do			549
3¼	120		− 5				do			550
3¼	160		− 20				do			551
3¼	235		− 90				do			552
	Spring							Saline chalybeate		553
3¼	60		− 20				Nacatoch			554
3¼	80		− 50				do		Casing, 71 feet	555
3¼	63		− 40				do			556
3¼	72		− 35				do			557
3	75						do		Formerly a flowing well	558
3¼	315	250	− 35				do			559
	300		− 50				do			560
3	400		−100				do			561
	325		([c])				do			562
3 ¼	375	234	− 2 5				do	Soft	Wood casing, 47 feet, cost, $75	563
3	360		− 60				do			564
3	375		− 50				do		370 feet to water rock	564A
3¼	433	220	Flows		Large		do	Soft	Cost, $80	565
3¼	228		− 50				do	Hard		566
3¼	244		− 45				do			567
3¼	243		− 55				do			568
3¼	165		− 40				do			569
3			− 2				do		Formerly a flowing well	570
3							do		do	571
3	150	286	[d]− 1 3				do		120 feet to water rock	572

[c] Near the surface

[d] January, 1902. Formerly stood 1 foot above the ground.

Wells and springs in southern Arkansas, northern

ARKANSAS

No	Location	Township	Range	Section	Owner	Driller	Authority
	NEVADA COUNTY—continued						
573	Prescott	11 S	22 W	4, SW¼ NW¼	A Aburrow		Geo W Hines
574	do	11 S	22 W	5, SW¼ NE¼	Aug Clements		Aug Clements
575	do	11 S	22 W	5, SE¼ NW¼	do	H W Wade	Geo B Hipp.
576	do	11 S	22 W	6, SW¼ NE¼	Alf Francisco	do	H W Wade
577	do	11 S	22 W	6, SW¼ NW¼	John Steward	Geo W Hines	Geo W Hines
578	do	12 S	22 W	6, SW¼ SW¼	Levi Francisco		do
578A	do	12 S	22 W	7, NW¼ NE¼	Allen Francisco		do
*579	do	12 S	22 W	8, SE¼	Ozan Lbr Co	H W Wade.	H W Wade
*580	do	12 S	22 W	8, SE¼	Corporation of Prescott (water works)		do
581	do	12 S.	22 W.	9, NW¼	Orange Williams	H W Wade	do
*582	do	12 S.	22 W.	9	General		do
583	do	12 S.	22 W.	9	Furniture factory	Geo W Hines	Geo W Hines
584	do	12 S.	22 W	9	Longview Lbr Co	do	do
585	do	11 S	22 W.	10, SW¼	L W Greeson	do	do
586	do	11 S.	22 W.	10, NE¼	do	do	do
587	do	11 S.	22 W	11, NE¼	Robt Barham	H W Wade	H W Wade.
588	do	11 S	22 W	12, NE¼	Luther Briscom.	Luther Lavender.	Geo W Hines
589	do	11 S	22 W	14, SE¼	Jasper Garrette	J C Lowdermilk	J C Lowdermilk.
590	do	11 S	22 W	14.	Green Wiley	do	do
591	do	11 S	22 W	14, SW¼	do	do	do
592	do	11 S	22 W	14.	Sam White	do	do
593	do	11 S	22 W	16, SW¼ SW¼	—— Cummings	John Lowdermilk	John Lowdermilk
594	do	11 S	22 W	18, NE¼ SW¼	Benj Waller	J C Lowdermilk	J C Lowdermilk.
595	do	11 S	22 W	21, SE¼ NE¼	A Butcher	Luther Lavender.	do
596	do	11 S	22 W	21, NE¼ NE¼	Salem Church		do
597	do	11 S	22 W	22, NE¼ NW¼			do
598	do	11 S	22 W	23, SW¼ SW¼	O F Bowles		do
599	do	11 S	22 W	23, SW¼	J C Lowdermilk	J C Lowdermilk	do
600	do	11 S	22 W	23, SW¼	Public well	do	do
601	do	11 S	22 W.	23.	Holiness camp ground	do	do
602	do	11 S	22 W.	25.	M W Greeson	do	do
603	do	11 S	22 W.	26, NW¼ NW¼	J T McCaskill	do	do
604	do	11 S	22 W	27, NE¼ NE¼	T J Lavender		do
605	do	11 S	22 W	27, NW¼	A Smith		do
606	do	11 S	22 W	28, SW¼ NW¼	Jas Dukes	Geo W Hines	Geo W Hines
607	do	11 S	22 W	29, NE¼ SE¼	Kenor Gill	John Lowdermilk.	John Lowdermilk
608	do	11 S	22 W	30, NE¼	Sam Cantley		Sam Cantley
609	do	11 S	22 W	32, SE¼	John Lowdermilk.	John Lowdermilk.	John Lowdermilk.
610	do	11 S	23 W	2, SW¼ SW¼	Chas Freiburger	G B Hipp	G B Hipp

* For additional data see "Descriptive notes," following this table

[a] Formerly flowed 2 feet above the ground.

Louisiana, and adjacent portions of Mississippi and Texas—Continued.

(SOUTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No.
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
3	...	290	[a]−1	...	...	...	Nacatoch. .	...	...	573
3	125	...	−24	...	.	...	..do....	...	In 1885 water was 17 feet from the surface	574
3	100	300.1	−1.5	..	...		. do....	......	...	575
3	75	...	Flows	..	.	.	do ..	..	...	576
3	132	..	−55	..	..	...	..do.	....	...	577
3	125		−38	...	...	...	..do....	...	...	578
3	165	...	−50	.	..	...	. do....	...	...	578A
6	170	305	[b]−30	150–170	...	[c]42	do... .	Hard . ..	Group of 3 wells.	579
10	170	...	[b]−30	150–170	...	...	.. do... ..	...	Also two 3-inch wells	580
3	170	331	−60	...	...	...	.. .do....	.....	164 feet to water rock. .	581
3–10	170	...	−50	...	...	...	. .do....	...	Water level has lowered 5 feet in ten years	582
4½	160	309.1	−49	...	...	......	.do... ..	...	...	583
4½	164	...	...	...	...	...	. .do...	...	...	584
3¼	227	..	−45	...	..	...	.do. ..	...	...	585
3¼	220	...	−55	..	...	..	. .do....	...	...	586
3	290	.	−60	...	...	...	do......	...	...	587
3	280	.	..	...	...	...	do......	.	...	588
3	280	...	−30	240–280	..	..	.do......	...	...	589
3	240	...	Flows	...	½	...	. ..do......	Soft. . ..	Old Gibson mill well....	590
3	260	..	−10	...	..	...	. ..do. .. .	...	230 feet to water rock, gin well	591
3	237	...	−15	...	...	...	.do....	...	230 feet to water rock. .	592
3	185	..	−20	...	..	.	. do	...	...	593
3¼	200	..	−55	...	...	...	do .. .	...	...	594
3¼	230		−15	...	.	.	do... ..	...	...	595
3¼	...	...	...	...	..	...	.do ..	...	Formerly a flowing well.	596
3¼		..	..	.	...	.	. .do. ..	...	.. .do	597
3¼	...	...	−0	...	...	...	do...	...	Formerly flowed at +5 feet	598
3¼	250	...	−0	...	..	..	.do	Soft......	244 feet to water rock, formerly a flowing well	599
3¼	260	...	Flows	..	5	...	.do.....	. .do. ..	...	600
3¼	261	...	..do	251–261	7.5	...	.do.....	....do.. .	...	601
3¼	291	..	.do..	...	4	...	do......	.....do. ..	286 feet to water rock...	602
3¼	240	.	Flows	..	1	...	..do ..	..	...	603
3¼	240	...	.do..	...	4	.	..do.... .	..	230 feet to water rock...	604
3¼	220	...	..do..	.	..	..	..do....	..	...	605
3¼	228	...	. do..	...	..	..	. .do.. .	.	...	606
3¼	220	...	. do..		..	...	. .do....	...	...	607
3¼	180	...	−30	...	...	..	...do.. . .	...	...	608
3¼	315	.	Flows	.	.	..	.do......	...	...	609
3	90	...	−80	..	...	...	. .do.. ...	.	...	610

[b] Water lowers on pumping to 70 feet
[c] Average of each well

Wells and springs in southern Arkansas, northern

ARKANSAS

No	Location	Township	Range	Section	Owner	Driller	Authority
	NEVADA COUNTY—continued						
611	Prescott	11 S	23 W	11, NE¼ NE¼	M W Greeson	G B Hipp	G B Hipp
612	do	11 S	23 W	14, NE¼ SW¼	Cole place	do	do
613	do	11 S	23 W	23, NW¼	Andy Crumby	do	do
614	do	11 S	23 W	23	Artesian Church		J C Lowdermilk
	Sutton						
615	Verde	12 S	23 W	34	Thos Wylie		Thos Wylie
616	do	12 S	23 W	27	Doctor Hamilton?		C D Hudson
617	do	12 S	23 W	27	John Davis	J J Byers	do
618	do	12 S	23 W	23, NE¼ SW¼	Liberty Church		do
619	do	12 S	23 W	23, SE¼ NW¼	Wm Hameric	C D Hudson	do
620	do	12 S	23 W	23, SE¼ NE¼	John Crank	do	do
*621	do	12 S	23 W	13, SE¼ SE¼	Wm Hill	do	do
*622	do	12 S	23 W	24, SE¼ NE¼	Hamilton Bros	do	do
623	do	12 S	23 W	24, SE¼ SE¼	Rev M D Armstrong	do	do
624	do	12 S	23 W	25	Dr A W Hamilton	do	do
*625	Verde (Sutton)	12 S	22 W	31, SW¼ SW¼	C W Hamilton	do	do
626	do	12 S	22 W	30, SW¼ SW¼	W M Munn	Hudson & Cornelius	do
627	do	12 S	22 W	19, SE¼ NW¼	P Easterling	C D Hudson	do
	OUACHITA COUNTY						
*628	Bearden, 1 mile east of				Cotton Belt Lumber Co		Cotton Belt Lumber Co
628A	Bearden ?				do		do
629	Camden (Frenchport)	14 S	16 W	28, SW¼ NE¼	J D Wood		Geo T Goodwin, county surveyor
*630	Camden, 7 miles southeast of	14 S	16 W	21, SW¼ SW¼	A H Patton	J P Clifford	A H Patton
631	do	14 S	16 W	19, SE¼	Geo T Goodwin		Geo T Goodwin, county surveyor
632	Camden				Agee & Thompson	J P Clifford	J P Clifford
*633	Camden, 3 miles west of				John Work		David D Owen [f]
*634	Eagle Mills ?						Freeman-Smith Lumber Co
*635	Millville				Freeman-Smith Lumber Co		do
636	Onalaska				Onalaska Lumber Co	L B Clifford	L B Clifford

* For additional data see "Descriptive notes," following this table

[a] Very slight, would probably not lift more than a few inches

[b] In 1894

[c] Height to which water rose in 1894, was flowing at +6 feet in 1903

Louisiana, and adjacent portions of Mississippi and Texas—Continued.

(SOUTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality.	Remarks.	No.
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
3 3	55 72	...	−15 −30	...	...	...	Nacatoch..	..	...	611
3	140	...	−40	...	...	...	...do ...	...	...	612
3 3	120 100	...	−20 Flows	...	...	...	.do....	...	...	613
3	100	...	..do	...	½	...	...do....	.	...	614
...	.	...	...	...	...	...	...	...	See Verde ...	
4	428	...	− 6	420–428	...	...	..do...	Soft. ...	Cost $140, casing 30 feet	615
...	419	...	+ 2	...	...	...	..do...	...	...	616
..	393	...	Flows	...	4	...	...do. ..	...	...	617
...	360	265 4	. do	...	...	...	..do.. ..	...	...	618
2	380	269 5	Flows	...	...	...	.do...	...	350 feet to water rock..	619
2½	359	252	[b]+22	...	1½	.	... do.....	Soft.. ...	Cost $110, casing 40 feet.	620
3-2	390	260 4	+10	...	...	...	...do ..	..do...	Cost $100, casing 45 feet	621
...	400	256 6	[c]+17	...	...	.	...do....	...	...	622
3-1½	419	262 5	[b]+13	...	[d]1	...	.. do .	Mineral.	Cost $130, casing 30 feet	623
3	474	...	−17	...	...	...	... do ..	Soft .. .	Cost $100 ...	624
3	570	...	−44	515-570	...	.	.do	...	...	625
...	490	292	.	...	.	...	do...	.	Incomplete in February, 1902	626
3	437	266	Flows	...		..	...do ..	...	...	627
6	1,001	230	[e]−50 −40	300 312 850–910	... ..	 200	Cockfield Sabine ...	... Bad, alkaline	Well abandoned, drilled in 1898	628
..	55	230	.	...	...	...	Quaternary or Lafayette		5 wells in surface gravel, dry in summer	628A
	225	90	.	.	..	Not any	... ..	... .	Abandoned ...	629
2	135	90	−35	99–135	..		Eocene...	Soft .	Completed in 1885 .	630
2	86	90		..	...	....	..do.. ..	...	...	631
2	170	...		150–170	...	...	... do ..	...	Water in very fine quicksand	632
..	Spring	..	..	.	..	..	.. .	Alum	Alum spring ...	633
...	130	...	...	.	...	...	Quaternary?	...	Water in gravel...	634
...	470	205	...	153-170	...	...	Eocene ..	...	Abandoned. ...	635
2 4	161	129	−34	...	...	...	....do	...	...	636

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[d] Flow has decreased
[e] Lowers on pumping to −150 feet
[f] Second Report of a Geological Reconnaissance of Arkansas, 1860, p. 132

Wells and springs in southern Arkansas, northern

ARKANSAS

No	Location	Township	Range	Section	Owner	Driller	Authority
	OUACHITA COUNTY—continued						
*637	Ouachita River (Buffalo Flats)				U S Eng. test boring		M H Marshall[a]
*638	Ouachita River (Beech Hill)				do		do
*639	Ouachita River (Newport Landing)				do		do
*640	Ouachita River (Haidee Shoals)				do		do
*641	Ouachita River (Smackover Shoals)				do		do
642	Syre, ½ mile north of						W B Howard, postmaster
	PHILLIPS COUNTY						
642A	Helena	2 S.	5 E.		Arkansas Cotton Oil Co		Arkansas Cotton Oil Co
642B	do	2 S.	5 E.		Helena Ice Co.		A H Purdue[c]
643	do	2 S.	4 E.		Helena Water Co.		do
*644	do				Test borings		E W Hilgard[d]
	PIKE COUNTY						
645	Bowen	9 S.	23 W.	4, NE¼ SW¼	G B Lee	J B Dillon	J B Dillon
646	do	9 S	23 W	6, SW¼ SW¼	Harry Johnson	do	do
647	do	9 S	23 W.	7, NE¼ SW¼	Langley Brothers	do	do
648	do	9 S.	23 W	7, NW¼ SE¼	C C Tate	do	do
649	do	9 S.	23 W.	8, SE¼ SW¼	Schoolhouse	do	do
*650	do	9 S	23 W	8, NE¼	W H Ward	do	do
*651	do	9 S.	23 W	8, SE¼ NE¼	do	do	do
652	do	9 S.	23 W.	8, NE¼ SE¼	do	do	do
653	do	9 S.	23 W	8, NW¼ SW¼	Dr J R Rogers	do	do
654	do	9 S	23 W.	12, NW¼ NW¼	East Brothers		Capt T M East
*655	do	9 S	23 W	15, NE¼	Jack Wingfield	J B Dillon	J B Dillon
*656	do	9 S.	23 W.	17, SE¼ NW¼	May heirs	do	do
*657	do	9 S	23 W	17, SW¼	Hewitt Brothers	do	do
658	do	9 S.	23 W.	17, NE¼ NW¼	John Hewitt	do	do
659	do	9 S.	23 W	18[e]	Hewitt Bros & Broch	do	do
660	do	9 S.	23 W.	18[e]	Public well, Bowen	do	do
661	do	9 S.	23 W.	18[e]	John Tate	do	do

*For additional data see "Descriptive notes," following this table

[a] Rept Chief of Eng for 1902, pt 2, 1902, pp 1568-1570

[b] Varies with height of river

[c] Water-Sup. and Irr. Paper No 102, U S Geol Survey, 1904, pp. 380-381.

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(SOUTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
	71.9	64.4							0.9 mile above Newport Landing	637
	15.2	62.61							0.5 mile above Newport Landing	638
	109.55 50.00 50.00 15.06 35.14	63.61 60.03 54.88 70.86 63.61								639
	54.53 48.23	49.57 58.30								640
	33.14	56.99								641
	Shallow.							Salty, alum	Near salt lick	642
6	110		5–15,	95–100			Quaternary.	Hard, alkaline.		642A
6	500		−30			10	Eocene	Soft		642B
8	543						do	Very good		643
	236.8 206.4								Test boring of Mississippi River Commission	644
4	236	399.3	−30				Bingen			645
4	134		+ 0		Small		do			646
4	148	295	+ 2	148	½		do			647
4	155	300	+ 0	155	Small		do			648
4	194		−25	194			do			649
4	234	370	−62.5	234			do	Hard		650
4	254	383	−90?	254			do			651
4	300	396	−80	300			do		Well abandoned	652
4	198	334	− 8					Hard		653
	200	240	Flows	200	½		Bingen	Soft		654
4	390	379	−90	390			do			655
4	205	273	+ 2	205	3		do			656
4	200	267	Flows		Large		do	Soft	Completed in 1900	657
4	198	317.6	+ 1				do		Supplies sawmill	658
4	197	312.0	+ 2		½		do	Soft	Well at gin	659
4	212	325	− 9				do			660
4	220	333.6					do			661

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[d] Rept of Miss River Com 48th Cong, 1st sess, House Ex. Doc. No 37, 1884, pp. 485–488.

[e] At Bowen post-office.

Wells and springs in southern Arkansas, northern

ARKANSAS

No.	Location	Township	Range	Section	Owner	Driller	Authority
	PIKE COUNTY—continued						
662	Bowen	9 S.	23 W	18, NW¼ NE¼	Johnson heirs	J B Dillon	J B Dillon
663	do	9 S.	23 W	18, NE¼ NE¼	do	do	do
664	do	9 S.	23 W	18, NE¼ SW¼	do	do	do
665	do	9 S.	24 W	2, SE¼ SE¼	Robt Langley	do	do
666	do	9 S	24 W	11	C K Garner	do	do
667	do	9 S.	24 W	11, NE¼ NE¼	McLaughlin heirs	do	do
668	do	9 S.	24 W	12, SW¼ NW¼	Mt Pisgah Church	do	do
669	do	9 S.	24 W	12, NW¼ SW¼	W M Jones	do	do
670	do	9 S	24 W	12, SW¼ SE¼	J B Roundtree	do	do
671	do	9 S	24 W	12, SE¼ SE¼	do	do	do
672	do	9 S	24 W	do	do	do	do
673	do	9 S.	24 W	13, NE¼ NE¼	J M Avery	do	do
674	do	9 S.	24 W	13, SE¼ NE¼	J B Dillon	do	do
675	do	9 S	24 W	13, SW¼ NE¼	Jas McLaughlin	do	do
676	do	9 S.	24 W	13, NW¼ SE¼	John Hendrix	do	do
677	do	9 S.	24 W	13, SE¼ NE¼	C. Harris	do	do
678	do	9 S.	24 W	13, NE¼ SE¼	John Harris	do	do
679	do	9 S.	24 W	do	Jack Wingfield	do	do
*680	do	9 S	24 W	do	do	do	do
681	do	9 S.	24 W	13, SW¼ NE¼	W R Brown	do	do
682	do	9 S.	24 W	13, NW¼ NE¼	C Harris	do	do
683	do	9 S.	24 W	13, NE¼ NW¼	Thos Garner	do	do
*684	do	9 S.	24 W	13, NE¼ SW¼	B M Linville	do	do
685	do	9 S.	24 W	14, NE¼ NE¼	Burl Williams	do	do
686	Broektown	8 S.	24 W		General		Postmaster
*687	do				do	J B Dillon	J B Dillon
*688	Delight	8 S.	23 W	(d)	R A F Key		P J Gault, superintendent
*689	do	8 S.	23 W	(d)	do		do
*690	do	8 S	23 W	31, NW¼ NW¼	J P Copeland, jr	J B Dillon	J B Dillon
691	do	8 S.	23 W	31, SW¼ NW¼	J P Copeland	do	do
*692	do	8 S	24 W	36, SE¼ SE¼	Mrs Buckner	do	do
*693	Murfreesboro	8 S	25 W	20	M M Manney		M M Manney
*694	do	8 S.	25 W		General		W M Gould
695	do	7 S.	25 W	33	General Royston		David Dale Owen[f]
*696	Pike City	7 S	24 W	28	Pike City		J H Purcell
697	do	7 S.	24 W	29	Pike City Lumber Co		do
*698	Wolf Creek	8 S.	24 W	10, SE¼ NW¼	Oil company		Wm Grayson

* For additional data see "Descriptive notes," following this table

[a] Original head

[b] Well has caved and this water level probably does not represent the true water head from the Bingen sand

[c] Curb very imperfect and water escapes into the surface gravels

Louisiana, and adjacent portions of Mississippi and Texas—Continued.

(SOUTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No.
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
4	210	340	− 30				Bingen			662
4	204	335					do			663
4	162	277	Flows				do			664
4	80	324	+ 0		Small		do			665
4	86		Flows				do			666
4	100	333.3	− 5				do			667
4	94	316	+ 2		1½		do	Soft		668
4	96	316	[a]+ 6		1		do			669
4	220	394.5	[b]− 38				do	Hard		670
4	210	380	− 40				do	do		671
4	187		Flows		Small		do			672
4	215	375	− 60				do			673
4	210	371	− 60				do			674
4	214	367	− 40				do		Surface beds 48 feet thick	675
4	202	343	− 17				do		Surface beds 30 feet thick	676
4	220	367	− 50				do		Surface beds 56 feet thick	677
4	180	328	− 5				do		Surface beds 12 feet thick	678
4	191	341	− 18				do			679
4	143	296	+ 2½		12		do	Soft, chalybeate	Rather gin well	680
4	205	361	− 30				do			681
4	160	315	+ 0		Small		do			682
4	145	315	Flows		½		do			683
4	150	282	Flows	150	10±		do	Soft		684
4	130	302	Flows	302	Small [c]		do			685
	20–30									686
4										687
12–8	195	330	[e]− 6				Bingen? [f]			688
48	32	350	− 15	27–32			do			689
4	70	425	− 64	70			Bingen	Soft		690
4	110	435	− 95	110			do	Hard		691
4	80	369	− 84?				do	do		692
48	50		− 10	10–14			Lafayette?	do		693
	25						do	do		694
	Spring						do	Saline, chalybeate		695
8	150	675	− 25							696
8	200	650	− 4							697
	1,400	450							Unsuccessful well for oil.	698

[d] At station

[e] Formerly a flowing well

[f] Second Report of a Geological Reconnaisance of Arkansas, 1860, p 125

Wells and springs in southern Arkansas, northern

ARKANSAS

No.	Location.	Township.	Range.	Section.	Owner.	Driller.	Authority.
	POINSETT COUNTY.						
*699					General	C. H. Winters	C. H. Winters
700	Greenfield (east side of ridge).				Greenfield Lumber Co.	do	do
701	Greenfield (west side of ridge).				do	do	do
702	Harrisburg				—— Bratcher	do	do
	POLK COUNTY.						
703	Mena				Kansas City Southern Rwy.		A. Rusk, chief engineer.
*704	do				New York and Arkansas Oil Co.	M. P. Oliver	M. P. Oliver
	POPE COUNTY.						
*705	Russellville				St. Louis, Iron Mountain and Southern Rwy.		E. Fisher, engineer, bridges and buildings.
	PULASKI COUNTY.						
*706	Alexander				St. Louis, Iron Mountain and Southern Rwy.	Brant & Ritz	E. Fisher, engineer, bridges and buildings.
707	Baring Cross				do		Division engineer.
*708	East Little Rock				do	C. H. Winters	C. H. Winters
709	Sweet Home				—— Bowman	J. P. Clifford	J. P. Clifford
710	Wrightsville				Wm. Ferral	do	do
	ST. FRANCIS COUNTY.						
711	Forrest City				Town		County clerk
	SEVIER COUNTY.						
712	Ben Lomond	10 S.	29 W.	11			
*713	do	10 S.	29 W.	22?			David Dale Owen[b]
714	do	10 S.	29 W.	33, NW¼ NW¼	Reuben Murphy	D. E. Cornelius	S. R. Meredith
715	do	10 S.	30 W.	35?	W. C. Hopson		do
716	do	10 S.	30 W.	35?	T. M. Beck		do
*717	do	11 S.	29 W.	5, NE¼	S. R. Meredith	S. R. Meredith	do
718	do	11 S.	29 W.	7, NE¼	D. A. Brooks	do	do
*719	do	11 S.	29 W.	7, NW¼ NE¼	do	do	do
720	do	11 S.	29 W.	7, SW¼ NE¼	A. S. Rhyme	do	do
721	do	11 S.	29 W.	7, SW¼ SE¼	H. P. Hasilip	do	do
*722	do	11 S.	29 W.	8, NW¼	A. S. Rhyme	do	do
*723	do	11 S.	29 W.	8, NW¼ NE¼	W. I. Beck	do	do

* For additional data see "Descriptive notes," following this table.

[a] Varies with river. Lowers 4 feet when pumping 300,000 gallons per day.

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(SOUTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
	30–35 250–300						Quaternary Eocene			699
2	300		− 16	300			do			700
2	290		− 60	290			do			701
	140			140						702
10	700								Sunk in 1896	703
	1,615		− 20 −100							704
12–10	1,006		− 19	50		40		Soft		705
10	308	330	− 37			110		Soft	Casing, 37 feet	706
10 6	87 65		(a)			200	Quaternary do	Hard do	Water from gravel bed on bed rock	707
8	66	268	− 27				do	do	Bed rock at 66 feet	708
	140	? 250	Flows.				Eocene	Soft	At mill Water below black clay	709
	120	257	No flow				do	do		710
4 6	465 465						do			711
	Shallow							Brine	Old salt works	712
	do							do	do	713
3	300		−100				Bingen			714
3	80	325	− 7				do			715
3	130	300+	Flows				do			716
3	300	410	− 96				do	Soft	Casing, 18 feet	717
3	360	385 ?	− 60	300–360			do	do		718
3	180	285	+ 30	140–180			do	do		719
3	180	285	Flows	100 180	5			Hard Soft		720
3	216	285	do	160–216	4		Bingen	do		721
3	400	325	− 6				do		Gravel at 400 feet, casing, 20 feet	722
3	540	440	−125	330–540			do		Gravel at 540 feet, casing, 20 feet.	723

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[b] Second Report of a Geological Reconnaissance of Arkansas, 1860, p 115.

Wells and springs in southern Arkansas, northern

ARKANSAS

No	Location	Township	Range	Section	Owner	Driller	Authority
	SEVIER COUNTY—continued						
724	Ben Lomond (Browns Creek)	11 S.	29 W	9, NE¼ NW¼	W C Sutton		S R Meredith
725	do	11 S	29 W	16, NW¼ NW¼	Mrs Walker		do
726	do	11 S	29 W.	16, SE¼ NW¼	P S Kinsworthy		do
727	Ben Lomond	11 S	29 W	17, SE¼ SE¼	John Toland		do
728	do	11 S	27 W.	17, NW¼ NW¼	W I Beck	S R Meredith	do
729	do	11 S	27 W	18, NW¼ NE¼	do		do
730	do	11 S	30 W.	1, NE¼ SE¼	Mrs Sarah Rhyme	S R Meredith	do
731	do	11 S	30 W	1, SE¼ SE¼	T M Beck	do	do
732	do	11 S	30 W	1, SE¼ NW¼	do	do	do
733	do	11 S	30 W	2	W E Walker	do	do
734	do	11 S.	30 W	2?	W C Hopson		do
735	Brownstown	11 S	29 W	11	J E Smith	S R Meredith	do
736	do	11 S.	29 W.	23?[a]	do	do	do
737	do	11 S	29 W	24	Capt D B Coulter	do	do
*738	do	11 S	29 W	24	do		John C Branner[b]
739	do	11 S	29 W	10?	Abel Ryan.	D R Shuptine.	D R Shuptine
740	do	10 S	29 W	10?	E V Maxey.	S R Meredith.	S R Meredith.
741	Chapel Hill.	8 S	32 W	20?	Salt springs		D F Shall[c]
742	Lockesburg, 4 miles south of				J H Sharpe		
743	Milford	10 S.	29 W		General		Postmaster
744	Paraclifta						
*745	Ultima Thule				"Graham Salt Works"		David Dale Owen[d]
	UNION COUNTY						
*745A	Blanchard Springs						J K Ramsey
745B	do						A C Peale[e]
*746	El Dorado, southwest of				N Bussey.		David Dale Owen[f]
746A	El Dorado.				Arkansas and Texas Consolidated Ice Co	A M Milton	A M Milton
746B	do				El Dorado Cotton Oil Co	Cook Well Co	do
*747	Ouachita River (Franklin Shoals)				U S Eng test boring		M H Marshall[g]

* For additional data see "Descriptive notes," following this table

[a] In river bottom south of Brownstown, 1 mile above White Cliffs

[b] Trans Am Inst Min Eng, vol 27, 1898, p 51

[c] Colton's map of Arkansas, 1857

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(SOUTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata.	Quality	Remarks	No
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
3	160	290	Flows				Bingen			724
3	128	290	do				do	Soft		725
3	135	285	do				do	do		726
	100+	285	do				do	do		727
3	132	285	do				do	do		728
3	162	285	do	140–162			do			729
3	150	285	+ 25	120–150			do		Casing, 60 feet	730
3	114	285	Flows	114			do			731
3	90	285	do				do			732
3	80	285	do				do	Soft	Flow has increased	733
3	80	285	do				do		2 wells	734
3	530	400+	−100	300 400–500		Small Large		Hard Soft		735
3	400	280	Flows	350–400					Gravel at 400 feet	736
3	330		− 60	300–330						737
										738
	225 150		−125 − 10							739
	200		− 30	120 200				Hard Soft		740
	Spring							Brine		741
	200					None			Abandoned	742
	28							Soft	Considerable difficulty in obtaining water	743
									See under Ben Lomond	744
								Brine		745
	43	200	Flows				Eocene			745A
	Spring				30		do	Saline, sulphuretted		745B
	do							Saline, chalybeate		746
6	142		18	130		42	Eocene	Soft, iron		746A
8	150						do			746B
	50 50	54 82 55 64								747

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[d] Second Report of a Geological Reconnaissance of Arkansas, 1860, p 112

[e] Bull U S Geol Survey No 32, 1886, p 119

[f] Second Report of a Geological Reconnaissance of Arkansas, 1860, p 136

[g] Fifty-seventh Cong, first sess, House Doc No. 448, 1902, Rept. Chief of Eng for 1902, pt 2, 1902, pp 1568–1570.

Wells and springs in southern Arkansas, northern

ARKANSAS

No	Location	Township	Range	Section	Owner	Driller	Authority
	UNION COUNTY—continued						
*748	Ouachita River (Jacks Island)	...	...	...	U S Eng test boring.	...	M H Marshall .
*749	Ouachita River (Perigeethe Shoals)	...	...	...	..do...	...	do ...
*750	Ouachita River (Marie Saline Landing)	...	...	...	do..	...	.do. ...
*751	Ouachita River (Rowland Raft)	...	...	...	.do ...	...	..do. ...
*752	Ouachita River (Yerricks Slough)	...	...	...	.do...	...	..do ...
753	Upland.	...	...	...	Summit Lumber Co	...	John D Ainsworth, postmaster
754	Upland, 1 mile southeast of	...	...	...	..do...	L B Clifford Well Co	L B Clifford . ..
	WHITE COUNTY						
*755	Higginson..	...	...	...	St Louis, Iron Mountain and Southern Rwy	C H Winters .	C H Winters.. .
							LOUISIANA
	AVOYELLES PARISH						
756	Bunkie ..	1 S ..	3 E .	...	General ..	...	Postmaster. ....
757	.. .do	1 S.	3 E...	...	Bunkie Compress and Warehouse Co	...	Bunkie Compress and Warehouse Co
*758	... .do ...	1 S. .	3 E..	...	Union Oil Co.....	...	Union Oil Co. ...
*759	. ..do ...	1 S. .	3 E..	...	Bunkie Ice and Bottling Co	...	C J Pope, president
760	. ..do ...	1 S.	3 E...	...	Texas and Pacific Rwy	...	G W Reiber, pumpman
761	Bunkie, 1 mile west of	1 S .	3 E..	...	—— Sentell	L B Hart Well Co.	L B Hart Well Co
762	Cottonport . . .	1 S. .	4 E. .	...	Lemoine Brothers	..do..	. .do...
*762A	Eggbend	...	..	...	T L. Grimes ...	...	T L Grimes .. .
763	Mansura..	1 N.	4 E..	...	Emil Regard.....	...	Emil Regard. .
764	... .do ...	1 N..	4 E...	...	Regard cotton gin	L B. Hart Well Co.	L B Hart Well Co.

*For additional data see "Descriptive notes," following this table

Louisiana, and adjacent portions of Mississippi and Texas—Continued.

(SOUTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality.	Remarks.	No.
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
...	202 5 50 30 52	50 03 57 54 53 22	...	...	...	...	...	...	...	748
...	50	52 26	...	...	...	...	...	...	...	749
...	35 4	46 56	...	...	...	...	...	...	...	750
...	68 9 50	51 08 48 55	...	...	...	...	...	...	...	751
...	32 8	58 7	...	...	...	...	...	...	...	752
...	100	...	...	...	...	...	Eocene ...	...	...	753
...	200	−20	...	...	...	...	... do ...	...	...	754
...	62 5	...	−10	...	...	...	Quaternary.	...	...	755

(NORTHERN)

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Flow	Pump	Geologic horizon of water-bearing strata	Quality.	Remarks.	No.
...	12–40	...	...	...	...	...	...	...	...	756
4	180	65	− 10	...	...	66	Quaternary.	...	...	757
4	158	...	− 8	...	...	50	.. do ...	Hard, alkaline	...	758
4	140	.	− 16	115-140	...	100	... do ...	Hard ..	Strainer, 16 feet ...	759
4 4	142 90	...	− 13	...	...	...	.. do ..	...	...	760
...	135	...	− 10	...	...	...	.. do ...	Hard ...	2 wells ...	761
...	135	...	...	...	...	...	do ...	... do ...	...	762
...	35–60	...	...	...	...	...	.. do ...	... do ...	...	762A
6	110	...	− 32	...	...	140	. do ..	Alkaline, magnesia	...	763
...	135	...	...	...	...	...	... do ...	...	...	764

Wells and springs in southern Arkansas, northern

LOUISIANA

No.	Location	Township	Range	Section	Owner	Driller.	Authority
	AVOYELLES PARISH—continued						
*765	Marksville	2 N.	4 E.		Natchez and Marksville Oil Co	W B Sturm	A W Meyers, foreman
*766	do	2 N.	4 E.		General		C P Couvillion
*767	do	2 N	4 E.		Corporation	Andrews Well Co.	do
	BIENVILLE PARISH						
*768	Arcadia	18 N.	5 W.		Vicksburg, Shreveport and Pacific Rwy	Andrews Well Co	H P Touzet, foreman for Andrews Well Co
768A	do	18 N	5 W.		Levy Compress Co.	Will A Strong	Will A Strong
*769	do	18 N.	5 W.	19	Dr J C Christian		Dr O Lerch [b]
*770	Jamestown	15 N.	8 W.		John Gigleux	John Gigleux	John Gigleux
*771	Kings Salt Works	15 N	8 W.	34-35	H P Wardlaw		A C Veatch [c]
*772	Rayburns Salt Works	15 N.	5 W.	34.	A G Whitlow		A C Veatch [d]
	BOSSIER PARISH						
773	Alden Bridge	20 N	13 W.	34 [e]	Whited & Wheless	L B Clifford Well Co	L B Clifford
*774	do	20 N.	13 W.	34 [e]	do	do	do
775	Allentown	18 N	11 W.	11 [e]	Allen Brothers & Wadley		Allen Brothers & Wadley
*776	Antrim	22 N	13 W.	27 [e]	Antrim Lumber Co	L B Clifford Well Co	Thos A Antrim, president
777	Arkana				Trigg Lumber Co.	do	L B Clifford
*778	Benton	20 N.	13 W.	30 [e]	W H Smith & Son.	J P Clifford	W H Smith
779	Benton, 1 mile north of				Lone Star Mill	do	J P Clifford
780	Benton				do	do	do
781	Benton, 4 miles east of				Hanks Sawmill.	do	do
*782	Bolinger	23 N.	13 W.	34	S H Bolinger & Co	L B Clifford Well Co	
*783	Bossier City, 3 miles north of				Cash Plantation	A L Pullin	A L Pullin

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* For additional data see "Descriptive notes," following this table

[a] See note

[b] Geology and Agriculture of Louisiana, pt 1, 1892, pp 46-47.

[c] Geol Survey Louisiana, Rept. of 1902, pp. 76-80.

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(NORTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No.
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
16	1,282	85		42–132 243–259 452–523		40	Quaternary	Hard		765
	40–150			40–45 65		Small Large	Quaternary	Hard		766
6–4	[a]290	82	− 42			100		Brackish	Public well, used for stock	767
8–6	540	363	−130	40 150–165 415–465 535–540?		53	Sabine	Hard	Supplies water tank, pumped with air lift	768
5–3½	535	370	−136	435			do	Soft	Casing and strainer, 480 feet	768A
									Mineral well	769
2	145	235		142			Sabine	Hard		770
5? 36	136 10–20	160 160	− 2				Nacatoch	Brine	Salt manufactured from 1840 to 1865	771
	10–20						do		Salt manufactured from 1840 to 1877	772
4	286	209	− 30	140–160 260–286		 42	Sabine do	Strongly alkaline Good [f]	In red sand In gray sand	773
6	233	211		120–140 230–233		 125	do do	 Good [f]	 In gray sand	774
5	110		− 9				do	Soft	Used for boilers in sawmill	775
5	300	255	− 6	160–263			do	do	Fine for boilers and drinking	776
3	110								Completed in 1896	777
2½	350	215	[g] − 20			Large	Sabine	Soft	Completed in 1899	778
3	196	215	([g])				do		Water above a bed of lignite	779
3	140	215	− 8				do			780
2½	170	215					do	Soft		781
3 4 4	235 235 315	309	− 40	162–235		Large	do	do	Used for mill and drinking, temperature, 64° F	782
3	330	177	−35	50–130 155–160 180–185 315–330		Large 20	Quaternary Sabine	Hard do Bad Good	Completed in 1898, casing, 120 feet.	783

[d] Op cit, pp 71–75
[e] In town
[f] Also reported "a little hard"
[g] Flowed for a short time.

Wells and springs in southern Arkansas, northern

LOUISIANA

No	Location	Township	Range	Section	Owner	Driller	Authority.
	BOSSIER PARISH—continued						
*784	Bossier City, 2½ miles north of				Benj Gray	A L Pullin	A L Pullin
*785	Bossier City				Shreveport Cotton Oil Co		
*786	do				Hamilton Oil Mill Co	Stoer & Backus	Stoer & Backus
787	Bossier City, 5 miles southeast of				J H Fullilove	do.	J H Fullilove.
*788	Collinsburg, 8 miles south of	21 N	14 W.		Will Sentell.		
789	Curtis	17 N	13 W.		A Curtis.		A Curtis
790	Curtis Station.	17 N.	13 W.		do.		
791	Foster Station.	18 N.	13 W		J F Foster		J F Foster
792	Foster Station, 1 mile north of	18 N	13 W		J M Foster Planting Co.		J M Foster Planting Co
793	Haughton	18 N.	11 W		R L McAnn	Stoer & Backus	Stoer & Backus
794	Poole	15 N	11 W.		Connell, Moss & Co	do	do
	Red River Valley				General	A L Pullin	A L Pullin
	CADDO PARISH						
*795	Belcher	20 N.	14 W.	5.	Glassell Brothers	A L Pullin	A L Pullin
*796	do.	20 N	14 W.	5	John Glassell	do	do.
*797	Belcher, 3 miles northeast of	21 N	14 W.	34	Colonel Swan.	do.	do
798	Blanchard	18 N	15 W.	3.	R T Coal & Son	do.	R T Coal.
*799	Dixie	20 N	14 W	29	M A & J D Dickson		
*800	Dixie, 2½ miles east of	20 N.	14 W.	26	John Sentell	A L Pullin	A L Pullin
*801	Dixie, 3 miles southwest of	19 N	15 W	2.	Glassell & Adger	do.	E M Adger
*802	Furrh.				Furrh & Co	do	A L Pullin
*803	Missionary	23 N	14 W.	4	W B Means	Stoer & Backus	Stoer & Backus

* For additional data see "Descriptive notes," following this table

[a] Flowed for a short time

[b] Water lowered on pumping to 30 feet below the surface

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(NORTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks.	No.
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
2½	330	175	^{a} −28	300-330		10	Sabine	Slightly hard	Completed in 1898, casing, 80 feet	784
4	600	170	^{b} −30	225-235			do		No water below 235 feet.	785
6-4	195	170	^{b} −12	147-159			do	Hard	Screen placed from 147 to 159 feet, end of casing at 169 feet	786
2½-1	210	164	^{c} −12	172-210		10	do	Iron, alkaline	Temperature, 66° F	787
2½	600	195	−15	30-120- 232-240-			Quaternary Sabine	Hard. Soft.	Well at Lake Point on Red River	788
2½	197	174	−15	197			do	Soft, alkaline	Temperature, 66° F, casing, 100 feet	789
	200±	170 ±						Poor		790
3	210	167	^{d} −14	200-210		20	Sabine	Hard.	Casing, 150 feet	791
3	215	167	−10			20	do	Soft	Casing, 140 feet	792
2½-1¼	250	230		200-250			do	do	1¼-inch screen from 200 to 250 feet, completed in 1890	793
	300 ?			105-111					Screen placed 105-111 feet	794
									See No 804	
3-2	260	186.5	−12	245-260		Large	Sabine	Soft	Casing, 3 inches, 0-160 feet, 2 inches, 160-220	795
2½	225	187.5	− 8	213-225			do	do	Temperature, 66° F, casing, 100 feet	796
2½	240	193	− 4	30-125 230-240		Large do	Pleistocene Sabine	Hard Soft.	Gravel at 125 feet, Crescent place	797
3	185	227	−16				do	Soft, fine	Casing, 100 feet	798
2½-1½	371	182	−12	219-225			do	Soft	No water below 225 feet	799
3 3	391 182	183	−16	170-182		16	do	Soft, brackish		800
	425	175		425		Large		Hard, salty	Abandoned	801
3	750								Dry hole, abandoned	802
3-2	290	205	^{e} +0.4	152-158 262-270	1	50	Sabine	Soft	Completed in 1900.	803

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[c] Lowers on pumping to −24 feet

[d] Depth to water in 1898 was 6 feet

[e] Sept. 20, 1902 In 1900 water would rise 2 feet

Wells and springs in southern Arkansas, northern

LOUISIANA

No	Location	Township	Range	Section	Owner	Driller	Authority
	CADDO PARISH—continued						
*804	Red River Valley	...	...	...	General	A L Pullin	A L Pullin[a]
*805	Robson	16 N	12 W.	18	Captain Robson	do	do
*806	Shreveport (Market street and Cross Bayou)	...	...	...	Shreveport Ice Co	American Well Works Co	F Collins, chief engineer
*807	Shreveport (Louisiana avenue and Cross Bayou)	...	...		Shreveport waterworks	A L Pullin	H F Juengst, C E
*808	Shreveport (Spring between Texas and Milam streets)	...			Henry Rose	Stoer & Backus	Stoer & Backus
809	Shreveport (Market and Cypress streets)		...	...	Shreveport Street Railway	...	L M Levison
810	Shreveport (Edwards and Cypress streets)	...	...	...	Shreveport Gas, Electric Light and Power Co	...	Engineer
811	Shreveport (Marshall and Crockett streets)		...	...	Shreveport Athletic Association	Stoer & Backus	Chas Stoer
*812	Shreveport (Milam and Louisiana streets)	...		...	The Inn	do	do
813	do	...	...	...	Aloe Simpson	do	do
814	Shreveport (Louisiana and Donavan streets)	...		...	Andrew Currie	...	...
815	Shreveport (Louisiana and Howell streets)	...	...	...	Queen City laundry	Stoer & Backus	John Sewell, proprietor
816	Shreveport (Louisiana and Lake streets)	...		...	Star bottling works	do	Chas Stoer
*817	Shrevport (Commerce and Battle streets)	...	...	...	City Ice Co	do	—— Alexander, manager
818	Shreveport (Texas and Tryon streets)	...	...	...	Chas Stoer	do	Chas Stoer
819	Shreveport (Texas street)	...	...	...	C C McCloud	do	do

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* For additional data see "Descriptive notes" following this table

[a] Geol Survey Louisiana, Rept for 1899, 1900, pp 179-181

[b] Depth also given, 165-175

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(NORTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No.
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
...	...	...	...	...	...	...	...	...	...	804
4	225	155	−16	79–106	...	Large	Pleistocene	Hard, alkaline, iron	Completed in 1898 ...	805
				225	..	...do..	Sabine	Soft, magnesia		
4	996	171	−20	200±	.....	...	...do....	Soft...	With gas, temperature, 84° F	806
			+15	961–996		...	Nacatoch.	Brine....		
5 4½ 4½	[b] 250	171	−30	200±	....	[c] 25	Sabine...	Soft...	Water used in making ice, temperature, 70°± F	
6–4½	244	194	−43	218–228	..	[d] 70	....do...	..do....	City supply from filtered surface water	807
4–2½	280	185	−18	...	...	20	...do..	...do...	Temperature, 66° F...	808
4	120	185	..	120	....	.....	...do....	.....do..	Good for boiler purposes	809
4	350±	185	−40	.....	.....	...	...do.....	Slightly hard	....	810
6–4	338	182	−24	106 150 ?	....	30±	..do.....	Alkaline, soft	Casing, 6-inch, 0 to 96 feet, 4-inch, 96 to 150 feet, screen, 20 feet	811
4–2½	324	190	..	99–109 148–163 ?	...	30	....do...	Soft....	Pumps sand if pumped hard	812
4–2½	335	195	−32	93–105 125–130 ?	....	...	...do	....	Casing, 4-inch, 0 to 83 feet, 2½-inch, 83 to 157 feet, used for laundry	813
	Springs	....	..	.....	±50	...	....	Soft......	Used largely for drinking water in Shreveport	814
3	150±	177	−4 5	....	......	Large.	Sabine...	...do...	Used for laundry in 1898	815
3–1½	137+	185	−30	117 ?	...	.do ..	....do....	....do....	Casing and screen, 137 feet, temperature, 68° F	816
6–4	150	182	.	140–150	...	[e] 7	....do.....	...do....	Water scales badly.....	817
6–4	180	182	−18	....	.....	9				
6–4	290	182	.	.....	.....	7				
2½	350±	215	−20	.....	.....	.....	....	....	....	818
2½	220	....	.....	....	...	.....	....	....	....	819

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[c] Each well

[d] Test November 1899

[e] With air lift, driller reports 24 gallons each with deep-well pump

Wells and springs in southern Arkansas, northern

LOUISIANA

No.	Location	Township	Range	Section	Owner.	Driller	Authority.
	CADDO PARISH—continued						
820	Shreveport (M, K & T and T & P crossing)	...	...	...	Shreveport Ice Co ...	A L Pullin ... Stoer & Backus....	A L Pullin.. ... Chas Stoer... ..
821	Shreveport Junction	..	...	...	Texas and Pacific Rwy	American Well Works Co	...
822	..do.	...	...	...	Stave factory ...	...	Chas Stoer.... ....
823	Shreveport (High House addition)	...	...	...	R. E Bell.	Stoer & Backus..	..do .. ...
824	Shreveport.....	..	...	...	T C Backus. ...	. .do.	...do .. ..
825	Shreveport (Olive street)	..	..	...	Claiborne Foster . .	Chas Stoer. ... A L Pullin. ...	.. do .... A L Pullin.... ..
826	. .do..	...	...	...	J M Foster..	. ..do. ...... Chas Stoer.	. do . .. . Chas Stoer .. ....
827	Shreveport (9-Mile House)	...	...	.	S B Nichols. ..	Richter & Pullin. .	. do... ...
828	Shreveport, 2½ miles southeast of, on Grigsbys Island	17 N.	13 W..	...	Ardis & Co.	...	U H Brown, agent .
*829	Shreveport, 3 miles southeast of, on Shreves Island	17 N.	13 W..	..	Aug Mayer..... .	...	Aug Mayer .. .. ..
830	Shreveport, 4 miles southeast of, on Harts Island	17 N	13 W.	.	Andrew Querbes .	...	Chas Stoer. . ...
831	Shreveport, 8 miles southeast of, on Dogwood Place	17 N	13 W.	...	R. K Colquitt .	Stoer & Backus.. .	..do . ... ..
*832	Shreveport, 10 miles southeast of, on Bayou Pierre	..	...	...	A H Leonard . ..	. . do .. .	Stoer & Backus .
*834	Surrey	20 N	16 W.	1...	...	...	A C Veatch[d]..... ..
*835	Uni	20 N.	14 W..	..	Uni Plantation. .	A L Pullin .. .	A L Pullin . .. ...
836	Uni, 1 mile west of....	21 N.	14 W.	8. ..	W S Taylor....	. .do.	. ..do.... . ....
	CALDWELL PARISH						
*837	Blankston. ...	14 N	3 E ..	....	U S Eng test boring.	...	M H Marshall[e] .. .
*838	Clarks.	12 N	3 E..	..	Clark Spur Lumber Co	Oscar Shanks......	Oscar Shanks..... ..
839	. . do.	12 N	3 E..	. .	.do....	. ..do....	. ..do.... .... . .
*840	. . do.	12 N	3 E..	..	. .do	. .do........ . .	.. .do.... . ...

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* For additional data see "Descriptive notes," following this table

[a] Estimated by engineer 75 gallons

[b] Slight smell of hydrogen sulphide

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(NORTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls.*	*Galls*				
6–4½	237	230		140–146 213–225		+30	Sabine	Soft	Completed June, 1899, temperature, 68° F	820
6–4½	338	230	−45	140–150 ?		[a]+30	do	Iron, soft[b]	Completed June, 1901, lignite at 240 feet	
7	561	230	−50	80–100 250–280		60	do	Soft	No water below 280 feet	821
4 2½	180	230	−60				do			822
2½–1½	225			120–123 140–144 ?			do	Soft	Casing, 158 feet, completed September, 1901	823
2½–1½	103+			103			do	do		824
2½	160						do	do	Casing, 100 feet	825
2½	245	240±					do	do	Completed in 1890	
2½	225	230±					do	do	do	826
2½	180						do	do	Casing, 80 feet	
2½	197							do	Completed in 1897	827
2½	210	176	−18			+ 5	Sabine	do	Does not scale boilers, temperature, 67 5° F	828
2½	201	172	−15	100			Quaternary	Alkaline, hard	Completed in 1893	829
				200		10	Sabine	Soft		
2½–1½	197	170	−20				do	do		830
2½–1½	288	167	[c]− 8			Large	do	do	Casing, 110 feet	831
2½–1½	205		−18			do	do	do	At gin	832
	55						Quaternary	Hard, sulphur		834
	650	185				None			No water in sand between 190 and 198 feet	835
	370					do			Same section as Uni well	836
	51 50 50	27 15 27								837
	208	150±	−70	135–145		68	Cockfield	Soft	Completed January 1, 1903	838
	300	150±	−80	252–300		50	Cockfield?	Iron	Completed August, 1901	839
	180	150±	−80	110–150		30	do	do	Bad for boilers and drinking Completed in 1902	840

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[c] Owner reports 15 feet

[d] Geol Survey Louisiana, Rept for 1899, [1900] p 190

[e] Rept. Chief of Eng. for 1902, pt. 2, 1902, pp 1560–1563

Wells and springs in southern Arkansas, northern

LOUISIANA

No	Location	Township	Range	Section	Owner	Driller	Authority
	CALDWELL PARISH—continued						
*841	Columbia	13 N	3 E	17	Town of Columbia	Oscar Shanks	County clerk
*842	Columbia, 2 miles below	13 N	3 E		U S Eng test boring		M H Marshall[a]
*843	Columbia				do		do
*844	Columbia, 1 mile above				do		do
*845	Columbia, 2 miles above				do		do
*846	Columbia, 3 miles above				do		do
*847	Ouachita River (Call Landing)				do		do
*848	Ouachita River (Lower Breston place)				do		do
*849	Ouachita River (Upper Breston place)				do		do
*850	Ouachita River (Smithland)				do		do
	CATAHOULA PARISH						
*851	Black River (New Hope place)	6 N	7 E		Test boring		M H Marshall[a]
*852	Black River (Star View place)	6 N	7 E		do		do
*853	Black River (Jones Bayou)	7 N	6 E		do		do
*854	Catahoula Lake						
*855	Leland				Catahoula Oil and Development Co		S McDowell, president
*856	Olla	11 N	2 E		St Louis, Iron Mountain and Southern Rwy		E Fisher, chief engineer of bridges and buildings
857	Olla, 1 mile south of	11 N	2 E		Smith & Adams Lumber Co		Smith & Adams Lumber Co
*859	Ouachita River (Catahoula Shoals)				Test boring		M H Marshall[a]
860	Tullos	10 N	1 E		St Louis, Iron Mountain and Southern Rwy		Postmaster
861	Tullos, northeast of						A R Kilpatrick[c]
*862	White Sulphur Springs	7 N	2 E				S.H Lockett[d]

* For additional data, see "Descriptive notes," following this table.

[a] Rept Chief of Eng for 1902, pt 2, 1902, pp 1560-1563

[b] See "Descriptive notes"

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(NORTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute.		Geologic horizon of water-bearing strata	Quality	Remarks	No.
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
4-2	503	65	+ 35	423–503	20		Sabine	Soft magnesia	Completed August, 1903	841
	43	15								842
	52	18.5								843
	220	20								844
	48	28								845
	52	24								846
	50 50	14 16								847
	47	13								848
	52 52	17 18								849
	47	19								850
	39 41	5 2								851
	50	8								852
	50	6								853
	Springs							Salty	Numerous salt springs	854
	1,550		Flows	(b)	10		Cockfield		Salt water with gas, temperature 86.5° F	855
	374					Small			Abandoned	856
	297	150±	−130			Large.	Cockfield	Sulphur, iron	Not used	857
	197	11	Flows	158–197	60		Catahoula			859
	400±	106					Cockfield	Salty		860
	Springs							Brine	Bayou Castor salt springs	861
	do						Catahoula	Sulphur		862

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[c] De Bow's Review, vol 12, 1852, pp 268–269

[d] Ann Rept Louisiana State Univ for 1869, 1870, p 57.

Wells and springs in southern Arkansas, northern

LOUISIANA

No	Location	Township	Range	Section	Owner	Driller	Authority
	CLAIBORNE PARISH						
862A	Haynesville				Hampton Stave Co.	Chas Halloway.	Hampton Stave Co
*863	Lisbon, 6 miles east of	21 N	4 W.	15			Dr O Lerch[a]
864	Stateline	23 N	8 W.		J F Deloach & Bro.	Stoer & Backus.	Chas Stoer
	CONCORDIA PARISH						
	Black River						
865	Black River station	7 N	6 E		Natchez, Red River and Texas R R		A A Gardner, vice-president
866	Ferriday				Texas and Pacific Rwy		B S Wathen, chief engineer
*867	Fish Pond				do		C H Chamberlin, division engineer
868	Helena				New Orleans and Northeastern R R		S McDowell
869	Vidalia	7 N	10 E		Natchez, Red River and Texas R R		A A Gardner, vice-president
870	do	7 N	10 E		Concordia Oil Co		S McDowell
	DE SOTO PARISH						
*871	Frierson	15 N	13 W.		R G Hedrick		Foreman
871A	Grand Cane, 3½ miles from						A C Peale[b].
	EAST CARROLL PARISH						
*872	Hays Landing	20 N	13 E		Test boring		E W Hilgard[c].
*873	Lake Providence	21 N	13 E.		do		do
874	do	21 N	13 E.		Town of Providence	L B Hart Well Co	F J Powell, mayor.
*875	do	21 N	13 E.				G D Harris[d].
	FRANKLIN PARISH						
876	Wisner	12 N	8 E.		St Louis, Iron Mountain and Southern Rwy	C H Winters.	C H Winters.
	GRANT PARISH						
*877	Colfax	6 N.	3 W.	7	Town of Colfax	L B Hart Well Co.	L B Hart.
878	Fairmount	5 N	3 W.		General		Postmaster
879	Georgetown	9 N	1 E		do		do
*880	Pollock	6 N	1 E.		Big Creek Lumber Co		

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* For additional data see "Descriptive notes," following this table

[a] Preliminary report on the wells of Louisiana south of the Vicksburg, Shreveport and Pacific Railway Geol and Agr. of Louisiana, pt 2, 1893, p 118

[b] Bull. U. S Geol. Survey No. 32, 1886, p. 124.

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(NORTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
4–3	600	350±	−20			Large	Sabine.	Soft.	Completed in 1904.	862A
	Spring.									863
3–1½	285		−65	205–285			Sabine.	Good, soft	Completed in 1900, casing 200 feet	864
									See under Catahoula Parish	
5	70						Quaternary.			865
	950	60	Flows	950	Small.	Large	Catahoula.	Brine	Alluvial deposits, 0–80, yellow clay, 80–950	866
4	145		−10	105–145		140	Quaternary		Used for locomotives	867
	340?	60	Flows					Brine.	Probably refers to Ferriday well	868
5	70	63	−40			15	Quaternary			869
	300±	63					Catahoula	Fresh.		870
8–4	1,500	198	Flows	241–281 998–1,275	10		Sabine Nacatoch?	Salty	Not tested Salt water with gas, temperature 70° F	871
					+60		Sabine.		De Soto Mineral Springs, local resort	871A
	181	100±							Test boring of Mississippi River Commission	872
	248	105								873
6	271	105	−22			80	Eocene	Good		874
	112	105					Quaternary.		Water excessively ferruginous	875
	100	75	−30			+50	Quaternary.			876
2½	1,128	96	−15 +65	70–130 1,103	 [e] 40	Large.	Quaternary. Cockfield.	 Salty.	Gas at 660 and 1,100 feet, 2 ounces of salt per gallon	877
	25	94					Quaternary.	Hard.		878
	35	76						Soft.	Below 35 feet water is salty	879
8–4	910	88	[f] +16	255	2		Catahoula.	do	Used for drinking purposes	880

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[c] Ann Rept Miss River Com for 1883 48th Cong, 1st sess, House Ex Doc No 37, 1884, pp 494–496

[d] Geol Survey Louisiana, Rept of 1902, pp 231–232

[e] In 1900, in 1902 flow reported 20 gallons

[f] In 1896, in 1902 would rise only 5 feet.

Wells and springs in southern Arkansas, northern

LOUISIANA

No	Location	Township	Range	Section	Owner	Driller	Authority
	GRANT PARISH—continued						
*881	Rochelle	9 N	1 E		Louisiana Lumber Co (Ltd)	Oscar Shanks	Oscar Shanks
*882	Sandspur (Antonia station)	7 N	1 E		St Louis, Iron Mountain and Southern Rwy	do	do
*883	Stay	6 N	1 W		S Hopper Mill Co	do	do
	JACKSON PARISH						
*884	Ansley	16 N	3 W	5	Davis Bros	L B Clifford Well Co	L B Clifford
*885	Hodge	16 N	3 W	19	Hute-Hodge Lumber Co	do	do
*886	Jonesboro	15 N	3 W	31	Southern Arkansas Lumber Co	do	G S Smith
*887	Wyatt				Wyatt Lumber Co	do	L B Clifford
	LINCOLN PARISH						
*888	Chautauqua Station				Louisiana Chautauqua		Dr O Lerch[a]
889	Dubach	20 N	3 W	26	Fred B Dubach Lumber Co	L B Clifford Well Co	L B Clifford
*890	Ruston	18 N	3 W		Ruston waterworks	do	do
891	do	18 N	3 W		Ruston Compress Co	do	do
	MADISON PARISH						
892	Barnes	16 N	13 E		Vicksburg, Shreveport and Pacific Rwy		R B Coxe, superintendent water division
*893	Delta	16 N	15 E		do		do
*894	Mound	16 N	14 E		do		F L Maxwell
	MOREHOUSE PARISH						
*895					General		A E Washburn, parish surveyor
*896	Bastrop	21 N	5 E		Court-house		W A Harrington
*897	Collinston	20 N	6 E		St Louis, Iron Mountain and Southern Rwy	C H Winters	C H Winters
*898	Mer Rouge	21 N	7 E		do	Oscar Shanks	Oscar Shanks
899[b]	Oak Ridge	19 N	7 E		do	C H Winters	C H Winters

* For additional data see "Descriptive notes," following this table

[a] Geology and Agriculture of Louisiana, pt 1, 1893, pp 46–47

[b] Chief engineer gives depth in 1902 as 137 feet

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(NORTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
	565	80	+ 5	555-565	1	75	Cockfield ..	Salty...	Abandoned . . .	881
6	75	189	− 45	60-75	. .	124	Lafayette? .	Soft . .	Group of three wells ..	882
6	78	. .. .	− 45	60-78	. ...	100	.. ...	. do...	Water in gravel......	883
5	245	190	− 33	190-245	......	100	Sabine....	Soft ...	Pumping 100 gallons per minute water lowers to 80 feet	884
4	300	205	− 36	292-300	.. ....	50	.. . do...	..do..	Casing, 300 feet, completed in 1901	885
5	545	200	− 34	500-545	...	40	.. do...	..do....	Well at planer, completed in 1901	886
4	538	200	− 34	490-538	.. .	34	. . do. ..	. do...	Well at sawmill, completed in 1902	
4	302	200±	.. − 52	242-252 272-302	. .	55	. .do....	..do....	.. ..	887
.	Spring	..	.	. . . .	... . .	...	. . .	Iron ...	... .	888
5	179	135	+ 6	173-179	. ..	Large.	Sabine .	Soft	Many fossil shells above water horizon	889
8-6	425	288	[b]−120	120-126	.... .	..	Claiborne (lower)	. . .	Will lower 40 feet when pumping 100,000 gallons per day	890
				373-425	.	68	Sabine. ..	Soft.. .		
4	449	301	−140	.	.	68	. .do. .	..do..	Supplies compress and ice factory	891
.... .	72	81	(c)	28-72	. . .	... ..	Quaternary	.. . . .	Used for locomotives	892
. ....	1,200±	87	[c]− 38	12-50 100-135	. . . .	. ..	. . . .	. . . .	No water below 135 feet	893
6	135	83	[c]− 30	.	.... .	.. .	Quaternary	.. .	Used for locomotives	894
.	25-60	.. .	.	. . . .	. .	. . .	Quaternary	Slightly hard	.. . .	895
36±	153	[d]113.4	[d]− 67.1	67-153	. . .	.. ..	...do . .	..	.. . .	896
6	81	79	− 8	64-81	.... .	140+	.. do . .	. . . .	Good soft water, excellent for locomotives	897
6	79	93	− 7	79-89	. . . .	70	.do... .	Iron	Completed in 1898. ...	898
.. .. .	40	(c)	. ..	24-40	. . ..	....	.. . do	. .. ..	... .	899

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[c] Varies with height of river

[d] Harris, G D, Geol. Survey Louisiana, Rept of 1902, p. 231

Wells and springs in southern Arkansas, northern

LOUISIANA

No	Location.	Township	Range	Section	Owner	Driller	Authority
	NATCHITOCHES PARISH						
900	Allen				General		D A Blackshear
*901	Boleyn	9 N.	10 W.	19	Petty & Brown Lumber Co		D G Petty
902	Campti, 2 miles northeast of				Louisiana Railway and Navigation Co		Louisiana Railway and Navigation Co
903	Derry				General		Postmaster
*904	Goldonna[a]	12 N	5 W.	21	Louisiana and Arkansas Rwy	H H Jones	H H Jones
905	Grappes Bluff	11 N.	8 W.		Sawmill	A L Pullin	A L Pullin
*906	Luella	9 N.	6 W.		J W Cockerham, jr.		J W Cockerham, jr.
907	do	9 N.	6 W.		do		do
*908	Montrose	7 N.	6 W.		Montrose Lumber Co		J C Rives, secretary
909	Natchitoches	9 N.	7 W.		City waterworks	Clifford Well Co.	Judge C H Levy, superintendent
*910	do	9 N.	7 W.		do		do
*911	do	9 N	7 W.		Natchitoches Normal School	Andrews Well Co.	President Caldwell
912	Natchitoches, 1 mile west of	9 N.	7 W.		Fourth of July Spring		G D Harris[c]
*913	Natchitoches, 1½ miles northwest of	9 N.	7 W.		Iron Springs		do
*914	Natchitoches, 2 miles northwest of	9 N	7 W		Breazeale Springs		do
915	Natchitoches, 2 miles north of	9 N.	7 W.		Sulphur Spring		
916	Sans Souci	11 N	6 W.	22			
917	Weaver Spur				Weaver Bros.	Stoer & Backus.	Chas Stoer
	OUACHITA PARISH						
*918	Bosco				U S Eng test boring.		M H Marshall[d]
*919	Cheniere, 3 miles southeast of	17 N.	3 E.		Louisiana Oil Co		
*920	Logtown				U S Eng test boring		M H Marshall[d]

* For additional data see "Descriptive notes," following this table.

[a] See No 994, Drakes Salt Works, Winn Parish

[b] Flowed for a short time after completion

Louisiana, and adjacent portions of Mississippi and Texas—Continued.

(NORTHERN)—Continued.

Diameter of well.	Depth of well.	Approximate elevation of surface.	Height of water above (+) or below (−) the ground.	Depths of principal water-bearing strata.	Yield per minute.		Geologic horizon of water-bearing strata.	Quality.	Remarks.	No.
					Flow.	Pump.				
Inches.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Galls.*	*Galls.*				
....	Springs.	....	....	....	....	....	Sabine.......	....	Many chalybeate springs.	900
1	412	250±	+20	412	....	....	.....do......	Good.....	....	901
....	Spring.	....	....	....	....	....	....	.....do....	Supplies railroad tank by pipe line.	902
....	....	....	....	....	....	....	....	....	No wells. Cisterns used exclusively.	903
....	475+	....	....	....	....	....	....	....	Test well..............	904
4	155	145	−25	....	....	....	Quaternary.	....	Water in coarse sand and gravel. 30-foot screen.	905
4	707	111	−20 Flows. ..do..	36-300? 640 700-707	....	....	.....do ?..... Sabine...... .....do......	Iron...... Salty..... .....do....	....	906
4 4 4	36 86 106	110	−20	....	....	10+	Quaternary.	Iron......	....	907
6	496	100	....	80-180	....	Large.	.....do......	Poor......	No water below 180 feet..	908
4	457	130	− 4	200-220 457	....	....	Sabine...... .....do......	Salty..... Brine.....	Salt water with gas.....	909
360 1½	19-64	....	− 3	....	....	200	....	Good, soft	....	910
4-2½	726	130	− 1.2 .... [b]− 0.5	35-38 96-108 710-726	....	 25	Claiborne?.. Sabine...... .....do......	Brine..... Fresh..... Brine.....	Small amount of gas at 710 feet.	911
....	Springs.	....	....	....	....	....	.....do......	....	Local resort............	912
....	...do....	....	....	....	....	....	.....do......	Iron......	....	913
....	...do....	....	....	....	....	....	.....do......	....	....	914
....	...do....	....	....	....	....	....	.....do......	Sulphureted.	....	915
....	...do....	....	....	....	....	....	.....do......	Iron......	Local resort............	916
4-2½	308	....	−17	188	....	....	Cockfield...	Good.....	Casing, 188 feet.........	917
....	44 32	25 16	....	....	....	....	....	....	....	918
....	515	85	Flows.	265-275 465-515	.... Small.	....	Sabine.......	....	....	919
....	50 50	15 17	....	....	....	....	....	....	....	920

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[c] Geol. Survey Louisiana, Rept. of 1902, pp. 147-148.
[d] Ann. Rept. Chief of Eng. for 1902, pp. 1564-1566.

Wells and springs in southern Arkansas, northern

LOUISIANA

No.	Location	Township	Range	Section	Owner.	Driller	Authority
	OUACHITA PARISH—continued						
*921	Monroe				Consolidated Ice Co	Will A Strong	Will A Strong
*922	do				do		Consolidated Ice Co
*923	do				Monroe Waterworks and Light Co	Will A Strong	Will A Strong
*924	do				Planters' Oil Co		
925	Monroe, ¼ mile south of				Ouachita cotton mills		Guy P Stubbs
926	Monroe, ½ to 1½ miles north of						G D Harris[a]
927	Monroe, 6 miles north of				Stubbs's place		M M Munson[b]
*928	Monroe				U S Eng test borings		M H Marshall[c]
*929	Rock Row Shoals (Ouachita River)	19 N	3 E				
	POINTE COUPEE PARISH						
930					General		E G Benker, sheriff
931	Batchelor				Texas and Pacific Rwy		B S Wathen, chief engineer
932	New Roads				do		do
	RAPIDES PARISH						
*933	Alexandria (city hall)	4 N	1 W		Corporation of Alexandria	Andrews Well Co	(d)
*934	Alexandria (waterworks)	4 N	1 W		do	do	(d)
*935	do	4 N	1 W		do	do	(d)
*936	Alexandria (corner Fourth and St James streets)	4 N	1 W		do	do	(d)
*937	Alexandria (roundhouse)	4 N	1 W		St Louis, Iron Mountain and Southern Rwy	Hart Well Co	L B Hart

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* For additional data see "Descriptive notes," following this table

[a] Geol Survey Louisiana, Rept of 1902, p 211

[b] Pump repairer, St Louis, Iron Mountain and Southern Rwy

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(NORTHERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No.
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
				20	..	.. ..	Quaternary	Alkaline.		
5-3½	485	75	+ 40	65	...	.....	..do....	..do...	Drilled in 1891.	921
				280-485	50	50	Sabine ...	Soft.....		
5-3½	360	75	+ 40	280-360	50	50	do. ..	..do...	Drilled in 1892, casing 80 feet	
7-3½	400	75	Flows.	250-400	20	50	do ...	Very soft	Drilled in 1901.	922
5-3½	385	80	.do..	320-385	.	..	.do....	Soft.. ..	Temperature 71° F, completed in 1892	923
4	400±	82	.do..	..	30	..	.do....	....do..	.. ... .	924
5-3½	375	85	.do	.	3	.....	...do ..	. do...	Used for factory and drinking	925
	400±	.....	.do..	..	..	.. ..	...do ...	.....	Three wells..	926
4	260	... .	.do..	...	.	....	. .do .	.. ...	Completed February, 1903, second well on this farm	927
..	51 50 44	38 44 28	..	......	.....	.....	....	.. ... .	....	928
...	157 63	42 39	.. ...	..	....	..	... . .	.. ..	... .	929
2-8	145-165	.. .	...	....	...	Large.	Quaternary.	.. .	Palatable for drinking in some cases, used for machinery on sugar and cotton plantation	930
.	170	....	..	... ..	...	....	.do .	Good .	All alluvial, water in sand and gravel	931
.	190	...	.	..	....	....	. .do. .	... do.	Water in sand and gravel	932
1½	473	78	[e]+ 10 [f]− 60	..	10±		Catahoula.	Soft. .	. .	933
4-2½	560	77	[e]+ 12 [f]−138	540-560	50±	118	.. .do....	.do.	Well No 1... ...	934
10-4	760	77	[e]+ 12 [f]−110	540 620 760	70±	121	. do ..	.. .do ...	Well No 2.. .	935
2	606	76	[e]Flow [f]− 49	. ..	...	...	.. do ..	.. .do ...	....	936
6-4	858	75	. .	850	. .	..	......	.. ..	Abandoned..	937

[c] Ann Rept Chief of Eng for 1902, pp 1564-1566

[d] See "Descriptive notes"

[e] In 1898

[f] August 6, 1902

Wells and springs in southern Arkansas, northern

LOUISIANA

No.	Location.	Township.	Range	Section.	Owner.	Driller.	Authority.
	RAPIDES PARISH—continued.						
*938	Alexandria (Sixth and Monroe streets).	4 N.	1 W.		Alexandria Ice and Storage Co.	Andrews Well Co.	Jas. Drouant[a]
*939	do	4 N.	1 W.		do	Hart Well Co.	G. D. Harris[b]
*940	Alexandria	4 N.	1 W.		Sonia Cotton Oil Co.		Ira W. Sylvester
*941	Ball	5 N.	1 E.		Ball Sawmill Co	Shanks & Smith	Oscar Shanks
942	Boyce	5 N.	3 W.		Texas and Pacific Rwy.	Hart Well Co.	L. B. Hart
*943	do	5 N.	3 W.		do	do	do
*944	do	5 N.	3 W.		Boyce Ice Manufacturing Co.		D. J. Heidrich
945	do	5 N.	3 W.		M. Grillette		do
946	do	5 N.	3 W.		Boyce Cotton Oil and Manufacturing Co.		H. P. Haynes, president.
*947	Lamothe				L. C. Sanford		L. C. Sanford
948	Lecompte	1 N.	1 E.		Corporation of Lecompte.		Ira W. Sylvester, consulting engineer.
949	Loyd	1 N.	1 E.		Postmaster		General
*950	Pineville	4 N.	1 W.		Pineville Development Co.		F. S. Hoyt, president.
*951	do	4 N.	1 W.		State Insane Asylum.	Oscar Shanks	Oscar Shanks
*952	Rapides	5 N.	2 W.		C. A. Morrow		C. A. Morrow
*953	do	4 N.	2 W.		do		do
954	Richland				General		Postmaster
955	Springhill	4 N.	4 W.	1, 2	J. A. Bentley Lumber Co.		J. A. Bentley
*956	Zimmerman	5 N.	3 W.		do		do
	RED RIVER PARISH.						
957	Coushatta				General		Postmaster
958	Coushatta, 10 miles east of.	12 N.	8 W.	22			J. W. Martin
959	Coushatta				—— Armstead	Chas. Stoer	Chas. Stoer
*960	Lake End	11 N.	9 W.		Atkins Bros	Stoer & Backus	Chas. Stoer
961	Wilson	14 N.	9 W.	10			J. W. Martin

* For additional data see "Descriptive notes," following this table.

[a] Foreman for Andrews Well Co.

[b] Water-Sup. and Irr. Paper No. 101, U. S. Geol. Survey, 1904, p. 20.

[c] Pressure stated to be 15 pounds when first drilled; lowers on pumping to −40 feet; casing, 200 feet long.

Louisiana, and adjacent portions of Mississippi and Texas—Continued.

(NORTHERN)—Continued.

Diameter of well.	Depth of well.	Approximate elevation of surface.	Height of water above (+) or below (−) the ground.	Depths of principal water-bearing strata.	Yield per minute.		Geologic horizon of water-bearing strata.	Quality.	Remarks.	No.
					Flow.	Pump.				
Inches.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Galls.*	*Galls.*				
8	580	77	−60	480 580		60	Catahoula		Abandoned	938
8	621+	77								
	927	77	Flows.	853–927	125		Catahoula	Soft		939
	110					Large.	Quaternary.	Hard		940
	365	145	−60	310–365					Drilled in 1899	941
7	300+	88	+15	300		100	Catahoula	Soft	Temperature, 60° F.; drilled in 1898.	942
6–4	810	88	+18	300 802			do Catahoula?	do Brackish	Drilled in 1898	943
8	302	85	[c] +34	292–302		30+	Catahoula	Soft	Drilled in 1900; used for ice manufacture; casing, 200 feet.	944
2	280	88	Flows.				do	do		945
3½	279		+ 7		[d] 30 [e] 4		do	do	Used for drinking only; completed in 1899.	946
2	105	90	− 8 −18	95–105		Large.	Quaternary.	Hard		947
6	125	75				100+	do	do	Completed in 1902; pronounced an excellent water.	948
									Many large springs	949
	720 100 230+								Test wells for oil	950
	1,020									951
2	96–106	85	−20	94–104		Large.	Quaternary.	Slightly hard.	Four wells completed in 1900.	952
2	323	85	−20 − 5 Flows. (?)	96 108 280 320?		do	do Catahoula do	do Soft do		953
	20–30						Quaternary.	Hard, alkaline.		954
	Spring							Soft	Supplies watering tank of Zimmerman, Leesville and Southern R. R.	955
4	175	94	[f] +25	175	[f] 20 [g] 2		Catahoula	do	Temperature, August, 1902, 58° F.; used for drinking only.	956
	25–50						Quaternary.	Hard		957
	Spring							Brine	Salt spring, with gas	958
4	[h] 140									959
4–2½	287.5	127	−24				Sabine	Brackish	Abandoned	960
	Shallow		Flows.				do		Ever-flowing well	961

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[d] In 1899.
[e] August 12, 1902.
[f] In 1897.
[g] August, 1902.
[h] Also reported 300 feet.

Wells and springs in southern Arkansas, northern

LOUISIANA

No.	Location	Township	Range	Section	Owner.	Driller.	Authority.
	RICHLAND PARISH						
962	Delhi	17 N	9 E.		Cotton gin		Mrs A K Hawley
963	Holly Ridge	17 N	8 E.		Vicksburg, Shreveport and Pacific Rwy		R B Coxe, superintendent water division
	SABINE PARISH						
964	East Pendleton	6 N	14 W.	2	Salt works		A C Veatch[a]
965	do	6 N	13 W.	33	do		do
*966	Loring	7 N.	12 W	9	Bowman-Hicks Lumber Co	L. B Clifford Well Co	W A Shields, superintendent
967	Many	7 N	11 W.	27	J T. Sirmon		Dan Vandegaer, parish surveyor
968	Myricks Ferry	9 N	14 W.				E W Hilgard[c]
*969	Negreet	5 N.	12 W.	5	D M Foster	D M Foster	D M Foster
970	Negreet Salt Works	5 N	13 W.	24			A. C Veatch[a]
*971	Noble	8 N.	13 W.		Trigg Lumber Co	L B Clifford Well Co	L B Clifford
*972	Pleasant Hill	9 N.	12 W.	2	John Ferrell		Dr O Lerch[d]
973	Plymouth	7 N.	12 W.	8	Bowman-Hicks Lumber Co	L B Clifford Well Co	G S Smith[e]
*974	Zwolle	8 N	13 W	36	H J Allen Lumber Co		—— Coxe, superintendent
	ST LANDRY PARISH						
*975	Melville, 12 miles south of	6 S	7 E		Latanier Oil Co.	Oscar Shanks	Oscar Shanks
	TENSAS PARISH						
976	Buck Ridge				—— Kelley		F L Maxwell
977	St Joseph				General		A Blanche
	UNION PARISH						
*978	Ouachita River (Loch Lomond)	20 N	3 E		U S Eng test boring		M H Marshall[f]
979	Randolph	23 N	3 W		Summit Lumber Co	L B Clifford Well Co	L B Clifford
	VERNON PARISH						
980	Hawthorne	3 N	9 W	29	Lumber company		
981	Pickering				do		—— Pickering

* For additional data see "Descriptive notes," following this table

[a] Geol Survey Louisiana, Rept of 1892, p 90

[b] See "Descriptive notes"

[c] Supplementary and Final Report of a Geological Reconnaissance of Louisiana, New Orleans, 1873, p. 22

Louisiana, and adjacent portions of Mississippi and Texas—Continued.

(NORTHERN)—Continued.

Diameter of well.	Depth of well.	Approximate elevation of surface.	Height of water above (+) or below (−) the ground.	Depths of principal water-bearing strata.	Yield per minute.		Geologic horizon of water-bearing strata.	Quality.	Remarks.	No.
					Flow.	Pump.				
Inches.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Galls.*	*Galls.*				
	825±	95	Flows.				Sabine	Brackish		962
	64	88	− 24	24- 62		100	Quaternary.	Hard		963
	Shallow							Brine	Abandoned salt works	964
	do							do	do	965
6	704	285	−100	([b])		30	Sabine	Soft	Water from 11 different sand beds.	966
	110		− 60					Good	Used in boiler	967
	Shallow							Brine	Salt and soda works during the war.	968
8	630	173	− 8 + 1 + 1 + 18	167 212 350 630	 30		Sabine		Temperature, 70° F	969
	Shallow							Brine	Abandoned salt works	970
	400	275		160		Fair	Sabine			971
	22								Ferrell's mineral well	972
4	521	277.5	−100	360-380 418-430 492-520		25	Sabine	Salty; alkaline.		973
4	120	203	− 12	100-120		55	do			974
6	195	203	− 16	100-120 190		55	do			
	2,103		Flows.	537-555 1450-2000	Large. do			Pure; soft. Sulphur		975
	135					Large.	Quaternary.	Good		976
	100-135					do	do	Iron		977
	50	48.8 47.5								978
4 5	206	140	[g]Flow. [h]− 16	200-206			Cockfield	Slightly alkaline.	Two wells	979
	280						Catahoula			980
8-6	740	223				None.				981

[d] Geology and Agriculture of Louisiana, pt. 2, 1894, pp. 118, 119.
[e] Foreman for L. B. Clifford Well Co.
[f] Rept. Chief of Eng. for 1902, p. 1566.
[g] In 1901.
[h] In 1902.

Wells and springs in southern Arkansas, northern

LOUISIANA

No	Location	Township	Range	Section	Owner.	Driller	Authority
	WEBSTER PARISH						
*982	Bistineau Salt Works	18 N	10 W	......	......	......	A C Veatch[a]
*983	Cotton Valley	21 N	10 W	....	Valley Lumber Co	L B Clifford Well Co	L B Clifford
984	Dubberly	...	......	...	Valentine Spring	......	......
984A	Long Springs	19 N	9 W	6	......	......	......
*985	Minden	19 N	9 W	21	Minden Lumber Co	L B Clifford Well Co	L B Clifford
*986	do	19 N	9 W	21	do	do	do
987	do	19 N	9 W	......	Minden steam laundry	do	do
*988	do	19 N	9 W	.....	Minden Cotton Oil and Ice Co	......	S G Webb, president
*989	Spring Hill	23 N	11 W	.....	Pine Woods Lumber Co	L B Clifford Well Co	L B Clifford
*990	Yellow Pine	17 N	9 W	7	Globe Lumber Co	A L Pullin	A L Pullin
	WEST BATON ROUGE PARISH						
*991	Baton Rouge Junction	8 S	12 E	...	Texas and Pacific Rwy	......	Chas Anderson, pumpman
992	Lobdell	7 S	12 E	...	do	......	B S Wathen chief engineer
	WEST CARROLL PARISH						
993	Floyd	...	.....	...	General	......	Postmaster
	WINN PARISH						
*994	Drakes Salt Works[b]	12 N	5 W	20-21 28-29	......	......	A C Veatch[c]
*995	Prices Salt Works	13 N	5 W 4 W	25 30	......	......	A C Veatch[c]
996	Pyburn	13 N	3 W	34	North Louisiana Lumber Co	......	North Louisiana Lumber Co
997	Tannehill	12 N	3 W	22	Hall & Legin	J M Phillips	J M Phillips
998	Winnfield	...	...	...	Winnfield ice factory	L B Clifford Well Co	L B Clifford
*999	Winnfield, 2 miles south of (Cedar Lick)	...	.....	.....	......	do	do
1000	Winona	.....	.....	.....	Pine Tree Lumber Co	......	Pine Tree Lumber Co.

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* For additional data see "Descriptive notes," following this table

[a] Geol Survey Louisiana, Rept of 1902, pp 81-99

[b] See also No 904, Goldonna, Natchitoches Parish

Louisiana, and adjacent portions of Mississippi and Texas—Continued.

(NORTHERN)—Continued.

Diameter of well.	Depth of well.	Approximate elevation of surface.	Height of water above (+) or below (−) the ground.	Depths of principal water-bearing strata.	Yield per minute.		Geologic horizon of water-bearing strata.	Quality.	Remarks.	No.
					Flow.	Pump.				
Inches.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Galls.*	*Galls.*				
	10-15	140					Nacatoch	Brine	Salt made from 1850 to 1892.	982
4	271	220	−48	245-271		55	Sabine	Soft		983
	Spring.							Sulphureted.		984
	do							Iron	Local resort	984A
6	317	192	−28	247-317		115	Sabine	Soft	Used for sawmill and drinking.	985
4	247	192	−28	247		110	do	do		986
4	251		−48				do			987
8	115	190	− 8	100-115		50	do	Soft; iron.	Temperature, 65.3° F	988
3	368	235	−14 −28	228-270 338-368			do	Soft	Temperature, 66° F.; lower horizon not developed.	989
4-3	1,015±	190				None.			Abandoned	990
	110			110		Large.	Quaternary.		Well fluctuates with the river.	991
	165					do	do	Good	Water in sand and gravel.	992
	40					Small.	do	Poor; hard		993
	10-20					Large.	Quaternary[d]	Brine	Saltworks 1800-1865	994
	100-200		Flow.					do		
10	1,011		+35		18		Cretaceous	do	Temperature, 75° F	
	6-15						Quaternary[d]	do	Salt works 1840-1869	995
6 4	600±	210	−18				Sabine		Two wells	996
4	270	120	−10	140-270		60	do	Soft	Water lowers 7 feet when pumping 60 gallons per minute.	997
	700	120	Flows.				do	do	Shells common from 20 to 490 feet.	998
	268+								Large amount of gas	999
4	454	210	−90	60 200			Sabine		Too much quicksand; well abandoned.	1000

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[c] Geol. Survey Louisiana, Rept. of 1902, pp. 51-64.
[d] Leaks from the Cretaceous beds into the bottom-land silts.
[e] Geol. Survey Louisiana, Rept. of 1902, pp. 64-70.

Wells and springs in southern Arkansas, northern

MISSISSIPPI

No	Location	Township	Range	Section	Owner	Driller	Authority
	ADAMS COUNTY						
*1001	Natchez				Natchez Water Supply and Sewer Co		Superintendent.
1002	do				Natchez ice factory		L C Johnson[a]
	BOLIVAR COUNTY						
1003	Cleveland	22 N	5 W	21	Sillers & Owens		L. C Johnson[a]
1004	do	22 N	5 W.	21	C S Glassco		do[a]
1005	O'Reilly	21 N	5 W	23	O'Reilly		do[a]
1006	Rosedale				City		
1007	Shaw				Yazoo and Mississippi Valley R R		Chas V Linstrom, superintendent motive power
	CLAIBORNE COUNTY.						
*1008	Port Gibson	11 N	2 E	4	Port Gibson waterworks		J H Fessell, superintendent
	COAHOMA COUNTY						
1009	Eaglenest	28 N	3 W.	22	James L Alcorn's estate		L C Johnson[a].
1010	Jonestown	28 N	3 W		Geo Richberger		do
1011	Lyon	27 N	3 W.	18	Lamar Fountaine		do
	HOLMES COUNTY						
1012	Tchula				City	Z P Stutts	Z P Stutts
*1013	do				do		L C Johnson[a].
*1014	do				W. B Jones		do
1015	do						J B Cunningham, county clerk
	ISSAQUENA COUNTY						
*1016	Mayersville				Mississippi River Commission test boring		E W Hilgard[c]
	LEFLORE COUNTY						
1017					General.	Wright & Bell.	G E. Williamson, county clerk
1018	Greenwood	19 N	1 E		Waterworks		L A Dabney.
1019	do	19 N	1 E		Illinois Central R R		General foreman waterworks
1020	do	19 N	1 E		Ice factory		L C Johnson[a].
1021	do	19 N	1 E		T J Phillips		do
1022	Ittabena	19 N	1 W	20	L J Young & Co		do
1023	do	19 N	1 W	13	R W Baird		do
1024	Minter City	22 N	1 W.		Illinois Central R R		General foreman waterworks

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* For additional data see "Descriptive notes," following this table

[a] Water-Sup and Irr Paper No 102, U S Geol Survey, 1904, pp 334-357

Louisiana, and adjacent portions of Mississippi and Texas—Continued

(NORTHWESTERN).

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No.
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*[c]				
8 6	296–350	100±	−40	.	..	.. .	Catahoula .	Slightly hard	4 8-inch wells, 1 6-inch well	1001
6	517	90	− 8	500	. .	50	Catahoula ?	Hard	. . . .	1002
6	300	90	−36	264	.	70	Catahoula	Good. .		
3	1,000	139	Flows	1,000	.	75	Eocene. .	Soft	Drilled in 1901. .	1003
4	1,000	139	..do .	1,000	. .	100	. do .	. do .	. do.. . . .	1004
4	1,002	.... . .	.. do.	. . .		100	..do....	do	do . .	1005
6	385	. . . .	+17	. . .	.	300	. .do. .	. do	Drilled in 1902. .	1006
4	100	. . . ..	. .. .	. ...	.	. ..	Quaternary	Hard, iron	Water in gravel, supplies watering tank	1007
8	260	(b)	−60 −50	60–130 213–260		. 600	 Catahoula	Hard... Soft..	. . .. .	1008
1½	825	.... .	Flows	825	8	..	Eocene .	.do .	... .	1009
2	800		do	700	8	. . ...	do	.do .	. . .	1010
4	975	173	+35	970	22	. .. ..	do.	do .	. ...	1011
2	456	115	+16	.	.	. .	. .do .	Excellent	Drilled in 1897	1012
4–2	1,125	115	+85		130	. .	..do . .	Soft, alkaline	. . . . .	1013
3–2	770	115	. . .	770	200	. . .	. .do .	Soft . ..	....	1014
. . .	470	115	. .	. . .. ..		. . ..	do . ..	. .	. . . .	1015
. .	132 9	.	.	. . . .	..	..	.	.	. . .. .	1016
. .	400	130	Flows	.. . ...	.	.	Eocene ..	.	Average of 20 wells sunk in 1898	1017
. . .	700	130	do	450 550 650	 300	.	.do ..	Soft	Well sunk in 1898...	1018
.. ..	506	130	+45	.. .	400	..	. .do.. ..	. ..	.. . .	1019
4	650	130	Flows	350 450 600	275	.	. .do. ..	Soft	The Buhrstone is reported at a depth of 200 feet	1020
4	650	130	+40	340 500 600	250	.	.do .	. . do	. . . .	1021
.	597	130	+35	. .	. .	. ..	do .	do .	. . . .	1022
3	365	130	Flows.	348	100	. .	. do ..	do ..	. ...	1023
......	... .	.. ..	..do..	400	.. . .	. ..	. . do	do ...	.. ..	1024

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[b] Elevation of Illinois Central Railroad station, 16 feet

[c] Ann Rept Miss River Com for 1883 48th Cong , 1st sess , House Ex Doc No 37, 1884, p 490

Wells and springs in southern Arkansas, northern

MISSISSIPPI (NORTH

No.	Location.	Township.	Range.	Section.	Owner.	Driller.	Authority.
	QUITMAN COUNTY.						
1025	Belen	28 N.	2 W	28	Turner Bros		L. C. Johnson [a]
1026	do	28 N.	1 W	29	do		do
1027	Riverside	28 N.	1 W	35	L. Marks		do
	SUNFLOWER COUNTY.						
1028	Dockery				W. A. Dockery		W. P. Gresham, chancery clerk.
1029	Doddsville						do
1030	Indianola				City		do
1031	Moorhead				C. H. Pond		do
1032	Ruleville						do
	WARREN COUNTY.						
1033	Valley Park				Yazoo and Mississippi Valley R. R.		Chas. V. Linstrom, superintendent motive power.
1034	Vicksburg				do		do
1035	do				do		do
1036	Vicksburg, mile south of.				do		do
1037	Vicksburg				Vicksburg Ice Co		D. W. Floweree, president.
1038	do				do		do
	WASHINGTON COUNTY.						
*1039	Greenville				City waterworks		Doctor Walker
1040	do				General		
*1041	do				Mississippi River Commission test boring.		E. W. Hilgard [c]
1042	Longwood				Yazoo and Mississippi Valley R. R.		Chas. V. Linstrom, superintendent motive power
	YAZOO COUNTY.						
1043	Bentonia				Capt. J. F. Powell	Z. P. Stutts	Z. P. Stutts
1044	Mechanicsburg	9 N.	3 W			do	do
1045	Satartia	9 N.	4 W		Monroe Kling	Stutts & Daris	do
1046	Yazoo City				W. F. Cummings	Z. P. Stutts	do
*1047	Yazoo City, 1 mile north of.				Capt. Z. P. Stutts	Stutts & Daris	A. F. Daris
1048	Yazoo City				Waterworks	Michigan Pipe Co	Geo. L. Wells, engineer
1049	do				Mississippi Cotton Oil Co.		E. Shaefer, manager

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* For additional data see "Descriptive notes," following this table.

[a] Water Sup. and Irr. Paper, U. S. Geol. Survey, No. 102, 1904, pp. 334-357.

Louisiana, and adjacent portions of Mississippi and Texas—Continued.

WESTERN)—Continued.

Diameter of well.	Depth of well.	Approximate elevation of surface.	Height of water above (+) or below (−) the ground.	Depths of principal water-bearing strata.	Yield per minute.		Geologic horizon of water-bearing strata.	Quality.	Remarks.	No.
					Flow.	Pump.				
Inches.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Galls.*	*Galls.*				
3	860		Flows.	810	60		Eocene	Soft		1025
2	724		+ 50	650	55		do	do		1026
2	636		+ 40	600	60		do	do		1027
			Flows.				do			1028
	700		do				do			1029
	1,250 800	121	do			None.	do	Soft, alkaline.	Abandoned	1030
	700–800		Flows.				Eocene	Soft, alkaline.		1031
	700–800		do				do			1032
4	100		(b)				Quaternary	Soft	Good for boilers	1033
8	180					Large.		Hard, alkaline.	Not suited for boiler purposes.	1034
	900								Abandoned	1035
	200							Good		1036
	1,100		Flows.		Small.		Sabine	Brackish	Temperature 70 °F	1037
10	220		[b] − 70			Large.		Hard	Used in ice manufacture.	1038
8	500	126	− 5	400–500		300	Eocene	Soft		1039
	125	126	(b)			Large.	Quaternary	Iron	Water in gravel	1040
	96									1041
	100±		(b)			Large.	Quaternary		Good boiler water	1042
	588	250	−130				Eocene			1043
	620	200±	− 40				do		Pumped with windmill	1044
	588	97	+ 12		14		do		Fine for drinking and washing.	1045
3	500	250	−140				do		Pumped with windmill	1046
	635	110	+ 20				do	Mineral		1047
	740 800 1,254	110	Flows.				do		Wells drilled in 1899	1048
4	475	110	+ 4		40		do			1049

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[b] Varies with the river.

[c] Ann. Rept. Miss. River Com. for 1883; 48th Cong., 1st sess., House Ex. Doc. No. 37, 1884. pp. 491–492.

Wells and springs in southern Arkansas, northern

TEXAS (NORTH

No.	Location.	Owner.	Driller.	Authority.
	ANDERSON COUNTY.			
1050	Palestine	International and Great Northern R. R.		L. Tice, general superintendent.
*1051	Palestine, 4½ miles from	Palestine Water and Power Co.	American Well Works	H. L. Wright, receiver
1052	Palestine, 10 miles east of	Palestine Oil Co	J. L. Mayo	J. L. Mayo [c]
1053	Palestine	Palestine Ice Co		Palestine Ice Co
	ANGELINA COUNTY.			
*1054	Angelina River (Nancy Lang League).			A. C. Veatch
1055	Grahams Saline			
*1056	Lufkin			Postmaster
1057	Popher	Eli Gillins	Savage Bros	Eli Gillins
1058	Popher, 1½ miles north of			do
	BOWIE COUNTY.			
*1059	De Kalb, 13 miles north of, at mouth of Mill Creek.	S. L. Moore	Hudson & Cornelius	Hudson & Cornelius
1060	New Boston	Town of New Boston	John Lowdernilk	John Lowdernilk
1061	do			C. A. Berkshire
1062	Pope ?	Cass Pope		Cass Pope
1063	Rolyat, 4 miles north of			Postmaster
1064	Rolyat, 3 miles west of	I. N. Phillips		I. N. Phillips
*1065	Rolyat	Postmaster		Postmaster
*1066	do	J. H. Williams	J. H. Williams	J. H. Williams
*1067	Texarkana [d]	Texarkana Ice Co		R. A. Munson
*1068	Texarkana	Jack Weed	John Lowdernilk	John Lowdernilk
*1069	do	Creosote Plant		Superintendent
1070	Wamba	"Dripping Springs" [e]		Postmaster
1071	do	"Tanyard Springs"		do

* For additional data see "Descriptive notes," following this table.

[a] Well No. 1.

[b] Well No. 2.

Louisiana, and adjacent portions of Mississippi and Texas—Continued.

EASTERN).

Diameter of well.	Depth of well.	Approximate elevation of surface.	Height of water above (+) or below (−) the ground.	Depths of principal water-bearing strata.	Yield per minute.		Geologic horizon of water-bearing strata.	Quality.	Remarks.	No.
					Flow.	Pump.				
Inches.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Galls.*	*Galls.*				
....	650	495	−200	....	....	Small.	Sabine	....	Drilled in 1877–8; not used.	1050
6 8-6 6 6	400–444	400	....	235–440	....	*a* 120 *b* 130	....	Iron, slightly hard.	....	1051
....	310	....	....	115-121	....	....	....	....	Test well for oil.	1052
6	560	495	− 80	200–250 −560?	....	100	Sabine	Iron	Casing 300 feet	1053
....	....	....	....	....	....	....	....	Brine	Abandoned salt works.	1054
....	Springs.	....	....	....	....	....	....	do	do	1055
....	1,300±	....	....	....	....	....	....	....	Abandoned	1056
....	312	....	− 1	....	....	....	....	Salty	Oil test well. Slight amount of inflammable gas.	1057
....	....	....	....	....	....	....	....	do	Salt lick	1058
2	425	....	....	− 2	....	Very small.	....	....	Abandoned	1059
3¾	536	352	....	500–536	....	....	Nacatoch	Salty	....	1060
5	1,200	352	− 60	+500	....	....	do	do	Used for watering stock; casing, 200 feet.	1061
6	196.5	....	− 60	145-196	....	....	....	Soft	....	1062
....	247	....	....	....	....	None.	....	....	....	1063
6	165	....	− 60	....	....	....	Nacatoch	Hard, alkaline.	Drilled in 1900	1064
8	119	....	− 49	....	....	....	do	Soft	Drilled in 1902	1065
6	140	....	− 20	135–140	....	....	do	Salty	....	1066
....	63	....	− 20	33–63	....	Large.	Sabine	Soft	....	1067
....	550	....	− 0	136 550?	....	....	do Arkadelphia ?	....	....	1068
3	65	....	....	20–60	....	....	Lafayette ?	....	Black clay below 60 feet.	1069
....	Spring.	....	....	....	....	....	do	....	....	1070
....	do	....	....	....	....	....	do	....	....	1071

[c] Second Ann. Rept. Geol. Survey Texas, 1890, p. 307.
[d] See also Nos. 478-480A, Texarkana, Miller County, Ark.
[e] See discussion under No. 478.

Wells and springs in southern Arkansas, northern

TEXAS (NORTH

No	Location	Owner	Driller	Authority
	CAMP COUNTY.			
1072	Pittsburg	W C Hargrove et al		W C Hargrove
1073	do	Arkansas and Texas Consolidated Ice and Coal Co		E L Wells, jr, manager
	CASS COUNTY			
1074	Hughes Spring	Hughes Spring		A C Peale[b]
1075	Viola	Bauguss Mineral Springs		do
	CHEROKEE COUNTY			
1076	Circle			J R Mitchell, postmaster
1077	do			do
1078	Jacksonville	Ice factory		Postmaster
1079	Lone Star, 4 miles south of	J W Beaird		J J Conner
1080	Morton	Arkansas Lumber Co	P M. Granberry & Co	Arkansas Lumber Co
1081	Rusk	East Texas Penitentiary		W M Lacy, assistant superintendent
	FRANKLIN COUNTY			
1082	Mount Vernon	St Louis Southwestern Rwy		A J Patton, county clerk
	GREGG COUNTY			
1083	Gladewater, 2 miles east of	J H Simmons		J H Simmons
*1084	Longview	Longview Ice Co		E L Wells, manager
	HARRISON COUNTY			
*1085	Marshall	Arkansas and Texas Ice and Coal Co		E L Wells, manager
1086	Marshall, 3 miles northeast of	City waterworks		E L Wells
1087	Marshall			do
1088	Marshall, 6 miles west of	Hynson's Iron Mountain Spring		A C Peale
*1089	Marshall, 9 miles south of	Roseborough Spring		Wm Kennedy[f]
1090	do	W J Roseborough, sr.		W. J Rosborough, sr.
*1091	do	do		do
*1092	Marshall, 16 miles from	Montvale Springs		Wm. Kennedy[g]

*For additional data see "Descriptive notes," following this table

[a] Lowers to 70 feet when pumped

[b] Bull U S Geol Survey No 32, 1886, p 135.

[c] Marshall station, 366 feet.

Louisiana, and adjacent portions of Mississippi and Texas—Continued

EASTERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
6-4	1,860	395	a− 8	220 750 1,700		140	Sabine Nacatoch Sub-Clarksville	Soft ..	Cased to 400 feet, drilled in 1900	1072
6	216	395	−20	150-216	. ..	50	Sabine.. .	. .do....	. . . .. .	1073
.	.. .	. .	..	... .	. ..		. . . . .	Chalybeate	Local resort . .	1074
. . .	.	. .	.	.	1	.	. . .. .	.	do	1075
.	300		Flows	. .	Large.	. .	Sabine. ..	Mineral.	.. . .	1076
	600			.. .	.	.	..	.	Test for oil .	1077
	386 360		.	. .	.	.	Sabine . .	. .	Water carries large amount of sand	1078
.	100+			.	.	.	.	.. . .	No water	1079
	600			..	.		.	.	Abandoned. . .	1080
	620		. .	. . .	.	Not any	. .	.	Bit caught and well abandoned	1081
.	400	. .	Noflow	. ..	. .	Large	. .	. . ...	. . .. .	1082
	310		Noflow	. . ..	. . .	Large	. . .	Slightly mineral	At Obyrne's switch. .	1083
.	500+ 90	330± 330±	. . −45	350[g] 45-80	. . .	80 25	Sabine. .. do .		Drilled in 1892 .	1084
6	208	(c)		60-100 150-180	.	d 150 e 50	Sabine	Alkaline	Three wells, temperature 68° F	1085
. .	60 150	250± 250±	Flow Noflow	 150	Small .	 Large.	Sabine[f]. Sabine	. .. . . .	Three wells	1086
.	1,000±	(c)	.	. .	...	. .		. .	Sunk about 1890 by waterworks contractor, seeking artesian water	1087
.. .	Spring	. .	. .	. . .	..		..	Chalybeate	Temperature 56° F, local resort	1088
	. do.	.	.	.	.			do. .	. . . . . .	1089
4	200		−75	.			Sabine	Slightly salty	. . . . ..	1090
6-4	450		.	150± 350	.		. . do...	. .	Test well for oil, incomplete	1091
. .	Spring..	.. .. .	.					Potash ..	Local resort	1092

[d] Without strainer
[e] With strainer
[f] Second Ann Rept Geol Survey Texas, for 1890, 1891, pp 158–159
[g] Op cit, p 159

Wells and springs in southern Arkansas, northern

TEXAS (NORTH

No	Location	Owner	Driller	Authority
	HOPKINS COUNTY			
*1093	Sulphur Springs	Sulphur Springs		Wm B Baxter
	HOUSTON COUNTY			
1094	Crockett	Mary Allen Seminary		J B Smith, president.
*1095	Kennard	Louisiana and Texas Lumber Co		J M Martin, superintendent
	JASPER COUNTY			
1096	Doorns Saline			A C Veatch
1097	Oil Spring, Joseph Conn, headright			do
	MARION COUNTY			
*1098	Jefferson	J M Deware		County clerk
	MORRIS COUNTY			
*1099	Omaha, 4 miles from	M C McCollum		M. C. McCollum
	NACOGDOCHES COUNTY			
*1100	Chireno	Mammoth Oil, Mineral, and Land Co		Mammoth Oil, Mineral, and Land Co [a]
1101	do	General		Postmaster
*1102	Garrison			Joseph B Walker [b].
*1103	Melrose, 1 mile south of (E A Day place)	Lubricating Oil Co.		do
1104	Oil City	Petroleum Prospecting Co		do
1105	do	do		do
1106	Tolliver			B W Pye, postmaster.
	PANOLA COUNTY			
*1107	Cozart	Brown Springs		Joseph B Walker [c].
	POLK COUNTY			
1108	Moscow, 4 miles from	T L Hackney		M T Hickman, postmaster
*1109	Valda, 5 miles west of			Wm Kennedy [d].
1110	Valda			A B Garvey, county surveyor

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* For additional data see "Descriptive notes," following this table

[a] Geol Survey Louisiana, Rept of 1902, pp 126-127

[b] Second Ann Rept Geol Survey Texas for 1890, 1891, pp. 270-286

Louisiana, and adjacent portions of Mississippi and Texas—Continued

EASTERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
6–4	1,514	400			..	Small.	...	...	"We found no sand worth developing" Drilled in 1900	1093
5–3	630	350	−190	350 630	. ..	Not used Many	Sabine?.	Sulphureted	...	1094
3	1,065		−105	.	.	80	Sabine .	Alum ...	Fossils at 800 feet	1095
....	Shallow. Spring	... . .		. .	..	. ..	..... .	Brine.. . .	Old salt works . . Brackish water with gas	1096
.	80±			...		..	...	. .	Water with oil, two wells	1097
.	800	190	Flows	.	Few..	..	Nacatoch.	Soft	....	1098
10	100		..	.		Large.	Sabine.	Mineral. .	Not used	1099
....	877	. .	Flows	382–462	50	....	.do ..	Sulphureted	....	1100
...	..	.	. do .	200–400	..	...	. . do. .	Soft, sulphureted	All test wells for oil	1101
. .	Spring .	.			...	..	....	Chalybeate	....	1102
.	255		.	. .	...	Not any	.....	. .	Oil test well abandoned.	1103
	Spring..	..	.	...		..	. . ...	Sulphureted oil bearing	Oil spring	1104
.	70-100	.	.	...	...	...	. . ...	.. ... .	Several oil wells.......	1105
....	375	.	Flows.	.....	...		Sabine .	.... ..	....	1106
....	Spring..	......	...	.	. .	. .		. . .	Local resort..	1107
	400−	...	.....	..	. .	Large	. . ...	Good ..	Well for sawmill.......	1108
...	543	.....	. .	36-95 195 530–540	. . .	. .. . .	Lafayette? Catahoula?	. . . .	....	1109
....	1,000±	.	. .	Flows	.	..	.....	.. ....	Abandoned.......	1110

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[c] Op cit, p 251

[d] Bull U S Geol Survey No 212, 1903, pp 54-55

Wells and springs in southern Arkansas, northern

TEXAS (NORTH

No.	Location	Owner	Driller	Authority.
	RED RIVER COUNTY			
*1111	Clarksville (public square).	Corporation of Clarksville.		Frank B Mason, mayor
*1112	Clarksville, ¼ mile south of	do		do
1113	Clarksville	Ice factory		do
1114	do	H J Hatch.		R J King, postmaster
1114A	do	Clarksville Ice Co		Clarksville Ice Co.
*1115	Kiomache	S J Wright.		S J Wright.
1115A	Lydia, 4 miles south of	W S. Perkins		Postmaster
1116	Manchester			do.
	RUSK COUNTY			
1117		General		R H Thompson, county surveyor
1118	Mount Enterprise	D W March		
1119	Stevens	Martin Baysinger		
	SABINE COUNTY			
*1120	Robinsons Ferry, 15 miles east-southeast of Hemphill	East Texas Timber and Oil Co	W A Turner	W A Turner
	SAN AUGUSTINE COUNTY			
1121	Denning			County surveyor
1122	San Augustine, 6 miles south of	Andrew Phillips	Savage Bros.	W. W Lawrence
	SHELBY COUNTY			
1123	Timpson	T C Whiteside et al		T C Whiteside
	SMITH COUNTY			
1124	Lindale, near county farm.	John Dickerts.		J A Tucker.
1125	Tyler	Tyler Ice Co.		
1126	do.	do		County clerk.
*1127	do	Col W S Herndon		Col W S Herndon
	TITUS COUNTY			
1128	Mount Pleasant.	H W. Cheney et al		H W Cheney
	WOOD COUNTY			
*1129	Mineola	City of Mineola		Dr A Patton

*For additional data see "Descriptive notes," following this table.

Louisiana, and adjacent portions of Mississippi and Texas—Continued

EASTERN)—Continued

Diameter of well	Depth of well	Approximate elevation of surface	Height of water above (+) or below (−) the ground	Depths of principal water-bearing strata	Yield per minute		Geologic horizon of water-bearing strata	Quality	Remarks	No
					Flow	Pump				
Inches	*Feet*	*Feet*	*Feet*	*Feet*	*Galls*	*Galls*				
	1,100	450				Large	Woodbine	Brine	Water accompanied with natural gas	1111
8 6	600	450?	− 50			do	Sub-Clarksville	Good Soft	Drilled in 1902	1112
	1,400		Flow.			do	Woodbine	Brine		1113
	1,800			1,000 1,600?		do	do.	Salty	Drilled in 1902	1114A
4	561		− 23	508–561		80	Sub-Clarksville	Soft.	Completed December, 1902	1114
6	301			301				do	Drill broke and well abandoned, drilled in 1892	1115
	200±	260?				Not any				1115A
									Numerous springs	1116
	Spring.								Many large springs.	1117
	do				Large			Chalybeate	Stockman's Spring	1118
	do				do			do	Sulphur Springs	1119
	1,975	120	Flow.	1,010-1,030	Large		Cockfield [a]		Pleasant-tasting water	1120
				1,800	do		Sabine	Brine		
	700		Flows				do		Oil test well	1121
6	415	200	+ 30	395–415	Large.		do	Clear and pure	Drilled August, 1900	1122
	900	392	− 80	700		(b)			Test well for oil	1123
4	500		Flows	130–500	3		Sabine	Soft		1124
6–4	60		− 60			100			Temperature, 63° F	1125
	500–600					Large				1126
6	1,207		−100	400		3		Soft and very pure	Abandoned	1127
76¼	300								Test for oil, incomplete	1128
6–3	1,200	400±	− 40						Temperature, 70° F	1129

[a] Here apparently part of the fossiliferous Claiborne

[b] Not tested

DESCRIPTIVE NOTES TO WELL AND SPRING TABLE.

1. Mr Maxwell states that on the western border of the county, along Big Bayou Meto, springs are very few, whereas on the eastern side, along the tributaries of White River, they are numerous

3. Mr A H Solkland reports "There is an unlimited supply of a very fine quality of water for all purposes at an average depth of 100 feet There are, perhaps, 1,000 of these wells in and around this town, whose average cost, complete with iron pump, is $50

"Until about fifteen years ago water was obtained on this prairie at a depth of from 30 to 40 feet by digging and curbing with wood, but now these shallow wells have been entirely replaced by the deeper driven wells This has improved the healthfulness of our people "

4. Gunter Brothers report having completed a well in August, 1904, which showed the following section

Section of well at Stuttgart, Arkansas County, Ark

Port Hudson	Feet
1 Loam and sand	0– 50
2 Blue clay	50–100
3 Gravel, water bearing	100–115

6. Mr E A McNimm, foreman for the L B Clifford Well Company, adds the following data Sulphur water at 450 feet, very thin deposit of rock salt at 600 feet, water-bearing sand, with salt water, 913–976 feet The salt water is pumped to supply the log pond

8. *Section of well at court-house, Hamburg, Ashley County, Ark*

	Thickness in feet
1 Sandy soil	3– 4
2 (?)	23
3 White pipe clay	10
4 Red clay	3– 6
6 Claystone concretions or geodes, yellow without, red and even black within small and numerous, forming a pebble bed, from which an abundance of good water is obtained	

"Specimens of No 4, the red clay, were dug up from the mound where the material had been placed after digging, and it was found to resemble precisely the red sandy-clay deposits, or the so-called chocolate clays, along Arkansas River The pebbles in No 6 are evidently the same as may be seen in various places in the fossiliferous districts in northern Bradley County They probably mark the upper surface of the undisturbed Tertiary of this place " [a]

9. A resident of Pine Prairie, which is from 6 to 8 miles east of Hamburg, says that in digging and drilling wells in this region one finds below the soil thick beds of joint clay and sand, and at a depth of 80 feet a pebble bed, some of the pebbles of which are as large as a hen's egg This gravel bed contains an abundant supply of water [b]

12. Owen [c] reports this as a strong alkaline sulphuret water, alkaline to test paper, and containing the following principal constituents Carbonate of alkalies, probably both soda and potash, sulphuret of alkalies; sulphate of magnesia (Epsom salts), and chloride of sodium (common salt)

13. Owen [d] states that of several springs examined, the strongest gave Sulphate of magnesia (Epsom salts), sulphate of soda (Glauber's salt), chloride of sodium (common salt), carbonate of lime, carbonate of magnesia, carbonate of soda (a trace), and carbonate of potash

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[a] Ann Rept Geol Survey Arkansas for 1892, vol 2, 1894, p 131

[b] Ibid, p 130.

[c] Second Report of a Geological Reconnaissance of Arkansas, 1860, p 140.

[d] Op cit., p 142

17. *Section of well of Bradley Lumber Company, Warren, Bradley County, Ark.*

	Feet
1 Clay	0– 90
2 Gray sand	90–150

20. *Section of well on William Thompson's place, 1 mile south of Hampton, Calhoun County, Ark (Owen)*

Port Hudson
  1 Clay
  2 Gravel, with streaks of red clay
Eocene?
  3 Pipe clay
Eocene
  4 Black dirt and lignite
    Total, 23 feet

23. This well was abandoned because of the large amount of fine sand which the water contained

27. *Section of well of Arkadelphia Ice and Fuel Company, Arkadelphia, Clark County, Ark.*

[By J M Phillips]

	Feet
1 Quicksand	0– 20
Arkadelphia and Nacatoch	
2 Blue clay, somewhat sandy, this layer contains water which first flowed at 100 feet This water was fresh, salt water was encountered at 150 feet	20–160
Marlbrook and Brownstown	
3 "White rock coming up in little grains which look like coarse salt" (perhaps gypsum or chalk)	160–166
4 Blue dirt, somewhat sandy, with salt water	166–321
Bingen	
5 Sand, with artesian salt water	321–

28. The depth to "water rock" near Beirne ranges from 167 to 170 feet Wells are generally sunk to a depth of from 10 to 12 feet below the rock

32. Mr Nelson reports a slight amount of asphaltum, similar to that found at Gurdon, from beneath the water rock

40. Mr Henderson Nelson has forwarded the following samples

Samples from well of Mrs Y G Thomas, near Beirne, Clark County, Ark

	Depth in feet
Arkadelphia clay	
1 Crystal of selenite	25
2 Fragments of oyster shells	30
3 Iron pyrites	76
4–5 Fragments of shells	106
Nacatoch sand	
6 "Water rock," an impure limestone	170

48. *Section of well at Britts Switch, Clark County, Ark*

[By Henderson Nelson]

	Feet
Quaternary	
1 Silt	0– 8
2 Gravel, water bearing	8–18

	Feet
Arkadelphia	
3 Blue clay	18–66
Nacatoch	
4 Water rock and water-bearing sand	66–90

A small amount of gas is reported in this well

50. *Section of well of Burtsell Lumber Company, Burtsell, Clark County, Ark.*

[By H W Wade]

	Feet
Quaternary	
1 Gravel	0– 20
Nacatoch	
2 Black sand	20– 50
3 Yellow sand, containing a little water, which rises to within 8 feet of the surface	50– 55
Marlbrook	
4 Bluish lime rock	55–105
5 Clay, varies from white to black and contains considerable rock, no water	105–365

51. This large group of springs at the Christian Church camp meeting grounds is reported to have various medicinal properties Branner gives the following, probably referring to this locality [a]

"Mineral springs, Clark County, are 2 miles northeast of Antoine post-office, a quarter of a mile south of the military road, on the Amity-Okolona road 6 miles north of Okolona Seven springs issue near each other and one larger spring a short distance away These springs are well tiled and the large one has a cover The water issues from a dark-colored sandy deposit, with streaks of black shale or clay, all of which are probably of Cretaceous age. These beds dip to the south at an angle of 45 ° The place is used as a local summer resort and camping place An open Methodist chapel, a dozen or more summer cottages, and frames for a number of tents have been built at this locality "

52. Mr. T M Ewing states that the 4-inch wells around Curtis are about 150 feet deep and usually cost $30 without casing From 20 to 40 feet of casing is required to reach the blue dirt

The usual section is

General section of wells about Curtis, Clark County, Ark.

[By T M Ewing]

	Thickness in feet
Arkadelphia	
1 Soil	½– 2
2 Red clay, weathering product of bed below	1½–40
3 Blue clay	
Nacatoch	
4 Water rock	1⅙– 4
5 Water-bearing sand	

54. Mr Monkern has three wells within 200 feet of each other, of these, two furnish salty water and the third fresh water

67. Harris [b] gives the following data "At Hart's Chapel, about 11 miles due south of Arkadelphia, wells penetrate bluish or black clay which yields impotable water An artesian well 296 feet deep, after passing through a very hard blue rock 18 inches in thickness, immediately filled with very saline water that rises several feet above the surface of the ground "

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[a] Ann Rept Geol Survey Arkansas for 1891, vol 1, 1892, p 111

[b] Harris, G D, The Tertiary geology of southern Arkansas Ann Rept Geol Survey Arkansas for 1892, vol 2, 1894, p 19

71. *Section of well 1 mile northeast of Daleville, Clark County, Ark.*

[By A. M. Crow.]

	Feet.
Quaternary:	
1. Alluvium	0- 20
2. Gravel, with slightly salty water	20- 32
Cretaceous:	
3. Dark-colored clay	32-100
4. Rock	100-101
5. Clay	101-200
6. Rock	200-
7. Salt water.	
8. Soft black material, thought to be asphaltum	325-
9. Rock	325-326
10. Sand, with artesian salt water (Bingen)	330-

72. Mr. Crow states that this was the site of a salt works in the early history of this section. Operations were begun in 1814 and were revived during the civil war.

74. Mr. J. J. Dunlop, postmaster at De Gray, reports regarding this region: "The majority of wells in this immediate settlement furnish plenty of water. South and southeast across De Gray Creek water is scarce and of poor quality, often being quite salty. Salty water is also found from 1½ to 2 miles north and west of De Gray."

78. Mr. Henderson Nelson has forwarded samples of asphaltum obtained from this well from just below the water rock. As this well is one-half mile or more from the Witherspoon well (84), in which asphaltum has also been found, it shows that this occurrence covers a considerable area.

82. In the town of Gurdon the surface beds, which contain more or less water, are from 25 to 50 feet thick. This portion of the wells is always cased. Below is black clay which does not require casing. This is followed by hard sandstone from 6 inches to 3 feet thick, commonly called the "water rock," below which is water-bearing sand.

All wells in Gurdon formerly overflowed, indicating a water head of something over 210 feet, but since the installation of the large wells at the Grayson-McLeod Lumber Company mills many have ceased to flow, and flowing wells are now seldom obtained where the altitude is over 200 feet above sea level. The deep well of the lumber company indicates, however, that a slight increase of head can be obtained in these domestic wells by going 15 or 20 feet deeper.

83. In 1902 two attempts were made by the Grayson-McLeod Lumber Company to sink a deep well. According to letters written to Mr. Grayson by the local management, the first hole reached a depth of 760 feet and the second 710 feet. From these letters the following notes have been taken:

Partial section of first deep well of Grayson-McLeod Lumber Company, Gurdon, Clark County, Ark.

	Feet.
1. Blue clay	105-140
2. Black sand, with water	199-
3. Warm water	225-
4. Hard substance—"gravel bed"	249-
5. Quicksand	-350
6. Blue clay	350-475
7. Gray mud, very thick and heavy. "Well is dry and water must be put in to enable buckets to take up drillings"	680-760

Partial section of second deep well of Grayson-McLeod Lumber Company, Gurdon, Clark County, Ark.

	Feet.
1. Quicksand	225-
2. "In sand, but water shut out"	335-
3. Blue clay	370-
4. Water, 1 gallon per minute	415-
5. "White slate" (chalk?)	425-545
6. Caving material at	545-
7. Caving material at	650

Well as abandoned has 55 feet of 10-inch casing and 356 feet of 8-inch casing, which is split between 200 and 225 feet to allow the inflow of water from the Nacatoch sand.

Mr. Peters, master mechanic, who superintended the sinking of the several 200-foot wells from which the company obtains its supply, and who watched the drilling of these deep wells very closely, gives the following record:

Section of 10-inch well of Grayson-McLeod Lumber Company, Gurdon, Clark County, Ark.

	Feet.
Arkadelphia:	
1. Blue clay	0–200
Nacatoch:	
2. Water-bearing sand	200–225
Nacatoch? and Marlbrook:	
3. Black clay and quicksand	225–320
Marlbrook and Brownstown:	
4. Blue clay, furnishing a little water at 415 feet	320–415
5. White slate (chalk marl outcropping at Okolona; "Saratoga formation")	415–554
6. Blue and white sand	554–585
7. Very soft blue clay	585–650

Mr. Peters adds that very large shells were obtained at 600 feet and that near this point there was a small flow of salt water. Mr. Sellers, of the Grayson-McLeod Company, gives the depth of the artesian salt water as 710 feet.

The following analysis is stated to refer to the water from the Nacatoch sand at 200 to 225 feet, though its general character suggests that it represents the lower water:

Analysis of water from 10-inch well of Grayson-McLeod Lumber Compcny, Gurdon, Clark County, Ark.

[By St. Louis Sampling and Testing Company.]

	Parts per million.
Total solids	882.4
Volatile solids	44.0
Thick solids	28.4
Silica	8.4
Sesquioxide iron and aluminum	3.6
Lime	12.0
Magnesia	12.9
Alkalies	29.2
Sulphuric anhydride	4.9
Carbonic acid	148.4
Chlorine	280.5

COMPOSITION.

Carbonate of lime	21.4
Carbonate of magnesia	27.0
Carbonate of sodium	301.4
Sulphate of sodium	17.6
Chloride of sodium	462.7

84. Mr. Peters, master mechanic, reports that while the water from the 200-foot layer, the Nacatoch sand, is highly alkaline, and causes considerable foaming unless the boilers are blown off regularly. He regards it as an excellent boiler water. For a time it was used in the engines on the Camden branch, but foamed so badly that it was abandoned.

The "water rock" is described as a hard sandstone, varying in thickness from 6 inches to 3 feet. It, as well as the underlying water sand, contains small fossil shells.

85. *Section of test well of St. Louis, Iron Mountain and Southern Railway, Gurdon, Clark County, Ark.*

[By C. H. Winters.]

	Feet
1. Surface sand and clay	0 – 35
Arkadelphia	
2. Blue clay	35 –201
Nacatoch	
3. Sand rock ("water rock")	201 –201.3
4. Water-bearing sand with clay	201.3–225

"Well will not yield enough water to justify erection of pumping station and tank."

86. The "40-foot rock" was encountered in this well at 190 feet, and the "water rock" at 235 feet. The latter was so soft that it was not necessary to use a drill.

87. Mr. Nelson has transmitted a quantity of asphaltum obtained from beneath the "water rock" in this well in 1903, with the statement, "Coal tar, like the sample sent, is found in some wells just beneath the 'water rock,' but I have never been able to get more than a handful from any well."

93. This well passed through the 40-foot rock, and the driller estimates that water would have been found at the depth of about 355 feet. It was abandoned because of the breaking of the tools.

99. Mr. R. B. F. Key, the former owner of this well, reports "oily material like coal tar" just above the water sand. This is probably asphaltum like that found around Gurdon.

113. The following data are given by Owen.[a] "An artesian well at Mr. Cargill's, on the hill near Okolona, was bored through the following strata:

Section of well at Okolona, Clark County, Ark.

[By David Dale Owen.]

	Feet
1. Soil and subsoil	0– 5
2. Gray or ash-colored marly limestone, containing black fossil *Turritites*, *Ostrea*, and other shells. This is the so-called "blue rock" which prevails along nearly the whole depth of the boring	305–308

"Water was obtained at 300 feet, in a hard cellular sand rock, which, however, soon gave way and caved in."

114. Captain East reports that the water rises in this well to within 15 feet of the surface, but lowers on pumping to 115 feet. The water was obtained in a gravel.

116. The depth of this well, reported by the driller and paid for by Mr. Hamilton, was 398 feet. In 1900 Mr. Geo. W. Hines, of Prescott, Ark., cleaned out the well and he reports the bottom at 250 feet. After this cleaning the quality and quantity of the water was the same as it was when first finished.

124. *Section of well of St. Louis, Iron Mountain and Southern Railway, Knóbel, Clay County, Ark.*

[By C. H. Winters.]

Quaternary (Port Hudson)	Feet
1. Clay	0– 8
2. Sand and clay	8–20
3. Fine yellow sand, with water	20–38
4. Coarse sand and gravel	38–56

126. *Section of well of Saline Lumber Company, Draughon, Cleveland County, Ark.*

[By S. E. Emmert.]

	Feet
Quaternary	
1. Sand and clay	0– 29
2. Gravel, with water, cased off	24– 32
Eocene	
3. Blue clay	32– 56
4. Lignite	56– 60
5. Blue clay	60– 95
6. Fine gray sand, not passed through	95–117

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[a] Second Report of a Geological Reconnaissance of Arkansas, 1860, pp. 123–124.

The 4-inch well was pumped for 60 days and nights at the rate of 183 gallons per minute without affecting the yield.

129. *Partial section of well of H C Newton, Kingsland, Cleveland County, Ark*

[By H C Newton]

		Feet
1	Lignite	81- 81
2	Lignite	120-121
3	Water-bearing sand at	160-
4	Water-bearing sand	180-200

137. Owen[a] gives the following result of a qualitative analysis of this spring "Temperature of the air 43°, of the water, 63° Bicarbonate of iron held in solution by some organic acid A small quantity of chloride of sodium (common salt)"

139. *Section of well of Louisiana and Arkansas Railway, Taylor, Columbia County, Ark*

[By L B Clifford]

	Feet
Quaternary (Port Hudson)	
1 Yellow clay	0- 9
2 Red clay	9- 22
3 Fine red sand, with seep water	22- 42
4. Red clay	42- 90
Sabine (Eocene)	
5 Blue joint clay	90-190
6 Blue sand, light water vein	190-202
7 Blue clay and hard rock	202-227
8 Gray sea sand, not passed through, good water vein	227-305

140. *Section of well of Calvin Powell, Taylor, Columbia County, Ark*

[By L B Clifford]

	Feet.
Quaternary (Port Hudson)?	
1 Red clay	0- 90
Sabine	
2 Blue-clay rock	90-210
3 Alternate layers of clay and gray sand, containing water	210-275

141. *Section of well of Neimeyer Lumber Company, Waldo, Columbia County, Ark*

[By L B Clifford]

		Feet	
1	No record	0	- 296
2	"Coal" (lignite)	296	- 300 7
3	No record	300 7	- 520
4	Water-bearing sand, water rose to within 70 feet of surface at	520	- 540
5	Dark-brownish clay, almost solid, with layers like flint every few feet	540	- 910
6	Clay	910	- 960
7	Shells (Midway?)	960	- 964
8	Hard clay	964	-1,000
9	No drillings brought up—water very milky (probably chalky limestone)	1,000	-1,038

142. *Section of well of Fordyce Lumber Company, Fordyce, Dallas County, Ark*

	Feet
Lafayette?	
1 Soil and sandy clay	0- 22
2 Coarse gray sand, with some gravel, water bearing	22-

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[a] Second Report of a Geological Reconnaissance of Arkansas, 1860, p 135

		Feet
Eocene		
3	No record	–318
4	Lignite	318–320
5.	No record	320–365
6	Hard blue clay	365–425
7	Water-bearing sand, rose to within 70 feet of the surface	425–450
8	No record	450–460
9	Very fine gray water-bearing sand, rose to within 70 feet of the surface	460–502

Temperature of water from 460 to 502 feet is 72 5° F Strainer 30 feet long

143. *Section of well of Desha Lumber Company, Arkansas City, Desha County, Ark.*

		Feet
Quaternary (Port Hudson)		
1	Sandy clay	0–100
2	Sand, with bad water	100–105
Jackson and Cockfield		
3	Blue clay	105–550
4	Water-bearing sand	550–

144. *Section of test boring No 2 at Choctaw Bar, near Arkansas City, Desha County, Ark* [a]

[By E W Hilgard]

		Feet
Alluvium		
1	Light-brown clay, with macerated vegetable matter	0– 1 2
2	Fine clayey sand	1 2– 23 6
3	Stiff clay, brown and sandy	23 6– 50 5
Port Hudson		
4	Fine gray sand, with lignite grains	50 5– 87 4
5	Very smooth blue clay, with lignite grains	87 4– 88 4
6	Grayish sand	88 4– 89 5
7	Coarse sand, with gravel and lignite grains	89 5–104 7
8	Brownish-gray sand	104 7–118 1
9	Very coarse sand	118 1–121 3
10	No record	121 3–151 0
"Claiborne Tertiary" (Jackson)		
11	Bluish clay, with crystals of pyrites and fragments of shells	151 0–165 5
12	Clayey marl, with greensand	165 5–166 5
13	Stiff blue clay	166 5–173 0
14	Light-bluish clay, with greensand and shell fragments	176 3–185 1
15	Limestone, apparently a concretion	185 1–185 2

"The other borings from the neighborhood of Choctaw Bar correspond closely to No 2, except that the thickness of the alluvial layer, as well as that of the underlying sand, varies from place to place In No 5 the alluvium is thickest, 67 feet The surface of the Tertiary seems to show a trough excavated to 40 feet below its highest point, cutting squarely across the two bends (from No 3 to No 2), as though indicating for a distance of 5 miles the direction of the ancient eroding current "

In 1901 Harris examined the specimens from the Choctaw Bar borings and identified the following species, which he regards as unquestionably Jackson [b]

"Boring No 1 —*Venericardia planicosta*, *Dentalium* (as at Helena), *Cadulus*, *Pleurotoma*, *Actæon*, *Turritella* (very small, unicarinate at base), *Phos hilli*

"Boring No 2 —*Phos hilli* (labeled '*Buccinum*' and '*Fusus magnocostatus*'), *Natica* (small), *Pleurotoma infans*, *Levifusus trabeatus*, *Cancellaria*, *Corbula* (small, probably *wailesiana*), *Turritella clevelandia*, *Venericardia rotunda*, *Volutilithes petrosus*, *Actæon*, *Calyptraphorus velatus* (tip of, labeled '*Nassa cancellata*')

"Boring No 4 —*Turritella* (small, sharply bicarinate), *Phos hilli*, *Oliva* cf *gracilis* Lea, *Natica* (small), *Venericardia parva*, *Corbula wailesiana*

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[a] Rept Miss River Com for 1883, 48th Cong, 1st sess, House Ex Doc No 37, 1884, pp 489–490

[b] Geol Survey Louisiana, Rept of 1902, pp 22–23

"Boring No 5—*Pseudoliva vetusta, Natica* (small), *Pleurotoma denticula, Venericardia planicosta, Turritella* (tip bicarinate), *Volutilithes petrosus Corbula wailesiana, Actæon* "

145. A bed of lignite is reported at about 480 feet

147. *Section of well in public square at Monticello, Drew County, Ark* [a]

[By David Dale Owen]

		Feet
1	Soil and subsoil	0–
2	Yellow clay	
3	Red clay and a little sand	– 20
4	"Black dirt," a dark, sticky clay, containing fossil shells at 145 feet	20–160

148. The city well was completed in 1899, and in September of that year Mr T E Hammock, the acting postmaster, gave the following section

Section of waterworks well at Monticello, Drew County, Ark

[By T E Hammock]

		Feet
1	No record	0–500
2	Sea mud mixed with leaves, some of which were perfect	500–555
3	Fine gray sand	555–575
4	Gravel and coarse sand	575–604

Well finished with a 30-foot strainer

In 1902 the superintendent of the waterworks, Mr D A Trammer, gave the following section.

Section of waterworks well at Monticello, Drew County, Ark

[By D A Trammer]

		Feet
1	Blue clay	0–497
2	Rock	497–500
3	Water sand, not passed through	500–750

151. The following partial section of the deep well was furnished by the secretary of the Gates Lumber Company October 15, 1902

Partial section of deep well of Gates Lumber Company at Wilmar, Drew County, Ark

		Feet
1	Water sand, gray sand with mica and black particles (developed in 5-inch well at planer)	184–194
2	Lignite	300–
3.	Water sand (15 to 20 feet thick)	313–333
4	Water sand (developed in well at sawmill)	400–500
5	Water sand, abundant supply of water, thought to be equal to that in No 4	800–

154. *Partial section of well of St Louis, Iron Mountain and Southern Railway, Conway, Faulkner County, Ark*

		Feet
1	Clay	0– 3
2	Soft shale	3– 10
3	Hard shale	10– 50
4	Soft shale, water bearing	50– 57
5	Hard shale	57– 92
6	Shale	92–176

154A. Dr H M Rector reports "In a well drilled at this point in 1893 to a depth of 860 feet, water was struck at a depth of 40 feet The supply from this source amounted to from 12 to 14 gallons per min-

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[a] Second Report of a Geological Reconnaissance of Arkansas, 1860, p 143

ute, and did not increase with continued drilling Therefore, after attaining a depth of 860 feet, the well was abandoned The character of the rock was generally slate or shale. with now and then a little quartz and what I call a hard sandstone or quartzite "

156. *Section of well of J B Ball, near Bell, Hempstead County, Ark*

[By J B Dillon]

	Feet
1 Surface, sand and clay, caves readily	0– 16
Brownstown	
2 "Blue dirt," a dark-colored calcareous clay	16–119
Bingen	
3 Lignite	119–127
4 Red sandy clay, caves	127–135
5 Water-bearing sand	135–

When completed the water in this well was quite soft, but when the iron casing decayed and the water came in contact with the "blue dirt," it became hard and highly mineral

159. Mr Robbins writes. "The water was clear and cold and could be used when first drawn, but after standing a while a blue-looking scum would rise, which would stick to the hand Stock would not drink the water Somewhere near 130 feet a strata of coal 10 feet thick was found "

160. *Section of well of Harrison Robbins, near Bell, Hempstead County, Ark*

[By J B Dillon]

	Feet
1 Surface sand and clay, caves badly	0– 35
Brownstown	
2 Blue clay	35–200
Bingen.	
3 Lignite	200–208
4 Red clayey sand, caves	208–230
5 Water sand	230

164. *Qualitative analysis of water from Long Spring, Hempstead County, Ark.*

[By Brackett and Smith][a]

Magnesium (Mg)	Chief constituents
Hydrochloric acid (HCl)	
Sodium (Na)	Small quantities
Potassium (K)	
Calcium (Ca)	
Iron (Fe)	
Sulphuric acid (SO_4)	Very little

HYPOTHETICAL COMBINATION

Chloride of magnesia ($MgCl_2$)	Chiefly
Sulphate of magnesia ($MgSO_4$)	
Chloride of soda (NaCl)	In smaller quantities
Chloride of potash (KCl)	
Chloride of lime ($CaCl_2$)	
Sulphate of potash (K_2SO_4)	
Sulphate of lime ($CaSO_4$)	
Sulphate or oxide of iron	

"Total solids in solution, dried on water bath, 74 043 parts per million Total solid material after ignition, 61.29 parts per million Upon ignition the solids burn brown and finally white, giving off white fumes with no decided odor The water is clear, odorless, and tasteless A slight yellowish sediment (iron hydroxide) is formed by the water "

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[a] Ann Rept Geol Survey Arkansas for 1891, vol 1, 1892, p 110

176. Mr C B Moore reports that in this well a small amount of asphalt was encountered under the "water rock "

192. In this well three "water rocks" were penetrated before a flow was obtained

194. Four or five rocks are reported in this well below the "water rock "

198. *Section of well of Albert Moore, on Red River south of Fulton, Hempstead County, Ark*

[By C D Hudson]

	Feet
Quaternary	
1 Reddish silty clay	0- 20
2 Quicksand	20- 60
3 Gravel	60- 80
Arkadelphia	
4 Blue clay	80-460
Nacatoch	
6 Water-bearing sand	460-480

This section may be taken as typical for the Moore, Shultz, and Ogden wells, the only factor varying being the blue clay

201. See No 198

202. See No 198

203. The first artesian wells in Fulton had an average depth of 160 feet, and all overflowed It is now necessary to go below the second rock, or to a depth of 165 feet, to get a satisfactory supply, and even then only the wells in the lowest parts of the town overflow Water in the wells, although standing higher than the water in the river, fluctuates with it (See p 80)

General section at Fulton, Hempstead County, Ark

[By C D Hudson]

	Feet
Quaternary (Port Hudson)	
1 Quicksand and clay	0- 60
Arkadelphia	
2 Black or blue clay	60-100
3 Chalky gray lime	100-150
Nacatoch	
4 Water-bearing sand, with occasional layers of hard rock	150-180

206. The following results of analysis of water from Fulton are quoted from Branner [a]

Analysis of well water from Fulton, Hempstead County, Ark

[By Richard N Brackett]

	Parts per million
Total solids	9,177 57
Chlorine	1,098 5
Sulphuric acid (anhydride)	381 5
Free ammonia	220
Albuminoid ammonia	156

Absence of notable quantities of lead, copper, or iron

"A partial qualitative analysis of the water showed the presence of chlorides and sulphates of magnesia, lime, and soda The salts in solutions are mainly Sulphate of magnesia (Epsom salts), sulphate of lime (gypsum), sulphate of soda (Glauber's salt), and chloride of sodium (common salt) The amount of total solids alone is sufficient to render the water unfit for drinking purposes

"The principal salts being chloride of soda and sulphates of soda, magnesia, and lime, indicates that this water comes from the Mesozoic salt beds of the same horizon as the salt waters east of Arkadelphia and the salt wells farther west "

Without knowing positively that this water was from the main Nacatoch water-bearing horizon at Fulton, it is impossible to make a direct comparison, but it should be stated in this connection that the physicians

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[a] Ann Rept Geol Survey Arkansas for 1891, vol 1, 1892, p 137

and leading men concur in the statement that since the use of artesian water sickness has decreased over 50 per cent

208. *Section of well of Charles McNabb, north of Lodi Ferry, Hempstead County, Ark*

[By C D Hudson]

	Feet
Quaternary?	
1 Quicksand	0–43
Nacatoch	
2 Hard rock	43–43 5
3 Water sand	43–96

212. *Section of well of Dan Harkness, sec 10, T 13 S , R 26 W , Hempstead County, Ark*

[By C D Hudson

	Feet
Quaternary and Lafayette?	
1 Clay	0– 30
2 Quicksand	30– 40
3 Gravel and quicksand	40– 52
Arkadelphia	
4 Blue clay	52–112
Nacatoch	
5 Soft sandstone	112–114
6 Black sand	114–118
7 Very hard rock (water rock)	118–121
8 Water-bearing sand	121–130

Layers 1–3 are commonly described as "surface dirt "

213. *Section of well of Dan Harkness, sec 2, T 13 S , R 26 W , Hempstead County, Ark*

[By C D Hudson]

	Feet
1 Surface dirt ("caving dirt")	0– 30
Arkadelphia	
2 Blue clay	30–120
Nacatoch	
3 Water rock	120–123
4 Water sand	123–133

214. *Section of well of Dan Harkness, sec 11, T 13 S , R 26 W , Hempstead County, Ark*

[By C D Hudson]

	Feet
1 Surface clay ("caving dirt")	0– 40
Arkadelphia	
2 Blue clay	40–170
Nacatoch	
3 Water rock	170–174
4 Water-bearing sand	174–175

220. *Section of well of Orange Smith, sec 1, T 13 S , R 26 W , Hempstead County, Ark*

[By C D Hudson]

	Feet
1 Surface clay	0– 30
Arkadelphia	
2 Blue clay	30–271
Nacatoch	
3 Black sand	271–273
4 Alternate layers of hard rock and soft sand	273–285

224. *Section of well of Will Gilbert, sec. 26, T. 12 S., R. 26 W., Hempstead County, Ark.*

[By C. D. Hudson.]

	Feet
1. Surface sand and clay	0–17
Arkadelphia:	
2. Blue clay	17–47
Nacatoch:	
3. Black sand	47–51
4. Water rock, very hard quartzite	51–54
5. Alternate layers of hard and soft sand containing water	54–97

225. *Section of well of John Gilbert, sec. 23, T. 12 S., R. 26 W., Hempstead County, Ark.*

[By C. D. Hudson.]

	Feet
1. Surface clay and sand	0–29
2. Fine gravel	29–31
Nacatoch:	
3. Blue sand, with water	31–51
4. White water-bearing sand	51–67

226. *Section of well at Liberty schoolhouse, sec. 24, T. 12 S., R. 26 W., Hempstead County, Ark.*

[By C. D. Hudson.]

	Feet
1. Surface sand and clay	0–17
Arkadelphia:	
2. Black clay	17–23
Nacatoch:	
3. Soft sandstone	23–25
4. Black sand	25–45
5. Hard rock	45–47
6. Water-bearing sand	47–54

227. *Section of well of John Gilbert, sec. 24, T. 12 S., R. 26 W., Hempstead County, Ark.*

[By C. D. Hudson.]

	Feet
1. Surface clay	0–20
Nacatoch?:	
2. Quicksand	20–40
Nacatoch:	
3. Water rock	40–42
4. Water-bearing sand	42–53

244. *Section of well of St. Louis, Iron Mountain and Southern Railway, at Guernsey, Hempstead County, Ark.*

	Feet
1. Sand	0– 10
Arkadelphia:	
2. Soft clay	10– 40
3. Hard blue clay	40–300
Nacatoch:	
4. Sandstone, water-bearing	300–460

Analysis of water from well of St Louis, Iron Mountain and Southern Railway, Guernsey, Hempstead County, Ark

[By Edward H Keiser]

	Parts per million
Total solid residue	388 94
Loss on ignition	21 55
Fixed residue	367 39
Calcium carbonate	207 68
Calcium sulphate	63 13
Sodium chloride	44 37
Sodium carbonate	52 21

"This is very good soft water, it leaves but little residue on evaporation It will work well in steam boilers, in short, it is an unusually good boiler water "

246. *Section of well of Frank Jett, 1 mile west of Guernsey, Hempstead County, Ark*

[By D E Cornelius]

	Feet
1 Surface clay and sand	0– 30
Arkadelphia	
2 Blue clay	30–302 5
Nacatoch	
3 Soft sand	302 5–304 5
4 Black sand	304 5–308 5
5 Very hard rock	308 5–311
6 Water-bearing sand	311 –327

261. Owen[a] gives the following principal constituents of this water Chloride of sodium, carbonate of soda, sulphate of soda, sulphate of magnesia, traces of carbonate of lime and magnesia, and trace of free sulphureted hydrogen

321. *Section of well at Hope, Hempstead County, Ark*

[By T M Phillips]

	Feet
1 Clay, ranging from gray to yellow, contains some sand, caves readily	0– 45
2 Thin layer of lignite, with selenite crystals	45– 47
Arkadelphia	
3 "Blue dirt" and very dark-colored stiff clay	47–364
Nacatoch	
4 Black sand, with fossil shells	364–374
5 Water rock	374–375
6 Water-bearing sand, with layers of rock	375–445
Marlbrook	
7 Blue clay, no water	445–950

322. Report of Scheuman & Bros , consulting engineers, July 26, 1899 "The new well is 9 inches in diameter from 0 to 400 feet, and 5 inches from 400 to 500 feet Rock, 'water rock,' was encountered at 400 feet Well is cased with 7-inch casing 400 feet long, and has a 5-inch water pipe 260 feet long set in it Water rises within 66 feet of the surface by actual measurement Test in July, 1899, for thirty-six minutes yielded 144 4 gallons per minute "

Report of M T Chapman, January 4, 1900 "Depth to water, 69 feet 10 inches Test from 5 04 to 8 35 p m , at the rate of 170 gallons per minute, lowered 66 feet "

332. Water-bearing sand was encountered in this well at a depth of 260 feet, from which the water rose to within 2 feet of the surface, but hoping to obtain flowing water, the well was drilled to a depth of 400 feet The water sand was entirely penetrated without any increase of head

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[a] Second Report of a Geological Reconnaissance of Arkansas, 1860, p 118

340. *Analysis of water from the Arkansas Lithia Spring, 4½ miles southwest of Hope, Hempstead County, Ark*

[By Muelher]

	Parts per million
Magnesium sulphate	185 31
Calcium sulphate	200 94
Strontium sulphate	23 89
Lithium carbonate	109 087
Sodium chloride	347 49
Potassium chloride	69 05
Magnesia chloride	6 91
Iron oxide	209 75
Magnesia iodide	26 31
Magnesia borate	1 36
Iron crenate	1 98
Silica	57 88
Alumina	15 95

Analysis of water from Lithia Spring, Hempstead County, Ark [a]

	Parts per million
Silica (SiO_2)	81 05
Sodium (Na)	155 27
Potassium (K)	17
Magnesium (Mg)	64 30
Calcium (Ca)	75 24
Lithium (Li) (the spectroscope shows a strong lithium line)	
Iron (Fe)	17 65
Aluminum (Al)	5 81
Sulphuric acid (SO_4)	175 10
Carbonic acid (CO_3), calculated	82 25
Chlorine (Cl)	114 57
Oxygen (basic)	21 55
Organic matter	135 26
Total solid material in solution	1,157 60

HYPOTHETICAL COMBINATION.

Silicate of soda (Na_2SiO_3)	164 50
Silicate of potash (K_2SiO_3)	34
Chloride of soda (NaCl)	236 32
Chloride of magnesium ($MgCl_2$)	190 32
Carbonate of lime ($CaCO_3$)	137 14
Sulphate of magnesia ($MgSO_4$)	81 22
Sulphate of lime ($CaSO_4$)	69 25
Sulphate of iron ($FeSO_4$)	48 05
Sulphate of alumina ($Al_2(SO_4)_3$)	36 59
Organic matter	135 26

"The water is clear, but has a brownish-yellow color, and contains much organic matter A slight sediment was formed in each bottle"

341. The well referred to was drilled for Julius City, and is situated about 100 feet west of the depot. No satisfactory data regarding its depth have been obtained From one source it was reported 300 feet, from another 480 feet The latter more nearly agrees with the depth indicated by the general dip of the beds in this region

The following approximate section has been furnished by Mr J B Dillon

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[a] Ann Rept Geol Survey Arkansas for 1891, vol 1 1892, p 62

Section of well of Julius City, Ozan, Hempstead County, Ark

[By J B Dillon]

	Thickness in feet.
1 Weathered surface beds	35
Brownstown	
2 Blue clay	
Bingen	
3 Lignite	10
4 Very red clay	10
5 Water sand	

342. The following results of a qualitative examination of the well water of J D Morrisett are given by Owen [a] "This water is strongly impregnated with the sulphate of magnesia, which is its characteristic ingredient, along with some chloride of sodium, bicarbonate of lime, bicarbonate of magnesia, and carbonate of alkali This water is very similar to the celebrated Harrodsburg water in Kentucky"

351. *Section of well of J W Byram, near Spring Hill, Hempstead County, Ark.*

[By C D Hudson]

	Feet
1 Surface clay and sand	0- 54
Arkadelphia	
2 Blue clay	54–407
Nacatoch	
3 Sand and rock with artesian water	407–427

356. In a letter dated June 26, 1899, Mr Meredith gives the following section of this well

Section of well at Washington, Hempstead County, Ark

[By S R Meredith]

	Feet
Nacatoch?	
1 Sand	0- 4
2 Red and yellow joint clay	4- 24
Nacatoch	
3 Quicksand	24- 54
4 Sandstone	54–103
5 Quartzitic sandstone	103–104
6 Water-bearing sand	104–105
Marlbrook and Brownstown?	
7 Blue clay, no water	105–750

The water from the sands above the blue clay stands within 35 feet of the surface

357. The general geologic structure and the record of the deep well (356) given above indicate that this well obtained its supply from a depth of less than 105 feet

358. Owen[b] reports that the water from a well on "Lowry's lot, on the north edge of the town of Washington," was tested and the constituents found to be "Protoxide of iron, partly held in solution by carbonic acid, and partly by an organic acid, chloride of sodium, traces of sulphate of soda and magnesia, bicarbonate of lime, bicarbonate of magnesia, carbonate of alkali"

361. Owen[a] gives the following qualitative analysis of this water Chloride of sodium, a trace of bicarbonate of lime, a trace of bicarbonate of magnesia

362. *Section of well on Walker farm, near Yancey, Hempstead County, Ark*

[By S R Meredith]

	Feet
1 Weathered clay	0–30
2 Blue marl	30–300
3 Lignite	300–301
4 Blue marl, with layers of shells and masses of iron pyrite, no water	301–700

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[a] Second Report of a Geological Reconnaissance of Arkansas, 1860, p 118

[b] Op cit, p. 117.

362A. *Section of well of Wisconsin-Arkansas Lumber Company, 1 mile south of Malvern, Hot Spring County, Ark*

[By G S Smith, foreman]

		Feet
1	Gravel	0–32
2	Blue clay	32–44
3	Lignite	44–47
4	Black clay	47–54
5	Hard limey rock	54–59
6	Black clay	59–82
7	White clay	82–112
8	White sand containing a little water	112–124
9	Black clay, with stones	124–170
10	Hard white quartz, described as a ledge	170–216
11	Black clay, with bowlders and some fossil shells	216–330
12	Ledge of white quartz	330–369
13	Black clay	369–420
14	Black shale	420–478

362B. *Section of well of William Kilpatrick, near Malvern, Hot Spring County, Ark*

[By A H Purdue]

		Feet
1	Gravel	0–14
2	Clay	14–34
3	Fuller's earth (blue mud)	34–103
4	White flinty rock (sandstone, with some pyrite)	103–250

370. *Section of well of W A Coleman & Bro , Allbrook, Howard County, Ark*

[By S R Meredith]

		Feet
1	Caving clay	0–25
	Brownstown	
2	Blue marl, with thin layer of coal just above rock	25–460
	Bingen	
3	Water-bearing sand	460–465
4	Blue marl	465–480
5	Rock	480–481
6	Water-bearing sand	481–500

Water from second water-bearing stratum will not rise any higher than that from the first

374. Mr Johnson writes "The water is so muddy it can not be used for any purpose but stock, and they like it "

375. *Section of well of Wilson & Walker, sec 15, T 11 S , R 27 W , Howard County, Ark*

[By S R Meredith]

		Feet
1	Weathered clay	0–15
	Annona	
2	White chalk	15–
	Brownstown	
3	Blue marl with shells	–380
	Bingen	
4	Rock (probably limestone)	380–
5	Water-bearing sand, water rises just to ground level	
6	Blue marl	–430
7	Rock	430–
8	Sand, with artesian water	

378. *Section of well of Allen Rose, sec 17, T 11 S, R 27 W, Howard County, Ark*

[By Allen Rose]

	Feet
1 Weathered clay	0- 19
Brownstown	
2 Blue marl	19-320
Bingen	
3 White sand and small gravel	320-340

"The well flowed for about three years and then the water sank about 16 feet, or to 8 feet below the surface of the ground"

382. It is reported that two water rocks were encountered and that the flow was materially increased by passing through the second

384. Mr Smith reports that the water from this well at first rose 10 feet above the surface

386. Mr R W Smith, who has had quite an extensive experience in drilling in this section, gives the following general information "The formations encountered are from 10 to 40 feet of soil and red clay, below which is white chalk rock This chalk formation becomes dark blue and softer at depths of 75 or 100 feet and continues thus, interspersed with a few lime shells or like substances, until a hardpan is reached which overlies the water Just at this point there is a thin stratum of lignite Under this there are about 100 feet of firm, porous, water-bearing sand rock If all of this is opened up the yield is greater than if it is not The nonflowing wells yield an abundant supply, but from 50 per cent of them the water is muddy if they are not cased below the coal stratum All the wells in this region should be cased to the water-bearing sand"

394. *Analysis of water from Mineral Springs, Howard County, Ark*

[By A E Menke][a]

	Parts per million
Silica (SiO_2)	32 67
Sodium (Na)	9 58
Potassium (K)	103
Magnesium (Mg)	017
Calcium (Ca)	1 54
Iron (Fe)	17
Sulphuric acid (SO_4)	068
Carbonic acid (CO_3)	14 88
Chlorine (Cl)	1 37

HYPOTHETICAL COMBINATION

Silica (SiO_2)	32 67
Chloride of soda (NaCl)	4 66
Chloride of potash (KCl)	17
Carbonate of soda (Na_2CO_3)	17 44
Carbonate of lime ($CaCO_3$)	8 04
Carbonate of iron ($FeCO_3$)	34
Sulphate of magnesia ($MgSO_4$)	086
Sulphureted hydrogen (H_2S)	Trace

398. *Section of well of Capt D P Terry, Nashville, Howard County, Ark*

[By S R Meredith

Bingen formation	Feet
1 Quicksand	0 - 60
2 Blue marl	60 -120
3 Rock	120 -120 5
4 Water-bearing sand	120 5-121
5 Marl	121 -131
6 Rock	131 -132
7 Water-bearing sand	

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[a] Ann Rept Geol Survey Arkansas for 1891, vol 1, 1892, p 66

401. Between 280 and 300 feet a small supply of hard water was encountered

402. *Section of well of Thomas L Jones, sec 35, T 11 S , R 27 W , Howard County, Ark.*

[By Thomas L Jones]

		Feet
1	Soil	0- 1
2	White chalk (Saratoga formation —Branner)[a]	1- 15
3	Very hard blue marl	15- 45
4	Very soft blue marl	45-200
5	Alternating soft and hard blue-marl beds	200-465
6	Alternate beds of lignite from 4 to 10 feet thick, between which were beds of sand, not water bearing	465-750
7	Coarse white and black water-bearing sand, with interspersed hard flint rock	750-787 6
8	Very hard flint rock, not penetrated	787 6-

403. It is stated that this well was pumped for six days with a steam pump connected with the gin without any perceptible change in the supply No gagings were made to determine the exact amount of water delivered

404. *Section of well at Saline Landing, Howard County, Ark*

[By J C Branner]

		Feet
1	Soil and clay	0- 25
2	Brown sand	25- 26
Annona		
3	White chalk	26-166
Brownstown		
4	Blue marl	166-456
Bingen		
5	Sandy bed, with pyrite, furnishes artesian water	456-

Qualitative analysis of water from artesian well at Saline Landing, Howard County, Ark

[By A E Menke][b]

Silica (SiO_2)
Chloride of soda (NaCl) } Large quantity
Carbonate of lime ($CaCO_3$) }
Carbonate or sulphate of potash (K_2CO_3 or K_2SO_4), trace, most probably K_2SO_4
Sulphate of magnesia ($MgSO_4$), the merest trace

Water collected by J C Branner, December 20, 1891 Total solids in solution, 90 41 grains per United States gallon

It may be noted as rather peculiar that this well shows a large quantity of carbonate of lime, while the other deep wells of the region uniformly furnish soft alkaline water Perhaps the carbonate reported in this water is in the form of sodium carbonate

405. *Section of well three-fourths mile northeast of Saline Landing, Howard County, Ark*

[By J C Branner][c]

		Feet
1	Soil	0- 1
Annona		
2	White chalk	1-111
Brownstown		
3	Blue marl	111-388
Bingen		
4	Sand, with pyrites, water bearing	388-

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[a] Twenty-second Ann Rept U S Geol Survey pt 3, 1902, p 714

[b] Ann Rept Geol Survey Arkansas for 1891, vol 1, 1892, p 105

[c] Trans Am Inst Min Eng , vol 27, 1898, p 52

409. *Section of well at Dexter, Jefferson County, Ark*

	Feet
1 Sand	0–85
2 Sandstone	85–86
3 Water-bearing sand	86–

411. *Section of well at St Louis Southwestern Railway shops, Pine Bluff, Jefferson County, Ark*

[By R M Galbraith]

	Feet
Quaternary (Port Hudson)	
1 Alluvial deposits	0– 30
2 Sand, with considerable water, very ferruginous and alkaline	30– 42
Eocene	
3 Blue clay	42– 72
4 Black clay	72–500
5 Limestone rock	500–505
6 Black clay	505–890
7 Coarse gravel and sand, water bearing	890–

The water is excellent for boiler purposes, making no scale Its use has produced a marked decrease in the percentage of sickness among the employees at the shops

412. The first wells of the Pine Bluff Water and Light Company were from 70 to 90 feet deep and were abandoned, as the water was very ferruginous The deep wells were sunk in 1898, and Mr F G Bridges has transmitted the following record by the driller

Section of well of Pine Bluff Water and Light Company, Pine Bluff, Jefferson County, Ark

[By W B Sharpe]

	Feet
Quaternary (Port Hudson)	
1 Clay	0– 35
2 Very coarse sand	35–110
Eocene	
3 Blue clay	110–350
4 Sand and water	350–354
5 Hard clay	354–803
6 Lignite	803–848
7 Hard rock	848–854
8 Sand	854–864
9 Water sand	864–915

The water level, as reported by Mr Bridges in 1899, was 31 feet from the surface In 1900 the superintendent gave it as 46 feet, and added that when they were pumping 1,000,000 gallons per day it lowered to 100 feet

Analysis of water from deep well of Pine Bluff Water and Light Company, Pine Bluff, Jefferson County, Ark

[By Edward H Kaiser]

	Parts per million
Total solids	106 40
Free ammonia	230
Albuminoid ammonia	125
Nitrites	180
Nitrates	None
Chlorides	None

415. *Record of well of Pine Bluff Ice Company, Pine Bluff, Jefferson County, Ark*

[By Jeff Hicks]

	Feet
Quaternary (Port Hudson)	
1 Sand and red mud, passing below into gravel	0–100
Eocene	
2 Blue clay, no water	100–300

Water was obtained only from the gravel above the blue clay, but the well was sunk to a depth of 300 feet, in order to furnish underground storage and that an air lift might be used to greater advantage

415A. *Section of well of Arkansas Cotton Oil Company, Pine Bluff, Jefferson County, Ark*

	Feet
Quaternary (Port Hudson)	
1 Surface	0- 87
Eocene	
2 Clay	87-413
3 Water-bearing sand	413-417
4 Very hard blue clay	417-806
5 Water-bearing sand	806-826

416. *Record of test well of St Louis, Iron Mountain and Southern Railway, Redfield, Jefferson County, Ark*

[By C H Winters]

	Feet
1 Surface	0- 16
Jackson	
2 Marl	16- 30
3 Hard blue clay	30- 60
4 Hard blue clay, with many fossil shells	60- 85
Eocene	
5 Blue clay, with occasional bowlders and thin beds of lignite	85-404
6 Water-bearing sand, water rises to within 60 feet of surface and furnishes 20 gallons per minute	404-412
7 Blue clay, with lignite	412-545

418. *Section of well of H Smith, near Bradley Station, Lafayette County, Ark* [a]

	Feet
1 Soil and sand	0-18
2 Red clay	18-27
3 Light sand, with water	27-37

419. *Section of well of Red River Lumber Company, Frostville, Lafayette County, Ark*

[By L B Clifford]

	Feet
Quaternary (Port Hudson)	
1 Yellow clay	0- 9
2 Red clay	9- 22
3 Red sand	22- 40
4 Red clay, passing below into red sand	40- 83
5 Gravel	83- 85
Sabine	
6 Blue clay	85-112
7 Gray water-bearing sand, water rises to within 36 feet of the surface	112-120
8 Clay and rock	120-140
9 Water-bearing sand, water does not rise quite so high as in layer No 7	140-160
10 Blue clay and rock	160-364
11 Water-bearing sand, water rises to within 54 feet of the surface	364

Water from stratum No 11 is of very poor quality and supply is drawn from layers 7 and 9 The 6-inch well was completed in 1902

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[a] Ann Rept Geol Survey Arkansas for 1892, vol 2, 1894, p 83

420. *Section of well of Red River Lumber Company, Kelly, 2 miles west of New Lewisville, Lafayette County, Ark*

[By L B Clifford]

		Feet
	Quaternary (Port Hudson)	
1	Red clay	0 – 19
2	Red sand	19 – 58
3	Red clay, with occasional layers of rock (probably concretions)	58 – 70
4	White sand	70 – 75
5	Gravel	75 – 79
	Sabine	
6	Very thin rock	79 – 79 4
7	Blue clay	79 4–170
8	"Soapstone" (hard blue clay)	170 –
9	Packed sand	–204
10	Gray water-bearing sand, water rose to within 30 feet of surface	204 –234
11	Blue clay and rock	234 –300
12	Water-bearing sand, water rose to within 32 feet of surface	300 –320
13	Blue clay, containing lignitized wood at 340 feet, and occasional layers of hard bluish rock	320 –468
14	Dark-blue water-bearing sand, water is strongly charged with H_2S, and rose to within 44 feet of surface	468 –480
	Midway?	
15	Clay	480 –502

421. *Section of well of L B Clifford, New Lewisville, Lafayette County, Ark*

[By L B Clifford]

		Feet
	Quaternary (Port Hudson)	
1	Red clay	0–19
2	Red sand	19–58
3	Dark-red clay with occasional concretions	58–70
4	White sand	70–75
5	Gravel, water bearing	75–79

The majority of the wells in the flats extending from New Lewisville to the State line obtain their water from this gravel bed, which separates the younger terrace deposits from the older beds of the Sabine formation

422. *Section of well of Sim Owen, 2 miles south of New Lewisville, Lafayette County, Ark*

[By L B Clifford]

		Feet
	Quaternary (Port Hudson)	
1	Red clay	0–36
2	White sand and gravel	36–44

424. *Section of court-house well at New Lewisville, Lafayette County, Ark*

[By L B Clifford.]

		Feet
	Quaternary or Lafayette?	
1	Surface gravels, not water-bearing	0– 30
	Sabine	
2	Black clay	30–223
3.	Water-bearing sand	223–240

426. *Section of well of Lewisville Lumber Company, 5 miles north of New Lewisville, Lafayette County, Ark.*

[By J M Phillips]

	Feet
Quaternary?	
1 Quicksand, no gravel	0– 50
Sabine	
2 Blue clay	50–150
3 Water-bearing sand	150–200

427. *Section of well of Bodcau Lumber Company, Stamps, Lafayette County, Ark*

[By L B Clifford]

	Feet
1 Yellow clay	0 – 9
Sabine	
2 Blue clay	9 – 50
3 Rock	50 – 51
4 Blue clay, with a few fossil shells and occasional rocks	51 –233
5 Gray sand, containing every 10 to 20 feet a thin layer of white, chalk-like rock, sand is water-bearing and increases in coarseness with depth	233 –345
6 Rock	345 –349 5
7 Blue clay, with occasional layers of rock (probably concretions)	349 5–370
8 Dark sand containing sulphur water	370 –415

Completed September, 1902

433. Mr J A Reinhardt reports "This well was never used, as the lumber camp for which it was intended was moved before the well was finished Strata (1) Dark sandy soil, (2) red clay subsoil, (3) joint clay, (4) blue clay"

434. *Section of well of J R Bowles, Ashdown, Little River County, Ark*

[By J R Bowles]

	Feet
Quaternary (Port Hudson)?	
1 Clay	0–10
2 Sand	10–19
3 Clay	19–25
4 Quicksand, passing into gravel	25–70

436. *Sanitary analysis of water from artesian well in sec 27, T 13 S, R 27 W, Little River County, Ark* [a]

[By Richard N Brackett]

	Parts per million
Total solids, dried at 275° F (134° C)	5,107 1
Chlorine (Cl)	2,828 9
Sulphuric acid (SO_4)	None
Iron (Fe)	Slight trace
Free ammonia	13 19
Albuminoid ammonia	.21

HYPOTHETICAL COMBINATION

Silica (SiO_2)	Small quantity
Chloride of soda (NaCl)	Chief constituent
Chloride of potash (KCl)	Traces
Chloride of lithia (LiCl)	
Chloride of lime ($CaCl_2$)	Small quantity

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[a] Ann Rept Geol Survey Arkansas for 1891, vol 1, 1892, p 109.

Chloride of magnesia ($MgCl_2$)	Trace (?)
Carbonate of magnesia ($MgCO_3$)	Very small quantity.
Carbonate of lime ($CaCO_3$)	Small quantity.
Organic matter, nitrogen	Large quantity, indicated by the free and albuminoid ammonia.

440. *Section of well of Frank Harkness, sec. 2, T. 14 S., R. 28 W., Little River County, Ark.*

[By S. R. Meredith.]

	Feet.
Quaternary (Port Hudson):	
1. Quicksand and gravel	0– 60
Arkadelphia:	
2. Blue marl	60–200
Nacatoch:	
3. Alternate layers of water-bearing sandstone and marl beds	200–300

443. *Section of well of Hudson River Lumber Company, Hudson, Little River County, Ark*

[By L. B. Clifford.]

	Feet.
Quaternary:	
1. Surface gravels containing alkali water	0–58
Nacatoch:	
2. Sandstone	58 –62.5
3. Sand with soft water	62.5–66.5
Marlbrook and Annona:	
4. Blue clay, no water	66.5–360
5. Light-colored rock, with hard water in crevice of rock	360–830

444. *Section of well of Judge M. W. Bates, Ogden, Little River County, Ark.*

[By S. R. Meredith.]

	Feet.
Pleistocene (Port Hudson):	
1. Sand and gravel	0– 80
Arkadelphia:	
2. Blue marl	80– 94
Nacatoch:	
3. Sand and sandstone, water bearing	94–224

445. Branner[a] gives the following data: "Holeman's well is 308 feet deep; 10 feet of shaly limestone overlie the blue chalk, which crumbles after long exposure; at 160 feet there are three 6-inch layers of reddish sand."

447. *Section of well of C. S. Walker, near Rocky Comfort, Little River County, Ark.*

[By C. S. Walker.]

	Feet.
Quaternary or Lafayette?:	
1. Hard cemented gravel	0– 12
2. Coarse sand and gravel	12– 17
Annona:	
3. Hard lime rock	17–117
Brownstown:	
4. Blue clay	117–267
5. Hard lime rock, with occasional layers of quicksand and coarse white sand	267–500

The well was a complete failure.

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[a] Trans. Am. Inst. Min. Engs., vol. 27, 1898, p. 48.

448. *Section of well of Jesse L. De Long, sec 32, T 13 S , R. 32 W , Little River County, Ark.*

	Feet
Pleistocene	
1 Red River alluvium	0– 70
Marlbrook formation	
2 Hard gray dirt	70–540
Annona chalk?	
3 Very hard gray dirt, almost solid rock	540–560

452. The following section has been taken from a blueprint furnished by the chief engineer of bridges and buildings of the Missouri Pacific system,

Section of well of St Louis, Iron Mountain and Southern Railway, Austin, Lonoke County, Ark

	Feet
1 Dug well (hard blue fossiliferous clay)	0 –34
2 Hard blue clay, with shells	34 –40 5
3 Hard limestone	40 5–43 5
4 Light-gray quicksand, with shells and some water	43 5–52 5
5 Dark clay, with mucky quicksand	52 5–60
6 Soft sandstone	60 –62
7 Dark blue sandy clay (will crumble)	62 –97 7
8 Hardpan and joint clay	97 7–275
9 Layers of sandstone and slate	275–281
10 Soft slate, with small layers of sand (containing no water)	281–332

"The top 48 feet is a dug well and is curbed with old stringers 13 feet by 14 feet, the bored well is placed near north side and the 8-inch casing comes up to the top It is claimed by Mr Boone that the bottom of the well will hold water like a jug"

461. A thick bed of lignite is reported at about 25 feet from the surface

464. *Section of well of Bryant & B'Shirs, on Red River, sec 8, T 14 S , R 26 W , Miller County, Ark*

[By C D Hudson]

	Feet
Quaternary (Port Hudson)	
1 Surface loam, passing below into coarse gravel	0– 80
Arkadelphia	
2 Blue clay	80–400
3 Soft layer, like hardened oil, no drillings came up	400–470
Nacatoch	
4 Sand, with artesian water	470–486

468. *Section of well of J Shultz, Clipper Spur, Miller County, Ark*

	Feet
Quaternary (Port Hudson)	
1 Loam and gravel	0– 60
Arkadelphia	
2 Blue clay	60–270
Nacatoch	
3 Water-bearing sand	270–

476. *Section of well of Joe Winters, sec. 18, T 13 S , R 27 W , Miller County, Ark*

[By C D Hudson]

	Feet
Quaternary (Port Hudson)	
1 Surface clay and fine sand	0– 93
2 Coarse gravel	93–108
Arkadelphia	
3 Blue clay	108–330
4 Red rock	330–334
Nacatoch	
5 Hard quartzitic rock	334–338
6. Water-bearing sand	338–408

478. *Section of test well of Waterworks Company, Texarkana, Miller County, Ark*

[By R A Munson]

	Feet
Quaternary or Lafayette	
1 Dirt, sand, and gravel	0- 50
Sabine	
2 White sand and clay, with water	50- 95
Midway? and Arkadelphia	
3 Dark-blue clay, no water	95-825
Nacatoch	
4 Sand and sand rock, water bearing	825-925
Marlbrook	
5 Blue clay	925-930

The casing extends only to the top of the blue clay The water from this well is occasionally used to supplement that from the shallow wells described under No 479 The water has been analyzed by Mr. Reuben Haines, of Philadelphia, with the following results

Sanitary analysis No 1 of water of deep well of Waterworks Company, Texarkana, Miller County, Ark

[By Reuben Haines]

[Sample received September 14, 1899, in stoneware jug]

	Parts per million
Free ammonia	1 716
Albuminoid ammonia	066
Nitrogen as nitrites	Considerable amount
Nitrogen as nitrates	None
Chlorine	3,293 9

Total hardness, 20 4°

Temporary hardness, 19 9°

Permanent hardness, 0 5°

Turbidity, considerable black sediment resembling lignite, together with fungus, colored with iron oxide

Color after filtration, slightly yellowish

Odor, moldy, especially when warm

"This sample had stood about ten days before being opened for analysis, comparison with sample received October 9, 1899, showed that this sample originally contained a much larger amount of ammonia than appears above The nitrites increased greatly on standing

"This well water is not hygienically safe as a domestic water supply It is contaminated with vegetable or animal matter, or both kinds Part of the ammonia is derived from lignite deposits, the chlorine from salt beds The well may be liable to surface contamination or from river flood-plain deposits The well should either be abandoned or sunk much deeper and piped the whole distance to bottom "

Sanitary analysis No 2 of water of deep well of Waterworks Company, Texarkana, Miller County, Ark

[By Reuben Haines]

[Sample received October 9, 1899, in glass bottle]

	Parts per million
Free ammonia	5 920
Albuminoid ammonia, mixed	130
Albuminoid ammonia, settled	053
Nitrogen as nitrites	Considerable amount

"Turbidity, small amount of sediment of fungous growth

"Color after filtration, slightly yellowish

"Odor, not observed

"After standing several days the free ammonia was again determined and found to have decreased greatly. The nitrites at the same time greatly increased Both samples are likely to have lost part of their free ammonia during transportation from Texarkana A contaminated water, not suitable for domestic use "

Mineral analysis of water of deep well of Waterworks Company, Texarkana, Miller County, Ark.

[By Reuben Haines]

	Parts per million
Sodium chloride (common salt)	5,428 9
Calcium carbonate (carbonate of lime)	186 7
Magnesium carbonate	71 5
Sodium sulphate	4 4
Silica, iron oxide, alumina	13 5
Total solid matter (by actual weight)	5,759 1
Total hardness	203 3

"This water will produce considerable scale, but is otherwise a good boiler water The scale will be comparatively soft, as sulphate of lime is absent There is no ingredient in the water which would cause corrosion The carbonate-producing scale may be removed by a good feed-water heater "

While this is clearly a highly mineral water and on this score may not be fit for domestic use, the situation of the well is such that there is absolutely no chance of contamination The high percentage of chlorine which caused this chemist to suggest pollution was not due to sewage of any sort, but to geologic conditions

The upper Bingen water horizon, the sub-Clarksville sand, should be encountered at this place at about 2,000 feet below sea level (Pl XXXVII, sec H) There is considerable likelihood, however, that this water will also be highly mineral, though its quality varies greatly from point to point It is the source of the 600-foot supply at Clarksville, Tex , which is of good quality In attempting to develop the sub-Clarksville horizon care should be taken to case off the hard, bitter water which is encountered from 100 to 200 feet above the main sand

The Woodbine horizons encountered at Clarksville, Tex , between 560 and 1,160 feet, would be found at this place at depths of from 2,500 to 3,000 feet below sea level (Pl XXXVII, sec H) The quality of the water from the upper horizon is likewise variable, but it is commonly decidedly mineral In the lower horizon good water is reported at Clarksville and doubtfully indicated at Paris (pp 77–78)

479. The supply of the Texarkana Water Company is obtained from 52 wells, having an average depth of 45 feet, ranging in diameter from 5 inches to 30 feet, and located in a branch valley in the northeastern part of the town, quite beyond the thickly settled portions The supply, which is almost wholly from the irregular surficial gravel deposits which mantle this region, is occasionally supplemented by water from the deep well described under No 478

Mr R. A Munson, superintendent, has kindly furnished a detailed report by Walcott C Foster, of New York, N Y , of the water prospects about Texarkana, which was submitted December 10, 1901 From this the following condensed statement has been taken

"The present supply is taken from a sand bed containing some gravel, which is found from 15 to 45 feet below the surface The overlying material is a clay with a layer or layers of very hard cemented or indurated material running through it This material is so very hard that it had to be blasted in some places to be removed The upper 2 to 4 feet of the sand bed consist of a layer of very fine, closely packed white sand, containing more or less clay This layer is very even in character, in some places almost entirely replaced by white clay Beneath the white sand is a layer of yellow sand containing some gravel, about 20 feet in thickness A considerable portion of this sand is very fine and contains more or less clay Test holes and the excavations made in the construction of your present wells show that the character of these beds varies considerably in short distances and that, in some locations, clay almost wholly replaces the sand On account of these conditions it would be unsafe to make any calculations of the area or volume of the water-bearing sand That it is limited in area, I think there is not much doubt, as a yellow sand and gravel seems to overlie the clay, both to the southeast and northwest of your pumping station, probably the outcrop of the bed from which you are drawing water It is in these outcrops of the sand and gravel that the springs near the city are found

"In my opinion you can not develop any more water from the gravel at your present plant, and are now taking out more than you should for a constant and steady supply

"This is indicated (1) by the drying up of the springs and marshes which formerly surrounded the pumping station, (2) by the continued lowering of the water levels in wells one-fourth mile distant, (3) by the fact that the catchment area and rainfall are insufficient to supply a demand of 1,000,000 gallons per day

"Other sources of supply are discussed below

"A large dug well was formerly used to supply the Texas side of the city The yield was very small and this source is hardly worth considering

"After the abandonment of the dug well the Texas side of the city derived its supply from Double Branch. The storage pond and station are about 2 miles from the city According to the best information obtainable the available supply is about 200,000 gallons per day

"Bramble Lake is a small artificial pond filled by the flow from a small spring The ground is very light-red and yellow clay, containing small pockets or bunches of gravel of about 1 or 2 cubic yards each The surface of the ground is covered with a thin layer of gravel, likely derived by the surface clay having been worked away by the rains There were no indications that any water could be developed in this neighborhood, and the flow from the spring is entirely too small to be of any moment

"Ghio Springs are located about 2 miles northwest of the city The flow is collected in a pond of several acres extent and, while apparently a considerable body of water, would be pumped out in a very few days The natural flow of the spring is too small to be of any substantial benefit

"Clear Lake is a pond about 8 miles northeast of the city From the analysis herewith presented it would not seem advisable to use this water

Analysis of water of Clear Lake, Miller County, Ark

	Parts per million
Nitrogen as nitrites	None
Nitrogen as nitrates	0 080
Nitrogen as free ammonia (unfiltered water)	066
Nitrogen as free ammonia (filtered water)	060
Nitrogen as albuminoid ammonia (unfiltered water)	460
Nitrogen as albuminoid ammonia (filtered water)	292
Chlorine	175 000
Oxygen consumed (unfiltered water)	8 400
Oxygen consumed (filtered water)	6 900
Alkalinity	108 000
Incrusting constituents	88 000
Carbonic acid, one-half bound	47 500
Carbonic acid, free	1 500
Carbonic acid, total	49 000
Total solids	640 000

Color, white
Odor, inappreciable
General appearance of sample, almost perfectly clear

"The chlorides, which tend to precipitate soap and act much the same as hard water, are high The high chlorine in the water is probably accounted for by the pond being filled from the overflow of Red River The difference in the chlorine between the analysis of Clear Lake water and the Red River water, given below, is accounted for by the fact that the Clear Lake water represents the flood waters of Red River when both the chlorine and hardness are probably at their lowest, and the analysis of the Red River water was made on a sample taken from the river at the lowest stage, when these constituents would likely be at their highest

"Filtration would not greatly improve the water Neither the chlorine nor the hardness can be reduced by filtration, and the latter is likely to be increased The water might be made lighter by it and the organic matter reduced, but this latter is merely vegetable and not of a disease-producing character from sewer contamination

"I am inclined to think that neither the character of the water nor the results to be obtained as to quantity would warrant the expenditure necessary to develop this as a source of supply and convey it to the city

"Sulphur River lies about 10 miles south of the city No detailed examination was made of it further than an inspection from the crossing of the Shreveport branch of the Texas and Pacific Railway The river is full of tree stumps and old logs, and the water is muddy Filtration, possibly coupled with sedimentation, would clarify the water The water itself has the reputation of being of a very bad quality and it is probably at least as hard and as full of chlorine as Red River, of which it is a tributary

"Nix Creek has quite a flow several miles below town, but the entire sewerage of the city is emptied into it above the point where it would be available

"There is a pond at the Kirby Natatorium that is of some extent, but it would be pumped out in one or two days The flow of the springs feeding it is so small that they would not be of any use.

"Dripping Springs are located 8 miles northwest of the city on the edge of Barkmans Creek, but their flow is so small, not over a few thousand gallons per day, that it would be of no use.

"Barkmans Creek lies about about 8 miles northwest of the city and empties into McKinney Bayou. The water is hard, or precipitates considerable quantities of soap. It will be referred to later on.

"Red River would furnish an unlimited supply, but the water is extremely hard and alkaline or salty. The analysis of it given below and such crude tests as I was able to make on the ground show it to be of such quality that it should not be used except in a very extreme case.

Analysis of Red River water from a point near Ogden, Ark.

	Parts per million.
Lime	210.0
Magnesia	47.7
Sulphuric acid	252.0
Chlorine as chlorides	420.0
Alkalinity in terms of carbonate of lime	216.0
Hardness in terms of carbonate of lime	443.0
Solid matter	1,382.4

"This solid matter is composed of lime, magnesia, and soda, combined with sulphuric, hydrochloric, and carbonic acids.

"About 6 miles northwest of the city, in the neighborhood of Ely Moores Bridge, there are a number of springs along the south bank of McKinney Bayou, which form five separate small streams running into the bayou. The water is soft and apparently of good quality so far as we were able to determine by rough tests on the ground. The natural flow of the springs at the time of examination was about 300,000 gallons per day. The quantity was determined partly by weir measurements and partly by estimate. The streams from the springs are scattered along the bayou for the distance of about 1¼ to 1½ miles, but could all be conducted by a vitrified-pipe line into one common well. On at least two and possibly three of these streams ponds could be constructed. If this proved to be the case, the surface flow of the wet season might be impounded and the quantity of available water increased.

"Clear Creek is spring fed and empties into McKinney Bayou about 1¼ miles west of Ely Moores Bridge. At the time of our visit it was flowing 265,000 gallons per day by weir measurement. There was some leakage under the weir, and the actual flow was somewhat larger. If suitable storage can be obtained to store the storm water, the quantity which could be obtained from this source would be greatly increased—probably more than doubled. It could probably be led into the same pump well as the Ely Moores Bridge springs by a vitrified-pipe conduit. Collecting the springs and Clear Creek together, they would furnish a dry-weather flow of between 500,000 and 600,000 gallons per day and, if suitable storage can be developed, from 1,000,000 to 1,500,000 gallons. As far as we were able to determine without actual analysis, the water of Clear Creek was soft and of as good quality as the springs and your present supply.

"Little River is a stream whose headwaters lie mainly in the Ozark Mountains. It empties into Red River a few miles west of Fulton. The nearest point on it to the city is some miles from Fulton, and it would require about 17 miles of pipe line to bring the water to the city. The water is soft and of good quality. It is colorless, odorless, and without unpleasant taste. It contains the following substances:

Analysis of Little River water.

	Parts per million.
Total	60.0
Chlorine	18.4
Oxygen-consuming power	2.5
Nitrogen as ammonia	.078
Nitrogen (albuminoid)	.075
Nitrites	None.
Nitrates	None.
Hardness, according to Clark's test	2

"At the present time the cost of developing this supply would be so great as to be prohibitive. It would not pay to go this distance unless a plant of at least 5,000,000 gallons daily capacity were installed. At the present time it would appear that this river is the only really large supply for good water within reach of Texarkana for a future supply."

480. *Section of well 1 mile northeast of Texarkana, Miller County, Ark.*

[By R. A. Munson.]

	Feet.
Lafayette?:	
1 Dirt, sand, and gravel	0- 50
Sabine.	
2 Clay and white sand, with water	50- 75
Midway? and Arkadelphia	
3 Blue clay, no water	75- 800
Nacatoch	
4 Sand and sandstone, with water	800- 900
Marlbrook:	
5. Blue clay, no water	900-1,300
6 Fine-grained limestone ("Saratoga formation")	1,300-1,370
7 Blue clay	1,370-1,390

Well abandoned September, 1902.

480A. *Record of well of Home Ice Company, Texarkana, Miller County, Ark.*

[By the American Well and Prospecting Company.]

	Feet.
Lafayette?.	
1. Coarse gravel	0- 6
Lower Eocene?.	
2 Yellow clay	6- 35
Lower Eocene and Arkadelphia:	
3 Blue clay	35- 880
Nacatoch	
4 Sand, containing brackish water, which rose within 15 feet of surface	880- 900
5 Hard sandstone	900- 911
6 Sand, containing brackish water, which rose within 5 feet of surface	911- 941
Marlbrook	
7. Blue clay	941-1,700
Annona	
8 White chalky limestone (White Cliffs chalk)	1,700-1,825
Brownstown	
9. Blue clay	1,825-1,900

502. *Section of well of C. B. Moore, Emmet, Nevada County, Ark*

[By C. B. Moore.]

	Feet.
Arkadelphia:	
1 Soil	0- 2
2. Clay, caves readily	2- 32
3 Blue clay, changing below to gray clay	32-190
Nacatoch.	
4 Black sand	190-198
5 Water rock	198-199
6 Water-bearing sand and rock	199-206

516. The prevailing depth of the rock indicates that water should be encountered here at a depth of about 550 feet.

525. This well is supposed to have entirely penetrated the water-bearing stratum.

537. Water should be encountered in the Bingen sands at a depth of about 600 feet. The water will probably flow.

538. The driller reports only 3 feet of black clay in this well; the water does not come in contact with it, and therefore is quite soft.

553. Owen[a] gives the following qualitative analysis of Judge Hubbard's spring, sec. 13, T. 10 S., R. 23 W.:

"This water was found to be a weak saline chalybeate, containing bicarbonate of iron, a trace of chloride of magnesia, chloride of sodium, and a small quantity of sulphate of soda and magnesia. Its medical properties will be slightly tonic and aperient."

This is marked "Iron Spring" on the Gurdon quadrangle.

563. *Section of well of A. J. Bolls, sec. 15, T. 11 S., R. 21 W., Nevada County, Ark.*

[By George W. Hines.]

	Feet
1. Soil and gravel	0– 7
2. Joint clay	7– 25
Arkadelphia:	
3. Blue clay	25 –369.5
Nacatoch:	
4. Black sand	369.5–373.5
5. Rock	373.5–375
6. Water-bearing sand	375 –

579. It was found necessary to case these wells entirely to the water rock because heavy pumping caused the blue clay to cave.

580. *Section of well at waterworks, Prescott, Nevada County, Ark.*

[By H. W. Wade.]

	Feet
1. Clay and gravel	0– 6
2. Hard yellow clay	6– 31
Arkadelphia:	
3. Very dark-colored clay ("blue dirt")	31–148
Nacatoch:	
4. Black sand, with fossils	148–150
5. Water rock and very hard sandstone	150–152
6. Gray water-bearing sand, not passed through	152–170

Well is cased to the water rock.

582. Mr. H. W. Wade states that near Prescott one well can be bored within 4 feet of another and the water not pass through the blue-clay wall between. On the northern edge of Prescott the water sand is black, and contains very little water; on the south and east it is gray, and furnishes an abundant supply.

608. Well on same farm and near center of section 30 originally flowed, but water level is now 10 feet below the surface.

621. *Section of well of William Hill, sec. 13, T. 12 S., R. 23 W., Nevada County, Ark.*

[By C. D. Hudson.]

	Feet
1. Surface sand and clay	0– 40
Arkadelphia:	
2. Blue clay, changing below into gray clay	40–373
Nacatoch:	
3. "Second water rock," hard sandstone	373–374
4. Black sand	374–382
5. Water-bearing sand	382–390

622. In this well no water rock was encountered. Below the blue clay there is 4 feet of black sand and 4 feet of light-gray water-bearing sand.

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[a] Second Report of a Geological Reconnaissance of Arkansas, 1860, p. 117.

625. *Section of well of C. W. Hamilton, sec. 31, T. 12 S., R. 22 W., Nevada County, Ark.*

[By C. D. Hudson.]

	Feet
1. Surface	0– 20
Arkadelphia:	
2. Blue clay	20–515
Nacatoch:	
3. Water-bearing sand and rock	515–570
Marlbrook:	
4. Blue clay	570–

628. *Section of well of Cotton Belt Lumber Company, 1 mile east of Bearden, Ouachita County, Ark.*

	Feet
1. Surface sand and gravel, water bearing	0– 80
2. Blue clay, with lignite and fossil shells	80– 300
3. Water-bearing sand, water of good quality, which rose to within 50 feet of surface	300– 310
4. No record	310– 850
5. Quicksand	850– 910
6. Blue clay, no water	910–1,001

Pipe was pulled back to 900 feet, including 50 feet of the smallest Cook well strainer. The water from this stratum was accompanied by a great deal of fine sand, which rapidly wore out the pump bearings. The water foams so badly that it can not be used in boilers with any satisfaction. It is believed that if a large pond were available in which the water could settle, it would give better results.

Analysis of water from well of Cotton Belt Lumber Company, near Bearden, Ouachita County, Ark.

[By George H. Seyms.]

	Parts per million
Sand and entirely insoluble matter	132
Made insoluble by heating	244
Readily soluble solid matter	912
Total solids	1,288

This total corresponds to the large amount of 75.08 grains to a United States gallon.

"I find a very large proportion of chlorides, very considerable carbonates, and some chlorides, associated with much soda and considerable magnesia, lime, and potash, combined as indicated by the analysis, in the form of sodium chloride (salt), sodium carbonate, sodium sulphate, magnesium carbonate, calcium carbonate, and potassium chloride.

"There was also quite an amount of fine sand and siliceous matter, considerable iron oxide, and a little organic matter, but no appreciable ammonia or nitrates.

"Considerable coarser sand, settling within one minute after agitation, was disregarded in analysis as readily removable and probably not a permanent characteristic of the water.

"The water was quite alkaline, the equivalent of nearly one-fourth the total solids (28.4 parts) being sodium carbonate.

"The amount of scale matter in this water is quite large, and is mostly magnesium carbonate, calcium carbonate, sand and siliceous matter, and iron oxide. Calcium sulphate, the worst constituent of most scale, is absent.

"The soluble solids are mainly sodium chloride, which is chief in amount, sodium carbonate, sodium sulphate, and potassium chloride.

"It is not a very good boiler water, still, it is better than the large amount of solid matter would indicate at first glance, and the salt—the principal constituent—is not associated with magnesium sulphate and lime and magnesium chloride, the last of which especially makes a little salinity of eastern waters so bad and corrosive. This water is also decidedly alkaline, and so not likely to be very corrosive, and the salt in it will tend to keep the sediment easy to blow out and not so readily form hard scale. Such a water as this, however, needs great care in its use. Boiler compounds will be of little or no avail with it. Dependence must be placed on regular blowing and cleaning, and the soluble solids must not be allowed to become too concentrated, and certainly not to form a salt and soda crust.

"I advise that you blow a gage or two several times a day, both at surface and bottom, to wash and clean out as often as every two weeks to insure removal of all deposit, and change the water in boiler.

"I have had a number of cases of water of this character, much worse than this, which have been used without serious detriment, as far as I know, so, with proper care, I think you can use this if you have no really good boiler water available. It would be well to let this water settle some hours."

630. *Section of well of A. H. Patton, on Ouachita River, 7 miles southeast of Camden, Ouachita County, Ark.*

[By A. H. Patton.]

	Feet
Quaternary (Port Hudson):	
1. Loam and sand, passing below into gravel	0– 49
Sabine:	
2. Solid clay	49– 99
3. White sand, water bearing	99–135

Mr. J. P. Clifford, the well driller, adds the following: "Bitter water at 100 feet, soft water at 140 feet."

633. Owen[a] states that the principal constitutents of John Works's alum spring are acid sulphate of alumina (and perhaps potash), but the acid reaction of the water rather indicates the more feeble base, alumina, a sulphate of the protoxide of iron, and traces of sulphate of magnesia and lime.

634. The Freeman-Smith Lumber Company writes: "Four miles southwest of our mill at Millville, a well was put down 135 feet through hard cemented gravel, which for a considerable time yielded a good supply of water, but eventually failed." It is thought that this refers to the Eagle Mills locality.

635. *Section of well of Freeman-Smith Lumber Company, Millville, Ouachita County, Ark.*

[By Freeman-Smith Lumber Company.]

	Feet
Quaternary ?:	
1. Gravel	0– 20
2. Quicksand, with a small amount of water	20– 28
Eocene:	
3. Blue clay	28–150
4. Lignite	150–153
5. Fine sand, water bearing	153–170
6. Blue clay, with occasional sand partings, not water bearing	170–470

"An attempt was made to develop stratum 5 with an air lift, but after drawing great quantities of water and sand the lignite caved and destroyed the cavity thus formed. The boring was done entirely with hand tools.

"We have at our place a number of small springs from which we obtain our water supply. These springs, however, are disposed to go nearly dry in our driest seasons."

The failure to develop stratum 5 is clearly due to an inadequate or improperly set strainer. A "hand-tool" man, with no experience outside of the Cretaceous region, would not be able to finish a well in the Sabine sands, as the conditions are quite different from those in the Cretaceous. An expert well man would have no difficulty in finishing a good well at this point in the 17 feet of water-bearing sand reported.

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[a] Second Report of a Geological Reconnaissance of Arkansas, 1860, p. 132.

637. *Sections of test borings in Ouachita River at Buffalo Flats, Ouachita County, Ark (329 7 miles above mouth of Black River)* [a]

BORING NO 31

		Depth in feet
1	Sandy clay	0 0
2	Sand and gravel	3 0
3	Sand, gravel, and shells	5 6
4	Gravel and green sandstone	10 6
5	Soft green sandstone	11 2
6	Stiff blue mud	12 2
7	Mud and sand	19 7
8	Sand	23 0
9	Quicksand	26 0
10	Sand, with clay	28 6
11	Green mud, with sand	30 9
12	Sand and mud	31 9
13	Sandstone	35 8
14	Sand and mud	36 1
15	Sand	36 5
16	Red stone	43 3
17	Sand	45 0
18	Sand and mud	49 6
19	Sand, mud, and coal	55 2
20	Red sandstone	55 8
21	Sand and mud	59 4
22	Gravel or conglomerate	69 9
23	Grindstone rock	70 2
24	Through stratum of grindstone rock	71 6

BORING NO 31a

1	Yellowish sand and mud	0 0
2	Yellowish sand and mud	1 6
3	Yellowish sand, mud, and gravel	3 6
4	Indurated clay	7 7
5	Indurated clay (harder)	8 5

BORING NO 31b

1	Yellowish sand and mud	0 0
2	Rock (ledge?)	6 8

638. *Section of test boring in Ouachita River at Beech Hill, Ouachita County, Ark (329 3 miles above mouth of Black River).* [b]

		Depth in feet
1.	Mud	0 0
2	White sand	3 28
3	Gray sand	7 71
4	Blue mud and sand	8 70
5	Red-brown clay and sand	9 36
6	Stiff blue mud	10 01
7	Hard blue clay	15 26

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[a] Ann Rept Chief of Eng for 1902, pt 2, 1902, p 1570

[b] Ibid., p 1569.

639. *Sections of test borings in Ouachita River at Newport Landing, Ouachita County, Ark (328.8 miles above mouth of Black River).*[a]

BORING NO 30

		Depth in feet
1	Brown sandy clay	0 0
2	Blue-black clay, with sand	7 05
3	Stiff blue-black clay, with small pieces of rock	8 69
4	Clean gray sand	11 16
5	Stiff clay, with gravel and sand	15 58
6	Clay, with pockets and streaks of sand	22 97
7	Same, also one tooth, apparently shark's	40 03
8	Clay, with pockets and streaks of sand	109 55

BORING NO 30a

1	Yellow-brown clay	0 0
2	Brown sand	0 98
3	Gray sand	3 41
4	Blue-black clay, full of chips of rock	11 81
5	Clay, with pockets and streaks of sand	19 12
6	Clay, with pockets and streaks of sand	50 00

BORING NO 30b

1	Brown sandy clay	0 0
2	Blue-black clay, with sand and gravel	7 54
3	Blue-black clay, with pockets and streaks of sand	14 60
4	Gray-black clay	50 00

BORING NO 30c

1.	Very stiff brown clay	0 0
2	White sandstone	4 10
3	Sand, impregnated with leaching of asphalt or bitumen	4 26
4	Green sandy clay	6 56
5	Clean gray sand	13 32
6	Blue-gray sandy clay	13 55
7	Sand, with clay	15 6

BORING NO 30d

1	Brown sandy clay	0 0
2	Blue-black clay, with sand	7 05
3	Stiff blue-black clay, with small pieces of rock	8 69
4	Clean gray sand	11 16
5	Stiff blue-black clay	16 40
6	Clay, with pockets and streaks of sand	22 97
7	Stiff blue-black clay, with pockets and streaks of sand	32 89
8	Stiff blue-black clay, with pockets and streaks of sand	35 14

640. *Section of test borings in Ouachita River at Hardee Shoals, Ouachita County, Ark (316 2 miles above mouth of Black River)* [b]

BORING NO 29

		Depth in feet
1	Gray sand and gravel	0 0
2	Blue-gray clay	9 84
3	Clean gray sand	46 59
4	Clean gray sand	54 53

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[a] Ann Rept Chief of Eng for 1902, p 1569

[b] Ibid , p 1568

BORING NO 29a

		Depth in feet
1	Gravel	0 0
2	Sand and gravel	5 12
3	Sand, with some mud	7 71
4	Blue clay	9 52
5	Gray sand	13 13
6	Gray sandy mud	18 27
7	Grayish-blue clay	21 03
8	Clean gray sand	29 53
9	Clean gray sand	48 23

641. *Section of test boring in Ouachita River at Smackover Shoals, Ouachita County, Ark* (*313 4 miles above mouth of Black River*) [a]

		Depth in feet
1	Yellowish sandy clay	0 0
2	Gray sand	1 64
3	Gravel and sand	3 28
4	Shells, sand, and mud	4 10
5	Shells, sand, and gravel	4 92
6	Sand and mud	5 74
7	Blue mud and sand	24 61
8	Blue mud, with a little sand	27 40
9	Mud and sand	33 14

644. *Section of Mississippi River Commission test boring No 1, Helena, Ark* [b]

[By E W Hilgard]

		Feet
Port Hudson		
1	Fine sand	31 – 45
2	Fine sand	45 – 87 4
3.	Coarser sand, with gravel	87 4–116 4
4	Clean sand, with gravel	116 4–142 7
5	Coarse sand	142 7–156 8
6	Finer sand	156 8–161 5
7	Coarse sand	161 5–162 3
"Northern lignitic" (see p 35)		
8	Smooth blue clay	162 3–189 5
9	Lignite in mass	189 5–189 7
10	Smooth blue clay	189 7–206 4

Section of Mississippi River Commission test boring No 2, Helena, Ark [c]

[By E W Hilgard]

		Feet
Loess		
1	Brownish-yellow loam, noncalcareous	0 – 0 5
2	Yellow silt, calcareous and full of snail shells and concretions of lime called "loess puppets"	0 5–139 7
Transition stratum		
3	Yellowish clay	139 7–167 8
Orange sand (drift)		
4	Chert pebbles	167 8–171 3
"Claiborne group" (Jackson)		
5	Stiff blue clay, with greensand and lignitized seaweed	171 3–199
6	Stiff blue clay, calcareous, a clayey greensand marl	199 –211 2

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[a] Ann Rept Chief of Eng for 1902, p 1568

[b] Rept Miss River Com , 48th Cong , 1st sess , House Ex Doc No 37, 1884, pp 485, 488

[c] Ibid , pp 486–487

"Claiborne group" (Jackson)—Continued	
7. Ferruginous concretion of stony hardness	211.2–211.4
8. Clayey greensand marl	211.4–231.3
9. Clay-colored calcareous rock	231.3
10. Dark sandy clay, with pebbles	234 –236.8
11. Clay-colored sand	236.8

Harris[a] reexamined the specimens of these borings in 1901, and identified the following species from test boring No. 2:

"*Dentalium* (very nearly smooth, but with traces of longitudinal striation), *Volutilithes petrosus* (fragments), *Corbula wailesiana*, *Corbula* sp., *Phos hilli* var., *Pseudoliva vetusta*, *Pleurotoma denticula*, *Actæon*, *Natica*."

He regards these species as proving the Jackson age of this bed.

650. This well, like all others in this region, is cased only through the surface sand and clay, or to a depth of 40 or 50 feet. The water stands in contact with the highly calcareous blue clay which overlies the water sand and is therefore quite hard. The well would furnish soft water if it were cased to the bottom.

651. *Section of well of W. H. Ward, sec. 8, T. 9 S., R. 23 W., Pike County, Ark.*

[By J. B. Dillon.]

	Feet
1. Surface sand and clay	0– 40
Brownstown:	
2. Blue clay	40–254
Bingen:	
3. Water-bearing sand	254

655. *Section of well of Jack Wingfield, sec. 15, T. 9 S., R. 23 W., Pike County, Ark.*

[By J. B. Dillon.]

	Feet
1. Surface sand and clay	0– 35
Brownstown:	
2. Blue clay	35–350
Bingen:	
3. Caving sand	350–390
4. Water-bearing sand	390

656. *Section of well of May heirs, sec. 17, T. 9 S., R. 23 W., Pike County, Ark.*

[By J. B. Dillon.]

	Feet
1. Surface sand, gravel, and clay	0– 30
Brownstown:	
2. Black clay	30–180
3. Caving brown clay	180–205
Bingen:	
4. Water-bearing sand	205

657. *Section of well of Hewitt Brothers, sec. 17, T. 9 S., R. 23 W., Pike County, Ark.*

[By J. B. Dillon.]

	Feet
1. Surface sand, gravel, and clay	0– 21
Brownstown:	
2. Blue clay	21–180
Bingen:	
3. White sand	180–200
4. Water-bearing sand	200

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[a] Geol. Survey Louisiana, Rept. of 1902, p. 22.

The amount of water flowing from this well can not be exactly estimated, as the curb is imperfect, and a large amount is leaking into the surface gravels. Much very fine white sand is suspended in the water, causing it to look quite milky. Water slightly ferruginous.

680. *Section of well of Jack Wingfield, sec. 13, T. 9 S., R. 24 W., Pike County, Ark.*

[By J. B. Dillon.]

		Feet
	1. Surface sand and gravel	0–21
Brownstown		
	2. Black clay	21–140
Bingen		
	3. Water-bearing sand	140–143

Temperature, 63° F., December 7, 1902. Mr. Dillon, the driller, states that in the valleys just above the blue dirt there is a layer of coarse gravel into which the artesian water escapes if the casing is not fixed firmly into the clay.

684. *Section of well of B. M. Linville, sec. 13, T. 9 S., R. 24 W., Pike County, Ark.*

[By J. B. Dillon.]

		Feet
	1. Surface sand and gravel	0–30
Brownstown		
	2. Blue clay	30–140
Bingen		
	3. Gray sand	140–150
	4. Water sand	150

This well is in the middle of a field on the edge of the Little Missouri bottoms, and its flow was so great that it proved injurious to the surrounding land, and an unsuccessful attempt was made to fill it up.

687. At Brockton wells are bored to a depth of about 100 feet in order to afford a reservoir in which the water may collect. A depth of 40 to 60 feet is reached before any water is found, and it then comes from little seeps. The boring is continued until enough of these little veins are encountered to furnish the amount of water desired from the well. The well really represents a deep hole in which the water collects from the sides, rather than one depending on a given water layer, like those about Bowen.

688. This well was put down in 1898 with a cable rig, and no record was kept of the material penetrated. It is reported to have flowed when first completed, but since it has been pumped the water has lowered to 6 feet below the surface. Used in a boiler it forms a red crust, but the engineer affirms that he has been able to prevent the formation of this scale by placing Irish potatoes in the water!

689. This is an open dug well near No. 688. The water originally stood 4½ feet from the surface, but has now lowered to 15 feet. The section is as follows:

Section of well at Key mill, Delight, Pike County, Ark.

[By P. J. Gault.]

		Feet
	1. Loamy soil	0–5
	2. Gravel	5–20
	3. Cemented gravel	20–22
Bingen		
	4. Blue clay	22–27
	5. White sand	27–32

690. *Section of well of J. P. Copeland, jr., sec. 21, T. 8 S., R. 23 W., Pike County, Ark.*

[By J. B. Dillon.]

		Feet
	1. Surface sand and gravel	0–30
Brownstown		
	2. Blue clay	30–56
Bingen		
	3. Clayey sand	56–70
	4. Water-bearing sand	70

Water is very soft and palatable, and is the only soft water in this section, where the main supply is from shallow dug wells, which extend only through the surface beds to the top of the calcareous blue clay.

692. The surrounding wells indicate that the water in this one should be about 20 feet from the surface The great depth reported indicates that the well has caved or has been improperly finished.

693. *Section of well of M. M Manney, sec 20, T 8 S, R 25 W, Pike County, Ark*

[By M M Manney]

	Feet
Quaternary and Lafayette	
1 Clay	0–10
2 Gravel, water-bearing	10–14
Trinity	
3 Blue clay and lime rock, no water, except in small seeps	14–50

694. Around Murfreesboro wells commonly strike lime rock or blue clay at about 20 feet The water supply comes from the gravel overlying the rock

696. *Section of municipal well at Pike City, Pike County, Ark*

[By J H Purcell]

	Feet
1 Gravel	0– 10
2 Yellow clay	10–100
3 Hardpan	100–150
4 Rock, with water	150

698. Hayes[a] gives the following data regarding this locality "Two wells were drilled for oil The wells penetrated from 100 to 120 feet of the Trinity formation, consisting chiefly of sands and clays, with a few thin seams of limestone, and then entered the Paleozoic sandstones and shales The latter are highly contorted, dipping at angles of 45° to 55°, and are intersected by numerous fractures No oil in commercial quantities has ever been discovered in rocks of this character, and it will be readily understood that even if they had originally contained oil it would, before the deposition of the Trinity, have had abundant opportunity to escape to the surface through the fractures which resulted from the folding of the strata

699. "On the east side of Crowleys Ridge, at an elevation of about 50 feet above the bottom, water is found at from 250 to 300 feet Away from the edge of the hills, in the bottom, water is found at a depth of from 30 to 35 feet in a sand filled with leaves and cypress bark"

General section of wells on east edge of Crowleys Ridge, Poinsett County, Ark

[By C H Winters]

	Feet
Quaternary (Port Hudson)	
1 Clay and gravel	0– 60
Cockfield, with some Jackson	
2 Light-bluish clay, with occasional layers of pure white, chalk-like clay, no grit	60–200
3 Light-blue clay, some sand Gradually becomes coarser and water bearing Lower part of water sand full of lignite grains	200
4 Lignite and blue clay, smooth, tough clay	

704. *Section of well of New York and Arkansas Oil Company, Mena, Polk County, Ark*

[By M P Oliver, driller]

	Feet.
1 Earth	0– 44
2 "Soapstone"	44– 100
3 Black shale, with thin layers of black sandstone	100– 613
4 Hard, white sandstone	613– 655
5 Black shale	655– 665
6 Black sandstone, water bearing	665– 675

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[a] Hayes, C W, Asphalt deposits of Pike County, Ark Bull U S Geol Survey No 213, 1903, p 355

		Feet
7	Black shale, with layers of black sandstone	675- 940
8	Black sandstone	940- 950
9	Black shale	950- 995
10	Black sandstone	995-1,000
11	Black shale	1,000-1,045
12	Dark-gray sandstone	1,045-1,050
13	Black shale and black sand	1,050-1,354
14	White sand, trace of oil	1,354-1,356
15	Black shale, with layers of black sandstone	1,356-1,615

As this well was drilled for oil, the water was cased out Casing was first put in when the well was 500 feet deep Water was struck at 530 feet, and below this point several water horizons were encountered All the water rose to within 30 feet of the surface, except that from one vein, which was 100 feet below the surface It is reported that the city contemplates buying this well and installing a pumping station

705. Mr Hovey, general foreman, reports to the department of bridges and buildings, Missouri Pacific system, under date of December 1, 1894 "Well drilled by W C Bowdin is 90 feet to rock and 3 feet in dirt Water comes up within 20 feet of top, but the steam pump exhausts the supply in three or four strokes, well fills up again in three or four minutes We can get down a casing pipe 5 5 inches outside diameter "

Mr. C M Michaelson, in letter dated February 19, 1901, regarding a new well drilled at Russellville, states "Well is 11 inches in diameter and 140 feet deep, water stands 19 feet below top of rail, water supply is 2,700 gallons per hour, water is soft and works well in drill-machine boiler, water supply comes from a crevice 50 feet below ground line, or top of rail, pumped water in well down to 123 feet below rail, at this level the above supply was obtained for two hours, while pumping this well it drained two 6-inch drilled wells which are 45 and 53 feet deep and 300 to 400 feet from Missouri Pacific well "

A blueprint record dated Pacific, Mo , June 7, 1901, gives the following section

Section of well of St Louis, Iron Mountain and Southern Railway, Russellville, Pope County, Ark

		Feet
1	Soil	0- 12
2	Slate, containing a small supply of water at 90 to 288 feet	12- 288
3	Sulphur rock	288- 354
4	Soapstone	354- 464
5	Slate	464-1,006

706. *Record of well of St Louis, Iron Mountain and Southern Railway, Alexander, Pulaski County, Ark*

[Compiled from reports by B V Ritts, driller]

		Feet
1	Soil and sand	0- 16
2.	Slate rock	16- 30
3	Gravel and sand, with water	30- 38
4	Lime rock	38- 40
5	Slate rock	40- 46
6	Flint rock	46- 48
7	Slate rock	48- 58
8	White limestone, with considerable water	58- 78
9	Black slate	78- 91
10	Black limestone	91-125
11	No record	125-235
12	Sand rock	235-243
13	Slate	243-248
14	Sand rock	248-270
15	Soft white slate	270-308

Test September 13, 1902, by F W Ward "110 gallons per minute, water stood 36½ to 37 feet from surface while pumping. Test lasted seven and one-half hours. Water after pumping, slightly milky "

Analysis of water from well of St Louis, Iron Mountain and Southern Railway, Alexander, Pulaski County, Ark.

[By Prof F H Keiser]

	Parts per million
Total solid residue	302 2
Organic and volatile matter	77 0
Fixed residue	225 0
Incrusted matter ($CaCO_3$, $MgCO_3$)	107 7
Nonincrusted matter ($NaCl$)	106 7
$NaSO_4$, $MgSO_4$	10 8

708. *Section of well of St Louis, Iron Mountain and Southern Railway, East Little Rock, Ark*

[By C H Winters]

	Feet
Quaternary (Port Hudson)	
1 Clay	0–18
2 Fine sand, with some water	18–22
3 Tough yellow clay, with streaks of sand	22–54
4 Brown clay, with large gravel and pieces of driftwood	54–58
5 Coarse sand and gravel, water bearing	58–66
6 Very hard rock	66–

Samples of wood from stratum 4 are but slightly lignitized

713. Owen[a] gives the following regarding a salt well near Ben Lomond "On a live-oak flat in sec 22, T 10 S, R. 29 W, is an old salt well which gives a strong reaction of chlorides with nitrate of silver The principal constituents of this water are chloride of sodium, bicarbonate of alkali, bicarbonate of lime, chloride of magnesia, bicarbonate of magnesia, and a trace of sulphates It is said that at one time, with 32 kettles of 35 gallons each, 20 bushels of salt were made daily for three months, and that it afforded a dry white salt"

717. *Partial section of S R Meredith's well, Ben Lomond, Sevier County, Ark*

[By S R Meredith]

	Thickness in feet
1 Soil and clay	15
Brownstown	
2 Blue marl	100
Bingen	
3 "Coal" (lignite)	3
4 Sandstone, no water	
5 Rock	
6 Sandstone, plenty of water	
Total depth	300

719. *Section of well of D A Brooks, near Ben Lomond, Sevier County, Ark*

[By S R Meredith]

	Feet
Quaternary	
1 Quicksand and gravel	0– 60
Brownstown and Bingen	
2 Blue marl and sandstone	60–140
Bingen	
3 Water-bearing sand, with occasional indurated layers	140–180

722. Mr Meredith reports a bed of gravel at 400 feet

723. *Partial section of well of W I Beck, near Ben Lomond, Sevier County, Ark*

[By S R Meredith]

	Feet
1 Surface sand and gravel	0– 15
Brownstown	
2 Blue rock	15–

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[a] Second Report of a Geological Reconnaissance of Arkansas, 1860, p 115

		Feet
Bingen		
3	Sandstone, water bearing (Clarksville sand)	-330
4	Blue rock (Eagle Ford clay ?)	330-430
5	Hard white substance, like glass (gypsum ?)	430-540
6	Gravel, water bearing (Woodbine)	540-

738. *Section of well of D B Coulter, 1½ miles north of White Cliffs, Sevier County, Ark*

[By J C Branner[a]]

		Thickness in feet
1	Water-worn gravel	3
Brownstown		
2	Clay	30
3	Blue lime marl	200+
Bingen		
4	White sand, water bearing	

745. Owen[b] reports "The country around Ultima Thule, both in Arkansas and over the line in the Choctaw country, is all based on limestone, or marly limestones, of the Cretaceous period, and flats, as well as extensive licks, indicative of salt, are frequently encountered I tested the Graham salt water and found it to be a strong brine Salt was formerly made here, but the works have been abandoned, probably because no pains were taken to tube out the fresh and weak water or because the borings were not carried to a sufficient depth The salt water rises through the Gryphæa beds of the Cretaceous formation, of which 40 feet are exposed in the slope of an adjoining low ridge, on which repose red clay and gravel, thus Coarse gravel and red clay, 25 to 30 feet Cretaceous (Gryphæa) limestone The rise of the salt water appears to be in connection with some axis of dislocation "

745A. Mr J K Ramsey reports "About eighteen years ago a man by the name of Groves bored a well at Blanchard Springs At the depth of 43 feet he struck water, and it flowed up to the surface and is still flowing to-day A curb was put in and the water was raised 2 feet No care is taken with the well, but it continues to flow "

746. The following partial analysis of N Bussey's mineral spring is given by Owen[c] "Bicarbonate of the protoxide of iron, crenate or apocrenate of iron, chloride of sodium It is a saline chalybeate Its medical properties are tonic, slightly laxative, and alterative "

747. *Sections of test borings in Ouachita River at Franklin Shoals, Union County, Ark (298 6 miles above the mouth of Black River)*[d]

BORING NO 27

		Feet
1	Sand and gravel	0 0 - 6.56
2	Stiff blue mud, with pockets and streaks of sand	6 56-50

BORING NO 27a

1	Gravel and sand	0 - 8 2
2	Stiff blue mud, with pockets and streaks of sand	8 2 -50

748. *Sections of test borings in Ouachita River at Jacks Island, Union County, Ark (278 4 miles above mouth of Black River)*[e]

BORING NO 26

		Feet
1	Sand, mud, and leaves	0 - 3 28
2	Gray sand, with very small per cent of clay	3 28- 75 62
3	Gray sand, with few small lumps of blue mud	75 62- 90 22
4	Very fine white sand, with small per cent of white clay	90 22- 97 97

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[a] Trans Am Inst Min Eng , vol 27, 1898, p 51

[b] Second Report of a Geological Reconnaisance of Arkansas, 1860, p 112

[c] Op cit , p 136

[d] Ann Rept Chief of Eng for 1902, pt 2, 1902, p 1568

[e] Ibid , p 1567

		Feet
5	Gray sand	97 97–104 99
6	White sand, with small per cent of white clay	104 99–108 27
7	Gray sand	108 27–124 61
8	White sand	124 61–132 94
9	Gray sand	132 94–135 17
10	Apparently a log, wash very dark, and substance resembles rotten wood (lignite bed?)	135 17–143 44
11	White sand	143 44–144 38
12	White sand, with small per cent of clay	144 38–145 70
13	White sand	145 70–150 04
14	Blue-gray clay, with pockets and streaks of sand	150 04–201 34
15	Hard brownish rock	201 34–201 97
16	Blue-gray clay, with pockets and streaks of sand	201 97–

BORING NO 26a

1	Sand and gravel	0 – 10 43
2	Gray sand	10 43– 50 00+

BORING NO 26b

1	Yellow sandy clay	0 – 3 94
2	Yellow sand	3 94– 5 25
3	Sand and gravel	5 25– 6 57
4	Blue mud	6 57– 7 88
5	Sand and mud	7 88– 12 31
6	Light-gray sand	12 31– 17 39
7	Mud	17 39– 19 69
8	Light-gray sand	19 69– 30 52+

749. *Sections of test borings in Ouachita River at Pengeethe Shoals, Union County, Ark (269 7 miles above mouth of Black River)* [a]

BORING NO 25

		Feet
1	Brown sand	0 – 9 84
2	Gray sand and gravel	9 84–12 24
3	Log	12 24–21. 56
4	Gray sand	21 56–32 06
5	Gray sand, with small per cent of clay	32 06–50 00+

BORING NO 25a

1	Yellowish sand and clay	0 – 3 55
2	Yellow sand and gravel, with very small per cent of clay	3 55–19 69
3	Gray sand and gravel, with very small per cent of clay	19 69–50 +

750. *Section of test boring in Ouachita River at Marie Saline Landing, Union County, Ark (253 5 miles above mouth of Black River)* [a]

		Feet
1	Yellowish sand and clay	0 – 1 64
2	Yellowish sand	1 64– 4 11
3	Light-gray sand	4 11–18 38
4	Mud and sand	18 38–35 44+

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[a] Ann Rept Chief of Eng for 1902, pt 2, p. 1567

751. *Sections of test borings in Ouachita River at Roland Raft, Union County, Ark (240 6 miles above mouth of Black River)* [a]

BORING NO 23

		Feet
1	Brownish sand	0 –23 23
2	Gravel	23 23–35 57
3	Gray sand	35 57–63 98
4	Very stiff blue-black clay	63 98–64 58
5	Rock	64 58–64 96
6	Very stiff blue black clay	64 98–68 90+

BORING NO 23a

		Feet
1	Brownish sand	0 – 9 84
2	Grayish sand	9 84–20 67
3	Gravel	20 67–30 22
4	Grayish sand	30 22–50 +

752. *Section of test boring in Ouachita River at Yerricks Slough, Union County, Ark (276 7 miles above mouth of Black River)* [b]

		Feet
1	Yellow sandy clay	0 – 4 59
2	Yellowish sand	4 59– 7 87
3	Gray sand	7 87–12 63
4	Broken shells	12 63–13 28
5	Gray sand, mud, and broken shells	13 28–15 58
6	Light-gray sand	15 58–17 22
7	Broken shells	17 22–18 53
8	Sand and broken shells	18 53–22 14
9	Light-gray sand	22 14–32 80
10	Gray sand	32 80–

755. *Section of well of St Louis, Iron Mountain and Southern Railway, Higginson, White County, Ark.*

[By C H Winters]

Quaternary (Port Hudson)	Feet
1 Clay	0–30
2 Fine sand	30–50
3 Coarse water-bearing sand	50–62 5

758. It is reported that this well interferes with the railroad well about one-fourth mile distant Used in boiler, the water forms a large amount of scale, but the addition of a little kerosene is found to furnish almost complete relief

Analysis of water from well of Union Oil Company at Bunkie, Avoyelles Parish, La

[By E W Brundage]

	Parts per million
Sodium chloride (NaCl)	39 5
Sodium sulphate (Na_2SO_4)	7 1
Sodium carbonate (Na_2CO_3)	15 5
Potassium carbonate (K_2CO_3)	1 2
Magnesium carbonate ($MgCO_3$)	183 8

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[a] Ann Rept Chief of Eng for 1902, pt 2, p 1566

[b] Ibid, p 1567

	Parts per million
Calcium carbonate ($CaCO_3$)	291 4
Silicon dioxide (silica) (SiO_2)	30 0
Oxides of iron and aluminum (Fe_2O_3, Al_2O_3)	23 0
Organic matter	148 0
Total	739 5

"Characteristics Odor suggestive of hydrogen sulphide, clear, turbid on standing, considerable sediment Test with litmus alkaline "

759. *Section of well of Bunkie Ice and Bottling Company, Bunkie, Avoyelles Parish, La*

Quaternary (Port Hudson)	Feet
1 Red clay	0– 70
2 Quicksand	70–115
3 Gravel	115–140

762A. Mr T L Grimes reports "I had the water from my well analyzed by Professor Caldwell, of Tulane University, who reported that it contained a little soda, a little magnesia, some lime, and a trace of iron and sulphuric acid He did not make a quantitative analysis A well was bored a few miles from me last year that behaved quite strangely The curbing was gotten down 64 feet by pumping out sand and letting it sink of its own weight, and then it refused to sink any deeper When they quit work at night there was 4 feet of water in the well, but next morning the water could be dipped from the top with a cup held in the hand There were constant noises like the escape of gas, and the height of the water changed often, though it was not affected by the stage of water in the river The well finally caved in This well was bored in the center of one of the numerous mounds that are all over this section of the State on the Bluff (Port Hudson) formation "

765. *Record of well of Natchez and Marksville Oil Company, Marksville, Avoyelles Parish, La*

[By A W Myers, driller]

		Feet	
1	Red clay, with ferruginous concretions	0	18
2	Fine red sand	18	42
3	Reddish sand and gravel containing good, fresh water	42	132
4	Soft sand rock	132	136
5	Coarse sand and pebbles	136	158
6	Rock	158	158 5
7	Medium red sand	158 5	174
8	Loose rock and bowlders	174	177
9	Sand and gravel about the size of a pea	177	193
10	Red clay	193	199
11	Fine red sand	199	206
12	Coarse sand	206	214
13	Red clay	214	222
14	Rock	222	222 5
15	Red sand and clay	222 5	232
16	Blue sand and gravel	232	243
17	Fine sand and gravel	243	259
18	Sticky blue clay and bowlders	259	318
19	Blue clay, with black particles	318	333
20	Red gumbo (stiff clay)	333	337
21	Black gumbo	337	360
22	Blue clay	360	380
23	Medium white sand	380	390
24	Blue gumbo	390	405
25	Blue clay, with mica	405	417

		Feet
26	Medium white sand	417 - 425
27	Blue shale	425 - 452
28	Very coarse sand (red, white, and blue)	452 - 523
29	Blue and red gumbo	523 - 623
30	Blue shale	623 - 631
31	Blue gumbo	631 - 645
32	Blue shale	645 - 663
33	Sticky blue clay	663 - 697
34	Rock	667 - 698
35	Blue sticky clay and shale	698 - 736
36	Brown clay and sand	736 - 796
37	Blue and red gumbo	696 - 806
38	Blue clay and sand	806 - 822
39	Blue clay, rather hard	822 - 827
40	Coal (lignite)	827 - 827 5
41	Blue gumbo	827 5- 847
42	White rock	847 - 849
43	Blue and red gumbo	849 - 855
44	Gumbo and bowlders, almost black	855 - 926
45	Sand and gravel	926 - 976
46	Sand and bowlders	976 -1,016
47	Sand, with pieces of wood	1,016 -1,034
48	Alternate layers of sand and rock	1,034 -1,062
49	Sand, gravel, and bowlders	1,062 -1,146
50	Impure limestone	1,146 -1,147
51	Blue sand	1,147 -1,205
52	Lime rock	1,205 -1,207
53	Very dark clay	1,207 -1,280
54	Clay, with iron pyrites	1,280 -1,282

Total depth December 12, 1902, 1,282 feet, casing, 320 feet In water well screen is placed from 70 to 100 feet below the surface There is an abundant supply of water, but it is not very soft

766. Around Marksville water is generally reached between 40 and 45 feet, but the supply is not permanent Below a thin bed of blue clay at about 65 feet a very good supply is reached, which yields slightly hard water in large quantities

767. No complete information is available concerning this well According to the drillers it was 800 feet deep, but it was sounded by Mr. C B Couvillion, parish surveyor, about two years after its completion in 1896 and found to be 290 feet deep As neither the quality nor the supply of water from the well had changed, and the bottom encountered at 290 feet was entirely solid, he concluded that this represented the total depth of the well

Mr H P Touzet, foreman in charge of the work, writes "I left the well after driving the 6-inch casing down 200 feet to blue clay There is an abundance of water to be found about Marksville at depths of 80 to 200 feet I have no written record referring to the well, but as far as I can remember my successors abandoned the work at a depth of 500 feet, after having bored to that depth with a 4-inch pipe without locating wate below the 6-inch casing "

G D Harris[a] reports "At a depth of 230 feet a 5-foot stratum of lignite was penetrated Mouth of well 0 3 foot above railroad station, hence approximately 82 feet above tide

"The gravel bed found between 100 and 160 feet is very much like the gravel found in the wells in the southwestern Louisiana rice fields A seam of black clay and lignite was found at 160 feet The gravel below the lignite was heavily charged with pyrites " It is doubtless from this layer that the water is obtained

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[a] Water-Sup and Irr Paper No 101, U S Geol Survey, 1904, p 54

768. *Section of well of Vicksburg, Shreveport and Pacific Railway, Arcadia, Bienville Parish, La*

[By H P Touzet]

		Feet
1	Yellow and red clay	0– 30
2	Coarse white sand	30– 40
3	Blue clay	40–100
4	Fine blue sand	100–110
5	Blue clay	110–150
6	Water-bearing gray sand	150–165
7	Calcareous rock	165–175
8	Blue clay	175–275
9	Calcareous rock	275–290
10	Blue clay, mixed with broken rock	290–415
11	Fine white sand	415–465
12	Hard blue clay	465–525
13	Calcareous rock	525–530
14	Very stiff white clay	530–535
15	Blue sand	535–540
16	Blue clay	540–

769. *Analysis of water from mineral well of Dr J C Christian, Arcadia, Bienville Parish, La* [a]

[By Maurice Bird]

	Parts per million
Soluble silica	1,114 9
Iron and alumina	226 7
Lime	573 9
Magnesia	540 2
Potash	11 6
Soda	520
Chlorine	1,647 7
Sulphuric acid	1,538 5

"Mainly sulphates and chlorides of alumina, lime, magnesia, and soda "

770. *Section of well of John Gigleux, Jamestown, Bienville Parish, La*

		Feet
1	Surface	0– 18
2	Shell marl, with many *Ostrea sellæformis* (Claiborne)	18– 30
3	Black clay	30– 90
4	Dark-colored clay, weathering white	90–100
5	Dark sand and clay	100–142
6	Sand, water bearing	142–145

771. *Analysis of brine from Kings Salt Works, Bienville Parish, La* [b]

[By Maurice Bird]

	Per cent
Sodium chloride	6 94
Calcium sulphate	01
Calcium chloride	152
Magnesium chloride	135
Alumina	148
Other solids	065

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[a] Geology and Agriculture of Louisiana, pt 2, 1892, p 47

[b] Geol. Survey Louisiana, Rept of 1902, p 80

772. *Analysis of brine from Rayburns Salt Works, Bienville Parish, La* [a]

[By Maurice Bird]

	Per cent
Sodium chloride	4 60
Sodium sulphate	022
Calcium sulphate	322
Magnesium sulphate	029
Alumina	061
Other solid matter, partly in suspension	03

774. Air lift brings from well fine dark-gray sand, with occasional white quartz grains as large as grains of wheat, and numerous particles of white clay

Dump heap is, for the most part, fine gray sand, similar to the Shreveport water sand It shows the following succession of strata

1 Red clay
2 Dark-colored clay
3 Chocolate-colored clay
4 Gray or greenish-gray sand

776. *Section of well of Antrim Lumber Company, Antrim, Bossier Parish, La*

[By L B Clifford]

Sabine		Feet
1	Yellow clay, passing below into blue clay	0– 44
2	Lignite of good quality	44– 48
3	Blue clay	48–160
4	Water-bearing sand	160–263
5	Sand and clay, no water	263–300

778. *Section of well of W H Smith & Son, Benton, Bossier Parish, La*

[By J P Clifford]

Sabine		Feet
1	Slate-colored clay	0–122
2	Gray rock	122–124
3	Stiff, hard clay	124–140
4	Mahogany-colored clay	140–
5	Water-bearing sand	
6	"Coal" (lignite)	–350

It is reported that this well flowed for a short time

782. *Partial section of well of S H Bolinger & Co , Bolinger, Bossier Parish, La*

[By L B Clifford]

Claiborne and Sabine		Feet
1	Yellow clay	0– 14
2	Sand rock	14– 16
3	Yellow clay	16–
4	Blue clay	–162
5	Water-bearing sand	162–235
6	Dark-colored sand and clay, no water	235–315

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[a] Geol Survey Louisiana, Rept of 1902, p 75.

783. *Section of well at Cash plantation, 3 miles north of Bossier City, Bossier Parish, La.*

[By A. L. Pullin.]

	Feet
Quaternary (Port Hudson)	
1 Clay, passing below into fine gravel, containing hard water	0–130
Sabine	
2 Blue clay	130–155
3 Sand, containing hard water	155–160
4 Blue clay	160–180
5 Sand, with bad water	180–185
6 Blue clay	185–225
7 Lignite	225–
8 Blue clay	–300
9 Brown clay	300–315
10 Water sand, water rises to within 35 feet of surface	315–330

784. *Section of well of Benj. Gray, 2½ miles north of Bossier City, Bossier Parish, La.*

[By A. L. Pullin.]

	Feet
Quaternary (Port Hudson)	
1 Soil	0.0– 10.0
2 Soft red sand, becomes coarser and passes into large gravel	10.0– 76.0
Sabine	
3 Rock (probably a limestone concretion)	76.0– 79.5
4 Blue clay, with layer of lignite at 160 feet	79.5–300.0
5 Water-bearing sand (water flowed over top of pipe when well was first sunk)	300.0–330.0

785. *Section of well of Shreveport Cotton Oil Company, Bossier City, Bossier Parish, La.*

	Feet
Quaternary (Port Hudson)	
1 Surface clay, sand, and gravel	0– 80
Sabine	
2 Blue clay, with occasional thin layers of sand	80–225
3 Water-bearing sand	225–235
4 Blue clay, containing no water	235–600

786. Six-inch pipe, 0–70.5 feet; 4-inch pipe, 70.5–168 feet. The 6-inch pipe passes through the Quaternary into the Sabine clays.

788. *Section of well of Will Sentell, Lake Point, just above Cedar Bluff, Bossier Parish, La.*

	Feet
Quaternary (Port Hudson)	
1 Surface clay, passing below into sand and coarse gravel	0–120
Sabine	
2 Blue clay	120–232
3 Fine sand, containing good soft water	232–240
4 Dark-colored clay, containing no water	240–600

Completed in 1902. Water lowers readily on pumping.

795. The gravel bed which usually lies at the base of the Quaternary deposits is in this well represented by a coarse sand. No lignite was encountered.

796. *Section of well of John Glassell, at Belcher, Caddo Parish, La.*

[By A. L. Pullin.]

	Feet
Quaternary (Port Hudson)	
1 Surface clays, passing below into fine gravel	0– 96
Sabine	
2 Clay	96–213
3 Water sand, not passed through	213–225

797. It is reported that the water is at one time soft and at another time hard, this is probably due to a leak in the pipe, which permits the water from the surface gravel to mingle with that in the Sabine sands

799. *Section of well of M A & J. D Dickson, Dixie, Caddo Parish, La*

		Feet
Quaternary (Port Hudson)		
1	Red sand	0– 6
2	Red buckshot clay	6– 12
3	Red sandy soil, becoming coarser below and passing into coarse sand	12– 60
Sabine		
4	Blue clay	60–219
5	White sand, water bearing	219–225
Sabine and Midway?		
6	Blue clay, with occasional rock	225–371

Well completed November, 1902

800. *Section of well of John Sentell, Cairo plantation, 2½ miles east of Dixie, Caddo Parish, La*

[By A L Pullin]

		Feet
Quaternary (Port Hudson)		
1	Red sand	0– 6
2	Buckshot clay	6– 12
3	Red sandy soil, becoming coarser below and passing into coarse sand containing water	12– 85
Sabine		
4	Soft white clay	85–160
5	White clay, changing gradually to dark brown and passing into lignite	160–170
6	White sand, water bearing	170–182

A test well put down at this place reached a depth of 391 feet without developing water A second well, a few feet distant, however, obtained water between 170 and 182 feet

Well completed April, 1902

801. *Partial section of well of Glassell & Adger, Sodo Lake, 3 miles southwest of Dixie, Caddo Parish, La*

[By A L Pullin]

		Feet
1	Overflow sand from Cottonwood Bayou	0 – 3
2	Clay	3 – 11
3	Soft red sand	11 – 41
4	White milky clay, mixed with white sand and gravel, with little or no water	41 –121
5	Hard brown clay	121 –131
6	Hard blue clay	131 –255
7	Hard blue rock	255 –278 5
8	Hard black clay	278 5–283 3
9	Hard brown clay	283 3–294 3
10	Dark-gray clay	294 3–310 3
11	Light-gray hard rock	310 3–311
12	Dark clay	311 –364

802. Furrh & Co report that a very small amount of hard water was obtained The driller reports shell marl at about 500 feet Well drilled in 1894

803. Three-inch casing, 0–132 feet, 2-inch casing, 132–290 feet, 2-inch screens placed at 152–158 and 262–270 feet Very sandy material from 152 to 290 feet Well first flowed at 270 feet

804. *General section of wells in Red River Valley below Shreveport, Caddo Parish, La*[a]

[By A L Pullin]

		Thickness in feet
Quaternary (Port Hudson)		
1	Red soil, sandy loam	4– 10
2	Red clay and sand, water bearing This stratum is clayey above and becomes more sandy below The lower 5 to 10 feet are quicksand This layer is the source of the highly mineral water which is obtained in the driven wells	45– 60
3.	Gravel and sand Firmly bedded, so much so that it is impossible to drive a pipe into it The gravel sometimes reaches the size of a goose egg White chert and quartz pebbles are common The gravel is largest at the top and gradually grows finer until at the base of the stratum it grades into a fine white sand	20– 40
Sabine		
4	Soft gray sandy clay, containing vegetable remains and occasional shells	8– 16
5.	Fine white sand	0– 40
6	Hard tenacious blue clay, called "rubber clay," containing scattered iron concretions about the size of a pea	40–132
7.	Indurated sand, water bearing Furnishes an abundant supply of soft water Water from this stratum generally rises to within 10 or 20 feet of the surface	

805. *Section of well of Captain Robson, Robson, Caddo Parish, La*[b]

[By A L Pullin]

		Feet.
Quaternary (Alluvium and Port Hudson)		
1	Red sandy loam	0– 4
2	Fine red clay, with sand	4– 79
3	Red sand, water bearing	79– 82
4	Gravel and sand, same as 3 in well No 804	82–106
Sabine		
5	Lignitiferous clay with shells	106–118
6	Brown lignite	118–121
7	Good black lignite	121–123
8	"Soapstone," soft white friable clay	123–130
9	Very hard blue limestone	130–131
10	Hard black lignite	131–135
11	Blue clay	135–225
12	Water sand, not passed through	225–

806. According to the best information obtained from several sources and from the sections in adjacent wells, the strata penetrated in this well are as follows

Section of deep test well of Shreveport Ice Company, Market street and Cross Bayou, Shreveport, Caddo Parish, La.

		Feet
Sabine		
1	Dark-colored clays, with lignite	0–200
2	Gray sand, water bearing	200–250
Midway and Arkadelphia		
3	Blue clay, with occasional hard streaks of rock, no water	250–961
Nacatoch		
4	Very hard quartzitic rock	961–
5	Soft sandstone, with occasional hard rock, furnishes artesian salt water with gas	–996

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[a] Geol Survey Louisiana, Rept for 1899 [1900], pp 179–180

[b] Ibid, pp 180–181

The gas from stratum 5 is used to light the ice factory Temperature of water, August 22, 1902, 84° F. The water used by the ice company is obtained from three wells developing stratum 3

807. *Section of test well of Shreveport Waterworks Company, Shreveport, Caddo Parish, La*

[By H F Juengst]

		Feet
1	Yellow clay	0 – 38
2	Lignite	38 – 43
3	Yellow clay	43 – 55
4	Sand	55 – 57
5	Blue clay	57 – 62
6	Black clay	62 – 65
7	Lignite	65 – 70
8	Blue clay	70 –105
9	Clay and sand	105 –115
10	Blue clay	115 –135
11	Yellow clay	135 –160
12	Blue sand and clay	160 –165 5
13	Blue clay	165 5–190 5
14	Lignite	190 5–193 5
15	Yellow clay	193 5–218 5
16	Sand	218 5–228 5
17	Blue clay	228 5–244

Casing, 6-inch, 0–80 feet, 4½-inch, 80–136 feet An attempt was made to retest the well in 1902, but yielded no results As the depth to water was at that time only 14 feet, the well had probably caved in and the water-bearing strata had been entirely cut off

Analysis of water from test well of Shreveport Waterworks Company, Shreveport, Caddo Parish, La

[By Francis C Phillips]

	Parts per million
Total solids	600
Hardness, expressed in parts per 1,000,000, of carbonate of lime	168
Hardness after boiling one-half hour	154
Chlorine	94
Nitrogen as nitrates	None
Nitrogen as nitrites	None
Free ammonia	38
Albuminoid ammonia	04
Oxygen required	1 38

808. The drillers report 83 feet of 4-inch casing, 44 feet of 2½-inch casing, and 15 feet of screen, indicating that a portion of the supply is from above 142 feet The drilling of this well was carefully watched by Mr S Y Snyder, who has furnished the following report

Section of well of Henry Rose, Shreveport, Caddo Parish, La

[By S Y Snyder]

		Feet
1	Clay and sand	0– 40
2	Dark-blue clay	40– 50
3	Yellow clay	50– 65
4	Quicksand, water bearing	65– 71
5	Hard blue clay	71–150
6	Sand, water bearing	150–165
7	No record	165–175
8.	Lignite	175–177
9	Sand	177–272
10	Rock	272

812. The drillers report 4-inch casing, 0–80 feet, 2½-inch casing, 80–169 feet, 10-foot screen, 99–109 feet; 15-foot screen, 148–163 feet, total depth, 324 feet Completed July, 1901 Cost, $700

817. Wells Nos 1 and 2 have 80 feet of 6-inch casing, 60 feet of 4-inch casing, and 12 feet of 4-inch screen at the bottom Well No 3 has 80 feet of 6-inch casing and 60 feet of 4-inch casing, no screen

829. Mr Mayer reports "In all the wells in this region water rises to within about 15 feet of the surface, is very soft, and free of alkali It remains pure as crystal at all times, pleasantly cool, and of the same temperature the year round, and extremely wholesome If allowed to stand exposed to the atmosphere and under ordinary atmospheric temperature it emits an odor of sulphureted hydrogen, no physical change is apparent The water rises from a stratum of beach sand "

832. *Section of well of A H Leonard on Bayou Pierre, 10 miles southeast of Shreveport, Caddo Parish, La.*

[By T C Backus]

	Feet
Quaternary (Port Hudson)	
1 Sandy clay	0– 40
2 Sand and gravel	40– 70
Sabine	
3 Dark-blue clay	70–130
4 No record	130
5 Water sand	205

Casing, 2½-inch, 0–80 feet, 1½-inch, 80–120 feet

834. *Section of well in sec 1, T 20 N, R 16 W, Caddo Parish, La* [a]

	Feet.
Port Hudson	
1 Fine loamy sand	0– 4
2. Yellow and gray mottled clay, post-oak clay	4–11
3 Red clay, with calcareous concretions in lower part	11–29
4 Blue mud, with vegetable matter and mussel shells	29–46
5 Fine blue sand, not passed through	46–55

835. *Section of gin well, Uni, Caddo Parish, La*

[By A L Pullin]

	Feet.
Quaternary	
1 Stiff red clay	0– 8
2 Fine red sand	8– 15
3 Buckshot soil	15– 20
4 Very fine yellow sand	20– 35
5 White sand, gradually becoming coarser	35– 60
6 Fine gravel, size of grain of corn, water bearing	60– 70
Sabine	
7 Blue clay	70–190
8 Dry white sand	190–198
Sabine and Midway?	
9 Brown clay	198–348
Midway?	
10 Shell marl	348–400
Arkadelphia	
11 Dark-gray clay	400–650

A second well was drilled to the same depth without obtaining water

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[a] Geol Survey Louisiana, Rept for 1899 [1900], p 190

837. *Section of test boring in Ouachita River near Blankston, Caldwell Parish, La (143 5 miles above mouth of Black River).*[a]

		Depth in feet
1	Stiff red clay	0 0
2	Sandy clay	19 7
3	Coarse gray sand, with small percentage of clay	22 4
4	Gray sand	26 3
5	Black sand and clay	51 2

Sections of test borings in Ouachita River near Blankston, Caldwell Parish, La (144 5 miles above mouth of Black River) [b]

BORING NO 16

		Depth in feet
1	Brown sand, with small percentage of clay	0 0
2	Gray sand, with some clay	27 89
3	Stiff clay, with some sand	50

BORING NO 17

		Depth in feet
1	Dark-gray sand and clay	0 0
2	Sand and clay	16 41
3	Gray sand and clay	19 69
4	Stiff, sticky blue clay, with small percentage of sand	43 38
5	Stiff and very sticky blue clay	50

BORING NO 17a

		Depth in feet
1	Sand and clay	0 0
2	Brown sand	1 65
3	Gray sand	13 13
4	Gray sand, with small percentage of clay	34 29
5	Gray sand, with larger percentage of clay	42 66
6	Gray sand, with still larger percentage of clay	50

838. *Section of well of Clark Spur Lumber Company near Clarks, Caldwell Parish, La*

[By Oscar Shanks]

		Feet
1	Clay	1–130
2	Pepper-and-salt water sand	130–145
3	Clay, white and sticky	145–208

840. *Section of well of Clark Spur Lumber Company near Clarks, Caldwell Parish, La*

[By Oscar Shanks]

		Feet
1	Clay	1–110
2	Water sand, red in color	110–150

841. *Section of well at Columbia, Caldwell Parish, La*

[By Oscar Shanks]

		Feet
1	Black sandy loam	0– 7
2	Brown clay	7– 17
3	Blue quicksand, lignite, and mica, mixed	17– 57
4	Gray-colored joint clay, with streaks of yellow sand	57– 72
5	Soft blue sandstone	72– 73
6	Coarse white water sand and gravel (iron water)	73– 85
7	Blue clay, mixed with shells	85–102

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[a] Ann Rept Chief of Engineers for 1902, pt 2, 1902, p 1563

[b] Ibid, p 1563.

		Feet
8	Blue flint rock, with gray-colored streaks	102–162
9	Black sticky clay	162–377
10	Chocolate-colored rock	377–388
11	Black sticky clay	388–422
12	Clay, with iron pyrite	422–423
13	Fine sand, with lignite and mica, containing artesian water	423–503

842. *Section of test boring in Ouachita River at Standfield Place, 2 miles below Columbia, Caldwell Parish, La (123 3 miles above mouth of Black River)* [a]

		Depth in feet
1	Yellowish sand and clay	0 0
2	Yellowish sand	1 62
3	Mud, with gray sand	19 69
4	Gray sand	22 31
5	Mud, with dark sand	25 10
6	Sand	41 01
7	Mud, with sand	43 47

843. *Section of test boring in Ouachita River at Columbia, Caldwell Parish, La (125 6 miles above mouth of Black River)* [a]

		Depth in feet
1	Reddish-yellow sand and clay	0 0
2	Reddish-yellow sand	8 20
3	Gray sand	9 84
4	Mud, with sand	15 75
5	Dark-gray sand	17 39
6	Mud, with small percentage of sand	24 28
7	Gray sand	24 61
8	Mud, with gray sand	29 03
9	Gray sand	32 31
10	Sand, with small percentage of mud	36 58
11	Gray sand	40 68
12	Mud and sand	50 59
13	Mud and sand	52 49

844. *Section of test boring in Ouachita River 1 mile above Columbia, Caldwell Parish, La (126 9 miles above mouth of Black River)* [b]

		Depth in feet
1	Brown sand and clay	0 0
2	Gray sand	16 41
3	Gray-brown sand	32 81
4	Blue-gray sand, with small percentage of clay and pieces of coal	48 23
5	Blue-gray sand, with some clay and gravel	73 43
6	Clay, with small percentage of sand and pieces of rock	100 03
7	Very coarse sand and clay	113 19
8	Gray sand	120 47
9	Gray sand, with small percentage of clay	177 07
10	Gray sand, with small percentage of clay	220 14

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[a] Ann Rept Chief of Engineers for 1902, pt 2, p 1561.

[b] Ibid, p 1561

845. *Section of test boring in Ouachita River 2 miles above Columbia, Caldwell Parish, La (127 5 miles above mouth of Black River)* [a]

		Depth in feet
1	Soft, boggy sand and mud, full of trash	0 0
2	Gray sand, with bark and wood	24 60
3	Gray sand	45 57

846. *Section of test boring in Ouachita River, 3 miles above Columbia, Caldwell Parish, La (128 1 miles above mouth of Black River)* [a]

		Depth in feet
1	Brown sand and clay	0 0
2	Gray-brown sand, with some clay	17 02
3	Gray-brown sand, with some clay	52 49

847. *Sections of test borings in Ouachita River at Calls Landing, Caldwell Parish, La (134 5 miles above mouth of Black River)* [b]

BORING NO 14

		Depth in feet
1	Brown sand, with some clay	0 0
2	Gray sand	9 84
3	Stiff gray-blue sand and clay	31 08
4	Stiff gray-blue sand and clay	50 86

BORING NO 14a

1	Brown sandy clay	0 0
2	Gray sand	6 56
3	Stiff gray-blue sand and clay	39 76
4	Stiff gray-blue sand and clay	50 00

848. *Section of test boring in Ouachita River at Lower Breston place, Caldwell Parish, La (132 2 miles above mouth of Black River)* [c]

		Depth in feet
1	Very soft sand and mud	0 0
2	Brown sand, with small percentage of clay	9 84
3	Lot of trash, principally wood	13 12
4	Fine, clean gray sand	16 40
5	Coarse, clean gray sand	19 68
6	Coarse, clean gray sand	45 57

849. *Sections of test borings in Ouachita River at Upper Breston place, Caldwell Parish, La (133 3 miles above mouth of Black River)* [c]

BORING NO 13

		Depth in feet
1	Brown sand and mud	0 0
2	Fine gray sand, full of trash	16 40
3	Coarse gray sand	34 78
4	Stiff blue mud, with some sand and pieces of rock	44 06
5	Stiff blue mud, with some sand and pieces of rock	52 59

BORING NO 13a

1	Soft brown sand	0 0
2	Fine gray sand, with some trash	16 40
3	Coarse gray sand	32 81
4	Stiff blue mud, with some sand and pieces of rock	47 64
5	Stiff blue mud, with some sand and pieces of rock	52 49

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[a] Ann Rept Chief of Engineers for 1902, pt 2, p 1561

[b] Ibid, p 1563

[c] Ibid, p 1562

850. *Section of test boring in Ouachita River at Smithland, Caldwell Parish, La. (131.2 miles above mouth of Black River).*[a]

	Depth in feet.
1. Brown sand, with some clay	0.0
2. Log	9.84
3. Gray sand, with small percentage of clay	10.50
4. Clean gray sand	16.41
5. Gray-brown sand	21.33
6. Gray sand, with clay in lumps or layers	32.81
7. Gray sand, with larger percentage of clay	34.16
8. Coal (lignite)	46.03
9. Gray sand and some clay	46.69

851. *Sections of test borings in Black River (37.9 miles above mouth) at New Hope place, Catahoula Parish, La.*[b]

BORING NO. 1

	Depth in feet.
1. Sandy clay	0.0
2. Sand and lumps of mud	6.57
3. Dark sand	9.85
4. Dark sand	41.02

BORING NO. 1a.

	Depth in feet.
1. Sandy clay	0.0
2. Dark-gray sand	3.93
3. Dark sand and mud	12.47
4. Blue mud	14.11
5. Mud and sand	18.21
6. Dark sand	29.53
7. Dark sand	39.37

852. *Section of test boring in Black River (42.2 miles above mouth) at Star View place, Catahoula Parish, La.*[b]

	Depth in feet.
1. Brown sand and mud	0.0
2. Gray sand	6.58
3. Gray sand	50.00

853. *Section of test boring in Black River (51.4 miles above mouth) at Jones Bayou, Catahoula Parish, La.*[b]

	Depth in feet.
1. Gray-brown sand	0.0
2. Clean gray sand	9.85
3. Clean gray sand	50.00

854. Salt springs are described in this region by a number of the early explorers.[c] They were visited by Hopkins in 1871 and pronounced to be of little economic value.

855. Mr. Thomas W. Robertson, field assistant, visited this well August 18, 1902, and obtained from Mr. A. A. Arnold, head driller, and Dr. J. C. Harden fossils found at a depth of 1,000 to 1,250 feet. These have been pronounced Jackson (Eocene) by Prof. G. D. Harris. The depth at which they were found confirms the dip observations made on Ouachita River between Stock Landing and Carter Landing.[d]

Dr. Harden, with whom the drillers stayed, was greatly interested in the well and kindly allowed Mr. Robertson to copy the following from his personal memorandum. It should be noted that it differs materially from the record furnished by the president of the company, and given below, which on the whole more nearly agrees with the known structure.

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[a] Ann. Rept. Chief of Engineers, 1902, pt. 2, p. 1562.

[b] Ibid., p. 1560.

[c] Geol. Survey Louisiana, Rept. of 1902, pp. 91-92.

[d] Ibid., p. 164.

Section of well of Catahoula Oil and Development Company, Leland, Catahoula Parish, La.

[By Dr. J. C. Harden.]

	Feet.
1. No record	0 - 40
2. Coarse gray sandstone, containing pure freestone water	40 - 60
3. Black clay, with pebbles	60 - 70
4. Soft sandstone, with water	70 - 246
5. Dark-green clay	246 - 546
6. Sandstone	546 - 559
7. Coarse red and white sand	559 - 601
8. Black and yellow clays	601 - 666
9. Soft sandstone	666 - 670.5
10. Sand, with soft, warm water	670.5- 700.5
11. Black clay	700.5- 760.5
12. Yellow clay	760.5- 775.5
13. Fine gray sand, with water	775.5- 800.5
14. Black clay	800.5- 875.5
15. No record	875.5-1,000
16. Clay, with shells (Jackson)	1,000 -1,250
17. No record	1,250 -1,300
18. Very black formation, old seaweed, mud, and lignite (Cockfield)	1,300 -1,500
19. Sand, with artesian salt water	1,500 -1,645
20. Rock, "gypsum"	1,645 -1,651
21. Very fine gray gypsum?; sand; water, not artesian	1,651 -1,701
22. Black and yellow clay	1,701 -1,751
23. Rock	1,751 -1,764
24. No record	1,764 -1,864

"Pipe was withdrawn from 1,864 to 900 feet, when an explosion occurred which could be heard over three-fourths mile; then a gusher of very foul-smelling gas, mud, lignite, and salty water shot up over 100 feet. This contained some oil. Flow continued for twenty-two hours, when it stopped by choking. Before flow stopped salty water became quite clear."

The president, Mr. S. McDowell, furnished the following record in February, 1903:

Section of well of Catahoula Oil and Development Company, Leland, Catahoula Parish, La.

[By S. McDowell, president.]

	Feet.
1. Gray-mottled clay	0- 60
2. Quicksand, with water	60- 80
3. Sandstone	80- 130
4. Blue or green clays	130- 370
5. Water-bearing sand	370-
6. Blue or green clays	-1,550
7. Artesian salt water	1,550-

No water was encountered between the 370-foot sand stratum and 1,550 feet.

856. *Section of test well of St. Louis, Iron Mountain and Southern Railway, Olla, Catahoula Parish, La.*

[From records in the office of E. Fisher, chief engineer of bridges and buildings.]

	Feet.
1. Clay	0–242
2. Water and sand	242–254
3. Streaks of sand and clay	254–257
4. Fine sand, with layers of sand rock and some water	257–314
5. Clay and sand in layers	314–328
6. Soapstone	328–341

	Feet.
7. Gray, hard clay, and black, tough clay or soapstone	341-358
8. Fine sand, water trace	358-364
9. Clay and fine sand, not much water	364-369
10. Fine sand; not much water	369-374

859. *Section of test boring in Ouachita River at Catahoula Shoals, Catahoula Parish, La. (77 miles above mouth of Black River).*[a]

	Depth in feet.
1. Sandy mud	0.0
2. Sand, clay, and gravel	.99
3. Gravel	3.28
4. Gray sand	15.75
5. Blue-brown sandy clay	30.35
6. Blue-gray rock	52.50
7. Very hard blue-gray clay or soft rock	54.33
8. Soft blue-gray rock	76.18
9. Blue sandy clay	86.32
10. Gray rock	139.67
11. Blue sandy clay	140
12. Fine gray sand; water flowed at the rate of 3,600 gallons per hour	158.07
13. Fine gray sand; water flowed at the rate of 3,600 gallons per hour	197.51

862. Lockett[b] gives the following regarding this locality: "In the vicinity of La Croix Ferry, and near the mouth of Trout Creek, is a small area of about 1 mile square, peculiarly characterized by numerous sulphur springs. The best known of these are on the eastern bank of Trout Creek, known as the Catahoula White Sulphur, and now owned by Mrs. Ward. Her husband first opened these springs to the public in 1846, and for many years they were a fashionable resort for the planters of Rapides and other parishes. Their waters were thought to be beneficial to those afflicted with liver complaint, dyspepsia, and all kinds of cutaneous diseases.

"One mile from Wards Springs, on the opposite side of Trout Creek, are the sulphur springs of Captain Welch, which are better, more numerous, and stronger than the former, but are not so well known, from never having been opened to the public."

863. *Analysis of spring water from sec. 15, T. 21 N., R. 4 W., Claiborne Parish, La.*[c]

	Parts per million.
Silica	52.4
Peroxide of iron and alumina	13.2
Lime	23.9
Magnesia	7.01
Potash	4.78
Soda	22.9
Sulphuric anhydride	22.9
Chlorine	16.59
Carbonic acid	35.9
Oxygen absorbed from potassium permanganate in three hours	.30

No ammonia and mere traces of nitrates, nitrites, and phosphoric acid.

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[a] Ann. Rept. Chief of Engineers, 1902, pt. 2, p. 1560.

[b] Ann. Rept. Louisiana State Univ. for 1869, 1870, pp. 56, 57.

[c] Preliminary report on the hill lands south of the Vicksburg, Shreveport and Pacific Railway to Alexandria: Geol. and Agric. of La., pt. 2, 1893, p. 118.

867. *Section of Texas and Pacific Railway well at Fish Pond, Concordia Parish, La*

[By C H Chamberlain]

		Feet
Alluvium and Port Hudson		
1	Top soil and clay	0– 40
2	Blue clay, with streaks of sand	40– 70
3	Quicksand	70– 95
4	Clay and cottonwood drift	95–100
5	Loose stones and gravel	100–105
6	Sharp water sand and gravel	105–145

871. *Section of R G Hedrick's test well, 2 1-2 miles northeast of Frierson, De Soto Parish, La*

		Feet
Sabine		
1	Gray sands and clays, with lignite	0– 241
2	Coarse white sand, lost water in large quantities	241– 281
Midway and Arkadelphia		
3	Dark clay	281– 301
4	Rock	301– 302
5	Dark-colored laminated lignitiferous clay, with large concretions and occasional layers of iron pyrite	302– 901
6	Harder clay, did not cave as badly as that above	901– 998
Nacatoch		
7	Indurated sand, containing Foraminifera and Ostrocoda Furnishes artesian salt water	998–
Marlbrook		
8	Blue clay	–1,275
9	White limestone, gas at 1,300 feet (Saratoga?)	1,275–1,300
10	Light clayey shale, with some sand	1,300–1,500

Diameter, 8 inches, 0–380 feet, 6 inches, 380–913 feet, 4 inches, 913–1,500 feet Temperature of artesian water August 25, 1902, 70° F Elevation of ground, 198 3 feet, top of 4-inch pipe, 203 5 feet above mean Gulf level

872. *Section of Mississippi River Commission test boring, Hays Landing, East Carroll Parish, La* [a]

[By E W Hilgard]

		Feet
Alluvium		
1	Noncalcareous clayey silt, with abundant vegetable matter not lignitized	0– 56
Port Hudson		
2	Coarse sand, with gravel and grains of lignite A clay streak occurs at 82 5 to 82 6	56–109
"Upper Claiborne" (Jackson)		
3	Whitish greensand marl On washing and settling the greensand falls to the bottom, the red sand occupies the middle, and the calcareous débris lies on top	127–132
4	Greensand marl like the last, with calcareous concretions containing shell fragments	132–135
5	Concretions from marl bed, with shell fragments	145–150
6	Bluish clay, with lignite grains	158–160
7	Fine sand of a clay color, with greensand	166–176
8	Bluish clayey silt, with lignite grains	176–181

"This boring at Hays Landing, about 5½ miles southwest from the boring at Lake Providence (873), shows in its upper portion the same unusual variety of materials as No 873 For that very reason it is extremely probable that if it were of the older formation the corresponding fossils would be easily found The depth

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[a] Ann Rept Miss River Com for 1883 48th Cong, 1st sess, House Doc No 37, 1884, pp 494, 496

of the alluvium here may therefore probably be placed at 56 8 feet, from this depth to that of 109 feet there can be no doubt of the true character of the older or 'bottom gravel '"

Harris[a] has identified the following forms from this well *Leda multilineata* (radial marking on anterior only), *Leda*, depth 135 feet, *Venericardia planicosta* and *V rotunda*, depth 137 feet

These forms, together with those obtained from the other borings along the river, indicate that this formation is Jackson rather than Claiborne

873. *Section of Mississippi River Commission test boring at Lake Providence, East Carroll Parish, La.*[b]

[By E W Hilgard]

		Feet.
Alluvium		
1	Yellowish noncalcareous silt, with macerated vegetable matter, varying in the proportions of sand and clay every few feet	0– 9 6
2	Blue clay	9 6– 15 6
3	Yellowish sand, slightly coherent	15 6– 29
4	Blackish-blue clay	29 – 30
5	Grayish-yellow sand, slightly coherent	30 – 42 9
Port Hudson		
6	Loose sand, with grains of lignite	54 8–
7	Fine brownish silt, darker below, with lignite in grains	56 – 82
8	Bluish-gray clay	82 – 84
9	Clayey silt of a terra-cotta color, abundant lignite grains	100 5–101
10	Grayish-yellow sand, vegetable matter abundant	101 –103 2
11	Brownish clay	103 2–104
12	Coarse sand, with chert pebbles	109 –127 6
13	Black lignite	127 –131 5
14	Whitish-blue sandy clay	131 5–170
15	Fine yellowish clayey sand	170 –191
16	Gray sand, with clayey streaks	191 –247
17	Blackish-brown clay	247 –248

"Boring No 2, the deep boring at Lake Providence town, is one of the most interesting, not only on account of the great depth reached (248 feet) and the great variety of materials encountered, but mainly from the fact that at this great depth the Tertiary strata (contrary to the impression of the engineer in charge) have not been reached " For the general run of wells in this section the writer is inclined to regard stratum No 12 as the base of the Quaternary or Port Hudson deposits

875. *Section of well at Lake Providence, East Carroll Parish, La*[c]

[By John L Kennedy]

		Feet
1	Black, blue, and red loam	0–10
2	Fine sand	10–19
3	Coarse water-bearing sand	19–34
4	"Concrete"	34–38
5	Water-bearing sand	38–77
6	"Concrete"	77–79
7	Sand	79–85
8	"Concrete"	85–86
9	Water sand	86–93

"Abandoned at 112 feet, the water being found too ferruginous for general purposes "

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[a] Geol Survey Louisiana, Rept of 1902, p 23

[b] Ann Rept Miss River Com for 1883 48th Cong, 1st sess, House Doc No 37, 1884, pp 494, 496.

[c] Geol Survey Louisiana, Rept of 1902, p 232

877. *Section of town well at Colfax, Grant Parish La*

[By L B Hart]

	Feet
Port Hudson	
1 Surface	0- 70
2 Water-bearing sand and gravel	70- 130
Jackson	
3 Very hard clay	130- 300
4 Blue joint clay	300- 550
Cockfield	
5 Fine quicksand	550- 650
6 Hard brown clay	650- 800
7 Sand rock	800- 835
8 Alternate layers of quicksand and black clay	835-1,000
9 Sand rock	1,000-1,060
10 Loose sand	1,060-1,100
11 Hard sandstone	1,100-1,128
12 Hard white clay, not passed through	1,128-

"Pipe pulled back and set at 1,103 feet This water proved to be very salty or full of soda It seemed to be propelled by gases, the water rising in a pipe 65 feet above the surface The natural flow is 60,000 gallons for twenty-four hours"

Mr R S Cameron reports that below 150 feet gypsum and shells (principally small spirals) were quite common No shells were found above 150 feet [a]

880. The artesian water obtained in the sandstone at 255 feet is used entirely for drinking The well was continued to 910 feet without obtaining water except at 500 feet, where an impotable water was found in a blue mud

881. *Section of well of Louisiana Lumber Company (Limited), Rochelle, Grant Parish, La*

[By Oscar Shanks]

	Feet
1 White dirt soil	1- 45
2 Fine sand, with sticks, logs, and acorns	45- 56
3 Alternate layers of blue clay and flint rock, with streaks of salt water in fine sand	56-555
4 Alternate layers of fine white sand and porous chocolate-colored rock, in layers 6 to 12 inches thick, furnishes artesian salt water	555-565

Mr F T Boles, manager of the Lord & Bushnell Lumber Company, Chicago, reports "Well at Rochelle was 1,100 feet deep, at that depth brackish water with gas was obtained One of our men who worked on the job reports that a slight flow of fairly good water was obtained at 700 feet" This refers to the same well reported by Mr Shanks

882. *Section of well of St Louis, Iron Mountain and Southern Railway at Sandspur, Grant Parish, La*

[By Oscar Shanks]

	Feet
1 Red clay	0-50
2 Cemented gravel	50-60
3 Coarse gravel and sand	60-75

Well finished with a cook strainer 14 feet long

883. *Section of well of S Hopper Mill Company, Stay, Grant Parish, La*

[By Oscar Shanks]

	Feet
1 White and yellow clay	1-20
2 Quicksand	20-30
3 Blue clay	30-60
4 Coarse gravel and white sand	60-78

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[a] Shells are incorrectly reported above 150 feet in Geol Survey Louisiana, Rept of 1902, p 211

884. *Section of well of Dams Brothers, Ansley, Jackson Parish, La*

[By L B Clifford]

Claiborne and Sabine	Feet
1 Red clay	0– 22
2 Blue clay and rock	22–190
3 Gray sand, water bearing	190–245

885. *Section of well of Huie-Hodge Lumber Company, Hodge, Jackson Parish, La*

[By L B Clifford]

Claiborne and Sabine	Feet
1 Marl and blue clay	0–292
2 Gray sand, water bearing	292–300

886. Mr L B Clifford writes "In the Jonesboro well there were about 70 feet of lignite in different layers, balance was blue marl, with occasional rocks The water-bearing sand was gray and about 30 feet thick "

887. *Section of well of Wyatt Lumber Company, Wyatt, Jackson Parish, La*

[By L B Clifford]

Claiborne	Feet
1 Blue shell marl	0– 70
Claiborne and Sabine	
2 Blue clay and layers of rock	70–208
3 Hard-packed sand, layers of blue rock at bottom	208–242
4 Fine white sand, water bearing	242–252
5 Hard-packed gray sand and rock	252–272
6 Gray sand, water bearing	272–302

888. *Analyses of spring water from Chautauqua grounds, near Ruston, Lincoln Parish, La* [a]

[By Maurice Bird]

Constituents (in parts per million)	Griffin Springs, No 1	Griffin Springs, No 2
Soluble silica	47 9	45 5
Iron and alumina	26 3	41 0
Lime	26 3	20 3
Magnesia	11 6	15 0
Potash	Trace	Trace
Soda	19 0	20 3
Chlorine	7 2	5 5
Sulphuric acid	11 5	12 8
Phosphoric acid	Trace	Trace
Nitrogen as nitrates	Trace	Trace
Nitrogen as nitrites	None	None
Nitrogen as ammonia	None	None
Carbonic acid	Not determined	Not determined

[a] Geology and Agriculture of Louisiana, pt 1, 1892, p 47

Both springs are slightly chalybeate

890. *Section of well of Ruston waterworks, Ruston, Lincoln Parish, La*

[By L B Clifford]

		Feet
1	Sand	0- 18
2	Light-blue clay	18- 59
3	Water-bearing sand	59- 60
4	Rock	60- 61
5	Blue clay, with limestone concretion	61- 67
6	Water-bearing sand	67- 68
7	Clay	68- 69
8	Rock	69- 74
9	Water-bearing sand	74- 76
10	Rock	76- 81
11	Water-bearing sand	81- 84
12	Rock	84- 85
13	Water-bearing sand	85- 86
14	Clay, with occasional rocks	86-120
15	Water-bearing sand	120-126
16	Clay, with occasional rocks	126-152
17	Water-bearing sand	152-154
18	Clay, with occasional rocks	154-373
19	Water-bearing sand	373-425

Pipe was perforated between 120 and 126 feet and between 373 and 425 feet

893. *Section of Vicksburg, Shreveport and Pacific Railway test well at Delta, Madison Parish, La.*

[By R B Coxe]

Alluvium and Port Hudson

		Feet
1	Clay	0- 12
2	Quicksand	12- 50
3	Light clay, passing below into sand and gravel	50- 118
4	Coarse gray water-bearing sand	118- 135
5	Clay, no water	135-1,200±

894. Pronounced by State experiment station a good drinking water

895. "Wells in the valleys and on the bayous are generally from 25 to 50 feet deep on the hills from 60 to 150 feet The water is in most cases slightly hard There is a flowing well in T 19 N , R 16 E , and one that flows at times in the channel of Bonne Idee Bayou in T 21 N , R 7 E Sulphur springs abound along upper Bartholomew and Boeuf rivers"

896. *Section of well at court-house, Bastrop, Morehouse Parish, La*

[By W A Harrington]

Port Hudson

		Feet
1	Clay and soil	0- 25
2	Dry sand	25- 65
3	Medium coarse sand, filled with good, almost pure, water	65-153
4	Hardpan	153-

897. *Section of well of St Louis, Iron Mountain and Southern Railway, Collinston, Morehouse Parish, La*

[By C H Winters]

Alluvium and Port Hudson

		Feet
1	Sandy clay and soil	0-10
2	Hard gumbo and yellow clay	10-64
3	Fine sand	64-68
4	Coarse sand and gravel	68-71
5	Fine sand	71-78
6	Gravel and sand	78-81

Well is furnished with a No 4 Cook well strainer When pumping 140 gallons per minute the water level remains unchanged

898. *Section of well of St Louis, Iron Mountain and Southern Railway, Mer Rouge, Morehouse Parish, La*

[By Oscar Shanks]

	Feet
Port Hudson	
1 Black soil	0- 6
2 Stiff clay	6-79
3 Water-bearing sand	79-89

901. Mr D G Petty reports "A well 1 inch in diameter was sunk here in the early part of 1902, and at 412 feet water flowed from the pipe 20 feet above ground for half a day The pipe was on a rock, and as that was the time of the oil excitement the workmen concluded to go through the rock and strike oil The rock was penetrated and the water ceased to flow Nothing more has been done to the well except to remove the pipe The pipe was never fast and one man could easily turn it at any time The water was very good for drinking Did not test for hard or soft

904. *Partial section of test well at Drakes Salt Works, sec 21, T 12 N , R 5 W , Natchitoches Parish, La*

[By H H Jones]

	Feet
1 Yellow sand clay	0- 5
2 White sand, with water which steams all right in a boiler, but turns deep red and coats everything with a salty crust	5- 42
3 Cypress log, very much decayed, charred on one side	42- 43
4 Soft sand, gravel, and streaks of clay of various colors so mixed in drilling that we could not classify or give stratification	43-318
5. Very porous crystalline limestone, crevices filled with white and yellow calcite crystals	318-475

"At 150 feet a foam found on the water which tasted very much of alum, puckering the mouth very much "

Samples from stratum 5 are in every way identical with the limestone found at the Winnfield "Marble Quarry "

906. *Partial section of well of J' W Cockerham, jr , Luella, Natchitoches Parish, La*

	Feet
Alluvium and Port Hudson	
1 Surface loam	0 - 36
Transition	
2 Sand and gravel, with large lignitized cottonwood (?) log at 270 feet	36 -300
Sabine	
3 Rock	300 -304
4 Blue clay, with occasional rocks several feet thick	304 -640
5 Sand, with artisian salt water	640 -
6 Fossiliferous sand, with artesian salt water	700 5-707

Mr Cockerham has three wells on his place which obtain water from the sand and gravel stratum No 2, and which are, respectively, 36, 86, and 106 feet deep The water in these stands from 18 to 21 feet below the surface, and from the 36-foot well a supply of 10 gallons per minute has been pumped without affecting the water level.

908. *Section of well of Montrose Lumber Company, Montrose, Natchitoches Parish, La*

	Feet
Alluvium and Port Hudson	
1 Surface clay and loam	0- 80
2 Quicksand, abundant supply of water, but it can not be used in boilers	80-180
Jackson and Cockfield	
3 Blue clay, with fossil shells, no water	180-496

Well sunk in January, 1899 Judging from the depth of the water-bearing sand in the Weaver Spur well, water should be obtained at this place at a depth of about 600 feet (P 138, Pl XXXVII, sec E)

910. *Section of well at waterworks, Natchitoches, Natchitoches Parish, La*

[By Judge C H Levy]

		Feet
Claiborne		
1	Red clay	0- 5
2	Blue clay	5-12
3	Red clay	12-13
4	Blue and red sandy clay	13-16
Sabine		
5	Fine gray quicksand, very variable in thickness	16-39
6	Black sandy clay	39-40
7	Coarse gray sand, not passed through	40-64

The well at the waterworks consists of a dug well, 30 feet in diameter and 19 feet deep, in which five 1½-inch pipes and one 3-inch pipe have been driven to a depth of 40 to 45 feet below the bottom of the well The water flows rapidly from the top of these pipes into the well

911. The following record has been prepared from the statements of President Caldwell, and from data collected on the ground while the well was being drilled

Section of well of Normal School, Natchitoches, Natchitoches Parish, La

		Feet
1	Red and chocolate clays	0 - 34
2	Soft sandstone, iron stained	34 - 35.5
3	Gray sand, with a moderate supply of very salty water, rising to within 14 inches of the surface	35.5- 38
4	Alternate beds of blue-gray and red-gray sandstone and blue clay, with occasional bits of pyrite and lignite	38 - 96
5	Very fine, nearly pure white sand, with a large supply of water, not distinctly salt	96 -108
6	Chocolate clay, blue clay, and thin beds of sand	108 -134
7	Iron pyrite	131 -144
8	Coarse, white, rounded sand	144 -156
9	Pyrite	156 -160
10	Alternate layers of clay and sand, with one or two thin beds of impure lignite	160 -462
11	Shells and gravel	462 -496
12	Blue clay	496 -558
13	Lignite	558 -558.5
14	Blue clay	558.5-560
15	Lignite	560 -571
16	Blue clay, with occasional seams of lignite	571 -637
17	Gray clay, with limestone concretions	637 -680
18	Lignite	680 -700
19	Sandstone	700 -704
20	Soft blue clay	704 -710
21	Light-gray sand with artesian salt water and gas	710 -726

Harris[a] adds the following information, obtained from the foreman of the Andrews Well Company:

Partial section of well of Normal School, Natchitoches, Natchitoches Parish, La

		Feet
1	Greenish brittle clay, with shells	0-547
2	Lignite	547-558
3	Clay, with shells	558-678
4	Bowlder	678-681
5	Clay (no shells), rock, fine sand	681-728

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[a] Geol Survey Louisiana, Rept of 1902, p 210

913. *Analysis of water from Iron Springs, near Natchitoches, Natchitoches Parish, La* [a]

[By Maurice Bird.]

	Parts per million.
Silica	64.0
Iron and aluminum oxides	8.0
Lime (CaO)	12.0
Magnesia	9.3
Sulphuric acid (SO_3)	20.6
Potash	4.0
Soda	22.0
Chlorine	17.4

"Water is colorless, but contains a little brown suspended matter, it is neutral to litmus paper and practically tasteless."

914. *Analysis of water from Breazeale Spring, 2 miles northwest of Natchitoches, Natchitoches Parish, La.* [b]

[By Maurice Bird.]

	Parts per million
Silica	55.0
Iron and aluminum oxides	4.0
Lime (CaO)	9.0
Magnesia	5.7
Sulphuric acid (SO_3)	20.6
Potash	4.0
Soda	22.0
Chlorine	17.4

"Water is clear and colorless, neutral to litmus paper, and practically tasteless."

918. *Sections of test borings in Ouachita River near Bosco, Ouachita Parish, La. (155 miles above mouth of Black River)* [c]

BORING NO. 18.

		Depth in feet
1	Yellow sand	0.0
2	Gray sand, with small percentage of clay	13.12
3	Mud	36.09
4	Mud, with small percentage of sand	43.96

BORING NO. 18a.

		Depth in feet
1	Fine, clean sand	0.0
2	Fine gray sand and mud	4.43
3	Coarse gray sand and blue mud, with gravel	17.06
4	Clean gray sand	17.56
5	Gray sand and mud	23.46
6	Mud, with small percentage of sand	21.78
7	Mud	25.10
8	Mud	32.14

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[a] Geol. Survey Louisiana, Rept. for 1899 [1900], p. 148.

[b] Ibid., p. 148.

[c] Ann. Rept. Chief of Engineers for 1902, p. 1564.

919. The following section of the well of the Louisiana Oil Company was prepared from samples at the well.

Description of samples from well of Louisiana Oil Company, 3 miles southeast of Cheniere, Ouachita Parish, La

[By A. C. Veatch.]

		Depth in feet
1	Dark clay	10
2	Light, sandy clay	35
3	Mottled clay	45
4	Pebbly clay	55
5	Dark, stiff clay	65, 75
6	Dark, sandy clay	85, 95, 105
7	Dark sand	115
8	Dark sand, with small shells	125, 135, 145, 155
9	Dark, sandy clay	165, 175, 185, 195
10	Light clay	205
11	Light clay and sand	215
12	Hard clay	225, 235, 245, 255
13	White sand	265-275
14	Sand and clay	285, 295
15	Clay, with shells	305, 315
16	Lignitic clay	325
17	Lignite and sand	335, 345
18	Sand	355, 430
19	Hard clay	445
20	Clay and sand	455
21	Gray sand, reported to contain artesian water	465-515

920. *Sections of test borings in Ouachita River near Logtown, Ouachita Parish, La. (160.1 miles above mouth of Black River)*[a]

BORING NO. 19

		Depth in feet
1	Brown sand and trash	0.0
2	Brown sand	1.64
3	Sand and coarse gravel	13.12
4	Very stiff, sticky blue-black clay	23.78
5	Very stiff, blue-black clay, with pockets and streaks of greensand and shells, also many small pieces of rock, some as large as a hen's egg	37.73-50

BORING NO. 19a

		Depth in feet
1	Brown sandy clay	0.0
2	Brown sand	1.97
3	White sand	13.13
4	Sand and coarse gravel	19.69
5	Sand and coarse gravel, with small percentage of clay	28.12
6	Stiff, sticky blue-black clay	34.78
7	Very stiff clay, with pockets and streaks of greensand marl	42.65
8	Very stiff clay, with pockets and streaks of greensand marl, also several pieces of rock about the size of a hen's egg	49.22-50

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[a] Ann. Rept. Chief of Engineers for 1902, p. 1564.

921. *Analyses of waters from wells of the Consolidated Ice Company, Monroe, Ouachita Parish, La* [a]

[By Maurice Bird]

Constituents (in parts per million)	Jackson well	Boone well
Soluble silica	14 022	50 958
Iron and alumina	27 018	30 438
Lime	14 022	17 955
Magnesia	2 394	3 420
Potash	3 762	3 762
Soda	224 694	259 407
Chlorine	24 795	27 018
Sulphuric acid	7 524	9 405
Phosphoric acid	12 825	17 784
Nitrogen as nitrates	None	None.
Nitrogen as nitrites	None	None
Nitrogen as ammonia	None	None
Carbonic acid	177 840	87 039

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[a] Report on the hills of Louisiana north of the Vicksburg, Shreveport and Pacific Rwy Geol and Agric of La, pt 1, 1893, pp 45–47

922. *Section of well of Consolidated Ice Company, Monroe, Ouachita Parish, La*

	Feet
Port Hudson	
1 Clay and earth	0–40
2 Sand, water bearing	40–60
3 Clay	60–65
4 Water-bearing sand	65–75
5 Hard clay	75–90
6 Coarse sand and gravel	90–95
Claiborne and Sabine?	
7 Blue clay mixed with sand and a few layers of rock	95–250
Sabine	
8 Sand, with some black substance like lignite, water begins to flow at 250 feet and flow increases with depth	250–400

923. There are three wells at the waterworks, but because of the large amount of mineral matter the water is used only in case of fire The main supply is derived from Ouachita River In 1898 Mr Strong gave the following record of this well

Section of waterworks well No 1, Monroe, Ouachita Parish, La.

[By Will A Strong]

	Feet.
Port Hudson	
1 Clay and quicksand	0–80
Claiborne and Sabine	
2 Soft bluish clay	80–180
3 Blue marl, with shells	180–190
4 Rock	190–191
5 Soft blue pipe clay	191–289
Sabine	
6 Water-bearing sand	289–385

The water first began to flow at 289 feet and the flow increased with the depth.

924. *Analysis of water from deep well of Planters' Oil Company, Monroe, Ouachita Parish, La* [a]

[By Maurice Bird]

	Parts per million
Soluble silica	71 820
Iron and alumina	52 668
Lime	7 182
Magnesia	14 364
Potash	7 524
Soda	252 909
Chlorine	53 865
Sulphuric acid	9 234
Phosphoric acid	None
Nitrogen as nitrates	None
Nitrogen as nitrites	None
Nitrogen as ammonia	None
Carbonic acid	102 942

928. *Sections of test borings in Ouachita River at Monroe, Ouachita Parish, La (183 4 miles above mouth of Black River)* [b]

BORING NO 20

		Depth in feet
1	Brown sand	0 00
2	Gray sand	17 39
3	Blue-black clay and sand	40 22
4	Blue-black clay and sand	51 38

BORING NO 20a

		Depth in feet
1	Brown sand and clay	0 00
2	Brown sand	3 28
3	Grayish sand	22 96
4	Blue-black clay, with some mud	36 28
5	Blue-black clay, with some mud	50 20

BORING NO 20b

		Depth in feet
1	Yellow sand and mud	0 0
2	Gray sand	6 56
3	Coarse sand mixed with gravel and mud	22 31
4	Coarse bits of broken gravel and sand	23 95
5	Sand	25 59
6	Fine sand and mud	27 23
7	Mud	28 55
8	Blue mud	31 50
9	Mud and sand	33 79
10	Mud	36 42
11	Mud and sand	41 01
12	Mud and sand	43 97

BORING NO 20c

		Depth in feet
1	Clean white sand	0 00
2	Yellow sand	5 26
3	Wet brown sand	5 58
4	Wet black sand	5 91
5	Gray sand	12 47
6	Fine sand and mud	35 86
7	Blue clay	39 77

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[a] Report on the hills of Louisiana north of the Vicksburg, Shreveport and Pacific Rwy Geol and Agric of La, pt 1, 1893 pp 45-47

[b] Ann Rept Chief of Engineers for 1902, pp 1564-1565

929. *Sections of test borings in Ouachita River at Rock Row Shoals, Ouachita Parish, La. (200.9 miles above mouth of Black River).* [a]

BORING NO. 21

		Depth in feet
1	Brown-gray sand, with small percentage of clay	0.00
2	Brown sand	1.64
	Claiborne	
3	Very stiff clay and greensand marl	24.27
4	Very stiff clay and greensand marl, with a few shells	49.70
5	Rock	62.73
6	Very stiff clay and greensand marl, with a few shells	62.99
7	Same clay, with more greensand and pieces of rounded rock, size 1 inch	69.62
8	Rock	70.99
9	Greensand, with small percentage of clay	71.68
10	Greensand and clay	74.45
11	Stiff clay with some greensand and a few small shells	78.74
12	Very stiff blue-black clay, with a few small shells	82.02
13	Rock	102.39
14	Very stiff blue-black clay, with a few small shells	102.72
15	Very stiff dark-brown clay and sand, with some shells	117.97
16	Gray rock, very hard and full of shells	126.31
17	Dark-gray sand and clay, with shells	126.46
18	Rock	131.36
19	Blue-black clay, with shells and sand	131.69
20	Gray and green rock full of shells	146.78
21	Very stiff clay, with shells and pockets of sand	149.14
22	Gray-green rock full of shells	153.70
23	Very stiff clay, with shells and sand	155.02
24	Gray-green rock full of shells	156.39
25	Gray-green rock full of shells	157.05

BORING NO. 21a

		Depth in feet
1	Brown-gray sand and mud	0.00
2	Greensand marl, with large percentage of clay	16.40
3	Stratum of rock about 1 inch thick	40.35
4	Very stiff greensand and clay	48.49
5	Very stiff mud or soft rock	62.79

933–936. In 1894 and 1895 four wells were put down by the city of Alexandria—two near the corner of Monroe and Fourth streets, where the waterworks now stand, one behind the city hall, and the fourth on the corner of St. James and Fourth streets. All these were flowing wells, the water rising from 4 to 10 feet above the surface, and were used at first to supply public watering troughs. After the installation of the waterworks in 1895, the yield of the wells at the city hall and St. James and Fourth streets gradually decreased. For several years they would cease flowing when pumping began at the waterworks, and recommence about three hours after the pumps had stopped. Since 1899 they have not flowed at all, and the water level is gradually lowering. On August 6, 1902, it was found to be from 58 to 60 feet below the surface in the city-hall well, and 49 feet in the well at St. James and Fourth streets (fig. 31).

No record was kept of these wells, and the various reports received concerning them are very contradictory and confusing. The following represents the best data obtainable.

Well behind city hall.—Diameter, 1.5 inches, completed in 1894, flowed intermittently until 1899, the water supplying a public watering trough. On August 6, 1902, the well was sounded and found to be 473 feet deep; about 20 feet of sand had accumulated in the bottom, but the plumb bob finally reached hard clay.

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[a] Ann. Rept. Chief of Engineers for 1902, pt. 2, pp. 1565–1566.

Waterworks well No 1.—Diameter, 4 inches, strainer, 2.5 inches, completed 1898. Mr. H. C. Kenneker, foreman in charge of the drilling, states that the well is 560 feet deep, the water-bearing sand extending from 540 to 560 feet. This, with well No. 2, was pumped with a direct-suction pump from 1895 to 1901, when an air lift was installed. The air-lift pipe is 198 feet long, and the air pressure on August 4, 1902, indicated that the water was at that time approximately 138 feet from the surface. Mr. Ira W. Sylvester, city engineer, states that it takes over a day for the water in No. 1 to rise to within 3 feet of the surface. Yield of well April 16, 1902, 53 gallons in twenty-seven seconds.

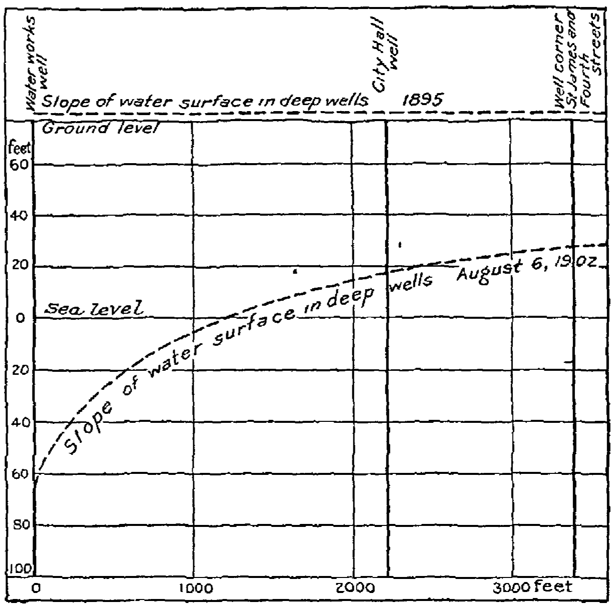

FIG. 31.—Curves showing head in deep wells at Alexandria, La., in 1895 and on August 6, 1902. Note effect of pumping.

Waterworks well No 2.—Diameter, 10 inches, 0–210 feet, 8 inches, 210–612 feet, 4 inches, 612–760 feet. Mr. H. C. Kenneker, the driller, reports that water-bearing sand was encountered at 540, 620, and 760 feet, and that strainers were placed at each of the sands. Mr. Ira W. Sylvester, city engineer, is of the opinion that there are no strainers in the well at 540 and 620 feet, because pumping well No. 2 does not affect the water level in well No. 1. Yield of well April 16, 1902, 53 gallons in twenty-six seconds. On August 6 the depth of water was about 110 feet.

Well corner St. James and Fourth streets.—Diameter, 2 inches, flowed originally 10 feet above the surface, flowed intermittently from 1894 until 1899. On August 6, 1902, well was sounded and found to be 606 feet deep, bottom of the casing was filled with about 50 feet of sand, plumb bob finally struck hard bottom.

In order to obtain some idea of the effect of pumping the waterworks wells a number of observations were made on the wells at the city hall and St. James and Fourth streets, on August 6 and 7, 1902. Both of the waterworks wells had been pumped steadily up to this time, and well No. 1 was cut out from 10.15 a. m. to 6 p. m., August 6. The water in the city-hall well rose steadily after the pumping of No. 1 ceased, indicating that these two wells depend on a common horizon. The well at the corner of St. James and Fourth streets, however, did not show any fluctuation which could clearly be attributed to the increased demand on well No. 2 (fig. 32).

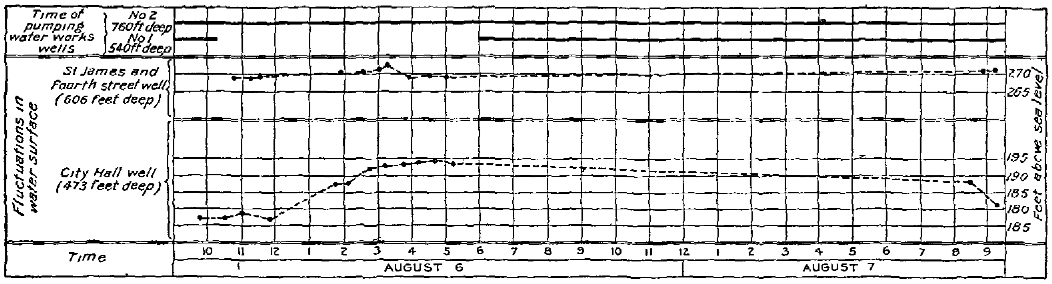

FIG. 32.—Diagram showing effect of pumping in waterworks wells on the water level in the wells at the city hall and St. James and Fourth streets, Alexandria, La., August 6–7, 1902.

937. In 1900 a well was started for the St. Louis, Iron Mountain and Southern Railway, near the roundhouse, by the Hart Well Company. Mr. Hart has furnished the following statement regarding it: "The well was drilled to a depth of 858 feet. Water was struck at 850 feet, but, through a disagreement with the railroad company, was not developed. A considerable thickness of sandstone was penetrated before reaching 850 feet, below this was loose sand."

The following has been taken from a blueprint, dated February 8, 1900, on file in the Iron Mountain Railway office at Bearing Cross, Ark.

Partial record of well of St. Louis, Iron Mountain and Southern Railway, Alexandria, Rapides Parish, La.

	Feet
Port Hudson:	
1. Soil	0– 60
2. White sand	60– 75
3. Yellow sand	75– 80
4. Bowlders	80– 90
Catahoula:	
5. Solid rock	90–110
6. "Slate" (blue clay) and sand rock	110–390
7. Sand rock	390–402
8. "Shale" (blue clay), sand rock, and blue soapstone (blue clay)	402–520
9. Sand rock	520–528
10. "Shale" (blue clay), sand rock, and blue soapstone	528–540

Casing, 6-inch, 0–300 feet; 4-inch, 300–482 feet.

938. In 1902 two test wells were put down on the property of the Alexandria Ice and Storage Company, near the corner of Monroe and Sixth streets, by the Andrews Well Company. Mr. James Drouant, foreman, has furnished the following data: "In well No. 1 water was struck at 480 and 580 feet; stratum at 480 feet yielded 60 gallons per minute; water from 580 feet stood within 60 feet of the surface."

Section of second test well of the Alexandria Ice and Storage Company, Alexandria, Rapides Parish, La.

[By James Drouant.]

	Feet
1. Clay	0–150
2. White sand	150–155
3. Clay	155–176
4. Rock	176–180
5. Clay	180–330
6. Sandstone	330–375
7. Clay	375–410
8. Shale	410–450
9. Sand	450–510
10. White rock	510–520
11. Clay	520–545
12. Sand	545–580
13. Green clay, typical Catahoula (Grand Gulf) material	580–621

These horizons are clearly the same as those developed in the waterworks wells. The depth to the water is about what would be expected because of the depression of the water table produced by the pumping at the waterworks.

As neither of these wells furnished the amount of water required by the ice factory, they were abandoned.

939. After the abandonment of the two Andrews test wells, a new well was drilled by the Hart well Company on the Fifth street line of the property. Harris gives the following section:

Section of well of Alexandria Ice and Storage Company, Alexandria, Rapides Parish, La [a]

[By G D Harris]

		Feet
1	Surface clay	0 – 21
2	Sand	21 – 23
3	Clay	23 – 38
4	Rock	38 – 65
5	Blue clay	65 –153
6	Hard rock	153 –155
7	Blue clay	155 –175
8	Rock	175 –183
9	Blue joint clay	183 –328
10	Limestone	328 –331
11	Clay	331 –374
12	Hardpan	374 –464
13	Hard limestone	464 –466 5
14	Green clay	466 5–478 5
15	Hard rock	478 5–480
16	Blue clay	480 –490
17	Sandstone	490 –504
18	Clay	504 –534
19	Sand	534 –537
20	Rock	537 –539
21	Clay	539 –549
22	Sand	549 –550
23	Clay	550 –558
24	Sand	558 –560
25	Blue clay	560 –649
26	Sand	649 –665
27	Clay	665 –693
28	Sand	693 –703
29	Blue clay	703 –727
30	Soft sandstone	727 –780
31	Clay	780 –804
32	Sand	804 –809
33	Soft sandstone	809 –851
34	Clay	851 –853
35	Sandstone	853 –897
36	Sand	897 –927

"This well is provided with a 70-foot strainer, and before it was cleaned had a flow of 125 gallons a minute, according to the report of a local paper "

The fact that this is a flowing well indicates a stratum entirely distinct from those developed in the waterworks wells

940. *Section of well of Sonia Cotton Oil Company, Alexandria, Rapides Parish, La*

[By Ira W Sylvester]

Port Hudson		Feet
1	Sandy soil	0– 5
2	Clay	5– 60
3	Shelly rock	60– 65
4	Sharp sand, water bearing	65– 95
5	Clay and gravel	95–110

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[a] Water-Sup and Irr Paper No 101, U S Geol Survey, 1904, p 20

941. *Section of well of Ball Sawmill Company, Ball, Rapides Parish, La*

[By Oscar Shanks]

	Catahoula	Feet
1	Yellow clay	0-17
2	Soft blue sandstone	17-22
3	Fine sand and clay	22-48
4	Medium sandstone	48-60
5	Blue clay	60-310
6	Fine water sand mixed with lignite and mica	310-365

This stratum was cased off and an attempt made to get flowing water, but the well was abandoned

943. *Section of well of Texas and Pacific Railway Company, Boyce, Rapides Parish, La*

[By Charles Anderson]

		Feet
1	Clay	0-42
2	White sand	42-62
3	Hard clay	62-82
4	Clay and sand	82-145
5	Sandstone	145-156
6	Clay	156-180.5
7	Sandstone	180.5-204.2
8	Sand	204.2-215.2
9	Blue clay	215.2-217.2
10	Flint rock	217.2-221.2
11	Hard clay	221.2-263.2
12	Quicksand	263.2-279.2
13	Clay	279.2-281.2
14	Sand and clay	281.2-300.2
15	Clay	300.2-318.4
16	Sandstone	318.4-325.4
17	Clay	325.4-329.4
18	Sandstone	329.4-335.4
19	Clay	335.4-344.4
20	Sandstone	344.4-368.4
21	Clay	368.4-376.4
22	Sandstone	376.4-398.4
23	Clay	398.4-411.4
24	Flint rock (quartzite)	411.4-418.8
25	Clay	418.8-438.8
26	Sandstone	438.8-441.2
27	Clay	441.2-529.2
28	Sandstone	529.2-531.2
29	Hardpan	531.2-541.2
30	Gravel and clay	541.2-616
31	Sandstone	616-696
32	Sand, with artesian water	696-708
33	Flint rock (quartzite)	708-711
34	No record	711-774
35	Soft sandstone	774-802
36	Soft sandstone, with brackish artesian water	802-808.6

"Depth September 14, 1898, 808.6 feet. Pipe was pulled back to 696 feet and well used until 1901, when it caved."

944. When this well is pumped the water lowers to 40 feet from the surface. It requires about eight days to entirely recover—that is, to flow. The original pressure at the top of the pipe was 15 pounds to the square inch.

947. *Section of well of L C Sanford, Lamothe, Rapides Parish, La*

[By L C Sanford]

Port Hudson

		Feet
1	Soil, sand and clay	0– 35
2	Quicksand does not yield the water readily	35– 80
3	Tough red clay	80– 95
4	Sand and gravel, with abundant supply of hard water	95–105

950. *Sections of wells of Pineville Development Company, Pineville, Rapides Parish, La*

[By F S Hoyt]

WELL No 1

		Feet	
1	Gravel, water bearing	200	–
2	Light-greenish clay (Catahoula)	235	5–
3	Gravel, water bearing, water flowed out of pipe 55 feet above the ground for four hours	430	–440
4	Sand, lost water at	460	-
5	Soft limestone	580	–600
	Total depth		–720

WELL No 2

1	Clay, with a little sand	0	–100

WELL No 3

1	Soil	0	– 12
2	Packed sand	12	–112
3	Rock	112	–124
4	Gravel from size of pea to that of a hen's egg, with a little water	124	–230
	Total depth (August 8, 1902)		–230

951. Mr Oscar Shanks has furnished the following samples from this well

Samples from asylum well, Pineville, Rapides Parish, La

		Feet	
1	Medium to coarse reddish-yellow quartz sand	20–	24
2	Fine white indurated sand	24–	35
3	Very fine light-gray sandy silt	52–	92
4	Clay conglomerate, composed of small rounded clay pebbles containing considerable lime	228–	324
5	Fine-grained white sand	324–	328
6	Light-gray clay with rounded calcareous clay pebbles	328–	428
7	Hard gray fine-grained quartzitic sandstone	455–	461
8	Green clay	461–	540
9	Green clay and fine gray sand	540–	610
10	Green clay and fine gray sand, with numerous thin calcareous plates that resemble shell fragments, but which can not be definitely proved to be of organic origin	610–	650
11	Greenish-gray clayey sand	720–	800
12	Medium white sand, with a little clay	800–	806
13	Very fine gray clayey sand	806–	925
14	Rounded white calcareous concretions, lignite, and gray laminated lignitic sand	927–	
15	Greenish clay, lignite, and sand a few thin white calcareous plates similar to those in sample 10	925–	985
16	Fine greenish-gray sand	985–	1,020

952. *Section of well at Judge Morrow's residence, near Rapides, Rapides Parish, La.*

[By C. A. Morrow.]

Port Hudson		Feet
1	Soil	0– 8
2	Red clay	8– 77
3	Sand	77–102
4	Gravel	102–106

953. *Partial section of deep test well near Rapides, Rapides Parish, La.*

[By C. A. Morrow.]

Port Hudson		Feet
1	Soil	0– 8
2	Red clay	8– 77
3	Sand	77–102
4	Gravel	102–108
Catahoula		
5	Clay	108–180
6	White sand, water bearing, water soft and pure and did not overflow	180–
7	Artesian water	288–
8	Quicksand, which forced its way up in the pipe 80 feet and caused the well to be abandoned	323–

956. *Section of well of J. A. Bentley Lumber Company, Zimmerman, Rapides Parish, La.*

[By J. A. Bentley.]

Port Hudson		Feet
1	Alluvial deposits	0 – 60
Catahoula		
2	Soft rock and clay, alternating	60 –175.5
3	Rather coarse white sand, containing artesian water	175.5–

960. *Partial section of well at Lake End, Red River Parish, La.*

[By Charles Stoer.]

Port Hudson		Feet
1	Clay soil	0–
2	Quicksand	
3	Gravel	– 64
Sabine		
4	Rock	64–
5	Clay	– 77
6	Lignite	77– 85
7	Fine sand, with turbid water	85–
8	Rock	115–116
9	Fine sand, water bearing	116–
10	No record	–287.5

Casing, 4-inch, 0–85 feet; 2.5-inch, 85–168 feet. Water was brackish and well is not used.

966. Mr. W. A. Shields, superintendent, reports water bearing sand at the following depths: 188–190, 220–230, 251–264, 436–444, 460–462, 505–507, 524–528, 536–540, 545–549, 560–566, 670–704 feet. Screens have been placed opposite each of these layers. At 454 and 557 feet a little oil is reported. Mr. L. B. Clifford, the driller, states that seven beds of lignite were encountered in this well.

Mr. Robert Moechel reports the following: "Reaction, faintly alkaline to litmus. Appearance, turbid, with brown sediment. Microscopically, the sediment showed the presence of refuse matter. The water after twenty-four hours' sedimentation contained the following:

Analysis of water from deep well at Loring, Sabine Parish, La

[By Robert Moechel]

	Parts per million
K_2O	15 91
Na_2O	25 66
Cl	27 00
SO_3	15 45
NO_3	1 77
SiO_2	50 20
Al_2O_3 (in clay)	1 20
$Fe_2O_3+Al_2O_3$	7 10
CaO	2 68
MgO	1 44
SO_3	1 47

HYPOTHETICAL COMBINATION

Sodium chloride	43 66
Potassium sulphate	27 79
Sodium sulphate	94 94
Sodium nitrate	2 43
Sodium carbonate	4 30
Silica+clay	51 40
Iron+alumina	7 10
Calcium sulphate	2 49
Calcium carbonate	2 94
Magnesium carbonate	3 02

"Suspended and settled matter contains 531 2 parts of solid matter per million, composed of 42 9 parts mineral matter, quite a per cent of which is phosphates

"This is not a mineral nor sanitary water analysis Determinations have been made so as to be able to render an intelligent opinion as to the suitability of this water for economically generating steam, etc This water contains sewage"

From a knowledge of the location and surroundings of this well, the writer is inclined to believe that the water is not contaminated Water derived from these lignitiferous beds containing considerable organic matter and chlorine must necessarily show characteristics which are in other regions interpreted as indicating sewage This well is situated on a knoll with no polluting source near it, is cased and the water sands amply protected by clayey layers So far as the possibilities of pollution are concerned the deep-well water is greatly to be preferred to the water from the shallow wells which are now exclusively used at this place for the supply of drinking water

969. *Section of Foster well, 2 5 miles southwest of Negreet, Sabine Parish, La*[a]

[By William Kennedy]

		Feet
1	Soil and clay	0- 18
2	Quicksand	18- 23
3	Blue clay, changing to blue shale	23- 50
4	Blue limestone	50- 52
5	Blue clay, with bowlders, first sign of oil at 75 feet	52- 75
6	Blue shale, oil signs, and plenty of gas	75-200
7	Lignite	200-205
8	Blue shale and gas	205-340
9	Brown gummy shale, oil on water	340-350
10	Blue shale, with oil and gas	350-430
11	Slate-colored talcky rock	430-494

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[a] Bull U S Geol Survey No 212, 1903, p 55

		Feet
12	Bluish-gray lime rock, very hard, gas blew out drillings	494–502
13	Tan-colored shale, with yellow sand	502–542
14	Milky-white talcose rock	542–580
15	Blue shale, with small white pebbles	580–600
16	Blue, hard, and flinty limestone, gas under this rock	600–604
17	Shells and pebbles, with strong indications of oil and much gas	604–630

971. The water-bearing layer at 160 feet is very thin, and was developed by pumping sand out until a sufficient cavity was made to yield a fair supply of water There is no strainer in the well

972. *Analysis of water from Ferrell's mineral well, near Pleasant Hill, Sabine Parish, La*

[By Maurice Bird]

	Parts per million
Silica	61 56
Peroxide of iron and alumina	10 26
Calcium	875 52
Magnesia	1, 134 02
Potash	3 42
Sodium	884 07
Sulphuric anhydride	3, 062 61
Chlorine	2, 110 14
Carbonic acid	206 91
Oxygen absorbed from potassium permanganate in three hours	1 642

HYPOTHETICAL COMBINATION

Sodium chloride (common salt)	2, 241 1
Calcium chloride	1, 162 8
Calcium sulphate	1, 368 0
Magnesium sulphate	3, 231 9
Magnesium bicarbonate	171 0

"On ignition, the residue obtained from evaporation fuses and darkens, quickly becoming white, however The water is perfectly clear and colorless and does not contain sufficient organic matter to make it unwholesome The mineral ingredients of this water are so high that it may properly be called a medicine, and for this reason it should be used only in cases of sickness, and then only upon the prescription of a physician who is acquainted with its composition The reaction of the water with litmus is slightly acid "

974. Mr Coxe, superintendent, reports that a small vein of lignite was encountered at about 75 feet, and that three water-bearing sands were encountered between 100 and 195 feet, the one between 100 and 120 being the thickest of the three

975. *Section of well of Latannier Oil Company, 12 miles south of Melville, St Landry Parish, La*

[By Oscar Shanks]

		Feet
1	River deposits	0– 20
2	Blue clay	20– 150
3	Gravel and bowlders	150– 232
4	Hard blue flinty rock	232– 336
5	Caving brown gravel	336– 532
6	Hard blue flinty rock	532– 537
7	Coarse blue sand, with a large flow of pure soft water	537– 555
8	Gumbo shale	555–1, 452
9	Pepper-and-salt sand, with a strong flow of water having a slight sulphur taste	1, 452–1, 458
10	Strata of gumbo and rock containing strong artesian sulphur water	1, 458–2, 003

Occasional layers of sand and shells are reported in stratum 10

978. *Sections of test borings in Ouachita River at Loch Lomond, Union Parish, La* [a]

BORING NO 22

		Depth in feet
1	Brown sand, with small percentage of gravel	0 00
2	Greensand marl, with medium percentage of clay	20 47
3	Greensand marl, with small percentage of clay	34 48
4	Very stiff greensand and mud	42 16
5	Very stiff greensand and mud	50 00

BORING NO 22a

1	Brown sand and mud	0 00
2	Brown sand, with small percentage of gravel	0 99
3	Greensand marl, with large percentage of clay	13 88
4	Greensand marl, with small percentage of clay	32 68
5	Very stiff greensand and mud	39 37
6	Very stiff greensand and mud	50 00

982. *Analyses of brines from Bistineau Salt Works, Webster Parish, La* [b]

[By Maurice Bird]

Constituents (in parts per hundred)	Bryan's well	Potters Pond	Head of Salt Island
Sodium chloride	8 450	7 810	3 800
Calcium chloride	234	301	081
Magnesium chloride	102	156	083
Alumina	056	052	056
Other solid matter	088	061	058

983. *Section of well of Valley Lumber Company, Cotton Valley, Webster Parish, La*

[By L B Clifford]

		Feet
1	Red clay	0– 40
2	Red sand	40– 45
3	Blue clay and rock	200–245
4	White sand	245-271

985. *Section of well of Minden Lumber Company, Minden, Webster Parish, La*

[By C L Whitmarsh]

Sabine

		Feet
1	White clay	0– 20
2	Fine sand	20– 70
3	Clay	70– 71
4	Lignite (1 foot thick)	71– 72
5	Sand and clay	72–110
6	Coarse white water-bearing sand	110–120
7	Clay	120–244
8	Lignite	244–247
9	Water-bearing sand, increasing in coarseness with depth	247–317

986. Mr L B Clifford states that the sand encountered in this well at 110 feet, which furnishes water at the ice factory, yields practically no water at this point

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[a] Ann Rept Chief of Engineers for 1902, pt 2, 1902, p 1566.

[b] Geol Survey Louisiana, Rept of 1902, p 89

988. *Section of well of Minden Cotton Oil and Ice Company, Minden, Webster Parish, La.*

[By S G Webb, president]

	Feet.
Sabine?	
1 Surface sands and clay	0– 60
2 Sand	60– 75
Sabine	
3 Dark-colored clay	75–100
4 Water sand	100–115

989. The water from the lower layer in this well is shut out and the well draws entirely from the stratum between 228 and 270 feet Both horizons furnish good soft water

990. Mr A L Pullin states that he worked on this well until it reached a depth of 750 feet and that the well was afterwards drilled to a depth of 1,015 feet He gives the following partial record

Partial record of well at Yellow Pine, Webster Parish, La

[By A L Pullin]

	Feet
1 Log at	280–
2 Layers of rock	
3 Marl that looks like slack lime	600–640
4 Rock	640–680
5 Blue clay, with a very offensive smell	680–750

"No water was encountered to a depth of 750 feet Casing, 4-inch, 0–500, 3-inch, 500–750 "

Mr H C Walter, woods foreman for the Globe Lumber Company, who was at Yellow Pine when the well was drilled, gives the total depth as 800 feet He says "The matter passed through was a black sticky clay, with a very bad odor, and was full of shells of all kinds In some places the clay changed to very hard rock At a depth of 500 feet a log was struck which was supposed to be a cypress They finally struck a very hard substance, which effectually stopped work with a rotary rig "

991. *Section of well of Texas and Pacific Railway, Baton Rouge Junction, West Baton Rouge Parish, La*

[By Charles Anderson]

	Feet
1 Black clay	0– 10
2 Heavy clay	10–100
3 Quicksand	100–110
4 Coarse sand, not passed through	110–

994. *Analyses of brines from Drakes Salt Works, Winn Parish, La* [a]

[By Maurice Bird]

Constituents (in parts per hundred)	I	II	III	IV
Sodium chloride	4 90	3 55	5 58	5 44
Calcium chloride	184	127	303	356
Magnesium chloride	142	133	135	159
Alumina	061	066	072	055
Other solid matter	083	044	070	030

I Little lick, west side, old Drake well ,
II Smith's lick
III Lower lick, old Drake well
IV Upper lick, south side, in slough

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[a] Geol Survey Louisiana, Rept of 1902, pp 63–64

995. *Analysis of brine from Prices Salt Works, Winn Parish, La* [a]

[By Maurice Bird]

	Per hundred
Sodium chloride	3 14
Calcium chloride	079
Magnesium chloride	138
Alumina	050
Other solid matter	030

999. This well was largely through porous crystalline limestone similar to that seen in a number of Cretaceous exposures in northern Louisiana. Between 250 and 260 feet a large amount of gas was encountered, which was used for fuel in the engines of the drilling machines The well was finally abandoned because of the heavy gas pressure, and the company planned to start a new hole in January, 1904 Two small oil-bearing layers are reported

1001. Mr L B Hart reports that a very hard rock was encountered in this well at a depth of 160 feet

1008. *Approximate section of well at Port Gibson Waterworks, Port Gibson, Claiborne County, Miss*

[By I H Fessell]

		Feet
1	Red and blue clay	0- 60
2	Quicksand	60-100
3	Coarse sand and gravel	100-130
4	Hard rock	130-140
5	Clay	140-165
6	Fine blue sand	165-205
7	Stone	205-213
8	Water-bearing sand	213-260
9	Rock	260-

1013. Analysis of the water shows it to be too alkaline for boiler purposes

1014. *Partial analysis of water from city well at Tchula, Miss*

	Parts per million
Solids	575 586
Sodium carbonate	516 112
Soluble silica	10 561

1016. Hilgard [b] gives the following data regarding this boring

"The Mayersville boring No 1 does not differ in any way from those of the Choctaw bar Down to 30 1 feet the material seems to be entirely of the usual character of alluvium, thence to 118 6 feet the character is the same as elsewhere—first a stratum of finer sands, then gravelly sand and larger pebbles These 88 5 feet undoubtedly belong to the older (Port Hudson) beds Whether the brownish clay penetrated between 118 6 and 132 9 feet is of Tertiary age the data are not sufficiently definite to determine, but this seems to be the most probable conclusion

1039. Doctor Walker, president of the Merchants and Planters' Bank, gives the following record of the waterworks well, which was put down for a private company of which he was president

Section of waterworks well, Greenville, Washington County, Miss

	Feet
Alluvium and Port Hudson	
1 Surface soil	0- 75
2 Hard blue clay	75-125
3 Quicksand, passing below into sand and gravel, water bearing, but water not good	125-200
Jackson and Cockfield	
4 Blue clay	200-400
5 Sand, growing coarser below, and becoming water bearing	400-500

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[a] Geol Survey Louisiana Rept of 1902, p 69

[b] Ann Rept Miss River Com for 1883 48th Cong , 1st sess , House Ex Doc No 37, 1884, p 496

"The water rises to within a few feet of the surface, and is now pumped with an air lift and yields about 350 gallons per minute, when well was first completed, it tested 500 gallons per minute, the water lowering to about 30 feet below the surface "

There are three 8-inch wells at the waterworks, situated within 200 feet of each other, and the engineer states that pumping one does not affect the water level in the others The first well was completed about 1889

Analysis of city water at Greenville, Miss

[By J W Mallett]

	Parts per million
Sodium	114 5
Potassium	4
Calcium	9
Magnesium	5
Aluminum	4
Iron	6
Carbonic acid (CO_3)	130 1
Chlorine	26 2
Sulphuric acid (SO_4)	3 2
Silica	12 4

1041. *Section of test boring at Greenville, Miss*[a]

[By E W Hilgard]

		Feet
Port Hudson		
1	Yellowish noncalcareous silt	0 - 2 4
2	Light-yellow sand or silt	2 4-10
3	Coarse sand mixed with silt and grains of lignite	10 -21 5
4	Bluish clayey silt, with lignite grains	21 5-22 8
5	Coarse white sand	22 8-26 9
6	A sandy brownish-blue clay, with lignite grains	26 9-28
7	Coarse white sand like that at 22 8	28 -50 2
8	Sandy blue clay, as at 26 9	50 2-53 5
9	Coarse gravelly sand, as at 28	53 5-64
10	Coarse gravelly sand like the last	64 -90
"Claiborne Tertiary" (Jackson)		
11	Greensand marl	90 -96

1047. *Section of well of Capt Z P Stutts, 1 mile north of Yazoo City, Yazoo County, Miss.*

[By A F Daris, driller]

		Feet
1	Soil and yellow clay	0- 50
2	Coarse gray sand, with water	50- 65
3	Alternate layers of gray fine muddy sand and clay	65-150
4	Gray sand rock, interbedded with sand containing water	150-550
5	Hard, tough clay	550-620
6	Soft black clay	620-626
7	Rock and clay	626-635
8	Gray sand, with artesian water	635-

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[a] Ann Rept Miss River Com for 1883 48th Cong, 1st sess, House Ex Doc No. 37, 1884, p 491

1051. *Section of well No. 1 of Palestine Water and Power Company, Palestine, Anderson County, Tex.*

	Feet.
1. Pipe clay, alternating with sand	0– 30
2. "Fire clay"	30– 60
3. Lignite	60– 70
4. Clay and sand	70–130
5. Sandstone	130–
6. Sand and clay	–230
7. Rock	230–235
8. Water-bearing sand	235–280
9. Rock	280–
10. Water-bearing sand	–440
11. Rock	440–444

The second well showed about the same material. In wells Nos. 3 and 4 no rock was found and the wells soon caved.

1054. Old salt works on both sides of the river at the Nancy Lang League, 3 to 4 miles below the Texas and New Orleans Railroad bridge. Twelve ruined furnace sites were seen here in 1902.

1056. It is reported that the driller contracted for a flowing well, and when one was not obtained the well was abandoned. From the depth it is quite probable that some of the Sabine water-bearing sands were penetrated, which would have furnished an abundant supply to pumps.

1059. *Section of well of S. L. Moore, at mouth of Mill Creek, Bowie County, Tex.*

	Feet.
1. Quicksand	0– 60
2. Very white limestone	60–360
3. Rock and sand, with very little water	360–425

1065. *Section of well at post-office, Rolyat, Bowie County, Tex.*

	Feet.
1. Clay and sand	0– 27
2. Pipe clay and sand	27– 37
3. Dark-blue clay, with a little sand	37– 70
4. Hard blue clay	70– 71
5. Blue clay and sand	71–119

1066. *Section of well of J. H. Williams, near Rolyat, Bowie County, Tex.*

	Feet.
1. Soil	0 – 1.5
2. Sand	1.5– 22
3. Black clay	22 –138
4. Blue packed sand	138 –140

Wells in this section average 125 feet deep.

1067. *Section of well of Texarkana Ice Company, Texarkana, Bowie County, Tex.*

	Feet.
1. Surface gravel and sand	0–30
2. White clay	30–33
3. White sand, water-bearing	33–63

This well differs from most of the wells in this town in the fact that it obtains its water supply from the Sabine sands rather than from surficial gravels.

1068. This well is described as having been put down at a point one block north and two blocks west of Union station. Water is reported at 136 feet, but it is stated that this was cased off and the boring was continued to 550 feet, where water was found in a sand rock. As neither of the deep wells in the northern part of the town show this stratum and it is entirely absent in the same formations to the eastward along the

Iron Mountain Railway and westward in Texas, it must be regarded as an extremely local occurrence The more natural source for this water is from the Sabine sands at a depth of about 100 feet

1069. *Section of test well at creosote plant, 3 miles southwest of Texarkana, Bowie County, Tex*

		Feet
1	Silt and gravel	0–60
2	Black clay	60–65

1084. Mr Wells writes "The Longview Ice Company gets about 80 gallons per minute from a well bored by the Texas and Pacific Railway Company, but not used by them because it makes their boilers foam It was supposed to be bored 700 feet deep, nitroglycerine was exploded about halfway down, and the present supply comes from that depth We (the Longview Ice Company) bored two wells there a year ago about 80 feet deep, the last 45 feet being through sand These wells yielded abundantly without strainers, but insisted on caving With strainers the sand is too fine and chokes the yield to about 25 gallons per minute We have had very little benefit from them The water stands about 50 feet from the top of the ground "

Maj B S Wathen, chief engineer of the Texas and Pacific Railway, writes "There was a deep well put down at Longview in 1892 a little over 500 feet Several veins of water were struck, but none were very strong Some lignite was struck, which made the water undesirable for locomotive purposes "

1085. Mr E L Wells, manager, reports "The ice company has three wells located about 15 feet from one another Two of these are finished with 30-foot Cook well strainers with very fine slots and one with a 20-foot strainer A 4-inch pipe with a 7 25-inch drill was used in boring the wells The first well was tested with a 4-inch boring pipe and air and yielded 3 barrels per minute The well was then cased with a 6-inch pipe, including strainer, and yield was only 1 barrel per minute It is probable that this was due to the strainer, but may have been partly caused by the fact that the 4-inch pipe was drawing water from the water-bearing strata between 60–100 and 150–180, while the 6-inch pipe was big enough to fill the hole and case off the upper stratum "

Section of well of Arkansas and Texas Consolidated Ice and Coal Company, Marshall, Harrison County, Tex.

[By E L Wells]

		Feet
1	Dirt and clay	0– 60
2	Water-bearing sand	60–100
3	Clay	100–150
4	Water-bearing sand	150–180
5	Rock	180–181
6	Clay	181–208
7	Rock	208–

1089. *Analysis of spring No 1, Roseborough, Harrison County, Tex*[a]

[By J H Herndon]

	Parts per million
Chloride of sodium	195 83
Sulphate of lime	626 15
Sulphate of magnesia	395 40
Sulphate of iron	282 10
Sulphate of soda	148 257
Sulphate of alumina	109 25
Silica and insoluble matter	93 76
Sulphate of potash	67 17

Free carbonic acid gas, 15 19 cubic inches per gallon

"Temperature at well, 68° Specific gravity not determined The water has a strong acid reaction and is of a pale amber color On reaching the laboratory a large amount of the iron had become oxidized and precipitated The jug containing the water was well shaken and portions taken for analysis "

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[a] Second Ann Rept Geol Survey Texas for 1890, 1891, pp 158–159

1091. *Partial section of well of J. Roseborough, 9 miles south of Marshall, Harrison County, Tex.*

	Feet.
1. Lignite	20–25
2. Water-bearing sand.	
3. Lignite	200–225
4. Water-bearing sand	350–

1092. *Analysis of Montvale Springs, 16 miles from Marshall, Harrison County, Tex.*

[By L. E. Magnenat.]

	Parts per million.
Bisulphate of potash	22.35
Bisulphate of soda	10.41
Sulphate of lime	26.78
Carbonate of lime	12.36
Carbonate of iron	14.43
Alumina	Trace.
Silica and insoluble matter	32.90
Chlorine	Trace.

Free carbonic acid gas, 15.52 cubic inches per gallon. Temperature at well, 65° F. This water has a light acid reaction.

1093. *Section of well at Sulphur Springs, Hopkins County, Tex.*

[By Wm. B. Baxter.]

	Feet.	
1. Surface soil	0	– 1
2. Red clay	1	– 9
3. Lignite	9	– 11
4. White sand, with water	11	– 15
5. Sandy blue shale	15	– 33
6. Buff sandstone	33	– 35
7. Pipe clay	35	– 37
8. Black shale, with mica	37	– 117
9. Limestone	117	– 118
10. Black shale, alternating with lighter shale, bowlders, pyrites, and mica, with iron concretions	118	– 683
11. Hard limestone	683	– 684
12. Black shale; fossil stratum of 1 inch	684	– 704
13. Light shale	704	– 712
14. Blue shale	712	– 800
15. Black shale, pyrites, bowlders, and fossils (reported as "*Cardita planicosta*")	800	– 810
16. Blue shale	810	– 900
17. White clay	900	– 920
18. Blue shale	920	–1,000
19. Hard limestone	1,000	–1,004
20. Blue shale	1,004	–1,034
21. Fine sand, with water	1,034	–1,036
22. Soft white clay	1,036	–1,051
23. Gray sandstone	1,051	–1,091
24. White pipe clay	1,091	–1,093
25. Sandstone	1,093	–1,108
26. Hard blue shale	1,108	–1,110
27. Soft sandstone	1,110	–1,123
28. Hard sandstone	1,123	–1,125.5

		Feet
29	Hard blue shale, sand, and mica	1,125 5–1,130 5
30	Fine gray sand	1,130 5–1,131 5
31	Very hard sandstone	1,131 5–1,132 8
32	Hard blue shale	1,132 8–1,303 8
33	Sand and water	1,303 8–1,317 8
34	Blue shale and sand	1,317 8–1,413 8
35	Blue shale and sand, with mica	1,413 8–1,514 8

1095. This mill is now moved, and the well is no longer used Mr Martin states that he supposed that several water-bearing layers were cased off

1098. Kennedy[a] gives the following regarding this well "The drill passed through alternate strata of sands, clays, and lignites to a depth of 802 feet Three heavy beds of lignite and a number of smaller ones are said to have been passed through in the boring "

1099. "We bored about 45 feet and struck a black dirt, as black as coal, below which we found a very good water We dug deeper and struck a very bad water, which forced us to abandon the well "

1100. *Section of well of Mammoth Oil, Mineral, and Land Company, Chireno, Nacogdoches County, Tex*[b]

		Feet
1	Red fossiliferous marl containing *Ostrea sellæformis* and *Anomia ephippioides* in upper portions, below changes to blue-gray marl.	0–110
2	"Oil sand," this outcrops to the north at the base of the Claiborne.	110–112
3	Blue to gray fossiliferous marl	112–382
4	White quicksand, strong flow of artesian water	382–462
5	Dark-gray lignitic clay	462–468
6	Lignite	468–477
7	White quicksand	477–515
8	Lignite	512–522
9	Gray-blue sand, with very small shell fragments, layer of pyrites 3 inches thick at base	522–562
10	Blue micaceous sand, fragments of shells reported, but sample shows only glittering particles of mica	562–632
11	Hard fossiliferous green sand	632–636
12	Dark-green sand	636–676
13	Soft dark-gray lignitic clay	676–736
14	Chocolate to yellow laminated clay	736–826
15	Indurated gray sand	826–836
16	White clay	836–840
17	Gray sand, with a little oil	840–865
18	Hard sand	865–873
19	Hard rock, not passed through	873–877

1102. "Within the limits of the town of Garrison is a spring which is frequented by persons who believe they derive benefit from the use of the water The property has been recently improved by excavating about 7½ feet and building a circular wall about 3 feet in diameter, capped with a heading of hydraulic cement Over this is an octagonal pavilion of wood, about 30 feet in diameter A company has been formed with a project for building a $5,000 hotel, with half the capital subscribed in town The water is from the main water-bearing sand, which overlies the lignite The water belongs to the chalybeate class, and judging from its taste, apparently contains iron, magnesia, alumina, carbonic acid, and perhaps a little free sulphuric acid derived from the decomposition of iron disulphide (pyrites) "[c]

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[a] Proc Phila Acad Nat Sci for 1895, 1896, pp 136–137

[b] Geol Survey Louisiana, Rept of, 1902, pp 126–127

[c] Second Ann Rept Geol Survey Texas for 1890, 1891, p 270

1103. *Section of well on Day farm, 1 mile south of Melrose, Nacogdoches County, Tex.*[a]

		Feet
1	Red clayey earth	0 – 9
2	Bluish-green calcareous shell marl	9 – 70
3	Dark-green calcareous shell marl	70 –119
4	Dark-drab clay	119 –139
5	Light-drab clay, with iron pyrites	139 –255.5
6	Sand, with iron pyrites, containing "slush oil"	255.5–258
7	Dark-drab clay	258 –293
8	Calcareous marl, with sand streakings	293 –299
9	Sandstone	299 –302
10	Clay, with sand streakings and iron pyrites	302 –309
11	Dark bluish-green shell marl	309 –338
12	Dark-drab clay	338 –349
13	Marl	349 –352

1107. "The water has a deep-amber color, not unlike the color of whisky, is not styptic in taste, makes no rusty deposit, and therefore has little if any iron in solution, and there is no indication of any other metallic salt. The place has been noted as a neighborhood resort for about thirty-five years, and recently a few temporary cabins have been erected for the accommodation of visitors."[b]

1109. *Section of Dean well, 5 miles west of Valda, Polk County, Tex.*[c]

[By William Kennedy.]

Elevation 225 feet.

		Feet
1	Surface sands and gravels	0– 22
2	White sand	22– 36
3	Strong water sand	36– 95
4	Clay, with lime	95–140
5	Blue clay	140–160
6	Greenish clay, with water at 195 feet	160–195
7	Green shale	195–230
8	Green shale, with gravel	230–240
9	Quicksand	240–251
10	Quicksand, with lime and shells	251–284
11	Blue clay	284–292
12	Green shale	292–296
13	Shale	296–321
14	Soft green shale	321–325
15	Green clay	325–350
16	Greensand, with pyrites	350–384
17	Quicksand	384–400
18	Greensand	400–403
19	Blue clay	403–424
20	Green shale	424–430
21	Blue clay	430–460
22	Shale rich in iron pyrites	460–496
23	Dark shale	496–507
24	Light shale	507–520
25	Shale	520–530
26	Water sand	530–540
27	Gray sand	540–543

"This well has been drilled through the Frio clays (Fleming formation) into and almost through the Fayette sands (Catahoula formation). The Frio beds here apparently have a thickness of 145 feet, giving the Fayette beds a thickness of 303 feet."

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[a] Second Ann. Rept. Geol. Survey Texas for 1890, 1891, p. 286.

[b] Ibid., p. 251.

[c] Bull. U. S. Geol. Survey No. 212, 1903, p. 54.

1111–1112. Mr Frank B Mason, mayor of Clarksville, writes "We have one well on the public square, bored some years ago, which encountered gas and salt water Water shows 1 5 pounds of salt to 10 gallons of water Gas in quantity sufficient to light public square, if properly handled In the fall of 1902 the city completed two wells, which furnished an abundant supply of fresh soft water, slightly alkaline "

1115. Mr S J Wright reports that in this well no water was encountered beneath the surface vein from 20 to 28 feet Below this were layers of rock, varying in thickness from 30 to 50 feet, separated by layers of black muck resembling coal and lignite The rock is very easily drilled until the hard rock, which overlies the water-bearing sand is reached It was in this layer that Mr Wright's drill became fastened, and the well was abandoned

1120. *Section of well of East Texas Timber and Oil Company, 1 mile below Robinsons Ferry, Sabine County, Tex*

[By W A Turner, driller]

		Feet		
1	Soil	0	–	2
2	Yellow sand	2	–	35
3	Blue clay	35	–	55
4	Hard blue clay	55	–	95
5	Rock, with fossil shells	95	–	98
6	Blue shale	98	–	120
7	Hard blue clay	120	–	180
8	Rock, with fossil shells	180	–	185
9	Stiff blue clay ("gumbo")	185	–	230
10	Sand	230	–	238
11	Gumbo (stiff blue clay)	238	–	286
12	Soft sand	286	–	290
13	Gumbo	290	–	321
14	Sand	321	–	327
15	Rock	327	–	331
16	Lignite	331	–	335
17	Sand	335	–	360
18	Dark-brown clay	360	–	375
19	"Coal" (lignite)	375	–	380
20	Blue gumbo	380	–	442
21	Sandstone	442	–	460
22	Limestone	460	–	468
23	Blue gumbo	468	–	498
24	Sandstone	498	–	516
25	Very dark gumbo	516	–	550
26	Soft clay	550	–	580
27	Hard clay	580	–	640
28	Fossiliferous marl	640	–	649
29	Hard clay	649	–	650 5
30	Fossiliferous sandstone	650 5	–	665
31	Rock	665	–	666 5
32	Hard clay	666 5	–	684
33	Flint rock, very hard	684	–	685 5
34	Dark-colored shale	685 5	–	726
35	Soft sandstone	726	–	741
36	Gumbo	741	–	767
37	Soft sandstone	767	–	779
38	Shale	779	–	784
39	Soft sandstone, with shells	784	–	800
40	No record	800	–	1,010
41	Sand, with pleasant-tasting artesian water	1,010	–	1,030

		Feet
42	Clays, mostly dark colored, containing fossil shells of the Claiborne (Eocene) below 1,215 feet	1,030–1,350
43	Hard rock	1,425–
44	Artesian salt water	1,800–
	Total depth March 2, 1903	–1,975

On November 30, 1902, Mr Turner wrote "At about 1,030 feet we got some 15 to 20 feet of sand and when we bailed the well we got a good flow of pleasant-tasting water It boiled about 1 foot above the top of the 6-inch casing, but would soon choke with sand When the flow weakened some gas would be noticed with the water Below 1,030 feet the formation was different clays, etc , mostly dark colored, but there was nothing that could be called sand until 1,350 feet was reached We put in 1,215 feet of 6-inch casing and bailed again Result, considerable gas and the hole filled to within 300 feet of the surface with clay shale and thick mud, no sand, the mud might be called greasy The shells which I send you came from the hole after putting in the 6-inch casing and washing and bailing They certainly came from below 1,215 feet "

These shells were referred to Dr W H Dall, who reported "They are of the horizon of the Claiborne sands, or mid-Eocene, and the specimens contain fragments of half a dozen characteristic Claibornian species "

Just north of this well there is a good exposure of fossiliferous Jackson marl in the river bank which definitely determines the fossiliferous beds encountered in the upper part of this well to be of Jackson age The lignitiferous clays below are clearly Cockfield The lignite beds suggest the impure lignite found in Lawhorn Bluff, and if in exactly the same stratigraphic position, indicate a depth of 82 feet per mile

The strong flow of salt water at 1,800 feet suggests the artesian sand encountered in wells in San Augustine (1122), Nacogdoches (1100, 1101, 1106), and Cherokee (1076) counties at 200 to 300 feet below the base of the Claiborne, and should probably be so correlated

The artesian sand encountered at 1,030 feet suggests the widespread horizon which in Pl XXXVII, sec F, is considered as basal Cockfield, although here overlain by fossiliferous beds which indicate that it is probably a part of the Claiborne and that, as Vaughan has already suggested, the basal Cockfield should be so correlated It is more or less synonymous with the uppermost Claiborne water horizon of Mississippi [a]

1127. *Partial section of well of Col W S Herndon, Tyler, Smith County, Tex*

		Feet
1	Blue clay	0–300
2	Sandstone, very hard	300–302
3	Sand	302–
4	Clay	
5	Sand, not water bearing	
6	Clay	
7	Sand	

1129. Dr A A Patten reports "The city of Mineola bored a well 1,200 feet deep, 6 inches in diameter down to 600 feet, and 3 inches in diameter below that point The record from 600 to 1,200 feet was not well kept " The section down to 600 feet is given below

Section of well at Mineola, Wood County, Tex [b]

		Feet
1	Top soil	0 – 1
2	Red clay	1 – 12
3	Gray or white sand, with water	12 – 20
4	Brownish-black clay	20 – 25
5	Brown clay	25 – 35
6	Blue clay	35 – 50
7	Brown clay, sand, and mica	50 – 66
8	Lignite, sand, and iron pyrites	66 – 70
9	Sandstone, with water	70 – 71

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[a] See Jackson well (Pl XLIII, sec I), and Johnson, L C , Water-Sup and Irr Paper No 102, U S Geol Survey, 1904, pp 342, 343, 353, well No 156

[b] Dumble, E T , Report of the brown coal and lignite of Texas Geol Survey of Texas, 1892, pp 132-135

		Feet	
10	Blue clay or mud	71	- 75
11	Gray sandstone, with water	75	- 80
12	Blue clay	80	-100
13	Potter's clay	100	-110
14	Sandstone, with water	110	-115
15	Gray or blue clay	115	-115.5
16	Sandstone, with water	115.5	-125
17	Bluish-gray clay and pyrites	125	-170
18	Bluish-gray clay, with some sand	170	-180
19	Blue clay, with limestone bowlders	180	-200
20	Gray sand	200	215
21	Black clay, with limestone, pyrites, etc.	215	-221
22	Dark limestone	221	-223
23	Gray sand and mica	223	-228
24	Black and blue clay, mica, and pyrites	228	-229
25	Gray sand, mica, brown clay, and water	229	-235
26	Sandstone, with water	235	-239
27	Brown-black clay	239	-265
28	White clay	265	-270
29	White or gray sand, mica, and pyrites, with water	270	-280
30	Lignite	280	-281
31	White clay, with thin strata of sand, with water	281	-300
32	Brown clay and white sand	300	-310
33	White sand, with water	310	-320
34	Brown clay and lignite	320	-340
35	Brown joint clay	340	-342
36	Gray sand	342	-350
37	Gray sand and lignite	350	-360
38	Gray sand and pyrites	360	-370
39	White sand	370	-375
40	Grayish-white sand and black mud	375	-380
41	Coarse white sand, with grains of lignite and water	380	-400
42	Brown clay	400	-405
43	Lignite	405	406
44	White sand, very coarse, with water	406	-408
45	Lignite	408	-411
46	Gray clay	411	-413
47	Grayish-white clay	413	-416
48	Brown clay	416	-421
49	Dark-brown clay	421	-422
50	Black mud	422	-424
51	Black mud, sand, and lignite	424	-426
52	Iron pyrites and black mud	426	-430
53	Black-brown clay and pyrites	430	-460
54	Lignite	460	-475
55	Black-brown clay	475	-480
56	Gray sand, with water	480	-490
57	Lignite	490	-495
58	White sand, with water	495	-505
59	Dark-brown joint clay	505	-515
60	Gray sand, mica, and water	515	-530
61	Dark-brown clay	530	-550
62	Grayish-blue clay	550	-575
63	Dark-brown clay	575	-595
64	Joint clay and sand at bottom of boring	595	-600

CHAPTER VI.

DICTIONARY OF ALTITUDES IN SOUTHERN ARKANSAS AND NORTHERN LOUISIANA.

INTRODUCTION

Relative elevations are of such importance in the solution of problems relating to underground waters that a list of altitudes becomes an imperative necessity in such investigations.

This region is particularly fortunate in having a very complete net of precise levels, from which railroad elevations can be so corrected that the error at any point is comparatively small In order that this error may be decreased still further a discussion of the nature of the corrections applied in the compilation of this dictionary is given below, from which a readjustment will be possible when more data are accumulated

In connection with the field work about 100 miles of reconnaissance levels were run, the results of which are given in the table of wells (Chapter V), to which the reader is referred for additional elevations

SOURCES OF DATA

ALEXANDRIA AND WESTERN RAILROAD

Elevations accredited to this source are from a small-scale profile, kindly furnished by Ira W Sylvester, C E., of Alexandria, La , of a preliminary line running from Alexandria to the junction of the Quelqueshoc (also called Calcasieu River) and Cypress bayous in T 2 N , R 4 W , thence through Walnut Hill to about the present site of Orange and southward to a point on Sabine River about 1 mile south of Toledo. As this survey started from the United States Engineers bench mark at Alexandria the only correction applied was that necessary to reduce Cairo datum to mean Gulf level (−20 280 feet) Because of the small scale of the profile the elevations have an error of ±10 feet This line was of very great value in controlling the topography shown on the geologic map (Pl III, in pocket)

ARKANSAS AND LOUISIANA RAILWAY

Data from this source were obtained from the profiles in the office of H. Rohwer, chief engineer of the Missouri Pacific system, at St Louis

The correction applied was obtained as follows.

Grade elevation of first bridge north of Hope	Feet
Line of levels from United States Geological Survey bench mark on bank building	337
From profile	84
Difference	+253

ARKANSAS SOUTHERN RAILROAD

These elevations were taken from the fragmentary original field profiles in the company's office at Ruston, La , September 26, 1902. They have been corrected in accordance with the following data:

Top of rail, Vicksburg, Shreveport and Pacific crossing	Feet
Line of levels from United States Engineers bench mark	304 47
Arkansas Southern profile	313 60
Difference	−9 13

These levels, as a whole, can be regarded as only approximate At Winnfield a rough comparison indicates that the Arkansas Southern levels, as corrected, are 5 feet higher than those of the Arkansas and Louisiana Railway This additional correction was not used, however, because of its uncertain value.

ARKANSAS SOUTHWESTERN RAILWAY

These elevations were obtained from fragmentary profiles in the office of the superintendent at Gurdon, Ark The correction applied was obtained as follows

	Feet
Corrected elevations St Louis, Iron Mountain and Southern Railway at Smithtown	210 6
Profile elevation Arkansas Southwestern Railway at Smithtown	279
Correction	−69 6

HOUSTON AND SHREVEPORT RAILROAD

These elevations were received from Mr. I A Cottingham, engineer maintenance of way, in 1904. The approximate correction applied depends on the following

Grade elevation Kansas City Southern and Houston and Shreveport crossing	Feet
From corrected Kansas City Southern profile	234
From Houston and Shreveport levels	228 5
Correction	+5 5

KANSAS CITY SOUTHERN RAILWAY

Elevations accredited to this source are of two classes:

1 Those marked "P" are from a line of levels beginning at the United States Coast and Geodetic Survey bench mark on the Hannibal and St. Joseph Railroad bridge at St Joseph, Mo , and running along the track of the Kansas City Southern Railway to Lake Charles, La , and Port Arthur, Tex This line was run after the railroad was built. Rail end benches were placed every half mile The error of closure with the top of boss of the United States Engineers bench mark in the post-office yard at Shreveport, La., was as follows:

	Feet
Elevation corrected by Hayford[a]	199 744
Elevation according to Kansas City Southern precise levels	201 785
Difference	−2 041

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[a] Ann Rept Supt Coast and Geodetic Survey for 1899, 1900, pp 493, 670

In the elevations given in the accompanying table, which extend from Gillham, Ark , to De Ridder, La , this correction has been applied as a constant, no attempt having been made to distribute the error

2 The elevations marked "R" are from the profiles made at the time of the construction of the road, those in Arkansas from copies in the office of the district engineer at Texarkana, and those in Louisiana from copies furnished by the chief engineer to the Geological Survey of Louisiana Corrections for the profiles south of Texarkana depend upon the following

	Feet
At Shreveport, La [a]	
Zero city datum (161 27 feet Cairo datum —7 18 feet) [b]	133 81
Zero city datum (Kansas City Southern profile levels)	221 9
Difference	—88 1
At Mooringsport, La	
Drawspan Ferry Lake bridge (Kansas City Southern profile)	286
Top of rail, drawspan Ferry Lake bridge (elevation boss of United States engineer bench, Mooringsport, +11 730 feet)	198 933
Correction for top of rail elevation	—87 067

As these two lines show an essential agreement, a correction of −88 feet has been applied for ground level and −87 feet for top of rail.

KANSAS CITY, WATKINS AND GULF RAILROAD

The levels along this line have been taken from Bulletin No. 160, United States Geological Survey, without alterations, because no data giving correction value was obtained

LOUISIANA AND ARKANSAS RAILWAY

The elevations given are the corrected values received from the chief engineer, Col G. Knobel, September 2, 1904, which depend on the value of the Hope United States Geological Survey bench mark of 356 feet. As the corrected value of this bench is 356 8 feet, 1 foot has been added to all the elevations A comparison with the United States Engineer bench mark at Sibley (Lanesville), La , suggests that an additional correction of about +1 foot should be applied south of that point.

LOUISIANA RAILWAY AND NAVIGATION COMPANY (RED RIVER VALLEY RAILROAD)

These elevations were obtained from profiles in the office of the chief engineer at Shreveport, La , October, 1902

All elevations between Shreveport and Colfax have been changed by adding 2 7 feet, as a note on the profile at St. Maurice reads "Add 1 76 feet to reduce to M G D J M P" Since this depended on the old value for Cairo datum (−21 26 feet[c]), it is necessary to add to it 0 98 feet to reduce to the new value for Cairo datum (−20 28 feet[d]).

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[a] Geol Survey Louisiana, Rept for 1899 [1900], pp 203–204

[b] Ann Rept Chief of Eng for 1902, pt 2, 1902, p 1448

[c] Ann Rept Chief of Eng for 1893, 1893, p 2064

[d] Ann Rept Chief of Eng for 1902, pt 2, 1902, p 1448

Between Colfax and Bordelonville a correction of +0.91 foot has been applied, which depends on the following values:

	Feet
Alexandria to Colfax:	
High water at Alexandria, 1892—	
Profile of Louisiana Railway and Navigation Company	81.5
United States Engineers[a]	82.41
Correction	+0.91
Alexandria to Bordelonville:	
Elevation boss United States Engineers pipe-stone bench in old jail yard, Alexandria—	
Louisiana Railway and Navigation Company levels	74.00
United States Engineers[b]	74.918
Correction	+0.91

The same correction has been applied on the Colfax-Winnfield line.

MISSISSIPPI RIVER, HAMBURG AND WESTERN RAILWAY.

Data obtained from profile in office of H. Rohwer, chief engineer of the Missouri Pacific system, at St. Louis, February, 1903. The correction applied was derived from the following:

	Feet
Approximate elevation top of rail at Montrose from United States Engineers bench	124
Profile elevation at Montrose	163
Difference	−39

MISSOURI, KANSAS AND TEXAS RAILWAY.

The elevations accredited to this source are taken from a profile furnished in 1898 by Maj. B. S. Wathen, chief engineer of the Texas and Pacific Railway. The portion of the line from Shreveport to the Texas State line was at that time leased by the Texas and Pacific. The correction applied to reduce this to mean Gulf level depends on the following:

	Feet.
Elevation top of rail at Kansas City Southern crossing near Stockyards, Shreveport:	
Kansas City Southern corrected profile	238.9
Missouri, Kansas and Texas profile	239.5
Correction for top of rail elevation	−0.6

NEW ORLEANS AND NORTHWESTERN RAILWAY.

Data along this line were taken from the profiles in the office of H. Rohwer, chief engineer of the Missouri Pacific system, at St. Louis. A comparison of the stations below Rayville with the United States Engineers bench marks shows a correction of approximately +15 feet. This has been applied to all elevations.

OLD RIVER AND KISSATCHIE RAILWAY.

The elevations along this line were obtained from the general manager in September, 1902, and were corrected on the assumption that the elevation of the top of rail, Texas and Pacific Railway, at Old River station is 100 feet above sea level.

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[a] Ann. Rept. Chief of Eng. for 1893, 1893, p. 1982.

[b] Ann. Rept. Chief of Eng. for 1902, pt. 2, 1902, p. 1458.

PINE BLUFF AND WESTERN RAILWAY

Elevations along this line were furnished by Mr W T Radford, and covered not only the portion already built, but a portion of the preliminary survey toward Benton The correction applied was +1 feet

ST LOUIS, IRON MOUNTAIN AND SOUTHERN RAILWAY

Main line —The elevations from the Hot Springs-Clark County line to Texarkana are taken from a detailed profile kindly loaned by Chief Engineer H. Rohwer. Lines of levels from the United States Geological Survey bench marks at Gurdon, Prescott, and Hope give the following corrections for top of rail elevations

	Feet
Gurdon	+103 06
Prescott	+103 10
Hope	+103 03

The value, +103 1, has been taken

Little Rock to Alexandria, La (*"Valley Road"*) —The section of the profile from Pine Bluff northward has not been corrected other than to add 1 foot for top of rail elevation On this the elevation of the depot at Little Rock is given as 268 feet, the St Louis Southwestern crossing at Pine Bluff 227 feet, and the depot at Pine Bluff 214 feet

The section from Pine Bluff to McGehee has been corrected according to the following

	Feet.
Approximate elevation top of rail McGehee station[a]	150 0
Profile elevation McGehee station	147 5
Difference	+2 5

From Riverton to Alexandria elevations were taken from profiles dated October, 1895, and indorsed "Built in 1892" The correction depends on the following

	Feet
Near Riverton, Caldwell Parish, La	
Railroad bench mark at Smith Lake	72 16
Elevation of same, United States Engineers[b]	66 722
Correction	−5 4
Red River bridge at Alexandria	
High water June 11–14, 1902—	
Profile St Louis, Iron Mountain and Southern Railway	85 5
United States Engineers[c]	83 3
Correction	−2 2

These corrections have been applied at the point indicated, and points between have been corrected according to their proportional distances

Warren branch —An attempt was made to connect this line with the United States Engineers pipe-flange bench at Dermott, Ark , but in the short time available

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[a] Elevation given by Gannett on authority of United States Coast and Geodetic Survey, plus correction from readjustment of levels by Hayford

[b] Ann Rept Chief of Eng for 1902, pt 2, 1902, p 1475

[c] Ann Rept Chief of Eng for 1893, 1893, p 1983

the writer did not succeed in finding the bench. The elevation given on the profile is, however, a very close approximation, as may be seen by a rough comparison of the elevations at Trippe, Dermott, and Baxter with the elevations of the United States Engineers pipe-flange benches at those places.

ST. LOUIS, SAN FRANCISCO AND NEW ORLEANS RAILROAD (ARKANSAS AND CHOCTAW RAILROAD).

The elevations from Ashdown to Hope were obtained from the division engineer, James Harrington, in December, 1902. The initial point of these elevations was the Kansas City Southern rail-end bench at milepost 468 at Ashdown, which was given an elevation of 330.69 feet (corrected from Shreveport = 328.65). The difference at Hope was:

Elevation United States Geological Survey bench mark on bank building:	Feet.
By Arkansas and Choctaw levels	359.34
By United States Geological Survey	356.81
Correction for Arkansas and Choctaw levels	−2.53

This correction has likewise been applied to the station elevations furnished by Chief Engineer J. F. Hinkley.

ST. LOUIS SOUTHWESTERN RAILWAY.

All elevations given are taken directly from Gannett's Dictionary of Altitudes.[a] A comparison with the United States Engineers benches along the same line indicates an error of ± 5 feet.

SIBLEY, LAKE BISTIENEAU AND SOUTHERN RAILROAD.

Data obtained from the company's office at Yellow Pine, through the kindness of Mr. J. W. Martin, general manager. The relation of the line to the United States Engineers bench mark at Sibley (Lanesville) is not known, as there is no record of elevations of the portion of the line from Sibley to Yellow Pine. The correction applied depends on the following:

Elevation south head block at depot Louisiana Railway and Navigation Company, Coushatta:	Feet.
According to Sibley, Lake Bistineau and Southern preliminary survey	141.1
According to Louisiana Railway and Navigation Company corrected profile	144.74
Correction	+3.6

SOUTHERN LUMBER COMPANY.

These elevations are from a small profile copied in the office of the manager at Warren, Ark., in November, 1902. The initial point is the St. Louis, Iron Mountain and Southern Railway bridge No. 714 at Warren, which has an elevation of 198 feet above sea level.

TEXAS AND PACIFIC RAILWAY.

In the absence of satisfactory correction data the elevations at stations along the Texas and Pacific are given exactly as received from Chief Engineer B. S. Wathen. Comparisons at Shreveport indicate that the error is not greater than 1 or 2 feet.

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[a] Gannett, Henry, Dictionary of Altitudes in the United States, 3d ed.: Bull. U. S. Geol. Survey No. 160, 1899.

The data in Caddo Parish are from a profile furnished by the chief engineer, which has been corrected to agree with the following

	Feet
Elevation Reisor	190 4
Elevation Reisor (profile)	155 9
Correction	+34 5

UNITED STATES COAST AND GEODETIC SURVEY

The elevations given refer to those of the Vidalia-Smithland, Vicksburg-Vidalia, Wilkersons-Vicksburg, and Little Rock-Wilkersons lines as corrected by Hayford in 1900 [a]

Bench marks —The permanent bench marks encountered on these lines are of the following classes, unless otherwise described

1 Stone posts dressed to 5 by 5 inches or 6 by 6 inches at the top, projecting a few inches above the surface, marked in one of the following ways

U S	U S	U S
□	B□M	B□M
BM	1880	1881

The bottom of the square cut in the top of the stone is the bench.

2 Copper bolts leaded in masonry, either horizontally or vertically. If horizontal, the bench is the center of the bolt or the center of the cross cut in the bolt, if vertical, the top of the bolt

UNITED STATES ENGINEERS

The elevations accredited to this source are from the Reports of the Chief of Engineers for 1893 and 1902 [b]

On the precise lines from Delta to Coushatta, Coushatta to Grand Bend, Grand Bend to Smithland, Monroe to mouth of Black River, Monroe to Little Rock, Camden to Shreveport, Rayville to Concordia, Parkville to Greenville via Arkansas City, Glendora to Farmerville, Delhi to Tensas River, Archibald to Bellevue and Three Rivers, Gilbert to New Light, Shreveport to Jeters Landing, and Baskin to mouth of Black River, the elevations are the mean Gulf elevations given in the engineer's report for 1902 A reduction of these values to the precise-level net of the Coast Survey was published by Hayford in 1900, to which the reader is referred.[c]

The elevations along the line from Fulton to Shreveport and of the high and low water marks, which in the engineers' reports are expressed in meters above Cairo datum, have been reduced by using the following values· 1 meter = 3 280833 feet;[d] mean Gulf level = +20.28 feet,[e] Cairo datum

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[a] Rept Supt Coast and Geodetic Survey for 1899, 1900, pp 482-483, 607-613

[b] Ann Rept Chief of Eng for 1893, 1893, pp 1953 1956-57, 1973-74, 1982, 2064 Idem for 1902, 1902, pp 1448-1453

[c] Rept Coast and Geodetic Survey for 1899, 1900, pp 482-483, 607-613

[d] Bull U S Coast and Geodetic Survey, November, 1901

[e] Ann Rept Chief of Eng for 1902, 1902, p 1448

Bench marks —The bench marks of the United States Engineers are of the following classes·

1 Pipestone benches. Pieces of limestone 46 cm square, 16 cm. thick, marked U S o B M, with spherical-headed copper bolts leaded in upper faces and buried 1.2 meters under ground, access being given through 12-cm. iron pipes set on top. Each pipe has a cast-iron cap, fastened by a horizontal bolt through cap and pipe. The cap has a small boss and the letters U S E o B M raised on top Elevations apply to the top of the bolt in the underground stone. Elevation of boss of pipe cap can be found in any case by adding 4 068 feet to elevation of copper bolt

2. Pipe-flange benches These consist of 4-cm gas pipes about 1 6 meters long, capped at upper end and having a 12-cm circular flange attached near lower end by lock nuts Monuments set with about 0.1 meter above ground surface. Flanges are surrounded in the usual case by a matrix of neat cement, approximately doubling the bearing area of the monument. Elevations apply to the top of cap

3 Root benches Temporary benches generally consisting of a nail in a knuckle chopped in the root of the tree On many trees the letters U S have been cut or branded above the bench

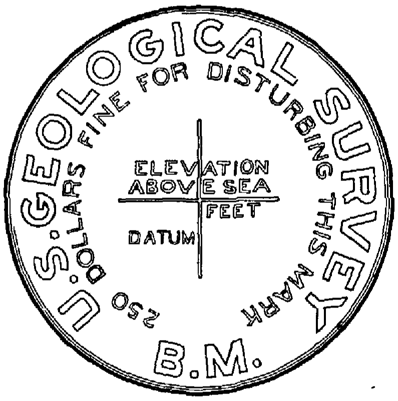

FIG 33 —Top of standard United States Geological Survey bench mark

UNITED STATES GEOLOGICAL SURVEY

The elevations given are the results of the precise levels run in connection with the survey of the Camden, Gurdon, and Caddo Gap quadrangles, adjusted by Mr D. H Baldwin, August, 1904

Bench marks —Permanent bench marks are of two types

1 Iron posts. These are hollow wrought-iron posts 4 feet 6 inches in length, 3.5 inches in outer diameter, split at the bottom and expanded to 12 inches, to prevent the easy subsidence of the post or malicious disturbance. In the top is riveted a bronze tablet 3 5 inches in diameter, one-fourth inch thick, lettered as shown in fig 33 These posts are buried in the earth, with only 1 foot of their length projecting above the surface. The intersection of the cross is taken as the bench mark.

2 Tablets Metal tablets fastened with Portland cement into rock or masonry structures, lettered as shown in fig. 33 The bench mark is the intersection of the cross lines

VICKSBURG, SHREVEPORT AND PACIFIC RAILWAY

These elevations were received from Resident Engineer L W Stubbs in November, 1898, expressed in feet, Cairo datum A connection with the United States Engineers gage at Shreveport, by City Engineer Cain, made November 22, 1898, gave the following correction

	Feet
Top of rail south end Vicksburg, Shreveport and Pacific bridge, from United States Engineers gage	189 32
Top of rail "Red River Bridge," Vicksburg, Shreveport and Pacific levels	206 4
Correction	−17 1

This correction has been applied throughout, and the error is probably ± 3 feet More exact elevations, however, may be had along this line in the permanent reference points of the United States Engineers.

ABBREVIATIONS

The elevations given below vary greatly in accuracy, and they have been divided roughly into the following classes

P=Precise levels of the United States Engineers, United States Coast and Geodetic Survey, and United States Geological Survey

E=Engineers' levels Levels run by United States Engineers, but not classed by them as precise In general, more accurate than railroad levels

R=Railroad levels As there is no economic need for extreme precision in elevations in railroad constructions, these levels, as a rule, may be regarded as only approximate The error, however, is relatively small and need not be considered in most of the geologic and water problems involved in this area

L=Reconnaissance levels Included in this head are preliminary surveys for railroads and other miscellaneous lines controlled by spirit-level surveys As a rule, they are less accurate than the three foregoing classes

A & W	Alexandria and Western Railroad
A & L	Arkansas and Louisiana Railway
A S	Arkansas Southern Railroad
A S W	Arkansas Southwestern Railway
H & S	Houston and Shreveport Railroad
K C S	Kansas City Southern Railway
K C, W & G	Kansas City, Watkins and Gulf Railroad
L & A	Louisiana and Arkansas Railway
L R & N	Louisiana Railway and Navigation Company
M R, H & W	Mississippi River, Hamburg and Western Railway
M, K & T	Missouri, Kansas and Texas Railway
N O & N W	New Orleans and Northwestern Railroad
N, R R & T	Natchez, Red River and Texas Railroad
O R & K	Old River and Kissatchie Railroad
P. B & W	Pine Bluff and Western Railway
St L, I M & S	St Louis, Iron Mountain and Southern Railway
St L, S F & N O	St Louis, San Francisco and New Orleans Railroad
St L S W	St Louis Southwestern Railway
S, L B & S	Sibley, Lake Bistineau and Southern Railway
S Lbr Co	Southern Lumber Company
T & P	Texas and Pacific Railway
U S C & G S	United States Coast and Geodetic Survey
U S E	United States Engineers
U S G S	United States Geological Survey
V, S. & P	Vicksburg, Shreveport and Pacific Railway.

ALTITUDES IN SOUTHERN ARKANSAS.

Location	Authority	Class	Elevation
ASHLEY COUNTY			*Feet*
Bayou Bartholomew, Cox Ford, pipe-flange bench in yard of Silver Mount Baptist Church	U S E	E	132 21
—— King (Bailey) place gage bench mark, root bench in white oak 160 feet above lane to railroad	U S E	P	118 556
—— Louisiana-Arkansas State line, 1,650 feet south of, pipe-flange bench 260 feet east of bayou and 50 feet east of railroad	U S E	P	107 075
—— McBride place, pipe-flange bench 108 feet from left bank and at juncture of Portland-Hamburg road and road from bayou	U S E	E	125 52
—— Morris place pipe-flange bench 10 feet west of left bank and 6 feet east of road	U S E	E	119 93
—— M R, H & W bridge, top of rail	M R, H & W	R	132
—— —— bed of bayou	M R, H & W	R	86
—— Noble (James) place, pipe-flange bench on bayou 132 feet west of St L, I M & S track at point nearest to bayou	U S E	P	113 766
—— Portland-Hamburg Ferry, high water 1874	U S E	E	122 17
—— Shearer Ferry, high water 1895	U S E	E	118 30
—— Tebbs Ferry, high water 1897	U S E	E	114 82
Bearhouse Creek, hill west of	M R, H & W	R	158
Chimanahaw Creek, M R, H & W bridge top of rail	M R H & W	R	156
—— —— bed of creek	M R, H & W	R	136
Crossett; top of rail, center of station	M R, H & W	R	161
Cypress, 1 mile north of, root bench in sweet gum east of track, 6 telegraph poles below milepost 490	U S E	P	106 404
—— root bench in pin oak east of track, 7 telegraph poles below milepost 491	U S E	P	105 010
—— 1 mile south of root bench in sweet gum east of track, at first telegraph pole south of milepost 492	U S E	P	107 002
Drew County line; root bench in oak 80 feet east of track, 3 telegraph poles above the Ashley-Drew County line	U S E	P	126 547
Hamburg; top of rail center of station.	M R, H & W	R	164
—— 6 miles west of prairie	M R, H & W	R	177
Kidds Spur; pipe-flange bench in P L McGurdy s yard, 80 feet east of track	U S E	P	124 237
Louisiana-Arkansas State line; top of rail.	N O & N W.	R	90
Montrose; top of rail St L, I M & S crossing.	M R, H & W	R	124
—— root bench in white oak 50 feet east of track, 9 telegraph poles below milepost 470	U S E	P	122 024
—— root bench in sweet gum 50 feet east of track, 4 telegraph poles north of milepost 470	U S E	P	124 883
Morrell, 1 mile north of, root bench in sweet gum 65 feet west of track, 6 5 telegraph poles below milepost 465	U S E	P	125 658
—— pipe-flange bench in yard of section house	U S E	P	130 102
—— zero of gage, Bayou Bartholomew	U S E	E	99 24
—— 1 mile south of, root bench in willow oak 50 feet east of track, 3 telegraph poles below sign reading 'Station 1 mile"	U S E	P	125 193
—— 2 miles south of, root bench in sweet gum east of track, 3 5 telegraph poles south of milepost 468	U S E	P	126 629
—— 3 miles south of, root bench in hickory west of track, 5 telegraph poles above milepost 469	U S E	P	128 658
Ouachita River, Marie Saline Landing, pipestone bench 1,000 feet from river and 30 feet north of road from landing	U S. E	E	62 95

Altitudes in southern Arkansas—Continued

Location	Authority	Class	Elevation
ASHLEY COUNTY—continued			*Feet*
Parkdale, 2 miles north of, root bench in black gum 65 feet west of track, 11 5 telegraph poles above milepost 482	U S E	P	118 045
—— 1 mile north of, root bench in sweet gum 50 feet east of track, 9 telegraph poles above milepost 483	U S E	P	117 440
—— pipe-flange bench in section-house yard	U S E	P	116 418
—— zero of gage, Bayou Bartholomew	U S E	E	85 59
Portland, 3 miles north of root bench in sweet gum 65 feet west of track, 13 telegraph poles below milepost 472	U S E	P	123 237
—— 1 mile north of, root bench in white oak 130 feet west of track, 6 telegraph poles below milepost 474	U S E	P	122 578
—— pipe-flange bench in section-house yard	U S E	P	127 449
—— 3 miles south of, root bench in hickory 65 feet east of track, 0 75 telegraph pole above milepost 478	U S E	P	112 813
Sunshine; pipe-flange bench in Ed Honeycutt's yard, 50 feet east of track, 2 telegraph poles south of milepost 479	U S E	P	117 967
Wilmot, *3 miles north of root bench in black gum 65 feet west o track, 5 5 telegraph poles below milepost 485*	U S E	P	113 465
—— 2 miles north of, root bench in oak 50 feet west of track, 6 telegraph poles above milepost 486	U S E	P	112 404
—— 1 mile north of, root bench in elm 65 feet west of track, 30 feet above milepost 487	U S E	P	109 482
—— pipe-flange bench in southeast corner of Hotel Chesnutt yard	U S E	P	114 367
—— 1 mile south of, root bench in oak 6 telegraph poles below milepost 489	U S E	P	108 771
BRADLEY COUNTY			
Bayou Moro; sec 3, T 13 S, R 12 W	S Lbr Co	R	146
Saline River; St L, I M & S bridge top of stringer	St L, I M & S.	R	124
—— —— bank level	St L, I M & S.	R	117
Warren; grade, center of station	St L, I M & S.	R	211
—— 4 miles west of, summit between Warren and Bayou Moro	S Lbr Co	R	282
—— 8 miles west of Steep Bank Eagle Creek, bed	S Lbr Co	R	192
—— 11 miles west of, Eagle Creek bridge	S Lbr Co	R	188
—— 11 miles west of, bed of Eagle Creek	S Lbr Co	R	178
CALHOUN COUNTY			
Harlow; iron post 450 feet southwest of station, 10 feet southwest of milepost 318	U S G S	P	271 137
—— 3 miles south-southeast of, iron post 380 feet north of Chambersville-Camden road, at northwest corner of sec 9, T 12 S, R 14 W	U S G S	P	285 261
Little Bay	St L S W	R	313
Locust Bayou, 5 miles west of iron post at corner of field where road forks, center of sec 33, T 13 S, R 16 W	U S G S	P	107 332
Ouachita River, Leppard's camp, pipestone bench 150 feet from river, 100 feet back of cabin	U. S E	P	90 415
—— Little Bay Creek, mouth of, pipestone bench on left bank	U S E	P	90 418
Smead, 4 miles north of, iron post on section line, 19 75 feet east of northwest corner of sec 23, T 12 S, R 15 W	U S G S	P	215 067
—— 3 miles south of, iron post at fork of roads northeast corner of northeast quarter of sec 26, T 13 S, R 15 W	U S G S	P	157 992
—— 3 5 miles east of, iron post at northwest corner of sec 9, T 13 S, R 14 W.	U S G S	P	215 770
Thornton.	St L S W	R	310
CHICOT COUNTY			
Bayou Bartholomew. *See* Drew County, Bayou Bartholomew			
Dermott, 4 miles north of, root bench in oak east of track, 2 5 telegraph poles above milepost 451	U S E	P	138 002
—— 3 miles north of, root bench in oak east of track, 3 5 telegraph poles above milepost 452	U. S E	P	136 563

Altitudes in southern Arkansas—Continued

Location	Authority	Class	Elevation
CHICOT COUNTY—continued			*Feet*
Dermott, 2 miles north of, root bench in persimmon east of track, 1 telegraph pole above milepost 453	U S E	P	135 327
—— 1 mile north of, root bench in maple east of track, 1 telegraph pole above milepost 454	U S E	P	136 492
—— root bench in pignut hickory north of track, 0 5 telegraph pole east of bridge 614 on Warren Branch	U S E	P	141 348
—— pipe-flange bench in section yard	U S E	P	139 990
—— top of rail at railroad crossing	St L , I M & S	R	140 4
—— 3 miles south of, root bench in oak west of track, 1 telegraph pole above second cattle gap below milepost 458	U S E	P	135 444
Hudspeth, 2 miles north of, root bench in hickory 65 feet west of track, 6 telegraph poles below milepost 459	U S E	P	137 878
—— pipe-flange benoh in section-house yard	U S E	P	132 936
—— 1 mile south of, root bench in hickory 50 feet east of track, 9 telegraph poles below sign reading "Station 1 mile"	U S E	P	128 753
CLARK COUNTY			
Antoine Creek, A S W BRIDGE, bed of creek	A S W	R	228
—— —— east bank of creek	A S W	R	265
Arkadelphia; bronze tablet in second stone above ground at northwest corner of court-house	U S G S	P	246 569
—— top of rail, center of station	St L , I M & S	R	189 1
—— cross on rail end, west corner of inclosure northeast of depot	U S E	P	188 340
—— pipe-flange bench on pine knoll northwest of station	U S E	P	216 206
—— zero of gage, Ouachita River	U S E	E	163 12
—— high water, 1882	U S E	E	188 18 188 45
—— low water 1892	U S E	E	164 50
—— *See* under Ouachita River			
—— 1 mile west of, spike in eleventh telegraph pole south of milepost 411	U S E	P	180 087
—— 2 miles west of, top of rail at milepost 412	St L , I M & S	R	182 5
—— 2 miles west of, ground at milepost 412	St L , I M & S	R	176
Beaver Slough, St L , I M & S BRIDGE, top of rail	St L , I M & S	R	204 1
Belrne; top of rail, center of station	St L , I M & S	R	226 5
—— iron post on Doctor Kerston's property, 250 feet west of Methodist Church	U S G S	P	238 225
Britts; top of rail, center of platform	St L , I M , & S	R	201 5
Burtsel; grade, center of station	A S W	R	264
Curtis; top of rail, center of depot	St L , I M & S	R	186 6
—— 0 25 mile south of station, iron post on east right-of-way line of Iron Mountain Rwy , and on line between sections 1 and 36	U S G S	P	170 880
—— pipe-flange bench 82 feet west, on line of south wall of depot	U S E	P	185 111
Dalark; iron post on line between Dallas and Clark counties, in northwest corner of sec 13, T 8 S , R 18 W	U S G S	P	272 499
Daleville; top of rail, center of station	St L , I M & S	R	193 4
—— ground at station	St L , I M & S	R	187
—— copper bolt in chimney of Arkadelphia Lumber Co , 2,625 feet north of Ouachita River	U S E	P	187 023
Gum Springs; top of rail, east head block	St L , I M & S	R	215 1
—— 2 miles west of, summit of track	St L , I M & S	R	215 3
—— pipe-flange bench near corner of section house	U S E	P	213 902
Gurdon; aluminum tablet near southeast corner brick building, northwest corner of Main and West Front streets	U S G S	P	209 895
—— top of rail, west end of depot	St L , I M & S	R	210 6
—— 2 miles west of, top of rail, at summit	St L , I M & S	R	245 1
Hebron, 3 miles southeast of, iron post 500 feet east of center of sec 10, T 10 S , R 18 W	U S G S	P	207 773
—— 2 miles east of, iron post 10 feet north of P Bennett's well, southeast corner of northeast quarter of northeast quarter of sec 33, T 9 S , R 18 W	U S G S	P	205 025

Altitudes in southern Arkansas—Continued

Location	Authority	Class	Elevation
CLARK COUNTY—continued			*Feet*
Hot Springs County line; top of rail	St. L., I. M. & S.	R	199.5
—— ground	St. L., I. M. & S.	R	194
Little Missouri River, T. 11 S., R. 19 W., cross between rails on top of stone pier at north end of St. L., I. M. & S. bridge, marked U. S. B. M.	U. S. E.	P	165.790
—— SEC. 19, T. 10 S., R. 21 W., *top of rail, St. L., I. M. & S. bridge*	St. L., I. M. & S.	R	210.9
—— —— bottom land	St. L., I. M. & S.	R	198
—— —— bed of river	St. L., I. M. & S.	R	172
—— ELKINS FORD, 1 mile north of, iron post 30 feet west of road at half-mile corner on east line of sec. 21, T. 9 S., R. 22 W.	U. S. G. S.	P	217.180
Okolona; station	A. S. W.	R	370
—— iron post in southwest corner of high school yard	U. S. G. S.	P	423.440
—— 3.5 miles south of, on Elkins Ford road, iron post at half-mile corner, east line of sec. 21, T. 9 S., R. 22 W., 30 feet west of road	U. S. G. S.	P	217.180
Ouachita River, ST. L., I. M. & S. BRIDGE, top of rail	St. L., I. M. & S.	R	198.8
—— —— bed of river	St. L., I. M. & S.	R	153
—— —— cross on pedestal stone, downstream end of right-bank pier	U. S. E.	P	194.909
—— —— on top coping stone, north end of west abutment	U. S. G. S.	P	193.18
Saline Bayou; near milepost 408, top of rail, bridge 636	St. L., I. M. & S.	R	196.1
—— bed of bayou, at bridge 636	St. L., I. M. & S.	R	173
Smithton; top of rail, center of station	St. L., I. M. & S.	R	210.6
—— 3,900 feet northeast of, pipestone bench at milepost 423 St. L., I. M. & S.	U. S. E.	P	206.242
—— 4 miles east of, iron post between two buildings on property of W. A. Young, sec. 20, T. 9 S., R. 19 W.	U. S. G. S.	P	176.944
Terre Noire Creek, ST. L., I. M. & S. BRIDGE, top of rail	St. L., I. M. & S.	R	175.6
—— —— bottom land	St. L., I. M. & S.	R	165
—— —— bed of creek	St. L., I. M. & S.	R	155
Tip-top station	A. S. W.	R	332
—— east of, iron post 100 feet north of track 30 feet west of Gurdon-Keyton road, southeast corner of sec. 15, T. 9 S., R. 21 W.	U. S. G. S.	P	319.309
Whelen Springs	St. L., I. M. & S.	R	251
—— iron post 450 feet west of station, 30 feet south of southwest corner of sec. 26	U. S. G. S.	P	247.267
—— pipe-flange bench, 100 feet east of depot, on line with north wall	U. S. E.	P	252.357
—— 3.75 miles northeast of, iron post north side of Gurdon-Camden road, between secs. 19 and 20, T. 11 S., R. 19 W.	U. S. G. S.	P	198.968
CLEVELAND COUNTY			
Kedron	St. L. S. W.	R	206
Kingsland	St. L. S. W.	R	209
Rison	St. L. S. W.	R	225
COLUMBIA COUNTY			
Bayou Dorcheat, ST. L. S. W. CROSSING, root bench on oak north of track, 300 feet west of trestle	U. S. E.	P	245.448
Buckner	St. L. S. W.	R	275
—— 2.3 miles east of, root bench on pine at road crossing, 65 feet south of track, 3.5 telegraph poles west of milepost 379	U. S. E.	P	276.597
—— 1 mile east of, root bench on oak north of track, 225 feet west of sign "Station 1 mile"	U. S. E.	P	245.448
Crooked Creek, L. & A. BRIDGE, top of stringer	L. & A.	R	251
—— —— bed of creek	L. & A.	R	243
Ferguson; grade, center of station	L. & A.	R	267
Lafayette County line; grade L. & A. track	L. & A.	R	273
Louisiana-Arkansas State line; grade L. & A. track	L. & A.	R	248
McNeil	St. L. S. W.	R	321
—— 500 feet from depot, pipestone bench 90 feet south from main track of St. L. S. W., 40 feet from transfer shed	U. S. E.	P	322.298
—— 2 miles west of, root bench in sweet gum 6 telegraph poles west of milepost 370, 50 feet south of track	U. S. E.	P	298.551

Altitudes in southern Arkansas—Continued

Location	Authority	Class	Elevation
COLUMBIA COUNTY—continued			*Feet*
Magnesia Springs; root bench in red oak 60 feet northeast of first cut southwest of station	U S E	P	303 314
Magnolia	St L S W	R	315
Milner, 2 miles north of, root bench in oak 65 feet northeast of track, 132 feet south of milepost 361	U S E	P	193 766
—— 0 5 mile north of, root bench in oak 50 feet northeast of track, north end of trestle 885	U S E	P	211 621
—— 650 feet north of station, root bench in maple 65 feet southwest of main track	U S E	P	219 19
—— at station	St L S W	R	268
Taylor; grade, center of station	L & A	R	253
Waldo, 0 2 mile east of, root bench in post oak 100 feet south of track, 3 5 telegraph poles west of milepost 373	U S E	P	354 884
—— pipestone bench 160 feet from track, 800 feet east of depot	U S E	P	352 025
—— 2 8 miles west of, root bench in white oak 50 feet north of track, 1,640 feet west of milepost 376	U S E	P	304 068
Welcome; grade, center of station	L & A	R	276
DALLAS COUNTY			
Dalark; iron post on line between Dallas and Clark counties, northwest corner of sec 13, T 8 S, R 18 W	U S G S	P	272 499
Dry Run station	St L S W	R	206
Fairview; iron post 200 feet south of corner known as "Gray Rock," at fork of roads on line between secs 22 and 23, T 9 S, R 17 W	U S G S	P	191 336
Fordyce	St L S W	R	275
Heine, 1 mile north of, iron post at southeast corner of Ouachita Church property, 860 feet northwest of northwest corner of sec 23, T 10 S, R 17 W	U S G S	P	156 633
Holly Grove, 3 miles northwest of, iron post 250 feet southeast of bridge over Whiteoak Creek, on south side of road, on line between secs 15 and 16, T 10 S, R 16 W	U S G S	P	156 04
Holly Springs, 6 miles east of, iron post in Mill Creek bottom, on property of of Mr Wm Marshall, sr, northwest corner of sec 15, T 10 S, R 15 W	U S G S	P	213 25
Nix, 1 5 miles southeast of, on iron post on road on section line 450 feet west of southeast corner of sec 5, T 9 S, R 16 W	U S G S	P	297 023
—— iron post 230 feet east of post-office, in east half of southeast quarter of sec 33, T 8 S, R 16 W	U S G S	P	227 928
Princeton, 4 5 miles (straight line) southeast of, iron post at intersection of dirt roads 120 feet south of Zion Church, T 9 S, R 14 W	U S G S	P	352 109
—— 3 miles south of, at intersection of Princeton, Bearden and Holly Springs roads, iron post on line between secs 14 and 15, T 9 S, R 15 W	U S G S	P	300 798
—— aluminum tablet on west of entrance to county jail	U S G S	P	287 587
Ramsey, 3 5 miles south of, iron post at intersection of Fordyce-Princeton roads and Harlow Lumber Co 's tramway, 450 feet east of old water tank, T 10 , R 14 W	U S G S	P	222 412
DESHA COUNTY			
Amos Bayou station; top of rail at switch block	St L, I M & S	R	158 5
Amos Bayou, ST L, I M & S BRIDGE, top of rail	St L, I M & S	R	157 5
—— —— bed of bayou	St L, I M & S	R	151 5
Arkansas City; granite post 6 feet south of house southwest of station	U S E	P	138 457
—— granite post 6 feet south of house southwest of station	U S C & G S	P	138 497
Drew County line; north of Winchester	St L, I M & S	R	156 5
—— south of Tillar	St L, I M & S	R	154 5
Dumas; top of rail, center of station	St L, I M & S	R	169 5
Halley; grade, center of station	St L, I M & S	R	138
Lear station; top of rail, center of station	St L, I M & S	R	165
McGehee; top of rail, center of station	St L, I M & S	R	150
—— pipe-flange bench in yard of cabin opposite north end of switch, west of St L, I M & S track	U S E	P	148 513
—— 1 mile south of, root bench in honey locust on west edge of right of way, 2 5 telegraph poles below milepost 448	U S E	P	147 112

Altitudes in southern Arkansas—Continued

Location	Authority	Class	Elevation
DESHA COUNTY—continued			*Feet*
McGehee, 2 miles south of, root bench in willow oak on east edge of right of way, 2 5 telegraph poles from milepost 449	U S E	P	138 135
—— 3 miles south of, root bench in sweet gum on edge of right of way, 2 5 telegraph poles above milepost 450	U S E	P	140 698
Reedville; top of rail, center of station	St L, I M & S	R	163 5
Roton; top of rail, center of station	St L, I M & S	R	165
Trippe Junction; grade, center of station	St L, I M & S	R	144
—— pipe-flange bench in R D Crenshaw's yard	U S E	P	144 522
Walnut Lake; top of rail, center of station	St L, I M & S	R	162 5
—— copper bolt in chimney of R A. Pickens's dwelling	U S C & G S	P	163 455
DREW COUNTY			
Allis station; grade, center of station	St L, I M & S	R	194
Ashley County line; root bench in oak 80 feet east of track, 3 telegraph poles above the county line	U S E	P	126 547
Bayou Bartholomew, Cox Ford, pipestone bench in yard of Silver Mount Baptist Church	U S E	E	132 21
—— Duke place, pipe-flange bench in field corner at intersection of Duke-Lephiew lane with road	U S E	E	142 55
—— —— pipe-flange bench on left bank of bayou in yard of cabin 70 feet south of county bridge	U S E	E	133 33
—— Richardson place, pipe-flange bench 68 feet from bayou at Mount Calvary Missionary Baptist Church (colored)	U S E	E	138 55
Baxter; grade, center of station	St L, I M & S	R	141
—— zero of gage Bayou Bartholomew	U S E	E	112 95
—— low water, Bayou Bartholomew, 1899	U S E	E	114 2
—— high water, Bayou Bartholomew, 1874	U S E	E	137 72
—— high water, Bayou Bartholomew, 1892	U S E	E	133 85
—— pipe-flange bench in yard of S A Duke, about 130 feet west of Bayou Bartholomew bridge	U S E	P	141 740
Blissville; root bench in oak east of track, 3 telegraph poles above Ashley County line	U S E	P	126 547
—— root bench in black gum west of track, 0 5 telegraph pole above north end of first curve above milepost 464	U S E	P	129 261
Collins; grade, center of station	St L, I M & S	R	168 5
Darraugh spur; top of rail, center of platform	St L, I M & S	R	154 5
Desha County line; north of Winchester	St L, I M & S	R	156 5
—— south of Tillar	St L, I M & S	R	154 5
Hays switch; grade, center of station	St L, I M & S	R	190
Monticello; grade, center of station	St L, I M & S	R	273
—— 0 5 mile east of, summit of track between Monticello and Baxter	St L, I M & S	R	296
—— reservoir, Rough and Ready Hill	City engineer	L	395
Nelson post-office; grade, center of station	St L, I M & S	R	194
Tillar; top of rail, center of station	St L, I M & S	R	154 5
—— copper bolt in chimney at back of H L Henry & Bro s store	U S C & G S	P	152 722
Wilmar; grade, center of station	St L, I M & S	R	149
Winchester; top of rail, center of station	St L, I M & S	R	157
GRANT COUNTY			
Darysaw Creek; sec 18, T 5 S, R 11 W	P B & W	R	241
Doyleston; station	P B & W	R	345
Hurricane Creek; sec 7, T 5 S, R 12 W, bank	P B & W	R	198
Lost Creek; sec 6, T 13 S, R 4 W	P B & W	L	248
Sheridan, 2 miles north of, sec 33, T 4 S, R 13 W, divide between Lost and Big creeks	P B & W	L	298
—— top of rail, center of station	P B & W	R	228
—— opposite court-house	P B & W	L	268
—— 3 miles east of, bottom of Hurricane Creek	P B & W	R	198
—— 8 miles east of divide between Hurricane and Darysaw creeks, sec 15, T 5 S, R 12 W	P B & W	R	308

Altitudes in southern Arkansas—Continued

Location	Authority	Class	Elevation
HEMPSTEAD COUNTY			*Feet*
Black Bois d'Arc Creek, St L , I M & S crossing, top of rail, bridge 753	St L , I M & S	R	277 1
—— —— bottom lands	St L , I M & S	R	266
—— St L , S F & N O crossing, bank	St L , S F & N O	R	277
—— —— bed	St L , S F & N O	R	272
Big Terre Rouge Creek, St L , I M & S crossing, top of rail, bridge 728	St L , I M & S	R	264 5
—— —— bottom land	St L , I M & S	R	255
—— —— bed of creek	St L , I M & S	R	245
Bridge Creek, St L , S F & N O crossing, bank	St L , S F & N O	R	287
—— St L , I M & S bridge, top of rail	St L , I M & S	R	260 1
—— —— bank of creek	St L , I M & S	R	246
—— —— bed of creek	St L , I M & S	R	240
Caney Creek; top of rail, bridge 754	St L , I M & S	R	277 1
—— bottom land	St L , I M & S	R	266
Centerville; iron post north side of Hope-Camden road near half-mile corner, on east side of sec 4, T 13 S , R 23 W	U S G S	P	338 563
Coler; grade, center of station	L & A	R	318
Compton station; near summit between Middle Fork of Ozan and Mine creeks, between mileposts 22 and 23	A & L	R	442
Fulton; zero U S E gage	U S E	E	224 50
—— high water, 1892	U S E	E	258 89
—— top of rail center of station	St L , I M & S	R	270 5
—— pipe-stone bench in B F Davis's yard, Mount Prairie street	U S E	E	253 74
—— pipe-stone bench, northeast corner Washington and Orleans streets	U S E	E	255 88
—— 1 mile east of, top of rail	St L , I M & S	R	287 1
Garlandville, 1 mile south of iron post on county line near southeast corner of sec 9, T 11 S , R 23 W , 50 feet north of Prescott-Washington road	U S G S	P	327 468
Guernsey; top of rail at east cattle yard	St L , I M & S	R	292 4
Hope, 5 miles north of, A & L bridge over Allen Branch	A & L	R	327
—— 4 5 miles north of, A & L , summit between Caney Creek and Allen Branch	A & L	R	344
—— 3 5 miles north of, A & L bridge over Caney Creek	A & L	R	306
—— 3 5 miles north of, bottom of Caney Creek at A & L bridge,	A & L	R	298
—— top of rail, center of station	St L , I M & S	R	355 1
—— station	St L , S F & N O	R	371 5
—— aluminum tablet, northeast corner stone of Hempstead County Bank, corner of Main and Second streets	U S G S	P	356 810
Lawrence Creek; top of rail, bridge 731	St L , I M & S	R	274 1
—— bottom land	St L , I M & S	R	265
Little River, St L , S F & N O crossing, bridge	St L , S F & N O	R	274
—— —— bank	St L , S F & N O	R	253
—— —— high water, 1892	St L , S F & N O	R	261
McNabbs; grade, center of station	St L , S F & N O	R	309 5
Nevada County line; iron post, east side of road, at southeast corner of sec 33, T 13 S , R 23 W	U S G S	P	332 156
—— iron post, south side of road, about 0 25 mile north of southeast corner sec 16, T 10 S , R 23 W	U S G S	P	346 295
—— *See* Centerville			
Ozan; station	A & L	R	377
Ozan Creek, Middle Fork of, A & L bridge	A & L	R	339
—— —— bottom of creek	A & L	R	333
Ozan Creek, South Fork of, A & L bridge	A & L	R	337
Red River, Brooks plantation, pipe-stone bench 700 feet below plantation quarters	U S E	E	251 73
—— Dooley Ferry, high water, 1892	U S E	E	247 17
—— Ferguson plantation pipe-stone bench 1,400 feet below gin and 400 feet from river	U S E	E	242 68
—— St L , I M & S bridge, top of rail	St L , I M & S	R	270 5
—— —— bed of river	St L , I M & S	R	221

Altitudes in southern Arkansas—Continued

Location	Authority	Class	Elevation
HEMPSTEAD COUNTY—continued			*Feet*
Sandy Bois d'Arc Creek, St L, I M & S crossing, bridge No 762, top of rail	St L, I M & S	R	264 1
—— —— bottom land	St L, I M & S	R	253
—— —— bed of creek	St L, I M & S	R	243
—— St L, S F & N O crossing, bank	St L, S F & N O	R	278
—— —— bed of creek	St L, S F & N O	R	265
Sheppard; top of rail, west head block	St L, I M & S	R	279 1
Spring Hill; southeast corner of frame around platform of scale at gin	Veatch	L	328 9
—— post-office	Veatch		340±
—— 1 5 miles north of, on Hope road, John Yocom's house	Veatch	L	373
Sprudel; top of rail at switch block	St L, I M & S	R	260 1
Turkey Creek, St L, S F & N O crossing, bank	St L, S F & N O	R	286
Washington, 2 miles north of on A & L, R R, summit between Washington and Ozan, near milepost 11	A & L	R	429
—— top of rail, center of station	A & L	R	374
—— 2 miles south of highest point on A & L R R between Washington and Hope, near milepost 7 top of rail	A & L	R	374
—— —— ground	A & L	R	378
Water Creek, St L, I M & S crossing, bottom land	St L, I M & S	R	251
—— St L, S F & N O crossing, bank	St L, S F & N O	R	272
—— —— bed	St L, S F & N O	R	266
HOT SPRINGS COUNTY			
Clark County line; top of rail	St L, I M & S	R	199 5
—— ground	St L, I M & S	R	194
Donaldson; cross on top of iron rail near southeast corner of depot	U S E	P	228 444
Malvern; iron post near front entrance to Hot Springs County court-house	U S G S	P	310 891
—— copper tablet in north meridian monument in court-house yard	U S G S	P	311 154
—— copper tablet in south meridian monument in court-house yard	U S G S	P	306 919
—— recess in stone sill at southeast corner of roundhouse, marked U S B M	U S E	P	270 739
HOWARD COUNTY			
Athens; iron post, 300 feet east of schoolhouse, at center of sec 15, T 5 S, R 28 W	U S G S	P	958 197
Baker Springs road, 9 miles north of Centerpoint, iron post at southeast corner of fence in front of E H Zolletts's	U S G S	P	669 140
Centerpoint; iron post, 35 feet north of cotton gin and along picket fence, 24 feet south of southwest corner of sec 25, T 8 S, R 28 W	U S G S	P	590 237
—— 5 miles east of, iron post in southwest corner of graveyard, southeast corner of southwest quarter sec 22, T 8 S, R 27 W	U S G S	P	670 733
Muddy Fork; post-office, iron post, 300 feet south of cotton gin and directly in front of new store	U S G S	P	562 939
Nashville; station	A & L	R	358
—— 1 5 miles south of, A & L bridge over Sandy Branch	A & L	R	363
—— 1 mile south of, A & L bridge over Mine Creek	A & L	R	347
—— 1 mile south of, bottom of Mine Creek at A & L bridge	A & L	R	333
Nathan, 1 5 miles northwest of, iron post, 10 feet north of rail fence, 300 feet south of John Cornish's house	U S G S	P	502 466
New Hope, 5 miles southwest of, iron post 20 feet east of crossing of Hot Springs-Locksburg and Centerpoint-Dallas roads	U S G S	P	769 94
JEFFERSON COUNTY			
Altheimer	St L S W	R	207
Baldwin station; top of rail at north head block	St L, I M & S	R	240
Chalmette station; top of rail, center of station	St L, I M & S	R	207.5
Dexter; top of rail at switch block	St L, I M & S	R	279
Doyleston station	P B & W	R	345
Duncan station; top of rail at switch block	St L, I M & S	R	325

Altitudes in southern Arkansas—Continued

Location	Authority	Class	Elevation
JEFFERSON COUNTY—continued			
			Feet
Fairfield; top of rail, center of station.	St L, I M & S	R	204 5
Faith	St L S W	R	225
Grace	St L S W	R	225
Jefferson; top of rail, center of station	St L, I M & S	R	346
Jefferson Spring, near, granite post	U S C & G S	P	340 028
Kearney station; top of rail at north head block.	St L, I M & S	R	347 5
Lincoln County line; top of rail.	St L, I M & S	R	186
Linwood; top of rail, center of station.	St L, I M & S	R	197
Noble Lake; granite post, southeast corner of north extension of station platform	U S C & G S	P	202 353
Pine Bluff; top of rail, center of station	St L, I M & S	R	215
—— station.	St L S W	R	213
—— crossing of St L, I M & S	St L S W	R	228
—— crossing of St L S W	St L, I M & S	R	228
—— copper bolt in south side of State Branch Normal School	U S C & G S	P	234 124
—— granite post at 803 West Fourth avenue, corner of Oak street	U S C & G S	P	224 200
Redfield; top of rail, center of station.	St L, I M & S	R	296
—— granite post in yard between J Converse's blacksmith shop and store.	U S C & G S	P	307 504
Rob Roy	St L S W	R	208
Samples station; top of rail, north head block	St L, I M & S	R	297
Sanders; top of rail at switch block	St L, I M & S	R	228
Saline County line; top of rail.	St L, I M & S	R	244
Sherrill.	St L S W	W	218
Tamo station; top of rail, center of station	St L, I M & S	R	192
Toronto; top of rail, center of station	St L, I M & S	R	192
Tucker	St L S W	R	226
Wilkins.	St L S W	R	208
LAFAYETTE COUNTY			
Baker; grade, center of station.	L & A	R	268
Bodcaw Bayou, bed of, at L & A crossing	L & A	R	245
Bradley, 2 miles north of, root bench in white oak west of track, midway between mileposts 406 and 407	U S E	P	249 146
—— pipestone bench, northwest corner of depot.	U S E	P	252 469
—— station	St L S W	R	258
—— 1 mile south of, root bench in post oak east of track, 65 feet from sign ‘station 1 mile”	U S E	P	252 228
—— 2 5 miles south of, root bench in post oak at road crossing east of track, 3 5 telegraph poles north of milepost 411	U S E	P	252 994
—— 3 5 miles south of, root bench in post oak west of track, 1,650 feet south of milepost 412	U S E	P	245 684
Canfield, 3 5 miles north of, root bench in red oak east of track, 1,650 feet south of milepost 399	U S E	P	258 058
—— 1 5 miles north of, root bench in post oak west of track, 11 telegraph poles north of milepost 401	U, S E	P	260 924
—— pipestone bench at southwest corner of cattlepen, 310 feet northwest of depot	U S E	P	258 632
—— railroad station.	St L, S W	R	263
Columbia County line	L & A	R	273
Frostville station; root bench in red oak east of track, 16 5 telegraph poles north of milepost 405	U S E	P	257 284
Kress City; root bench in white oak east of track, 230 feet south of station platform	U S E	P	267 703
—— 1 4 miles south of, root bench in post oak east of track, 4 telegraph poles north of milepost 396	U S E	P	252 084
—— 3 4 miles south of, root bench in black-jack west of track, 7 telegraph poles north of milepost 398	U S E	P	242 915
Lewisville; ground at old court house	Veatch	L	355

Altitudes in southern Arkansas—Continued

Location	Authority	Class	Elevation
LAFAYETTE COUNTY—continued			
			Feet
Louisiana-Arkansas line; 1 telegraph pole north of, root bench in red oak east of St L S W track	U S E	P	244 107
McKamie; grade, center of station	L & A	R	281
New Lewisville, 1 6 miles east of, root bench in pine north of track, 30 feet west of milepost 388	U S E	P	278 564
—— pipestone bench at east corner of cattle pen, 295 feet southwest of depot	U S E	P	259 847
—— station	St L S W	R	271
—— 3 4 miles west of, root bench in ash north of track, 12 telegraph poles west of milepost 393	U S E	P	225 127
Prairieville station; grade, center of station	L & A	R	276
Red River, ANTHONY LAKE, 900 feet below north end of, pipestone bench halfway between lake and river	U S E	E	206 79
—— ARMOUR PLANTATION, pipestone bench on front levee, 1.500 feet above gin	U S E	E	221 25
—— JORDAN FERRY, pipestone bench on Ward place, 10 feet south of Terrell Bayou, 500 feet east of river	U S E	P	215 528
—— JORDAN LANDING, 800 feet from, pipestone bench 500 feet south of Terrell Bayou at angle in levee	U S E	P	215 832
—— same	U S E	E	216 17
—— SMITH BEND PLANTATION, pipestone bench at edge of woods 2,000 feet west of point where levee crosses neck	U S E	E	210 56
—— SULPHUR RIVER, 1 mile above, 200 feet from river and 450 feet above small cabin	U S E	E	209 94
Spirit Lake	St L S W	R	231
Stamps	St L S W	R	266
—— grade at St L S W crossings	L & A	R	258
—— pipestone bench 165 feet from L & A depot, 125 feet north of St L S W main track	U S E	P	207 195
—— 1 2 miles west of, root bench in post oak north of track, 130 feet east of milepost 386	U S E	P	255 394
LINCOLN COUNTY			
Grady; top of rail, center of station	St L, I M & S	R	186
Jefferson County line; top of rail	St L, I M & S	R	186
Varner; top of rail, center of station	St L I M & S	R	180
—— granite post in east corner of yard of R R Rice's residence	U S C & G S	P	179 004
LITTLE RIVER COUNTY			
Alleene, 3 miles north of, rail-end bench 25 feet south of second telegraph pole north of milepost 453	K C S	P	325 55
—— 2 5 miles north of, rail-end bench 12 feet west of milepost 453 5	K C S	P	346 62
—— 2 miles north of, rail-end bench 10 feet northeast of milepost 454	K C S	P	345 23
—— 1 5 miles north of, rail-end bench 20 feet south of milepost 454 5	K C S	P	321 22
—— 1 mile north of, rail-end bench 8 feet east of milepost 455	K C S	P	311 49
—— 0 5 mile north of, rail-end bench 8 feet north of milepost 455 5	K C S	P	311 72
—— station, rail-end bench 5 feet west of milepost 456	K C S	P	320 75
—— 0 5 mile south of, rail-end bench 20 feet west of milepost 456 5	K C S	P	311 78
—— 1 mile south of, rail-end bench 12 feet west of milepost 457	K C S	P	294 69
—— 1 5 miles south of, rail-end bench 10 feet north of milepost 457 5	K C S	P	293 91
—— 2 miles south of, rail-end bench 10 feet west of milepost 458	K C S	P	306 81
—— 2 5 miles south of, rail-end bench 8 feet west of milepost 458 5	K C S	P	314 23
—— 3 miles south of, rail-end bench 12 feet west of milepost 459	K C S	P	293 19
—— 3 5 miles south of, rail-end bench 10 feet south of milepost 459 5	K C S	P	315 89
Ardeen; grade, center of station	St L S F & N O	R	349 5
Arkinda; grade center of station	St L, S F & N O	R	446 1
Ashdown, 3 miles north of rail-end bench 6 feet west of milepost 465 5	K C S	P	326.93
—— 2 5 miles north of, rail-end bench 10 feet west of milepost 466	K C S	P	328 40
—— 2 miles north of, rail-end bench 8 feet west of milepost 466 5	K C S	P	329 04
—— 1 5 miles north of, rail-end bench 9 feet west of milepost 467	K C S	P	329.08

Altitudes in southern Arkansas—Continued

Location	Authority	Class	Elevation
LITTLE RIVER COUNTY—continued			*Feet*
Ashdown, 0.5 mile north of, rail-end bench 7 feet east of milepost 467.5	K. C. S.	P	324.47
—— station, rail-end bench 8 feet west of milepost 468	K. C. S.	P	328.65
—— grade center of station	St. L., S. F. & N. O.	R	327.5
—— 0.5 mile south of, rail-end bench 8 feet west of milepost 468.5	K. C. S.	P	329.26
—— 1 mile south of, rail-end bench 7 feet west of milepost 469	K. C. S.	P	328.54
—— 1.5 miles south of, rail-end bench 10 feet west of milepost 469.5	K. C. S.	P	326.68
Foreman; grade, center of station	St. L., S. F. & N. O.	R	402.5
Hudson, 1 mile north of, rail-end bench 8 feet west of milepost 470	K. C. S.	P	322.15
—— 0.5 mile north of, rail-end bench 6 feet north of milepost 470.5	K. C. S.	P	321.61
—— station, rail-end bench 10 feet west of milepost 471	K. C. S.	P	317.13
—— 0.5 mile south of, rail-end bench 6 feet west of first telegraph pole south of milepost 471.5	K. C. S.	P	314.71
—— 1 mile south of, rail-end bench 10 feet west of milepost 472	K. C. S.	P	312.75
—— 1.5 miles south of, rail-end bench 6 feet west of milepost 472.5	K. C. S.	P	317.21
—— 2 miles south of, rail-end bench 8 feet west of milepost 473	K. C. S.	P	316.69
Little River; rail-end bench 15 feet southeast of first telegraph pole south of milepost 443.5	K. C. S.	P	302.57
—— rail-end bench 30 feet south of milepost 444	K. C. S.	P	301.55
—— WHITE CLIFFS, high water 1892	St. L., S. F. & N. O.	R	267.7
—— ST. L., S. F. & N. O. CROSSING, bridge	St. L., S. F. & N. O.	R	274
—— —— bank	St. L., S. F. & N. O.	R	253
—— —— high water, 1892	St. L., S. F. & N. O.	R	261
Long; grade center of station	St. L., S. F. & N. O.	R	313.5
Morris Ferry, 0.6 mile north of, rail-end bench 30 feet south of milepost 444	K. C. S.	P	301.55
—— 0.1 mile north of, rail-end bench 25 feet north of first pole north of milepost 444.5	K. C. S.	P	308.43
—— 0.4 mile south of, rail-end bench 10 feet south of milepost 445	K. C. S.	P	320.39
—— 0.9 mile south of, rail-end bench 10 feet southwest of milepost 445.5	K. C. S.	P	326.38
Ogden, 2.3 miles north of rail-end bench 8 feet west of second telegraph pole south of milepost 473.5	K. C. S.	P	311.02
—— 1.8 miles north of, rail-end bench 8 feet west of milepost 474	K. C. S.	P	314.59
—— 1.3 miles north of rail-end bench 9 feet west of milepost 474.5	K. C. S.	P	311.61
—— 0.8 mile north of, rail-end bench 10 feet east of milepost 475	K. C. S.	P	316.11
—— 0.3 mile north of, rail-end bench 40 feet northwest of milepost 475.5	K. C. S.	P	309.00
—— 0.2 mile south of, rail-end bench 5 feet south of milepost 476	K. C. S.	P	279.86
—— 0.7 mile south of rail-end bench 15 feet east of milepost 476.5	K. C. S.	P	273.24
—— 1.2 miles south of, rail-end bench 20 feet southeast of milepost 477	K. C. S.	P	273.36
Orton; grade, center of station	St. L., S. F. & N. O.	R	292.5
Rankin, 0.2 mile north of, rail-end bench 6 feet west of milepost 464.5	K. C. S.	P	325.74
—— 0.3 mile south of, rail-end bench 8 feet northwest of second telegraph pole north of milepost 465	K. C. S.	P	312.08
Red River K. C. S. BRIDGE, bench mark on southeast parapet wall, south abutment of bridge B 478	K. C. S.	P	292.715
—— —— bank of river	K. C. S.	R	274.00
—— —— bed of river	K. C. S.	R	241.00
—— —— rail-end bench 20 feet southeast of milepost 477	K. C. S.	P	273.36
—— —— bench mark on northeast corner of parapet wall, north abutment of bridge B 478	K. C. S.	P	292.774
Wilton, 2.9 miles north of rail-end bench 10 feet north of milepost 460	K. C. S.	P	312.25
—— 2.4 miles north of, rail-end bench 10 feet west of milepost 460.5	K. C. S.	P	297.96
—— 2.1 miles north of, rail-end bench 8 feet west of milepost 461	K. C. S.	P	302.11
—— 1.4 miles north of, rail-end bench 25 feet north of milepost 461.5	K. C. S.	P	309.12
—— 0.9 mile north of, rail-end bench 8 feet north of second telegraph pole north of milepost 462	K. C. S.	P	298.74
—— 0.4 mile north of, rail-end bench 50 feet north of second telegraph pole south of milepost 462.5	K. C. S.	P	305.87
—— 0.1 mile south of, rail-end bench 60 feet north of milepost 463	K. C. S.	P	317.70

Altitudes in southern Arkansas—Continued

Location	Authority	Class	Elevation
LITTLE RIVER COUNTY—continued			*Feet*
Wilton, 0 6 mile south of, rail-end bench 7 feet north of milepost 463 5	K C S	P	316 52
—— 1 1 miles south of, rail-end bench 12 feet south of milepost 464	K C S	P	318 90
White Cliffs. *See* Little River			
Winthrop, 3 25 miles north of, rail-end bench 8 feet northeast of milepost 446	K C S	P	319 69
—— 2 75 miles north of, rail-end bench 12 feet east of milepost 446 5	K C S	P	324 38
—— 2 25 miles north of, rail-end bench 15 feet northeast of milepost 447	K C S	P	322 04
—— 1 75 miles north of, rail-end bench 10 feet north of milepost 447 5	K C S	P	312 53
—— 1 25 miles north of, rail-end bench 8 feet north of milepost 448	K C S	P	318 25
—— 0 75 mile north of, rail-end bench 6 feet north of milepost 448 5	K C S	P	319 84
—— 0 25 mile north of, rail-end bench 20 feet north of second telegraph pole north of milepost 449	K C S	P	318 90
—— 0 25 mile south of, rail-end bench south of milepost 449 5	K C S	P	324 07
—— 0 75 mile south of, rail-end bench 7 feet north of milepost 450	K C S	P	318 04
—— 1 25 miles south of, rail-end bench 8 feet north of milepost 450 5	K C S	P	335 03
—— 1 75 miles south of, rail-end bench 8 feet north of milepost 451	K C S	P	327 87
—— 2 25 miles south of, rail-end bench 10 feet west of milepost 451 5	K C S	P	308 93
—— 2 75 miles south of, rail-end bench 10 feet southwest of first telegraph pole north of milepost 452	K C S	P	300 11
—— 3 25 miles south of, rail-end bench 10 feet south of milepost 452 5	K C S	P	296 99
MILLER COUNTY			
Cameron Mills	St L S W	R	390
Clipper switch; top of rail at switch block	St L, I M & S	R	264 5
—— ground	St L, I M & S	R	253
Garland	St L S W	R	233
—— zero U S E gage	U S E	E	203 16
—— high water, 1892	U S E	E	231 64
—— pipestone bench on right bank of Red River, 1,640 feet southwest of depot, 80 feet west of main track	U S E	P	231 397
—— pipestone bench at northwest corner of section house	U S E	P	230 699
—— pipestone bench at section house of St L S W R R	U S E	E	230 80
Genoa	St L S W	R	306
Homan, 3 miles east of, top of rail at milepost 474	St L, I M & S	R	264 1
—— 3 miles east of, ground at milepost 474	St L, I M & S	R	253
—— top of rail, center of station	St L, I M & S	R	268 6
—— ground at station	St L, I M & S	R	266
—— 1 mile west of, top of rail at milepost 478	St L, I M & S	R	265 9
—— 1 mile west of, ground at milepost 478	St L, I M & S	R	259
—— 3 miles west of, top of rail at milepost 480	St L, I M & S	R	260 6
—— 3 miles west of, ground at milepost 480	St L, I M & S	R	258
Mandeville, 1 mile east of, bed of McKinney Bayou	St L, I M & S	R	263
—— top of rail, center of station	St L, I M & S	R	308 5
Ravana, 1 4 miles north of, rail-end bench 15 feet west of milepost 511	K C S	P	258 31
—— 0 9 mile north of rail-end bench 15 feet west of milepost 511 5	K C S	P	233 04
—— 0 4 mile north of, rail-end bench northwest of first telegraph pole south of milepost 512	K C S	P	228 72
—— rail-end bench 15 feet west of milepost 512 5	K C S	P	248 54
—— 0 6 mile south of, rail-end bench 15 feet west of milepost 513	K C S	P	231 95
—— 1 1 miles south of, rail-end bench 15 feet west of milepost 513 5	K C S	P	214 65
—— 1 6 miles south of, rail-end bench 15 feet west of first telegraph pole south of milepost 514	K C S	P	216 67
—— 2 1 miles south of, rail-end bench 65 feet southwest of second telegraph pole south of milepost 514 5	K C S	P	236 16
—— 2 6 miles south of rail-end bench 30 feet northeast of milepost 515	K C S	P	226 57
—— 3 1 miles south of, rail-end bench 8 feet west of first telegraph pole north of milepost 515 5.	K C S	P	205 28

Altitudes in southern Arkansas—Continued

Location	Authority.	Class	Elevation
MILLER COUNTY—continued			*Feet*
Red River, Arkansas-Louisiana State line, 500 feet above pipestone bench, 30 feet from bluff and 75 feet from bank of bayou	U. S. E.	E	212.04
—— Blankstown Bluffs, pipestone bench at foot of, 500 feet north of Arkansas-Louisiana State line	U. S. E.	E	212.04
—— Booker plantation, pipestone bench 1,000 feet above landing at bend of levee	U. S. E.	E	219.22
—— California plantation, pipestone bench 66 feet west of lower end of Nigger Lake, 28 feet north of slough	U. S. E.	E	214.92
—— Chandler (Dr. P. H.) plantation, pipestone bench 1 mile below house, 2,800 feet from river on back levee	U. S. E.	E	221.25
—— Collins Bluff, pipestone bench at store	U. S. E.	E	228.18
—— —— high water, 1892	U. S. E.	E	217.65
—— Cryer plantation, pipestone bench at southwest corner of old field on top of levee	U. S. E.	E	224.77
—— Diggs Bluff, pipestone bench 35 feet southeast of old warehouse	U. S. E.	E	209.51
—— —— 3.5 miles below, 137 feet from river in heavy timber	U. S. E.	E	207.34
—— Dooley Ferry, high water, 1892	U. S. E.	E	247.17
—— K. C. S. crossing, bench mark on southeast parapet wall, south abutment of bridge B 478	K. C. S.	P	292.715
—— Mills (Doctor) plantation, 1,050 feet below lower end of, and 530 feet from river	U. S. E.	E	241.46
—— Murphy plantation, lower end of, pipestone bench in corner of garden	U. S. E.	E	213.75
—— Pearson plantation, upper end of, pipestone bench 1,500 feet from river on levee	U. S. E.	E	232.39
—— —— lower end of, pipestone bench on levee	U. S. E.	E	229.85
—— Sims Landing, 3,600 feet below, pipestone bench 2,000 feet above Red Lake and 400 feet from river	U. S. E.	E	239.33
—— Spring Bank, high water, 1892	U. S. E.	E	217.58
—— —— 3 miles below, pipestone bench at Diggs Bluff near old warehouse	U. S. E.	E	209.51
—— St. L., I. M. & S. bridge, pipestone bench at west end of, 10 feet from bridge seat	U. S. E.	E	265.19
—— —— top of rail	St. L., I. M. & S.	R	270
—— —— bed of river	St. L., I. M. & S.	R	221
—— Wood & Thaxler plantation, near lower end of, pipestone bench inside second levee	U. S. E.	E	234.97
Texarkana, 8 miles north of, rail-end bench 25 feet east of milepost 478.5	K. C. S.	P	274.35
—— 7.5 miles north of, rail-end bench 8 feet southeast of milepost 479	K. C. S.	P	271.64
—— 7 miles north of, rail-end bench 7 feet south of milepost 479.5	K. C. S.	P	271.26
—— 6.5 miles north of, rail-end bench 10 feet south of milepost 480	K. C. S.	P	272.70
—— 6 miles north of, rail-end bench 8 feet north of milepost 480.5	K. C. S.	P	272.31
—— 5.5 miles north of, rail-end bench 6 feet east of milepost 481	K. C. S.	P	273.29
—— 5 miles north of, rail-end bench 10 feet east of first telegraph pole north of milepost 481.5	K. C. S.	P	273.38
—— 4.5 miles north of, rail-end bench 7 feet east of fourth telegraph pole south of milepost 482	K. C. S.	P	301.90
—— 4 miles north of, bench mark on northeast corner east head wall of culvert	K. C. S.	P	309.23
—— 3.5 miles north of, bench mark on northeast corner, east cover, stone culvert	K. C. S.	P	323.28
—— 3 miles north of, on northeast corner parapet wall, south abutment, bridge A484	K. C. S.	P	336.45
—— 2.5 miles north of, rail-end bench 20 feet east of milepost 484	K. C. S.	P	354.87
—— 2 miles north of, rail-end bench 140 feet south of milepost 484.5	K. C. S.	P	332.64
—— 1.5 miles north of, rail-end bench 40 feet southeast of milepost 485	K. C. S.	P	329.27
—— 1 mile north of, rail-end bench 75 feet northeast of milepost 486	K. C. S.	P	300.53
—— 0.5 mile north of, rail-end bench 10 feet southeast of milepost 486.5	K. C. S.	P	299.23
—— bench mark on northeast corner of south pedestal of east pier, water tank	K. C. S.	P	291.57
—— rail-end bench 80 feet north of third telegraph pole south of Cotton Belt crossing	K. C. S.	P	278.47
—— rail-end bench 40 feet south of milepost 488	K. C. S.	P	277.56
—— rail-end bench 8 feet northwest of first telegraph pole south of mile post 488.5	K. C. S.	P	263.77

Altitudes in southern Arkansas—Continued

Location	Authority	Class	Elevation
MILLER COUNTY—continued			*Feet*
Texarkana, bench mark on brick, southeast corner Cotton Belt building, on passenger depot spur	K C S	P	304 39
—— station	St L S W	R	285
—— top of rail, center of union station	St L, I M & S	R	299 1
—— 1 mile east of, top of rail, Nix Creek bridge	St L, I M & S	R	298
—— 4 5 miles east of, top of rail at milepost 486	St L, I M & S	R	350
—— 1 mile south of, rail-end bench 6 feet east of first telegraph pole south of milepost 489	K C S	P	261 57
—— 1 5 miles south of, rail-end bench 8 feet east of first telegraph pole north of milepost 489 5	K C S	P	267 28
—— 2 miles south of, rail-end bench 6 feet northeast of milepost 490	K C S	P	270 67
—— 2 5 miles south of, rail-end bench 9 feet east of milepost 490 5	K C S	P	279 71
—— 3 miles south of, rail-end bench 10 feet north of milepost 491	K C S	P	283 57
—— 3 5 miles south of rail-end beach 8 feet east of milepost 491 5	K C S	P	277 42
—— 4 miles south of, rail-end bench 10 feet southeast of milepost 492	K C S	P	272 95
—— 4 5 miles south of, rail-end bench 7 feet north of milepost 492 5	K C S	P	282 90
—— 5 miles south of, rail-end bench 7 feet north of milepost 493	K C S	P	282 22
NEVADA COUNTY			
Bennett Crossroads; iron post at southeast corner of sec 16, T 13 S, R 22 W	U S G S	P	372 693
Bluff City, 1 75 miles southwest of, south line sec 10, T 12 S, R 20 W, iron post 75 feet west of road and 60 feet north of Spring Branch	U S G S	P	284 281
Bodcaw, 3 miles southeast of, iron post on north side of road, 600 feet south of northeast corner of sec 16, T 14 S, R 22 W	U S G S	P	371 770
Boughton; iron post 130 feet north of track in E De Laughter's yard	U S G S	P	234 414
—— top of rail, center of station	St L, I M & S	R	236 1
Caney, 0 12 mile west of, quarter corner east side of sec 21, T 13 S, R 20 W, iron post 80 feet north of road	U S G S	P	324 807
Centerville; iron post north side of Hope-Camden road near half-mile corner on east side of sec 4, T 13 S, R 23 W	U S G S	P	338 563
Emmett; iron post 130 feet west of center of station, 25 feet north of main line St L, I M & S	U S G S	P	293 695
—— top of rail, center of station	St L, I M & S	R	297 1
Hempstead County line; iron post east side of road at southeast corner of sec 33, T 13 S, R 23 W	U S G S	P	332 156
—— iron post south side of road about 0 25 mile north of southeast corner sec 16, T 10 S, R 23 W	U S G S	P	346 295
—— *See* Centerville			
Lanesburg, 0 5 mile north of, iron post at southeast corner of sec 9 T 12 S, R 22 W	U S G S	P	284 407
Little Missouri River, ST L, I M & S BRIDGE, top of rail	St L, I M & S	R	210 9
—— —— bottom land	St L, I M & S	R	198
—— —— bed of river	St L I M & S	R	172
Little Terre Rouge Creek, ST L, I M & S CROSSING, top of rail, Bridge No 719	St L, I M & S	R	249 1
—— —— bottom land	St L, I M & S	R	240
Morris, 0 25 mile north of, iron post at southwest corner of Caney Church cemetery, northwest quarter of sec 26, T 12 S, R 21 W	U S G S	P	264 948
Prescott, 4 5 miles north of, iron post at northeast corner of sec 20, T 10 S R 22 W	U S G S	P	376 770
—— 5 miles west of *See* Hempstead County, Garlandville			
—— 6 miles east of, iron post on south side of Prescott-Bluff City road, near northeast corner of sec 17, T 11 S, R 21 W	U S G S	P	333 814
—— copper tablet of north meridian monument in court-house yard	U S G S	P	319 057
—— copper tablet of south meridian monument in court-house yard	U S G S	P	316 468
—— top of rail, center of station	St L, I M & S	R	326 2
Prescott-Bluff City road; 4 miles north of Bluff City, iron post on north side of road, on line between secs 21 and 22, 0 25 mile south of north corner T 11 S, R 20 W	U S G S	P	174 286
Register, 2 miles southeast of, iron post on county line east of road, southwest corner sec 34, T. 13 S, R 23 W	U S G S	P	332 156

Altitudes in southern Arkansas—Continued

Location	Authority	Class	Elevation
NEVADA COUNTY—continued			*Feet*
Rosstown, southwest of crossroads to, iron post south of center of sec 21, T 13 S, R. 21 W	U S G S	P	378.707
Willisville, 2 miles east of, iron post at junction of Rosstown-College Hill and Camden-Texarkana roads, southeast corner of sec 16, T 14 S, R 21 W	U S G S	P	362.068
Woodlawn, 1 mile southwest of, iron post north side of road, east side of creek, 500 feet west of southeast corner sec 14, T 14 S, R 20 W	U S. G S	P	255.175
OUACHITA COUNTY			
Barham, 2 miles northeast of, iron post 150 feet east of road, 300 feet northeast of house of J B Benton, at half-mile corner on south line of sec 26, T 11 S, R 19 W	U S G S	P	267.391
Bearden	St L S W	R	227
——0.5 mile north of, at intersection of roads, iron post at northwest corner of sec 35, T 11 S, R 15 W	U S G S	P	229.917
Buena Vista; iron post 75 feet south of main track in front of Mrs Martha Sifford's house	U S G S	P	287.784
——same	U S E	P	287.610
——pipe-stone bench 30 feet west of main track, 360 feet south of depot	U S E	P	282.201
Camden; station	St L S W	R	120
——same	St L, I M & S	R	155
——zero of gage, Ouachita River	U S E	E	71.09
——high water, 1882	U S E	E	117.09
——low water, 1899	U S E	E	73.42
——tablet in stone near northwest corner of court-house	U S G S	P	199.627
——cross in granite sill of east door G L Ritchie's store	U S E	P	133.503
——same	St L S W	R	131.37
——cross on second step at west entrance of court-house	U S E	P	199.313
——pipe-flange bench in southwest corner of Shiloh (colored) Methodist Church yard	U S E	P	138.514
——about 6 miles west of, iron post at fork of Camden-Texarkana dirt road, sec 33, T 13 S, R 18 W	U S G S	P	137.283
Chidester	St L, I M & S	R	232
——iron post about 180 feet northeast of station and 50 feet east of track	U S G S	P	230.838
——pipe-flange bench in yard of Doctor Tidwell	U S E	P	230.362
Dowling	St L, I M & S	R	135
Eagle Mills	St L S W	R	139
Elliott, pipe-flange bench at southwest corner of north store building	U S E	P	254.036
Evans	St L S W	R	202
Finns station	St L S W	R	137
——iron post 45 feet west of track, 140 feet north of railroad crossing	U S G S	P	144.054
——root bench in water oak 50 feet east of track, 165 feet north of store	U S E	P	142.368
Jones & Frisby mill, St L S W R R, 0.25 mile north of, root bench in sweet gum 100 feet south of vacant cabin	U S E	P	277.158
Kemp, 2 miles north of, iron post 40 feet west of Mrs Justice's barn lot and 35 feet west of quarter corner between secs 22 and 23, T 11 S, R 17 W	U S G S	P	143.367
——3 miles northeast of, about 0.8 mile east of Chapel Creek, iron post at northwest corner of sec 28, T 11 S R 16 W	U S G S	P	144.023
Lester, 650 feet east of station, pipe-flange bench 50 feet south of track	U S E	P	113.762
——iron post 10 feet east of Lester Lumber Co 's office and post-office, 55 feet west of Iron Mountain track	U S G S.	P	120.208
Liberty, 2.5 miles southwest of, iron post north side of road, 300 feet east of White Oak Creek, sec 7, T 13 S, R 19 W	U S G S	P	218.682
Lilley	St L S W	R	126
——*See also* Onalaska			
Lufra, 3 miles west of, iron post 30 feet north of Camden-Texarkana road on property of H. L Lusby, northeast quarter of southeast quarter of sec 10, T 14 S, R 19 W	U S G S	P	263.566
Moro Spur; root bench in red oak 65 feet east of track, 0.5 mile north of water tank.	U S E	P	186.717

Altitudes in southern Arkansas—Continued

Location	Authority	Class	Elevation
OUACHITA COUNTY—continued			Feet
Ogamaw, 1 5 miles east of, root bench in white oak 65 feet north of track, 1,900 feet below milepost 352, 6 telegraph poles north of wagon-road crossing	U S E	P	232 504
—— 0 6 mile below, root bench in sweet gum 65 feet west of track, 450 feet south of trestle 853	U S E	P	188 037
Onalaska; iron post 600 feet southwest of station, 8 feet southwest of milepost 329	U S G S	P	129 885
Ouachita River, BEECH HILL, pipe-stone bench at foot of hill, 328 feet northwest of shanty on top	U S E	P	92 951
—— FRENCHPORT, high water, 1895	U S E	E	94 78
—— —— pipe-flange bench on knoll 400 feet from river, 300 feet south of old dwelling	U S E	P	122 990
—— —— pipe-flange bench between gum trees near old dwelling, 500 feet from river	U S E	P	113 999
—— NEWPORT LANDING, high water, 1882	U S E	E	104 88
—— —— root bench in largest sweet gum, 30 feet northwest of upper warehouse	U S E	P	99 386
—— PEDRON WOOD YARD, pipe-stone bench 200 feet from right bank of river and 30 feet from old railroad track	U S E	E	102 26
—— TREADAWAYS, 0 3 mile below Camden, pipe-stone bench in yard of residence	U S E	E	115 05
—— WALNUT HILL, 80 feet from foot of, pipe-stone bench 80 feet from bayou	U S E	P	90 271
Smackover Creek, ST L S W CROSSING, root bench in holly 50 feet from left bank, 65 feet south of track	U S E	P	182 519
Stephens	St L S W	R	221
—— 330 feet north of station, root bench in pine 65 feet west of track, in front of gin	U S E	P	233 632
—— pipe-stone bench in northeast corner of yard of hotel belonging to Mrs Boggs	U S E	P	235 660
Two Bayou, ST L S W CROSSING, root bench in sweet gum 40 feet east of track, 200 feet south of south end of trestle	U S E	P	108 787
Vanduzer, 2 5 miles southwest of, railroad spike in milepost 334	U S G S	P	110 41
—— 3 5 miles northwest of, iron post 12 feet southeast of James Dunn's old store building in southwest part of sec 13, 0 125 mile north of line, T 12 S, R 17 W	U S G S	P	118 813
Wyloe; iron post 800 feet south of Mrs Allen's house and 800 feet south of intersection of Chidester-Wyloe dirt road with Arkansas Mill Co 's tram, T 11 S, R 18 W	U S G S	P	223 858
PIKE COUNTY			
Antoine, 3 miles south of, iron post at west side of military road, in sec 33, T 8 S, R 23 W	U S G S	P	324 980
Antoine Creek, A S W BRIDGE, bed	A S W	R	228
—— —— east bank	A S W	R	265
Daisy; bronze tablet in large bowlder 30 feet southeast of Dr Phillips's store	U S G S	P	628 544
Delight	A S W	R	351
Kirby, center of town, aluminum tablet in brown sandstone rock opposite post-office, northeast corner of cross streets	U S G S	P	665 693
Langley, 0 5 mile east of, iron post at southwest corner of crossroads running through Fancy Hill and Star of the West	U S G S	P	787 101
Hopewell Church, sec 10, T 8 S, R 24 W	A S W	R	414
Lissie, 2 miles southeast of, iron post at crossroads by log house, 0 25 mile south of log railway	U S G S	P	540 970
Lodi, 5 miles west of, iron post in corner of field on main road, at sign "Free Will Church 1 5 miles," and on section line 0 25 mile south of section corner	U S G S	P	869 420
Murfreesboro, 6 miles west of, iron post 90 feet north of old military road sec 21, T 8 S, R 26 W	U S G S	P	654 197
—— aluminum tablet in east wall of court-house	U S G S	P	366 376
Pike City; iron post at northwest corner of platform of Frank Pennington's general store	U S G S	P	658 815
—— station	A S W	R	665
Rock Creek, 1,000 feet west of post-office, bronze tablet in huge brown sandstone bowlder at edge of creek	U S G S	P	535 418
Wilson, in front yard of post-office, aluminum tablet in blue-gray siliceous sandstone	U S G S	P	803 87
Wolf Creek, post-office, iron post 20 feet north of building	U S G S	P	515 039
—— A S W BRIDGE, in southwest quarter of southwest quarter of sec 34, T 7 S., R. 24 W.	A S W	R	459

Altitudes in southern Arkansas—Continued

Location	Authority	Class	Elevation
SALINE COUNTY			*Feet*
Benton	St L ,I M & S	R	280
—— iron post in depot yard of Iron Mountain Railway	U S G S	P	298 426
—— cross on iron rail in garden inclosure east of depot	U S E	P	298 411
Big Lake station; top of rail, center of station	St L ,I M & S	R	250
Ferrell station; *top of rail, center of station*	*St L ,I M & S*	R	253
Hensley; top of rail, center of station	St L ,I M & S	R	253 5
Jefferson County line; top of rail	St L ,I M & S	R	244
Pulaski County line; top of rail	St L ,I M & S	R	251 5
Saline River; cross on top of stone pedestal at north end of west abutment of St L ,I M & S bridge	U S E	P	282 373
Traskwood; top of iron rail at northeast corner of lot in front of G U Winter's hotel	U S E	P	291 952
Woodson; top of rail, center of station	St L ,I M & S	R	249
SEVIER COUNTY			
Ben Lomond, town well	Veatch	A	475
Brownstown	Veatch	A	400±
Burlingame; rail-end bench 10 feet north of first telegraph pole south of milepost 438 5	K C S	P	450 03
De Queen, 2 8 miles north of, rail-end bench 30 feet north of milepost 430 5	K C S	P	451 67
—— 2 3 miles north of, rail-end bench 20 feet northwest of milepost 431	K C S	P	425 58
—— 1 8 miles north of, rail-end bench 65 feet north of third telegraph pole north of milepost 431 5	K C S	P	421 67
—— 1 3 miles north of, rail-end bench 10 feet south of first telegraph pole south of milepost 432	K C S	P	398 00
—— 0 8 mile north of, rail-end bench 10 feet northwest of milepost 432 5	K C S	P	391 67
—— 0 3 mile north of, rail-end bench 8 feet west of first telegraph pole south of milepost 433	K C S	P	377 87
—— 0 2 mile south of, rail-end bench 6 feet east of milepost 433 5	K C S	P	379 65
—— 0 7 mile south of, rail-end bench 20 feet north of milepost 434	K C S	P	353 26
—— 1 2 miles south of, east end north abutment bridge No 435	K C S	P	355 42
—— 1 7 miles south of, rail-end bench 90 feet south of milepost 435	K C S	P	357 26
—— *2 2 miles south of, rail-end bench 10 feet west of milepost 435 5*	K C S	P	366 20
—— 2 7 miles south of, rail-end bench 20 feet west of 436	K C S	P	397 69
—— 3 2 miles south of, rail-end bench 12 feet northeast of milepost 436 5	K C S	P	434 52
—— 3 7 miles south of, rail-end bench 15 feet east of milepost 437	K C S	P	468 62
Gillham, 2 2 miles north of, rail-end bench 20 feet south of milepost 419	K C S	P	810 59
—— 1 7 miles north of, rail-end bench 12 feet south of milepost 419 5	K C S	P	815 16
—— 1 2 miles north of, rail-end bench 50 feet north of milepost 420	K C S	P	800 09
—— 0 7 mile north of, rail-end bench 7 feet northeast of third telegraph pole north of milepost 420 5	K C S	P	790 32
—— 0 2 mile north of, rail-end bench 60 feet north of first telegraph pole south of milepost 421	K C S	P	750 73
—— northwest corner of north pedestal of east pair, water tank	K C S	P	747 614
—— 0 3 mile south of, rail-end bench 8 feet south of milepost 421 5	K C S	P	745 43
—— 0 8 mile south of, rail-end bench 10 feet southwest of first telegraph pole south *of milepost 422*	K C S	P	736 91
—— 1 3 miles south of, rail-end bench 40 feet north of milepost 422 5	K C S	P	732 39
—— 1 8 miles south of, rail-end bench 20 feet south of first telegraph pole north of milepost 423	K C S	P	711 17
—— 2 3 miles south of, rail-end bench 25 feet northwest of milepost 423 5	K C S	P	697 86
—— 2 8 miles south of, rail-end bench 30 feet north of first telegraph pole south of milepost 424	K C S	P	670 87
Horatio, 3 1 miles north of, rail-end bench 10 feet north of first telegraph pole north of milepost 437 5	K C S	P	498 71
—— 2 6 miles north of, rail-end bench 10 feet west of first telegraph pole south of milepost 438	K C S	P	484 16
—— 2 1 miles north of, rail-end bench 10 feet north of first telegraph pole south of milepost 438 5	K C S	P	450 03

Altitudes in southern Arkansas—Continued

Location	Authority	Class	Elevation
SEVIER COUNTY—continued			*Feet*
Horatio, 1 6 miles north of, rail-end bench 8 feet west of milepost 439	K C S	P	418 30
—— 1 1 miles north of, rail-end bench 10 feet west of milepost 439 5	K C S	P	390 16
—— 0 6 mile north of, rail-end bench 5 feet south of milepost 440	K C S	P	368 61
—— 0 1 mile north of, rail-end bench 5 feet south of milepost 440 5	K C S	P	341 21
—— 0 4 mile south of, rail-end bench 8 feet west of milepost 441	K C S	P	322 78
—— 0 9 mile south of, rail-end bench 20 feet south of first telegraph pole north of milepost 441 5	K C S	P	309 29
—— 1 4 miles south of, rail-end bench 8 feet northeast of milepost 442	K C S	P	304 72
—— 1 9 miles south of, rail-end bench 10 feet northeast of milepost 442 5	K C S	P	303 25
—— 2 4 miles south of, rail-end bench 6 feet northeast of milepost 443	K C S	P	304 08
—— 2 9 miles south of, rail-end bench 15 feet southeast of first telegraph pole south of milepost 443 5	K C S	P	302 57
Neal Springs; rail-end bench 8 feet northeast of milepost 442	K C S	P	304 74
Pullman, 2 8 miles north of, rail-end bench 20 feet south of milepost 424 5	K C S	P	632 70
—— 2 3 miles north of, rail-end bench 15 feet south of milepost 425	K C S	P	627 18
—— 1 8 miles north of, rail-end bench 45 feet south of milepost 425 5	K C S	P	613 22
—— 1 3 miles north of, rail-end bench 12 feet north of second telegraph pole north of milepost 426	K C S	P	608 75
—— 0 8 mile north of, rail-end bench 90 feet south of milepost 426 5	K C S	P	575 33
—— 0 3 mile north of, rail-end bench 20 feet north of first telegraph pole north of milepost 427	K C S	P	546 20
—— 0 2 mile south of, rail-end bench 95 feet south of milepost 427 5	K C S	P	544 52
—— 0 7 mile south of, rail-end bench 35 feet north of milepost 428	K C S	P	575 45
—— 1 2 miles south of, rail-end bench 15 feet south of milepost 428 5	K C S	P	566 35
—— 1 7 miles south of, rail-end bench 25 feet south of milepost 429	K C S	P	531 84
—— 2 2 miles south of, rail-end bench 10 feet west of milepost 429 5	K C S	P	499 71
—— 2 7 miles south of, rail-end bench 12 feet east of milepost 430	K C S	P	463 66
UNION COUNTY			
Cargile.	A S	R	218
Champagnolle. *See* Ouachita River, Champagnolle			
Eldorado[a]	A S	R	260
Johnson Spring, 250 feet above root bench in persimmon 13 feet north of ravine, 500 feet south of Langford's house	U S E	P	108 777
Junction City	A S	R	164
Ouachita River, ARKANSAS-LOUISIANA LINE, pipe-flange bench 292 feet from right bank of river and 2,000 feet below small cabin on left bank	U S E	E	64 56
—— BAYOU LAPILE, 1 mile above, pipestone bench in woods 250 feet west of river	U S E	P	61 358
—— CANEY MARIE LANDING pipestone bench 115 feet from right bank and 65 feet west of small drain	U S E	E	68 73
—— CAREYVILLE pipestone bench on lane 525 feet southeast of river and 492 feet south of warehouse	U S E	P	81 985
—— CHAMPAGNOLLE, zero of gage	U S E	E	—17 98
—— high water, 1882	U S E	E	97 24
—— pipestone bench 500 feet from river in fork of valley near store	U S E	P	97 389
—— 3 5 miles below, pipestone bench south side of Bell's field, 1,500 feet from river	U S E	P	80 838
—— ELDORADO LANDING, pipestone bench in yard of R T Goodwin	U S E	P	87 918
—— EUTAW SHOALS, 1 800 feet below, pipestone bench in woods 200 feet west of river, on slough	U S E	P	72 344
—— FLETCHERS LANDING, high water, 1894	U S E	E	89 30
—— 1,600 feet below, pipestone bench in edge of woods on east side of field 130 feet south of river	U S E	P	84 299
—— FRANKLIN BAYOU, root bench 2,000 feet above mouth, 30 feet from river	U S E	P	80 402
—— 800 feet northwest of mouth of, pipestone bench 400 feet southwest of river	U S E	P	74 209
—— GRAND MARY LANDING, 650 feet above, root bench in white oak 300 feet from river	U S E	P	65 790

[a] From profile in office of Arkansas Southern Railway Company, which starts at Camden with an elevation of 141 feet

Altitudes in southern Arkansas—Continued.

Location.	Authority.	Class.	Elevation.
UNION COUNTY—continued.			Feet.
Ouachita River, Jacks Island, opposite lower end of; pipestone bench on old road 300 feet south of river.	U. S. E	P	77.928
—— Lake Landing, 800 feet below; pipestone bench 50 feet east of Pools Bayou and 250 feet southwest of Ouachita River.	U. S. E	P	58.991
—— Ouachita Belle Landing, 650 feet southwest of; pipestone bench 575 feet south of road.	U. S. E	P	64.246
—— Pigeon Hill Landing; pipestone bench 250 feet south of, 150 feet west of warehouse.	U. S. E	P	81.168
—— Smackover Creek; pipestone bench on right bank, 80 feet below mouth of creek.	U. S. E	P	86.477
—— Wilmington; high water, 1882	U. S. E	E	94.45

ALTITUDES IN NORTHERN LOUISIANA.

AVOYELLES PARISH.			Feet.
Atchafalaya River, Water Valley Landing; pipestone bench on Tom Carruth's plantation.	U. S. E	P	42.712
Bayou des Glaises, Lemoines Ferry, 1 mile above; root bench in locust 115 feet from Tony Lien's dwelling.	U. S. E	P	53.959
—— —— 115 feet above; root bench in chinaberry on left bank	U. S. E	P	56.558
—— Moreauville, Rabelais plantation; copper bolt in chimney of cabin 100 feet from bayou.	U. S. E	P	61.255
—— Pavey plantation; copper bolt in chimney of cabin of Bazil François, 0.3 mile southeast of Hamburg, 200 feet from bayou.	U. S. E	P	55.695
—— Norwood plantation; copper bolt in chimney of cabin about 575 feet east of Harlands Bayou.	U. S. E	P	50.515
Bayou Choctaw, L. R. & N. bridge; sec. 8, T. 1 N., R. 3 E., top of stringer	L. R. & N	R	63.4
—— —— bank of bayou	L. R. & N	R	51
—— —— bed of bayou	L. R. & N	R	36
Bordelonville; grade, center of station	L. R. & N	R	50.4
Bunkie; grade, center of station	T. & P	R	65.7
Cocoville; root bench in black locust 156 feet southeast of Avnes Collar's residence.	U. S. E	P	72.541
Cypress Bayou, southeast bank of; root bench in pecan 165 feet northeast of Mansura-Moreauville road.	U. S. E	P	50.670
Eggbend post-office; root bench in locust at foot of levee opposite store	U. S. E	P	63.156
Grand Isle; ground at summit	L. R. & N	R	83
—— grade at summit	L. R. & N	R	71
Hamburg, 0.3 mile southeast of: on Pavey's plantation, copper bolt in chimney of cabin of Bazil François 200 feet from Bayou des Glaises.	U. S. E	P	55.695
Hessmer; grade, center of station	L. R. & N	R	78.2
Mansura; copper bolt in northwest pier of gallery of David Siess's store	U. S. E	P	76.422
—— near southern limits; copper bolt in chimney of Mme. V. Claude's residence	U. S. E	P	79.686
—— T. & P. crossing	L. R. & N	R	78.3
—— east of summit of Coutee des Grues	L. R. & N	R	83.4
Marksville; north end, root bench in chinaberry in front of Dr. Mix's residence	U. S. E	P	81.572
Marksville-Barbin Landing road; Bize's gin, 800 feet north of; root bench in pin oak.	U. S. E	P	77.711
—— Bordelon store, in front of root bench in west side of most northerly chinaberry.	U. S. E	P	81.780
—— Mrs. Frame's house, in front of; root bench in pin oak	U. S. E	P	79.324
Moreauville, Rabelais plantation; copper bolt in chimney of cabin 100 feet south of Bayou des Glaises.	U. S. E	P	61.255
Red Fish post-office, 1 mile below; root bench in sycamore 165 feet north of cabin occupied by Philip Bankes on William Perkins's place.	U. S. E	P	49.050
Red River, Barbin Landing; pipe-flange bench in corner of yard at residence, 130 feet southwest of warehouse.	U. S. E	P	57.980
—— —— *root bench in cottonwood 165 feet from river, 65 feet west of warehouse.*	U. S. E	P	56.992

Altitudes in northern Louisiana—Continued

Location	Authority	Class	Elevation
AVOYELLES PARISH—continued			*Feet*
Red River, BAYOU L'EAU NOIR, 60 feet south of, nail in side of pecan south of road, 650 feet east of road crossing from Saline Point	U S E	P	51 588
—— BETTEVY'S STORE, 100 feet below, root bench on cottonwood 30 feet from river	U S E	P	57 913
—— BROUILLETTE PLACE, upper end of, root bench on sycamore 500 feet below last cabin on Bettevy's place, 80 feet from river	U S E	P	56 236
—— CHOCTAW BAYOU, root bench in willow on left bank of bayou	U S E	P	63 210
—— —— root bench in cottonwood 265 feet below bayou, 80 feet from right bank of river	U S E	P	63 483
—— DAVID FERRY, copper bolt in chimney at southwest end of Laborde's house	U S E	P	66 353
—— EGG BEND LANDING, root bench in locust at foot of levee opposite store	U S E	P	63 156
—— JUNCAN PLACE, 250 feet below residence, root bench in cottonwood 65 feet from right bank of river	U S E	P	57 032
—— LABORDE LANDING, 800 feet below, root bench in elm opposite large two-story frame house on left bank	U S E	P	60 789
—— MURRAY LANDING, Monlard's place, root bench on leaning willow 65 feet from bank of Red River, 300 feet above house on Old Raccourn place	U S E	P	52 300
—— NORMANDS LANDING, 0 4 mile above, root bench in sycamore 30 feet from river	U S E	P	59 030
—— —— 330 feet above Reynand's place, root bench in cottonwood 165 feet from river	U S E	P	57 212
—— REYNAND'S PLACE, copper bolt in chimney of residence	U S E	P	61 532
—— SALINE BAYOU, mouth of, high water, 1892	U S E	E	56 98
—— SALINE POINT, 3,250 feet south of, pipe-flange bench in yard at residence of John White	U S E	P	54 472
Simmesport, 1 5 miles west of, copper bolt in chimney of cabin on Atchafalaya road, right bank of Bayou des Glaises, about 575 feet east of Harlands Bayou	U S E	P	50 515
—— pipestone bench in J Trudeau's yard, south of Norwood's store	U S E	P	41 962
Vorhees; grade, center of station	L R & N	R	55 4
BIENVILLE PARISH			
Alberta; grade, center of station	L & A	R	181
Arcadia, 2 miles east of, root bench in pine north of track, 325 feet east of milepost 117	U S E	P	352 543
—— root bench in white oak north of track, 325 feet west of milepost 119	U S E	P	358 877
—— pipestone bench in yard of most easterly of four section houses	U S E	P	368 984
—— top of rail, center of station	V, S & P	R	361 9
—— 2 miles west of, root bench 120 feet north of bridge, 325 feet east of milepost 121	U S E	P	338 040
Black Lake Bayou; L & A BRIDGE, top of stringer	L & A	R	158
—— —— high water	L & A	R	153
—— —— bed of bayou	L & A	R	131
Camp Long; southeast corner sec 3, T 15 N, R 9 W	S, L B & S	R	288
Castor; grade, center of station	L & A	R	181
Castor Bayou, L & A CROSSING, bed of bayou	L & A	R	154
Davis station; top of rail, center of platform	S, L B & S	R	287
Freyburg; grade, center of station	L & A	R	257
Gibsland, 2 miles east of, root bench in white oak south of track, 115 feet west of milepost 126	U S E	P	229 776
—— root bench in hickory 115 feet north of track, 250 feet west of milepost 128	U S E	P	219 233
—— pipestone bench in Colbert Hotel yard, 100 feet south of track	U S E	P	241 941
—— top of rail, center of station	V, S & P	R	246 9
Grand Bayou, S, L B & S BRIDGE, secs 21-22, T 15 N, R 9 W, top of rail	S, L B & S	R	239
—— —— bed of bayou	S, L B & S	R	228
—— —— secs 27-28, T 15 N, R 9 W, top of rail	S, L B & S	R	230
—— —— bed of bayou	S, L B & S	R	221
Jamestown; grade, center of station	L & A	R	231
Lawhon; grade, center of station	L & A	R	268
Martin Junction	S, L B & S	R	259
Red River Parish line	S, L B & S	R	223

Altitudes in northern Louisiana—Continued

Location	Authority	Class	Elevation
BIENVILLE PARISH—continued			*Feet*
Ringgold; top of rail, center of station	S, L B & S	R	274
—— 1 mile south of, 0 25 mile south of northwest corner of sec 10, T 15 N, R 9 W, summit between Brushy and Grand bayous	S, L B & S	R	291
Taylor	V, S & P.	R	227
—— pipestone bench in gin yard, 58 feet south of track	U S E	P	218 269
Thomas station.	S, L B & S	R	252
BOSSIER PARISH			
Alden Bridge; pipestone bench in hotel yard, 260 feet west of track, 400 feet northeast of station	U S E	P	215 521
—— 1 3 miles south of, root bench in post oak east of track, 130 feet south of milepost 433	U S E	P	212 468
Antrim; root bench in pine east of track, 80 feet south of milepost 424	U S E	P	255 732
Arkanna; root bench in red oak east of track, 1 telegraph pole north of State line	U S E	P	245 534
Atkins; grade, center of station	L R & N	R	150 7
Benton, 2 miles north of, root bench in post oak, 165 feet south of milepost 435	U S E.	P	213 359
—— pipestone bench in northeast corner of section-house yard	U S E	P	210 067
Bodeau; top of rail, center of station	V, S & P.	R	206 1
—— pipestone bench in Oliver Williams's yard, 80 feet south of track.	U S E	P	203 713
Bolinger, 0 5 mile north of, root bench in white oak east of track, 8 telegraph poles north of milepost 419	U S E	P	339 504
Bossier City; pipestone bench in yard of Mrs M D C Cane	U S E	E	170 70
—— St L S W crossing	L R & N	R	175 1
—— V, S & P bridge, "X" on anchor bolt on first pier at east end	U S E	P	186 250
Brownlee station, 0 5 mile north of, root bench in elm 130 feet east of track, 4 5 telegraph poles south of milepost 445	U S E	P	172 314
—— 0 5 mile south of, root bench in elm east of track at trestle 90	U S E	P	172 889
Chalk Level; grade, center of station	L R & N	R	173 7
Curtis; grade, center of station	L R & N	R	163 7
Curtis post-office, 1,000 feet south of root bench in cottonwood, 650 feet east of Red River	U S E.	P	166 385
Elm Grove; grade, center of station	L R & N	R	155 2
Harvey; grade, center of station.	L R & N.	R	159 7
Haughton; top of rail, center of station	V, S & P	R	239 9
—— pipestone bench in J T Edwards's yard	U S E.	P	236 759
Hughes, 1 5 miles north of, root bench in post oak west of track, 2 5 telegraph poles south of milepost 429	U S E	P	219 553
Hunter; grade, center of station	L R & N	R	153 7
Ninock; grade, center of station	L R & N	R	150 7
Plain Dealing; pipestone bench 325 feet north of depot, 60 feet west of track.	U S E	P	260 415
Poole; grade, center of station.	L R & N	R	148 7
Red River; ALBANS CANAL No 1, 80 feet from south side of, pipestone bench, 450 feet from river	U S E.	E	200 98
—— BENOIT BAYOU, 420 feet above, pipestone bench on levee in front of T J Vance's house	U S E	E	181 69
—— —— same	U S E	P	181 739
—— BOONE BEND, head of, pipestone bench opposite narrow part of neck and 128 feet from river	U S E	E	203 60
—— CURTIS, high water, 1892	U S E	E	171 12
—— —— 1,000 feet south of, root bench in cottonwood 650 feet east of river.	U S E	P	166 385
—— DUTCH JOHN LAKE, pipestone bench between lake and river, 320 feet above Fuller inlet	U S E	E	197 30
—— GILMER LANDING, 2,400 feet above, pipestone bench on top of bluff just below Fuller outlet	U S E.	E	237 86
—— —— 1,000 feet above, pipestone bench at Dr Vance's residence	U S E	E	222 17
—— HURRICANE BLUFF, 0 9 mile above mouth of Old River, 80 feet from left bank.	U S E	E	191 96
—— —— pipestone bench at residence of Walter Ivory	U S E	P	191 500
—— —— 1,000 feet above mouth of bayou, at top of boss of standard bench-mark pipe, 1,650 feet from river	U S E	P	228 803

Altitudes in northern Louisiana—Continued

Location	Authority	Class	Elevation
BOSSIER PARISH—continued			
			Feet
Red River; LUSK FERRY, pipestone bench in southwest corner of yard of Jake Lusk, 1,300 feet from river	U S E	P	229 139
——— KINCAID PLACE, pipestone bench in field 165 feet east of bayou, 375 feet back of levee	U S E	P	163 901
——— LAKE HOME PLANTATION, pipestone bench on back levee, 150 feet below bend	U S E	E	189 50
——— MILLERS BLUFF, pipestone bench in southwest corner of yard of Jake Lusk, 1,300 feet from river	U S E	P	229 139
——— NINOCK BAYOU, high water, 1892	U S E	E	149 27
——— PANDORA PLANTATION, pipestone bench on levee at first bend above ferry	U S E	E	181 16
——— POSTEN BAYOU, 160 feet below, pipestone bench 250 feet from river	U S E	E	198 78
——— ——— same	U S E	P	198 254
——— VANCE (COLONEL) PLANTATION, pipestone bench at intersection of north stable yard fence with public road	U S E	E	177 26
——— VANCE (T J) PLANTATION *See* VANCEVILLE			
Red River Parish line; grade	L R & N	R	147 7
Roberta; root bench in red oak west of track, 100 feet south of wagon-road crossing	U S E	P	320 842
Taylortown; grade, center of station	L R & N	R	155 7
Vanceville, 1 8 miles north of, root bench in cottonwood 650 feet east of track, 8 telegraph poles north of milepost 442	U S E	P	178 325
——— 1 mile north of, X cut on brick chimney below mark "U S" 200 feet west of track, 3 5 telegraph poles north of milepost 443	U S E	P	177 802
——— pipestone bench on levee in front of residence of T J Vance	U S E	P	181 739
——— same	U S E	E	181 69
Wadley station; top of rail, center of station	V, S & P	R	189 9
Willow Chute, 0 5 mile north of, root bench in sycamore west of track, 9 telegraph poles north of milepost 439	U S E	P	183 673
CADDO PARISH			
Albany Point; pipestone bench in northeast corner of yard	U S E	P	222 868
Ananias, 1 6 miles north of, rail-end bench 45 feet northeast of milepost 533 5	K C S	P	181 61
——— 1 1 miles north of, rail-end bench 12 feet west of milepost 534	K C S	P	190 72
——— 0 6 mile north of, rail-end bench 15 feet west of milepost 534 5	K C S	P	194 73
——— 0 1 mile north of, rail-end bench 15 feet west of milepost 535	K C S	P	196 42
——— 0 4 mile south of, rail-end bench 18 feet west of first telegraph pole north of milepost 535 5	K C S	P	205 28
——— 0 9 mile south of, rail-end bench 60 feet north of milepost 536	K C S	P	206 15
Arkansas-Louisiana State line; rail-end bench 9 feet west of milepost 516	K C S	P	228 80
Beckville; grade, center of station	M, K & T	R	271
Black Bayou; K C S CROSSING, top of rail	K C S	R	203
——— ——— high water	K C S	R	200 50
——— ——— bank of bayou	K C S	R	183
——— ——— bed of bayou	K C S	R	174
Blanchard, 4 miles north of, rail-end bench 15 feet west of first telegraph pole north of milepost 544	K C S	P	285 33
——— 3 5 miles north of, rail-end bench 60 feet southwest of second telegraph pole south of milepost 544 5	K C S	P	305 84
——— 3 miles north of, rail-end bench 60 feet southwest of milepost 545	K C S	P	292 60
——— 2 5 miles north of, rail-end bench 70 feet southwest of milepost 545 5	K C S	P	286 57
——— 2 miles north of, rail-end bench 15 feet northwest of first telegraph pole south of milepost 546	K C S	P	283 77
——— 1 5 miles north of, rail-end bench 12 feet west of milepost 546 5	K C S	P	270 17
——— 1 mile north of, rail-end bench 12 feet west of milepost 547	K C S	P	244
——— 0 5 mile north of, rail-end bench 10 feet west of milepost 547 5	K C S	P	226 43
——— rail-end bench 12 feet west of milepost 548	K C S	P	227 91
——— depot, top of rail, at center	K C S	R	227
——— 0 5 mile south of, rail-end bench 30 feet northwest of milepost 548 5	K C S	P	223 83
——— 1 mile south of, rail-end bench 25 feet west of milepost 549	K C S	P	213 19

Altitudes in northern Louisiana—Continued

Location	Authority	Class	Elevation
CADDO PARISH—continued			*Feet*
Blanchard, 1.5 miles south of, rail-end bench 25 feet northwest of milepost 549.5	K. C. S.	P	211.65
——— 2 miles south of, rail-end bench 20 feet west of milepost 550	K. C. S.	P	203.96
——— 2.5 miles south of, rail-end bench 40 feet north of first telegraph pole north of milepost 550.5	K. C. S.	P	201.50
——— 3 miles south of, rail-end bench 30 feet southwest of third telegraph pole south of milepost 551	K. C. S.	P	187.84
——— 3.5 miles south of, rail-end bench 95 feet south of milepost 551.5	K. C. S.	P	186.36
——— 4 miles south of, rail-end bench 20 feet southwest of milepost 552	K. C. S.	P	195.15
——— 4.5 miles south of, rail-end bench 15 feet northwest of milepost 552.5	K. C. S.	P	195.86
——— 5 miles south of, rail-end bench 75 feet north of first telegraph pole north of milepost 553	K. C. S.	P	191.06
——— 5.5 miles south of, rail-end bench 85 feet north of milepost 553.5	K. C. S.	P	186.56
——— 6 miles south of, rail-end bench 25 feet northwest of milepost 554	K. C. S.	P	183.68
Boggy Bayou, T. & P. bridge, top of stringer	T. & P.	R	171.4
——— ——— bed of bayou	T. & P.	R	155
Brushy Bayou, T. & P. bridge, top of stringer	T. & P.	R	203.5
Buchanan Bayou, T. & P. bridge, top of stringer	T. & P.	R	179.6
Bungalow; top of rail, center of station	H. & S.	R	173.8
Caddo Lake, K. C. S. crossing, bridge	K. C. S.	R	199
——— ——— high water	K. C. S.	R	190
——— ——— bed	K. C. S.	R	170
Chinquepin Bayou, T. & P. bridge, top of stringer	T. & P.	R	202.7
Cross Lake, K. C. S. bridge, top of rail	K. C. S.	R	182
——— ——— high water	K. C. S.	R	178
——— ——— bed of lake	K. C. S.	R	160
——— ——— bed of channel	K. C. S.	R	155
Cypress Bayou, T. & P. bridge, top of stringer, north end	T. & P.	R	176.5
——— ——— bed of bayou	T. & P.	R	161
De Soto Parish line; top of stringer, Keatchie Bayou bridge	H. & S.	R	239
Ferry Lake, Jeters Landing, pipestone bench near northeast corner of deserted cabin	U. S. E.	P	197.246
——— Mooringsport, pipestone bench on north side of C. S. Croon's store	U. S. E.	P	183.135
Flournoy; grade, center of station	M., K. & T.	R	284
Forbing, 1.8 miles north of, rail-end bench 15 feet west of first telegraph pole north of milepost 564	K. C. S.	P	202.67
——— 1.3 miles north of, rail-end bench 50 feet southwest of milepost 564.5	K. C. S.	P	204.47
——— 0.8 mile north of, rail-end bench 20 feet west of milepost 565	K. C. S.	P	206.03
——— 0.3 mile north of, rail-end bench 25 feet west of milepost 565.5	K. C. S.	P	206.31
——— rail-end bench 25 feet northwest of first telegraph pole south of milepost 566	K. C. S.	P	225.13
——— 0.7 mile south of, rail-end bench 15 feet west of milepost 566.5	K. C. S.	P	206.09
——— 1.2 miles south of, rail-end bench 10 feet west of milepost 567	K. C. S.	P	208.85
——— 1.7 miles south of, rail-end bench 20 feet west of milepost 567.5	K. C. S.	P	202.73
——— 2.2 miles south of, rail-end bench 15 feet west of milepost 568	K. C. S.	P	200.24
——— 2.7 miles south of, rail-end bench 15 feet west of milepost 568.5	K. C. S.	P	198.26
——— 3.2 miles south of, rail-end bench 15 feet northwest of milepost 569	K. C. S.	P	198.18
——— 3.7 miles south of, rail-end bench 30 feet southwest of first telegraph pole south of milepost 569.5	K. C. S.	P	191.87
——— 4.2 miles south of, rail-end bench 40 feet north of milepost 570	K. C. S.	P	196.95
——— 4.7 miles south of, rail-end bench 45 feet north of milepost 570.5	K. C. S.	P	172.29
——— 5.2 miles south of, rail-end bench 35 feet north of fifth telegraph pole north of milepost 571	K. C. S.	P	167.44
Gilmer Bayou, T. & P. bridge, top of stringer, south end	T. & P.	R	182.8
Greenwood; grade, center of station	M., K. & T.	R	226
——— 1.5 miles east of, summit grade	M., K. & T.	R	297
——— 1.5 miles east of, summit ground	M., K. & T.	R	306
Henderson Mills, Caddo Lake, pipestone bench near northwest corner of deserted house	U. S. E.	P	244.352

Altitudes in northern Louisiana—Continued

Location	Authority	Class	Elevation
CADDO PARISH—continued			*Feet.*
Hosston; station (approximate)	(a)	R	249
Irvings Bluff; base	(b)	L	184
—— top of hill south of ferry	Veatch	A	330
Jeters Landing, FERRY LAKE, pipestone bench near northeast corner of deserted cabin	U S E	P	197 246
Jewella; grade, center of station	M, K & T	R	241
Keatchie Bayou; top of stringer H & S bridge	H & S	R	239
Keithville; grade, center of H & S crossing	T & P	R	196 7
—— grade, T & P crossing[c]	H & S	R	197 5
—— top of rail, center of station[d]	H & S	R	205 3
La Rosen; top of rail, center of station	H & S	R	219 7
Lewis, 1 4 miles north of, rail-end bench at milepost 530 5	K C S	P	208 91
—— 0 9 mile north of, rail-end bench 8 feet west of milepost 531	K C S	P	205 93
—— 0 4 mile north of, rail-end bench 15 feet northwest of milepost 531 5	K C S	P	201 61
—— 0 1 mile south of, rail-end bench at milepost 532	K C S	P	193 87
—— 0 6 mile south of, rail-end bench 40 feet north of milepost 532 5	K C S	P	187 74
—— 1 1 miles south of, rail-end bench 15 feet west of milepost 533	K C S	P	189 49
Missionary; post-office, 1902	Veatch	L	204
—— 2 miles below, pipestone bench 90 feet south of Bargetown slough, east of levee	U S E	E	204 85
Mooringsport, 2 8 miles north of, rail-end bench 70 feet north of first telegraph pole south of milepost 536 5	K C S	P	202 55
—— 2 3 miles north of, rail-end bench 15 feet west of first telegraph pole north of milepost 537	K C S	P	195 05
—— 1 8 miles north of, rail-end bench 50 feet southwest of second telegraph pole south of milepost 537 5	K C S	P	209 87
—— 1 3 miles north of rail-end bench 15 feet west of milepost 538	K C S	P	192 73
—— 0 8 mile north of, rail-end bench 7 feet west of first telegraph pole north of milepost 538 5	K C S	P	200 12
—— 0 3 mile north of, rail-end bench 15 feet west of first telegraph pole south of bridge "B 539"	K C S	P	201 32
—— pipestone bench on north side of C S Croon's store	U S E	P	183 135
—— depot, top of rail at center	K C S	R	197
—— 0 2 mile south of, bench mark on northeast corner of north pedestal, east pair, water tank	K C S	P	194 33
—— 0 7 mile south of, rail-end bench 45 feet left of track opposite milepost 540	K C S	P	206 05
—— 1 2 miles south of, rail-end bench 20 feet west of first telegraph pole north of milepost 540 5	K C S	P	195 06
—— 1 7 miles south of, rail-end bench 20 feet west of milepost 541	K C S	P	190 87
—— 2 2 miles south of, rail-end bench 25 feet west of milepost 541 5	K C S	P	198 23
—— 2 7 miles south of, rail-end bench 20 feet west of milepost 542	K C S	P	207 53
—— 3 2 miles south of, rail-end bench 15 feet west of milepost 542 5	K C S	P	238 50
—— 3 7 miles south of, rail-end bench 15 feet west of milepost 543	K C S	P	261 90
—— 4 2 miles south of, rail-end bench 20 feet southwest of milepost 543 5	K C S	P	277 56
Myrtis, 0 8 mile north of, rail-end bench 15 feet north of fifth telegraph pole south of milepost 522	K C S	P	215 86
—— 0 3 mile north of, rail-end bench 15 feet southwest of second telegraph pole north of milepost 522 5	K C S	P	198 12
—— platform, top of rail, at south end	K C S	R	211
—— 0 2 mile south of, rail-end bench 10 feet west of milepost 523	K C S	P	207 78
—— 0 7 mile south of, rail-end bench 15 feet west of milepost 523 5	K C S	P	221 64
—— 1 2 miles south of, rail-end bench 75 feet north of milepost 524	K C S	P	212 14
—— 1 7 miles south of, rail-end bench 18 feet west of milepost 524 5	K C S	P	227 35
—— 2 2 miles south of rail-end bench 17 feet west of milepost 525	K C S	P	234 50

[a] Corrected from original survey of T , S & N R R See Geol Survey Louisiana, Rept for 1899 [1900], p, 206

[b] Obtained by comparison of Woodruff survey maps with those of Red River survey

[c] Corrected from blueprint of profile received from chief engineer in 1898, on which K C S crossing Shreveport=228 feet

[d] Corrected according to data given on p 328

Altitudes in northern Louisiana—Continued.

Location	Authority	Class	Elevation
CADDO PARISH—continued			*Feet*
Preston; top of rail, center of station	H. & S.	R	270.3
Red River, Arkansas-Louisiana State line, 500 feet above, pipestone bench 30 feet from bluff and 75 feet from bank of bayou	U. S. E.	E	212.04
—— Ashwood Landing, root bench in barren mulberry 50 feet below gin on Cash place	U. S. E.	P	156.305
—— —— pipestone bench 450 feet from river and 270 feet northwest of bayou on Cash plantation	U. S. E.	P	152.286
—— Barrs Ferry, pipestone bench in yard of cabin 400 feet from river	U. S. E.	E	172.60
—— Bargetown Slough, 90 feet south of, pipestone bench east of levee	U. S. E.	E	204.85
—— Bear Point, 1,950 feet below, root bench in small chinaberry on road, 65 feet from river	U. S. E.	P	151.741
—— Beasleys Landing, pipestone bench at cabin 1,000 feet back of store	U. S. E.	E	186.87
—— Bonner plantation, pipestone bench near cabin 600 feet from river, 1,000 feet southwest of gin	U. S. E.	P	144.013
—— Campo Bello plantation, high water, 1892	U. S. E.	E	151.80
—— —— pipestone bench in Dr. T. Allison's yard	U. S. E.	P	146.437
—— Caspiana Landing, pipestone bench on Hutchinson's plantation 8 feet east of gin, 415 feet from river	U. S. E.	P	148.141
—— Corner plantation, pipestone bench 2,500 feet below Cottonwood Bayou at cabin on small slough	U. S. E.	E	182.31
—— Cotton Point store, root bench in chinaberry 65 feet south-southwest of store, 165 feet northwest from gin	U. S. E.	P	146.983
—— Dixon's store, pipestone bench 400 feet back of levee between branches of Cowhide Bayou	U. S. E.	E	189.92
—— Eric (John) plantation, pipestone bench in field below house, 800 feet back of gin	U. S. E.	E	180.64
—— Gold Point plantation, southwest corner of, at intersection of lanes, 600 feet from river	U. S. E.	E	178.24
—— Herndon (E. B.) plantation, pipestone bench back of cabin, opposite Doctor Dillard's, 600 feet from river	U. S. E.	E	174.57
—— Herndon plantation, pipestone bench at cabin nearly opposite line between Cash and Carmouche plantations	U. S. E.	E	174.86
—— Lotus Landing, high water 1892	U. S. E.	E	163.18
—— —— pipestone bench in yard of Captain Robson's store, 150 feet from river	U. S. E.	P	157.639
—— Missionary place, upper end of, high water, 1892	U. S. E.	E	213.64
—— Peru plantation, pipestone bench on levee between plantation and Dooleys Bayou, 300 feet from bayou	U. S. E.	E	195.50
—— Rush Point, high water, 1892	U. S. E.	E	195.27
—— Soda Fount plantation, pipestone bench on back levee near Carolina plantation line	U. S. E.	E	180.53
—— Southside plantation, west side of, pipestone bench on levee along small bayou	U. S. E.	E	176.70
—— Wild Lucia, high water, 1892	U. S. E.	E	199.01
Reisor; grade, center of station	T. & P.	R	190.4
Rhodessa, 3 miles north of, rail-end bench 15 feet west of milepost 516.5	K. C. S.	P	218.46
—— 2.5 miles north of, rail-end bench 20 feet west of milepost 517	K. C. S.	P	211.04
—— 2 miles north of, rail-end bench 65 feet north of first telegraph pole north of milepost 517.5	K. C. S.	P	201.02
—— 1.5 miles north of, rail-end bench 15 feet west of milepost 518	K. C. S.	P	208.11
—— 1 mile north of, rail-end bench 20 feet west of milepost 518.5	K. C. S.	P	206.60
—— 0.5 mile north of, rail-end bench 15 feet west of milepost 519	K. C. S.	P	230.18
—— rail-end bench at second telegraph pole north of milepost 519.5	K. C. S.	P	226.91
—— depot, at center, top of rail	K. C. S.	R	329
—— 0.5 mile south of, rail-end bench 12 feet west of fourth telegraph pole north of milepost 520	K. C. S.	P	213.78
—— 1.5 miles south of, rail-end bench 7 feet west of milepost 521	K. C. S.	P	211.87
—— 2 miles south of, rail-end bench 12 feet west of first telegraph pole north of milepost 521.5	K. C. S.	P	214.67
Robson; pipestone bench in yard of Captain Robson's store, 150 feet from river	U. S. E.	P	157.639
—— high water, 1892	U. S. E.	E	163.18

Altitudes in northern Louisiana—Continued

Location	Authority	Class	Elevation
CADDO PARISH—continued			*Feet*
Shreveport, 4 miles north of, rail-end bench 15 feet west of milepost 555.	K C S	P	163 41
—— 3 5 miles north of, rail-end bench 60 feet north of third telegraph pole south of milepost 555 5	K C S	P	185 78
—— 3 miles north of, rail-end bench 45 feet left of track opposite milepost 556	K C S.	P	189 79
—— 2 5 miles north of, rail-end bench 85 feet north of third telegraph pole south of milepost 556 5	K C S.	P	208 34
—— 2 miles north of, rail-end bench 20 feet southeast of second telegraph pole south of milepost 557	K C S.	P	230 43
—— 1 5 miles north of, bench mark on 0 75-inch rod 1 foot west of west side of roundhouse	K C S.	P	249 124
—— rail-end bench 15 feet west of first telegraph pole north of south head block of Y	K C S.	P	219 51
—— rail-end bench 25 feet northwest of third telegraph pole south of milepost 559	K C S	P	206 63
—— pipestone bench in yard of post-office	U S E.	P	[a]195 744
—— high water, 1892	U S E	E	176 70
—— zero, U S E gage	U S E	E	140 99
—— V , S & P BRIDGE, west end, top of rail.	V , S & P.	R	189 3
—— "X" on lower course of top stones on south side of west abutment V , S & P bridge	U S E	P	181 800
—— highest point in, Hicks street, east of Fairfield street	(b)	L	276
—— T & P crossing	H & S	R	228
—— M , K & T crossing, top of rail	K C S	R	238 9
—— T & P crossing, top of rail	K C S.	R	238 3
—— H & S freight station, top of rail center of	H & S	R	234
—— H & S crossing, grade.	K C S	R	234
—— bench mark on southwest corner stone door sill, men's waiting room at union depot	K C S	P	208 61
—— bench mark on southwest corner of brick foundation on first bent south end of coal-chute track	K C S	P	247 55
—— bench mark on corner curb, north side of Jordan street, 20 feet right of track	K C S	P	243 86
—— junction, pipe under oak 68 feet right of track	T & P	R	230 28
—— 0 5 mile south of, rail-end bench 12 feet west of milepost 559 5.	K C S	P	202 64
—— 1 mile south of, rail-end bench 75 feet north of milepost 560	K C S	P	203 02
—— 1 5 miles south of, rail-end bench 25 feet northwest of milepost 560 5	K C S.	P	214 88
—— 2 miles south of, rail-end bench 12 feet west of milepost 561	K C S	P	225 01
—— 2 5 miles south of, rail-end bench 25 feet west of milepost 561 5	K C S	P	210 52
—— 3 miles south of, rail-end bench 25 feet northwest of first telegraph pole north of milepost 562	K C S	P	219 04
—— 3 5 miles south of, rail-end bench 25 feet west of milepost 562 5	K C S	P	206 17
—— 4 miles south of, rail-end bench 25 feet west of milepost 563	K C S	P	203 30
—— 4 5 miles south of, rail-end bench 25 feet northwest of milepost 563 5	K C S	P	202 67
Sodo Lake, lower end of, right bank, pipestone bench at Albany Point, in northeast corner of yard	U S E.	P	222 868
—— upper end of, right bank, pipestone bench near northwest corner of deserted house at Henderson Mills	U S E	P	244 352
Texas-Louisiana State line	M , K & T	R	261
Twelvemile Bayou, head of, right bank, pipestone bench at Albany Point, in northeast corner of yard	U S E	P	222 868
Vivian, 1 2 miles north of, rail-end bench 20 feet northwest of milepost 525 5	K C S	P	224 35
—— 0 7 mile north of, rail-end bench 12 feet west of milepost 526	K C S	P	250 91
—— 0 2 mile north of, rail-end bench 65 feet south of first telegraph pole north of milepost 526 5	K C S.	P	246 28
—— depot, at center, top of rail	K C S	R	250 8
—— 0 3 mile south of, rail-end bench 12 feet west of milepost 527	K C S.	P	251 36
—— 0 8 mile south of, rail-end bench 8 feet west of milepost 527 5	K C S	P	245 95
—— 1 3 miles south of, rail-end bench 10 feet southwest of second telegraph pole north of milepost 528	K C S.	P	247 10
—— 1 8 miles south of, rail-end bench 15 feet west of second telegraph pole north of milepost 528 5	K C S	P	226 47

[a] Elevation by line Camden to Shreveport, 195 585 feet

[b] Map of Shreveport showing sewer-pipe system, November, 1900

Altitudes in northern Louisiana—continued.

Location.	Authority.	Class.	Elevation.
CADDO PARISH—continued.			*Feet.*
Vivian, 2.3 miles south of; rail end bench 20 feet west of milepost 529.	K. C. S	P	215.93
—— 2.8 miles south of; rail-end bench 20 feet west of second telegraph pole north of milepost 529.5.	K. C. S	P	206.29
—— 3.3 miles south of; rail-end bench 45 feet north of milepost 530	K. C. S	P	206.63
CALDWELL PARISH.			
Banks Spring; grade, at water tank	St L., I. M. & S	R	184.0
Bayou Crew, 500 feet west of bridge on north side of Columbia-Three Rivers road; root bench on pin oak.	U. S. E	P	59.117
Bayou Lafourche, 650 feet northeast of bridge on east side of Boeuf River-Columbia road; root bench on Spanish oak.	U. S. E	P	66.143
Black Bayou, St. L., I. M. & S. crossing; grade	St. L., I. M. & S	R	118.4
Blanktown; pipestone bench in J. A. Davis's yard	U. S. E	P	64.252
Boeuf River, Big Creek; pipe-flange bench opposite mouth of	U. S. E	E	54.33
—— Bird Lake Landing, 1,000 feet above; pipe-flange bench on Harris place, 130 feet from river.	U. S. E	P	65.020
—— Brandin (Leopold) place; root bench in pin oak 15 feet from river, 500 feet northwest of residence.	U. S. E	P	64.150
—— Brandin (Paul) place; pipe-flange bench at old Doucier Landing	U. S. E	P	65.113
—— Duff place; pipe-flange bench on river bank 200 feet from Duff's cabin	U. S E	E	61.30
—— Harris place; pipe-flange bench 130 feet from river, 1,000 feet above Bird Lake Landing.	U. S. E	P	65.020
—— Herberts; zero of gage, 1898	U. S. E	E	[a]—20.12
—— Herberts Landing; pipe-flange bench in garden back of house of widow Johnson.	U. S. E	P	62.502
—— Three Rivers Ferry; pipe-flange bench 250 feet above Columbia-Winnsboro road.	U. S. E	P	54.415
Boeuf River post-office, 0.5 mile above; root bench in pin oak, east side of Boeuf River-Landerneau road.	U. S. E	P	63.101
Columbia; pipestone bench at corner of Wall and Main streets	U. S. E	P	61.341
—— *station; grade, north head block*	St. L., I. M. & S	R	126.8
—— station; grade, south head block	St. L., I. M. & S	R	134.8
—— low water, 1873	U. S. E	E	20.44
—— high water, 1882	U. S. E	E	69.78
—— 1 5 miles below; pipe-flange bench on the I. Davis place, on left bank	U. S. E	P	68.325
—— opposite; root bench in water oak 90 feet from river bank, 250 feet northwest of ferry landing.	U. S. E	P	64.003
Columbia-Three Rivers road, north side of; root bench in pin oak 500 feet west of bridge over Bayou Crew.	U. S. E	P	59.117
Grayson; grade, center of station	St L., I. M. & S	R	159.0
Hurricane Creek, St. L., I M. & S. crossing; bridge	St. L., I. M. & S	R	127.1
—— —— high water	St. L., I. M. & S	R	122.7
—— —— bank	St. L., I. M. & S	R	121
—— —— bed of creek	St. L., I. M. & S	R	110
Kelly; grade, center of *station*	St. L., I. M. & S	R	120.4
Landernau; root bench in water oak in front of gin	U. S. E	P	—63.580
—— high water, 1882	U. S. E	E	70.24
—— low water, 1899	U. S. E	E	38.18
—— zero of gage	U. S. E	E	[a]—20.44
Ouachita River, Bellevue Landing; root bench in pecan 311 feet north of landing.	U. S. E	P	65.268
—— Big Lake; root bench in white oak 65 feet west of lake, 425 feet south of Indian mound.	U. S. E	P	62.253
—— Coles Landing; pipestone bench in southwest corner of V. Thompson's field 50 feet east of Wade Bayou.	U. S. E	P	60.567
—— Cottingham Landing; pipestone bench on top of ridge 72 feet west of road	U. S. E	P	57.860
—— Davis (I.) place; pipe-flang beench near south boundary, 690 feet from east boundary.	U. S. E	P	68.325

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[a] See note, p. 14.

Altitudes in northern Louisiana—Continued.

Location.	Authority.	Class.	Elevation.
CALDWELL PARISH—continued.			*Feet.*
Ouachita River, Danville; top of gas pipe in northwest corner of horse lot adjoining Baughman's residence.	U. S. E	P	60.219
—— —— root bench in pecan 200 feet from river 65 feet south of Bayou Dam	U. S. E	P	58.368
—— —— high water, 1882	U. S. E	E	69.58
—— Gibson Landing, pipe-flange bench in J. W. Price's yard	U. S. E	P	61.253
—— Henriette Landing, 2,625 feet from; root bench in elm on south side Harrisonburg road.	U. S. E	P	59.653
—— Jacks Landing, 250 feet southeast of; boat spike in sweet gum 130 feet from river.	U. S. E	P	65.652
—— Long Lake Landing; root bench in red oak 50 feet east of left river bank	U. S. E	P	61.336
—— Myer (C. C.) place; root bench in pin oak 20 feet west of west fence, 65 feet east of road.	U. S. E	P	60.094
—— Peters Bayou; root bench in sweet gum on north bank, 980 feet above mouth.	U. S. E	P	56.510
—— St. L., I. M. & S. bridge, grade	St. L., I. M. & S	R	81.1
—— —— chisel mark in upper edge of lowest piece of sheet-iron casing of northwest pier.	U. S. E	P	56.261
—— Sinope Landing; root bench in catalpa in front of house	U. S. E	P	73.124
—— —— high water, 1882	U. S. E	E	70.50
—— —— pipe-flange bench southeast of Filhiol residence, 450 feet from left bank of river.	U. S. E	E	69.75
—— Upper Breston Landing; pipe-flange bench in first lane south of residence, 425 feet from river.	U. S. E	E	68.99
—— Waco Landing, 0.6 mile above; pipe-flange bench at lane end, 200 feet from Methodist Church.	U. S. E	E	74.77
—— Wade place; pipe-flange bench 500 feet below steam gin	U. S. E	P	69.353
Riverton; grade, center of station	St. L., I. M. & S	R	68.1
—— zero of gage	U. S. E	E	14.92
—— 325 feet southeast of station; root bench on sweet gum 30 feet from track	U. S. E	P	67.312
—— 1 mile south of; root bench in mulberry 800 feet from north end of trestle approach to drawbridge.	U. S. E	P	66.722
—— 1 mile south of; pipestone bench 1,000 feet from north end of trestle approach to drawbridge.	U. S. E	P	63.141
Smith Lake; 820 feet from end of trestle approach to drawbridge over Ouachita River.	U. S. E	P	66.722
Three Rivers Ferry; pipe-flange bench on Boeuf River 250 feet above Columbia-Winnsborough road.	U. S. E	P	54.415
CATAHOULA PARISH.			
Black River, Boatner plantation; root bench in oak 50 feet east of levee, 650 feet northeast of residence.	U. S. E	P	54.745
—— —— root bench in oak on road 25 feet east of levee, 500 feet from river, 3,250 feet below store.	U. S. E	P	55.834
—— Jones Bayou; pipe-flange bench on south side of bayou, on Nicholia place	U. S. E	P	58.923
—— Mays Landing, 325 feet southwest from; root bench in pecan 50 feet west of levee.	U. S. E	P	55.953
—— Montgomery Landing; pipe-flange bench on south side of road 1,200 feet from river.	U. S. E	E	53.64
—— Security; high water, 1882	U. S. E	E	61.41
—— Security post-office; root bench in cottonwood 600 feet south of store, 50 feet west of river.	U. S. E	P	57.402
—— Trisler Landing, 2,000 feet below; pipe-flange bench on mound west of Fairplay place.	U. S. E	E	57.80
—— Whitehead (John & Gabe) gin; root bench in persimmon 800 feet north of gin, 65 feet west of river.	U. S. E	P	56.343
Boeuf River, Alligator Landing, 1.4 miles above; pipe-flange bench on right bank, 6 miles above mouth.	U. S. E	E	49.14
Chickasaw Creek, St. L., I. M. & S. trestle; grade	St. L., I. M. & S	R	85.0
Chisum station; pipe-flange bench on Newman plantation road, 100 feet west of track.	U. S. E	P	71.739
Copeland; pipe-flange bench 115 feet east of track, 115 feet southeast of station	U. S. E	P	64.058
—— 2 miles west of; root bench in elm east of track, 5 telegraph poles north of milepost 26.	U. S. E	P	53.664

Altitudes in northern Louisiana—Continued.

Location.	Authority.	Class.	Elevation.
CATAHOULA PARISH—continued.			*Feet.*
Florence station; pipe-flange bench 400 feet north of depot, 50 feet west of track.	U. S. E.	P	72.373
—— 1.4 miles north of; pipe-flange bench at Chisum, south side of road, 100 feet west of track.	U. S. E.	P	71.739
Funne Louis Creek, L. & A. crossing; bed of creek	L. & A.	R	74
Harrisonburg, V-mark on brick at ground level on northeast corner of clerk's office in court-house yard.	U. S. E.	P	67.378
—— copper-bolt in second brick from southwest corner of parish jail	U. S. E.	P	79.077
—— high water, 1882	U. S. E.	E	65.68
Jena; grade, center of station	L. & A.	R	156
—— 1.5 miles west of; divide between Trout and Hemphill creeks near milepost 185.	L. & A.	R	211
Jonesville; high water, 1882	U. S. E.	E	62.73
—— pipestone bench in Doctor Baker's lot	U. S. E.	P	54.018
Kirks Ferry. *See* under Tensas River.			
Little River, St. L., I. M. & S. crossing; bridge	St. L., I. M. & S.	R	87.3
—— —— high water	St. L., I. M. & S.	R	86.3
—— —— north bank	St. L., I. M. & S.	R	56
—— —— bed of river	St. L., I. M. & S.	R	27
—— L. & A. crossing; bed of river	L. & A.	R	24
Olla; grade, center of station	St. L., I. M. & S.	R	153.6
Ouachita River, Bushley Bayou, 130 feet north of; root bench in live oak 100 feet southeast of Hugh's dwelling.	U. S. E.	P	59.800
—— —— 650 feet south of mouth; pipe-flange bench at wood line 1,050 feet from right bank of river.	U. S. E.	E	59.12
—— Catahoula Shoals; pipestone bench in pine grove 40 feet from west bank of river.	U. S. E.	P	57.194
—— —— high water, 1890	U. S. E.	E	62.82
—— Davis Landing; pipe-flange bench on upper edge of old Davis place, 550 feet from right bank of river.	U. S. E.	E	58.79
—— Gillespie place; root bench in pecan 235 feet northwest of river, 115 feet southwest of Mrs. Calvert's residence.	U. S. E.	P	58.004
—— Peters Bayou, 2,300 feet below; pipe-flange bench on left bank of river	U. S. E.	E	62.79
—— Stafford; pipestone bench 230 feet west of river, opposite mouth of Boeuf River.	U. S. E.	P	56.367
—— —— high water, 1882	U. S. E.	E	66.79
—— —— zero of gage	U. S. E.	E	[a]−20.28
—— Tew Lake Outlet; pipe-flange bench 1,650 feet from right bank of river, 165 feet south of wood line.	U. S. E.	E	57.48
—— Trinity, 0.25 mile above; pipe-flange bench on upper side of Gillespie place, 800 feet from right bank of river.	U. S. E.	E	57.44
Peck; pipe-flange bench in corner of cotton field, about 80 feet from station seed house.	U. S. E.	P	74.793
—— 2.4 miles south of; pipe-flange bench on Newman property 30 feet east of trestle on north bank of bayou.	U. S. E.	P	71.403
—— 1 mile south of; root bench in pin oak east of track, 820 feet south of milepost 33	U. S. E.	P	73.213
Searcy; grade, center of station	L & A.	R	121
—— 3 miles east of; grade near milepost 183	L & A.	R	202
Security. *See under* Black River.			
Sicily Island post-office. *See* Florence Station.			
Stafford. *See under* Ouachita River.			
Tensas River, Anchor place; root bench in oak on east side of road	U. S. E.	P	60.927
—— Greenville; pipe-flange bench 265 feet from N. O. & N. W. track, 113 feet west of main right bank.	U. S. E.	P	64.484
—— Kirks ferry; pipe-flange bench in yard of S. F. Kiper, above mouth of Choctaw Bayou.	U. S. E.	P	64.957
—— —— zero of gage	U. S. E.	E	[a]−17.06
—— —— high water, 1897	U. S. E.	E	63.77
—— Lee Bayou; pipe-flange bench on bank 165 feet west of track	U. S. E.	P	63.392

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[a] See note, p. 14.

Altitudes in northern Louisiana—Continued.

Location	Authority	Class	Elevation
CATAHOULA PARISH—continued			
			Feet
Trinity; pipestone bench on Guss estate, back of kitchen	U S E	P	53 624
—— high water, 1882	U S E	E	62 86
—— low water, 1873	U S E	E	8 26
Tullos; grade, center of station	St L , I M & S	R	106 1
Urania; grade, center of station	St L , I M & S	R	91
CONCORDIA PARISH.			
Acme post-office. *See under* Black River.			
Black Hawk. *See under* Mississippi River			
Black River, Acme, pipe-flange bench in field on J A Lanius's place, 630 feet from Black River	U S E	E	52 10
—— —— pipe-flange bench 75 feet northeast of river, 265 feet below Burleighs Landing	U S E	P	50 224
—— Alton Landing, 950 feet below, pipe-flange bench 40 feet from river	U S E	E	55 18
—— Barker Landing, 2,000 feet south of, root bench in iron wood on levee, 650 feet south of bayou	U S E	P	53 381
—— Calhoun Landing *See* Eva post-office			
—— Cynthia Bayou, root bench in ironwood on levee, 650 feet south of bayou	U S E	P	53 381
—— Delhoste Landing, pipe-flange bench 100 feet from river, 225 feet from landing	U S E	P	48 984
—— Emmerson Landing, pipe-flange bench 75 feet south of river, 125 feet northeast of residence.	U S E	P	51 995
—— Eva post-office, pipe-flange bench 30 feet west of bank of Black River, 200 feet north of N Calhoun's residence	U S E	P	53 590
—— Gillespies Bayou, 1,300 feet above, pipe-flange bench in Jackson's field, 13 feet from bank	U S E	E	52 32
—— Hardscramble Landing, pipe-flange bench 20 feet south of road, 60 feet south of levee.	U S E	P	54 242
—— Lanius (J A) place, 0 6 mile above Acme post-office, pipe-flange bench in field 650 feet from river	U S E	E	52 10
—— Lums Landing, pipe-flange bench 50 feet southeast of Pauhl's residence, 500 feet north of river.	U S E	P	52 284
—— Monterey, 0 5 mile below, pipe-flange bench on line between T 5 and 6 N.	U S E	E	54 19
—— Mouth of, high water, 1882	U S E	E	57 97
—— —— high water, 1892	U S E	E	56 39
—— —— zero of gage	U S E	E	a—20 51
—— Ploudens Bayou, 560 feet north of, pipe-flange bench on line of T 5 and 6 N R 7 E.	U S E	E	54 19
Black River station; zero of gage	U S E	E	4 49
—— high water, 1893	U S E	E	59 28
—— pipestone bench opposite mouth of Little River, 200 feet from depot	U S E	P	51 198
—— root bench in hackberry 225 feet from main bank of Ouachita River, near high-water section of gage	U S E	P	55 097
—— root bench in pignut hickory near U S gage	U S E	P	48 741
—— root bench in sweet gum near U S gage	U S E	P	50 571
—— 7 miles east of, root bench on pecan south of N , R R & T track, 80 feet southeast of milepost 7	U S E	P	57 377
Bougere. *See under* Mississippi River			
Clayton. *See under* Tensas River			
Concordia; pipe-flange bench 16 feet south of N , R R & T track at station	U S E	P	60 329
Cypress; pipe-flange bench in yard of Henry Elerbee (colored), 275 feet west of N O & N W R R track	U S E	P	58 243
Eva post-office. *See under* Black River			
Frogmore; pipestone bench in southwest corner of section-house yard	U S E	P	56 442
Helena; pipe-flange bench 65 feet from track in lane on property of Graves-Veaton Co	U S E	P	60 396
Mississippi River, Ashley plantation, granite post	U. S C & G. S	P	54 088

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[a] See note, p 14

Altitudes in southern Arkansas—Continued.

Location	Authority	Class	Elevation
CONCORDIA PARISH—continued			*Feet*
Mississippi River, BLACK HAWK, 3 miles south of, on Ballamagan plantation, near engine house, cut in cistern, marked "U S B M ☐ LII"	U S C & G S.	P	56 409
——— ——— granite post at east steps of E Pullen's residence	U S C & G S	P	52 265
——— BOUGERE, Ashland plantation, granite post at steps of W G Walton's residence	U S C & G S	P	56 959
——— BULLITS BAYOU PLANTATION, marble post at right of entrance of residence next plantation store	U S C & G S.	P	64 378
——— DEER PARK PLANTATION, marble post at steps of agent's house	U S C & G S	P	59 152
——— FAIRVIEW, BRABSTON PLANTATION, marble post at steps of residence	U S C & G S	P	56 150
——— GIBSONS LANDING, marble post at northwest corner of Stanton & Brandon's store	U S C & G S	P	65 967
——— LUMS POINT, copper bolt in stone post on Lum's plantation opposite Fort Adams, Miss	U S C & G S	P	53 010
——— ——— Point Breeze plantation, copper bolt in stone post.	U S C & G S.	P	53 142
——— MORO PLANTATION, marble post near steps of owner s dwelling.	U S C & G S.	P	64 129
——— ——— 0 5 mile below the above, granite post	U S C & G S	P	63 098
——— MORVILLE LANDING, 2 miles below, on Ashley plantation, granite post.	U S C & G S	P	54 088
——— ——— 1 mile above, on Moro plantation, granite post.	U S C & G S	P	63 098
Monterey. *See under* Black River			
New Era; pipe-flange bench 75 feet south of river, 125 feet northeast of residence at Emmerson Landing	U S E.	P	51 995
Otts Bayou, N, R R & T, CROSSING, pipestone bench on east bank, 35 feet north of track, 35 feet east of trestle	U S E.	P	56 442
Red River, BLACK RIVER, 500 feet below mouth of, cement-filled vitrified pipe in Delhoste's field	U S E.	E	47 40
Stanton station, east of, pipe-flange bench near cotton platform on Athlone place	U S E.	E	55 88
Tensas River, ATHLONE PLACE, high water, 1893	U S E.	E	60 63
——— ——— pipe-flange bench near cotton platform east of Stanton station	U S E	E	55 88
——— CLAYTON, pipe-flange bench 82 feet northeast of N O & N W track, 30 feet southeast of river	U S E.	P	61 337
——— ——— zero of gage	U S E.	E	−17 06
——— ——— high water, 1893	U S E.	E	63 77
——— ——— low water.	U S E	E	20 70
——— HAPHAZARD, high water, 1893	U S E.	E	61 25
——— LAMARQUE PLACE, high water, 1893	U S E.	E	62 63
Vidalia, 4 5 miles above, marble post in levee, near old brick wall	U S C & G S.	P	68 256
——— marble post at steps of Judge W H Hough's residence	U S C & G S.	P	63 276
——— same.	U S E	P	63 422
——— bolt in granite monument in lot behind court-house and jail[a]	U S C & G S.	P	61 089
——— same[b]	U S E.	P	61 235
DE SOTO PARISH			
Benson, 3 6 miles north of, rail-end bench 15 feet west of milepost 600 5	K C S.	P	304 24
——— 2 6 miles north of, rail-end bench 108 feet west of milepost 601 5.	K C S.	P	276 22
——— 2 1 miles north of, rail-end bench 40 feet north of first telegraph pole south of milepost 602	K C S	P	280 09
——— 1 6 miles north of, rail-end bench 15 feet west of milepost 602 5	K C S	P	268 52
——— 1 1 miles north of, rail-end bench 15 feet southwest of milepost 603	K C S.	P	252 94
——— 0 6 mile north of, rail-end bench 35 feet southwest of third telegraph pole south of milepost 603 5	K C S	P	248 12
——— 0 1 mile north of, rail-end bench 12 feet southwest of milepost 604	K C S	P	249 29
——— 0 4 mile south of, rail-end bench 8 feet west of mile post 604 5.	K C S.	P	241 70
——— 0 9 mile south of, rail-end bench 10 feet west of milepost 605.	K C S	P	231 03
——— 1 4 miles south of, rail-end bench 35 feet southwest of first telegraph pole north of milepost 605 5	K C S	P	229 37
Billmore; top of rail, center of station	H & S.	R	312 5

[a] "Bench found disturbed in 1893"

[b] In 1893

Altitudes in northern Louisiana—Continued.

Location	Authority	Class	Elevation
DE SOTO PARISH—continued			*Feet*
Caddo Parish line; top of stringer, Keatchie Bayou bridge.	H & S.	R	239
Cypress Bayou, T & P BRIDGE, top of stringer, north end	T & P.	R	176 5
—— bed of bayou	T & P.	R	161
De Soto Parish line; rail-end bench 35 feet southwest of first telegraph pole north of milepost 605 5	K C S.	P	229 37
Franks; top of rail, center of station	H & S.	R	330 6
Frierson, 4 2 miles north of, rail-end bench 15 feet west of first telegraph pole south of milepost 572	K C S.	P	166 63
—— 3 7 miles north of, rail-end bench 20 feet west of milepost 572 5	K C S.	P	183 56
—— 3 2 miles north of, rail-end bench 45 feet right of first telegraph pole north of milepost 537	K C S.	P	203 38
—— 2 7 miles north of, rail-end bench 35 feet southwest of first telegraph pole west of milepost 573 5	K C S.	P	208 52
—— 2 2 miles north of, rail-end bench 20 feet west of milepost 574	K C S.	P	227 56
—— 1 7 miles north of, rail-end bench 20 feet southwest of third telegraph pole south of milepost 574 5	K C S.	P	212 86
—— 1 2 miles north of, rail-end bench 15 feet west of milepost 575.	K C S.	P	201 59
—— 0 7 mile north of, rail-end bench 15 feet west of milepost 575 5	K C S.	P	190 95
—— 0 2 mile north of, rail-end bench 55 feet south of milepost 576	K C S.	P	185 88
—— 0 3 mile south of, rail-end bench west of milepost 576 5	K C S.	P	187 61
—— 0 8 mile south of, rail-end bench 15 feet west of milepost 577	K C S.	P	177 17
—— 1 3 miles south of, spike in milepost 577 5.	K C S.	P	164 17
—— 1 8 miles south of, rail-end bench 18 feet west of milepost 578.	K C S.	P	174 26
—— 2 3 miles south of, rail-end bench 20 feet west of milepost 578 5	K C S.	P	164 04
—— 2 8 miles south of, rail-end bench 18 feet west-southwest of sixth telegraph pole south of milepost 579	K C S.	P	165 07
—— 3 3 miles south of, rail-end bench 18 feet northwest of milepost 479 5	K C S	P	179 43
Funston; top of rail, center of station	H & S.	R	231 7
Gloster; grade, center of station	T & P	R	250 1
Grand Cane; grade, center of station	T & P	R	301 5
Hollingsworth station; rail-end bench 15 feet west of first telegraph pole north of milepost 588	K C S	P	251 17
Holly, 3 2 miles north of, rail-end bench 15 feet northwest of milepost 581	K C S.	P	195
—— 2 7 miles north of, rail-end bench 50 feet southwest of first telegraph pole south of milepost 581 5	K C S.	P	178 09
—— 2 2 miles north of, rail-end bench 15 feet west of milepost 582	K C S.	P	168 54
—— 1 7 miles north of, rail-end bench 60 feet south of milepost 582 5	K C S.	P	206 44
—— 1 2 miles north of, rail-end bench 10 feet west of sixth telegraph pole south of milepost 583	K C S.	P	231 51
—— 0 7 mile north of, rail-end bench 10 feet west of first telegraph pole north of milepost 583 5	K C S.	P	217 93
—— 0 2 mile north of, rail-end bench 15 feet west of first telegraph pole north of milepost 584	K C S	P	196 97
—— 0 3 mile south of, rail-end bench 90 feet south of milepost 584 5	K C S.	P	185 84
—— 0 8 mile south of, rail-end bench 35 feet northwest of milepost 585	K C S.	P	178 01
—— 1 3 miles south of, rail-end bench 15 feet southwest of milepost 585 5	K C S.	P	193 95
—— 1 8 miles south of, rail-end bench 30 feet north of second telegraph pole north of milepost 586	K C S	P	195 65
—— 2 3 miles south of, rail-end bench 35 feet southwest of milepost 586 5	K C S	P	178 16
—— 2 8 miles south of, 20 feet southwest of first telegraph pole north of milepost 587	K C S.	P	198 96
Keatchie; top of rail, center of station	H & S	R	338 4
Kingston, 0 1 mile north of, rail-end bench 40 feet north of milepost 580	K C S	P	201 16
—— 0 4 mile south of, rail-end bench 75 feet south of milepost 580 5	K C S	P	216 58
Lupton; top of rail, center of station	H & S	R	253 2
Logansport; top of rail, center of station.	H & S.	R	207 4
Mansfield, 3 7 miles north of, rail-end bench 95 feet north of milepost 587 5	K C S.	P	224 83
—— 3 2 miles north of, rail-end bench 15 feet west of first telegraph pole north of milepost 588	K C S.	P	251 17

Altitudes in northern Louisiana—Continued

Location	Authority	Class	Elevation
DE SOTO PARISH—continued			*Feet*
Mansfield, 2 7 miles north of, rail-end bench 20 feet northwest of third telegraph pole south of milepost 588 5	K C S	P	281 33
—— 2 2 miles north of, rail-end bench 15 feet northwest of second telegraph pole south of milepost 589	K C S	P	302 80
—— 1 7 miles north of, rail-end bench 60 feet south of first telegraph pole south of of milepost 589 5	K C S	P	299 75
—— 1 2 miles north of, rail-end bench 90 feet north of second telegraph pole north of milepost 590	K C S	P	311 83
—— 0 7 mile north of, rail-end bench 15 feet west of milepost 590 5	K C S	P	324 69
—— 0 2 mile north of, rail-end bench 20 feet west of milepost 591	K C S	P	339 28
—— 0 8 mile south of, rail-end bench 85 feet north of first telegraph pole north of milepost 592	K C S	P	332 02
—— 1 3 miles south of, rail-end bench 15 feet west of milepost 592 5	K C S	P	351 31
—— 1 8 miles south of, rail-end bench 15 feet west of third telegraph pole south of milepost 593	K C S	P	351 16
—— 2 3 miles south of, rail-end bench 85 feet north of milepost 593 5	K C S	P	343 06
—— 2 8 miles south of, rail-end bench 75 feet south of first telegraph pole south of milepost 594	K C S	P	356 22
—— 3 3 miles south of, rail-end bench 20 feet southwest of second telegraph pole north of milepost 594 5	K C S	P	364 26
—— 3 8 miles south of, rail-end bench 18 feet west of first telegraph pole south of milepost 595	K C S	P	351 70
Mansfield Junction, 0 5 mile north of, rail-end bench 15 feet west of third telegraph pole south of milepost 593	K C S	P	351 16
—— grade, center of station	T & P	R	316
—— T & P CROSSING, top of rail	K C S	R	343 7
—— —— rail-end bench 85 feet north of milepost 573 5	K C S	P	343 06
—— 0 5 mile south of, rail-end bench 75 feet south of first telegraph pole south of milepost 594	K C S	P	356 22
Odin; top of rail, center of station	H & S	R	274 0
Oxford; grade, center of station	T & P	R	257
Pelican; grade, center of station	T & P	R	315 5
Sabine Parish line; rail-end bench 35 feet southwest of first telegraph pole north of milepost 605 5	K C S	P	229 37
Stonewall; grade, center of station	T & P	R	211 8
Trenton, 2 5 miles north of, rail-end bench 15 feet west of second telegraph pole north of milepost 595 5	K C S	P	358 46
—— 2 miles north of, rail-end bench 12 feet west of third telegraph pole south of milepost 596	K C S	P	353 71
—— 1 5 miles north of, rail-end bench 15 feet west of first telegraph pole south of milepost 596 5	K C S	P	346 81
—— 1 mile north of, rail-end bench 18 feet south of milepost 597	K C S	P	359 21
—— bench mark on northwest corner north pedestal of west pair, water tank	K C S	P	347 78
—— rail-end bench 12 feet west of milepost 598	K C S	P	341 02
—— 0 5 mile south of, rail-end bench 60 feet north of milepost 598 5	K C S	P	346 05
—— 1 mile south of, rail-end bench 50 feet south of fourth telegraph pole south of milepost 599	K C S	P	315 42
—— 1 5 miles south of, rail-end bench 75 feet north of milepost 599 5	K C S	P	314 92
—— 2 miles south of, rail-end bench 18 feet west of second telegraph pole south of milepost 600	K C S	P	309 07
Wallace Lake; rail-end bench 40 feet south of first telegraph pole south of lake.	K C S	P	163 69
EAST CARROLL PARISH			
Henderson; copper bolt in pillar of dwelling owned by Mrs Emma E Peck	U S C & G S	P	101 819
—— copper bolt in chimney of cabin opposite old gin	U S C & G S	P	99 168
Lake Providence; zero, U S E gage	U S E	E	69 34

Altitudes in northern Louisiana—Continued.

Location.	Authority.	Class.	Elevation.
FRANKLIN PARISH.			*Feet.*
Baskin station; pipe-flange bench opposite north end of platform	U. S. E	P	73.752
Bayou Macon, Cutoff Bayou, mouth of; pipe-flange bench on knoll west of warehouse.	U. S. E	E	68.43
—— —— above; zero of gage	U. S. E	E	[a]−20.61
—— Cutoff Landing; high water, 1893	U. S. E	E	67.88
—— Jacksons Landing; pipe-flange bench in Tom Griffin's barn lot	U. S. E	P	87.042
—— —— root bench on right bank of Pullaway Bayou, 65 feet from Bayou Macon.	U. S. E	P	73.658
—— Osbornes Ferry; pipe-flange bench in northeast corner of yard of W. R. Osborne.	U. S. E	P	78.181
—— Osborne Landing; high water, 1882	U. S. E	E	76.80
—— —— high water, 1893	U. S. E	E	71.75
—— Pullaway Bayou; root bench on right bank, 65 feet from Bayou Macon	U. S. E	P	73.658
—— Pullaway Landing. *See* Bayou Macon, Jacksons Landing.			
—— Sunshine Landing; pipe-flange bench in lot adjoining J. L. Newcomer's residence.	U. S. E	P	91.878
—— Warsaw Landing; root bench in red oak 165 feet below large warehouse	U. S. E	P	84.605
Big Creek, N. O. & N. W. Crossing; pipe-flange bench 225 feet east of bank, 80 feet south of track.	U. S. E	P	74.391
Big Creek station, 1 mile south of; root bench on post oak east of track, 4.5 telegraph poles south of milepost 60.	U. S. E	P	74.279
Boeuf River, Daly Landing; pipe-flange bench 50 feet northeast of warehouse.	U. S. E	E	66.30
—— De Sha Landing; pipe-flange bench 40 feet from river on Smith place	U. S. E	E	64.37
—— Gum Point Landing; pipe-flange bench 32 feet north of warehouse	U. S. E	E	60.33
—— Masons Landing; zero of gage, 1899	U. S. E	E	[a]−20.44
Como-New Lights road, Roaring Bayou, 500 feet west of; root bench in white oak on south side of road.	U. S. E	P	58.329
Delhi-Warsaw road, Dover, 350 feet south of; root bench in red elm	U. S. E	P	87.154
—— Jackson Landing, near; pipe-flange bench in Tom Griffin's barn lot	U. S. E	P	87.042
Eden station; pipe-flange bench 30 feet east of track, 260 feet north of platform.	U. S. E	P	71.667
Elam; pipe-flange bench at Mrs. L. Allen's store, 100 feet west of track	U. S. E	P	72.210
Gilbert; pipe-flange bench in southwest corner of garden of Ephraim Williams, 500 feet southwest of depot.	U. S. E	P	77.748
Lamar post-office, 742 feet south of; root bench in white oak west side of Warsaw road.	U. S E	P	88.492
Osbornes Ferry. *See under* Bayou Macon.			
Peck, 1 mile north of; root bench in thorn west of track, 2 telegraph poles north of milepost 35.	U. S. E	P	58.404
Steele switch; pipe-flange bench 50 feet east of track, 130 feet south of trestle	U. S E	P	72.238
Warsaw-Delhi road. *See* Delhi-Warsaw road.			
Winnsboro, 1 mile north of; root bench on white oak 1.5 telegraph poles south of milepost 53.	U. S. E	P	70.812
—— pipe-flange bench in lot of Mrs. Adams opposite depot	U. S. E	P	72.142
Wisner; pipe-flange bench 65 feet east of track, 650 feet south of depot	U. S. E	P	74.745
—— 1 mile south of; root bench on hickory east of track, 9 telegraph poles south of milepost 37.	U. S. E	P	73.068
GRANT PARISH.			
Antonia station; grade, center of depot	St. L., I. M. & S	R	189.0
—— 1 mile north of; summit of grade near milepost 615	St. L., I. M. & S	R	195.4
Bayou d'Artigo, L. R. & N. bridge; sec. 22, T. 8 N., R. 4 W., top of stringer	L. R. & N	R	119
—— —— bed of bayou	L. R. & N	R	110
—— —— secs. 10-15, T. 8 N., R. 4 W., root bench on beech north of bayou, west of track.	L. R. & N	R	134.3
Bayou de Gang, L. R. & N. bridge, north of; root bench on pin oak west of track.	L. R. & N	R	89.2
—— ——, top of stringer	L. R. & N	R	94

[a] See note, p. 14.

Altitudes in southern Arkansas—Continued

Location	Authority	Class	Elevation
GRANT PARISH—continued			
			Feet
Bayou Marteau, L R & N BRIDGE, top of stringer	L R & N	R	90 9
—— bed of bayou	L R & N	R	61
Bayou Nantaches, L R & N BRIDGE, top of stringer	L R & N	R	102 2
Bayou Patessa, L R & N BRIDGE, top of stringer	L R & N	R	87 9
Big Creek, St L, I M & S BRIDGE, south end	St L, I M & S	R	95 2
—— —— high water	St L, I M & S	R	93 2
—— —— bed of creek	St L, I M & S	R	82 2
Boggy Bayou, L R & N BRIDGE, top of stringer	L R & N	R	101 6
—— —— high water, 1892	L R & N	R	93 7
Colfax; grade, center of station	L R & N	R	96
—— pipestone bench in court-house yard	U S E	P	96 183
—— high water, 1892	U S E	E	95 73
Cornfield Bayou, L R & N BRIDGE, top of stringer	L R & N	R	98
—— —— bed of bayou	L R & N	R	85
Fairmount post-office, 1 25 miles above, pipestone bench on Mrs A C Deal's plantation, opposite Deloaches Rock	U S E	P	94 552
Finley spur; grade, center of station	St L, I M & S	R	172 3
Fish Creek, St L, I M & S BRIDGE, north end	St L, I M & S	R	84 8
Georgetown; grade, St L, I M & S crossing	L & A	R	94
—— grade, center of station	St L, I M & S	R	97 4
Howcott station; grade, center of station	St L, I M & S	R	85 6
—— 1 mile north of, grade at milepost 607	St L, I M & S	R	96 6
Kitchens Creek, ST L, I M & S BRIDGE, top of stringer	St L, I M & S	R	152 5
—— —— bed of creek	St L, I M & S	R	137 5
Little River; ST L, I M & S CROSSING, grade of bridge	St L, I M & S	R	87 3
—— —— high water	St L, I M & S	R	86 3
—— —— south bank	St L, I M & S	R	70
—— —— bed of river	St L, I M & S	R	27
—— L & A CROSSING bed of river	L & A	R	24
Montgomery; grade, center of station	L R & N	R	152 7
—— high water, 1892	U S E	E	101 37
Nugent station, 2 miles north of, summit of grade near milepost 625	St L, I M & S	R	206 3
—— grade, center of station	St L, I M & S	R	171 4
Pollock; grade, center of depot	St L, I M & S	R	96 2
Rapides Parish line; grade, L R & N track	L R & N	R	89
Rochelle; grade, center of station	St L, I M & S	R	81
Sandspur. *See* Antonia station			
Red River, DUNN LANDING, 1,200 feet above, pipestone bench near cabin on Dunn plantation	U S E	P	104 749
—— FAIRMOUNT, 1 25 miles above, pipestone bench on plantation of Mrs Deal, opposite Deloaches Rock	U S E	P	94 552
Sandy Creek, ST L, I M & S BRIDGE, top of stringer	St L, I M & S	R	152 3
Winn Parish line; grade, L R & N track	L R & N	R	164
Verde station; grade, center of station	L R & N	R	165 0
—— 400 feet south of, root bench on red oak east of track	L R & N	R	161 14
JACKSON PARISH			
Allendale	A S	R	177
Ansley station	A S	R	191
Bridge Creek, A S BRIDGE, sec 8, T 16 N, R 3 W, top of rail	A S	R	182 3
—— —— bed of creek	A S	R	172
Clay post-office; top of rail at Elmore station	A S	R	206 3
Cypress Creek, A S BRIDGE, sec 31, T 16 N, R 3 W, top of rail	A S	R	162
—— —— bank of creek	A S	R	157
—— —— bed of creek	A S	R	147

Altitudes in northern Louisiana—Continued

Location	Authority	Class	Elevation
JACKSON PARISH—continued			*Feet*
Elmore station; top of rail, center of station	A S	R	206 3
Hodge; top of rail, center of station	A S	R	191
Jonesboro; top of rail, center of station	A S	R	212
—— 2 miles south of, at milepost 23	A S	R	246
Lincoln Parish line; top of rail, A S R R	A S	R	211
Parsons Creek, A S BRIDGE, sec 18, T 16 N, R 3 W, top of rail north end of bridge	A S	R	181
Winn Parish line; top of rail, A S R R	A S	R	170
Wyatt; top of rail, north head block	A S	R	191
LINCOLN PARISH			
Allengreen; top of rail, center of station	V, S & P	R	330
—— pipestone bench 165 feet northwest of station, 150 feet north of track	U S E	P	330 169
Alexton, near, top of big cut	A S	R	231
Averitt; top of rail, center of station	V, S & P	R	156
Choudrant; top of rail, center of station	V, S & P	R	154 9
—— pipestone bench 215 feet north of track, at southeast corner of Farmer's Union office	U S E	P	152 279
—— 2 miles west of, root bench in white oak 65 feet north of bridge 215, 650 feet west of milepost 97	U S E	P	152 090
Dubach; top of rail, center of station	A S	R	135
Jackson Parish line; top of rail A S R R	A S	R	211
Ruston, 1 5 miles east of, root bench in large pine north of track, 100 feet west of milepost 101	U S E	P	249 635
—— top of rail, V, S & P crossing	A S	R	304 5
—— pipestone bench in court-house yard at corner of Louisiana and Vienna streets	U S E	P	314 460
—— top of rail, center of station	V, S & P	R	311 9
—— 1 5 miles west of, tail-end bench south of track, 650 feet from milepost 104	U S E	P	241 181
Tremont, 2 miles east of, root bench in large pine south of track, 1,315 feet west of milepost 89	U S E	P	178 501
Simmsboro; top of rail, center of station	V, S & P	R	325 9
—— pipestone bench in yard of Mr Madden	U S E	P	320 312
MADISON PARISH			
Bayou Macon, ANDREWS FERRY 0 6 mile below, root bench in pin oak 288 feet below cabin on Montgomery place	U S E	P	73 894
—— ANDREWS FIELD, root bench in pin oak on north side of lane, 0 4 mile south of bayou	U S E	P	76 362
—— MONTGOMERY PLACE *See* ANDREWS FERRY			
Barnes; top of rail, center of station	V, S & P	R	88 3
—— pipestone bench in yard of cabin opposite store	U S E	P	81 030
California station; pipestone bench in yard of Mrs N Thomas	U S E	P	88 217
—— top of rail, center of station	V, S & P	R	95 3
Dallas; top of rail center of station	V, S & P	R	87
—— zero of Tensas River gage	U S E	E	54 10
—— pipestone bench about 7 feet east of cabin just west of Tensas River, on north side of track	U S E	P	76 206
Delta; top of rail center of station	V, S & P	R	93 2
—— copper bolt in stone post south of V, S & P R R and east of Main street	U S E	P	87 453
—— same	U S C & G S	P	87 495
Duckport. *See under* Mississippi River			
Eldorado; top of rail, center of station	V, S & P	R	87 8
Kelloggs Landing. *See under* Mississippi River			
Lake One station; top of rail, center of station	V, S & P	R	90
—— pipestone bench northwest of Waddell's sawmill, 187 feet northeast of east pier of V., S & P bridge	U S E	P	77 301

Altitudes in northern Louisiana—Continued.

Location	Authority	Class	Elevation
MADISON PARISH—continued			*Feet*
Lums; top of rail, center of station	V, S & P	R	91.4
Millikens Bend. *See under* Mississippi River			
Mississippi River, CABIN TEELE PLANTATION, copper bolt in northeast pillar of dwelling	U S C & G. S.	P	98.641
—— CRYSTAL SPRING PLANTATION, *copper bolt in east chimney of dwelling*	U S C & G S	P	87.619
—— DUCKPORT PLANTATION, copper bolt in third pillar from northeast corner of dwelling porch	U S C & G S	P	97.202
—— ECHO PLANTATION, copper bolt in chimney of dwelling	U S C & G S	P	97.665
—— KELLOGGS LANDING, *copper bolt in southeast chimney of post-office building*	U S C & G S	P	88.267
—— MILLIKENS BEND 0.75 mile above, copper bolt in third brick from northeast corner of foundation of H P Morancy's house	U S C & G S	P	97.514
—— OMEGA POST-OFFICE, 0.25 mile above, Ditchley plantation, copper bolt in chimney of Mrs Sarah A Nutt's dwelling	U S C & G S	P	96.549
—— POINT PLACE PLANTATION, copper bolt in second pillar from southeast corner of dwelling	U S C & G S	P	90.901
—— RIVERVIEW PLANTATION, copper bolt in northeast pillar of dwelling-house porch	U S C & G S	P	94.394
—— SARGENTS POINT, copper bolt in cement block near cabin 2,000 feet from river	U S C & G S	P	85.694
—— WILLOW GLENN PLANTATION, copper bolt in second pillar from southeast corner of dwelling-house porch	U S C & G S	P	91.061
Mound station; pipestone bench at northeast corner of easternmost section house of V, S & P R R	U S E	P	83.138
—— top of rail, center of station	V, S & P	R	91.1
Omega. *See under* Mississippi River			
Quebec; top of rail, center of station	V, S & P	R	87.8
—— pipestone bench at store 200 feet southeast of railroad bridge over Bayou Dispute	U S E	P	75.072
—— near, on east bank of Tensas River, 30 feet south of track	U S E	P	78.131
Tallulah; top of rail, center of station	V, S & P	R	99.9
—— copper bolt 1.5 feet above floor of gallery, 1.75 feet west of main door of court-house	U S E	P	91.802
Tendal; top of rail, center of station	V, S & P	R	87.8
Tensas River, GRAY PLACE, pipe-flange bench in yard of house occupied by James McPherson	U S E	P	75.264
—— JACKS BAYOU, zero of gage	U S E	E	42.81
—— QUEBEC PLACE, high water, 1893	U S E	E	83.16
—— V, S & P BRIDGE, high water, 1893	U S E	E	79.69
Waverly; pipestone bench in yard of section foreman	U S E	P	78.532
—— top of rail, center of station	V, S & P	R	87.8
MOREHOUSE PARISH			
Arkansas-Louisiana State line; top of rail, N O & N W R R	N O & N W	R	90
Bayou Bartholomew, ARKANSAS-LOUISIANA STATE LINE, 1,650 feet south of, pipe-flange bench 260 feet east of bayou, 50 feet east of railroad	U S E	P	107.075
—— BONNER PLACE, pipe-flange bench in yard of cabin on lower end of place	U S E	P	91.780
—— BONNER FERRY, pipe-flange bench on right top bank of bayou, 20 feet from road to ferry	U S E	E	94.68
—— DAVIS PLACE, root bench in oak on bayou side of road, 1,150 feet below Pecan Landing	U S E	P	94.838
—— HUGHES FORD, pipe-flange bench 95 feet from bank at angle where road leaves bayou and goes up lake	U S E	E	109.31
—— JONES PLACE, pipe-flange bench in yard around second cabin from residence, 65 feet north of bayou	U S E	P	86.641
—— —— pipe-flange bench 65 feet east of lane to Williams place and 50 feet south of bayou	U S E	P	90.227
—— LINDGROVE LANDING, pipe-flange bench in west corner of field where road from Bonita comes to bayou	U S E	P	105.634
—— LINDGROVE, zero of gage	U S E	E	75
—— MYERS PLACE, pipe-flange bench 65 feet south of bayou, at end of lane leading to Marble place	U S E	P	90.703

Altitudes in northern Louisiana—Continued.

Location.	Authority.	Class.	Elevation.
MOREHOUSE PARISH—continued.			*Feet.*
Bayou Bartholomew, N. O. & N. W. BRIDGE; top of rail	N. O. & N. W	R	97
—— —— bed of bayou	N. O. & N. W	R	66
—— PECAN LANDING; 1,150 feet below residence, root bench in oak on bayou side of road on Davis place.	U. S. E	P	94.838
—— PRATT PLACE; zero of gage	U. S. E	E	68.24
—— SANDIDGE PLACE; zero of gage	U. S. E	E	53.63
—— —— pipe-flange bench in southwest corner of field, 30 feet north of bayou	U. S. E	P	89.114
—— WARDS FERRY; pipe-flange bench 10 feet northeast of bridge across drain, 30 feet north of bayou.	U. S. E	P	97.096
—— WARD PLACE; pipe-flange bench in southwest corner of field near second cabin below residence.	U. S. E	P	95.703
—— WELLS PLACE; pipe-flange bench in northwest corner of field east of first cabin east of residence, 30 feet south of bayou.	U. S. E	P	99.914
Bastrop, 15.5 miles north of; grade, Shiloh (Charlon) Creek bridge	N. O. & N. W	R	75
—— 12.5 miles north of; summit between White Oak Creek and Shiloh (Charlon) Creek.	N. O. & N. W	R	113
—— 11.5 miles north of; grade, White Oak Creek bridge	N. O. & N. W	R	100
—— 4 miles north of; summit between Horse Bayou and Bayou Bartholomew	N. O. & N. W	R	125
—— top of rail, center of station	N. O. & N. W	R	140
Boeuf River; top of rail, N. O. & N. W. bridge	N. O. & N. W	R	80
Bonita, 3 miles north of; root bench in white oak east of track, 700 feet south of first cattle gap south of milepost 497.	U. S. E	P	101.393
—— 2 miles north of; root bench in elm east of track, between third and fourth telegraph poles above milepost 498.	U. S. E	P	100.806
—— pipe-flange bench northeast of corner of section-house garden	U. S. E	P	106.308
Charlon (Shiloh) Creek; N. O. & N. W. bridge	N. O. & N. W	R	75
Collinston, 2.5 miles north of; summit of grade, Bastrop Hills, track	N. O. & N. W	R	145
—— 2.5 miles north of; summit of grade, Bastrop Hills, top of cut	N. O. & N. W	R	155
—— top of rail, center of station	N. O. & N. W	R	79.5
Doss	St. L., I. M. & S	R	[a]77.
Horse Bayou, N. O. & N. W. BRIDGE; north end	N. O. & N. W	R	91
—— —— bed of bayou	N. O. & N. W	R	85
Jones station; pipe-flange bench in corner of field opposite station platform, 65 feet south of milepost 496.	U. S. E	P	106.709
Lindgrove. *See under* Bayou Bartholomew.			
Mer Rouge	St. L., I. M. & S.	R	93[a]
Oak Ridge; top of rail, center of station	N. O. & N. W	R	87.5
Parkville; pipestone bench in Bob Tucker's yard 130 feet from Bayou Bartholomew, 650 feet above mouth.	U. S. E	P	77.259
Tinsey Bayou. *See* Charlon Creek.			
White Oak Creek, N. O. & N. W. BRIDGE; top of rail	N. O. & N. W	R	100
NATCHITOCHES PARISH.			
Antoine Creek, L. & A. BRIDGE; bed of creek	L. & A	R	178
Ashland, grade, center of station	L. & A	R	238
Bayou Pierre, T. & P. BRIDGE; grade, north end	T. & P	R	125
—— —— bed of bayou	T. & P	R	75
Black Lake; high water, 1902	L. R. & N	L	107
—— lowest point of bed, sec. 11, T. 11 N., R. 7 W	L. R. & N	L	87
Chestnut; L. N. W. crossing, grade	L. & A	R	261
Chopin; grade, center of station	T. & P	R	99.8
Clarence; top of rail, center of station	L. R. & N	R	114.7
Campti; top of rail, center of station	L. R. & N	R	124.7
—— 1 mile north of, northwest quarter of northeast quarter sec. 29, T. 11 N., R. 7 N.; root bench on oak at fork of roads.	L. R. & N	L	171
Cypress; grade, center of station	T. & P	R	100.2

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[a] From Bull. U. S. Geol. Survey No. 160; not corrected.

Altitudes in northern Louisiana—Continued.

Location.	Authority.	Class.	Elevation.
MOREHOUSE PARISH—continued.			*Feet.*
Bayou Bartholomew, N. O. & N. W. BRIDGE; top of rail	N. O. & N. W	R	97
—— —— bed of bayou	N. O. & N. W	R	66
—— PECAN LANDING; 1,150 feet below residence, root bench in oak on bayou side of road on Davis place.	U. S. E	P	94. 838
—— PRATT PLACE; zero of gage	U. S. E	E	68. 24
—— SANDIDGE PLACE; zero of gage	U. S. E	E	53. 63
—— —— pipe-flange bench in southwest corner of field, 30 feet north of bayou	U. S. E	P	89. 114
—— WARDS FERRY; pipe-flange bench 10 feet northeast of bridge across drain, 30 feet north of bayou.	U. S. E	P	97. 096
—— WARD PLACE; pipe-flange bench in southwest corner of field near second cabin below residence.	U. S. E	P	95. 703
—— WELLS PLACE; pipe-flange bench in northwest corner of field east of first cabin east of residence, 30 feet south of bayou.	U. S. E	P	99. 914
Bastrop, 15.5 miles north of; grade, Shiloh (Charlon) Creek bridge	N. O. & N. W	R	75
—— 12.5 miles north of; summit between White Oak Creek and Shiloh (Charlon) Creek.	N. O. & N. W	R	113
—— 11.5 miles north of; grade, White Oak Creek bridge	N. O. & N. W	R	100
—— 4 miles north of; summit between Horse Bayou and Bayou Bartholomew	N. O. & N. W	R	125
—— top of rail, center of station	N. O. & N. W	R	140
Boeuf River; top of rail, N. O. & N. W. bridge	N. O. & N. W	R	80
Bonita, 3 miles north of; root bench in white oak east of track, 700 feet south of first cattle gap south of milepost 497.	U. S. E	P	101. 393
—— 2 miles north of; root bench in elm east of track, between third and fourth telegraph poles above milepost 498.	U. S. E	P	100. 806
—— pipe-flange bench northeast of corner of section-house garden	U. S. E	P	106. 308
Charlon (Shiloh) Creek; N. O. & N. W. bridge	N. O. & N. W	R	75
Collinston, 2.5 miles north of; summit of grade, Bastrop Hills, track	N. O. & N. W	R	145
—— 2.5 miles north of; summit of grade, Bastrop Hills, top of cut	N. O. & N. W	R	155
—— top of rail, center of station	N. O. & N. W	R	79. 5
Doss	St. L., I. M. & S	R	[a]77.
Horse Bayou, N. O. & N. W. BRIDGE; north end	N. O. & N. W	R	91
—— —— bed of bayou	N. O. & N. W	R	85
Jones station; pipe-flange bench in corner of field opposite station platform, 65 feet south of milepost 496.	U. S. E	P	106. 709
Lindgrove. *See under* Bayou Bartholomew.			
Mer Rouge	St. L., I. M. & S.	R	93[a]
Oak Ridge; top of rail, center of station	N. O. & N. W	R	87. 5
Parkville; pipestone bench in Bob Tucker's yard 130 feet from Bayou Bartholomew, 650 feet above mouth.	U. S. E	P	77. 259
Tinsey Bayou. *See* Charlon Creek.			
White Oak Creek, N. O. & N. W. BRIDGE; top of rail	N. O. & N. W	R	100
NATCHITOCHES PARISH.			
Antoine Creek, L. & A. BRIDGE; bed of creek	L. & A	R	178
Ashland, grade, center of station	L. & A	R	238
Bayou Pierre, T. & P. BRIDGE; grade, north end	T. & P	R	125
—— —— bed of bayou	T. & P	R	75
Black Lake; high water, 1902	L. R. & N	L	107
—— lowest point of bed, sec. 11, T. 11 N., R. 7 W	L. R. & N	L	87
Chestnut; L. N. W. crossing, grade	L. & A	R	261
Chopin; grade, center of station	T. & P	R	99. 8
Clarence; top of rail, center of station	L. R. & N	R	114. 7
Campti; top of rail, center of station	L. R. & N	R	124. 7
—— 1 mile north of, northwest quarter of northeast quarter sec. 29, T. 11 N., R. 7 N.; root bench on oak at fork of roads.	L. R. & N	L	171
Cypress; grade, center of station	T. & P	R	100. 2

[a] From Bull. U. S. Geol. Survey No. 160; not corrected.

Altitudes in northern Louisiana—Continued.

Location	Authority	Class	Elevation
NATCHITOCHES PARISH—continued			*Feet*
Derry; grade, center of station.	T & P.	R	105
Goldonna; grade, center of station	L & A.	R	141
Grappes Bluff; top of rail, center of station.	L R & N.	R	153 7
Hyams; grade, center of station	T & P.	R	116
Irma; grade, center of station	L R & N.	R	112 7
Luella; grade, center of station	L R & N.	R	111 2
Marthaville; grade, center of station.	T & P	R	253 4
Montgomery, 1 mile below, pipestone bench in yard on Dr R E Jackson's plantation	U S E	P	99 182
Montrose			100 ±
—— 4 miles south of, summit of grade northeast quarter sec 6, T 6 N, R 6 W	O R & K.	R	235
—— 5 miles south of, summit of grade, southwest quarter of sec 12, T 6, N, R 7 W	O R & K.	R	326
—— 10 miles south of, sec 35, T 6 N, P 7 W.	O R & K.	R	280
Natchitoches; grade, center of station	T & P	R	118
North Cypress Creek, L & A BRIDGE sec 9, T 13 N, R 7 W, top of stringer	L & A	R	189
Piney Creek, L & A BRIDGE, sec 24, T 13 N, R 7 W, north end, top of stringer	L & A.	R	198
—— —— bed of bayou	L & A	R	180
Provincal, grade, center of station	T & P.	R	166 1
Red River, BOYCE PLANTATION, just below, pipestone bench near house of George Johnson (colored)	U S E	P	121 162
—— BUXTONS LENDING, pipestone bench on J A Williams's plantation, east of house, 250 feet below mouth of Little River	U S E	P	92 242
—— GALLION (H P) yard, pipestone bench on east bank of Fausse River opposite lower end of Tiger Island	U S E	P	112 795
—— JACKSON (R E) PLANTATION, 1 mile below Montgomery, pipestone bench in yard	U S E.	P	99 182
—— TIGER ISLAND, opposite lower end, pipestone bench in H P Gallion's yard	U S E	P	112 795
—— WILLIAMS (J A) PLANTATION, pipestone bench east of house	U S E	P	92 242
—— WILLOW, high water, 1892	U S E	E	114 13
Red River Parish Line, ground level, L R & N R R	L R & N	R	164
—— grade, L R & N R R	L R & N.	R	157 7
Robeline, grade center of station	T & P	R	147
Saline Bayou, L R & N BRIDGE, top of stringer	L R & N.	R	116 2
—— L & A BRIDGE, stringer	L & A	R	120
—— —— bank of bayou	L & A.	R	112
—— —— bed of bayou	L & A.	R	93
South Cypress Creek, L & A BRIDGE, sec 10, T 13 N R 7 W, top of stringer, north end	L & A.	R	192
—— —— bed of creek	L & A	R	181
Victoria, grade, center of station	T & P.	R	196
OUACHITA PARISH			
Calhoun, 2 miles east of, root bench in gum south of track, 1,000 feet west of milepost 84	U S E.	P	151 750
—— pipestone bench in C C Harris's yard, 150 feet south of track	U S E	P	165 500
—— top of rail, center of station	V, S & P.	R	164 8
Cheniere; top of rail, center of station	V, S & P	R	98 9
—— pipestone bench at corner of section house	U S E	P	89 606
Cuba post-office. *See under* Ouachita River			
Forksville; top of rail, center of station	V, S & P	R	150
Gordon station; pipestone bench in yard of L-shaped cabin on Whitehead's plantation	U S E.	P	64 321
Logtown; high water, Ouachita River, 1871	U S E.	E	74 1
—— pipestone bench in south corner of R M Filhiol's field, 10 feet west of warehouse	U S E	P	71 077

Altitudes in northern Louisiana—Continued

Location	Authority	Class	Elevation
OUACHITA PARISH—continued			*Feet*
Monroe; top of rail, center of station	V., S. & P.	R	89.4
—— pipestone bench in northwest corner of court-house yard	U. S. E.	P	78.025
—— pipestone bench in grass plot south of roundhouse at V., S. & P. shops	U. S. E.	P	71.527
—— zero of gage, Ouachita River	U. S. E.	E	31.10
—— high water, Ouachita River, 1882	U. S. E.	E	80.77
—— low water, Ouachita River, 1894	U. S. E.	E	32.05
—— low water, Ouachita River, 1899	U. S. E.	E	31.10
—— 2 miles west of, root bench in hickory north of track, 32 feet east of milepost 74	U. S. E.	P	78.121
Ouachita River, Bayou Bartholomew, 3,940 feet below mouth of, root bench in walnut 650 feet above storehouse	U. S. E.	P	88.590
—— Bayou D'Arbonne, mouth of, pipe-flange bench 1,100 feet from river, 170 feet from right bank of bayou	U. S. E.	P	74.96
—— Bayou de Siard, 325 feet below mouth of, pipestone bench on Indian mound	U. S. E.	P	103.314
—— Bayou Lapine, 0.4 mile below, pipe-flange bench at west end of lane forming north boundary of Refugio place	U. S. E.	E	77.03
—— Bright Oak place root bench in gum 25 feet south of road, 325 feet below dwelling	U. S. E.	P	74.356
—— Burnham Landing, 0.75 mile below, pipe-flange bench near northern boundary of Terry place, 325 feet from left bank of river	U. S. E.	E	78.73
—— Cheniere Creek, 1 mile above, pipe-flange bench in yard of cabin at end of last lane across "Thirteen-mile bend"	U. S. E.	E	77.98
—— Cuba post-office, pipe-flange bench 28 feet from southeast corner of post-office building	U. S. E.	E	72.27
—— Chaff plantation, root bench in sycamore 82 feet in front of residence	U. S. E.	P	79.897
—— Glendora place, pipestone bench on division line between Young and Glendera places, 1,500 feet from river	U. S. E.	P	81.093
—— Pargoud place, pipestone bench on Indian mound 325 feet below mouth of Bayou de Siard, 300 feet east of river	U. S. E.	P	103.314
—— Rock Row Shoals, pipestone bench on Mrs. Seal's place, 130 feet north of left bank of river, 330 feet west from Lonewa place fence	U. S. E.	P	76.576
—— Smith (Bank) place, pipestone bench 200 feet east of river, 165 feet northeast of old cabin	U. S. E.	P	78.968
—— Zeph Lake, root bench in white oak on road 250 feet from southeast corner of lake, 500 feet from river at bight of bend.	U. S. E.	P	73.622
West Monroe; pipestone bench at southwest corner of Cotton and Natchitoches streets	U. S. E.	P	75.568
—— arrow cross in granite capstone of west pier of V., S. & P. bridge over Ouachita River	U. S. E.	P	80.893
Whited; top of rail, center of station	V., S. & P.	R	75.5
RAPIDES PARISH			
Alexandria; St. L., I. M. & S. bridge, high water, 1892	U. S. E.	E	83.36
—— high water, 1892	U. S. E.	E	82.41
—— L. R. & N. bridge, grade	L. R. & N.	R	94.9
—— grade, center of station	T. & P.	R	76.6
—— K. C., W. & G. R. R. crossing	L. R. & N.	R	75.8
—— T. & P. crossing	St. L., I. M. & S.	R	79.3
—— pipestone bench in court-house yard	U. S. E.	P	73.690
—— pipestone bench in yard of Rapides Parish jail	U. S. E.	P	70.910
Ball spur; grade at milepost 629	St. L., I. M. & S.	R	145.5
Bayou Boeuf, sec. 11, T. 3 W., R. 11 W., bank	A. & W.	L	85
—— —— hills just west of	A. & W.	L	130
Bayou Latanier, L., R. & N. bridge, grade	L., R. & N.	R	68.7
Bayou Rigolets, L., R. & N. bridge, grade	L., R. & N.	R	88.1
—— —— bed of bayou	L., R. & N.	R	48
Boyce; grade, center of station	T. & P.	R	88.9
—— pipestone bench on right, at first angle in lane running southwest from warehouse	U. S. E.	P	85.846
—— high water, Red River, 1892	U. S. E.	E	88.48

Altitudes in northern Louisiana—Continued

Location	Authority	Class	Elevation
RAPIDES PARISH—continued			*Feet*
Calcasieu River, SEC 17, T 2 N, R 4 W, bed of river	A & W.	L	145
——— bottom land.	A & W	L	165
Cheneyville; grade, center of station	T & P.	R	63 7
Cypress Bayou (Bayou Comrade), SEC 10, T 2 N, R 4 W, bank	A & W.	L	160
Flaceon Bayou, ST L, I M & S BRIDGE, grade	St L, I M & S	R	130 6
——— high water, 1886.	St L, I M & S	R	127 6
Forest Hill	K C, W & G	R	170
Glenmore.	K C, W & G.	R	138
Grant Parish line; grade, L, R & N R R	L, R & N	R	89
Gravel Hill; sec 19, T 3 N, R 2 W.	A & W	L	190
Lamourie; grade, center of station	T & P	R	68 9
Latanier; grade, center of station	L R & N	R	68 7
Lecompte grade, center of station	T & P.	R	75 4
Lena; grade, center of station	T & P	R	113 8
Levin station; grade at milepost 630.	St L, I M & S	R	148 6
Magda; grade, center of station.	L R & N	R	62 2
Moreland; grade, center of station	T & P	R	78 9
Pineville, west of, St L, I M & S crossing	L R & N	R	103 8
Poland. *See under* Red River			
Rapides; grade, center of station	T & P	R	86 6
—— 1 mile below pipestone bench at intersection of levee and Marye and Cruikshanks division line	U S E.	P	78 442
Red River, BOYCE, pipestone bench on right, at first angle in lane running southwest from warehouse	U S E.	P	85 846
—— CANNON'S WOOD YARD, opposite, pipestone bench on C O Harris's plantation, 105 feet west of levee	U S E.	P	72 481
—— GRAND BEND, pipestone bench on Peart's plantation, midway of neck on thicket side of fence	U S E	P	71 078
—— GRIMES BLUFF, high water, 1892	U S E	E	70 89
—— HARRIS (C O) PLANTATION, pipestone bench opposite Cannon's wood yard, 105 feet west of levee	U S E	P	72 481
—— JONES QUARTER LANDING, 1 000 feet below, pipestone bench 30 feet south of parish road 40 feet from levee	U S E	P	66 293
—— NEW POLAND, high water, 1892	U S E	E	72 60
—— NORMAND LANDING, high water, 1892	U S E	E	59 38
—— ONCE MORE LANDING, high water, 1892	U S E	E	70 07
——— pipestone bench in George Wilson's horse lot	U S E	P	60 846
—— PEART'S PLANTATION *See* Grand Bend			
—— POLAND POST-OFFICE 2 miles below, at Once More Landing, pipestone bench in George Wilson's horse lot	U S E.	P	60 846
—— RAPIDES POST-OFFICE 1 mile below, pipestone bench at intersection of levee and Marye and Cruikshanks division line	U S E.	P	78 442
—— ROGERS LANDING, root bench in pecan on road 30 feet inside of levee, 225 feet from dwelling	U S E	P	70 406
——ST L, I M & S BRIDGE, grade	St L, I M & S	R	95 4
——— high water, 1892	U S E.	E	83 3
Rocky Bayou, L R & N BRIDGE grade.	L R & N	R	95 1
——— bed of bayou.	L R & N	R	71
Spring Creek, sec 6, T 2 N, R 3 W	A & W	L	200
Tioga; grade at milepost 630	St L, I M & S	R	148 6
Willow Glen; grade, center of station	T & P	R	80 4
Woodsworth	K C, W & G	R	88
RED RIVER PARISH			
Bienville Parish line; grade S L B & S R R.	St L, B & S.	R	223
Bossier Parish line; grade L R & N R R	L R & N.	R	147 7
Carroll;, grade, center of station	L R & N.	R	138 7

Altitudes in northern Louisiana—Continued

Location	Authority	Class	Elevation
RED RIVER PARISH—continued			
			Feet
Coushatta; high water, Red River, 1892	U S E	E	135 07
—— grade center of station	L R & N	R	144 7
—— pipestone bench in court-house yard	U S E	P	132 242
—— pipestone bench in yard of Methodist Church	U S E	P	133 633
Crichton station; grade, center of station	L R & N	R	139 7
—— high water, Red River, 1892	L R & N	R	141 7
Desare station; grade, center of station	L R & N	R	148 7
East Point; grade, center of station	L R & N	R	144 7
Grand Bayou, SECS 16–21, T 14 N, R 9 W, bank	St L, B & S	L	186
—— SEC 4, T 13 N, R 9 W, bank	St L, B & S	L	174
—— —— bed	St L, B & S	L	165
—— SEC 32, T 13 N, R 9 W bank	St L, B & S	L	149
—— —— bed	St L, B & S	L	142
—— OLIVER BRIDGE (ABOUT SEC 32, T 13 N, R 9 W), top of floor of bridge	St L, B & S	L	148 7
—— —— high water	St L, B & S	L	148 8
Hope; grade, center of station	L R & N	R	145 7
Howard post-office; pipestone bench near cabin, 100 feet southwest of residence and 650 feet south of gin	U S E	P	141 374
—— high water, Red River, 1892	U S E	E	148 84
Kenilworth; grade, center of station	L R & N	R	129 7
Lake End post-office; pipestone bench back of cabin 2 000 feet southeast of Lake End landing, 1,000 feet from bank	U S E	P	126 431
Lockwood station, grade, center of station	L R & N	R	139 7
Loggy Bayou; L R & N BRIDGE, top of stringer	L R & N	R	152 7
—— —— bank	L R & N	R	148
—— —— bed of bayou	L R & N	R	126
—— *See under* Red River			
Natchitoches Parish line; ground level, L R & N R R	L R & N	R	164
—— grade, L R & N R R	L R & N	R	157 7
Nicholas Bayou, L R & N BRIDGE, top of stringer	L R & N	R	129 7
Red River, BELL (THOS) PLANTATION, pipestone bench in yard	U S E	P	143 778
—— CRICHTON PLANTATION, pipestone bench in yard of two cabins at sharp bend, 1,300 feet below residence	U S E	P	137 736
—— LOGGY BAYOU, high water, Red River, 1892	U S E	E	146 48
—— —— root bench in chinaberry at mouth of bayou	U S E	P	143 748
—— —— pipestone bench in yard of Thomas Bell	U S E	P	143 778
—— STRINGFELLOW PLANTATION, pipestone bench near cabin 100 feet southwest of residence, 650 feet south of gin	U S E	P	141 374
—— UPPER BROWNVILLE PLANTATION, pipestone bench back of cabin 2,000 feet southeast of Lake End landing, 1,000 feet from bank	U S E	P	126 431
Wilson station; grade, center of station	St L, B & S	R	211
RICHLAND PARISH			
Alto, 0 6 mile east of, root bench in pin oak in front of Thomason residence, south side of Archibald-Alto road	U S E	P	72 345
—— pipe-flange bench in southwest corner of yard of E H Cook, 65 feet from Boeuf River	U S E	P	73 983
—— zero of Boeuf River gage	U S E	E	[a]—20 28
—— low water Boeuf River, 1899	U S E	E	54 70
—— high water Boeuf River, 1882	U S E	E	72 76
—— high water Boeuf River, 1892	U S E	E	72 47
Alto-Archibald road. *See* Archibald-Alto road			
Alto-Charleville road, ADILE CHURCH (COLORED), 130 feet west of, root bench in sweet gum on north side of road	U S E	P	73 178
—— HARLAND FIELD, pipe-flange bench at nothwest corner of store	U S E	P	73 878

[a] See note, p 14

Altitudes in northern Louisiana—Continued

Location	Authority	Class	Elevation
RICHLAND PARISH—continued			*Feet*
Alto-Charlieville road, MOUNT ZION CHURCH, 500 feet south of, root bench on cow oak on west side of lane, 15 feet east of cypress swamp	U S E	P	73 149
—— MULHERN PLACE, 0 25 mile south of residence, root bench on sassafras, west side of lane	U S E	P	75 370
Archibald; pipe-flange bench in northwest corner of yard of J J Archibald, 100 feet southeast of station	U S E	P	76 870
—— 1 mile south of, root bench in hickory 50 feet east of N O & N W track 500 feet southeast of cabin	U S E	P	77 601
Archibald-Alto road, HEMLEY (WM) PLACE, opposite southeast corner of root bench in black oak on south side of road	U S E	P	73 191
—— LITTLE CREEK METHODIST CHURCH, 165 feet north of, root bench in post oak on south side of road	U S E	P	73 855
—— THOMASON RESIDENCE, in front of, root bench on pin oak on south side of road	U S E	P	72 345
—— SHADY GROVE CHURCH, 500 feet south of, root bench in sycamore	U S E	P	73 073
Bayou Macon; V , S & P CROSSING, pipestone (pipe gone) bench on west bank of bayou near railroad bridge 125 feet south of track, 40 feet from bayou	U S E	P	74 211
Bee Bayou; top of rail, center of station	V , S & P	R	88
Big Creek, N O & N W CROSSING, root bench in sweet gum west of track, 150 feet north of end of trestle	U S E	P	72 221
Boeuf River, ADILE CHURCH, 130 feet west of, root bench in sweet gum on north side of road	U S E	P	73 178
—— ALTO, pipe-flange bench in southwest corner of yard of E H Cook.	U S E	P	73 983
—— CHARLIEVILLE, root bench in walnut in front of warehouse	U S E	P	69 898
—— HARLAND FIELD, pipe-flange bench at northwest corner of store	U S E	P	73 878
—— HOLLY GROVE LANDING, pipe-flange bench in northwest corner of yard at residence of Frank Hatch	U S E	P	70 147
—— —— root bench on catalpa at upstream corner of Frank Hatch's warehouse.	U S E	P	70 288
—— OPPOSITE LANDERNAU, pipe-flange bench 130 feet east of Green Grove Church.	U S E	P	68 412
—— McINTOSH PLACE, root bench in sweet gum on bank of river, 650 feet below residence of R McIntosh	U S E	P	66 680
—— MUDDY BAYOU, pipe-flange bench on left top bank	U S E	E	55 84
—— NOBLE PLACE, pipe-flange bench 130 feet from left bank, in pasture near road from Holly Grove Landing	U S E	P	67 598
—— N O & N W BRIDGE, top of rail	N O & N W	R	80
—— Point Jefferson, high water, 1892	U S E	E	93 14
—— —— zero of gage	U S E	E	a−20 35
—— STOKES PLACE, pipe-flange bench 130 feet from river, 500 feet below residence	U S E	P	72 282
—— —— pipe-flange bench 65 feet above cabin of Henry Hunter	U S E	P	72 443
—— V , S & P CROSSING, pipestone bench on east bank 1 5 miles east of Girard, 230 feet south of track	U S E	P	80 023
Burke station; pipe-flange bench 165 feet east of track, 30 feet north of road	U S E	P	75 639
Carpenter station; pipestone bench in yard of cabin opposite railroad platform	U S E	P	86 392
Charlieville; root bench in walnut in front of warehouse	U S E	P	69 898
—— opposite pipe-flange bench 130 feet from river, 500 feet below Stokes s residence	U S E	P	72 282
—— high water, Boeuf River, 1882	U S E	E	70 24
—— high water, Boeuf River, 1892	U S E	E	68 93
Crew Lake; pipestone bench in garden northwest of station, 75 feet from track	U S E	P	67 449
—— top of rail, center of station	V , S & P	R	76 7
Delhi; pipestone bench in W T Insley's yard, 65 feet east of Catholic Church yard	U S E	P	94 307
—— top of rail, center of station	V , S & P	R	97 9
—— high water, Bayou Macon, 1882	U S E	E	88 28
—— high water, Bayou Macon, 1892	U S E	E	84 28
—— low water, Bayou Macon, 1886	U S E	E	49 80
—— zero of gage	U S E	E	50 62
—— bench mark on northeast corner of brick pier at northeast corner of S Blum's store	U S E	P	96 390

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[a] See note, p 14

Altitudes in northern Louisiana—Continued.

Location.	Authority.	Class.	Elevation.
RICHLAND PARISH—continued.			*Feet.*
Delhi; 0.6 mile south of; root bench east side of Delhi-Warsaw road	U. S. E	P	95.821
Delhi-Warsaw road, ARMSTRONG PLACE; root bench in cow oak on right bank of bayou, 980 feet south of house.	U. S. E	P	81.763
—— PHILLIPS (S.) PLACE, 45 feet south of; root bench in sweet gum on east side of road.	U. S. E	P	90.985
—— PORTER PLACE, 100 feet south of; root bench in hickory 131 feet south of swale.	U. S. E	P	84.062
—— PUSSY BAYOU; root bench in white oak 725 feet north of culvert over bayou.	U. S. E	P	87.864
Girard; high water, Boeuf River, 1886	U. S. E	E	80.05
—— low water, Boeuf River, 1899	U. S. E	E	52.16
—— low water, Boeuf River, 1886	U. S. E	E	53.74
—— zero of Boeuf River gage, 1886	U. S. E	E	52.88
—— top of rail, center of station	V., S. & P	R	87.3
—— pipestone bench 13 feet east of Mrs. Broshear's house	U. S. E	P	79.197
—— copper bolt in east chimney of Mrs. Broshear's house	U. S. E	P	86.224
—— 1.5 miles east of; pipestone bench on east bank of Bayou Boeuf, 230 feet south of track.	U. S. E	P	80.023
Holly Ridge; top of rail, center of station	V., S. & P	R	90.9
—— pipestone bench in yard of W. F. Winstead, 6 feet west of entrance	U. S. E	P	84.998
Landernau, opposite; pipe-flange bench 130 feet southeast of Green Grove Church.	U. S. E	P	68.412
Mangham; pipe-flange bench in southeast corner of yard of H. H. Nash	U. S. E	P	74.629
Rayville; top of rail, center of station	N. O. & N. W	R	80.4
—— top of rail, center of station	V., S. & P	R	85.9
—— pipe-flange bench 3 feet north of north wall of court-house	U. S. E	P	80.317
—— copper bolt in face of "L" of court-house front	U. S. E	P	87.959
SABINE PARISH.			
Bayou Toro, K. C. S. CROSSING; top of rail opposite milepost 646.5	K. C. S	R	206
—— —— high water	K. C. S	R	201
—— —— bottom land	K. C. S	R	194
—— —— bed of bayou	K. C. S	R	182
Bear Creek, K. C. S. CROSSING; top of rail at south end of bridge	K. C. S	R	225.69
—— —— bed of creek	K. C. S	R	210
Buvens Bayou, K. C. S. CROSSING; top of rail at south end of bridge	K. C. S	R	212
—— —— bottom land	K. C. S	R	203
—— —— bed of bayou	K. C. S	R	190
Christie, 2 miles north of; rail-end bench 10 feet west of milepost 645	K. C. S	P	212.69
—— 1.5 miles north of; rail-end bench 18 feet west of milepost 645.5	K. C. S	P	204.78
—— 1 mile north of; rail-end bench 18 feet west of second telegraph pole south of milepost 646.	K. C. S	P	207.22
—— 0.5 mile north of; rail-end bench 60 feet north of second telegraph pole south of milepost 646.5	K. C. S	P	197.87
—— rail-end bench 15 feet southwest of milepost 647	K. C. S	P	202.07
—— 0.5 mile south of; rail-end bench 10 feet west of milepost 647.5	K. C. S	P	213.92
—— 1 mile south of; rail-end bench 35 feet northwest of first telegraph pole north of milepost 648.	K. C. S	P	215.59
—— 1.5 miles south of; rail-end bench 10 feet northwest of third telegraph pole south of milepost 648.5.	K. C. S	P	232.66
—— 2 miles south of; rail-end bench 40 feet south of milepost 649	K. C. S	P	245.96
—— 2.5 miles south of; rail-end bench 55 feet south of second telegraph pole north of milepost 650.	K. C. S	P	295.33
—— 3 miles south of; rail-end bench 65 feet south of milepost 650.5	K. C. S	P	320.56
—— 3.5 miles south of; rail-end bench 65 feet south of first telegraph pole north of milepost 651.	K. C. S	P	338.74
Choctaw Bayou, K. C. S. CROSSING; top of rail at pile opening	K. C. S	R	209.38
—— —— bottom land	K. C. S	R	197
—— —— bed of bayou	K. C. S	R	196

Altitudes in northern Louisiana—Continued.

Location	Authority	Class	Elevation
SABINE PARISH—continued			*Feet*
Converse, 4 miles north of, rail-end bench 50 feet south of third telegraph pole south of milepost 606	K. C. S.	P	223.52
—— 3.5 miles north of, rail-end bench 40 feet northwest of milepost 606.5	K. C. S.	P	224.85
—— 3 miles north of, rail-end bench 10 feet west of milepost 607	K. C. S.	P	220.10
—— 2.5 miles north of, rail-end bench 25 feet southwest of third telegraph pole south of milepost 607.5	K. C. S.	P	220.23
—— 2 miles north of, rail-end bench 20 feet west of third telegraph pole south of milepost 608	K. C. S.	P	211.66
—— 1.5 miles north of, rail-end bench 10 feet west of first telegraph pole south of milepost 608.5	K. C. S.	P	215.28
—— 1 mile north of, rail-end bench 15 feet west of milepost 609	K. C. S.	P	200.21
—— 0.5 mile north of, rail-end bench 10 feet west of milepost 609.5	K. C. S.	P	214.96
—— rail-end bench 15 feet west of milepost 610	K. C. S.	P	210.57
—— depot, top of rail, at center	K. C. S.	P	213.61
—— 0.5 mile south of, rail-end bench 10 feet west of milepost 610.5	K. C. S.	P	211.28
—— 1 mile south of, rail-end bench 30 feet north of milepost 611	K. C. S.	P	207.41
—— 1.5 miles south of, rail-end bench 10 feet northwest of first telegraph pole south of milepost 611.5	K. C. S.	P	193.76
—— 2 miles south of, rail-end bench 10 feet west of fourth telegraph pole south of milepost 612	K. C. S.	P	193.58
—— 2.5 miles south of, bench mark on northeast corner east plate, north pedestal of east pier, water tank	K. C. S.	P	191.89
—— 3 miles south of, rail-end bench 50 feet south of milepost 613	K. C. S.	P	184.29
Cross Lake, K. C. S. CROSSING, top of rail opposite milepost 555	K. C. S.	R	182
—— —— bed of lake	K. C. S.	R	163
—— —— high water	K. C. S.	R	178
—— —— channel, milepost 555.5	K. C. S.	R	154.50
Estes Bayou, K. C. S. CROSSING, top of rail at south end of bridge	K. C. S.	R	198
—— —— bottom land	K. C. S.	R	191
—— —— bed of bayou	K. C. S.	R	185
Fisher, 0.8 mile north of, rail-end bench 12 feet southwest of first telegraph pole south of milepost 638	K. C. S.	P	361.06
—— 0.3 mile north of, rail-end bench 10 feet west of first telegraph pole south of milepost 638.5	K. C. S.	P	341.87
—— 0.2 mile south of, rail-end bench 90 feet south of fourth telegraph pole south of milepost 639	K. C. S.	P	324.36
—— 0.7 mile south of, rail-end bench 65 feet north of milepost 639.5	K. C. S.	P	304.44
Florien, 2.3 miles north of, rail-end bench 30 feet north of milepost 640	K. C. S.	P	296.05
—— 1.8 miles north of, rail-end bench 60 feet south of first telegraph pole south of milepost 640.5	K. C. S.	P	289.42
—— 1.3 miles north of, rail-end bench 35 feet south of milepost 641	K. C. S.	P	273.07
—— 0.8 mile north of, rail-end bench 20 feet southwest of milepost 641.5	K. C. S.	P	271.32
—— 0.3 mile north of, rail-end bench 60 feet north of second telegraph pole south of milepost 642	K. C. S.	P	255.91
—— 0.2 mile south of, rail-end bench 10 feet west of milepost 642.5	K. C. S.	P	250.16
—— 0.7 mile south of, rail-end bench 15 feet west of milepost 643	K. C. S.	P	234.07
—— 1.2 miles south of, rail-end bench 75 feet north of first telegraph pole south of milepost 643.5	K. C. S.	P	229.95
—— 1.7 miles south of, rail-end bench 15 feet southwest of first telegraph pole south of milepost 644	K. C. S.	P	234.23
—— 2.2 miles south of, rail-end bench 80 feet north of milepost 644.5	K. C. S.	P	222.59
Harpoon Bayou, K. C. S. CROSSING, top of rail at north end of bridge	K. C. S.	R	212
—— —— bottom land	K. C. S.	R	210
—— bed of bayou	K. C. S.	R	194
La Nana Bayou, K. C. S. CROSSING, top of rail at north end of bridge	K. C. S.	R	236
—— —— bottom land	K. C. S.	R	230
—— bed of bayou	K. C. S.	R	216
Loring, 1 mile north of, rail-end bench 70 feet north of milepost 624.5	K. C. S.	P	271.57
—— 0.5 mile north of, rail-end bench 20 feet west of first telegraph pole north of milepost 625	K. C. S.	P	266.97

Altitudes in northern Louisiana—Continued

Location	Authority	Class	Elevation
SABINE PARISH—continued			*Feet*
Loring, rail-end bench 50 feet north of second telegraph pole north of milepost 625.5	K. C. S.	P	282.89
—— 0.5 mile south of, rail-end bench 20 feet northwest of second telegraph pole south of milepost 626	K. C. S.	P	271.97
—— 1 mile south of, rail-end bench 10 feet west of first telegraph pole south of milepost 626.5	K. C. S.	P	274.21
—— 1.5 miles south of, rail-end bench 20 feet southwest of third telegraph pole south of milepost 627	K. C. S.	P	268.31
Many, 5.8 miles north of, rail-end bench 8 feet west of first telegraph pole south of milepost 627.5	K. C. S.	P	288.31
—— 5.3 miles north of, rail-end bench 15 feet southwest of first telegraph pole south of milepost 628	K. C. S.	P	290.09
—— 4.8 miles north of, rail-end bench 10 feet west of first telegraph pole south of milepost 628.5	K. C. S.	P	266.21
—— 4.3 miles north of, rail-end bench 10 feet west of first telegraph pole south of milepost 629	K. C. S.	P	239.71
—— 3.8 miles north of, rail-end bench 40 feet north of second telegraph pole south of milepost 629.5	K. C. S.	P	229.36
—— 3.3 miles north of, rail-end bench 25 feet southwest of milepost 630	K. C. S.	P	216.82
—— 2.8 miles north of, rail-end bench 45 feet north of milepost 630.5	K. C. S.	P	224.76
—— 2.3 miles north of, rail-end bench 18 feet southwest of first telegraph pole north of milepost 631	K. C. S.	P	226.71
—— 1.8 miles north of, rail-end bench 18 feet west of milepost 631.5	K. C. S.	P	210.01
—— 1.3 miles north of, rail-end bench 10 feet west of third telegraph pole south of milepost 632	K. C. S.	P	213.11
—— 0.8 mile north of, rail-end bench 10 feet west of milepost 632.5	K. C. S.	P	210.91
—— 0.3 mile north of, rail-end bench 10 feet west of milepost 633	K. C. S.	P	234.22
—— depot, top of rail at center	K. C. S.	R	239
—— 0.2 mile south of, rail-end bench 20 feet west of milepost 633.5	K. C. S.	P	239.92
—— 0.7 mile south of, bench mark on northwest corner east plate, north pedestal of west pair of water tanks	K. C. S.	P	237.08
—— 1.2 miles south of, rail-end bench 10 feet west of first telegraph pole south of milepost 634.5	K. C. S.	P	238.55
—— 1.7 miles south of, rail-end bench 10 feet west of third telegraph pole south of milepost 635	K. C. S.	P	259.25
—— 2.2 miles south of, rail-end bench 10 feet west of second telegraph pole south of milepost 635.5	K. C. S.	P	283.87
—— 2.7 miles south of, rail-end bench 110 feet south of milepost 636	K. C. S.	P	302.70
—— 3.2 miles south of, rail-end bench 10 feet west of first telegraph pole north of milepost 636.5	K. C. S.	P	327.15
—— 3.7 miles south of, rail-end bench 15 feet northwest of first telegraph pole north of milepost 637	K. C. S.	P	349.75
—— 4.2 miles south of, rail-end bench 20 feet southwest of milepost 637.5	K. C. S.	P	371.95
Many-Negreet road, CARROLL PLACE, root bench in oak in center of road, southwest of house	Veatch	L	247
—— LA NANA CHURCH, sec. 32, T. 7 N., R. 11 W., road in front of	Veatch	L	286
—— METHODIST EPISCOPAL CHURCH, northeast quarter of southeast quarter sec. 14, T. 6 N., R. 12 W., 10-penny nail in top of foundation block at northwest corner of church	Veatch	L	235
—— TAR CREEK BRIDGE, top of side rail	Veatch	L	210
Midkiff Bayou, K. C. S. CROSSING, top of rail at north end of bridge	K. C. S.	R	351.7
—— —— bed of bayou	K. C. S.	P	331
Negreet, NEGREET CHURCH, root bench in twin pin oak west of road, 100 feet southwest of church, cross blazed above bench	Veatch	L	209
—— CURTIS STORE, ground	Veatch	L	207
Nashs Mill Creek, K. C. S. CROSSING, north end of bridge, top of rail	K. C. S.	R	218.64
—— —— bed of creek	K. C. S.	P	201.5
Noble, 2.9 miles north of, rail-end bench 15 feet southwest of milepost 613.5	K. C. S.	P	185.15
—— 2.4 miles north of, rail-end bench 12 feet west of second telegraph pole south of milepost 614	K. C. S.	P	190.32
—— 1.9 miles north of, rail-end bench 18 feet northwest of second telegraph pole south of milepost 614.5	K. C. S.	P	207.95

Altitudes in southern Arkansas—Continued

Location	Authority	Class	Elevation
SABINE PARISH—continued			*Feet.*
Noble, 1 4 miles north of, rail-end bench 12 feet west of first telegraph pole south of milepost 615	K C S	P	232.71
—— 0 9 mile north of, rail-end bench 50 feet northwest of first telegraph pole south of milepost 615 5	K C S	P	251 01
—— 0 4 mile north of, rail-end bench 10 feet southwest of milepost 616	K C S	P	267 83
—— 0 1 mile south of, rail-end bench 10 feet northwest of first telegraph pole north of milepost 616 5	K C S	P	277 67
—— 0 6 mile south of, rail-end bench 10 feet southwest of second telegraph pole south of milepost 617	K C S	P	253.22
—— 1 1 miles south of, rail-end bench 10 feet northwest of first telegraph pole north of milepost 617 5	K C S	P	229 38
—— 1 6 miles south of, rail-end bench 65 feet north of first telegraph pole south of milepost 618	K C S	P	222 73
—— 2 1 miles south of, rail-end bench 65 feet north of milepost 618 5	K C S	P	217 41
—— 2 6 miles south of, rail-end bench 45 feet north of first telegraph pole south of milepost 619	K C S	P	202 05
Pleasant Hill; grade, center of station	T & P	R	284 6
Plymouth; top of rail, 0 2 mile north of milepost 624	K C S	R	277 6
San Patrice Bayou, K C S CROSSING, 640 feet north of milepost 613, top of rail at end of bridge	K C S	R	192
—— —— bed of bayou	K C S	R	177
—— —— bottom land, 1,500 feet south of bridge	K C S	R	184
Sodus; grade, center of station	T & P	R	284.6
Zwolle, 2 2 miles north of, rail-end bench 90 feet north of milepost 619 5	K C S	P	196 68
—— 1 7 miles north of, rail-end bench 90 feet north of milepost 620	K C S	P	177 97
—— 1 2 miles north of, rail-end bench 30 feet north of milepost 620 5	K C S	P	171 45
—— 0 7 mile north of, rail-end bench 15 feet southwest of milepost 621	K C S	P	178 09
—— 0 2 mile north of, rail-end bench 12 feet south of milepost 621 5	K C S	P	198 35
—— depot, top of rail, at center	K C S	R	200 63
—— 0 3 mile south of, rail-end bench 40 feet north of first telegraph pole south of milepost 622	K C S	P	186 00
—— 0 8 mile south of, rail-end bench 15 feet west of milepost 622 5	K C S	P	189 45
—— 1 3 miles south of, rail-end bench 45 feet north of second telegraph pole south of milepost 623	K C S	P	204 90
—— 1 8 miles south of, rail-end bench 20 feet north of first telegraph pole south of milepost 623 5	K C S	P	230.90
—— 2 3 miles south of, rail-end bench 18 feet west of milepost 624	K C S	P	248 58
TENSAS PARISH			
Mississippi River, DUCK POND PLANTATION, copper bolt in brick chimney of ginhouse	U S C & G S	P	76.035
—— HARD TIMES PLANTATION, copper bolt in cement block near cabin, 150 feet south of Lake St Joseph	U S C & G S	P	79 094
—— KEMPS LANDING, marble post at W H Goldman's residence	U S C & G S	P	72 472
—— L'ARGENT LANDING, AGNASCO PLANTATION, cut in cistern, marked "U S B M ," about 150 feet southwest of Mrs Moreland's house	U S C & G S	P	69 282
—— L'ARGENT, DUNCAN PLANTATION, copper tack in post at end of old levee	U S C & G S	P	71 617
—— PANOLO PLANTATION, copper bolt in brick chimney of ginhouse	U S C & G S	P	81 692
—— POINT PLEASANT PLANTATION, copper bolt in north chimney of dwelling	U S C & G S	P	87 779
—— RIVERSIDE PLANTATION, copper bolt in east chimney of dwelling	U S C & G S	P	83 326
—— VILLA CLARA PLANTATION (opposite Rodney, Miss), marble post at front entrance of Capt E L Whitney's residence	U S C & G S	P	70 972
—— WATERPROOF, marble post at A P Martin's residence	U S C & G S	P	67 203
—— —— 3 miles below, cut in top of cistern, marked ' U S B M —1881," about 150 feet from main levee	U S C & G S	P	67 803
—— WAVELAND PLANTATION, copper bolt in brick chimney of ginhouse	U S C & G S	P	78 219
New Light, pipe-flange bench in northeast corner of yard of James R Lynch, 30 feet from river	U S E	P	71 719
New Light-Como road, south side of, root bench in white oak 500 feet west of Roaring Bayou	U S E	P	58 329

Altitudes in northern Louisiana—continued

Location	Authority	Class	Elevation
TENSAS PARISH—continued			
			Feet
New Light-Como road, south side of, root bench in pin oak 325 feet from Cross Bayou	U S E	P	61 770
—— south side of, opposite mouth of Mound Bayou, root bench in pecan 260 feet west of cabin	U S E	P	68 583
Tensas River, Myer place, root bench in pecan opposite mouth of Mound Bayou, 260 feet west of cabin	U S E	P	68 583
—— Mound Bayou place, root bench in pin oak in yard of I S Osborne	U S E	P	71 383
—— Mound Bayou, opposite mouth of, root bench in pecan on south side of road 260 feet west of cabin on Myer place	U S E	P	68 583
—— —— high water, 1893	U S E	E	72 21
—— —— zero of gage	U S E	E	22 83
—— New Light, pipe-flange bench in northeast corner of yard of James R Lynch	U S E	P	71 719
UNION PARISH			
Bayou Cornie, A S crossing, top of rail	A S	R	106
—— —— bank of creek	A S	R	101
—— —— bed of creek	A S	R	79
—— Scotts Bluff, pipe-flange bench on right bank of bayou and 60 feet below old warehouse	U S E	P	75 846
—— Scotts Landing, high water, 1874	U S E	E	83 85
—— Steins Bluff, near, high water, 1874	U S E	E	84 08
Bayou D'Arbonne, Cox Ferry, root bench in post oak on right bank below mouth of slough	U S E	P	65 722
—— —— high water, 1874	U S E	E	82 97
—— —— high water, 1883	U S E	E	72 60
—— —— right bank of, 85 feet below Cox Ferry road, pipe-flange bench	U S E	P	70 583
Bernice; top of rail, center of station	A S	R	226
—— 1 mile north of, summit between Cornie and Middle Fork	A S	R	239
Cox Ferry. *See under* Bayou D'Arbonne			
—— 85 feet below ferry road, pipe-flange bench on right bank of Bayou d'Arbonne	U S E	P	70 583
Farmerville, pipe-flange bench in northwest corner of court-house yard	U S E	P	179 459
Farmerville-Port Union road, Colson post-office road junction, root bench in conspicuous red oak on top of hill	U S E	P	182 087
—— Echels Ford road, root bench in twin cherry tree 250 feet west of cross road to Echels Ford	U S E	P	181 112
—— Farmerville, second hill from, root bench in sweet gum to left, opposite 2 cabins in field	U S E	P	153 293
—— Hay place, pipe-flange bench in W T Hay's yard	U S E	P	135 173
—— Hoffman house, 500 feet east of, root bench in post oak to left and about 150 feet south of cabin	U S E	P	97 513
—— Point Pleasant Baptist Church, 1,325 feet east of, root bench in pin oak in small swale	U S E	P	149 031
—— Purdue (Jim) residence, 0 25 mile east of, boat spike in pine on left of road, 35 feet east of small branch	U S E	P	155 420
—— Rocky Branch, top of hill west of, boat spike in pin oak in front of J T Slack's house	U S E	P	156 740
—— Rogers (Pattison) place, pipe-flange bench in yard on lower road	U S E	P	175 370
—— Sixteenth Creek, top of hill west of, root bench in white oak on right of road	U S E	P	110 853
—— Slack place, boat spike in pin oak in front of house of J T Slack	U S E	P	156 740
—— Taylor (W W) place, *root bench in pine 1,200 feet south of road, in front* of dwelling	U S E	P	118 631
—— Tucker Creek *See* Sixteenth Creek			
—— Underwood (Jim) place, 850 feet west of house, root bench in post oak 32 feet north of road	U S E	P	118 235
—— —— east of dwelling at end of level stretch, root bench in white oak at top of hill	U S E	P	131 293
—— Ward place, root bench in hickory north of road 125 feet from southeast corner of house of John Ward	U S E	P	181 383
—— White (William) place, in yard of, pipe-flange bench at junction of Farmerville, Ouachita City, and Port Union roads	U S E	P	179 045

Altitudes in northern Louisiana—Continued

Location	Authority	Class	Elevation
UNION PARISH—continued			*Feet*
Farmville-Port Union road, root bench in post oak on north side of road 250 feet west of fork of lower and middle roads to Port Union	U. S. E.	P	167.025
Junction City	A. S.	R	164
Lillie	A. S.	R	120
Middle Fork, A. S. CROSSING, top of rail	A. S.	R	114.3
—— —— bank of creek	A. S.	R	109
—— —— bed of creek	A. S.	R	96
Ouachita River, ARKANSAS-LOUISIANA STATE LINE, pipe-flange bench 292 feet from right bank, 2,000 feet below small cabin on left bank	U. S. E.	E	64.56
—— ALABAMA LANDING, pipestone bench on road, 150 feet southwest of store	U. S. E.	P	69.477
—— —— high water 1882	U. S. E.	E	85.79
—— FISHTRAP SHOALS, 1,650 feet below, 262 feet west of river	U. S. E.	P	69.511
—— FRANK PIERCE CREEK, 165 feet above mouth of, pipestone bench on left bank	U. S. E.	P	55.826
—— MILL BAYOU, pipestone bench on left bank 800 feet above mouth	U. S. E.	P	71.391
—— OUACHITA CITY, gas pipe near store of J. A. Peck, 265 feet from river	U. S. E.	E	84.94
—— —— zero of gage	U. S. E.	E	−20.28
—— SHILOH SHOALS 650 feet above, pipestone bench 300 feet west of river	U. S. E.	P	56.644
Port Union; pipe-flange bench in R. C. Webb's yard, 200 feet from river	U. S. E.	P	84.569
Randolph	A. S.	R	133
Ryan	A. S.	R	112
Scotts Bluff. *See under* Bayou Cornie			
Steins Bluff. *See under* Bayou Cornie			
VERNON PARISH			
Barham, 0.3 mile north of, rail-end bench 80 feet north of first telegraph pole north of milepost 653	K. C. S.	P	301.40
—— 0.2 mile south of, rail-end bench 10 feet west of milepost 653.5	K. C. S.	P	291.35
—— 0.7 mile south of, rail-end bench 40 feet north of milepost 654	K. C. S.	P	297.94
Bayou Castor, K. C. S. CROSSING, top of rail opposite milepost 670.5	K. C. S.	R	211
—— —— bottom land	K. C. S.	R	204.5
—— —— bed of channel	K. C. S.	R	194.5
Bayou Zourie, K. C. S. CROSSING, top of rail opposite milepost 675	K. C. S.	R	210
—— —— bottom land	K. C. S.	R	201
—— —— bed of channel	K. C. S.	R	185
Buttons (Palmetto) Creek; sec. 33, T. 2 N., R. 7 W.	A. & W.	L	250
Calcasieu Parish line; rail-end bench 10 feet west of milepost 686.5	K. C. S.	P	177.71
Cooper; bench mark on northwest corner of east plate, north pedestal of west pair, *water tank*	K. C. S.	P	212
East L'Anacoco Bayou, K. C. S. CROSSING, top of rail opposite milepost 660.5	K. C. S.	R	252
—— —— bottom land	K. C. S.	R	242
—— —— bed of channel	K. C. S.	R	230
Flat Creek, K. C. S. BRIDGE, bed of creek	K. C. S.	R	172
Hawthorne, 0.8 mile north of, rail-end bench 12 feet northwest of first telegraph pole north of milepost 663.5	K. C. S.	P	268.50
—— 0.3 mile north of, rail-end bench 40 feet southwest of milepost 664	K. C. S.	P	269.56
—— station, 0.2 mile south of, rail-end bench 10 feet west of milepost 664.5	K. C. S.	P	243.26
—— 0.7 mile south of, rail-end bench 18 feet west of milepost 665	K. C. S.	P	230.47
Hornbeck,[a] 0.5 mile north of, rail-end bench 10 feet west of milepost 651.5	K. C. S.	P	326.15
—— depot, at center, top of rail	K. C. S.	R	310.64
—— bench mark on northwest cast plate, north pedestal, water tank	K. C. S.	P	317.01
—— 0.5 mile south of, rail-end bench, 40 feet north of milepost 652.5	K. C. S.	P	311.34
Leesville, 2.8 miles north of, rail-end bench 12 feet northwest of milepost 665.5	K. C. S.	P	246.90
—— 2.3 miles north of, rail-end bench 40 feet north of milepost 666	K. C. S.	P	260.73
—— 1.8 miles north of, rail-end bench 30 feet southwest of first telegraph pole north of milepost 666.5	K. C. S.	P	273.72

[a] *See also* Christie, Sabine Parish

Altitudes in northern Louisiana—Continued

Location	Authority	Class	Elevation
VERNON PARISH—continued			*Feet.*
Leesville, 1.3 miles north of, rail-end bench 12 feet southwest of fifth telegraph pole north of milepost 667	K C S	P	274.83
—— 0.8 mile north of, rail-end bench 12 feet southwest of second telegraph pole north of milepost 667.5	K C S	P	257.70
—— 0.3 mile north of, rail-end bench 25 feet north of first telegraph pole north of milepost 668	K C S	P	234.85
—— depot, at center, top of rail	K C S	R	235
—— 0.2 mile south of, rail-end bench 15 feet west of milepost 668.5	K C S	P	233.22
—— 0.7 mile south of, rail-end bench 8 feet west of milepost 669	K C S	P	225.38
—— 1.2 miles south of, rail-end bench 45 feet south of first telegraph pole south of milepost 669.5	K C S	P	215.68
—— 1.7 miles south of, rail-end bench 40 feet southwest of third telegraph pole south of milepost 670	K C S	P	215
—— 2.2 miles south of, rail-end bench 30 feet northwest of milepost 670.5	K C S	P	206.33
—— 2.7 miles south of, rail-end bench 40 feet south of third telegraph pole south of milepost 671	K C S	P	222.47
—— 3.2 miles south of, rail-end bench 105 feet south of milepost 671.5	K C S	P	239.04
—— 3.7 miles south of, rail-end bench 20 feet south of first telegraph pole north of milepost 672	K C S	P	256.20
—— 4.2 miles south of, rail-end bench 10 feet northwest of first telegraph pole north of milepost 672.5	K C S	P	253.19
—— 4.7 miles south of, rail-end bench 40 feet north of milepost 673	K C S	P	245.04
—— 5.2 miles south of, rail-end bench 18 feet northwest of milepost 673.5	K C S	P	255.79
—— 5.7 miles south of, rail-end bench 55 feet north of milepost 674	K C S	P	244.45
Neame, 2.7 miles north of, rail-end bench 10 feet west of fourth telegraph pole south of milepost 677	K C S	P	283.46
—— 2.2 miles north of, rail-end bench 8 feet west of first telegraph pole north of milepost 677.5	K C S	P	297.74
—— 1.7 miles north of, rail-end bench 10 feet west of second telegraph pole south of milepost 678	K C S	P	321.05
—— 1.2 miles north of, rail-end bench 10 feet west of milepost 678.5	K C S	P	304.72
—— 0.7 mile north of, rail-end bench 35 feet north of milepost 679	K C S	P	279.60
—— 0.2 mile north of, rail-end bench 60 feet north of first telegraph pole south of milepost 679.5	K C S	P	272.73
—— 0.3 mile south of, rail-end bench 10 feet north of milepost 680	K C S	P	274.97
—— 0.8 mile south of, rail-end bench 7 feet west of milepost 680.5	K C S	P	256.89
—— 1.3 miles south of, rail-end bench 8 feet west of milepost 681	K C S	P	250.30
—— 1.8 miles south of, rail-end bench 85 feet south of first telegraph pole south of milepost 681.5	K C S	P	239.52
Orange, 4 miles north of, rail-end bench 10 feet west of first telegraph pole north of milepost 654.5	K C S	P	297.05
—— 3.5 miles north of, bench mark on northwest corner of present top step, end of north abutment bridge A 655	K C S	P	277.26
—— miles north of, rail-end bench 10 feet west of milepost 655.5	K C S	P	302.47
—— 2.5 miles north of, rail-end bench 45 feet south of first telegraph pole south of milepost 656	K C S	P	33.84
—— 2 miles north of, rail-end bench 10 feet west of second telegraph pole north of milepost 656.5	K C S	P	348.67
—— 1.5 miles north of, rail-end bench 30 feet northwest of sixth telegraph pole south of milepost 657	K C S	P	276.05
—— 1 mile north of, rail-end bench 25 feet southwest of first telegraph pole north of milepost 657.5	K C S	P	365
—— 0.5 mile north of, rail-end bench 30 feet southwest of first telegraph pole north of milepost 658	K C S	P	343.30
—— rail-end bench 95 feet south of milepost 658.5	K C S	P	338.05
—— 0.5 mile south of, rail-end bench, 60 feet south of fifth telegraph pole south of milepost 659	K C S	P	314.30
—— 1 mile south of; rail-end bench 10 feet west of milepost 659.5	K C S	P	294.73
—— 1.5 miles south of, rail-end bench 8 feet west of milepost 660	K C S	P	268.78
—— 2 miles south of, rail-end bench 50 feet south of second telegraph pole south of milepost 660.5.	K C S	P	251.50

Altitudes in northern Louisiana—Continued

Location	Authority	Class	Elevation
VERNON PARISH—continued			
			Feet
Orange, 2.5 miles south of, rail-end bench 8 feet west of milepost 661	K C S	P	267.68
—— 3 miles south of, rail-end bench 10 feet west of milepost 661.5	K C S	P	298.80
—— 3.5 miles south of, rail-end bench 25 feet southwest of first telegraph pole north of milepost 662	K C S	P	286.21
—— 4 miles south of, rail-end bench 40 feet southwest of third telegraph pole south of milepost 662.5	K C S	P	299.77
—— 4.5 miles south of, rail-end bench 10 feet west of milepost 663	K C S	P	289.62
Palmer (St Johns') Creek sec 30, T 2 N, R 7 W	A & W	L	260
Pickering, 0.6 mile north of, rail-end bench 105 feet north of milepost 675.5	K C S	P	215.96
—— 0.1 mile north of, rail-end bench 70 feet south of second telegraph pole north of milepost 676	K C S	P	223.51
—— 0.4 mile south of, rail-end bench 80 feet north of first telegraph pole north of milepost 676.5	K C S	P	250.63
Prairie Creek; sec 13, T 3 N, R 9 W	A & W	L	280
—— K C S Crossing, 200 feet north of milepost 665, top of rail	K C S	R	237
—— —— bottom land	K C S	R	229
—— —— bed of channel	K C S	R	217.5
Rose Pine, 1.7 miles north of, rail-end bench 45 feet south of third telegraph pole south of milepost 682	K C S	P	222.06
—— 1.2 miles north of, rail-end bench 30 feet south of first telegraph pole north of milepost 682.5	K C S	P	208.29
—— 0.7 mile north of, rail-end bench 10 feet west of milepost 683	K C S	P	210
—— 0.2 mile north of, rail-end bench 15 feet southwest of milepost 683.5	K C S	P	224.63
—— 0.3 mile south of, rail-end bench 7 feet south of milepost 684	K C S	P	222.18
—— 0.8 mile south of, rail-end bench 70 feet north of milepost 684.5	K C S	P	204.31
—— 1.3 miles south of, rail-end bench 60 feet northwest of first telegraph pole south of milepost 685	K C S	P	177.70
—— 1.8 miles south of, rail-end bench 40 feet south of milepost 685.5	K C S	P	179.88
—— 2.3 miles south of, rail-end bench 15 feet northwest of milepost 686	K C S	P	167.86
—— 2.8 miles south of, rail-end bench 10 feet west of milepost 686.5	K C S	P	177.71
Sabine River, 1 mile south of Toledo, water level, November 16, 1902.	A & W	L	90
—— —— bank level	A & W	L	110
—— —— top of hills	A & W	L	220
Sandy Creek; secs 9–10, T 2 N R 11 W	A & W	L	160
Sayles Branch, K C S crossing, 1,200 feet north of milepost 670, top of rail	K C S	R	215
—— —— bottom land	K C S	R	109
—— —— bed of channel	K C S	R	201.5
West L'Anacoco Bayou, K C S crossing, top of rail, middle of bridge	K C S	R	281.5
—— —— bed of channel	K C S	R	260
West Fork L'Anacoco Bayou; sec 23, T 3 N, R 10 W	A & W	L	230
Wolf Creek, K C S crossing, rail-end bench 15 feet northwest of milepost 686	K C S	P	167.86
WEBSTER PARISH			
Arkansas-Louisiana State line, L & A R R	L & A	R	250
Bayou Bodcau, west of Spring Hill, high water	L & A	R	174
—— —— bed of bayou	L & A	R	164
Brushy Bayou, S, L B & S bridge, top of rail	S, L B & S	R	154
—— —— bed of bayou	S, L B & S	R	156
—— L & A bridge, bed of bayou	L & A	R	171
Cotton Valley; grade, center of station	L & A	R	233
Dorcheat Bayou, L & A crossing, top of stringer of bridge	L & A	R	168
—— —— bed of bayou	L & A	R	143
—— 2 miles west of Sibley, pipestono bench on east bank, 65 feet south of track	U S E	P	140.911
Doyline	V, S & P	R	227
—— east of, root bench in oak north of track, 1,300 feet west of milepost 147	U S E	P	202.495
—— pipestone bench in Doyle's field southwest of station	U S E	P	223.224

Altitudes in northern Louisiana—Continued.

Location	Authority	Class	Elevation
WEBSTER PARISH—continued			
			Feet
Dubberly; pipestone bench in yard of P H McCary	U S E	P	255 943
—— top of rail, center of station	V, S & P	R	253 9
Heflin; grade, center of station	L & A	R	274
Hortman; grade, center of station	L & A	R	183
Lanesville. *See* Sibley			.
Lee Wright Creek, L & A BRIDGE, sec 34, T 18 N, R 9 W, top of stringer	L & A	R	182
—— —— bed of bayou	L & A	R	169
Long Springs; grade, center of station	L & A	R	176
Minden; grade, center of station	L & A	R	181
Sarepta; grade, center of station	L & A	R	251
Sibley station; top of rail, center of station	V, S & P	R	195 4
—— grade, V, S & P crossing	L & A	R	193
—— pipestone bench in Mr Allison's yard, 90 feet south of track	U S E	P	188 980
—— 2 miles west of, pipestone bench on east bank of Bayou Dorcheat, near V, S & P bridge, 65 feet south of track	U S E	P	140 911
Spring Hill; grade, center of station	L & A	R	251
Yellow Pine; head block, sawmill spur	S, L B & S	R	192 8
WINN PARISH			
Big Creek, A S CROSSING, top of rail, north end of bridge	A S	R	142
Calvin station; grade, center of station	L & A	R	173
Carter; grade, center of station	L & A	R	173
Dodson; top of rail, center of station	A S	R	211 6
—— 1 5 miles north of, top of rail, north end of Big Creek bridge	A S	R	142
—— 1 mile north of, top of rail, Deans Branch bridge	A S	R	171 2
Dugdemona Bayou, A S CROSSING, top of rail	A S	R	110
—— —— bank of bayou	A S	R	96
—— —— bed of bayou	A S	R	82
Grant Parish line; grade, L R & N R R	L R & N	R	164
Jackson Parish line; grade, A S R R	A S	R	170
Kelsche Creek, L & A CROSSING, sec 8, T 11 N, R 3 W, top of stringer, north end of bridge	L & A	R	122
—— —— bank of creek	L & A	R	118
Lyles Branch, A S CROSSING, sec 5, T 13 S R 3 W bridge top of rail	A S	R	161 4
Packton; grade, center of station	L & A	R	162
Port Luce Bayou, L & A BRIDGE, top of stringer	L & A	R	115
—— —— bed of bayou	L & A	R	101
—— A S BRIDGE, top of rail	A S	R	100
—— —— high water	A S	R	96
—— —— bank of bayou	A S	R	92
—— —— bed of bayou	A S	R	86
Pyburn station; grade	A S	R	211
Saline Bayou, L & A BRIDGE, top of stringer	L & A	R	120
—— —— bank of bayou	L & A	R	112
—— —— bed of bayou	L & A	R	93
Sonnet Bayou, L & A BRIDGE, sec 15, T 11 N, R 2 W, top of stringer	L & A	R	116
—— —— bed of bayou	L & A	R	105
St. Maurice; high water, 1892	U S E	E	107 87
—— pipestone bench in lot southeast of E W Tidlie's store	U S E	P	107 688
Tannehill station; grade	A S	R	123
Winnfield; grade, center of station	A S	R	124
—— Arkansas Southern crossing	L & A	R	113
—— Arkansas Southern crossing	L R & N	R	115
—— grade, center of station	L & A	R	123

GENERAL INDEX.

[For well data by names of owners see following index.]

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