BUREAU OF ECONOMIC GEOLOGY
The University of Texas
Austin 12, Texas

JOHN T. LONSDALE, Director

Report of Investigations—No. 7

Subsurface Woodford Black Shale, West Texas and Southeast New Mexico

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SAMUEL P. ELLISON, JR.

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ILLUSTRATIONS

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ABSTRACT

The geographic distribution, lithology, thickness, and paleontology of the subsurface Woodford in the Permian basin are described and illustrated. On the basis of conodonts and spores, the Woodford is assigned to the Upper Devonian and correlated with the Ready Pay member of the Percha shale in New Mexico, Woodford and Chattanooga of Oklahoma, Kansas, and Arkansas, and tentatively correlated with the Upper Devonian parts of the Caballos novaculite and Arkansas novaculite of Texas and Arkansas. The lithology and paleontology suggest a stagnant marine environment such as might be found in a partly enclosed arm of the sea. The postulated limits of this sea are outlined for Texas, New Mexico, and Oklahoma.

INTRODUCTION

The black spore-bearing Woodford shale is one of the most conspicuous pre-Permian stratigraphic units in the Permian basin. The lithologic nature of the shale is such that it stands out in sharp contrast to beds above and below and gives distinctive patterns on the electric and radioactive logs. Although it is doubtful that any oil is or will be produced from the Woodford in the Permian basin, the ease with which its boundaries are recognized has placed it in an important practical position in the preparation of structural geologic maps.

The purpose of this paper is to assemble the data on the geographic distribution, lithology, thickness, and paleontology of the Woodford shale in the Permian basin with the objectives of interpreting its geologic age, stratigraphy, environment of deposition, and paleogeography.

ACKNOWLEDGEMENTS

Acknowledgment is gratefully made to E. Hazen Woods, for supplying valuable cores; to J. T. Bartley, Berte Haigh, E. R. Powell, E. L. Reed, G. P. Crawford, Nugent Brasher, Russell Farmer, W. T. Wynn, C. F. Henderson, E. Russell Lloyd, E. W. Vanderpool, and Louise Fillman, for assistance in procuring logs and well data; and to R. K. DeFord, for critical reading of the manuscript. The photographs of the fossils were made with the financial assistance of grant number 276 of The University of Texas Research Institute. The work was sponsored jointly by the University Lands, Bureau of Economic Geology, and Department of Geology, at The University of Texas.

METHODS

The geographic distribution, lithology, and thickness data of the Woodford were assembled from cuttings, cores, sample logs, electric logs, and radioactive logs in the manner practiced in most oil company geological offices. Samples from key wells and available cores were examined. The thickness data were plotted on the well control map (fig. 1) and certain wells were selected for lines of cross-sections (Pl. I). Paleontological specimens were obtained from cuttings and cores. The fossils were whitened with ammonium chloride and photographed on 35-mm Panatomic X film, using a 32-mm micro-tessar coated lens.

GEOGRAPHIC DISTRIBUTION

The Woodford in the subsurface exists in an area of more than 13,500 square miles in west Texas and southeast New Mexico (fig. 2). Pre-Permian erosion has removed it on the crests of many of the northwest-southeast trending folds of the Central Basin Platform. Those structural highs whose crests are completely devoid of Woodford are: Fort Stockton ridge, Sand Hills, Penwell-Jordan, TXL, Goldsmith, Embar, Parker, Keystone, Dollarhide, Fullerton, Union-Biles, and the Eunice uplift. Truncated and partially removed sections are found on the flanks of these folds. Truncated Woodford is found over the crests of the more deeply buried structural highs such as Block 31, Yarbrough and Allen, Monahans, Ratcliff and Bedford, and Wheeler.

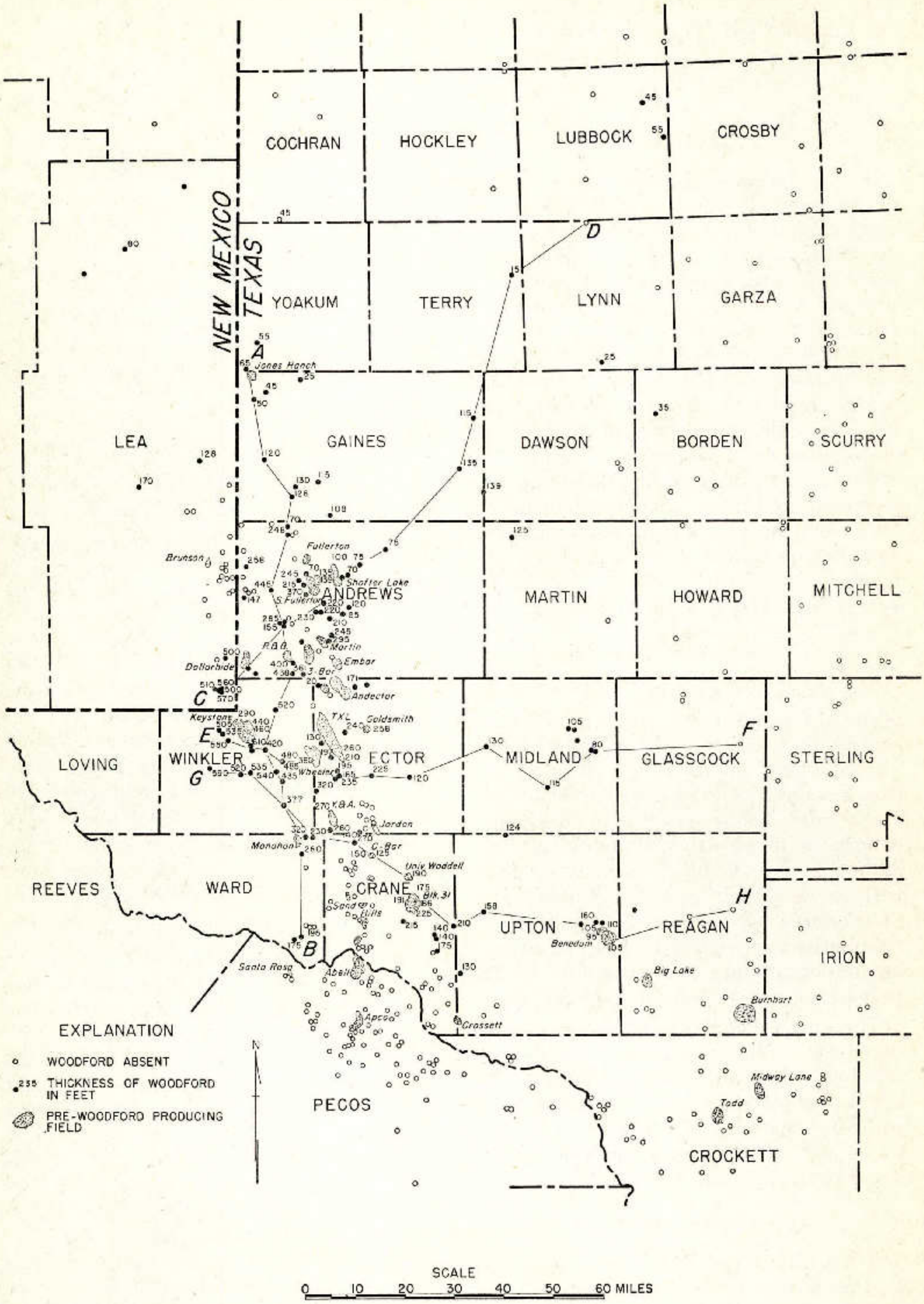

Figure 1. Well control for Woodford data.

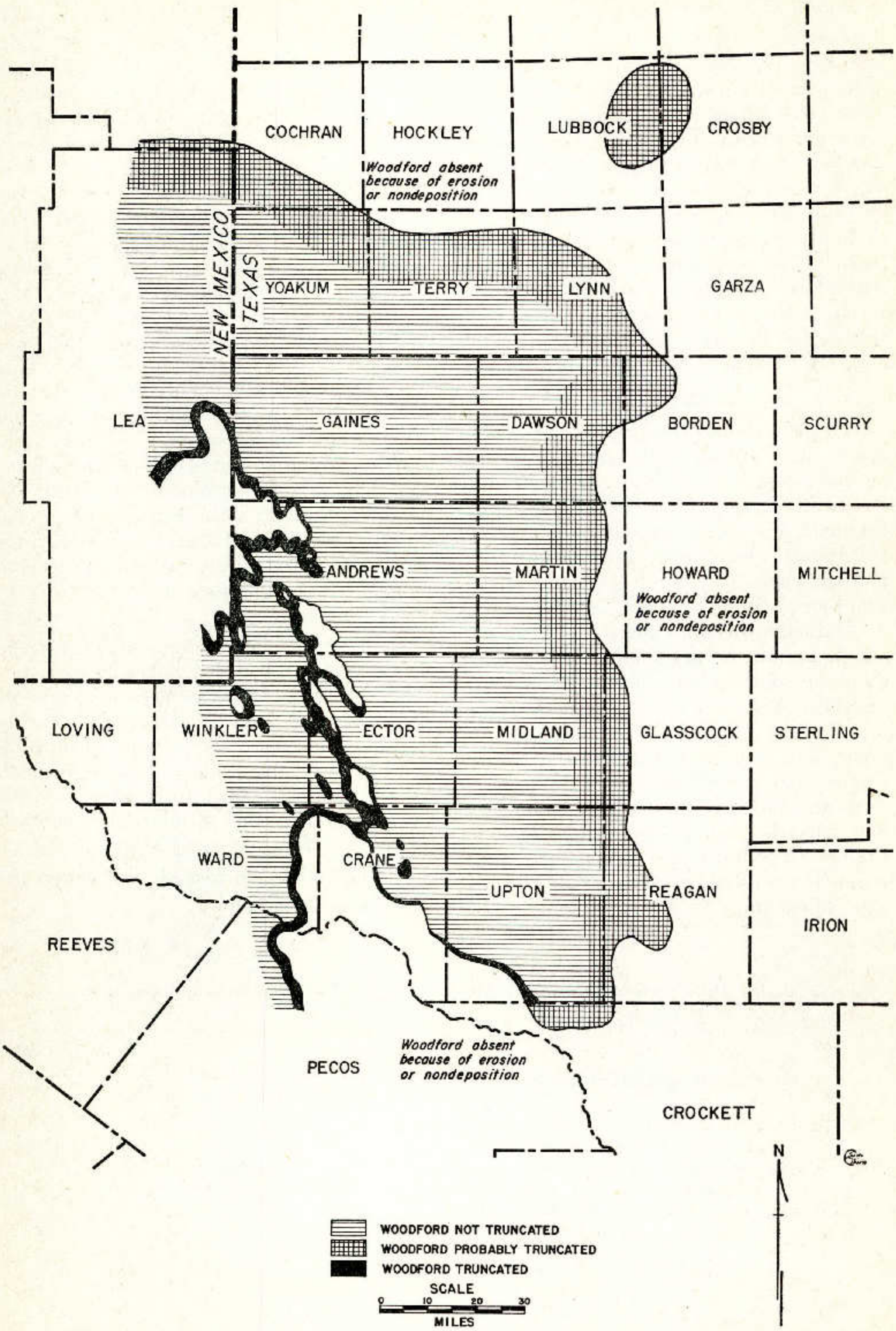

Figure 2. Woodford distribution map.

Woodford is absent north of an irregular line extending from the northern line of Lea County, New Mexico, eastward to north-central Crosby County, Texas. It is absent east of an irregular line extending from north-central Crosby County southward to south-central Reagan County. The shale is not known south of the northern parts of Crockett and Pecos counties. It probably exists throughout the Delaware basin to the west but is so deeply buried that it has not yet been reached by the drill. It is known in wells to the west beyond the edge of the map (fig. 2) in both Texas and New Mexico (Lloyd, 1949, pp. 46–49).

LITHOLOGY

The Woodford consists of brownish-black, iron sulfide rich, resinous spore-bearing, fissile shale that gives a characteristically high radioactive reading on the Gamma Ray log. Small quantities of calcareous shale and brown to black mottled chert are found at various stratigraphic positions within the Woodford. A distinctive detrital member, sandy and conglomeratic, occurs about 100 feet above the base of the shale in Winkler County (fig. 3). A similar conglomerate is recognized at the base of the Woodford to the north and east in north-central Andrews County and in western Borden County.

On the basis of lithology and radioactive and electric log patterns, the Winkler County Woodford is divided into three units, lower, middle, and upper (fig. 3). The upper unit is brownish-black shale with very few small resinous spores. The middle unit, the main spore-bearing unit, is marked at the top with a brownish-black chert and calcareous shale, which gives a high resistivity reading on the normal curve. Various other calcareous and cherty beds occur in this unit and the base is arbitrarily drawn at the bottom of the detrital member mentioned previously. The middle Woodford is characterized by extraordinarily high readings on the Gamma Ray curve and probably is the most widespread unit of the Woodford. Chert and calcareous material become important constituents of the lower Woodford. This results in a high resistivity reading on the normal curve and a reduced reading on the Gamma Ray curve as compared to the middle and upper units. Further, spores are rare in the lower Woodford. The lower unit is known in a limited area along the western part of the Central Basin Platform and is interpreted by some as belonging to the Devonian limestone and chert of pre-Woodford age.

Many cores have been cut in various parts of the Woodford but none is available that includes the entire thickness of the shale from one well. Most of the coring was undertaken for the purpose of locating the top of the Devonian limestone beneath the Woodford. Therefore, most of the cores are near this stratigraphic contact.

Mr. E. Hazen Woods, Midland, Texas, has generously furnished for study the cores described below.

Sinclair Prairie Oil Company's University No. 2 "143", 660 feet from the south and west lines of section 1, block 14, University Lands, Andrews County, Texas.

	Feet	*Inches*
Core from 9,745 to 9,765 feet.		
Woodford—		
Brownish-black, iron sulfide rich, thinly bedded, dense shale with resinous spores and conodonts	12	0
Conglomeratic shale consisting of paurograined, light gray limestone fragments with a brownish-black irregularly bedded shale matrix	0	6
Devonian limestone—		
Light gray, mesograined, stylolitic limestone	0	6
Total	13	0

Sinclair Prairie Oil Company's University No. 6 "154", 660 feet from the north and east lines of section 24, block 13, University Lands, Andrews County, Texas.

	Feet	*Inches*
Diamond bit core from 9,244 to 9,257 feet.		
Woodford—		
Brownish-black, iron sulfide rich, thinly bedded, dense shale with resinous spores and conodonts	11	0
Dark gray, mesograined, glauconitic, dense limestone	0	2
Irregularly bedded layers of black shale with subangular pieces of light gray, mesograined limestone. The shale has slickensides	0	2
Devonian limestone—		
Very light gray to white, mesograined limestone	1	8
Total	13	0

Sinclair Prairie Oil Company's Bryan No. 1, 660 feet from the south and east lines of section 40, block 32, township 6 north, EL & RR survey, Borden County, Texas.

	Feet	*Inches*
Diamond bit core from 9,892 to 9,930 feet.		
Mississippian—		
Dark gray to black chert and dark siliceous shale	5	0
Dense, dark greenish-gray, glauconitic, very fine sandstone	1	0
Light to medium gray, paurograined, shaly and siliceous limestone and grayish-green siliceous shale with scattered fragments of crinoid stems, brachiopods and conodonts	3	0
Woodford—		
Brownish-black, thinly bedded, dense, resinous spore-bearing shale	26	0
Total	35	0
9,930 to 9,934 feet drilled with conventional bit.		
Diamond bit core from 9,934 to 9,962 feet.		
Woodford, continued—		
Irregularly bedded, subangular, conglomeratic, medium gray, mesograined, dolomitic limestone with brownish-black shale matrix	1	0
Ellenburger (Lower Ordovician)—		
Medium gray, mesograined, dolomitic limestone	2	6
Dark gray, mesograined, dolomitic and shaly limestone with black stylolitic slickensides	0	6
Medium light gray, mesograined limestone	5	6
Dark gray shale with streaks of granular calcite	0	6
Pinkish-gray, megagrained limestone with many stylolites	11	5
Total	21	5

THICKNESS

The thickness data of the Woodford are compiled on the well control map (fig. 1) and are contoured with a 100-foot contour interval on the isochore map (fig. 4). The map term isochore is used here because the measurements are drilled thicknesses with none corrected to true stratigraphic thicknesses. However, the dips in much of the area are so low that in reality this is an isopach map.

The Woodford reaches a maximum thickness of 610 feet in the Richardson and Bass' Kansas City Stock Company No. 1, south of Keystone field, Winkler County, Texas. The isochore map infers that thicker Woodford may occur to the west in the Delaware basin but has not been drilled. Radial thinning to the north, east, and south from the north-central Winkler County maximum is regular and rapid. The rate of eastward thinning across the Central Basin Platform is approximately 13 feet per mile. Beyond the platform to the north and east the rate of thinning is reduced to 3 feet per mile, thus permitting large areas east of the platform to be underlain by Woodford less than 150 feet thick.

Nearly all pre-Permian structural highs show rapid thinning of the Woodford toward the crests of the anticlines. Most of this is due to erosional truncation but some of the thinning may be interpreted as due to locally thinner deposition. The thinner sections exhibit electric log patterns similar to those of the normal Woodford

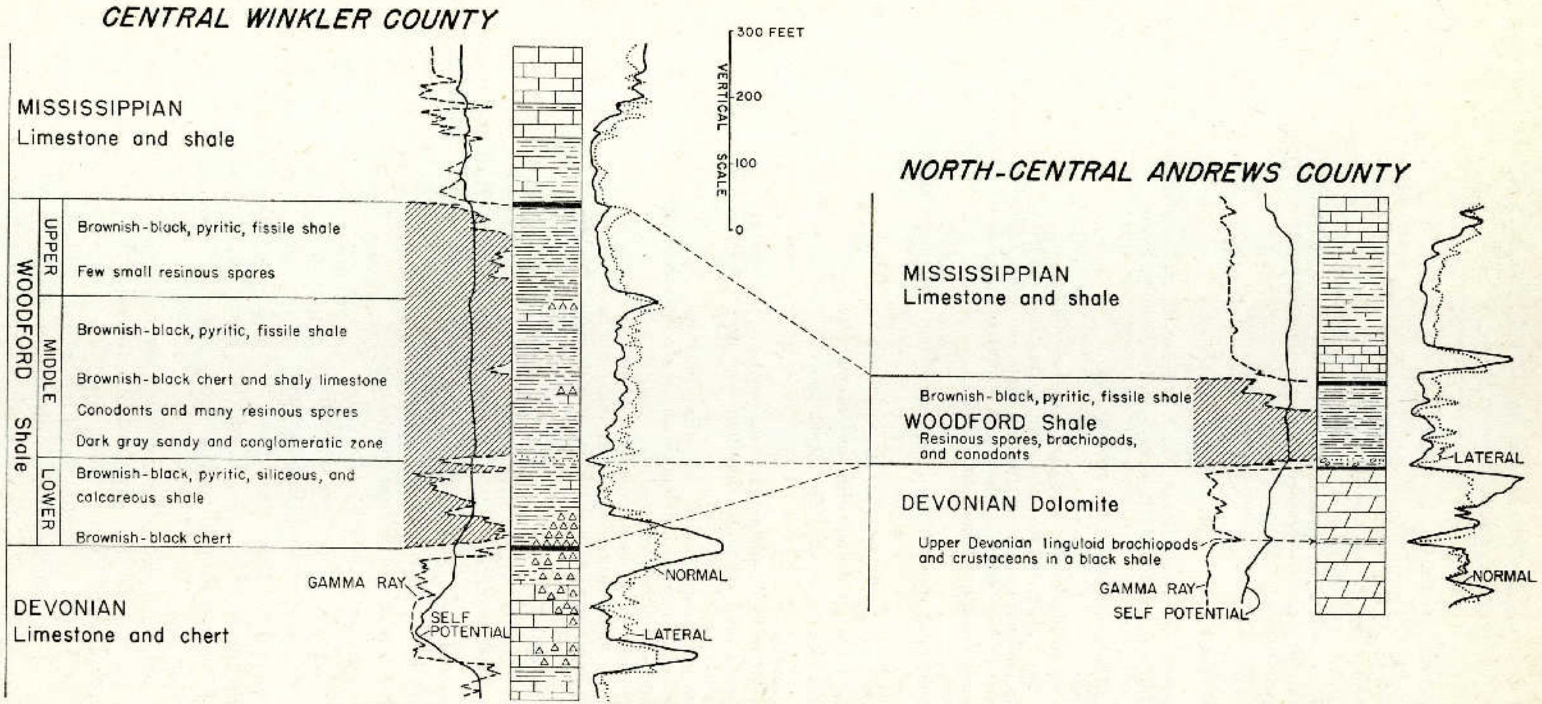

Figure 3. Typical Woodford sections.

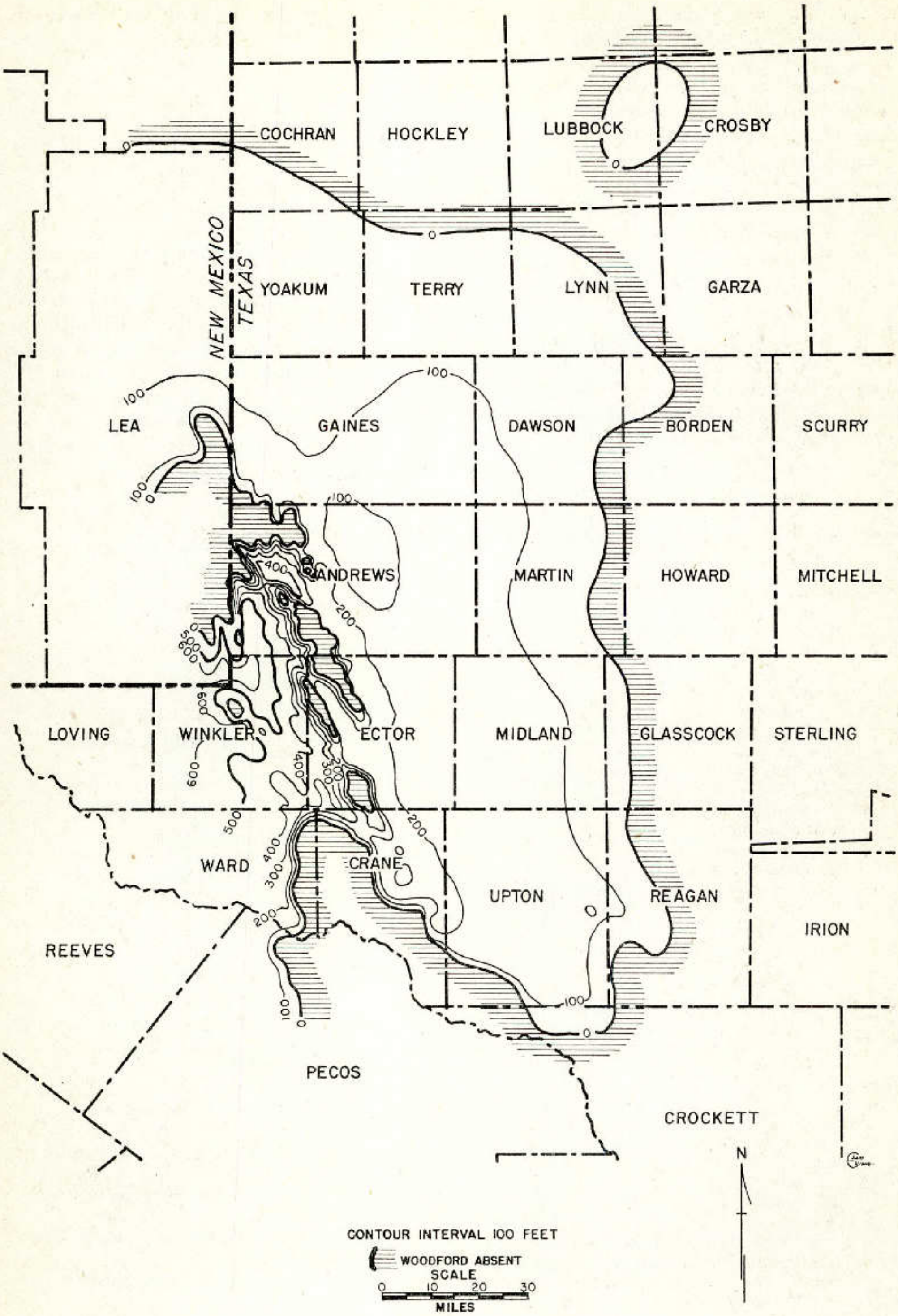

Figure 4. Woodford isochore map.

except that the pattern is displayed in miniature. This suggests that upward movements along the structural highs occurred before and during Woodford deposition. In the preparation of the restored thickness map (fig. 5) the local thinning over the sharp Central Basin Platform structures is assumed to be entirely due to truncation in order to obtain the contour of the Woodford depositional basin from a regional view.

PALEONTOLOGY

Spores, brachiopods, and conodonts have been identified from the Woodford shale in the Permian basin. These are illustrated on Plates II and III, and a record of their occurrence is as follows:

A core from 9,745 to 9,765 feet, Woodford shale, Sinclair Prairie Oil Company's University No. 2 "143", 660 feet from the south and east lines of section 1, block 14, University Lands, Andrews County, Texas.

Spores—
- Tasmanites huronensis (Dawson) Schopf, Wilson, and Bentall, 1944

Brachiopods—
- Lingula sp.

Conodonts—
- Ligonodina sp.
- Ozarkodina sp.
- Prioniodus sp.
- Bryantodus sp.
- Hindeodella sp.
- Nothognathella sp.
- Polygnathus sp.
- Ancyrognathus sp.
- Palmatolepis sp.
- Palmatolepis minuta Branson and Mehl, 1934
- Palmatolepis perlobata Ulrich and Bassler, 1926
- Palmetolepis subperlobata Branson and Mehl, 1934

A core from 9,244 to 9,257 feet, Woodford shale, Sinclair Prairie Oil Company's University No. 6 "154", 660 feet from the north and east lines of section 24, block 13, University Lands, Andrews County, Texas.

Spores—
- Tasmanites huronensis (Dawson) Schopf, Wilson, and Bentall, 1944

Conodonts—
- Hindeodella sp.
- Palmetolepis sp.

A core from 8,016 to 8,025 feet, Woodford shale, Stanolind Oil and Gas Company's Williamson No. 1, 660 feet from the north and east lines of section 5, block 45, township 1 north, T & P survey, Ector County, Texas. (This list is published by permission of the Stanolind Oil and Gas Company from a letter in the Midland office files dated November 30, 1945, addressed to Russell Farmer. The specimens were unavailable for restudy.)

Conodonts—
- Prioniodus sp.
- Hindeodella sp.
- Ozarkodina sp.
- Bryantodus sp.
- Spathognathodus sp.
- Icriodus sp.
- Polygnathus sp.
- Polygnathus linguiformis Hinde, 1879

In connection with the work of examining Woodford cores, a Devonian black shale, devoid of resinous spores, approximately 90 feet below the Woodford in the south Fullerton area was found to be fossiliferous. The occurrence of these fossils is recorded here as evidence of the lower age limits of the Woodford and no attempt is made to interpret them as Woodford in age.

A core from 8,830 to 8,848 feet, a Devonian black shale 90 feet definitely below the Woodford, Sinclair Prairie Oil Company's University No. 3 "160", 660 feet from the south and 1,980 feet from the west lines of section 14, block 13, University Lands, Andrews County, Texas.

Brachiopods—
- Lingula sp.
- Lingula (Lingulipora) williamsana Girty, 1898
- Lingulidiscina sp.
- A fragment of an articulate brachiopod

Crustaceans—
- Spathiocaris sp.

GEOLOGIC AGE

The interpretation of the geologic age of the subsurface Woodford is based mainly on conodonts because little is known concerning the stratigraphic limits of Woodford spores and brachiopods. However, all conodonts are not good age indicators and the interpretations made here follow those outlined by Ellison (1946, pp. 107–110).

Long range, bladed and bar conodonts, poor age indicators—
- Ligonodina sp. (Silurian through Permian)
- Prioniodus sp. (Ordovician through Permian)
- Hindeodella sp. (Ordovician through Permian)
- Ozarkodina sp. (Ordovician through Permian)
- Spathognathodus sp. (Silurian through Permian)

Limited range, bladed and bar conodonts, fair age indicators—
- Bryantodus sp. (Upper Devonian through Middle Mississippian)

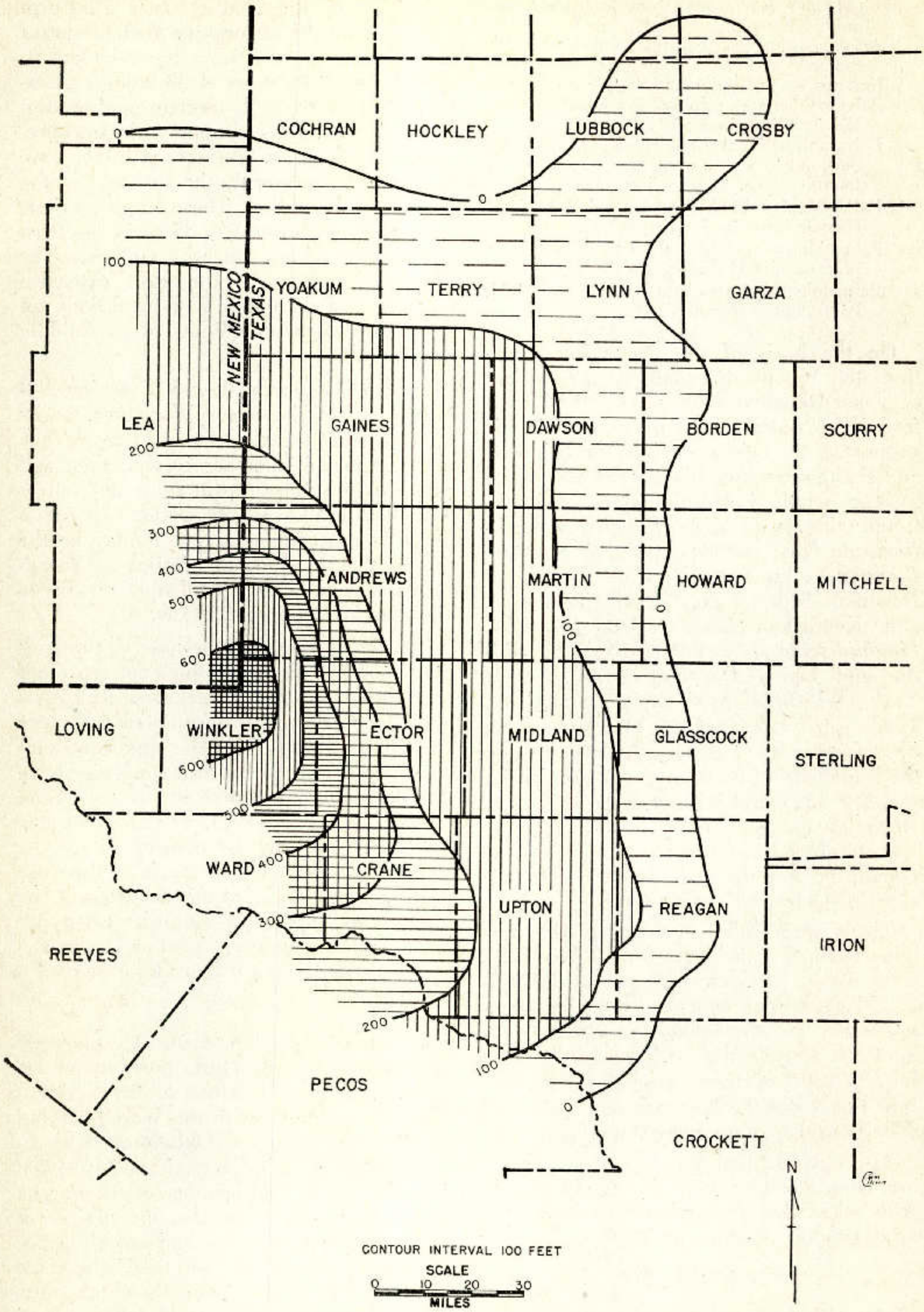

Figure 5. Restored thickness of Woodford.

Limited range, platform conodonts, good age indicators—
- Ancyrognathus sp. (Middle and Upper Devonian)
- Icriodus sp. (Middle and Upper Devonian)
- Polygnathus sp. (Upper Devonian through Middle Mississippian)
- Polygnathus linguiformis Hinde, 1879 (Upper Devonian)
- Palmatolepis sp. (Upper Devonian)
- Palmatolepis minuta Branson and Mehl, 1934 (Upper Devonian)
- Palmatolepis perlobata Ulrich and Bassler, 1926 (Upper Devonian)
- Palmatolepis subperlobata Branson and Mehl, 1934 (Upper Devonian)

On the basis of the above interpretations the Woodford conodonts are typical of Upper Devonian faunas. That the Woodford is no older than Upper Devonian is supported by evidence from brachiopods and crustaceans found below the Woodford in the south Fullerton area, Andrews County, Texas. *Lingula (Lingulipora) williamsana* Girty, 1898, a peculiar punctate *Lingula*, is known only from the Upper Devonian beds of New York, Tennessee, and Kentucky (Girty, 1898, p. 387). *Lingulidiscina* sp. is known from the Middle and Upper Devonian beds of New York (Whitfield, 1890, p. 122, and Girty, 1928, pp. 129, 241). The crustacean *Spathiocaris* sp. has been recorded from the Woodford of Oklahoma (Cooper, 1932, pp. 249–352) and is interpreted as Upper Devonian in age. These fossils found below the Woodford point to an Upper Devonian age for the beds below the Woodford in Andrews County, Texas.

There is no fossil evidence in the Permian basin that the Woodford is Mississippian in age. For example, none of the typical Mississippian platform conodont genera such as *Siphonodella*, *Pseudopolygnathus*, *Gnathodus*, or *Solenodella* have been found. Further, none of the typical brachiopods of the Mississippian have been found in the subsurface Woodford.

To conclude that the Woodford fossils are Upper Devonian in age is compatible with all of the geographic, lithologic, and stratigraphic evidence at hand.

STRATIGRAPHY

Permian basin.—The key to the correlation of the three Woodford members is the sandy, conglomeratic detrital zone at the base of the middle member. The correlations east of the Central Basin Platform are based on the assumption that the basal conglomerate in that area is equivalent to the detrital at the base of the middle member. Lithology and electric and radioactive log patterns support this interpretation. The cross sections (Pl. I) have been constructed with the detrital as the horizontal base line. These cross sections show that the lower Woodford is the least widespread of the three members. The middle Woodford is the most extensive member, and the upper Woodford does not reach the geographic limits of the middle unit.

Evidence at the south end of section A-B indicates that the lower Woodford, in its most southerly extent, may become the most important member in that area and probably grades southward into an equivalent chert and novaculite section. This evidence is not conclusive but it may be the reason that black shale similar to Woodford is not known south of northern Pecos and Crockett counties, Texas.

The detrital zone at the base of the middle Woodford probably does not represent a major stratigraphic break because fossils above and below are interpreted as Upper Devonian. However, it is important that the occurrence of Woodford fossils is above this detrital. Since these fossils have been interpreted as Upper Devonian, then the middle Woodford is considered to be Upper Devonian. On the basis of the close lithologic and stratigraphic relations of the middle and upper Woodford, the upper Woodford is also interpreted as Upper Devonian, even though it lacks fossil evidence for its age.

Beyond the Permian basin.—On the basis of lithology, stratigraphic position, and a few fossils, the Woodford of the Permian basin is correlated with the Woodford and Chattanooga shales of Oklahoma, Kansas, and Arkansas. Similarly, it is correlated with the Ready Pay member of the Percha shale outcropping in the mountains of southern New Mexico and west Texas. Tentative correlation of the subsurface Woodford with the Upper Devonian parts of the Caballos novaculite, west Texas, and Arkansas novaculite, Oklahoma and Arkansas, is based mainly on stratigraphic position and similar fossils.

PALEOGEOGRAPHY

The published data on the outcrop and subsurface occurrences of the Woodford and its equivalents are compiled on the paleogeographic map (fig. 6). A postulated boundary of the Woodford sea is shown so as to include within its limits all of the recorded occurrences. The blank areas within this sea area represent either areas of no data or areas where Woodford is absent because of removal by erosion.

If the postulated boundary of the sea is reasonably correct then it is suggested that two important connecting basins may have existed during Woodford times. One of these basins is centered in southeastern Oklahoma and may be called the Oklahoma Woodford basin. The other is centered in Texas west of the Central Basin Platform and may be called the west Texas Woodford basin. That the two areas were connected is evidenced by the similarity of lithology in each basin.

The remarkable uniformity in lithology and thickness of the Woodford suggests that the surrounding land areas were of low relief. Further, the climatic conditions on these surrounding lowlands must have been conducive to a small steady supply of fine clays for deposition as black muds.

ENVIRONMENT OF DEPOSITION

No attempt will be made here to review the extensive literature on the environment of deposition of black shales. This is thoroughly reviewed by Ruedemann (1934, pp. 43–53). However, the association of conodonts, inarticulate brachiopods, and spores in brownish-black, iron sulfide rich, fissile shale in a uniformly extensive deposit such as the Woodford leads to a series of suggestions and speculations on the origin and conditions of deposition.

First, there seems to be little doubt that the spores must have floated into Woodford waters or were blown in by winds. Second, conodonts may have been part of the Woodford nekton or possibly a part of the benthos. It is most probable that conodonts flourished in more favorable waters and occasionally wandered into the toxic Woodford waters to meet their death. Third, brachiopods are admitted as part of the benthos and the *Lingula*-type forms must have been rugged to withstand the lifeless, stagnant waters. Fourth, the abundance of iron sulfides as nodules, cementing agent, and as irregular masses would indicate that the depositional environment was highly charged with hydrogen sulfide making for extreme reducing conditions. Fifth, and finally, the uniformity in bedding and the lack of ripple marks, cross-bedding, and other shallow water sedimentary structures suggests deposition below wave action or in waters having little wave and current action.

In speculating on the depositional conditions of black shales, Ulrich (1911, pp. 356–359) indicated that shallow arms of the sea may become stagnant and fouled by decaying organic material. The surface waters may remain relatively normal and capable of supporting life, but at depths the waters are toxic and highly charged with hydrogen sulfide. The modern Black Sea waters are known to be stagnant and charged with hydrogen sulfide below depths of 80 fathoms (Schott, 1945, p. 685). Animals or plants that encounter the stagnant toxic waters fail to survive and probably are preserved in the black muds on the sea floor. The Black Sea is unusually deep, averaging more than 650 fathoms, and it is suggested that the Woodford sea differs in never being much deeper than about 200 fathoms.

Ruedemann's (1934, p. 43) conclusions that black shale faunas and floras are like those of modern Sargasso seas does not seem to fit the Woodford picture because of the absence of abundant plant remains other than spores.

In conclusion, the ideas outlined above indicate that Woodford black shale probably was deposited in stagnant waters of a partly enclosed arm of the sea where bottom conditions were toxic with hydrogen sulfide.

SUMMARY

1. The Woodford occurs in an area of 13,500 square miles in west Texas and southeast New Mexico.

2. The Woodford is a brownish-black fissile shale and is divided into three members on the basis of lithology and radioactive and electric log patterns.

3. The Woodford reaches a maximum thickness of 610 feet in Winkler County, Texas, and thins radially to the north, east, and south.

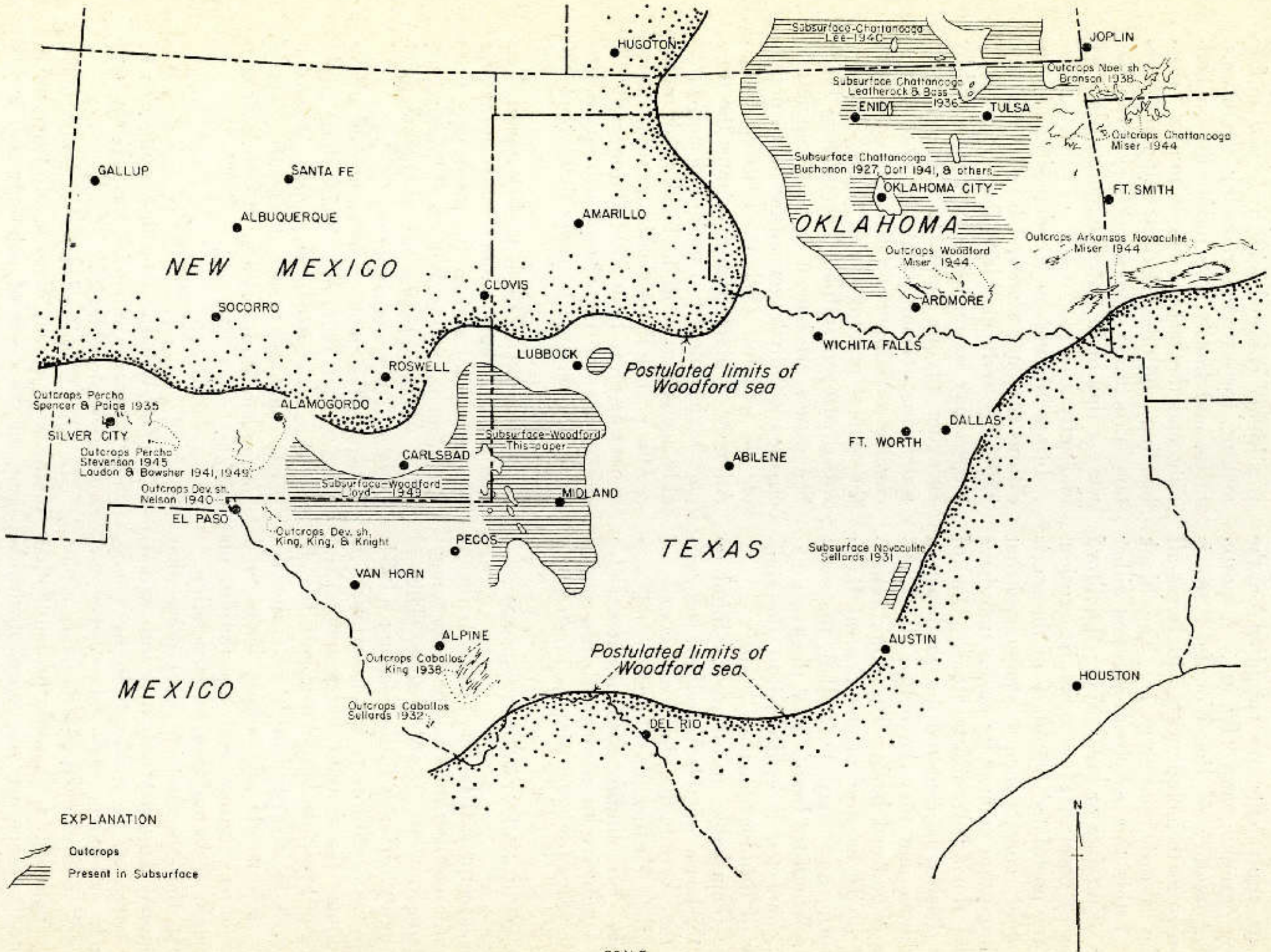

Figure 6. Woodford paleogeography.

4. The fossils of the Woodford include spores, conodonts, and brachiopods and are interpreted as Upper Devonian in age mainly on the basis of conodonts.

5. The Woodford is correlated with Woodford and Chattanooga shales of Oklahoma, Kansas, and Arkansas; with the Percha shale of New Mexico; and with the Caballos and Arkansas novaculities of Texas and Arkansas.

6. Two connecting depositional basins are postulated for Woodford seas, and the surrounding land areas are thought to have had low relief.

7. A stagnant marine environment in a partly enclosed arm of the sea is postulated for the Woodford. Waters highly charged with hydrogen sulfide are thought to have existed at depths similar to those in the modern Black Sea.

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PLATE II

Conodonts of the Woodford shale
(All figures x27.5)

FIGURES—

1, 2, 4, 5, 7, 12. *Ligonodina* sp. Lateral views. (Nos. 19324, 19325, 19327, 19328.)*
3. *Ozarkodina* sp. Lateral view. (No. 19326.)
6. *Bryantodus* sp. Lateral view. (No. 19325.)
8. *Hindeodella* sp. Lateral view. (No. 19330.)
9. *Prioniodus* sp. Lateral view. (No. 19325.)
10, 11, 13, 18,
20, 21, 22, 26. *Palmatolepis* sp. Aboral views. (Nos. 19324, 19325, 19326, 19332, 19333, 19335.)
14, 16. *Nothognathella* sp. Lateral views. (Nos. 19325, 19326.)
15. *Palmatolepis* sp. and *Ligonodina* sp. Aboral and lateral views respectively. (No. 19324.)
17. *Palmatolepis minuta* Branson and Mehl, 1934. Aboral view. (No. 19331.)
19. *Ancyrognathus* sp. Aboral view of fragment. (No. 19324.)
23. *Palmatolepis subperlobata* Branson and Mehl, 1934. Oral view. (No. 19325.)
24. *Palmatolepis perlobata* Ulrich and Bassler, 1926. Oral view. (No. 19334.)
25. *Palmatolepis* sp. Aboral view. (No. 19338.)

Figures 1–24, 26 from Woodford shale, core 9,745 to 9,765 feet, Sinclair Prairie Oil Company's University No. 2 "143", 660 feet from the south and east lines of section 1, block 14, University Lands, Andrews County, Texas.

Figure 25 from Woodford shale, core 9,244 to 9,257 feet, Sinclair Prairie Oil Company's University No. 6 "154", 660 feet from the north and east lines of section 24, block 13, University Lands, Andrews County, Texas.

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*Bureau of Economic Geology accession numbers for the chips of core to which fossils are attached. In many cases, more than one genus is attached to a single piece of rock.


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PLATE III

Brachiopods and spores of the Woodford shale
and
Brachiopods and crustaceans of a shale below the Woodford

FIGURES—

1. *Lingula (Lingulipora) williamsana* Girty, 1898. x11. (No. 19339.)

2, 3. *Lingula* sp. x11. (Nos. 19336, 19337.)

4. *Lingulidiscina* sp. x11. (No. 19340.)

5, 6, 8. *Tasmanites huronensis* (Dawson) Schopf, Wilson, and Bentall, 1944. x55. (No. 19329.)
    5, 6. With transmitted light.
    8. With reflected light.

7. *Lingula* sp. x11. (No. 19341.)

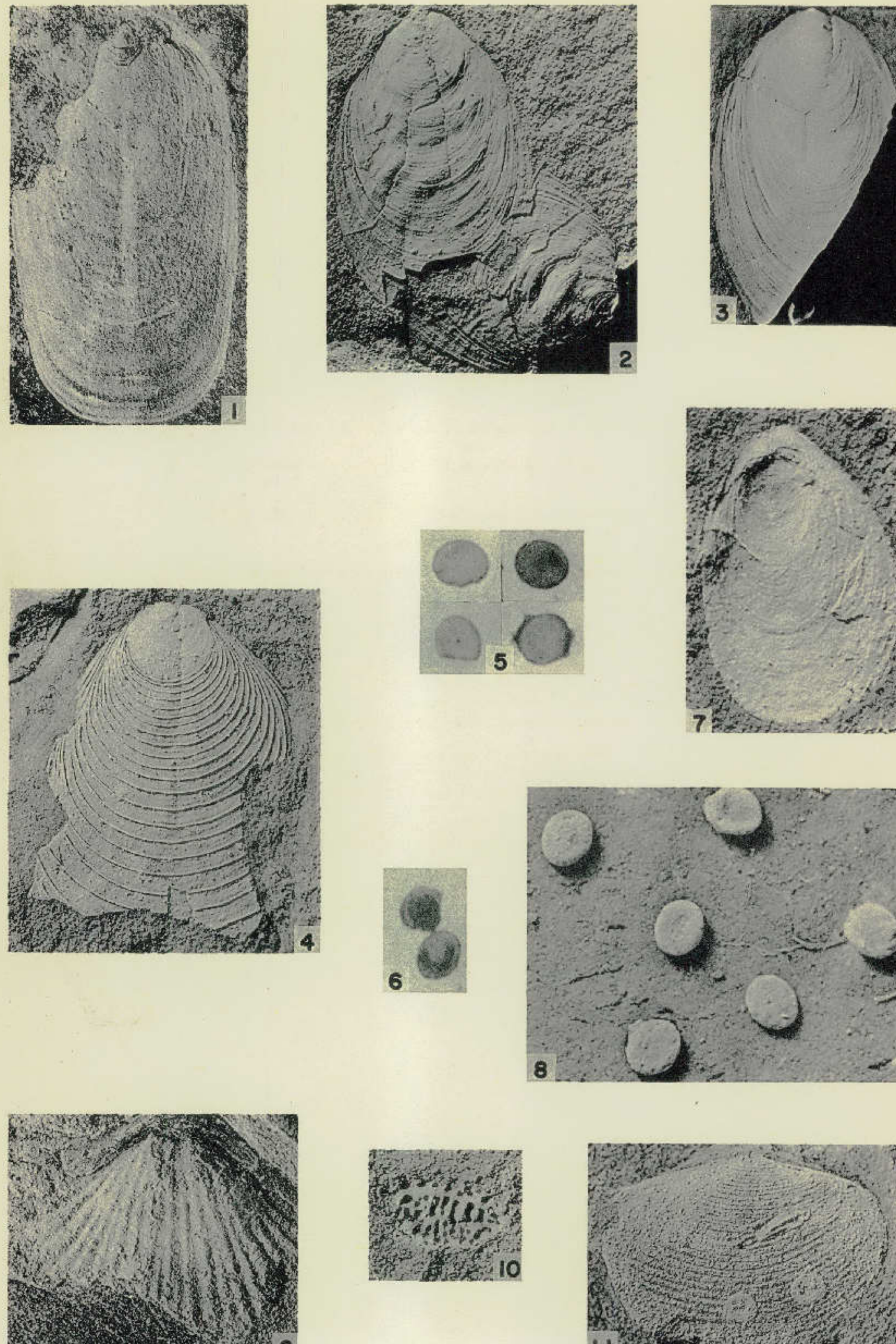
9. An unidentified articulate brachiopod fragment. x11. (No. 19342.)

10. An unidentified mold probably of the oral surface of the conodont genus *Polygnathus*. x27.5. (No. 19334.)

11. *Spathiocaris* sp. (crustacean). Side view. x11. (No. 19343.)

Figures 1, 4, 7, 9, 11 from a Devonian black shale definitely below the Woodford, core 8,830 to 8,848 feet, Sinclair Prairie Oil Company's University No. 3 "160", 660 feet from the north, 1,980 feet from the west lines of section 14, block 13, University Lands, Andrews County, Texas.

Figures 2, 3, 5, 6, 8, 10 from Woodford shale, core 9,745 to 9,765 feet, Sinclair Prairie Oil Company's University No. 2 "143", 660 feet from the south and east lines of section 1, block 14, University Lands, Andrews County, Texas.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