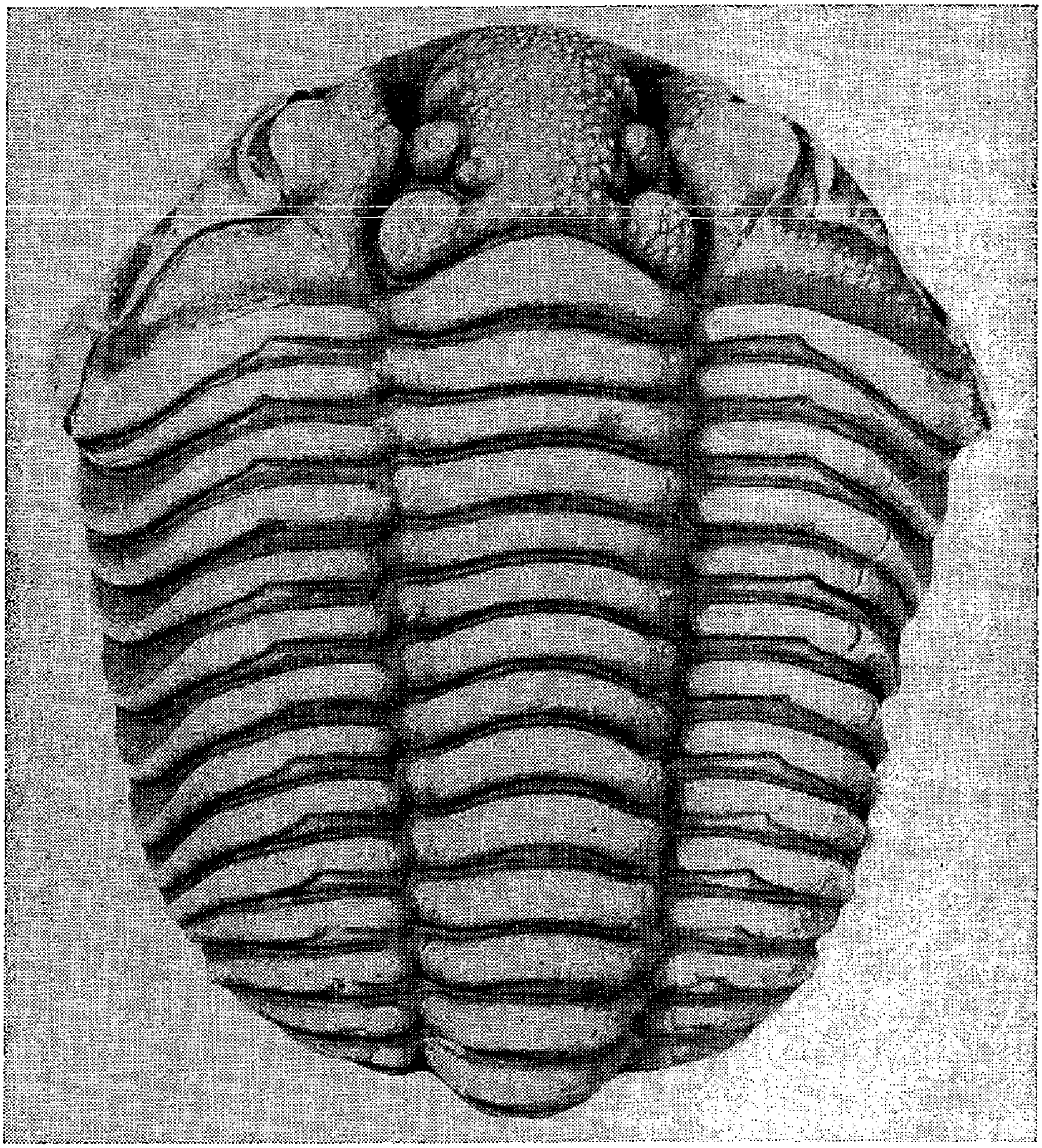
OKLAHOMA GEOLOGY NOTES



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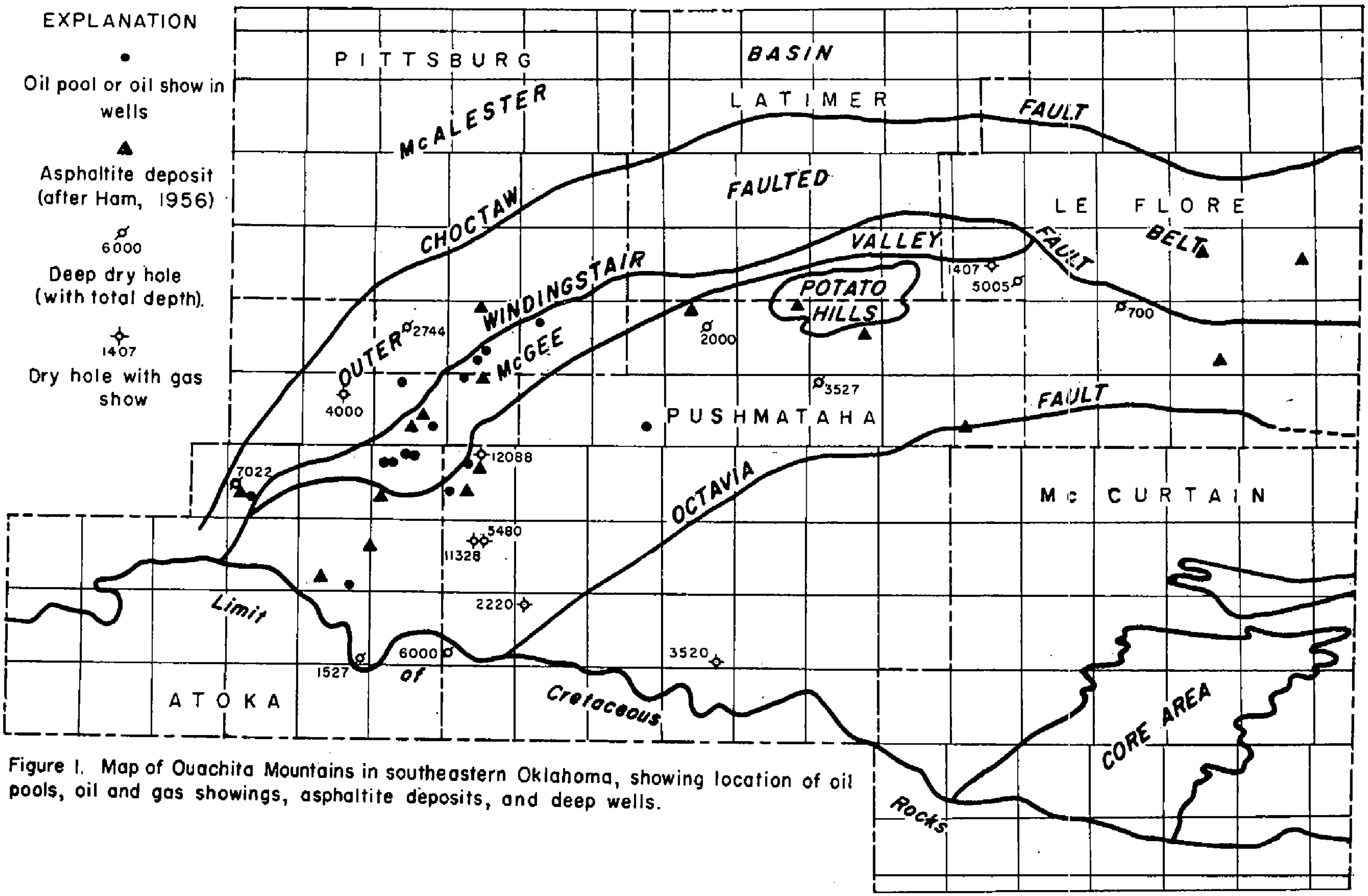

Figure I. Map of Ouachita Mountains in southeastern Oklahoma, showing location of oil pools, oil and gas showings, asphaltite deposits, and deep wells.

Is There Oil and Gas in the Ouachita Mountains?

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For many years oil men interested in Oklahoma have repeatedly condemned the Ouachita Mountain area as a possible future oil-producing province. The reasons cited for this general condemnation include: 1) "High carbon ratios," 2) "The rocks are metamorphosed," 3) "The sandstones lack porosity," 4) "There is no adequate source rock," 5) "The pre-Atoka rocks are all silicified," and 6) "There has been extensive thrust faulting." That this discouraging outlook is not entirely justified, and that where oil is now being produced (albeit in minor quantities) there is not only a possibility but a likelihood that more will be found, is the theme of this paper.

High carbon ratios: The fixed carbon ratios to which the critics most often refer are those of the Arkansas Valley-McAlester basin and not of the Ouachita Mountains. In general, coals are rare in the Ouachita facies and carbon ratio analyses have not been made. That published maps show a great southward and southeastward increase in carbon ratios in the McAlester basin is undeniable. And yet large quantities of natural gas are at present being produced in areas of Arkansas and eastern Oklahoma where carbon ratios range as high as 80 percent—far beyond the theoretical "deadline" for gas. Furthermore, as Levorsen (1954, p. 609-613) has pointed out, there are many reasons (Levorsen lists nine) for doubting the reliability of such carbon ratio studies. If coals were widespread areally and stratigraphically and analyses were made with careful regard to the geology of the coal and of the associated strata it might be possible to produce a carbon ratio map that would be an accurate guide to prospecting. For the Ouachita Mountains no such map exists.

Metamorphism of the strata: The widespread misunderstanding of the nature of the rocks in the Ouachita Mountains stems from Honess' (1923, p. 23) statement that the rocks of the Ouachita facies are "profoundly metamorphosed." Subsequent investigators have gradually reduced the concept of the degree of metamorphism to "low-grade metamorphism" (Pitt, 1955, p. 10). And even this stage of metamorphism appears to exist only in the area of the core of the mountains in McCurtain County, Oklahoma, and adjacent parts of western Arkansas. In the outer belt of the mountains there has been no detectable metamorphism. Many of the Stanley sandstones may be described, moreover, as "poorly cemented" or "friable." Shales deserve the designation "clay shales," "fissile," or "flaky." None of the rocks can be properly classed as metaquartzite, phyllite, slate, or marble, the common metamorphic equivalents of sandstone, shale, and limestone.

Lack of porosity: In some test wells in and near the mountains the sandstones have been noted as generally non-porous or only slightly porous. Similar observations have been recorded at surface exposures. In this instance also the critics of the region have made this an all-inclusive generalization leading to condemnation of a large area. This is a grossly misleading proposition. Even within the core area the sandstones are porous, although the porosity is localized in zones or beds separated by non-porous intervals.

The sandstones of the outer belt of the mountains are no more tightly cemented than they are in many of the producing areas of south-central Oklahoma. Indeed, it is difficult to distinguish a hand specimen of a Stanley sandstone from one of a Springer sandstone. Much of the Stanley sandstone contains quantities of clay-like interstitial matter which tends to reduce primary porosity. This in itself should not be regarded as a wholly unfavorable factor in the light of oil and gas production. True graywacke reservoir rocks are known in many areas of the country, notably in Pennsylvania and along the Gulf Coast.

A comparison of electric logs and samples from wells along a line from the Max Pray No. 1 Wyrick, sec. 26, T. 1 N., R. 14 E., to the Tom Potter No. 1 Ellis, sec. 31, T. 5 S., R. 16 E., almost across the entire exposed portion of the Ouachita Mountains in Oklahoma, reveals a considerable increase in grain size, porosity, and friability of the Stanley in a southerly direction.

Lack of adequate source beds: A region in which the rocks consist predominantly of eugeosynclinal facies (slates, graywackes, siliceous rocks, and pyroclastics) has always been considered an unprofitable area in which to prospect for oil and gas. "Source beds," a term glibly used but inadequately defined in the literature, are considered to be necessary for an oil province. The environment most likely to produce source beds (presumably organic-rich strata) is the shelf. The Ouachita Mountain area has often been described as eugeosynclinal in nature and yet the great bulk of the older (pre-Mississippian) sediments are unexposed except for a few small inliers. And even within the core area of McCurtain County many of the strata exhibit characteristics typical of the shelf environment (Pitt, 1955). Misch and Oles (1957, p. 1904) have pointed out that the apparent contrast between the rocks of the Arbuckle facies (proven to be excellent "source beds") and the Ouachita facies, at least insofar as the exposures in Black Knob Ridge and the Potato Hills are concerned, is due more to an unfortunate dual nomenclature than to any real differences. A further point lies in the possibility that rocks of the miogeosyncline (Arbuckle facies) and shelf may lie beneath the "eugeosynclinal facies" and thus provide adequate, though deeply buried, source beds.

Silicification of pre-Atoka rocks: Chert and novaculite form a significant proportion of the pre-Pennsylvanian strata in the Ouachita Mountains. The Jackfork and Stanley groups contain extensive, though relatively thin, siliceous shales; the Stanley encloses a tuff lentil in the core area. The most prominent and widespread siliceous rock is the Arkansas novaculite. This formation in part grades westward into the Woodford shale of the Arbuckle area with which it is identical. Harlton (1956, p. 136) has pointed out that strata in the oil region of the Ardmore basin are similar to the lower middle Arkansas novaculite. The Santa Maria district of California, from which nearly 250 million barrels of oil have been drawn, produces from a similar siliceous rock (Monterey shale) and the reservoir rock of some west Texas oil pools is the Caballos novaculite, considered the westward equivalent of the Arkansas novaculite of the Ouachita Mountains. The mere presence of siliceous rocks is not, therefore, to be considered as enough to condemn the region.

Extensive thrust faulting: The very presence of thrust faults of great magnitude in the Ouachita Mountain area is a subject of considerable dispute. Pitt (1955) has shown that the area in McCurtain County previously mapped as a fenster is in reality a relatively simple anticlinal uplift. Misch and Oles (1957) propose a similar explanation for the fenster in the Potato Hills. Hendricks (1958), on the other hand, has taken exception to many of the points brought out by Misch and Oles.

The presence or absence of thrust faults, however, has little bearing on the oil and gas possibilities of the area. They can, of course, enormously snarl the job of structure mapping and complicate the life of the development geologist. But enough oil pools of the world are situated in thrust-faulted regions (i.e. Turner Valley, Alberta, and Rose Hill, Virginia) to absolutely contradict the assertion that thrust faulting alone is sufficient to condemn the province.

Shows of Oil

Oil is actually being produced from a few small pools within the Ouachita Mountains. Perhaps the best known of these occurrences are those along the floor of McGee Valley in Atoka and Pittsburg Counties. The Redden pool (now abandoned) was located in T. 1 S., R. 14 E., about a mile south of the settlement of Redden, producing from a Stanley sandstone bed. The trap is apparently effected by an asphalt seal, as the producing zone crops out within a few feet of the wells. The field was discovered in 1914. About 15 wells have been drilled, ranging in depth from 90 to 350 feet. The oil is of 36° gravity and was produced at a total rate of 8 to 9 barrels per day from three active wells.

Five producing wells are located on the flanks of a small fold in sec. 33, T. 2 N., R. 15 E., and sec. 5, T. 1 N., R. 15 E., in the Bald pool. This production is likewise from the Stanley sandstone, at a depth of about 185 feet. The trap is probably stratigraphic since the wells appear to be quite far down on the limbs of an anticline. The oil is dark green, 42° gravity, and is pumped at a rate of one or two barrels per day.

Oil was found at a depth of approximately 450 feet in three wells in sec. 35, T. 2 S., R. 13 E., Atoka County. Here also the production is obtained from Stanley sandstone. The location is along the northwest limb of a large syncline, close to a thrust fault. The oil is 25° gravity; during initial tests it was pumped at rates from 4 to 15 barrels per day. The field, discovered in 1932, has since been abandoned.

A well, drilled in 1950 near the town of Stanley in sec. 26, T. 1 N., R. 17 E., is reported to have produced as much as 30 barrels of 52° gravity oil per day. An offset well was dry, and the first well has been abandoned. This location is in the Kiamichi Valley, a long asymmetrical anticlinal fold east of the prominent Tuskahoma syncline. Oil was found at a depth of 345 feet in the Stanley sandstone.

Numerous other test wells in the Ouachita Mountains have reported showings of oil, particularly those in McGee Valley. The valleys of McGee Creek, Buck Creek, and North Jackfork Creek form a nearly continuous lowland (collectively known as McGee Valley) extending from a point about five miles south of Redden in T. 1 S., R. 14 E. northeast to and beyond the settlement of Weathers in T. 2 N., R. 17 E. This lowland is located in structures essentially anticlinal in nature, though it lies between the Windingstair and Jackfork Mountain faults in an area where faulting and tight folding is the rule. A long strike fault splits the valley in two.

The greatest number of test wells has been drilled in this valley and it has the distinction of being the only area in the Ouachita Mountains in which oil is currently produced.

No active oil seeps are known in the Ouachita Mountains but Ham (1956, p. 2) reports that some of the asphaltite deposits appear to be softer at depth, becoming more petroleum-like. These solid hydrocarbon deposits occur as veins and dikes at many localities in the outer part of the mountains, most of them in the Stanley and Jackfork groups, though others have been noted in the Bigfork chert and in the Arkansas novaculite.

Shows of Gas

A few wells in the Ouachita Mountain area have encountered shows of natural gas. The Sikes-Burkhalter No. 2 Denton-Perrin, sec. 9, T. 2 S., R. 15 E., was drilled in 1958 in an attempt to exploit gas sands encountered in the Southwest Exploration No. 1 Perrin, in the same section. Several non-commercial shows of gas were tested in the Stanley sandstones, and the well is now flaring gas, but abandoned. The Max Pray No. 1 Wyrick, sec. 26, T. 1 N., R. 14 E., near Daisy in the McGee Valley, tested two gas sands in the Stanley, one of which flowed gas at the rate of 200,000 cubic feet per day, the other at 300,000 cubic feet per day. No analyses of the gas in these wells are available but it is assumed to be dry gas. Hendricks et al. (1951) report that a well in the Potato Hills area in Latimer County struck a small flow of wet gas. The Shawnee Drilling Company's No. 1 Moyers in sec. 6, T. 3 S., R. 16 E., near the town of Moyers, is at present bubbling sizeable quantities of gas, presumably leaking around the plugged surface casing from a source in the Stanley.

Conclusions

If it is assumed that high pressures and elevated temperatures (resulting from intense diastrophism and metamorphism of rock) tend first, to convert low-grade petroleum or organic matter to higher-grade petroleum and second, to expel the lighter oil and gas from the area of activity leaving a residue of asphalt it is difficult to explain the present conditions in the Ouachita Mountains. Here are found not only the solid hydrocarbon "residues" in several forms, but also a wide range of oils and gases. If a slow distillation process has been responsible, as suggested by Rich (1927), it is not only impossible to explain the very presence of oil and gas, but also to account for the downward softening of the asphaltite deposits, since presumably the metamorphism would be more intense at depth.

On the other hand, if the oil, gas, and asphaltite are present in the rocks without having been distilled to any great degree, all of the conditions are explainable. Presumably, the liquids and gases are held within porous zones in the reservoir strata in the way common to that of most oil-producing regions. Some has reached the surface through fractures or as a result of erosion to become hardened by a slow loss of volatiles, still more must remain trapped below. Whether or not the actual source of the petroleum in all its forms is within the Ouachita facies or in the Arbuckle facies beneath has little bearing on the problem. Oil and gas are present within the Ouachita Mountain province and it remains simply a matter of time before commercial deposits are discovered. The reluctance of oil companies to venture into the region results from prejudices based on misinterpretation of facts and the general dearth of knowledge of the geologic conditions within the mountains.

36-3S-13E NW NW NE Scrivner #1 Plettner, TD 1,527, dry, no shows. 1940. Drilled in Cretaceous overlap. Top Paleozoic (Jackfork?) 1128.

30-3S-15E SW NE NE Halliburton #1 Bagwell, TD 6,000, dry. No shows reported. Probably in Stanley at TD. A very strong odor of kerosene can be detected at the site of this well.

31-3S-15E NW SW NE George et al. #1 Ish and Ryan, TD 804. Dry, no shows. Probably in Cretaceous at TD.

32-3S-15E NE NW SW George et al. #1 Jordan, TD 805. Dry, no shows. Probably in Cretaceous at TD.

32-3S-15E NW NW NW George et al. #1 Harry Schweitzer, TD 825. Dry, no shows.

6-3S-16E C SE SE Inland Oil Co. (Shawnee Drlg. Co.) #1 Moyers, TD 2,220. Dry. In Stanley at TD. This well was drilled on the axis of the Moyers anticline. Considerable gas is leaking through the surface casing.

35-3S-18E SE SE SW Whitehead Oil Corp. #1 Messer, TD 3,520. Dry. Shows of gas reported at 1,350, 1,555, and 2,700, all in Stanley. In Stanley at TD.

25-2S-13E SE NE NW Rayl and Bryant #1 Albright, TD 500, dry, no shows.

35-2S-13E NW NE SE Huddle #1 Snyder, TD 504. P 4¼ BOPD, from 480-487 (Stanley).

35-2S-13E SW NE SW Huddle #5 Snyder, TD 300. Show oil at 220 in Stanley. Dry.

35-2S-13E SE Malernee #1 DOK Ranch, TD 721. P approx 15 BOPD from Stanley at 452. Drld 1932.

35-2S-13E NE NW SE Malernee #3 DOK Ranch, TD 412. P 5 BOPD from 412 ft. in Stanley. Drld 1932.

35-2S-13E SE SE SW Motex #9 Snyder, TD 677. Dry. Drld 1957.

3-2S-15E SW NW SW Rawson and Vosburg #1 Jordan, TD 1,002. Dry, show of gas at 540-579 feet in Stanley. This well is located east of the axis of the Jumbo anticline. Drld 1924.

10-2S-15E NW NW NE Rawson and Vosburg #1 Klutts, TD 1,000. Dry, several shows of oil and gas. This well is about one mile southeast of the same company's #1 Jordan (above) and appears to be downdip.

9-2S-15E SE SW Southwest Exploration #1 Perrin, TD 11,328, dry. Several shows of gas in Stanley sandstones. Drilled in 1957 near the surface axis of the Jumbo anticline after extensive surface geologic work and seismic surveys. The well started in Stanley shales and drilled an almost complete section. Very steep dips (up to 75°) were encountered and the well is thought to have crossed a high angle (65°) reverse fault near the bottom of the hole. An electric log and micrólog are available, from which the following approximate tops are taken: Stanley at surface: Hatton tuff 5,490; Arkansas novaculite 6,400; Missouri Mtn. shale 9,200; Polk Creek shale 9,550;

Bigfork chert 9,820; fault 10,780; Bigfork (repeated) 10,780; TD electric log 11,135. Microlog permeability is indicated in several zones in the well. Three zones in the Stanley were perforated (3,980-4,004, 3,832-3,848, 2,770-2,786) but operators reported no commercial shows of oil or gas.

2-1S-12E SE NE SW Welsch #1 Andrews, TD 486, dry. Drld 1952. Rainbow show of oil at 369 ft. in Stanley.

2-1S-12E SE NE SW Welsch #2 Andrews, TD 805, dry. Drld 1952. Operator reports the section in this well was faulted and the sands extremely hard, impossible to maintain straight hole with cable tools.

19-1S-12E SE SW SW Northern Ordnance #1 Fulton Ranch, TD 7,022, dry. Drld 1944. No shows, no tops available.

19-1S-12E SW SW SW Fleetborn #1 Fulton Ranch, TD 3,000, dry. Drld 1935. No shows, no tops available.

22-1S-12E NW NW SE Blauner #2 Henson, TD 769. Temp. abandoned. Good oil show 566-625 (one or two feet of oil in hole after standing all night). Gravity 27.6°. Gas show 688-692. All in Stanley (samples available through Shawnee cut). Operator's comment: "We are not through with well as yet." Drilled 1949.

12-1S-13E SE SE SW No name #1 Priestly, TD 1,520. Dry. Drld 1915.

3-1S-14E NE SE SW Croxton #1 Schumaker, TD 908, plugged. Drilled 1930. This well made considerable oil and gas from Stanley sands but operator experienced considerable difficulty in completing the well and it was eventually plugged to protect the sands from surface water. A sand from 596-606 flowed gas and 51° gravity oil, another from 656-666 had 49° gravity oil and a third sand at 700-757 had 43° gravity oil.

4-1S-14E NW NE NW Croxton #1 Mason, TD 1,806, dry. Drilled 1930. Shows of oil and gas were encountered in the Stanley.

4-1S-14E SE SE SE Buck #1 Melton, TD 1,121, dry. Drld 1953.

8-1S-14E SW Newman #1 ? TD 805, Dry. Drld 1936? This well is reported to have encountered at least three shows of oil in the Stanley.

9-1S-14E Cen SW N½ NE Croxton #1 Miller, TD 556, P 3 BOPD from Stanley sand (Miller sand) from 88-95 feet. Drilled 1930.

9-1S-14E Cen S½ N½ NE Croxton #2 Miller, TD 192, P 3 BOPD Gravity 39° from Stanley sand at 165 ft. Drilled 1930.

9-1S-14E SW NE NE Croxton #3 Miller, TD 315, plugged. "Large amount" of oil bailed from the hole from sand in Stanley at 246 ft. Caving prevented completion of the well. Drld 1933.

9-1S-14E SE NW NE Croxton #5 Miller, TD 175, oil well. No data. Drld 1933.

9-1S-14E SE NW NE Myers #3 E. P. Miller, TD 147, ½ BOPD, 40°. Production from the Miller sand (Stanley) at 106-147. Drld 1944.

9-1S-14E SE NW NE Myers #4 E. P. Miller, TD 235, dry. Drld 1944.

9-1S-14E NE SW NE Myers #3 A. Miller, TD 246, dry. Drld 1942.

9-1S-14E NW SW NE Myers #4 A. Miller, TD 230, dry. Drld 1942.

9-1S-14E NW NE NE Fentermacker #4 M. Vaughan, TD 192, P3 BOPD, Gravity 42° from Stanley sand 148-192. Drld 1954.

16-1S-14E NE NW NW Croxton #1 Green, TD 200, dry. Drld 1932.

19-1S-14E SW SW SW Collins #1 Cole, TD 375, oil well. Production figures unknown. Producing zone is in Atoka formation at 100-300 feet. Drld 1956.

14-1S-15E NE SW SE Curtis #1 Kontze, TD 995, dry. This well was drilled into the Jackfork sandstone on the west flank of the Tuskahoma syncline.

19-1S-15E SW SW NW Bickley and Pearson #1 Brown, TD 1,289. This well was drilled in Jackfork sandstone on a narrow anticline west of the Jumbo fold and is reported to have made some oil. Drilled in 1937.

15-1N-12E NW NW NW Stauffer #1A Sandlin, TD 2,169, Fl 8 mill CFGD from 2,153-2,169. This well is located just west of the Choctaw fault and probably produces from the Hartshorne sandstone. Drilled 1952.

10-1N-13E NW SW NE Pierce #1 Aetna Life Insurance Co., TD 4,004, dry. Several shows of oil and gas recorded. This well was first abandoned because of crooked hole trouble and then redrilled after skidding rig. Well started in Atoka formation in faulted zone of Ouachitas. No tops available.

4-1N-14E NE SE NE Twin State #8 West, TD 793, oil well. No data. Drilled 1919.

13-1N-14E SW SE NW Shelby #1 Wolf, TD 451. Drilled 1932, no data available. This well is in the McGee Valley area and probably encountered Stanley shale from surface to TD.

25-1N-14E NW NE NW Madden #1 Ellis, TD 760, dry. Comments same as well above.

26-1N-14E NW NW NW Madden #1 Wyrick, TD 551, dry. No shows. Drilled 1953.

26-1N-14E SE SW NW Ohio Fuel #1 State, TD 993, dry. No data. Drilled 1953.

26-1N-14E NW NW NE Redwine #1 Miller, TD 330. No data available, probably drilled about 1930. Reported show of oil at 265-295 (Stanley).

33-1N-14E NE SW SE Gratz #1 Sparks, TD 453. No data available. Drilled 1939.

35-1N-14E SW SE SE L and L #1 Mason, TD 300, dry. No data available. Drilled 1937.

26-1N-14E C NW NW Vaughan #2 State, TD 580, oil well. No data available. Drilled 1952.

26-1N-14E NE NE NE Vaughan #1 Miller, TD 937, oil well. No data available. Drilled 1953.

35-1N-14E NW NW SW Buck #1 Mason, TD 1,000, dry. No data available. Drilled 1953.

5-1N-15E NE SW SE Booth #6 Crockett, TD 205, P 5 BOPD, gravity 42°, from sand in Jackfork? 185-205. Reported top Jackfork

183, Stanley at surface. This well is near the center of the McGee Valley area and it is doubtful if the reported sand is actually Jackfork. It seems more likely that the production is from the "Miller sand," a Stanley sandstone.

26-1N-17E NE SW NE Tom Lott #1 De Bogory, TD 625, plugged. This well is reported to have made as much as 30 BOPD from a Stanley sand at a depth of 345 feet. Gravity of the oil, 52°. Operator reports this well plugged because of difficulties with the land owner and because of extremely cold weather. The well is located near the west side of the Kiamichi anticline on the flank of what appears to be a small subsidiary closure. Note: The National Oil Well Index reports two deep gas wells in T1N R17E, the Tascosa #1 Gum in section 3, and the Texas Co. #1 Miller in section 10, both drilled in 1951. The location shown would place these wells near the axis of the Tuskhoma syncline in a very mountainous wooded area and it is considered unlikely that the location is correctly reported.

6-1N-20E SW Empire #1 Wood, TD 3,537, dry. Drilled 1923. No data available. This location is on the north side of Kiamichi Mountain, on the flank of the Lynn Mtn syncline. The well probably started in Jackfork sandstone and may have gone deep enough to test the Stanley.

16-2N-14E NE SE Southwest Exploration #1 Hoehman, TD 8,744, dry. Drilled 1954. This well was drilled in a supposed fault outlier (klippe) in the outer folded and faulted zone of the Ouachita Mtns. According to Misch and Oles ('58) the well has shown the hypothesis of a klippe to be incorrect.

22-2N-15E NE SE Hedges #1 Roland, TD 750, dry. Drld 1956. This well was drilled in Jackfork sandstone in a severely faulted portion of the McGee Valley. Two oil saturated sands were encountered but no production obtained.

8-2N-16E NW NW NW Craig #1 Hailey, TD ? P 10 BOPD Gravity 40.2°. Drilled 1946. Comments same as for well above.

8-2N-16E SW NW NW Craig #1 Wilkins, TD ? No data available. Probably dry.

30-2N-16E NW SW NW Mack #1 Smith, TD 345, dry. Drilled 1947. No data available. This well was drilled in the McGee Valley area, probably starting in Stanley shale.

10-2N-18E SE NE NW Herndon #1 Flatt, TD 2,000, dry. Drilled 1956. No shows. This well was drilled on the Sardis anticline about one half mile east of the grahamite mines. No tops available but the entire well was probably in Stanley.

14-2N-18E SE NW NW Mack #1 Kindred, TD 330, dry, no shows. This well is also reported as being in T2N R16E, in the McGee Valley.
Note: The National Oil Well Index lists a well, Cities Service #1 Myers, in 8-2N-14E. TD 2,823, gas production. This is probably a mis-location.

16-3N-22E W SW NW Kiamichi Valley #1 Allen, TD 1,407, F 1,250,-000 CFGD. Drilled 1921. This well is situated in the Talihina area east of the Potato Hills. Probably produces from the

Stanley. Rock pressure was very low (57#) and production no doubt declined rapidly.

16-3N-22E NW NE SE Miller #1 McGowan, TD ?, dry. No data available.

25-3N-22E C NW NE Sellers #1 Jones, TD 5,005, dry. Drilled 1950.

Addenda

19-1S-14E SE SW SW Fletcher #1 Cole, TD 243, plugged. Swbd 2 BOPD first 24 hours. Probably in Atoka.

26-1N-14E C NE NW Vaughan #1 Schoolland, TD 902, P3 BOPD from 480-510 in Stanley sand.

26-1N-14E N½ S½ N½ NW Vaughan #2 Schoolland, TD 487, P 5 BOPD, gravity 43° from Stanley sand.

26-1N-14E SW NW SE Max Pray #1 Wyrick, TD 12,088, dry. Several shows of oil and gas encountered. Stanley at surface; Bigfork 8,420, Womble 9,098 (electric log tops). DST: 8,431-9,852, open 5 hrs., gas in 4 minutes, est 300,000 cfd; DST: 8,293-8,303, open 4 hrs., gas in 12 minutes, est 200,000 cfd. Completed Sept., 1958.

26-1N-17E NE NE SE NE Tom Lott, #2 De Bogory TD 247, dry. See notes under Lott #1 De Bogory.

21-2N-15E SE SE SE SE Hedges #1 James, TD 379, dry. Drld 1957.

22-2N-15E NE NE NE NE Webb #1 Darley, TD 992, P 1-2 BOPD with some butane. Asphaltic oil. Drld 1958.

28-2N-15E E½ NE NE Able #3 James, TD 621, P 1 BO and 2½ BSWPD. Drld 1952.

28-2N-15E E½ W½ NE NE Able #4 James, TD 365, P 8 BOPD. Drld 1952. These wells are in the McGee Valley, probably producing from the Stanley.

28-2N-15E NE NE NE NE Sterling #4 James, TD 402, dry. Show of oil at 300 feet in Stanley.

32-2N-15E NW NW NE NE Smith #1 Hewitt, TD 300, dry, no shows. Drld 1953.

33-2N-15E NW NE NW SW Miller #2 Smith, TD 760, dry. Ran electric log. Drld 1956.

8-2N-16E NW NW NW Edgar #2 Wilkins, TD 227, dry. This well is in the very complexly faulted area west of the McGee valley.

11-2N-16E NE NW NE Wright #1 Mitchell, TD 440, dry. No data available. No log.

4-2N-24E NE NE NE NW Lippert #1 New Jersey Oil, TD 703, dry, no shows, drilled 1956. This well is in the Talihina area east of the Potato Hills. Probably all in Stanley.

4-2N-24E N½ SW NE Hudspeth #1 Pendleton, TD 503, dry, no shows. Ran electric log. Drld 1956.

4-1S-16E SE SW NE Newman #1 Baskett, TD 382, dry. Shows of oil and gas. Drilled 1947. This well is near the axis of the Tuskahoma syncline in Jackfork sandstone. Probably in Jackfork at TD.

35-2S-13E SW NE SE McDermott #1-A DOK Ranch, TD 497 P 2 BOPD.

9-2S-15E SW SE SE Sikes-Burkhalter #2 Denton-Perrin, dry. TD 5,480. This well is located on the Jumbo anticline and was drilled after the Southwest Exploration #1 Perrin in an attempt to exploit the gas sands discovered in that well. Several non-commercial shows of gas and distillate were encountered and the well is now flaring gas. Drilled in Stanley from surface to TD.

33-3S-16E NW NW NW Rissler #1 Atterbury, TD 576, dry, no shows. This well is in the Stanley valley southeast of the Octavia fault but west of the axis of the Big One anticline.

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Oil and Gas in Ellis County

Louise Jordan

Ellis County is in the northwestern part of Oklahoma just south of the Laverne Gas District of Harper County where in recent years large reserves of gas have been developed and some oil has been discovered. Ellis County has a land area of 1,222 square miles or 782,080 acres. At the beginning of 1958 more than 552,000 acres were under lease by major oil companies and active exploration for hydrocarbons actually commenced with the drilling of 22 tests which resulted in eight gas-productive wells in five new field areas. Previous to 1958, only 13 tests, three of which recovered gas, had been drilled in the entire County. As of August 1, 1959, Ellis County has 13 producing areas, (Figure 1), the latest discovered being that in the Pan American No. 1 Phillips (C SW¼ NE¼, sec. 15, T. 24 N., R. 24 W.) where open-flow tests in Pennsylvanian rocks yielded 3.65 million cubic feet of gas from Missourian sandstone (Tonkawa sand) at 5,834-5,839 feet and 16 million cubic feet from Morrowan sandstone at 7,654-7,657 feet. This is the first well in the County to have commercial production at two stratigraphic levels. Production is from Morrowan sandstone in all areas except that west of Harmon (T. 19 N., R. 22 W.). All gas wells are shut in

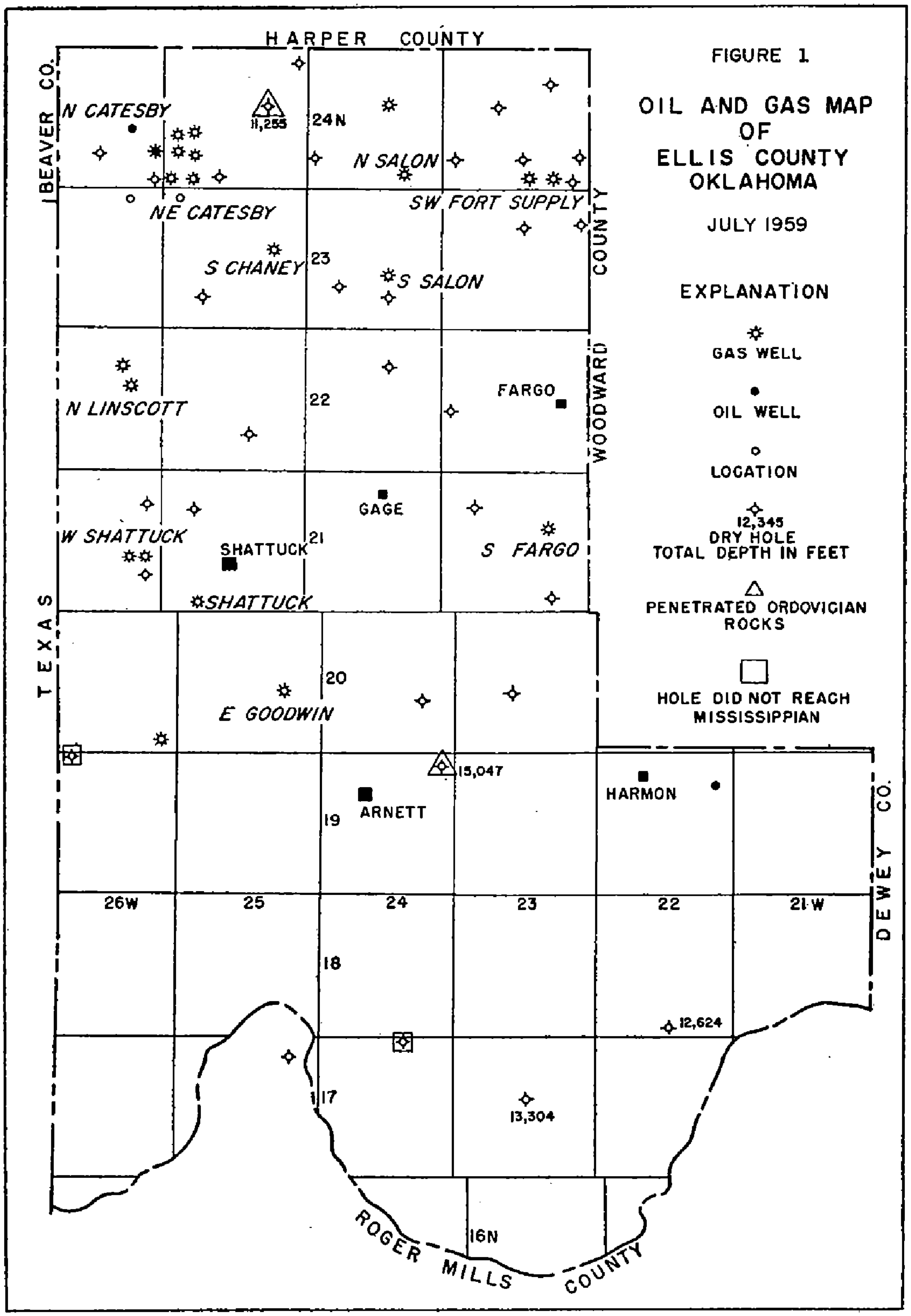

FIGURE 1
OIL AND GAS MAP OF ELLIS COUNTY OKLAHOMA
JULY 1959

awaiting construction of a transmission pipeline to the West Coast.

In 1926 before any wells had been drilled through the Pennsylvanian in northwestern Oklahoma and little information existed about the Permian section, R. L. Clifton (1926, p. 24) stated that no test exploring for oil "should be started in Ellis County unless it planned to drill to a depth of 5,000 feet. Even at this depth the drill will not test the full section of Pennsylvanian rocks that should underlie the area." Revised estimates of the thickness of Permian and Pennsylvanian rocks as well as that of the Mississippian section were necessary in 1930 when Sinclair drilled the No. 1 Howell (sec. 14, T. 26, N., R. 24 W.) in southern Harper County. The test, deepest in the state at that time at a total depth of 8,589 feet, penetrated nearly 4,100 of Permian and 2,900 feet of Pennsylvanian rocks. Actual thickness of the section near the north and south boundaries of Ellis County were not known until the Continental No. 1 Berryman (sec. 15, T. 17 N., R. 23 W.) was drilled in 1953.

Cenozoic rocks with a maximum thickness of about 300 feet, consisting of clay, sand, and gravel, in part calcareous and well-cemented, unconformably overlie Permian rocks in most of the County. The Cloud Chief formation and Whitehorse group of Permian age crop out along the North Canadian and Canadian Rivers.

In the subsurface the Permian section, consisting of red and variegated shale, fine sandstones to siltstones, salt and anhydrite, is 4,300 feet thick in the north and 5,900 feet thick in the south. Thickness of the Pennsylvanian ranges from 4,000 feet at the north to 7,300 feet at the south. The rocks, consisting of limestone, sandstone, and shale, are divided into five series (descending order) and increase in thickness southward as follows: Virgil, 700 feet; Missouri, 450 feet; Atoka-Des Moines, 1,250 feet; Morrow, 1,100 feet. Mississippian limestones, divided into Chester, Meramec, Osage and Kinderhook series (descending order), range in thickness from 2,290 feet at the north to 2,800 feet in sec. 1, T. 19 N., R. 24 W. Only two wells in the County drilled through the Mississippian and penetrated part of the Ordovician. At the north, Sinclair No. 1 Berry (sec. 14, T. 24 N., R. 25 W.) was drilled 336 feet into Arbuckle dolomite and limestone to a total depth of 11,255 feet. This test encountered a normal section except that no Sylvan shale nor Hunton limestone are reported. Sunray No. 1 Hanan (sec. 1, T 19, N., R 24 W.) was drilled to

Table 1. Results of exploratory and development tests and annual footage drilled in Ellis County, 1944-1958.[1]

Year[2]	Gas-condensate	Dry	Total	Footage drilled
1944	0	1	1	9,305
1945	0	2	2	13,168
1950	0	2	2	26,302
1952	1	0	1	9,806
1953	1	1	2	22,404
1954	0	1	1	8,285
1957	3	1	4	35,200
1958	8	14	22	207,304
	13	22	35[3]	331,774

[1]Source of data: *National Oil Scouts and Landmen's Association,* yearbooks; and *Oil and Gas Journal,* annual review issues.

[2]Only years listed in which holes were drilled.

[3]Ten of the 35 holes drilled are considered development tests, spacing 640 acres. Four tests resulted in gas-condensate wells; six tests were dry.

15,047 feet and penetrated the upper part of the Simpson group (Wilcox sand). Sylvan is present and Hunton is reported as 281 feet thick. These two wells were drilled in 1950.

Only five tests, totaling 48,775 feet, were drilled in the seven year period, 1944-1950 (Table 1). The sixth test, Carter No. 1 Rosendale, drilled in 1952, discovered the South Salon field. This well was the first production for the County and tested 2.5 million cubic feet of gas and 27 barrels per day of 52.6° gravity condensate through ¾-inch choke from Morrowan

Field, date discovered	Discovery well, location	Initial production (24 hrs), depth in feet and name of reservoir
Catesby, N 12-1958	Skelly 1 Alexander 25-24N-26W	128 bbls. oil, 43.3° gravity, ¼" choke. Morrow: 8,131-54
Catesby, NE 5-1957	Shell 1 Peetom 29-24N-25W	2,400 Mcf gas, open flow Morrow: 7,961-76, 8,032-43
Chaney, S 12-1958	Pan American 1 Catesby Unit 2 14-23N-25W	481 Mcf, ⅜" choke Morrow: 8,525-74
Fargo, S 2-1958	Pan American 1 Moore 14-21N-23W	6,880 Mcf, ½" choke Morrow: 9,358-9,543
Fort Supply, SW 11-1957	Pan American 1 Tune Unit 35-24N-23W	16,500 Mcf, open flow, 83 bbls. cond. 60° gravity. Morrow: 7,855-77
Goodwin, E 3-1958	Pan American 1 Schoenhals 23-20N-25W	1,550 Mcf, 13 bbls. cond. 62° gravity, ⅛" choke Morrow: 10,745-47
Linscott, N 2-1959	Pan American 1 Shattuck Unit 1 11-22N-26W	12,200 Mcf, 1" choke Morrow: 9,088-94
Salon, N 1-1959	Pan American 1 Herndon 35-24N-24W	1,714 Mcf, 1" choke Morrow: 7,980-8,106
Salon, S 6-1951	Carter 1 Rosendale 22-23N-24W	2,477 Mcf, ¾" choke, 27 bbls. cond. Morrow: 8,455-8,510
Shattuck 12-1958	Pan American 1 Batt Unit 32-21N-25W	1,817 Mcf, open flow Morrow: 9,722-10,107
Shattuck, W. 6-1958	Magnolia 1 Schoenhals 24-21N-26W	4,350 Mcf, open flow, 135 bbls. cond. 55.7° gravity. Morrow: 9,243-9,683
unnamed 2-1959	Magnolia 1 Meier 36-20N-26W	12,000 Mcf, open flow Morrow: 10,668-12,245
unnamed 2-1959	Odessa Natural 1 Potter 12-19 N-22 W	312 bbls. oil on pump, 40° gravity. Cottage Grove: 7,980-94

Table 2. Discovery well of fields in Ellis County, date of completion, initial production depth and name of producing sandstone. (Mcf=thousand cubic feet).

sandstone at 8,455 to 8,510 feet. At total depth of 9,806 feet, Meramecian limestones were penetrated. A development well drilled one mile south in 1953 did not obtain commercial production.

In 1957, four tests were drilled and two fields, Northeast Catesby and Southwest Fort Supply, were discovered. (See Table 2 for discovery well and initial production, and depth of reservoir of fields). In 1958 oil was found at North Catesby; gas-condensate at South Chaney, South Fargo, East Goodwin, Shatuck and West Shattuck. (See oil and gas map, Figure 1). Wildcat drilling in 1959 has already found two new gas fields with Morrowan production, North Salon and an unnamed field in sec. 36, T. 20 N., R. 26 W; and an oil field west of Harmon in sec. 12, T. 19 N., R. 22 W., where production is from Cottage Grove sandstone (Missourian sandstone below the Tonkawa).

Exploration will continue in Ellis County and may increase in the southern townships depending in part upon the economic success of the Magnolia No. 1 Young (sec. 3, T. 15 N., R. 24 W., Roger Mills County) which will test Pennsylvanian rocks just south of Ellis Countyy.

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A Re-Illustration of the Trilobite Lonchodomas mcgeheei Decker From the Bromide Formation (Ordovician) of Southern Oklahoma

by

Patrick K. Sutherland and Thomas W. Amsden

In 1931 Charles E. Decker described (p. 154, fig. 1) a new trilobite species from the Bromide formation in southern Oklahoma which he called *Ampyx (Lonchodomas) mcgeheei.* He designated and figured only the holotype, now in the collection of the U. S. National Museum. This specimen, here refigured (Pl. I, fig. 4), has lost the free cheeks and genal spine; the glabellar spine has been broken since originally figured by Decker, but the specimen shows the typical features of the pygidium and thorax and most of the features of the cranidium. Later, Decker was given a specimen with the genal spines preserved and gave a description of this added feature (1940, p. 107) although he did not figure the specimen, which is here illustrated (Pl. I, fig. 3). One other specimen in the University of Oklahoma collection (Pl. I, fig. 1) has a label in Decker's handwriting identifying the species and recording the locality and stratigraphic position.

All of the above mentioned specimens are from "Rock Crossing," a well known Ordovician fossil locality on Hickory Creek in the Criner Hills about 8 miles southwest of Ardmore, N½ S½ sec. 35, T. 5 S., R. 1 E. (fig. 1). At this locality the upper part of the Bromide formation and the lower 50 feet of the overlying Viola formation, also of Ordovician age, are exposed in the creek bed.

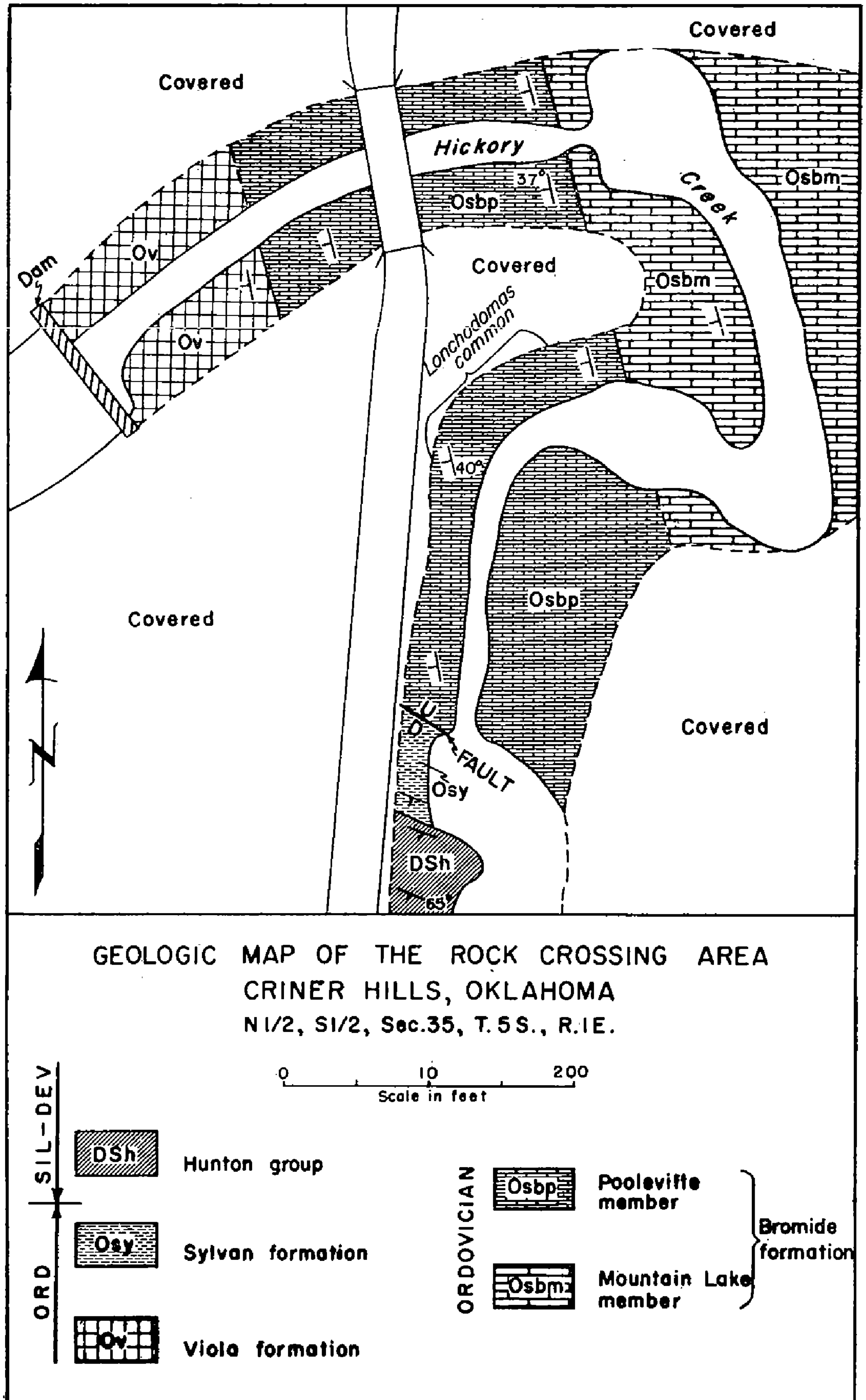


Fig. 1. Geologic map of the Rock Crossing area.

Decker (1931, p. 155) did not record the exact stratigraphic position at Rock Crossing where he collected the holotype but stated that the species "is found in marly limestone in Zone 2 near the top of the Bromide formation on both sides of the bridge across Hickory Creek." Decker and Merritt (1931, p. 83) recorded 15 zones for the Bromide at Rock Crossing (numbered from the top downward), their Zone 2 being 24 feet 8 inches

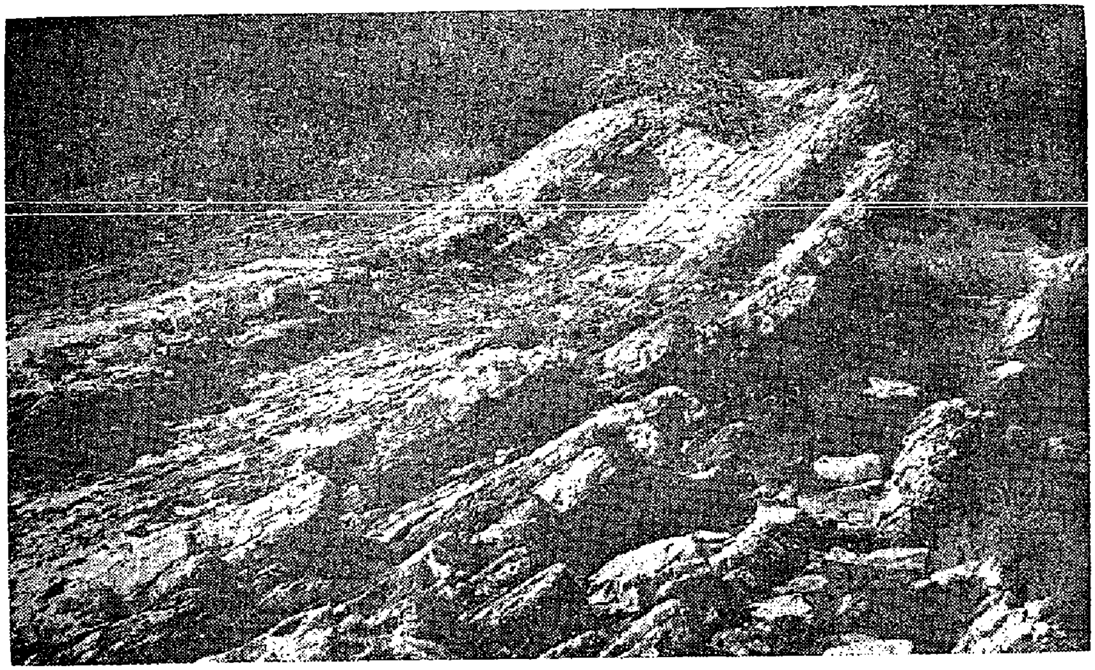


Figure 2. Lower limestones of the Pooleville member of the Bromide formation, looking north across Hickory Creek 110 feet east of iron bridge. Arrow points to contact of Pooleville member with underlying Mountain Lake member. Specimens of Lonchodomas *have not been observed in this part of section.*

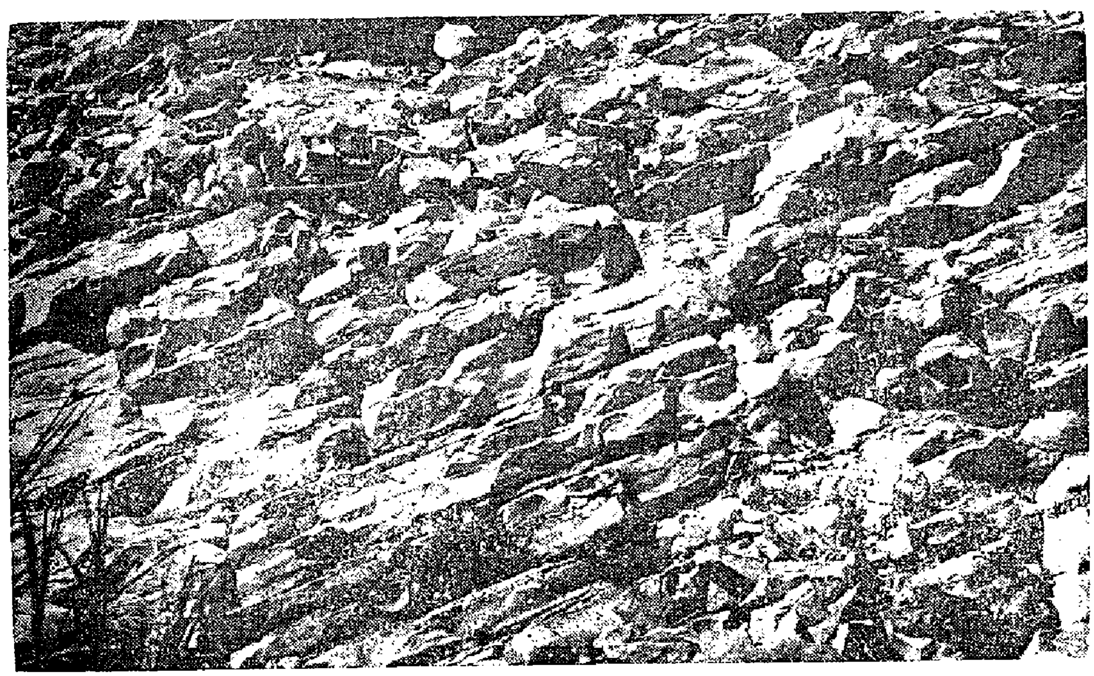


Figure 3. Detail of limestones 40 to 50 feet above base of Pooleville member of the Bromide formation. Lonchodomas *common in these layers. Picture taken looking southwest, at sharp bend of creek 150 feet south of iron bridge.*

to 63 feet 8 inches below the top of the formation. This would be the arêa of the creek bed just under the iron bridge. However, better exposures of the same stratigraphic interval are found about 150 feet southward along the strike where these steeply dipping limestone beds are exposed again in the creek bank downstream around a sharp bend in the creek (figs. 1 and 3). Sutherland visited this locality with Decker in 1944 who pointed out this second spot as the best place to collect this trilobite species. It therefore appears likely that the holotype came from this location. In any case, the total area is small and the lithology distinctive, so it seems reasonable to recognize all specimens from Rock Crossing as topotypes.

Cooper (1956, p. 120) divided the Bromide formation in southern Oklahoma into two members, the lower Mountain Lake member and the upper Pooleville member. At Rock Crossing the upper part of the Mountain Lake member and the whole of the Pooleville member are well exposed (fig. 2). The upper member has a total thickness at Rock Crossing of about 130 feet and includes Decker's Zone 2 mentioned earlier. *Lonchodomas mcgeheei* is common in the beds from about 25 feet to about 100 feet above the base of the Pooleville member. In the locality 150 feet south of the iron bridge specimens are most common in a sequence from about 40 to 70 feet above the base of this member (figs. 1 and 3). This interval has some thin beds which contain great numbers of broken fragments of this trilobite. At this most southerly location the uppermost part of the Pooleville member is eliminated by the Criner fault which does not affect the exposure immediately under the iron bridge. Most recognizable specimens show only the cephalon without the genal spines but the glabellar spine is not uncommonly preserved. Complete specimens are few.

Lonchodomas mcgeheei Decker 1931

Plate I, figs. 1-4; Plate II, fig. 1.

Ampyx (Lonchodomas) mcgeheei Decker, 1931, Jour. Paleontology, vol. 5, p. 154-155, figs. 1, 2.

Ampyx (Lonchodomas) mcgeheei Decker, 1940, Okla. Academy Science, Proc., vol. 20, p. 107.

Dimensions of figured specimens:

Specimen	Greatest width of cephalon	Length of cephalon excl. spine	Length of thorax	Length of pygidium	Length of glabellar spine	Length of genal spine
Pl. I, fig. 1	9.5 mm	6.1 mm	3.1 mm	2.1 mm	--	--
Pl. I, fig. 2	9.5 mm	7.6 mm	3.3 mm	--	--	13.6 mm
Pl. I, fig. 3	9.2 mm	6.5 mm	--	--	15.3 mm	--
Holotype Pl. I, fig. 4	9.4 mm	6.8 mm	3.0 mm	2.2 mm	--	--
Pl. II, fig. 1	10.8 mm (Crushed?)	6.9 mm	--	2.3 mm	--	--

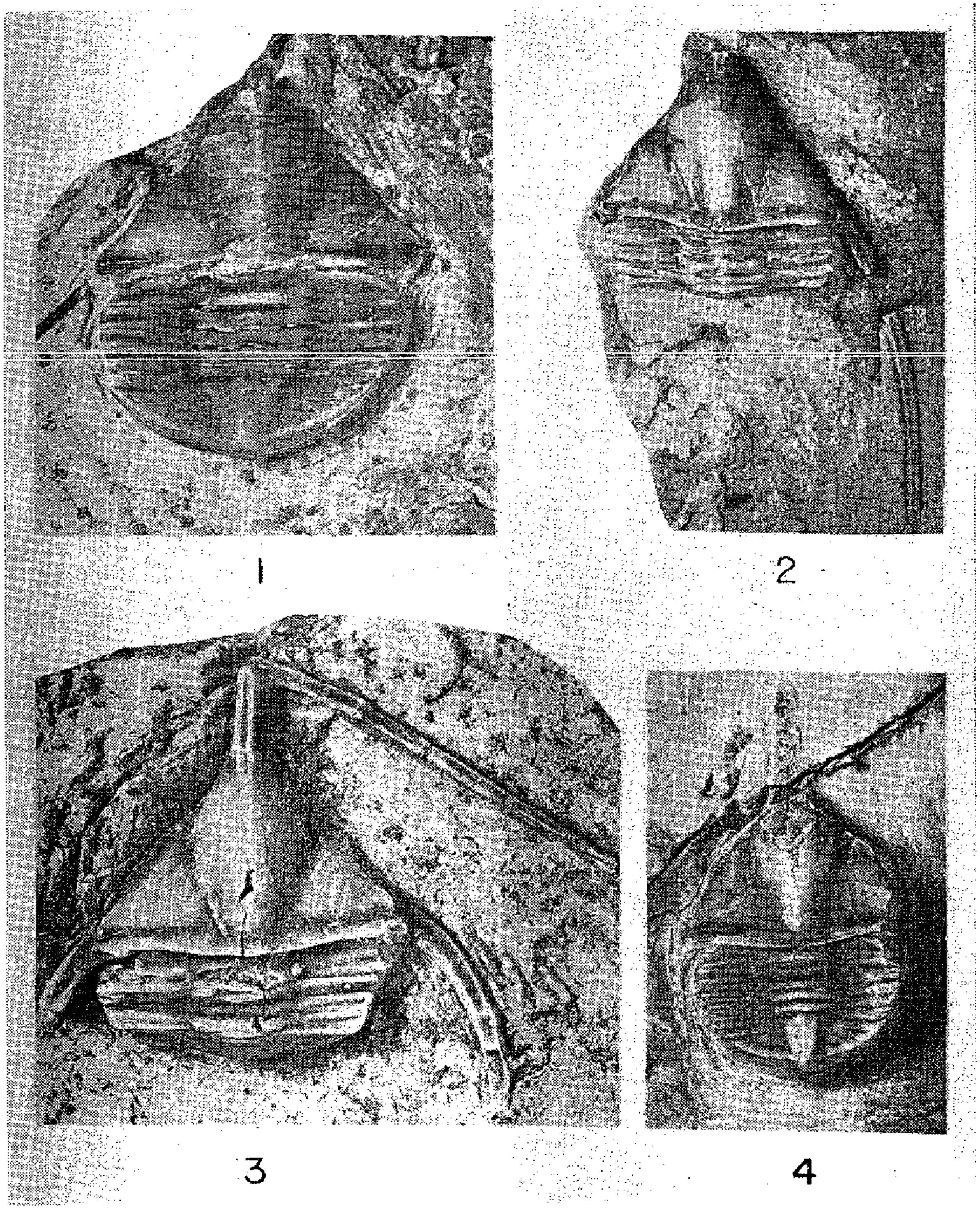


PLATE I

The following description is based on seven more or less complete specimens, including the holotype and topotoypes here figured, and on several dozen isolated cephalons, a considerable number of which have the glabellar spine but not the genal spines preserved. Loose pygidia are also common. All of the figured specimens appear to represent mature stages. One of the unfigured, complete specimens, presumably an immature form, has proportionately smaller dimensions. Measurements of the figured specimens given above suggest a consistency in mature forms of this species of the length of the pygidium, length of the thorax and width of the cephalon. However, considerable variation occurs in the length of the cephalon.

Cephalon. The cephalon, which has no brim, forms an almost perfect isosceles triangle. The occipital furrow is shallow and coincides laterally with a well marked posterior border furrow. The posterior margin of the cephalon is turned under in a distinct flange (not seen from exterior). The glabella is diamond-shaped and in most cases featureless with smooth sides rising gently to a low ridge along the axis. The glabella is produced anteriorly into a long median spine, directed more or less horizontally, which is quadrate in section with a groove on each of the four sides. The length of this spine appears to be variable and that shown on Pl. I, fig. 3 is longer than on any other specimen thus far observed. The species is eyeless and the fixed cheeks are smooth. Long, curved genal spines are present which are similar in cross-section to the glabellar spine in being quadrate and with grooves on each of four surfaces. Each genal spine is attached to a small free check, the part located on the dorsal surface being confined to a small crescentic spur fitting around the rounded genal angle corner of the fixed cheek and a narrow plate extending forward for two or three mm bordering the outer edge of the fixed cheek (Pl. II, fig. 1).

The cephalon shows the following distinctive pairs of pits on the dorsal surface. The first and second are present on all specimens studied.

(a) A single pair of small, elongated pits 0.5 mm in length located in the axial furrow opposite the widest point of the glabella (Pl. 1, figs. 1-3). They coincide on the ventral interior with small, elongated ridges.

(b) A single pair of elongated pits 0.3 mm in length located near the distal extremities of the posterior border furrow (Pl. I, fig. 1).

(c) Most specimens have a smooth glabella but a single specimen (Pl. I, fig. 2) has a pair of distinct narrow pits located 0.7 mm to each side of the crest of the glabella and 1.5 mm in front of the occipital furrow. A few other specimens show slight discolorations in this area and a few specimens show faint irregular depressions. The one specimen available for study of the ventral interior shows no markings on the under side of the glabella wall.

Explanation of Plate I

Figure 1. *Lonchodomas mcgeheei* Decker x 4. Bromide formation, Pooleville member, Rock Crossing, Carter County, Oklahoma; N½ S½ sec. 35, T. 5 S., R. 1 E. From about 30 feet below top of member. Collected by C. E. Decker. O. U. Cat. No. 3118.

Figure 2. *L. mcgeheei* Decker x 3. Same formation and locality as above; from about 60 feet above base of Pooleville member, 150 feet south of iron bridge. Collected by P. K. Sutherland and Richard Hedlund. O. U. Cat. No. 3176. Pygidium probably present but downturned in matrix.

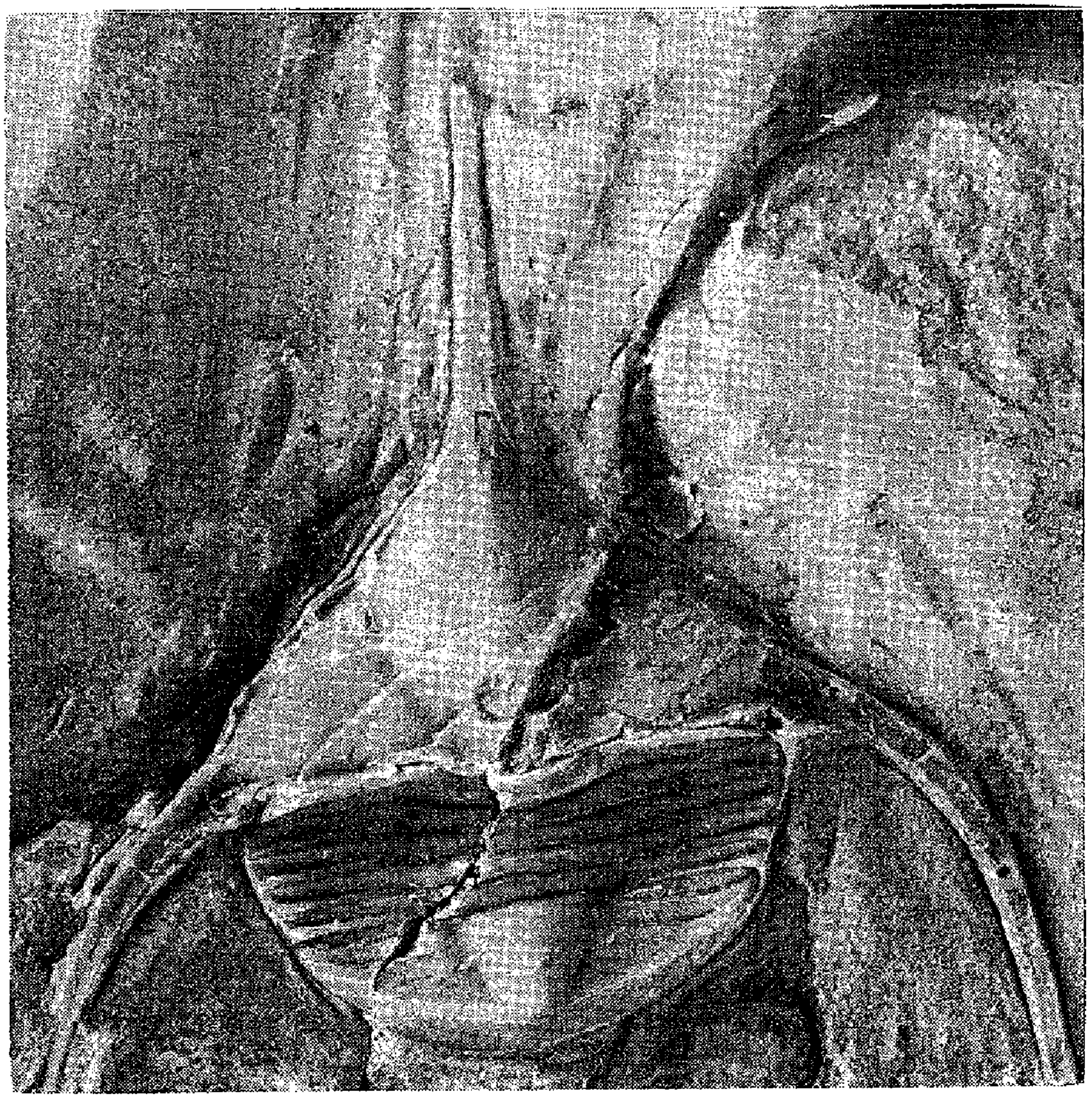
Figure 3. *L. mcgeehei* Decker x 4. Same formation and locality as above. Collected by W. T. Watkins. This is the specimen described but not figured by Decker (1940, p. 107). O. U. Cat. No. 3177. Pygidium present but downturned.

Figure 4. *L. mcgeehei* Decker x 3. Holotype. Same formation and locality as above. Collected by C. E. Decker. This specimen is in the collection of the U. S. National Museum, Cat. No. 114537; plastoholotype, O. U. collection, Cat. No. 3196. The glabellar spine has been broken since originally figured by Decker.

The above features have been interpreted by some authors as dorsal surface reflections of internal muscle attachment scars (Harrington, 1959, p. O97).

Thorax. The thorax consists of five segments with a maximum width of about 9 to 9.5 mm. The ends of the segments form smooth arcs with the anterior and posterior segments being shortened.

Pygidium. The pygidium is short, broad and smoothly rounded along the gently curved posterior margin, which is marked by a relatively wide, steeply tilted border. This border, ornamented by fine, even, closely spaced line, forms an angle of about 120 degrees with the upper surface of the



EXPLANATION OF PLATE II

Figure 1. *Lonchodomas mcgeheei* Decker x 5½. Same formation and locality as Plate I; from about 50 feet above base of Pooleville member, 150 feet south of iron bridge. Collected by Allen Graffham. O. U. Cat. No. 3198. The cephalon is slightly crushed giving broader appearance to cephalon than is natural. This specimen shows particularly well the way in which the narrow free cheek, including the genal spine, is attached to the cranidium. Compare with Pl. I, fig. 1 which has the free cheeks missing.

pygidium and its width is equal to about one-half the length of the upper surface. The pleural lobes show five pairs of pleural furrows of which the posterior two are faint (Pl. I, fig. 1). The axial lobe is normally smooth but on some specimens the shell is sufficiently transparent to see five or perhaps six transverse rows of dots, largest near the lateral margins of the glabella, which presumably indicate markings on the ventral surface. In addition, a few specimens have scarcely perceptible pairs of shallow depressions on the dorsal surface corresponding to these dots. One specimen (Pl. I, fig. 3) shows faint transverse grooves on the dorsal surface of the axial lobe suggesting segmentation.

None of the complete specimens studied is curled up, but two (*see* Pl. I, figs. 2, 3) have the pygidium sharply downturned in relation to the thorax.

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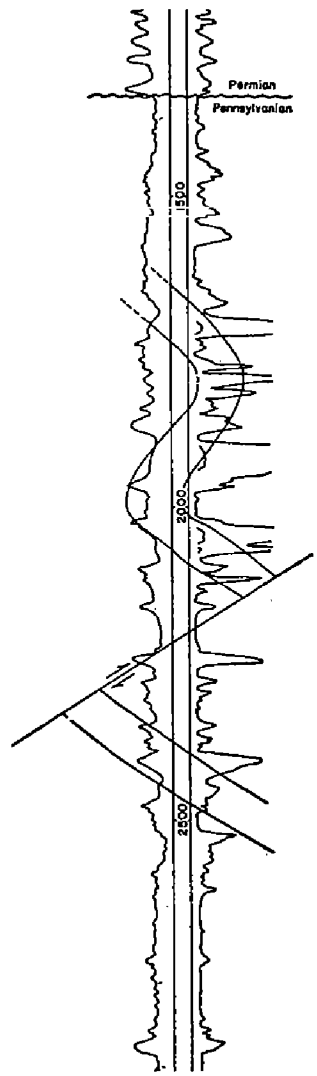
Recumbent Folding in the Velma Area

Philip A. Chenoweth

The Velma oil pool, now a part of the Sho-Vel-Tum district, situated in Stephens County, Oklahoma, has often been cited as an example of complex folding and faulting (Mallory, 1948, Rutledge, 1956, and others). The original anticline apparently began as a faulted, though relatively simple fold in the Early Pennsylvanian (Wichita) orogeny. Later Pennsylvanian (Arbuckle) orogenic movements also strongly affected the area and the folds were rejuvenated, many of the older faults dislocated again and some fault planes folded. Still later, though lesser, movements have occurred in the region leaving an exceptionally complicated faulted anticline along which deep intermittent erosion has produced profound unconformities.

Many deep wells in the field have passed through one or more of the fault planes and unconformities, exposing to the drill entirely new sets of geologic conditions. One well, however, the Skelly Oil Company's #1 Leonard, a dry hole in SW¼ SW¼ NE¼ sec. 6, T. 2 S., R. 4 W., drilled through a remarkable fold in the County Line limestone, an Upper Pennsylvanian (Missourian) unit, at a relatively shallow depth. The limestone was first encountered upside down at a depth of 1,665 feet, again right side up at 1.895 feet, and still again upside down at 2,020 feet. A reverse fault was drilled at approximately 2,200 feet and the County Line limestone once more at 2,390 feet in its normal position (see cut). From this depth the well passed through a normal section of Pennsylvanian and Mississippian rocks, to reach a depth of 5,878 feet in the Sycamore limestone.

Folding of this sort is, of course, indicative of the intensity of the orogenic forces which have been brought to bear in the area. Although it can be expected that this folding is more or less common close to the faults and in the areas of extreme compression the closely spaced wells in the field have failed to reveal any large scale folds of this type. Indeed, the fold here described cannot be traced for any distance away from the well.



A portion of the electric log of the Skelly #1 Leonard, sec. 6, T. 2 S., R. 4 W., showing folding in the County Line limestone.

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