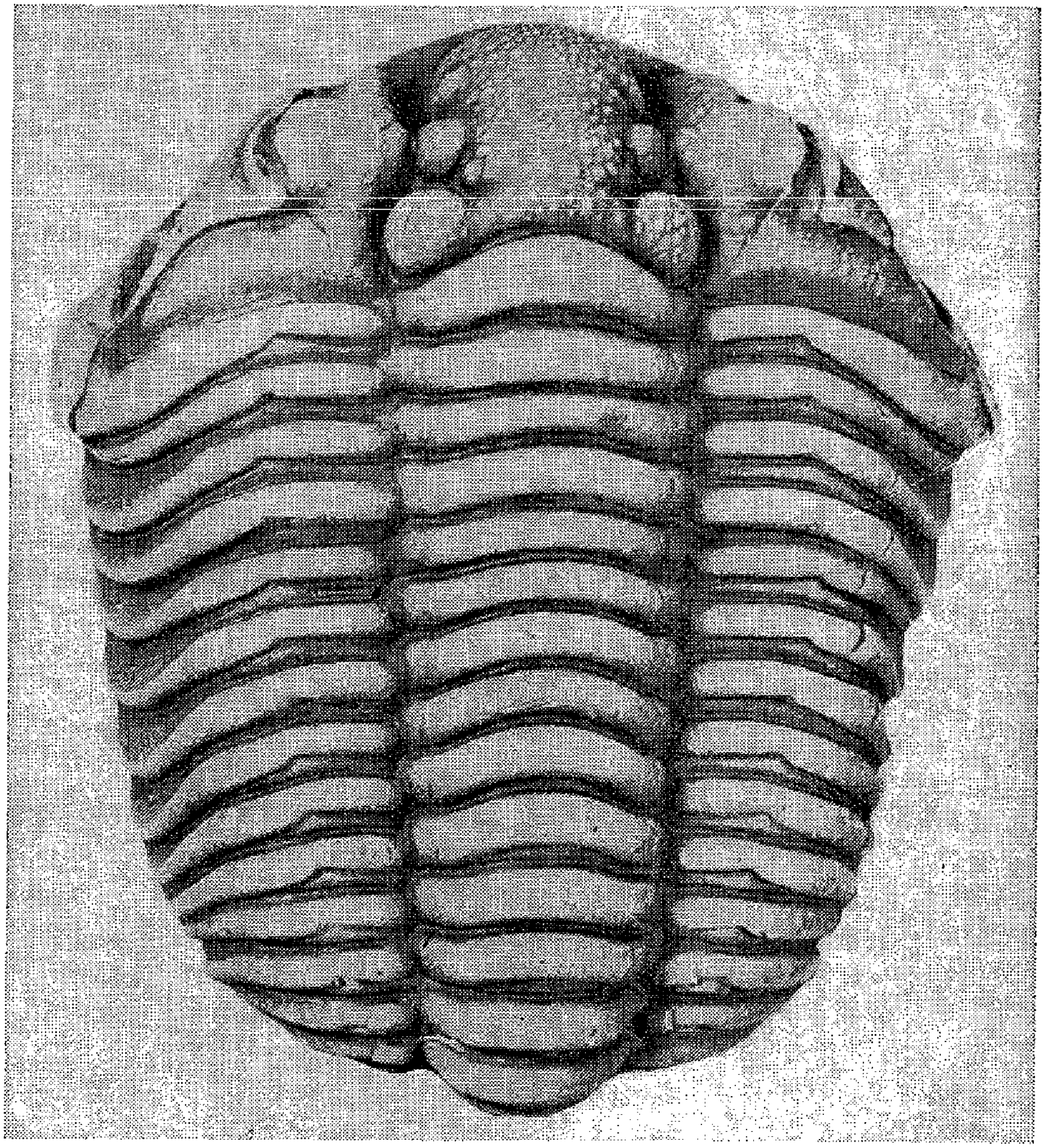
OKLAHOMA GEOLOGY NOTES



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A NOTATION ON PENNSYLVANIAN CONULARIA

Harrell L. Strimple

Although specimens of the Conulariidae are found in many horizons of the Pennsylvanian, they are relatively rare forms. As pointed out by Sinclair (1952) the only Pennsylvanian form described prior to that time was *Conularia crustula holdenvillae* Girty (1911—see Girty,1915). Sinclair (1952) proposed a classification of the Conulariidae and described a Pennsylvanian species as *Calloconularia strimplei* Sinclair which was taken as the genotype of *Calloconularia* Sinclair under a new subfamily *Paraconulariinae* Sinclair. He also mentions the existence of six undescribed species from the Pennsylvanian of Oklahoma and Texas.

The six specimens (holotype and five paratypes) of *Calloconularia strimplei* were listed as being from the "Ochilate group—north-northeast of Capan, Oklahoma". They were collected by me and the misspelled words were due to my poor handwriting on the label. The exact location and horizon should read: Pennsylvanian, Missouri series, Ochelata group, an unnamed shale 30 feet above the Torpedo sandstone member. SW¼ NW¼ section 10, T. 28 N., R. 13 S., Washington County some two miles north-northwest of Copan, Oklahoma.

Sinclair noted that the apex and the apertural lobes of the species, and therefore of the genus and subfamily, were either missing or too poorly preserved for observation. It is therefore of considerable importance to have discovered a specimen of the genus that is complete in both of these respects.

A complete specimen and two smaller, incomplete specimens were collected on a field expedition of July 27, 1959 in the exposure of the Barnsdall formation of Oakes (1952), Virgil series, 14.4 miles by highway west of Skiatook in Osage County, Oklahoma. The exact horizon is about 35 feet below the Wildhorse dolomite in a blue shale just above a foot-thick red limestone. This is the same horizon and locality that had produced *Exocrinus virgilensis* Strimple (1949), *Perimestocrinus politus* Moore (1939) and other interesting crinoids, and was formerly known as the Nelagoney formation. The legal description is SW¼ section 21, T. 22 N., R. 10 E., Osage County.

Description is not attempted here because the forms would be better handled in the forthcoming monograph by Sinclair on the conulariids. Permanent depository is the paleontological collections of the School of Geology, University of Oklahoma, No. 3195. Overall measurements are, length 33.2 mm, maximum width 15.5 mm at the aperatural opening (mildly distorted due to lateral compression).

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The Continuing Search for Commercially Acceptable Shales and Clays

RE: DUCK CREEK SHALE, MARSHALL COUNTY

by

Albert L. Burwell

A majority of the shales cropping out in Oklahoma that are used in the manufacture of brick and tile "fire" to some shade of red or salmon. Since there is considerable demand in Oklahoma for buff-colored brick, the Oklahoma Geological Survey continues to look for light-burning clay and shale. Buff-burning clays and shales have been reported by Snyder (1911)[1] Sheerar (1932)[2] and more recently by Burwell and Branson (1955)[3].

Brick and tile plants operating in Oklahoma are located in Creek, Custer, Garfield, Lincoln, Oklahoma, and Tulsa Counties. The products are, generally speaking, from dark red to light salmon. Where building construction requires buff or yellowish color for the brick, they are usually imported from Kansas, Texas, or other states.

The ability of a particular clay or shale to yield a white, cream, buff or other light-colored product may depend upon a number of factors including composition, atmosphere during firing and rate and temperature. The composition of the raw material is the factor of greatest importance. The presence of iron, manganese, and other elements which yield colored oxides, especially under oxidizing conditions, is objectionable from a light-color standpoint. However, a relatively large percentage of finely-divided free silica, in silt or smaller particle size, will reduce or change the color due to formation of light-colored silicates at the firing temperature. Further, the presence of an adequate amount of calcareous material will usually assure a buff-colored product. According to Ries (1927)[4], if the temperature of the kiln is raised beyond that at which the carbonate ingredients decompose to liberate carbon dioxide and calcium oxide and "if some of the mineral particles soften, a chemical reaction begins between the lime, iron, and some of the silica and clay, the result being the formation within the clay of a new silicate of very complex composition. According to Seger, if the lime is three times that of the iron, the clay burns to a buff color." Of the Oklahoma clays and shales examined and reported which burn to a white, cream or buff color, a few are relatively free from color-producing elements, a few others contain an appreciable amount of free finely divided silica, but the majority, especially those that burn to a buff, are highly calcareous.

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During 1953, shortly after completion of State Highway No. 99 fro U. S. No. 70, east of Tishomingo, to Madill, the writer noticed an exposu of bluish-gray shale in the fresh road cut about one and one-half mil south of the Marshall-Johnston County line and about four miles northea of Madill. This location corresponds to the section line between sectio 5 and 6, T. 5 S., R. 6 E., Marshall County and about half way between t north and south lines of the sections. The thickness of this shale bed not known. However, approximately four feet is exposed above the roa with a thin overburden of soil. Channel sample was taken from the we bank and later one from the east side. According to Bullard's map Marshall County in Okla. Geol. Survey Bull. 39, a shale exposure at th location should be in the Duck Creek formation. This has been verified Neville M. Curtis, Jr., geologist on the Survey staff, who states: "the a of the shale exposed in a 15 foot road cut, 1.8 miles south of the county li on State Highway 99, is Duck Creek. The shale is 30-40 feet from top Kiamichi or base of the Duck Creek."

Examination of this particular sample discloses plates or small nodul of hard material, identical in color with the shale. In order to remove th material, the crushed shale was soaked in water, agitated to form a th suspension which was facilitated by addition of a small amount of ammoni and wet screened through a sixty-mesh sieve. The particles retained on t screen amounted to approximately **six percent** of the crushed material, a were later identified and classed as argillaceous limestone.

The slurry was dehydrated to a plastic condition, part of which w used in ceramic tests and a smaller portion was dried and used for chemic analysis. Table I gives the result of the chemical analysis and the probab mineral composition calculated from the analysis.

TABLE I

Chemical Analysis of Shale after removing plus-60-mesh particles
Lab. Sample No. 10086

SiO_2	29.25%	CaO	26.49%	P_2O_5	0.064
Al_2O_3	12.26%	MgO	2.10%	SO_3	0.59
Fe_2O_3	2.54%	K_2O	1.51%	V_2O_3	0.0
TiO_2	0.50%	Na_2O	0.35%	H_2O	0.51
MnO_2	tr.	LOI	24.39%	CO_2	20.32

Mineral composition, (calculated)	Calcium carbonate	-46.2
	Calcium sulfate	- 1.0
	Clay and other minerals	-52.8

Composition of clay and other minerals (calculated)

SiO_2	55.4%	CaO	nil	K_2O	2.8
Al_2O_3	23.2%	MgO	4.0%	Na_2O	0.7
Fe_2O_3	4.8%	TiO_2	0.9%	LOI	7.6

Firing Tests

A portion of the plastic mass was cast in standard test bars (1"x1" cut into 3½" lengths, and oven dried at 320°F. The working properties the material were not very satisfactory; the mass was sticky and warp and cracked on drying. The color of the fired product was dependent the temperature used and ranged from a distinct salmon to a yellowish cream. Table II shows the results on firing and the physical properties of the products.

TABLE II

No.	Firing temp.	Density bulk	Porosity % by vol.	Absorption % by weight	Color of product
1	1650°F	1.61	28.7	17.8	salmon
2	1740°F	1.55	28.8	18.6	salmon
3	1830°F	1.54	31.5	20.5	pale salmon
4	1920°F	1.58	31.9	20.2	yellowish cream

The unsatisfactory working properties of the plastic material and equally unsatisfactory products led to tests with addition of powdered silica (silica flour made from glass sand) to the plastic mass. The undesirable properties were largely overcome. Further tests were then made by blending "popped volcanic ash" (pumicity popcorn)[5], with the plastic clay-shale. The blend was prepared using 38.25% clay-shale (dry basis), 11.75% "popped volcanic ash", and 50% water, all thoroughly worked to a smooth paste. 1" x 1" test bars wer cast, dried at 320°F., then fired at 1920°F, the temperature being gradually attained over a 5 hour period, and maintained for 1 hour, then allowed to cool to room temperature. Table III lists the properties of the unfired and fired test pieces.

TABLE III

Linear shrinkage on drying	4.0%
Weight loss on drying	50.0%
Linear shrinkage on firing	6.3%
Weight loss on firing	19.7%
Bulk density of product	0.97%
Crushes under pressure (psi)	1,425 lbs.
Color of product	light tan

The properties of the fired test pieces of this blend of shale and expanded pumicite indicate the posibility of ceramic insulation brick and tile of relatively light weight from such blends.

Further, the effect of silica flour on the working properties of the shale and the color of the fired product can be closely duplicated by the use of highly siliceous clay occurring in the Trinity formation in nearby areas for example, a yellowish clay found in the E½ sec. 25, T. 4 S., R. 5 E. which analysed better than 83% SiO_2 or silty clay portions of the Trinity sand in the W½ of the same section.

Expansion Tests

The current interest in shales that will bloat or expand to yield lightweight products suitable for use as aggregate in concrete and other compositions led to tests on this particular shale. The lumps of dried shale, as taken from the exposure, was crushed to minus ½", then screened to remove "fines" (less than ¼"). After the granular material had been dried at 320°F, a portion in a refractory clay crucible was introduced into an electric furnace the muffler of which had already attained a temperature of 2100°F. After exposure to this temperature for 15 minutes the crucible and contents were withdrawn and cooled. On examination the product wa found to consist of two different kinds of material, a distinction base on hardness only observed in the raw shale. One kind was glassy, dar drab in color, and cellular in structure. The other appeared to be porou rather than cellular, was not expanded, and was cream colored. A simila portion of granular shale subjected under similar conditions to a tempera ture of 2200°F confirmed the distinction. At 2200°F the dark pieces wer more glassy and might be classed as over-bloated, whereas the cream-colore pieces appeared the same as those produced at 2100°F. Specimens of the dar glassy bloated grain and of the cream-colored unbloated grains were picke from fired material. On immersing in distilled water, the pH of the wate containing the dark glassy particle remained near 7, whereas the pH of th water containing the cream-colored particle increased rapidly to over indicating the presence of free lime (calcium oxide) in the particle. Als on the addition of a small amount of hydrochloric acid to the water contair ing the dark glassy particle no action was observed whereas pronounced a tion was observed on the cream-colored particle, leaving a soft friable re idue, and a solution containing both iron and calcium.

Other Tests

The possibility of this shale qualifying as suitable for the manufactu of hydraulic cement was checked with negative results. Finely-ground ca cine was mixed with silica sand (Oil Creek), slaked with small amount water, cast in barmold, and water cured. The color of the product wa light tan, but the physical properties were not acceptable.

Conclusions

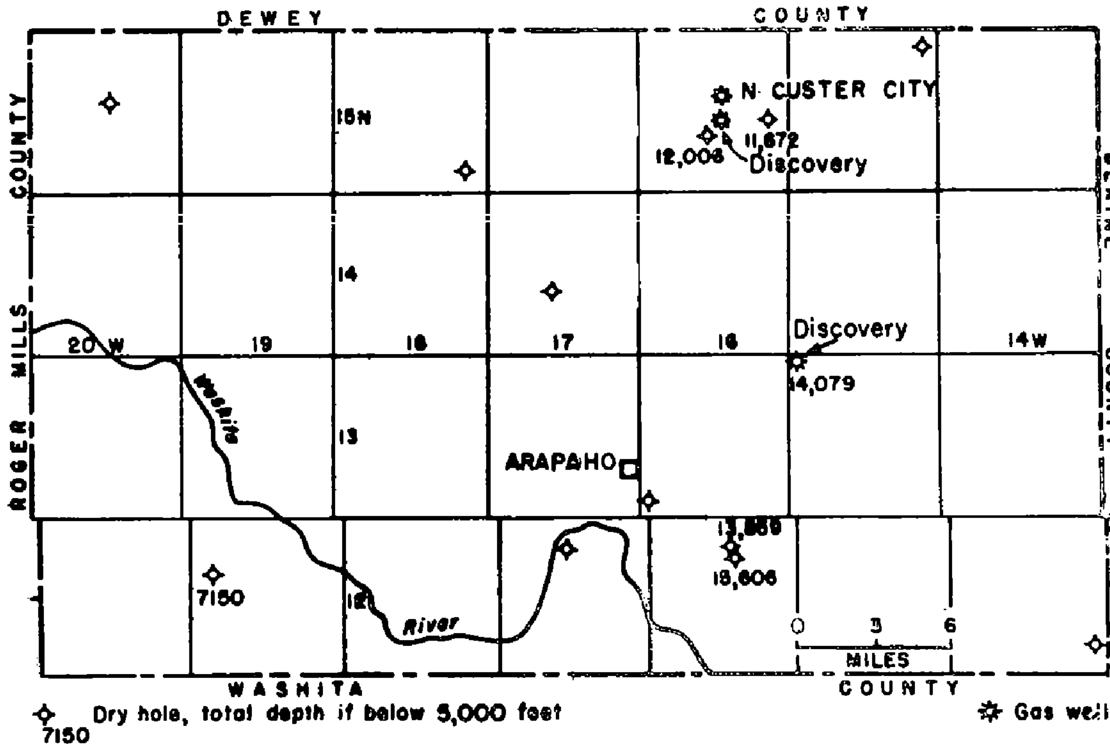
This shale is highly calcareous and contains about six percent of a gillaceous limestone either as plates or nodules. It is possible to separat the limestone portion from the shale by weathering or by soaking, followe by washing out the clay-size material. The clay-sized may serve as a ra material for ceramics only if blended with suitable silica or siliceous mate ials. The granular shale, due to the limestone particles, would not produc a marketable expanded product unless it is subjected to a beneficiation pro cess. This shale does not yield a satisfactory hydraulic lime but should b suitable for portland cement if properly blended, although a lower magnesi content would be preferred.

Apparently, the usefulness of this shale will be limited to certain spe cialized items in the field of ceramics. It should be noted, however, tha other portions of the Duck Creek may be free from objectionable limeston strata or nodules and therefore be more acceptable for commercial use Reference should be made to Oklahoma Geological Survey Bulletin 39, b Bullard, already cited.

Gas in Custer County, Oklahoma

Louise Jordan

Seventy of Oklahoma's 77 counties are commercially productive of hy drocarbons since the discovery, early in 1959, of the North Custer Cit Field in the northeastern part of Custer County. The discovery well, Mag nolia No. 1 Boyd Miller (sec. 22, T. 15 N., R. 16 W.), flowed at a daily rat of 95 million cubic feet of gas (open-flow gauge) from two stratigraphi levels in carbonate rocks of the Hunton group. The significance of th discovery lies not only in that a new area of gas accumulation has been found, but also, that rocks of the Hunton group are established as a major objective throughout the deeper parts of the Anadarko basin. A second producing area for the County may be added this year, 1959, by successful completion in Springer sandstone of a small gas well, Gulf No. 1 Burgtorf (sec. 6, T. 13 N., R. 15 W.) about six miles northeast of Arapaho. (See Figure).



GAS IN CUSTER COUNTY

Custer County, in western Oklahoma, is approximately 1,000 square miles in area. The northwest-trending axis of the Anadarko basin is postulated to pass near the southwest corner of the County. The two discoveries of gas accumulation are in the deep portion of the northern flank of the basin. Late Permian rocks consisting of the Rush Springs, Cloud Chief and Quartermaster formations crop out at the surface. Cretaceous rocks occur as erosional remnants, not more than a few acres in extent, in the southwestern part of the County along the Washita River. The average thickness of Permian rocks penetrated in Custer County is about 5,500 feet with a reported thickness of 5,800 feet in T. 12 N., R. 19 W. The base of the Permian dips toward the basin at an average rate of 30 feet per mile. Pennsylvanian rocks increase in thickness from about 6,500 feet (T. 15 N., R. 16 W.) to over 10,000 feet (T. 15 N., R. 16 W.) in a distance of 16 miles. The base of the Pennsylvanian dips southward at an average rate greater than 275 feet per mile.

Only five tests (Table 1) had been drilled into Pennsylvanian rocks previous to the 1959 discoveries. Three tests in the area of North Custer City Field were drilled to depths of about 12,000 feet, and penetrated Early Pennsylvanian or Late Mississippian rocks. The Magnolia No. 1 F. Jones originally was completed in 1954 as a low-capacity gas well with open-flow initial potential of 1,690,000 cubic feet and 27 barrels of 45° gravity oil. The well was abandoned in 1956. In the three holes, gas was encountered and tested as non-commercial at places in all series of rocks except Virgil The North Custer City Field discovery is the first test to penetrate the stratigraphic section of Mississippian and older rocks in a large area of western Oklahoma on the north flank of the Anadarko basin. Depths in feet from surface datum to the top of a series or formation in the Magnolia No. 1 Miller are listed below:

Permian (surface elevation datum: 1,810 feet)	0
Pennsylvanian:	
Virgil-Missouri	5,250
Des Moines	9,405
Atoka	10,447
Morrow, Springer (age in question)	10,858
Mississippian:	
Chester	11,792
Meramec-Osage-Kinderhook	13,080
Devonian:	
Woodford shale	14,258
Devonian-Silurian:	
Hunton group	14,380
Ordovician:	
Sylvan shale	14,823
Viola limestone	14,920
Simpson sandstone	15,420
Arbuckle group	16,072
Total depth	17,000

Table 1. Tests drilled in Custer County, 1944-1959

Year	Name, location of test	Elevation	Age or formation at total depth
1944	Fox & Fox, 1 Derrickson NE NE 19-12N-19W	1,784	Virgilian, 7,150
1951, 53	Parker (Brill), 1 Newcomb, OWDD NW NW 10-12N-16W	1,686	Springer 13,859
1953	Parker, 1 Miller NE SW 22-15N-16W	1,806	Mississippian, 11,97[illegible]
1954	Magnolia, 1 F. Jones SE SE SE 21-15N-16W	1,834	Mississippian, 12,006
1955	Magnolia, 1 W. W. Jones SW NW 24-15N-16W	1,794	Springer, 11,672
1959	Huber, 1 Wagner NE SW 10-12N-16W	1,708	Springer, 15,606
1959	Magnolia, 1 Miller SE NW 22-15N-16W	1,810	Ordovician, 17,000
1959	Magnolia, 1 Carter SE NW 15-15N-16W	1,802	Drlg. below 15,000
1959	Gulf, 1 Burgtorf SE NW 6-13N-15W	1,822	Mississippian, 14,07[illegible]

The Miller No. 1 was completed as a gas producer after light acidization in two formations of the Hunton: Bois d'Arc limestone at 14,383 to 14,472 feet, and Chimneyhill limestone at 14,773-14,818 feet. Encouragement to deep drilling for Hunton rocks in the Anadarko basin is the existence of 12 percent average porosity in the Bois d'Arc and 8 percent in the Chimneyhill. Permeability is described as "good".

In addition to commercial flows, small showings of gas and oil in Early Pennsylvanian or Late Mississippian sandstones, in three zones of the 928 feet of penetrated Arbuckle and in Simpson sandstones were recorded in the test. Arbuckle and Simpson rocks were tested through perforations. A five-point initial production test was made. The fifth-point test flowed through 20/64 inch choke for four hours, tubing pressure 4,798 pounds-per-square-inch gauge, at a rate of 9,994,000 cubic feet daily, 6.5 barrels acid water production.

A second test in North Custer City Field, Magnolia No. 1 Carter, is being drilled one mile to the north of the discovery. A drill stem test, open for four hours in the upper zone of the Hunton at 14,686 to 14,751 feet, showed gas in 50 minutes flowing at the rate of 2,310,000 cubic feet daily with water flowing at the rate of five barrels per hour at the end of test. Flow pressure rose from 1,852 to 1,860 pounds, while shut-in pressure reached 6,445 pounds-per-square-inch in one hour. Gas shows in cores of lower Hunton at 15,036 to 15,071 feet will be tested. The top of the Woodford shale in the well (elevation: 1,802 feet) was encountered at 14,572 feet, or 322 feet lower than in the Miller No. 1.

The second gas producing area in the County is at the location of Gulf No. 1 Burgtorf, now being tested. Sandstones called Springer were perforated at 13,365-378 feet, at 13,410-425 feet, at 13,532-536 feet, and at 13,570-580 feet. Current daily rate of flow is 1,920,000 cubic feet of gas with 10 barrels of fluid through ½ inch choke. Fluid is approximately 38 percent mud and 62 percent condensate of 47° gravity. Approximately 150 feet of slightly oolitic silty limestone considered Chesterian (Mississippian) in age was penetrated. Placement of the Mississippian-Pennsylvanian boundary in southern Oklahoma is in question. Faunal evidence, clay studies, and regional correlation at present indicate that Springer rocks may be of Mississippian rather than of Pennsylvanian age.

SOURCE OF THE VAMOOSA QUARTZITE PEBBLES

By

Philip A. Chenoweth

The Vamoosa formation (Early Virgilian) crops out in a narrow north-south band across Oklahoma from the northern edge of the Arbuckle Mountains to Kansas. As described by Morgan (1924), Levorsen (1930), Tanner (1956), and others, the formation consists of lenticular sandstone, conglomerate, shale, calcareous sandstone, and calcareous siltstone. It rests unconformably on the Hilltop shale and is overlain by the Ada formation which gradually overlaps and truncates the Vamoosa southward. The formation thickens northward in Seminole County, reaching a maximum thickness of about 1000 feet. The southward thinning is the result of numerous periods of erosion.

In Seminole County the Vamoosa consists principally of shale and sandstone, but the general appearance of the unit is that of a rather coarse conglomerate. Resistant ledges of chert conglomerate are quite conspicuous wherever the unit crops out, and are quarried in several large pits in northern Seminole County. The coarsest conglomerates occur in the middle and lower portions of the formation, coarsening towards the north but becoming less abundant in the same direction. In the northern part of Seminole County only the lowermost layers of the formation contain conglomerate.

The pebbles and cobbles of the Vamoosa range is size up to a maximum of 7 inches in diameter and are largely chert. Tanner (1956) distinguished four principal classes of pebbles:

1. buff, subangular chert (the most common)
2. banded buff and green subangular chert
3. brecciated (tectonic) chert
4. miscellaneous (i.e., chalcedony, quartzite, quartz, clay plates).

He presented evidence which strongly suggests a south or south-southwest source for the chert breccia pebbles. According to him it is not necessary to seek a source in the Ouachita Mountains or to the southeast for the chert pebbles.

Pebbles of quartzite are much less common than either of the first two classes of chert pebbles, but in many layers of the formation (particularly in exposures along Oklahoma Highway 9 east of Seminole) far exceed the breccia pebbles in abundance. The writer has also found rare pebbles of fossiliferous limestone. In contrast to the chert pebbles which are usually subangular, the pebbles of quartzite, which have been found up to three inches in diameter, are well rounded. Tanner (p. 96) has suggested that more than one provenance may have supplied material to the Vamoosa, and indeed the difference in angularity between the chert and quartzite pebbles appears to bear out such a theory. In view of the fact that quartzite is unknown in either the Arbuckle or Ouachita Mountains (the two most likely sources of the chert pebbles) the existence of another source area seems obvious. Several possibilities may be considered:

1. the Rocky Mountains
2. the Wichita Mountains
3. the Appalachian Mountains
4. the Canadian Shield
5. a southerly source ("Llanoria").

The Rocky Mountains, the Canadian Shield, the Appalachian Mountains, and the Wichita-Red River Uplift all contain metamorphic rocks including dense, tough (probably Precambrian) quartzites. Stratigraphic relations in Oklahoma eliminate the Rocky Mountains as a possible source: Virgilian strata between central Oklahoma and the Rocky Mountains contain no extensive conglomerates, but rather shale and marine limestone are the dominant rock types in western Oklahoma and southwest Kansas. The only known quartzite in the Wichita Mountains is the Meers formation which occurs in a small outcrop area on the north flank of the mountains in a direction almost due west from the Vamoosa outcrops. Between the Meers outcrop and the Vamoosa of Seminole County the Virgil consists mostly of shale and sandstone and generally lacks conglomerates of any sort. Likewise, the Canadian Shield is separated from Seminole County by a vast area in which the Upper Pennsylvanian strata are composed principally of shale and limestone with no coarse clastics. The Appalachian Mountain region, while affording a large source of metamorphic rocks is located such a great distance east of the Vamoosa outcrop that it too is considered an unlikely provenance.

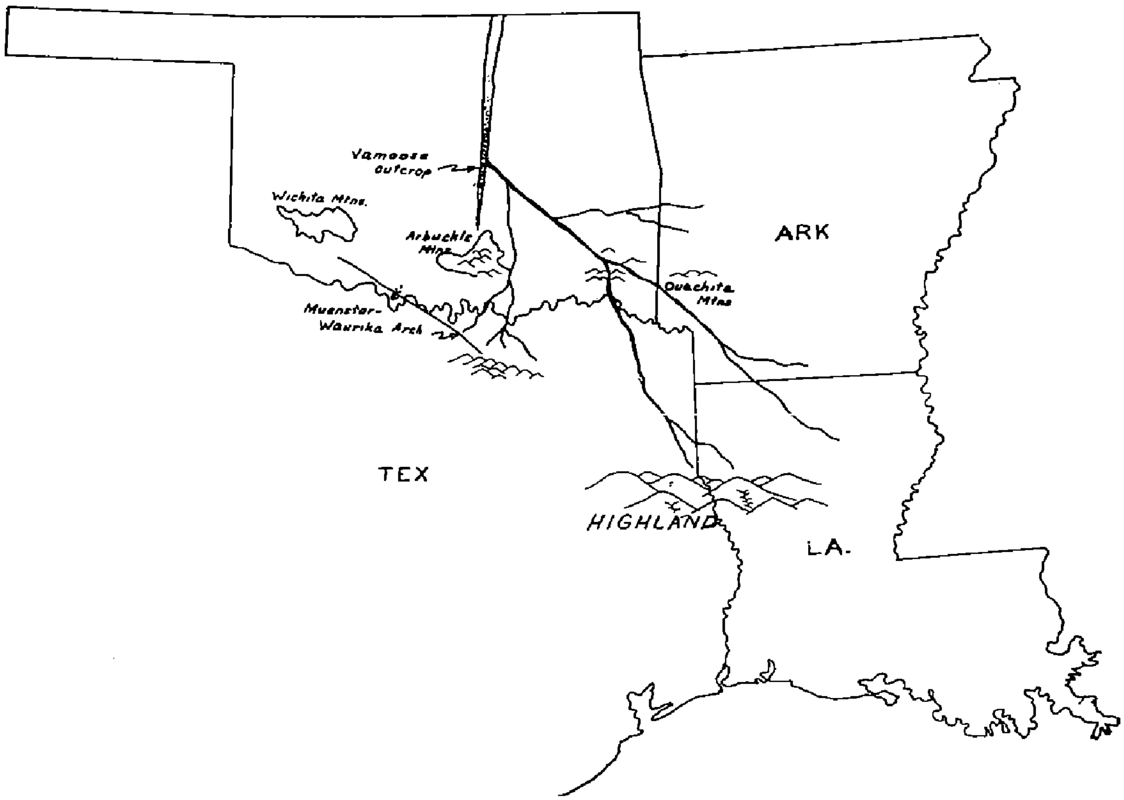


Figure 1. Hypothetical stream system of Late Pennsylvanian time in the Oklahoma-Arkansas-Louisiana-Texas area as deduced from study of the chert and quartzite pebbles of the Vamoosa formation.

Elimination of the Rocky Mountains, the Canadian Shield, the Wichita and Appalachian Mountains narrows the possibilities of source areas to the south and southeast. In that direction from Seminole County though, there are no known exposures of metamorphic rocks. Deep wells along the Muenster-Waurika Arch in Jefferson County, Oklahoma, have, however, encountered gneiss beneath the Upper Pennsylvanian, and a metamorphic terrane (probably metasedimentary) is regarded as existing beneath the Pennsylvanian and Cretaceous cover in north central Texas and south central Oklahoma (Denison, 1958). The Muenster-Waurika arch can be traced southeast to Denton County, Texas. It was, at least in part, a positive area in Late Pennsylvanian time. Assuming that the metasedimentary strata of Jefferson County are present in a band along the southeastern extremity of the Muenster-Waurika Arch, and further assuming that quartzites make up a significant portion of the terrane, a southerly source is thus established.

A southeasterly source is another likelihood. Both Hugh D. Miser and William E. Ham recognized many chert and breccia pebbles in Tanner's collection as being similar to portions of the Arkansas novaculite of the Ouachita Mountains. The writer has collected dozens of pieces of brecciated Arkansas novaculite which are identical, except for the degree of weathering, to the breccia pebbles of the Vamoosa. Tanner regarded the breccia pebbles as having originated in the Arbuckle Mountains rather than in the Ouachita Mountains. Assuming that the breccia and much of the chert was derived from the Ouachita Mountain region still does not explain the source of the quartzite, for extensive deposits of this material are absent in the Ouachitas as well. If the source of the quartzite pebbles lay to the southeast from Seminole County it must have been beyond (south of) the present Ouachita Mountains, possibly in the Louisiana—East Texas area, and could conceivably be a southeastward continuation of the Muenster-Waurika Arch (Wichita Mountain Uplift) as suggested by P. B. King (1951, p. 140).

Summary

The quartzite pebbles of the Vamoosa formation of central Oklahoma most likely were eroded from a high area which, during Virgil time, lay south of the Red River in north central Texas, east Texas, and Louisiana. Streams which rose in this positive area traversed the Ouachita Mountain region enroute to the sea. They were no doubt joined near the coast by shorter, more vigorous streams originating in the rising Arbuckle Mountain area. The conclusions of Taff (1901), Morgan (1924), Levorsen (1930), and Oakes (1948), according to whom the source of the Vamoosa gravels lay to the southeast, cannot be dismissed.

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LATE PALEOZOIC LLANORIAN RIVERS IN OKLAHOMA

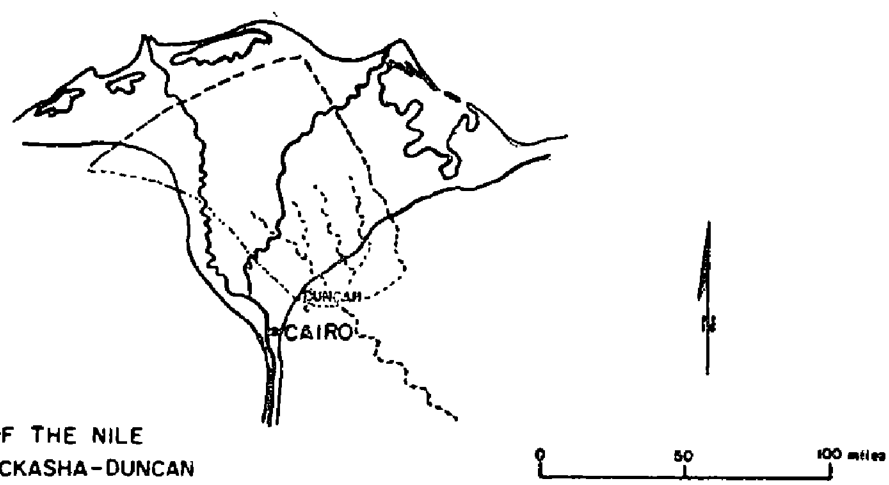
By

Philip A. Chenoweth

At least two features of the Late Pennsylvanian and Early Permian strata in central Oklahoma indicate that a land mass of great areal extent existed in the area of the present East Texas basin and the Gulf Coast geosyncline. That a highly elevated and probably volcanic land was present in that area during Mississippian time appears quite obvious when one considers the nature of the strata belonging to that system in the Ouachita Mountains of Oklahoma and Arkansas (Miser, 1921). The land which supplied the debris now composing the Stanley, Jackfork, and Hot Springs formations of Oklahoma and Arkansas and the Parkwood formation of Alabama endured a long history probably including periods of rapid uplift, periods of volcanic activity, times of prolonged erosion, and repeated inundations. During Virgilian and Wolfcampian times the broad low-lying landmass at the site of former volcanic highlands was drained to the north and northwest by at least two large rivers which reached the sea in central Oklahoma.

The Chickasha and Duncan formations (Permian) together make up a large wedge of deltaic sediments between the Hennessey shale and the Marlow sandstone. This delta, referred to as the Duncan Delta, crops out in a horseshoe shape around the flanks of the Anadarko syncline. The units thin northward and northwestward from the vicinity of Duncan, Stephens County, and give way to the marine shale, dolomite, and gypsum of the Flowerpot, Blaine, and Dog Creek formations. Northward along the east flank of the Anadarko syncline the Duncan sandstone disappears at about the latitude of the Canadian River, the Chickasha clay gall conglomerates can be traced as long tongues another 40 miles northward to the vicinity of Kingfisher, Kingfisher County. Westward along the south flank of the Anadarko syncline the Chickasha can be traced into Kiowa County, north of the Wichita Mountains, and the Duncan sandstones are mapped at least as far west as Greer County. The subsurface extent of this sandy wedge is not known precisely but it is supposed that the outer edge of the former delta is now an irregular line of facies change between Kingfisher and Greer Counties.

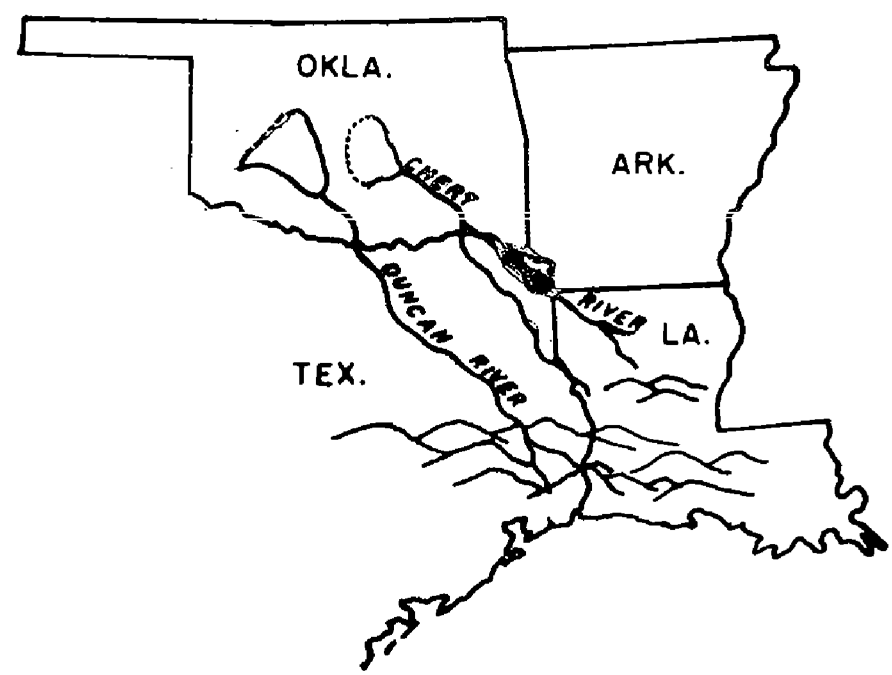
The present Duncan delta is but a remnant of a probably much larger wedge of sandstone and conglomerate. It has been preserved by virtue of



DELTA OF THE NILE
AND CHICKASHA-DUNCAN
DELTA REMNANT DRAWN
TO SAME SCALE

its having been folded into a syncline; the sides of the delta have been removed by post-Permian erosion, the top was beveled by pre-Marlow erosion. Nevertheless, even this remnant is of considerable extent, approximately 100 miles northwest-southeast, and it compares quite favorably in size and shape with the exposed delta of the modern Nile River (Figure 1).

The major rivers of the world, such as the Nile, the Amazon, and the Mississippi, follow approximately straight courses for hundreds of miles before reaching their deltas. Assuming then that the river which deposited the Duncan delta was nearly of the size of the Nile, since the deltas correspond so closely, and that it flowed in a straight course approximately perpendicular to the edge of the deposit, it probably drained a land of large area southeast of central Oklahoma (Figure 2).



PENNSYLVANIAN AND PERMIAN RIVERS OF THE SOUTHWEST.

The Vamoosa formation (Virgil) of central Oklahoma sheds some further light on the drainage of this ancient land. Conglomerate beds in the Vamoosa contain rather common pebbles and cobbles of dense tough quartzite and rare pebbles of igneous material. The quartzite and the igneous rock are entirely foreign to Oklahoma. For various other reasons the quartzite of the Vamoosa is thought to have been carried from some distance south of the present Arbuckle and Ouachita Mountains (Chenoweth, 1959) by a stream (called "Chert River" by Oakes, 1948) which flowed in a course somewhat east of the Permian river responsible for the Duncan-Chickasha deposits.

Another delta, intermediate in age between the Vamoosa and the Duncan, is represented by the upper portion of the Garber-Wellington formations of central Oklahoma. Only a fragment of this delta is preserved, owing to the westward tilt of the strata and deep post-Permian erosion, but Oakes has postulated that this deposit was likewise laid down by a stream flowing from the southeast across southern Oklahoma.

Deep drilling in north Louisiana has revealed the presence of a thick marine shale (Morehouse shale) which is regarded as Middle Pennsylvanian (Desmoinesian) in age. The southern limit of the Morehouse formation is unknown. It is succeeded by non-fossiliferous salt and anhydrite beds which are in turn unconformably overlain by beds of Middle Jurassic age. The interval represented by this post Des Moines—pre Jurassic unconformity is most likely the time of existence of the landmass which supplied the debris now incorporated in the central Oklahoma deltas.

Summary

In Late Pennsylvanian and Early Permian time a broad land area in the region of East Texas and Louisiana was drained towards the northwest by large rivers. The earlier of the two streams which are known reached the sea in east-central Oklahoma, bringing from the interior quantities of coarse gravels composed of quartzite and minor amounts of igneous rock. The younger of the two known rivers followed a somewhat longer course to build a delta in central western Oklahoma. This river was no doubt a more mature stream and the remnant of the delta is consequently composed of sand and silt with some arkose.

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ARKOMA BASIN

Louise Jordan

C. C. Branson (1956, p. 83) suggested that the area north of the Ouachita Mountains in Oklahoma and Arkansas, where the Pennsylvanian geosyncline orginated at the beginning of Atokan time, might be called the Arkoma basin. For the most part, the Oklahoma portion is known as the McAlester basin and the portion in Arkansas as the Arkansas basin, although the two areas make up a single geologic province. Apparently no single acceptable term for the basin exists as the geologists of the Tulsa Geological Society (1951) in discussing possible future petroleum provinces in the Mid-continent region refer to the Arkansas Valley region of eastern Oklahoma and western Arkansas as the Arkansas-Oklahoma coal basin.

The names Arkansas coal field or basin (Hendricks 1937, p. 1403), Arkansas River basin (Petroleum Week, p. 12, fig.), and Arkansas valley (Caplan, 1958, p. 101) have been applied to the portion which lies in Arkansas. Hendricks (1937, 1939), Knechtel (1937), Dane and others (1938) described the geology and fuel resources of the McAlester basin under the term, Oklahoma coal field. Arbenz (1956) on the tectonic map of Oklahoma refers to the entire area as the McAlester-Arkansas foredeep, but on the tectonic map of the United States (1944), it is called the Arkansas basin.

Confusion in nomenclature is resulting now that this basin, one of the country's large and virtually unexplored areas, is promising to be of importance in increasing the gas reserves of the nation. Writers may refer to the entire basin as either the McAlester basin (Gardner, 1959, p. 143) or the Arkansas valley (Ballard, 1957, p. 264 and Morrisey, 1958, p. 194.) Arkansas valley is a physiographic division (Hendricks, 1937, fig. 1, p. 1404) which consists of the area south of the Brushy and Boston Mountains and north of the Ouachita Mountains. Although names of physiographic provinces are applied at many places to geologic provinces, the basin lies south of the Arkansas River in Okahoma. Branson (1956, p. 83) notes that "north of a belt in the general position of the Arkansas River valley, the rocks are in the platform facies . . . ." Just as the term Anadarko is used for the basin extending into Texas, the name Arkoma may be applied to the basin north of the Ouachitas in both Oklahoma and Arkansas without causing loss of face to either state. In bibliographies, all articles on geology and exploration for oil and gas in the basin then will be listed under one term. Perhaps also, geological reports on the basin will not be affected by the state line boundary.

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