Cover Picture

MINERAL INDUSTRIES OF OKLAHOMA

Glass

For the past 50 years Oklahoma has had more glass-manufacturing plants than any other state west of the Mississippi River, with the exception of California. Twelve plants are currently in operation, employing nearly 2,400 workers and producing annually about $30,000,000 in finished glass products. Produced in great numbers are bottles, jars, and window panes, together with a lesser volume of tumblers and tableware, pyrex glass, lamps, and specialty glassware.

The twelve plants, located at Ada, Cedars, Henryetta, Muskogee, Okmulgee, Sand Springs, Sapulpa, and Tulsa, are in the eastern third of Oklahoma where natural gas supplies were first developed as a source of fuel for glass making. Although first attracted by the abundance and cheapness of natural gas, the plants became firmly established through the availibility in Oklahoma of high-purity glass sand, limestone, and dolomite, all of which are essential raw materials for glass.

High-purity silica sand, commonly called "glass sand" or "melting sand," makes up about 43 percent of the raw materials used in a typical batch for bottle or container glass. Because glass sand is thus the dominant material in glass, and also because it is a low-cost bulky ingredient that can not be shipped far at overland freight rates, it is imperative to have adequate sources nearby.

Large reserves of high-purity silica sand in the Arbuckle Mountains supply the needs of virtually all the glass plants in Oklahoma, and at the same time they are worked for substantial exports for glass making, foundry sands, and the manufacture of sodium silicate, and in ground form for use in ceramics and as inert fillers. Thick layers of loosely consolidated sandstone in the Simpson Group (Middle Ordovician) are produced by open-pit mining. The white sands in the face of the pit are first blasted down, then disaggregated by hydraulic monitors, and finally washed and dried for sale to the glass plants. The plant-run sands contain more than 99.8 percent silica and normally 0.01 to 0.03 percent iron oxide.

Two glass-sand plants currently operate in Oklahoma. Mid-Continent Glass Sand Company at Roff has been in continuous operation since 1913. Shown on the front cover is part of the working face of the Pennsylvania Glass Sand Company quarry at Mill Creek. Acquired in 1947, the newly modernized plant produces chiefly glass sand but also supplies ground silica in all standard specifications.

—W. E. H.

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Statistics of Oklahoma's Petroleum Industry, 1963

Louise Jordan

In Oklahoma, 109 new areas of hydrocarbon production were discovered, and 129 wells found either a new productive zone or an extension in an old field area in 1963. Eighteen of the new fields and 21 of the new zones or extensions resulted from working over an old dry test or of drilling deeper. The greatest number (12) of new field discoveries was made in Garfield County, where Oswego and Mississippian limestones are the prime targets. Six discoveries were made in Kingfisher and McClain Counties, five in Ellis County, and four or fewer in the remaining 30 counties where new fields were found.

Some of the highlights of the year are: (1) exploration and development of Oswego production in Kingfisher, Garfield, and Dewey Counties; (2) extension of the search for Mississippian production across central and western Garfield County and parts of Major and Alfalfa Counties; (3) expansion and new zone discoveries in the Greensburg-Oakdale-Waynoka area of Woods County; (4) successful operations at deep depths in the Alex-Chitwood area and eastward in Grady County; (5) discoveries of new fields and new zones at depths from 8,000 to 13,000 feet in the complicated faulted area of McClain County; (6) development of gas reserves in the Arkoma basin of eastern Oklahoma now provided with the Arkansas Louisiana Gas Co. pipeline, which extends from the Centrahoma gas field in Coal County to Paris, Arkansas.

The petroleum industry in Oklahoma, as well as in the United States, discovered less new reserves of crude oil and natural-gas liquids than it did in 1962. In Oklahoma, estimated proved reserves of crude oil were down 100,130,000 barrels and those of natural-gas liquids decreased 18,810,000 barrels. Reserves of natural gas, on the other hand, increased 780,082 million cubic feet. Tables I and II show the record of reserve estimates, annual production, and change of re-

Table I.—Estimated Proved Reserves, Production, and Change in Reserves, 1955-1963*

	Crude Oil			Natural-gas Liquids		
End of	Reserves (1,000 bbls)	Production (1,000 bbls)	Change (MM bbls)	Reserves (1,000 bbls)	Production (1,000 bbls)	Change (MM bbls)
1955	2,016,045	200,799	+61	354,354	29,365	+20
1956	2,009,798	211,811	−6	355,588	30,860	+1
1957	1,941,521	211,447	−68	342,643	34,097	—13
1958	1,898,128	198,519	−43	357,507	29,585	+15
1959	1,864,749	193,446	−33	367,569	28,319	+10
1960	1,790,500	189,654	−74	338,313	28,483	—29
1961	1,787,429	187,845	−3	329,180	26,849	—9
1962	1,728,268	196,245	−59	347,003	22,374	+18
1963	1,628,138	194,497	−100	328,193	25,772	—18

*American Petroleum Institute, annual report.

Table II.—Estimated Proved Reserves of Natural Gas in Oklahoma, 1955-1963*

End of	Reserves (MMCF)	Production (MMCF)	Change (Trillions)
1955	13,204,739	878,698	+0.9
1956	13,755,049	916,602	+0.57
1957	14,259,480	944,569	+0.50
1958	15,206,769	903,297	+0.95
1959	16,651,292	956,096	+1.44
1960	17,311,402	993,975	−0.66
1961	17,350,924	1,016,485	+0.04
1962	18,358,738	1,035,470	+1.01
1963	19,138,820	1,128,132	+0.78

*American Gas Association, annual report.

Table III.—Exploratory Producers (oil, gas, and condensate) and Dry Holes Drilled in Oklahoma, 1955-1963*

	No. of Producers	No. of Dry Holes	Total Tests	Footage	Average Depth (Feet)
1955	205	718	923	3,934,360	4,263
1956	266	863	1,129	4,827,949	4,276
1957	200	823	1,023	4,305,680	4,209
1958	282	914	1,196	4,670,946	3,905
1959	238	843	1,081	4,442,912	3,110
1960	260	674	934	4,210,821	4,508
1961	250	616	866	3,978,322	4,594
1962	257	546	803	3,747,798	4,667
1963	248	468	716	3,459,315	4,831

*Lahee, F. H., 1962, Statistics of exploratory drilling in the United States, 1945-1960; and American Association of Petroleum Geologists, annual June issues.

Table IV.—Development Wells Drilled in Oklahoma, 1955-1963

	Oklahoma Exclusive of Panhandle[1]					All Oklahoma[2]
Year	Oil	Gas	Dry	Total	Percent Successful	Total
1955	4,501	230	1,873	6,604	71.8	7,579
1956	4,380	208	1,972	6,560	70.0	7,189
1957	3,373	96	1,654	5,123	67.7	5,488
1958	3,185	218	1,603	5,006	67.9	5,500
1959	2,561	185	1,354	4,100	66.9	4,532
1960	1,539	251	570	2,360	75.8	4,102
1961	1,880	248	617	2,745	77.5	5,316
1962	1,797	340	573	2,710	78.9	4,770
1963	1,779	347	590	2,716	78.3	4,076

[1]American Association of Petroleum Geologists, annual June issues of Bulletin; success percentage computed here.
[2]Oil and Gas Journal, annual forecast-review issues.

TABLE V.—DRILLING ACTIVITY IN OKLAHOMA, 1963

	1963					1962	1964
	CRUDE	GAS	DRY	SERVICE	TOTAL	TOTAL	FORECAST
All wells							
Number of completions	2,273	430	1,260	529	4,492	5,203	4,389
Footage	8,362,091	2,774,166	5,308,549	915,293	17,360,099	20,467,560	17,290,000
Average footage	3,679	6,452	4,213	1,730	3,865	3,934	
Exploration wells							
Number of completions	53	37	326		416	433	498
Percentage of completions	12.7	8.9	78.4		100		
Footage	327,882	240,959	1,671,894		2,240,735	2,552,933	
Average footage	6,186	6,512	5,128		5,386	5,896	
Development wells							
Number of completions	2,220	393	934	529	4,076	4,770	3,891
Footage	8,034,209	2,533,207	3,636,655	915,293	15,119,364	17,914,627	

Source: Oil and Gas Journal, annual forecast and review issue, vol. 62, no. 4, January 27, 1964.

serves from previous year for the period 1955 through 1963 of crude oil, natural-gas liquids, and natural gas. Crude-oil reserves and production in Oklahoma have decreased since 1955, whereas reserves and production of natural gas have steadily increased.

Closely related to discovery of new reserves is the number of exploratory and development holes drilled each year (tables III, IV). It is noteworthy that, in the 1956-1963 period, the annual total number of exploratory holes rather steadily decreased from 1,129 tests to 716 tests; total footage decreased from 4.8 million to 3.5 million; and the average depth of holes increased from 4,276 to 4,831 feet. The success ratio in 1956 was 23.6 percent and that in 1963 was 34.6 percent. The number of development wells drilled in Oklahoma (exclusive of the Panhandle) also decreased from 6,604 in 1955 to 2,716 in 1963 (table IV). The *Oil and Gas Journal's* figures (column 6), which include all of Oklahoma, show the same trend and indicate an almost 50-percent reduction in the number of development holes drilled annually. This is partly due to wider spacing of oil wells in some parts of the State. Spacing of oil wells in the 1960's has increased in many areas from 40 to 80 acres, and some development in 1963 was based on one well to 160 acres.

Drilling activity in the State in 1963 (table V) decreased from that in 1962. Total well completions were down 711, or nearly 14 percent, and footage drilled decreased 3.1 million feet, or nearly 15 per-

TABLE VI.—HYDROCARBON PRODUCTION IN OKLAHOMA, 1962-1963

	END OF 1962	END OF 1963
Crude oil and lease condensate		
Total annual production (1,000 bbls)[1]	202,732	201,700
Value ($1,000)[1]	591,977	584,930
Cumulative production, 1891-year (1,000 bbls)[1]	8,622,209	8,823,909
Daily production (bbls)[2]	545,359	549,370
Total number of producing wells[3]	80,098	81,952
Daily average per well (bbls)[3]	6.8	6.7
Wells flowing naturally at end of year (estimated)[2]	3,750	n.a.[4]
Oil wells on on artificial lift (estimated)[2]	77,795	77,686
Natural gas		
Total annual marketed production (MMCF)[1]	1,060,717	1,095,800
Value ($1,000)[1]	135,772	141,400
Total number of gas and gas-condensate wells[2]	6,218	6,639
Natural-gas liquids		
Total annual marketed production (1,000 gals)[1]	1,391,698	1,406,300
Value ($1,000)[1]	60,987	63,400

[1]Item for 1962 is U. S. Bureau of Mines final figure. Item for 1963 is U. S. Bureau of Mines preliminary figure: U. S. Bureau of Mines, Mineral Industry Surveys Area Report IV-167; also in Okla. Geology Notes, vol. 24, p. 20.

[2]World Oil, 1964 forecast and review issue, vol. 158, no. 3, February 15, 1964.

[3]Oil and Gas Journal, annual forecast and review issue, vol. 62, no. 4, January 27, 1964.

[4]Not available.

cent. Successful completions of exploratory wells were 53, or 12.7 percent, finding oil and 37, or 8.9 percent, discovering gas.

Deep drilling in Oklahoma is setting a strong foundation for future exploration (Oil and Gas Journal, vol. 62, no. 17, Apr. 17, p. 198). In 1963, 19 wildcats were drilled with total footage of 269,191 feet, or an average depth of 14,168 feet. Ten of these (53 percent) discovered hydrocarbons. One each was drilled in Custer, Dewey, Love, and Stephens Counties; three each in Grady and McClain Counties. Oklahoma's deepest producer in the Chitwood field of Grady County (Mobil 1 S. M. Miller, SW¼ SE¼ NW¼ sec. 28, T. 5 N., R. 6 W.) discovered 1,107 MCFD and 222 barrels of condensate per MMCF of gas in the Third Bromide (Simpson Group, Ordovician)

TABLE VII.—GIANT OIL FIELDS OF OKLAHOMA*

FIELD (PRIMARY COUNTY)	1963 PRODUCTION (1,000 BBLS)	CUMULATIVE PRODUCTION (1,000 BBLS)	ESTIMATED RESERVES (1,000 BBLS)	NO. OF WELLS	YEAR OF DISCOVERY
Allen (Pontotoc)	1,445	92,436	7,564	910	1927
Avant (Osage)	255	104,444	2,556	599	1904
Bowlegs (Seminole, Pontotoc)	1,110	143,483	16,517	111	1927
Burbank (Osage)	13,685	421,792	53,208	1,475	1920
Cement (Caddo)	3,340	112,123	12,877	1,585	1917
Cushing (Creek)	2,828	421,271	33,729	1,810	1912
Dover-Hennessey (Kingfisher, Garfield)	9,010	21,296	178,704	757	1958
Earlsboro (Seminole)	340	137,012	2,988	91	1930
Edmond, West (Oklahoma)	1,150	112,876	17,239	650	1943
Elk City (Beckham)	840	57,281	52,719	287	1947
Eola-Robberson (Garvin)	3,384	60,257	39,743	490	1920
Fitts (Pontotoc)	810	119,501	7,499	441	1953
Glenn Pool (Creek)	3,303	275,368	34,632	1,383	1905
Golden Trend (Garvin)	13,427	269,024	90,976	2,440	1944
Healdton (Carter)	2,506	245,262	24,738	2,196	1913
Hewitt (Carter)	2,466	168,921	26,079	1,405	1949
Little River (Seminole)	340	131,396	3,604	138	1937
Oklahoma City (Oklahoma)	2,300	723,790	46,210	485	1928
Seminole (Seminole)	785	166,662	8,338	261	1926
Sho-Vel-Tum (Carter, Stephens)	24,995	622,824	177,176	4,097	1914
St. Louis (Pottawatomie)	1,535	195,549	14,451	661	1925
Tonkawa (Kay, Noble)	260	128,272	1,728	120	1921
Total (MM bbls)	90.11	4,731	853	22,392	

*Oil and Gas Journal, annual forecast and review issue, vol. 62, no. 4, January 27, 1964, p. 163-164.

TABLE VIII.—STRIPPER WELLS IN OKLAHOMA, 1961-1962

	END OF 1961	END OF 1962*
Number of stripper wells	68,740	68,722
Production (1,000 bbls)	116,058	114,544
Abandonments	2,546	3,683
Average daily production per well (bbls)	4.63	4.57
Producing acres	1,212,700	1,207,994
Reserves estimated at end of year (1,000 bbls)		
Primary	725,275	506,815
Secondary	570,665	532,233
Total	1,295,940	1,039,048

*Oil and Gas Journal, 1963, Stripper wells show little change: Oil and Gas Jour., vol. 61, no. 45, (Nov. 11), p. 94, from annual stripper-well survey prepared jointly by the Interstate Oil Compact Commission and the National Stripper Well Association.

at 16,954 feet to 17,176 feet, with a total depth of 17,364 feet. This well is the third deepest producing well in the United States and the second deepest gas-productive well. Another deep test discovered Arbuckle production from 11,470 feet to 12,528 feet in the West Payne field of McClain County. A triple completion, the Goff 2-A Dempsey-Mantooth (W½ SW¼ sec. 17, T. 5 N., R. 3 W.) had a flowing initial potential of 687 barrels of oil daily. The Arbuckle is the ninth productive zone found in this area. The nine dry holes, ranging in depth from 12,500 to 16,000 feet, were drilled in Blaine, Dewey, Grady, Marshall, and Stephens Counties in the Anadarko-Ardmore basin area, and in Latimer and Le Flore Counties of the Arkoma basin.

The 22 giant fields (100 million barrels or more) contributed more than 90 million barrels, or 44.9 percent, to the 1963 production of crude oil in Oklahoma (table VII). The remaining reserves in these fields is estimated at 853 million barrels. Ultimate production in these fields is calculated to be 5,584 million barrels or 51.1 percent of the estimated ultimate production in Oklahoma without additional discoveries.

Stripper-well production in 1962 (table VIII) amounted to 114,544,000 barrels, or 56.5 percent of the annual production. The reserves at the end of 1962 from these wells, which average less than 10 barrels per day, were estimated to be an additional 1,039 million barrels. However, the study by the agencies includes those fields which have previously been classified as such, even though secondary-recovery operations may have increased production.

Helium recovered from natural gas in the Oklahoma Panhandle amounted to 232,470,000 cubic feet with a value of $8,136,000 in 1963. Data for 1962 are 282,214,000 cubic feet and $9,917,000, showing that both quantity and value decreased during 1963.

Capacity of underground storage for natural gas increased in 1963 to 305,600 million cubic feet by the addition of a 55,600-million-cubic-foot facility constructed by Cities Service Gas Company near Webb, Grant County. LPG underground storage was increased by

Table IX.—Some Basement Tests Drilled in 1963-1964

SEC.	T.	R.	WELL NAME	LOCATION OF BASEMENT SAMPLES
14	1N	3W	Home Petroleum, 1 Newberry	
15	1N	3W	Mobil Oil, 13 R. J. Mauldin "B"	Cores at OGS
24	1N	3W	E. Dunlap Jr., 1 Hudson	
26	2N	9W	Daube, 1 Emmons	
34	2N	9W	Trice Production, 1 Tullous	
2	4N	19W	D & J Production, 1 Warren	Cuttings at OGS
30	7N	23W	G. McCutchin, 1 Covington et al.	
21	9N	23W	T. K. Hendrick, 1 Thompson	
34	25N	1W	Apco, 1 Endicott	Shawnee
7	4N	4E	Tidewater, 1 Wood	Cuttings and cores at OGS
19	7N	5E	Hembree, C-3 Hembree	Cuttings at OGS, restricted to Jan. 1, 1965
28	8N	23E	Pan American, 1 Tackett	Cores at OGS
24	16N	12E	Schermerhorn, 1 Tiger	Cuttings at OGS and Shawnee
5	16N	16E	Emrich & Austin, 1 Carter	Cuttings at OGS, restricted to Jan. 1, 1965
5	20N	11E	Southern Union, 1-C Atchison	Cuttings at OGS
1	21N	7E	Gulf Oil, 65 F. Boston	Cores at OGS
29	25N	8E	Texaco, 16-WS Kohpay	Cores at OGS
2	27N	5E	Bradford & Mayo, 1 Horinek	
7	7S	10E	California Oil, 1 E. Williams unit	
12	7S	10E	Sinclair, 1 Rodgers	

the addition of several salt-solution cavities at Mocane, Beaver County, by Warren Petroleum Company and by another facility in Wellington salt, built by Continental Oil Company in Grant County. Total capacity for LPG storage is 1,125,000 barrels, an increase of 305,000 barrels over that of 1962.

The Oklahoma Geological Survey is currently engaged in a study of the basement rocks of the State. Data on basement-rock tests are not usually given separately in statistical reviews and tabulations. Table IX is a list of the more recent basement tests compiled from various sources. The Survey would appreciate receiving samples of basement rocks and of the overlying formations. Some basement-rock samples will be used for age determinations.

New Theses Added to O. U. Geology Library

The following Master of Science theses have been added recently to The University of Oklahoma Geology Library:

Quantitative study of electrical parameters, Prue sand (Pennsylvanian), southern Creek County, Oklahoma, by Abdolhossein Baharloui.

Palynology of the Drywood coal (Pennsylvanian) of Oklahoma, by Kenneth V. Bordeau.

Hedbergella, an Oklahoma Genus of Foraminifera

The genus *Hedbergella* is based upon the type species *Globigerina seminolensis* Harlton, supposedly from Pennsylvanian rocks of Carter County. Plummer and others have shown that the species is Cretaceous. Maslakova late in 1963 discussed *Hedbergella* and related genera. The paper was translated by Ronald D. Grisby, graduate student at The University of Oklahoma. The article appeared in Akademia Nauk S. S. S. R., Paleontologicheskii Zhurnal, 1963, no. 4, p. 112-116. The translation follows:

On the Classification of the Genus *Hedbergella*

N. I. MASLAKOVA

Hedbergellas are widely distributed in the Albian and Cenomanian deposits of the Mediterranean and Middle European provinces, where they have great stratigraphic significance. In the USSR the most numerous occurrences are in the Caucasus, in Crimea, and in the eastern Carpathians.

Concerning the question of classification of Hedbergellas, in the foreign literature there exists much difference of opinion. In domestic literature they have been previously classified as Foraminifera under the generic name *Globigerina*.

Hedbergellas were first classified by Brönnimann and Brown (1955) under the generic name *Hedbergina*. The type species *Globigerina seminolensis* Harlton, 1927, is shown in figures 1a,b [not reproduced here]. The stratigraphic position and precise location of this species has not been clear. B. Harlton first thought they came from the Pennsylvanian System. C. Tomlinson (1929) expressed doubt about this, and H. Plummer (1945) reached the conclusion that the species came from younger deposits. Brönnimann and Brown surmised that the specimen described by Harlton came from the Comanchean Series, that is, from the Aptian-Cenomanian deposit. From the indistinct picture and brief description of the holotype of *Globigerina seminolensis*, these authors erroneously identified with it the Cuban specimen, figured in figures 1v-d [not reproduced here]. Unfortunately, they did not specify the exact stratigraphic position and only noted the Aptian or Albian-Cenomanian of Cuba. The authors considered as the most characteristic feature of the genus *Hedbergina* the elongation of the last few chambers into a relatively small umbilicus in which short, diverging, laminated protuberances do not form an umbilical plate. They considered it to be a phase in the phylogenetic development from "*Globigerina*" with a narrow (compact) umbilicus to *Ticinella* Reichel with a broad umbilicus and an umbilical plate. Recently, Bolli, Loeblich, and Tappan (1957) have described the holotype of *Globigerina seminolensis* preserved in the

U. S. National Museum; it is shown in figures 1e-z [not reproduced here]. Their investigation showed that the holotype does not meet the specifications of Brönnimann and Brown for the species and consequently for the genus. The shell was smooth, with completely closed apertural pores and umbilicus. In addition, they noted that the holotype of *G. seminolensis*, as well as of the Cuban specimen, did not have an elongation of the final chambers, which, in the opinion of Brönnimann and Brown, is the most characteristic feature of the genus *Hedbergina*.

Because of the discrepancy between the characteristics of the genus and the features of its typical species in addition to the absence of reliable data on the apertural structure of the investigated specimens, Bolli, Loeblich, and Tappan considered the genus *Hedbergina* to be a possible synonym of *Praeglobotruncana* Bermudez, 1952. At the same time they did not attach systematic significance to the character of the peripheral edge (presence or absence of a keel).

Because the holotype of *G. seminolensis* did not seem to satisfy the characteristics of the genus *Hedbergina*, Brönnimann and Brown (1958) proposed a new generic name—*Hedbergella*, with type species *Anomalina lorneiana* Orbigny var. *trocoidea* Gandolfi (1942); thus they changed the variety into a species. Because R. Gandolfi did not specify the holotype, Brönnimann and Brown selected the specimen, illustrated by him in plate 2, figures 1a-c, as a lectotype. We have figured the latter in figures 1i-l [not reproduced here]. This specimen comes from Aptian or Albian rocks.

Brönnimann and Brown also classified the Cuban specimen as *Hedbergella trocoidea* (Gandolfi). However, judging by the description, it is distinguished from *H. trocoidea* by the small number of chambers in the final part of the whorl, by the large size of the umbilicus, and by the small diameter of the first part of the whorl. From an analysis of original and published material, we believe that similar forms evolved mainly in the Cenomanian epoch and existed to the end of the Albian. In all probability the Cuban specimen came from the lower Cenomanian deposits and represents not *H. trocoidea* but rather another species, possibly a new one that is genetically related. Hence the authors' admitted mistake becomes clear with respect to the description of the generic characteristics of the umbilicus and aperture. Likewise the artificiality of the classification of the Cretaceous *Globigerina*-like foraminifer as a *Hedbergella* with a relatively small umbilicus and a "globigerin" with a narrow (compressed) umbilicus becomes clear. The species *H. trocoidea* is characterized by a narrow umbilicus and a peripheral (basal)[1] aperture, whereas the Cuban form has a large umbilicus and, judging by the description, an um-

[1]The term "peripheral aperture" was introduced by the paleontologist F. Brotzen (1942) for the septal aperture located in the base of the septum, that is, at its internal edge. In Russian literature the common name is "basal" aperture.

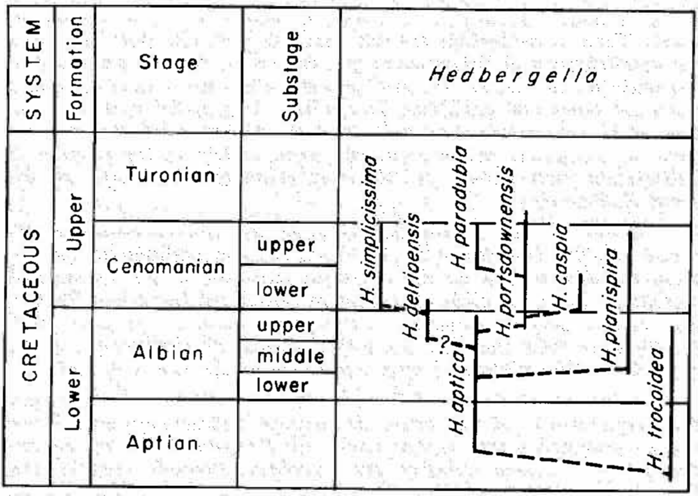

Figure 2. Diagram representing the phylogenetic development of the genus Hedbergella.

bilical-peripheral aperture[2] which partially opens into the umbilicus. Therefore, the aperture in the genus *Hedbergella* may be not only peripheral as the authors of this genus thought, but also umbilical-peripheral.

Various authors view the systematic position of *Hedbergella* somewhat differently. Brönnimann and Brown place them in the family Globotruncanidae, giving, in our opinion, a more accurate assignment. Bolli, Loeblich, and Tappan, on the hypothesis that the nature of the principal aperture[3] is the most important systematic feature of these families, refer these forms to the family Globorotaliidae for which, according to their opinion, a peripheral aperture is characteristic. Z. Reiss (1958) and J. Sigal (1958) have placed *Hedbergella* in the Globotruncanidae, and considered the latter to be a family (Sigal) or a subfamily (Reiss) of Globorotaliidae. F. Banner and W. Blow (1959) referred them to subfamily Rotaliporinae. However, these authors placed Rotaliporinae not in Globotruncanidae, with which they are genetically related, but in the entirely unrelated family Hantkeninidae upon the basis of the external similarity in the character of the apertures of these groups. Thus they considered *Hedbergella* to be the subgenus *Praeglobotruncana*, with the presence or absence of a peri-

[2]The umbilical-peripheral aperture is that having two parts—umbilical and peripheral. Brotzen (1942) called the umbilical part the "umbilical" aperture, which exists as an aperture in the wall of the umbilical part of the chamber.

[3]By the principal aperture we mean the orifice in the last chamber.

pheral keel on the shell as the important feature for a subgeneric characteristic.

Shortly after the work of Sigal, Loeblich and Tappan (1961), considering Rotaliporinae as a family, established a new subfamily, Hedbergellinae, characterized by the absence of additional apertures in the shell. Besides *Hedbergella*, the authors included in the subfamily the genera *Praeglobotruncana* Bermudez and *Clavihedbergella* Banner and Blow, artificially separating them from the other genetically related genera lacking additional apertures.

Our investigation of *Hedbergella* from the Upper Cretaceous and partially from upper Albian deposits of the Caucasus, Crimea, and eastern Carpathians in addition to published data has permitted us to draw several conclusions concerning size, systematic position, phylogenetic evolution, and stratigraphic importance of the groups of foraminifers being considered.

1. *Hedbergella* represents a distinct, morphologically isolated group of forms characterizing a definite stage in the evolution of the Cretaceous planktonic foraminifers; therefore sufficient basis exists to classify them as a genus. The extent of this genus will widen as forms having a narrow (compact) umbilicus, formerly considered by the authors of the genus to be "Globigerina" ancestral to Hedbergella, are included in it.

2. It is necessary to introduce into the generic characteristics a supplement concerning the structure of the aperture of the shell. It may be both peripheral (basal) and umbilical-peripheral. The first type of aperture is found in the oldest representatives, which are widespread in the Aptian and Albian (*H. aptica* Agalarova, *H. trocoidea* Gandolfi). The remaining species of this genus, which have evolved in the upper Albian and Cenomanian, are characterized by an umbilical-peripheral aperture. They have a noticeably elongate umbilicus, into which opens the umbilical part of the aperture.

3. The literature contains a large number of synonyms used by different authors for the same species. The foremost reason for this situation appears to be the poor quality of the descriptions of the species, which, as a rule, lack data concerning the variability and comparison of them with the truly closely related species. Moreover, some authors, when establishing new species, did not take into account the vast literature on Cretaceous foraminifers.

Our presentation of the phylogenetic development of *Hedbergella* (fig. 2) has permitted us to classify at this time the following species in this genus: *H. trocoidea* (Gandolfi), *H. aptica* (Agalarova), *H. planispira* (Tappan), *H. portsdownensis* (W. Mitchel), *H. caspia* (Vassilenko), *H. paradubia* (Sigal), *H. delrioensis* (Carsey), and *H. simplicissima* (Magne and Sigal).

We consider many of the well-known names in the literature to be synonyms (table I). Some of the listed species (*H. delrioensis* and *H. planispira* L. V. Zakharova-Atabekyan, 1961) are classified in the new genus *Planogyrina*, having as type species *Globigerina gaultina* Morozova, which we believe to be a synonym of *H. planispira*. This "new" genus differs from *Hedbergella* only by the inclusion of the spiral-planar forms together with the trochoids. The systematic location of the former has heretofore not been clear. Loeblich and Tappan (1961) classify them in the genus *Globigerinelloides* Cushman and Dam and in the family Planomalinidae, considering the shell structure as a fundamental feature for the family. Because of the absence of reliable data at the present time on the taxonomic importance of the spiral-planar shell structure of minute Cretaceous planktonic foraminifers, we confine the genus *Hedbergella* to forms having a spiral-conical (trochoid) shell, which is characteristic of all globotruncanids.

TABLE 1.—HEDBERGELLA WELL-KNOWN IN THE LITERATURE

SPECIES	FORMER NAME	SYNONYMY
Hedbergella delrioensis (Carsey)	*Globigerina cretacea* var. *delrioensis*	*Globigerina infracretacea* Glaessner
		Globigerina gautiriensis Brönnimann
		Globigerina gaultina Morozova
Hedbergella planispira (Tappan)	*Globigerina planispira*	*G. globigerinellinoides* Subbotina
		Globorotalia youngi Fox
		Praeglobotruncana modesta Bolli
Hedbergella trocoidea (Gandolfi)	*Anomalina lorneiana* var. *trocoidea*	*Globigerina almadensis* Cushman and Todd
		G. undrizevi Djafarov and Agalarova
		Praeglobotruncana rohri Bolli
Hedbergella portsdownensis (William-Mitchel)	*Globigerina portsdownensis*	
Hedbergella aptica (Agalarova)	*Globigerina aptica*	
Hedbergella paradubia (Sigal)	*Globigerina paradubia*	*Hedbergella brittonensis* Loeblich and Tappan
Hedbergella simplicissima (Magne and Sigal)	*Hastigerinella simplicissima*	*Hedbergella amabilis* Loeblich and Tappan
Hedbergella caspia (Vassilenko)	*Globigerina caspia*	

4. *Hedbergella* is genetically linked with the genera *Ticinella* Reichel and *Praeglobotruncana* Bermudez and appears to be their ancestor. These genera, together with *Thalmanninella* Sigal and *Rotalipora* Brotzen, are considered to be part of the subfamily Rotaliporinae Sigal, 1958, which is classified in the family Globotruncanidae Brotzen, 1942.

5. As seen from the phylogenetic scheme (fig. 2), *Hedbergella*, together with other members of the planktonic foraminifers, may be utilized for the separation of the borderline horizons of the Lower and Upper Cretaceous. They permit the separation of the middle and upper Albian and the lower and upper Cenomanian.

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(End of translation)

Addendum

CARL C. BRANSON

In a short note published in 1959 (Branson, p. 138-140) the confused information about the stratigraphic level and locality of *Globigerina seminolensis* was reviewed. Harlton's 1927 locality record was considered correct, and it was concluded that the lone specimen was washed upon Pennsylvanian rocks from nearby Lower Cretaceous (Trinity) outcrops. A search made by R. W. Harris failed to reveal another specimen, but further efforts will be made.

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Emendation of Ostracode Ranges in Simpson Group (Ordovician) of Oklahoma

Reginald W. Harris

Further examination of Ostracoda in Simpson strata of Oklahoma reveals the necessity of some emendations in four of the five ostracode range charts published by Harris (1957). The emendations are listed in table I; columns A, B, C, and D correspond to the columns of chart 5 in the following manner:

A U. S. Highway 77 Section
B Oklahoma Highway 99 Section
C West Spring Creek Section
D Rock Crossing Section

The individual section charts of Bulletin 75 are indicated by chart numbers as given in the bulletin:

2 U. S. Highway 77 Section
3 Oklahoma Highway 99 (Murray Lane) Section
4 Criner Hills (Rock Crossing) Section

On charts 3 and 5 the location of Oklahoma Highway 99 Section is incorrectly given and should be sec. 12, T. 1 N., R. 6 E.

The following type numbers should be added to the explanations of plates 5, 6, and 7; all types are in the Harvard Museum of Comparative Zoology.

PLATE	FIGURE	SPECIES	TYPE NUMBER
5	14a-14b	*Cryptophyllus simpsoni*	Holotype MCZ 4570A
6	17a-17b	*Primitiopsis bassleri*	Paratype MCZ 4593
7	7a-7b	*Dicranella macrocarinata*	Holotype MCZ 4624C

Table I.—Emendations of Ostracode Ranges of Harris, 1957

(Emended zones are underscored)

		General Ostracoda Range Chart (Chart 5, Bull. 75)				Individual Section Charts		
		A	B	C	D	2	3	4
1	Eoleperditia abrupta					84		
5	E. mediumbonata					101		
6	E. mediumbonata debilis			67b-68				
12	Aparchites maccoyii			5-13	1-14			
14	Paraparchites circulantis		36-50?	5-8				
15	Hyperchilarina angularis						38-48	
16	H. nodosimarginata	10-21						
18	H. symmetrica		63-68					
21	Leperditella brookingi			68-69		98-101		
25	L. incisa		22-23	5-6	2-4			
30	L. rex minima						22-26	
36	Schmidtella affinis	22-76		20-43				
37	S. asymmetrica	31-32						
38	S. brevis	30-34		24-33				
42	S. minuta		36-38			8-22		
47	Paraschmidtella pauciperforata					86-91		
48	P. perforata			50-53				
49	P. perforata dispersa	100-101		66				
54	Cryptophyllus gibbosum		22-61		5-12			
55	C. magnum					82-91		
57	C. simpsoni				3-14			
59	Macronotella mcgeheei			49-52		86		
60	M. upsoni			50-53				
66	Eoprimitia cooperi	8-12	22-23	6				
68	E. quadrata		22-23					
73	Primitiopsis elegans	22-32			6-14			
78	Eohollina depressa papillosa				7-11			
91	Acanthobolbina loeblichi		36					
92	Ballardina concentrica	85		66-68				
93	B. minuta	87-99		56-69				
96	Dicranella fragilis			6-7				
100	Eurychilina simplex	86		64				
101	E. subradiata		22-34	7	3-4			
114	Thomasatia simplex		34-61					7-10
118	Rayina calvini		22-23	6				
119	R. calvini parva				7	22		
121	Platyrhomboides quadratus			6				

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Palynological Assemblage Resemblance in the Croweburg Coal of Oklahoma*

L. R. Wilson

One of the primary objectives in geological palynology research is the correlation of stratigraphic units. The abundance of palynomorphs (exceeding all other fossils), their minute sizes, their wide dispersal by wind and water, and their good preservation in most sedimentary environments make them the best paleontological objects for statistical analysis. Early in the development of palynology, graphs and histograms illustrating relative abundance of genera or species were used to demonstrate forest succession in Pleistocene peat deposits, and later the same techniques were applied to coal and shale deposits of older rocks for the correlation of stratigraphic horizons. More sophisticated statistical treatments recently have been applied (Gray and Guennel, 1961; Rouse, 1962). These indicate that in the future detailed mathematical studies will be made of palynological assemblages.

The present study was undertaken with the object of testing and applying to palynology the technique of measuring faunal resemblances published by Simpson (1960). The Croweburg coal, a widely distributed Pennsylvanian seam in Oklahoma, Kansas, and Missouri, was chosen for examination because its stratigraphy is certain, it is remarkably uniform in thickness, and its palynology is well known. The palynology of the Croweburg coal in Oklahoma was described by Wilson and Hoffmeister (1956), and, except for some minor corrections in taxonomy, their data and text serve as the basis for this investigation.

*A study conducted under National Science Foundation Grant G-22083.

Table I.—Croweburg Coal Collections

Assemblage No. and Mine	Locality	Thickness of Sample
(1) Sam Crabtree Mine	NC sec. 26-16N-14E Okmulgee Co.	1′6″
(2) Concharty Mtn. Mine	sec. 6-16N-15E Wagoner Co.	float
(3) Fisher Mine	sec. 8-18N-15E Wagoner Co.	1′9″
(4) McNabb Mine	NE¼ sec. 33-20N-15E Rogers Co.	1′6″
(5) Brady Mine	sec. 3-20N-15E Rogers Co.	1′10″
(6) Sequoyah Mine	sec. 14-22N-16E Rogers Co.	1′6″
(7) Ashley Property	sec. 9-23N-17E Rogers Co.	1′8″
(8) Stewart Mine	sec. 30-25N-18E Craig Co.	float
(9) Omer Williams Mine	sec. 33-26N-18E Craig Co.	1′1″

Simpson (1960), in an abstract of his paper, stated:

> Of various measures of taxonomic resemblance, the percentage in the smaller of two faunal samples of the number of taxa common to both is most useful. It tends to eliminate the effects of discrepancy in size between the two faunas or samples, and when that discrepancy is a factor in the problem being studied the percentage of common taxa may be used. When faunas closely similar taxonomically are compared, it may be desirable to take into account differences in the relative abundances of taxa in common. For that purpose, measures based on rank correlation are suggested, but no such measure seems full satisfactory.

In the text of his paper, he further stated that where measures are based on numbers of taxa, "presence and absence of taxa, for purposes

TABLE II.—SUMMARY OF SPORE PERCENTAGES AT NINE CROWEBURG COAL SEAM LOCATIONS
(Modified from Wilson and Hoffmeister, 1956)

Spore Species	Crabtree	Concharty Mtn.	Fisher	McNabb	Brady	Sequoyah	Ashley	Stewart	Williams	Composite
1. Lycospora punctata*	45.6	38.5	47.5	48.3	38.0	35.0	39.0	25.0	43.0	42.1
2. Laevigatosporites minutus	28.0	25.0	33.0	28.6	36.0	32.0	32.0	21.0	30.5	28.4
3. Florinites pellucidus †	10.6	14.5	5.0	5.6	10.0	9.0	12.0	13.0	4.0	9.2
4. Endosporites ornatus	3.0	2.0	2.0	8.3	2.0	4.5	1.3	9.0	1.0	3.5
5. Laevigatosporites desmoinesensis	0.0	3.0	0.0	0.3	5.0	2.5	1.0	8.0	6.0	2.9
6. Calamospora hartungiana	4.6	2.0	1.0	1.0	2.5	2.5	3.3	2.0	3.5	2.5
7. Laevigatosporites globosus	3.6	3.0	2.0	1.0	1.5	1.0	3.6	6.0	3.0	2.9
8. Triquitrites bransonii	2.0	1.0	0.0	1.0	1.0	1.5	1.3	6.0	3.5	1.9
9. Lycospora intermedia*	0.3	5.5	2.0	1.0	1.0	1.0	0.3	1.0	0.5	1.4
10. Punctatisporites orbicularis	0.0	1.0	3.0	2.0	1.0	3.0	0.3	4.0	0.5	1.6
11. Granulatisporites verrucosus and G. granularis	0.6	0.5	0.5	0.3	1.0	2.0	2.0	2.0	1.0	1.1
12. Punctatisporites dentatus	0.6	2.5	0.5	0.6	0.5	1.5	1.0	0.0	0.0	0.8
13. Triquitrites dividuus	0.3	0.0	3.0	0.3	0.5	0.5	1.0	0.0	0.0	0.5
14. Triquitrites crassus	0.6	0.5	0.0	0.0	0.0	1.5	0.3	0.0	1.5	0.4
15. Raistrickia crinita	0.0	0.0	0.0	1.0	0.0	0.5	0.3	0.0	0.0	0.2
16. Calamospora straminea	0.0	0.0	0.0	0.0	0.0	0.5	1.0	0.0	1.5	0.3
17. Granulatisporites deltiformis	0.0	0.5	0.5	0.0	0.0	0.5	0.3	0.0	0.5	0.2
18. Raistrickia grovensis	0.0	0.5	0.0	0.6	0.0	0.5	0.0	0.0	0.0	0.1
19. Calamospora decora	0.0	0.5	0.0	0.0	0.0	0.5	0.0	1.0	0.0	0.1
20. Laevigatosporites minimus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.1

*Wilson and Hoffmeister, 1964.
†Wilson, 1963.

of measurement of faunal resemblances, are adequately quantified by the following symbols and concepts:

E_1, Number of taxa (at a specified level) in the first, smaller (or equal) of the two faunas or samples compared, but absent in the second.
E_2, Number of taxa in the second, larger (or equal) fauna or sample but absent in the first.
C, Number of taxa common to both.
$N_1 = E_1 + C$, Total taxa in first.
$N_2 = E_2 + C$, Total taxa in second.
$N_t = E_1 + E_2 + C = N_1 + N_2 - C$, Total taxa in both.

Where measures involve abundance of individuals, the following additional symbols and concepts may be employed:

I_{E1}, I_{E2}, Number of individuals of taxa not in common in first and second samples, respectively.
I_{C1}, I_{C2}, Number of individuals of taxa in common in first and second samples, respectively.
$I_1 = I_{E1} + I_{C1}$, $I_2 = I_{E2} + I_{C2}$, Total number of individuals in first and second samples, respectively.

Thirteen measures are given by Simpson (p. 310) for the faunal resemblance, and indices (2) and (11) are especially significant for comparisons. In the present Croweburg coal study these indices have been found most useful. Their algebraic formulas are as follows:

$$(2) \qquad \frac{C}{N_1} \times 100$$

$$(11) \qquad \left(\frac{I_{C1}}{I_1} + \frac{I_{C2}}{I_2} \right) \times 50$$

Rouse (1962) in a comparison study of four palynological assemblages also employed Simpson's index (3):

$$(3) \qquad \frac{C}{N_2} \times 100$$

These values were also computed for the Croweburg coal but were found to be of less comparative significance and are not given here. Simpson (p. 303) noted that "there seems little reason to use index (3)."

Nine localities of the Croweburg coal are examined here for palynological assemblage resemblance. Assemblage numbers and the names of the mines, their locations, and the thickness of each coal exposure, or the nature of the sample collection, are given in table I.

An analysis of the nine assemblages was made with the use of the concepts and indices described above, but the results reported here do not consist of a comparison of each assemblage to every other assemblage. It appears sufficient to compare assemblage 1 (the smallest of the nine) with each of the others; for example, 1 to 2, 1 to 3, 1 to 4, etc., and to compare assemblage 3 to 2, 3 to 4, 5 to 4, 5 to 6, 7 to 6, 8 to 7, and 8 to 9. Note that the smaller palynological assemblage in each comparison is given first. The results of these comparisons are shown in tables III and IV, and these have been computed from data given in table II.

An examination of tables III and IV reveals a remarkably high degree of resemblance between the palynological assemblages of the Croweburg coal outcrops in Oklahoma. The values of index (2)

TABLE III.—COMPARATIVE MEASURES OF CROWEBURG COAL PALYNOLOGICAL RESEMBLANCES ACCORDING TO INDICES OF SIMPSON (1960)

	PALYNOLOGICAL ASSEMBLAGE LOCALITIES							
DATUM	1-2	1-3	1-4	1-5	1-6	1-7	1-8	1-9
E_1	1	2	1	1	0	0	3	2
E_2	5	2	4	2	7	5	4	4
N_1	12	12	12	12	12	12	12	12
N_2	16	12	15	13	19	17	13	14
C	11	10	11	11	12	12	9	10
I_{C1}	298	292	297	299	300	300	294	296
I_{C2}	190	196	288	188	186	291	170	183
I_1	300	300	300	300	300	300	300	300
I_2	200	200	300	200	200	300	200	200
INDEX								
(2) $\frac{C}{N_1} \times 100$	91.6	83.3	91.6	91.6	100	100	75.0	83.0
(11) $\left(\frac{I_{C1}}{I_1} + \frac{I_{C2}}{I_2}\right) \times 50$	97.0	97.6	97.5	96.8	96.5	98.5	91.5	95.0

TABLE IV.—COMPARATIVE MEASURES OF CROWEBURG COAL PALYNOLOGICAL RESEMBLANCES ACCORDING TO INDICES OF SIMPSON (1960)

	PALYNOLOGICAL ASSEMBLAGE LOCALITIES						
INDEX	3-2	3-4	5-4	5-6	7-6	8-7	8-9
(2) $\frac{C}{N_1} \times 100$	91.6	91.6	100	100	100	84.6	84.6
(11) $\left(\frac{I_{C1}}{I_1} + \frac{I_{C2}}{I_2}\right) \times 50$	96.0	97.7	99.1	98.0	99.5	93.6	97.2

range from 75 to 100, and those of index (11) range from 91.5 to 99.5. Zero value is minimal resemblance and 100 is recognized as identical. Several factors have bearing on the index ranges, and probably the most important is the manner in which the samples were collected. In table I it will be seen that collections 2 and 8 are labeled float. These two collections were made at abandoned mine tipples, and, although the collections were from a wide selection of coal fragments, most of them were of "bright coal." This coal type is generally most abundant in the upper part of the Croweburg seam, and these levels contain fossil spores and pollen derived from plants which were part of the last stages of ecological succession in the coal swamp. Consequently these palynomorph assemblages will be less complete in taxa and paleoecologic stages than will those from samples representing channel sections through the coal seam. When coal seams are studied as vertical segments of one or two inches, the palynological assemblages from the bottom to the top generally show marked changes, indicating that plant succession occurred in, and possibly near, the coal swamp. The Croweburg coal in Oklahoma shows three stages of spore succession; consequently in order to obtain the closest palynological resemblance between the assemblages it is necessary to carefully sample the complete seam at each outcrop. Other factors that are important for close comparison are: (1) the samples must be processed essentially alike, for different or excessive treatment at one or another stage of sample preparation will destroy certain species, (2) the lithology of samples should be as nearly identical as possible to eliminate paleoecological differences, and (3) the taxonomy of the fossils in the assemblages must be known because confusion of closely related species will markedly affect the results.

The linear distance between localities 1 and 9 is approximately 70 miles, and the measurements of resemblance between the two are 83.0 for index (2) and 95.0 for index (11). The Croweburg coal has been correlated with the Colchester coal of Illinois, approximately 350 miles northeast of locality 9 (Wilson and Hoffmeister, 1956). The number of species in common is 21, or 51.2% of the taxa at specific rank. The number of species restricted to the two coals is six, which is five greater than with the Greenbush coal seam below, and six greater than with the Summum coal seam above the Colchester. Data concerning the number of individual fossils in the Colchester coal assemblage are not available; consequently index (11) could not be determined.

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———— 1964, Taxonomy of the spore genera **Lycospora** and **Cirratriradites** in the Croweburg coal: Okla. Geol. Survey, Okla. Geology Notes, vol. 24, p. 33-35, 1 pl.

Mineral and Gem Societies in Oklahoma

In the last few years a number of gem and mineral societies, with a total membership of 923, have been organized in Oklahoma. Mrs. Lucille McLennan, co-editor of the *Sooner Rockologist*, kindly supplied information for the following directory.

Alva Gem and Mineralogical Society.
Organized 1962; current membership, 24.
Meetings: Place announced, second Monday, 7:30 p.m.
Secretary: Mrs. A. F. Johnson, 639 Hart St., Alva.
Publication: In process of being organized; editor, Bill Evans, 1107 4th St., Alva.

Enid Gem and Mineral Society.
Organized 1958; current membership, 68.
Meetings: Science Building, Phillips University, first Thursday, 7:30 p.m.
Secretary: Arthur D. Bever, Kremlin, Oklahoma.
Publication: Enid Gem and Mineral Newsletter; editor, Mrs. Howard T. Puckett, 1905 E. Maple, Enid.

Northern Oklahoma Gem and Mineral Society, Inc. (Ponca City).
Organized 1959; current membership, 80.
Meetings: Osage Room, Hutchins Memorial Building, second Friday, 7:30 p.m.
Secretary: Mrs. Frank Williams, 525 N. 11th, Ponca City.
Publication: Pebble City News; editor, Mrs. Alton Horne, 308 Coolidge, Ponca City.

Oklahoma Mineral and Gem Society, Inc. (Oklahoma City).
Organized 1946; current membership, 259.
Meetings: Board of Education Building, 901 N. Klein, first Thursday, 8 p.m.
Secretary: Mrs. Louis Burns, 1512 S.W. 61st, Oklahoma City.
Publication: Sooner Rockologist; co-editors, Mrs. Lucille McLennan, 1001 S.W. 74th, and Mrs. Norma Wray Skala, 3413 N.W. 41st, Oklahoma City.

Okmulgee Flintstones.

Current membership, 21.

Meetings: Oklahoma State Tech., 403 N.W. Okmulgee, first and third Thursdays.

Secretary: Linda Raney, Box 2334, Okmulgee.

Osage Hills Gem and Mineral Society (Bartlesville).

Current membership, 81.

Meetings: Tuxedo Lions Community Building, second Thursday, 7:30 p.m.

Secretary: Joan Van Scoyoc, 1301 Madison Rd., Bartlesville.

Publication: Osage Hills Gems; editors, Tom and Ula Windle, Box 173, Bartlesville.

Southwest Oklahoma Rock and Mineral Society (Altus).

Organized 1960; current membership, 36.

Meetings: Chamber of Commerce Building, first Tuesday, 7:30 p.m.

Secretary: Frank E. Birtciel, 19 N. Gum Ave., Altus.

Publication: Rock Knockers News; editor, Mrs. Frank Birtciel.

Tulsa Rock and Mineral Society, Inc.

Organized 1959; current membership, 314.

Meetings: Room 224, Petroleum Science Building, Tulsa University, second Monday, 7:30 p.m.

Secretary: Dorothy North, 1601 S. Utica, Tulsa.

Publication: T-Town Rockhound; editor, Mrs. Jackie Wood, 3190 S. 89th E. Ave., Tulsa.

Wichita Mountains Rock Club (Hobart).

Organized 1962; current membership, 40.

Meetings: Public Service Auditorium, first Sunday, 2:30 p.m.

Secretary: Durwood Stafford, Box 42, Roosevelt, Oklahoma.

Publication: Wichita Mountains Rock Club Newsletter; editor, Durwood Stafford, Box 42, Roosevelt, Oklahoma.

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