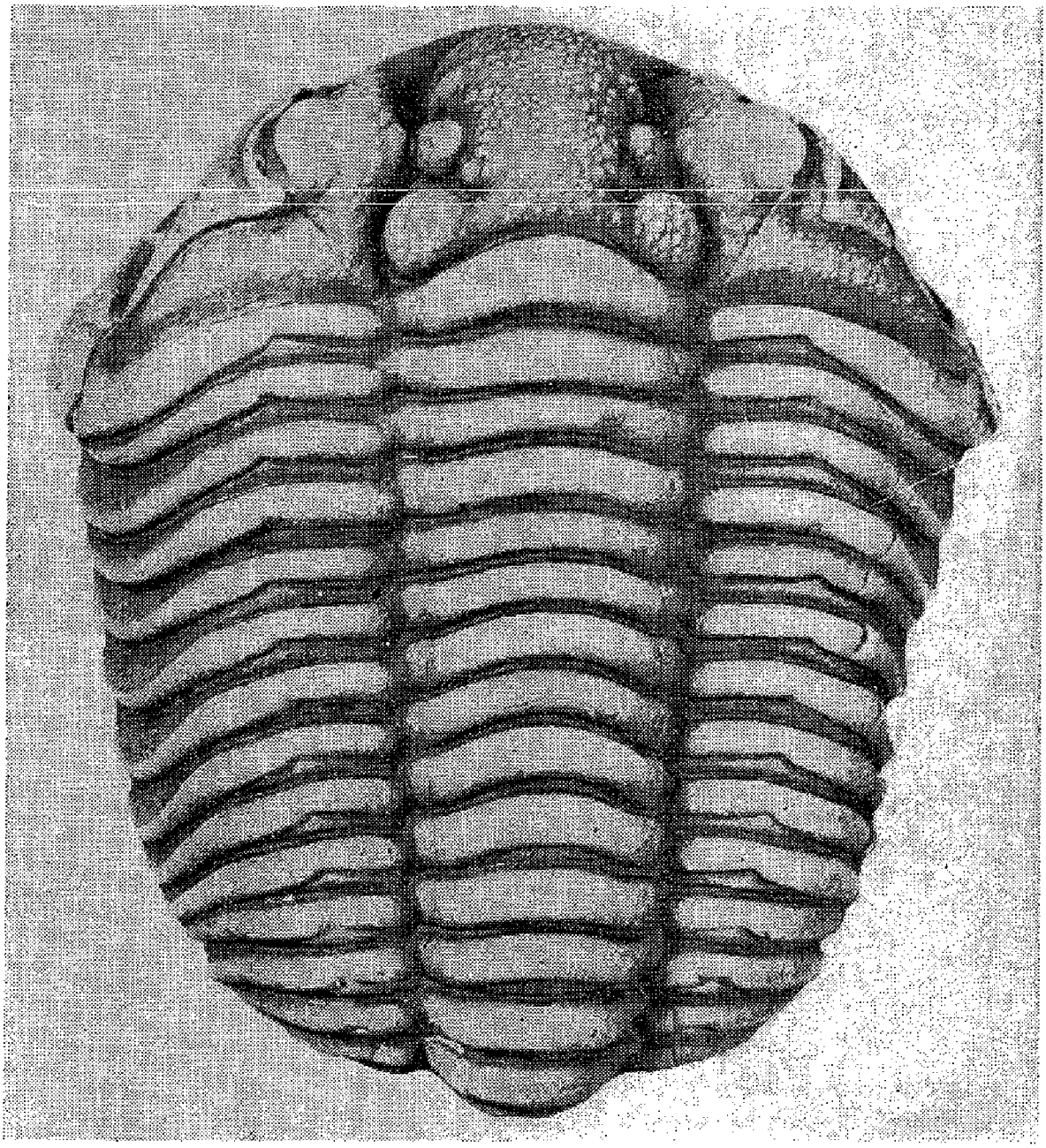
OKLAHOMA GEOLOGY NOTES



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GEOLOGIC SIGNS ALONG HIGHWAY 77

Each traveler on the highway across the Arbuckle Mountains from Ardmore finds added interest and pleasure in the trip because signs along the right of way identify the rocks and give some facts about them. The idea of marking the points of geologic interest was conceived by Dr. Charles N. Gould of the Oklahoma Geological Survey in 1926. At the suggestion of C. W. Tomlinson, the Lions Club of Ardmore erected the first seven signs in that year.

Some years later Dr. Tomlinson planned 18 more signs (25 in all were erected) and these were built and painted by CCC labor in the shop in Lake Murray State Park under the direction of the National Park Service. Sites were selected by Dr. Tomlinson and the signs were erected in 1937 by a crew working on a WPA project sponsored by the Oklahoma Geological Survey. These signs were placed along Highway 77 at points from near Overbrook, south of Ardmore, to the Sylvan shale at the north edge of the Arbuckle Mountains.

At the crest of the mountains is a large sign showing diagrammatically in color the geologic structure of the range. This highly useful and interesting sign was one of the first group erected.

Four signs were also placed along Highway 70 on the outcrops of the Goodland limestone, the Devils Kitchen sandstone, the Bostwick conglomerate, and the Red Beds. Copy for all signs was written by Dr. Tomlinson.

The signs have to be repainted every two or three years, and replaced at longer intervals. The 1957 tornado blew down some signs. Once during World War II, when paint and painters were hard for civilians to obtain. the Oklahoma Highway Department did the repaint job. The Ardmore Geological Society contributed to the cost of the most recent repair and repaint job. The Ardmore Lions Club has provided all other needed maintenance for a third of a century now. Widened and rerouted highways have resulted in some cases in poorer outcrops, hardly worthy of signs; but signs are still maintained on 17 different formations along Highway 77. Vandalism has been remarkably little compared to that along most American highways.

The sign in the hair-pin curve has had to be changed as geological information improved. It first read Pontotoc conglomerate, then Franks conglomerate, finally Collings Ranch conglomerate. The Sylvan shale was originally recorded as Lower Silurian, but now reads Ordovician. The age designation of the Woodford has varied between Devonian and Mississippian in accordance with what seemed to be prevailing paleontological opinion at the time.

The signs are a service to travelers along the highways and as such have been favorably commented upon by visitors from many states. Dr. Tomlinson and the Lions Club of Ardmore richly deserve the thanks of all citizens of the State and of all visitors to the Arbuckle Mountains.

C. C. B.

NONMETALLIC MINERAL PRODUCERS IN OKLAHOMA, 1958

William E. Ham

The most recent published list of mineral producers in Oklahoma is that contained on the *Mineral Map of Oklahoma,* issued by the Oklahoma Geological Survey in 1955. Significant changes have been made since that date, and a new list of nonmetallic mineral producers for 1958 is given in this report. The list is based on files prepared cooperatively by the Survey and the U. S. Bureau of Mines, Region IV, Bartlesville, Oklahoma. It includes producers of nonmetallic rock and mineral products that are offered for sale on the open market, and thus embraces what is commonly called "commercial production". The list excludes "noncommercial producers", such as the Oklahoma State Highway Department and private contractors producing for State or Federal construction jobs.

During 1957 approximately 135 quarries and pits in Oklahoma produced nonmetallic minerals, and gross value of crude mineral production was $34 million. The principal commodities are limestone, dolomite, granite, gypsum, shale, sand and gravel, salt, and silica sand, all present in virtually inexhaustible deposits. Also produced in lesser volume are tripoli, volcanic ash, fullers earth, and sulfur. From these mineral resources several hundred useful products, in the following general catagories, are made.

Twelve glass plants in Oklahoma utilize the natural combination of silica sand, limestone, dolomite, and natural gas for making plate and window glass, pyrex glass, and flint glass for containers, tableware. and art objects.

More than 150 gypsum products are made from thick beds of gypsum in western Oklahoma, where four quarries are active. Wallboard, plasters, fillers, agricultural gypsum; and gypsum for use as retarder in the manufacture of portland cement are the chief uses.

Portland and masonry cement are made in two large plants, using limestone, shale, and natural gas. Lime is produced from deposits of nearly pure limestone in eastern Oklahoma. In addition to the use of lime for water treatment, building mortar, and metallurgy, it is the raw material used for the manufacture of calcium carbide in a plant near Pryor.

Pottery, brick, tile, and expanded construction aggregates are made in 16 major plants widely distributed over the state.

Salt for stock use and for recharging water softeners is produced at three plants in western Oklahoma. Pink, gray, and black granite for monumental and decorative use is worked at six quarries in southwestern and southern Oklahoma. Building sandstone and limestone, mostly for home and building construction, are worked in eight quarries. Fullers earth, a special type of clay found in western Oklahoma, is extensively used as an adsorbent. Tripoli and volcanic ash, entirely different in origin but similar in physical properties, are produced from large deposits in northwestern and northeastern Oklahoma. And, finally, the important materials of construction — crushed stone, sand, and gravel

— are produced from a hundred quarries and pits throughout the State for concrete roads, streets, bridges, driveways, and general construction use.

The following summary of commodities is listed by principal uses, number of producers, and county or counties of production.

Cement, portland and masonry	
Two plants.	Pontotoc and Washington Counties
Clay	
Sixteen pits or plants, producing fullers earth, lightweight aggregates, pottery clay, and structural clay products.	Creek, Custer, Dewey, Garfield, Greer, Lincoln, Oklahoma, Pittsburg, Rogers, Seminole, and Tulsa Counties
Gypsum	
Four plants, producing gypsum plasters, wallboard, fillers, cement retarder, and agricultural gypsum.	Blaine and Caddo Counties
Lime	
One plant, producing quicklime and hydrated lime for water treatment, manufacture of calcium carbide, building mortar, and metallurgical flux.	Sequoyah County
Salt	
Three plants, producing for livestock use and for recharging water softening systems.	Beckham, Harmon and Woods Counties
Sand and Gravel	
Fifty-seven plants producing sand and gravel for building aggregates, road surfacing, filter sand, and wellpacking gravel.	Alfalfa, Blaine, Bryan, Caddo, Cherokee, Dewey, Garvin, Grady, Greer, Harmon, Johnston, Kay, Kingfisher, Kiowa, Logan, Major, Muskogee, Murray, Oklahoma, Pawnee, Pottawatomie, Seminole, Texas, Tillman, Tulsa, Woods, and Woodward Counties
Silica Sand	
Two plants producing high-purity silica sand for the manufacture of glass, pottery, and sodium silicate, and for foundry sand, fillers, and abrasives.	Johnston and Pontotoc Counties

Stone

Forty-eight quarries producing asphaltic limestone and sandstone for road building; chat for railroad ballast and construction aggregates; crushed dolomite for glass manufacture and mineral fillers; limestone, dolomite, and sandstone for building stone; granite for monuments and exterior trim; and crushed limestone for riprap, concrete and asphaltic aggregates, road metal, railroad ballast, agricultural limestone, asphalt filler, glass manufacture, filter stone, coal mine dusting, and mineral feeds.	Atoka, Caddo, Coal, Comanche, Greer, Jackson, Johnston, Kay, Kiowa, Mayes, Murray, Nowata, Okmulgee, Osage, Ottawa, Pawnee, Payne, Pontotoc, Pushmataha, Sequoyah, Tulsa, and Washington Counties

Sulfur

One plant produces elemental sulfur from natural gas for making sulfuric acid.	Marshall County

Tripoli

One plant produces tripoli for use as a fine abrasive in scouring and polishing compounds, as facing for foundry sands, and as admixture in concrete.	Ottawa County

Volcanic Ash

One plant produces volcanic ash for use as a fine abrasive and as admixture in concrete.	Beaver County

The list of companies engaged in nonmetallic mineral production in Oklahoma is given below. Although the list is revised each year, based on information available to the Geological Survey and Bureau of Mines, it probably does not contain all the active producers in the State. This results in two great disadvantages. The annual mineral production canvass, which is made from this list, is believed to be incomplete and to represent less than actual total values. Furthermore, the State and Federal agencies responsible for statistical mineral data are unable to answer fully those requests from consumers about sources of raw materials.

Any producer omitted from the list will confer a favor by reporting his name, location of quarry and plant, and kind of product, sending it to the Director, Oklahoma Geological Survey, Norman, Oklahoma.

NONMETALLIC MINERAL PRODUCERS IN OKLAHOMA, 1958

CEMENT, PORTLAND AND MASONRY

Producer	Quarry or Pit	Other Business Address
Dewey Portland Cement Co.	Dewey, Washington Co.	
Ideal Cement Co.	Lawrence, Pontotoc Co.	Ada, Okla.

CLAY

Fullers Earth		
Filtrol Corp.	Camargo, Dewey Co.	L. S. Fisher, Woodward, Okla.
Lightweight Aggregates		
Chandler Materials Co.	Catoosa, Rogers Co.	Tulsa, Okla.
Oklahoma Lightweight Aggregate Corp.	Choctaw, Oklahoma Co.	
Pottery Clay		
Frankoma Pottery Co.	Sapulpa, Creek Co.	
Structural Clay Products		
Acme Brick Co.	Clinton, Custer Co.	
Acme Brick Co.	Oklahoma City, Oklahoma Co.	
Acme Brick Co.	Tulsa, Tulsa Co.	
Enid Brick and Tile Mfg. Co.	Enid, Garfield Co.	
Mangum Brick and Tile Co.	Mangum, Greer Co.	
Oklahoma State Penitentiary	McAlester, Pittsburg Co.	
Sapulpa Brick and Tile Corp.	Sapulpa, Creek Co.	
Stroud Clay Products Co.	Stroud, Lincoln Co.	
United Brick and Tile Co.	Oklahoma City, Oklahoma Co.	
United Brick and Tile Co.	Tulsa, Tulsa Co.	
United Brick and Tile Co.	Collinsville, Tulsa Co.	
Wewoka Brick and Tile Co.	Wewoka, Seminole Co.	

GYPSUM

Harrison Gypsum Co., Inc.	Cement, Caddo Co.	Lindsay, Okla.
Universal Atlas Cement Co.	Watonga, Blaine Co.	
U. S. Gypsum Co.	Southard, Blaine Co.	
Walton and Sons	Gyp, Blaine Co.	Fairview, Okla.

LIME

St. Clair Lime Co.	Sallisaw, Sequoyah Co.	Oklahoma City, Okla.

Producer	Quarry or Pit	Other Business Address
	SALT	
E. S. Blackmon	Freedom, Woods Co.	
Oklahoma Salt Industries, Inc.	Sayre, Beckham Co.	
Salton Salt Works	Northern Harmon Co.	Erick, Okla.
	SAND AND GRAVEL	
Amis Sand and Gravel Co.	Camargo, Dewey Co.	Elk City, Okla.
Arkansas River Sand Co.	Tulsa, Tulsa Co.	
Bagby Harris Sand Co.	Tulsa, Tulsa Co.	
Blackwell Sand and Gravel Co.	Blackwell, Kay Co.	
Briggle Sand and Gravel Co.	Choctaw Co.	
Chandler Materials Co.	Tulsa, Tulsa Co.	
D. J. Cox	Mangum, Greer Co.	
Craft and Bates Material Co.	Asher, Pottawatomie Co.	Antlers, Okla.
Curry Materials Co.	Antlers, Pushmataha Co.	
Davis Sand and Gravel Co.	Kiowa Co.	
Osage Sand Co.	Cleveland, Pawnee Co.	
The Dolese Co.	Guthrie, Logan Co.	Oklahoma City, Okla.
The Dolese Co.	Oklahoma City, Oklahoma Co.	
The Dolese Co.	Dover, Kingfisher Co.	Oklahoma City, Okla.
The Dolese Co.	Tuttle, Grady Co.	Oklahoma City, Okla.
Francis and Behue	Guymon, Texas Co.	
Granite Gravel Co.	Granite, Greer Co.	
H and H Material Co.	Asher, Pottawatomie Co.	Konawa, Okla.
Johnson Gravel Co.	Muskogee Co.	
Ray H. Karlin	Hydro, Caddo Co.	
Floyd King	Grandfield, Tillman Co.	
Earl Kirkpatrick	Byron, Alfalfa Co.	
Klines Sand Pit	Woodward, Woodward Co.	
Claude Kreger	Tishomingo, Johnston Co.	
Claude Lamb	Tishomingo, Johnston Co.	
Orin Law	Cleo Springs, Major Co.	
Lamar Lawson	Pauls Valley, Garvin Co.	
Elmer Long	Wynnewood, Garvin Co.	
Lugert Sand and Gravel Co.	Kiowa Co.	Clinton, Okla.
M and K Sand and Gravel Co.	Bryan Co.	Denison, Texas
John McConnel	Crescent, Logan Co.	
Makins Sand and Gravel Co.	Dougherty, Murray Co.	Oklahoma City, Okla.
Makins Sand and Gravel Co.	Oklahoma City, Oklahoma Co.	

Producer	Quarry or Pit	Other Business Address
SAND AND GRAVEL (Cont'd)		
Oliver May	Harmon Co.	Hollis, Okla.
McMichael Concrete Co.	Tulsa, Tulsa Co.	
Midwest Concrete Supply Co.	Blackwell, Kay Co.	
Mohawk Sand Co.	Tulsa, Tulsa Co.	
Muskogee Materials Co.	Muskogee, Muskogee Co.	
Pitts Sand and Gravel Co.	Elmer, Jackson Co.	Wichita Falls, Texas
H. C. Rustin Sand and Gravel Co.	Durant, Bryan Co.	
Sand Products, Inc.	Oklahoma City, Okla. Co.	
Sand Springs Sand Co.	Sand Springs, Tulsa Co.	
Sizemore Sand and Gravel Co.	Oklahoma City, Okla. Co.	
Smith Sand Co., Inc.	Tulsa, Tulsa Co.	
Sober Bros. Sand and Gravel Co.	Ponca City, Kay Co.	
Southwest Sand Co.	Snyder, Kiowa Co.	
Standard Industries, Inc.	Tulsa, Tulsa Co.	
Stewart Bros. Sand and Gravel	Guymon, Texas Co.	
Thompson Sand Co.	Cromwell, Seminole Co.	
Tindel Materials Co.	Geary, Blaine Co.	
Tindel Materials Co.	Hydro, Caddo Co.	
Tulsa Sand Co.	Pawnee Co.	Tulsa, Okla.
Tulsa Sand Co.	Tulsa, Tulsa Co.	
Waynoka Sand and Gravel Co.	Waynoka, Woods Co.	Enid, Okla.
Morris Weryavah	Walters, Cotton Co.	
Yahola Sand and Gravel Co.	Fort Gibson, Muskogee Co.	
Yahola Sand and Gravel Co.	Cherokee Co.	Fort Gibson, Okla.
SILICA SAND		
Mid-Continent Glass Sand Co.	Roff, Pontotoc Co.	
Pennsylvania Glass Sand Corp.	Mill Creek, Johnston Co.	
STONE		
Asphaltic Limestone and Sandstone, Crushed		
Producer	*Quarry or Pit*	*Other Business Address*
United States Asphalt Corp.	Dougherty, Murray Co.	Santa Fe, New Mexico

Producer	*Quarry or Pit*	*Other Business Address*
	Chat (Crushed Chert and Limestone)	
American Zinc-Lead Smelting Co.	Picher, Ottawa Co.	Joplin, Missouri
Baxter Chat Co.	Picher, Ottawa Co.	Baxter Springs, Kansas
Eagle-Picher Co.	Picher, Ottawa Co.	Miami, Okla.
S. A. Fones, Inc.	Picher, Ottawa Co.	Baxter Springs, Kansas
	Dolomite, Crushed	
Rock Products Mfg. Corp.	Mill Creek, Johnston Co.	
	Dolomite, Building Stone	
J. W. McPhearson	Hydro, Caddo Co.	
Masters Stone Co.	Creta, Jackson Co.	Duke, Okla.
	Granite, Monumental and Bldg.	
Century Granite Co.	Snyder, Kiowa Co.	Frederick, Okla.
Century Granite Co.	Mill Creek, Johnston Co.	Frederick, Okla.
J. P. Gilman Granite Co.	Mountain Park, Kiowa Co.	Kansas City, Kansas
Pellow Bros. Monument Works	Granite, Greer Co.	
Roosevelt Granite Co.	Mountain Park, Kiowa Co.	
Wichita Granite Co.	Snyder, Kiowa Co.	
	Limestone, Building Stone	
Ada Stone Co.	Pontotoc, Johnston Co.	Oklahoma City, Okla.
Townsend Quarry	Fittstown, Pontotoc Co.	
	Limestone, Crushed	
Anchor Stone and Materials Co.	Tulsa, Tulsa Co.	
Atlas Stone Co.	Pryor, Mayes Co.	
Burbank Rock Co.	Burbank, Osage Co.	
Chandler Materials Co.	Tulsa, Tulsa Co.	
Cookson Stone Co.	Ponca City, Kay Co.	
Cookson Stone Co.	Pryor, Mayes Co.	Ponca City, Okla.
Cookson Stone Co.	Ralston, Pawnee Co.	Ponca City, Okla.
Cookson Stone Co.	Cushing, Payne Co.	Ponca City, Okla.
Cookson Stone Co.	Drumright, Creek Co.	
Cookson Stone Co.	Avery, Lincoln Co.	
Cookson Stone Co.	Pawhuska, Osage Co.	
Dolese Bros. Co.	Bromide, Coal Co.	Oklahoma City, Okla.
Dolese Bros. Co.	Richards Spur, Comanche Co.	Oklahoma City, Okla.
Dolese Bros. Co.	Big Canyon, Murray Co.	Oklahoma City, Okla.
Dolese Bros. Co.	Rayford, Murray Co.	Oklahoma City, Okla.
Matoaka Stone Co.	Bartlesville, Washington Co.	
Mervine Stone Co.	Uncas, Kay Co.	Ponca City, Okla.

Producer	Quarry or Pit	Other Business Address
	STONE (Cont'd)	
Mervine Stone Co.	Betts, Osage Co.	
Peerless Rock Co.	Lenapah, Nowata Co.	Coffeyville, Kansas
Roosevelt Material Co.	Mountain View, Kiowa Co.	
St. Clair Lime Co.	Marble City, Sequoyah Co.	
E. C. Schroeder Co., Inc.	Carnegie, Caddo Co.	
Southwest Stone Co.	Stringtown, Atoka Co.	Dallas, Texas
Standard Industries, Inc.	Tulsa, Tulsa Co.	
Standard Industries, Inc.	Tulsa, Tulsa Co.	
Townsend Quarry	Fittstown, Pontotoc Co.	
Park Ward Co.	Cement, Caddo Co.	Oklahoma City, Okla.
Yahola Sand and Gravel Co.	Cherokee Co.	
	Sandstone, Building	
Producer	*Quarry or Pit*	*Other Business Address*
Ada Stone Co.	Henryetta, Okmulgee Co.	Oklahoma City, Okla.
Mike Emery	Moyers, Pushmataha Co.	
Z. L. Langston	Locust Grove, Mayes Co.	
	SULFUR	
Central Chemical Co.	Madill, Marshall Co.	Tulsa, Okla.
	TRIPOLI	
American Tripoli Division, The Carborundum Co.	Peoria, Ottawa Co.	Seneca, Missouri
	VOLCANIC ASH	
LaRue-Axtell Co.	Gate, Beaver Co.	Calaway, Nebraska

A STRATIGRAPHIC LEAK

Daniel J. Jones of the University of Utah recently discussed occurrences in which fossils are found in beds younger or older than the time at which they lived (1958). These stratigraphic leaks occur in many ways: older fossils may be in glacial till, younger fossils may pass down into solution openings, exotic boulders may be incorporated in later sediments. An unusually complicated case is known in the Criner Hills.

In April, 1958, (Okla. Geol. Notes, vol. 18, p. 80) this writer reviewed a paper in which a Cretaceous foraminiferan was recognized in a Pennsylvanian outcrop. The history of this form is extremely confused. Harlton (1927, p. 24-25, pl. 5, figs. 7a-b) described a form as *Globigerina seminolensis*. The single specimen (U. S. Nat. Museum No. 71380) was listed as from an outcrop of the Upper Glenn, SW¼ SW¼ NW¼ sec. 20, T. 5 S., R. 1 E., Carter County, Oklahoma, "about four miles north of Ardmore."

Tomlinson (1929, p. 72, 78) suggested that the locality is actually in

T. 5 S., R. 2 E., a locality near the horizon of the Arnold limestone member of the Deese formation. The original locality as given by Harlton would be seven miles southwest of Ardmore, as given by Tomlinson it would be four miles south of Ardmore. Harlton (1929, p. 308) gives the locality as NW¼ NW¼ sec. 2, T. 5 S., R. 1 E.

The specific name *seminolensis* is not explained, but Harlton had many specimens from scattered localities and may have named it for specimens he had from subsurface samples in the Seminole district. Plummer (1945, p. 264) recognized that the species is unlikely to be found in Pennsylvanian strata.

In 1956 Brönniman and Brown (p. 529) described the new genus *Hedbergina* and designated *Globigerina seminolensis* Harlton as holotype and figured a Cuban specimen referred to the species. They recognized that the strata from which it came are Cretaceous. Bolli, Loeblich and Tappan (1957, p. 39-40, pl. 9, figs. 4a-c) recognized the Cretaceous age of the species and referred it with question to the genus *Praeglobotruncana*, tentatively reducing *Hedbergina* to synonymy. They overlooked Tomlinson's revision of the locality, as did this reviewer (1958, p. 80).

Brönnimann and Brown (1958, p. 15-17) later examined the holotype and recognized that *Globigerina seminolensis* does not represent the generic concept they had in mind and they erected the new genus *Hedbergella* for the group of species typified by *Anomalina lorneiana trocoidea* (Gandolfi). They stated that *Hedbergella* is a new name. They referred the Cuban specimen formerly referred to *Hedbergella* to the type species, elevated from varietal rank as *Hedbergella trocoidea*. They considered Harlton's species to be Upper Cretaceous, a seemingly impossible assignment.

Todd (1958, p. 78) interpreted Brönnimann and Brown's 1958 paper as replacing the name *Hedbergina* by *Hedbergella*, whereas, as Burma (1959, p. 15) points out, the name *Hedbergina* must remain with its type and they in fact erected a new genus *Hedbergella*.

We have a choice of three localities for the holotype of *Globigerina seminolensis:*

Harlton 1927—sec. 20, T. 5 S., R. 1 E., a point shown by Frederickson (1957, map) to be above the Anadarche limestone and below the Daube limestone, but within one half mile of Trinity outcrops.

Harlton 1929—sec. 2, T. 5 S., R. 1 E., a locality on the outcrop of the Dornick Hills group within the Lake Murray formation and more than three miles from Cretaceous outcrops.

Tomlinson 1929—sec. 20, R. 5 S., R. 2 E., near the outcrop of Arnold limestone and several miles from Cretaceous rocks.

It would seem necessary to seek and study the species in the Trinity northwest of the Criner Hills in order to settle finally the questions of the probable original locality, the nature of the genus *Hedbergina*, and the stratigraphic position of the species. On the basis of propinquity of Cretaceous outcrop, Harlton's 1927 locality description would appear to be correct.

C. C. B.

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1958 STATISTICS OF THE PETROLEUM INDUSTRY IN OKLAHOMA

The source of the following data on drilling for, production of, and reserves of crude oil, natural gas, and natural-gas liquids, except where noted, is the annual review issue of the *Oil and Gas Journal*, vol. 57, no. 4, January 26, 1959. One must accept one source in compiling annual statistics of the petroleum industry as there is little agreement between sources. As an example, the *Oil and Gas Journal* reports a total of 854 wildcats drilled in 1958 in Oklahoma. *World Oil* reports 770 wildcats, and the committee on statistics of exploratory drilling of the American Association of Petroleum Geologists lists 1,196 wildcats for the same period. All related information differs similarly.

Drilling

Exploratory tests

Completions in 1958: crude, 116; condensate, 25; gas, 40; dry holes, 673. Toial: 854

Results of exploration: 16.5% oil and condensate; 4.7% gas; 78.8% dry.

Exploratory footage; 674,344 feet, oil; 225,789, condensate; 217,280 feet, gas; 2,487,804, dry. Total: 3,605,217 feet. Average: 4,222 feet.

Completions in 1957: 474

Forecast for 1959: 838

Development tests

Completions in 1958: crude, 3,135; condensate, 97; gas, 300; dry, 1,663; service, 305. Total: 5,500.

Footage: 9,761,265 feet, oil; 706,163 feet, condensate; 1,416,886 feet, gas; 4,888,274 feet, dry; 635,640 feet, service. Total: 17,408,228 feet.

Completions in 1957: 5,488

Forecast for 1959: 6,840

Total exploratory and development tests

	1957	1958	Forecast 1959
Number of wells:	6,235	6,354	7,678
Amount of footage:	21,594,609	21,013,444	25,575,000
Average footage:	3,463	3,307	

Wells drilled by cable tool in 1958: 1,358

Wells drilled by rotary in 1958: 4,996

Total: 6,354

Second deepest hole in world: Shell No. 5 Rumberger, Elk City Field, Beckham County, at 24,002 feet in Mississippian rocks.

Second deepent producing well in the United States: British American No. 1 Krieger, Knox Field, Stephens County, producing condensate and gas from 16,912 feet in Ordovician rocks.

Production

	1957	1958
Crude oil and lease condensate		
Total annual production (barrels):	214,661,000	199,953,000
Daily production (barrels of crude):	558,438	547,817
Total number of producing wells:	77,610	79,425
Daily average per well (barrels):	7.5	6.9
Wells flowing naturally (percent):	3.7	
Number of stripper wells:[1]	59,983	
Daily average of stripper wells (barrels):[1]	4.2	
Natural gas		
Total annual marketed (millions of cubic feet):	719,794	763,000
Total number of producing wells:[2]	4,407	4,801

Estimated reserves at end of year

	1957	1958
Crude oil (thousand barrels):	2,228,164	2,141,000
Natural gas (billion cubic feet):	14,260	14,800
Natural-gas liquids (thousand barrels):	342,643	355,000
Primary crude oil reserves of 59,983 stripper wells (thousand barrels):[1]	612,640	
Secondary crude oil reserves of above wells (thousand barrels):[1]	704,740	
Total:	1,317,380	
Reserves of Oklahoma's 20 "giant"* fields (thousand barrels):[1]	1,030,000 or 48.1% of all reserves	949,000 or 42.6% of all reserves

*Allen, Avant, Bowlegs, Burbank, Cement, Cushing, Earlsboro, West Edmond, Elk City, Fitts, GlennPool, Golden Trend, Healdton, Hewitt, Little River, Oklahoma City, Seminole, Sho-Vel-Tum, St. Louis, and Tonkawa Fields are "giant" fields which have or will produce over 100 million barrels of oil. Oklahoma City Field has produced over 710 million barrels, Sho-Vel-Tum nearly 500 million barrels, Cushing about 410 million barrels and Burbank nearly 350 million barrels.

Refineries, Natural Gasoline Plants, Cycling Plants

Number of refineries: 14[3]
Crude capacity per calendar day: 391, 780 barrels
Number of natural gasoline plants: 66[4]
Capacity: 2,282,600,000 cubic feet per day (incomplete)
Number of cycling plants: 2[4]
Capacity: 273,900,000 cubic feet per day.

[1] Oil and Gas Journal, vol. 57, no. 11, March 9, 1959, p. 87.
[2] World Oil vol. 148, no. 3, February 15, 1959, p. 148.
[3] Oil and Gas Journal, vol. 57, no. 14, March 30, 1959, p. 128.
[4] Oil and Gas Journal, vol. 57, no. 18, April 27, 1959, p. 134.

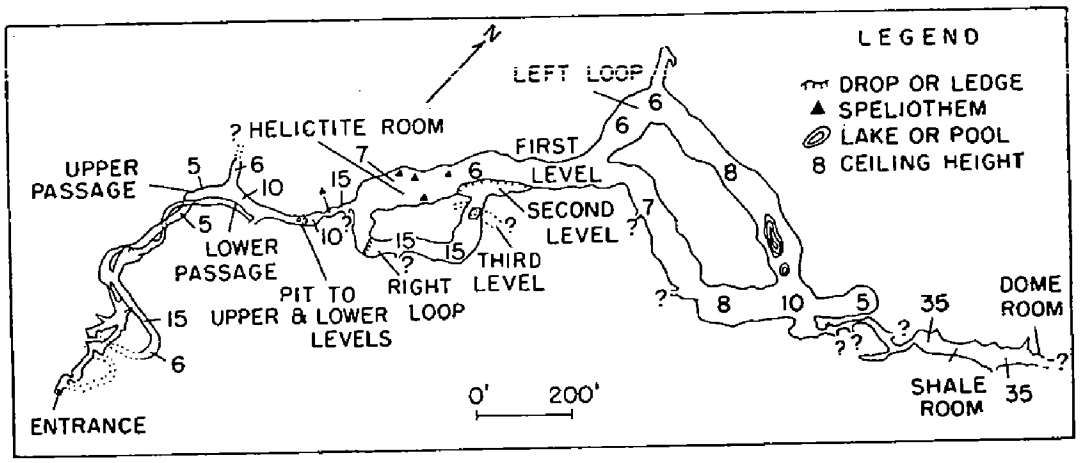
L. J.

Cottonwood Cave, Sequoyah County, Oklahoma

NEVILLE M. CURTIS, JR.

In a recent issue of Oklahoma Geology Notes (vol. 19, no. 2, p. 20-31) there appeared a résumé of caves in the Arbuckle Mountains area. The Oklahoma Geological Survey, in the hope of publishing all available data on caves in Oklahoma, presents an account of Cottonwood Cave.

Data and map were made available by Jack Burch who surveyed the cave with the help of L. C. Perryman.



Cottonwood Cave is located in the NW¼ SW¼ sec. 1, T. 13 N., R. 23 E. in Sequoyah County, Oklahoma. The cave is a series of intermingling passages with four or more different levels. About 1,000 feet from the entrance is a large, partially dry room, roughly 60 feet wide, 7 feet high, and 400 feet long. Many of the rooms in Cottonwood Cave have widths of 100 feet and more and one large room has a lake 70 feet long and 30 feet wide.

Cottonwood Cave has formed in the St. Clair formation, which is Silurian in age. The formation is a gray to pink, heavy-bedded limestone.

Guano Deposits in Caves of Oklahoma

Mr. Jack Burch of Springer, Oklahoma, recently stated that there are at least six caves in Oklahoma containing deposits of guano.

Guano is now being mined in Bat Cave, Greer County, Oklahoma, and according to Mr. Burch, this deposit is the largest in Oklahoma. It has been estimated that up to 3,000,000 bats use this cave. Two other caves, Bat Cave and Ice Box Cave, located in northern Woodward County have been leased for their guano deposits.

It has been reported that Corbyn Cave in Cherokee County contains approximately one ton of guano, as does Twin Cave. The deposit in Twin Cave is not centralized, but is scattered. A small amount of guano has been reported from Bat Cave, south of Kansas, Oklahoma.

The main use of guano is as a fertilizer and in 1955, the United States imported 7,625 long tons valued at $673,554[1]. In 1956 the import was increased to 11,157 long tons valued at $949,180[1]. In 1957 the United States imported 16,685 long tons valued at $1,542,385[2].

N. M. C.

A PLIOCENE BADGER
Pliotaxidea nevadensis (Butterworth) from Harper County, Oklahoma

DAVID B. KITTS and ARTHUR J. MYERS

During the summer of 1955, A. J. Myers found a nearly complete mustelid right mandible with M_1 and M_2 and the roots of P_2, P_3, and P_4 (O.U.S.M. No. 2100) which had weathered out of the Ogallala formation in Harper County, Oklahoma. Several horse teeth which have been deposited in the University of Michigan Museum of Paleontology (U.M.M.P. Nos. 33081-33084) were found in association with the mustelid jaw. They have been identified by Dr. Donald E. Savage of the University of California Museum of Paleontology as pertaining to *Nannippus* ?, *Neohipparion* cf. *N. eurystyle* and *Pliohippus* sp., and are believed to be of middle or late Hemphillian age.

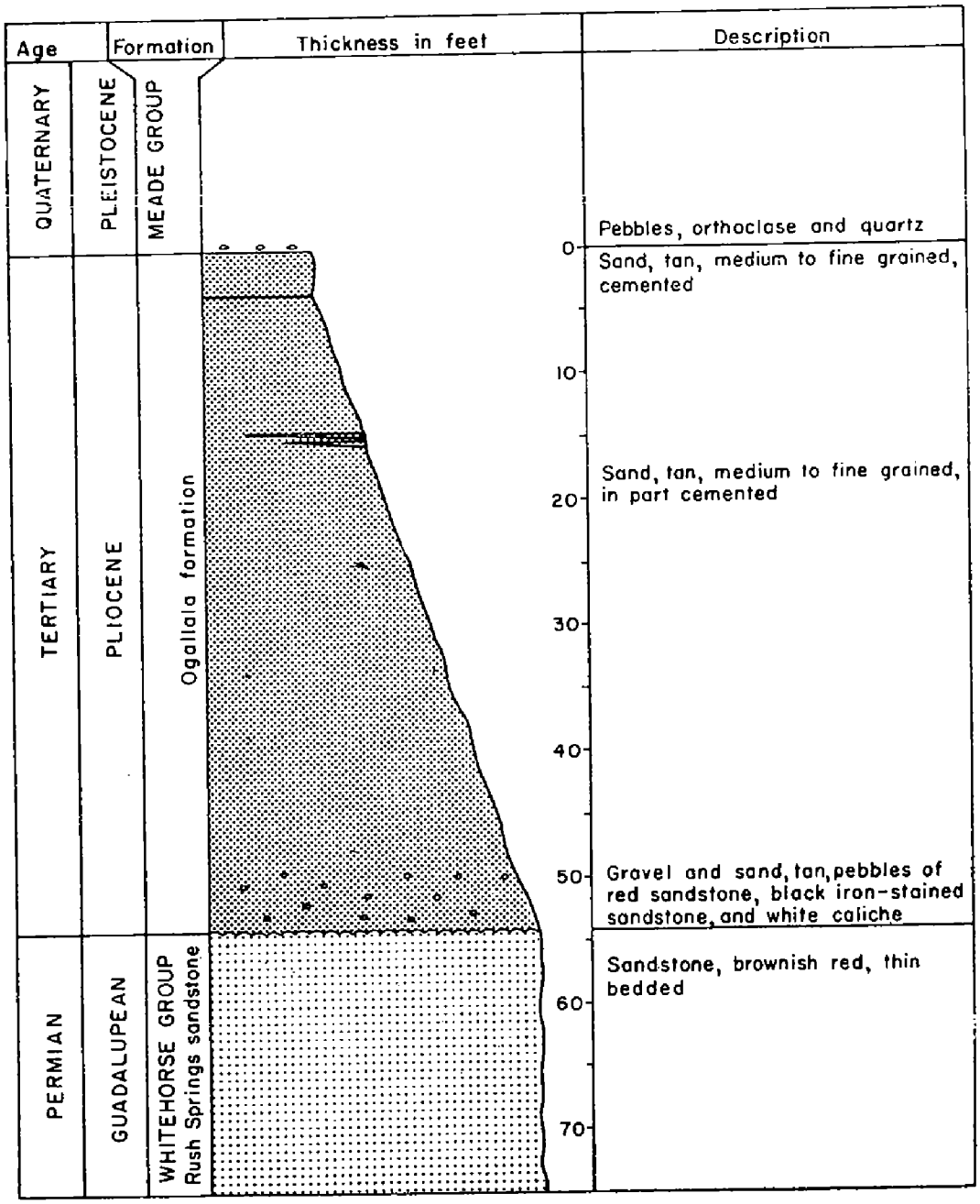
The outcrop in which the badger was found is a horseshoe-shaped outlier of Pliocene Ogallala formation on the Raymond Bently ranch in the NE¼ sec. 34, T. 27 N., R. 24 W. in Harper County. The Pliocene Ogallala formation lies unconformably above the Permian Whitehorse formation. The exposure consists of 54 feet of moderately well sorted, poorly consolidated, sand and gravel. The lowermost 5 feet contains red sandstone pebbles up to 4 inches in diameter, black iron-stained pebbles ranging in diameter from ½ inch to 2 inches, and white caliche pebbles ranging in diameter from 3 to 6 inches. The remaining 49 feet is medium- to fine-grained sand. There are two zones of consolidated beds: a 3.7 foot bed at the top and a 1.8 foot zone of thin lenticular beds 39 feet from the base. The badger was found 5 feet below the lenticular zone. Pebbles of quartz and orthoclase, ½ to 1¼ inches in diameter, mantle the hill top.

The alluvial sand and gravel were deposited by streams flowing eastward from the Rocky Mountains. The Pliocene streams flowing across the Permian rocks carried pebbles derived from the Permian, the Cretaceous Kiowa shale, and Tertiary formations in addition to material from the Rocky Mountains. The coarseness of the gravel indicates that at times the velocity was relatively high. As the load was deposited the stream shifted its channel and migrated over a large area, forming a broad alluvial plain. The total thickness of the alluvium was greater and covered a much larger area than it does at present. With the melting of the Pleistocene glaciers in the Rocky Mountains, the melt water stream flowed across this area and transported the feldspar and quartz pebbles from the Rocky Mountains. At one time this area was probably covered with Pleistocene alluvium which may have been tens of feet thick; however, subsequent erosion has removed everything except the pebbles.

The morphology of the molars and jaw suggest the meline affinities of the specimen and comparison indicates that it can confidently be assigned to *Pliotaxidea nevadensis* (Butterworth) 1916.

The type specimen of *Taxidea nevadensis* from the Thousand Creek formation of Nevada consists of a right mandibular fragment with P_3-M_2 (University of California Museum of Paleontology No. 22290). Butterworth stated that the species differed from *Taxidea taxus* in having a rela-

tively larger heel on M_1, less specialization of the heel tubercles of M_1 for cutting, and more prominent, more anterior protoconid. The teeth of the Harper County specimen are well-worn and consequently the cusp relationships are not evident. The relative size and form of the heel of M_1 is, however, like that of the type specimen.



Hesse (1936) assigned to *Taxidea* a left P^4, a left M^1 and a left M_1 from the late Hemphillian Optima fauna of Texas County, Oklahoma (U.C.M.P. Nos. 30440-30442). Hall examined these teeth in 1936 (see Hall, 1946, p. 15) and was at that time unwilling to identify these specimens as pertaining to a species different from *Taxidea taxus* because of the lack of material of the recent species for comparison.

Hall (1946), on the basis of the type specimen of *Taxidea nevadensis*, a skull and the left lower cheek teeth from Harney County, Oregon[1]; a partial P^4 from the Esmeralda beds of Esmeralda County, Oregon (U.C.M.P. No. 27130); and the Optima material erected the genus *Pliotaxidea*. Hall cites a number of skull and tooth characters which distinguish *Pliotaxidea* from *Taxidea* and there is no doubt that generic distinction is fully warranted.

With respect to the M_1, the only diagnostic tooth which is well preserved in the Harper County specimen, Hall points out that in *Pliotaxidea* the talonid is wider in relation to the trigonid, and that the trigonid is transversely wider in relation to its length. An examination of Table 2 will reveal that the Harper County specimen is almost identical to the other specimens assigned to *Pliotaxidea* in the size and proportions of M_1. A small piece of the posteroexternal portion of M_1 is missing, and consequently the talonid appears to narrow rather sharply. (see Figure 1).

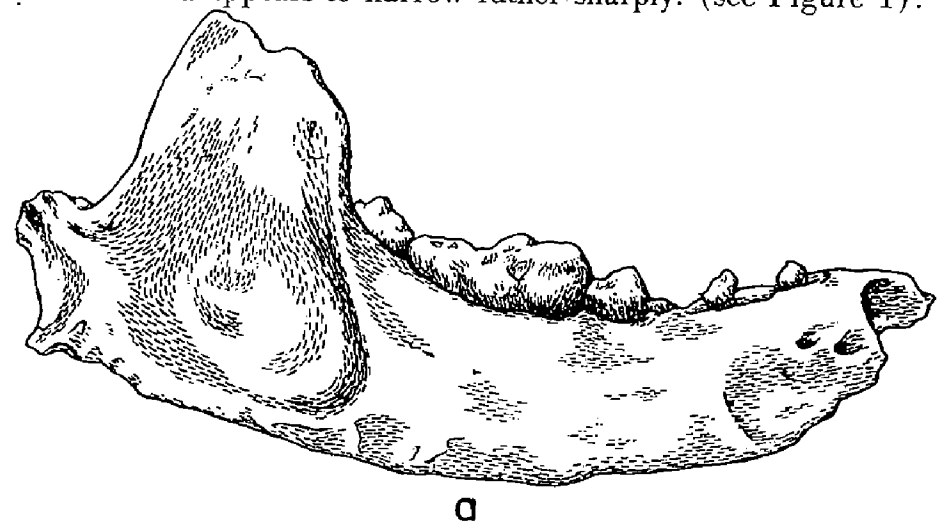


FIG. 1. *Pliotaxidea nevadensis* (Butterworth), O.U.S.M. No. 2100, right lower jaw. a. Lateral view. b. Crown view x2.

REFERENCES CITED

Butterworth, E. M., 1916, A new mustelid from the Thousand Creek Pliocene of Nevada: Calif., Univ., Publ., Dept. Geol. Sciences, Bull., vol. 10, p. 21-24.

Hall, E. R., 1946, A new genus of American Pliocene badger, with remarks on the relationships of badgers of the northern hemisphere: Carnegie Inst. Washington, Publ. 551, p. 11-25.

Hesse, C. T., 1936, A Pliocene vertebrate fauna from Optima, Oklahoma: Calif., Univ., Publ., Dept. Geol. Sciences, Bull., vol. 24, p. 57-70.

[1] Hall did not give the catalog number of the specimen. At the time his paper was published the specimen was in the collection of the California Institute of Technology.

TABLE 1

	Harper County, Oklahoma	Thousand Creek, Nevada	Optima, Oklahoma
	O.U.S.M. NO. 2100	U.C.M.P. NO. 22290	U.C.M.P. NO. 30442
Length from anterior border P_2 to posterior border M_2.	25.4		
Anterior-posterior diameter M_1	9.3	9.6	10.3
Transverse diameter of M_1 at protocone	4.7	4.5	4.9
Anterior-posterior diameter of talonid	4.0	3.9	4.3
Transverse diameter of talonid	4.4	4.5	5.0

Comparative measurements of three specimens of Pliocene badgers.

Changing Times

"Quartzite: tough and expensive . . . but hard to beat for railroad ballast" is the title of an article in the November issue of Rock Products. The writer is reminded of a contractor who attempted to produce novaculite for use as riprap. He quit that endeavor in a hurry. The operating and maintenance costs were far too high for him to make a profit.

With quartzite and novaculite in somewhat the same category as regards composition, and cost of quarrying and crushing, the title did not "make sense." However, on reading further it was soon evident that there were considerations other than quarrying and crushing expense. The Chicago and North Western Railroad is actually producing a Wisconsin quartzite for use as ballast and substituting it for the currently-used softer and less rugged gravel and limestone throughout their system. The C&NW found by a series of tests that quartzite possesses advantages over the other ballast materials that more than offset the much higher cost.

The difficulty with most ballast materials is that the abrasion between particles caused by fast trains, heavy trains, and heavy traffic disintegrates the ballast,—wearing the desired rough edges that interlock, and producing quantities of fine dust. The dust clogs the road bed and prevents drainage. This necessitates highly expensive maintenance operations. This did not happen with quartzite.

Quartzite occurs in Oklahoma. The best known occurrence is in the Wichita Mountain area, near Meers, but it is doubtful that the quantity is

sufficient to warrant a quarry operation for railroad ballast. However, as Dr. Ham suggested to the writer, certain other Oklahoma mineral materials possess similar composition and similar physical properties to quartzite and might be equally suitable and desirable for railroad ballast. He mentioned not only novaculite from the Ouachita Mountains of southeastern counties but also the "chat" from the zinc-mining area in the extreme northeast and highly siliceous limestones and cherts found not only in the northeastern counties but also in the Arbuckle Mountains area.

Perhaps it would be not such a bad idea if railroads operating in Oklahoma would secure materials of several kinds along their lines and subject them to comparative tests under present-day operating conditions. Low-cost ballast may not be good economy. A. L. B.

THE OKLAHOMA MINERAL EXHIBIT AT THE ST. LOUIS WORLDS FAIR

by
Chas. N. Gould

At the time of the Louisiana Purchase Exposition, usually spoken of as the St. Louis Worlds Fair, 1904, Oklahoma had been a territory a little more than ten years. In 1902 the territorial legislature made an appropriation of $40,000 for all purposes to take care of Oklahoma's part in the big show. Governor Cassius A. Barnes appointed as a commission to look after the matter the following men: Joseph A. Meibergen, a merchant of Enid, Otto A. Shuttee, a banker of El Reno, and Fred L. Wenner of Guthrie who was at that time secretary to the governor. Later, on account of press of other duties, Mr. Wenner resigned and Mr. Edgar A. Marchant, an editor, of Aline, was appointed. Mr. Meibergen was chairman of the commission, Mr. Marchant secretary, and Mr. Shuttee treasurer.

At that time I had been teaching geology at the University of Oklahoma only about two years, but was already becoming enthused with the vast possibilities of the development of the mineral wealth of the twin territories, Oklahoma and Indian Territory. This was six years before statehood, but at that time many of us believed that the two territories would eventually become a single state.

I conceived the idea that it would be a profitable thing to have an exhibit of the minerals of Oklahoma at the Worlds Fair and with this thought in mind I wrote Secretary Wenner at Guthrie regarding the matter, and received from him a very courteous reply. A few weeks later I was asked to attend a meeting of the commission at which time arrangements were made for me to have active charge of the mineral exhibit, and I was instructed to begin collecting the materials for such an exhibit.

It was then that my troubles began. I really knew very little about exhibits of any kind and had never attended a very large exposition, and really did not know just how to go about the matter. Another difficulty was that the Territory of Oklahoma did not at that time have any considerable amount of minerals. Oil was unknown. There was no coal, lead or zinc, and about all that we had in the Territory was an abundance of red dirt, some gypsum, salt and building stone. I determined,

however, to make the best showing possible of the things we had, and during the winter, I employed a student at the University, Mr. Eck F. Schramm, of Newkirk, to collect samples of building stone. Mr. Schramm visited quarries in Kay, Osage, Pawnee, Noble and Payne Counties, and the material collected was shipped to the campus at Norman. I employed a stone mason to dress the stone into cubes about eight inches square, giving a different finish to each of the faces. These blocks of building stone were sent to St. Louis and afterwards returned and served for a number of years at the State Fair at Oklahoma City, and are now back on the campus at the University.

The exposition was held at Forest Park, a suburb of St. Louis. A large number of buildings were constructed mainly of staff, or gypsum plaster mixed with excelsior. The mineral building was about the size of two city blocks. Oklahoma was assigned a space near the center of the building about midway between two doors. On one side of us was Indian Territory and on the other Kansas. Across the aisle were Arkansas and Montana. Most of the states at that time greatly exceeded Oklahoma in variety and abundance of mineral wealth, and it looked as if we were doomed to be lost in the shuffle.

During the year 1903 and the spring of 1904 I made several trips to St. Louis to arrange for space and for tables and shelving. During these trips I saw a number of prominent men; David R. Francis, ex-governor of Missouri and ex-Secretary of Interior in Cleveland's cabinet, was president of the Exposition. I remember seeing Grover Cleveland, Theodore Roosevelt, who was then president, Cardinal Gibbons, and a number of other men of national reputation.

The two chief objects of interest in the Oklahoma exhibit were, first, a plaster model of the Territory painted in vivid colors, and second, two immense blocks of gypsum. The model had been prepared at Norman by a model maker, D. J. M. Finney. It occupied a prominent space in the center of the exhibit. After the close of the exposition it was shipped back to the campus of the University and for many years has been in the Science Building of the University.

The blocks of gypsum were used rather effectively to advertise the resources of the State. As I have said, there was at that time no large amount or great variety of minerals in Oklahoma. Gypsum was in fact our leading mineral. I arranged with the manager of a gypsum company in Blaine County to send us two large blocks of gypsum just as they were quarried from the ledges. These blocks of gypsum were about three feet square at the base, and stood about eight feet high, tapering slightly toward the top. Instead of setting these blocks at the rear of the booth, near the wall, I decided to put them out in front. Two extra heavy tables were made, and we were obliged to reenforce the floor beneath. These two heavy blocks of gypsum were arranged flush with the center aisle of the building, which led past the booth.

I used to get a kick out of standing off at one side and watching the people coming into the building. A man would enter the door, look down the long aisle, and his eye would be attracted by these pillars of white gypsum standing upright near the center of the building, and it almost seemed as if they would draw like a magnet, and the man would focus his eye on the gypsum and would march past much better exhibits

than ours, those with brass rails and plate-glass cases, and stand before our rather crude exhibit of gypsum. This was the time when we took the opportunity of preaching to him the gospel of Oklahoma, the new Territory.

Since 1904 I have had the pleasure many times of having people from all parts of the State tell me that the first time they ever became interested in Oklahoma was at the mineral exhibit in St. Louis when they were standing by the big block of gypsum and listening to the boys tell of the wonders of the new Territory.

In conducting an exhibit of any kind it is not only essential to collect the material, but it is even more essential to have some one who can explain it to visitors. This was our difficulty. We had no money to pay a salary to any one to remain with the exhibit, so I hit upon the following plan. At that time there were a number of young fellows interested in geology at the University who were willing to spend two weeks in St. Louis for expenses only. I arranged with the commission to pay the railroad fare and board of a number of men, each of whom was to stay at the exhibit for two weeks. The plan was that one could be sent up from Oklahoma each week, and each man spent the first week learning what it was all about and seeing the rest of the exposition and the second week in teaching the new man who came on the job. I am not quite sure that I can remember all the names of the men who were employed, but the following list is approximately complete:

Eck F. Schramm
Chester A. Reeds
Ralph Sherwin
A. M. Alden
Pierce Larkin
Tom B. Matthews
Charles Long
Robt. Severin
E. L. Edwards
Clarence Reeds
L. L. Hutchison
Chas. T. Kirk
William Low
Harry B. Tosh
Everette L. De Golyer
Ira W. Montgomery

Mr. Schramm and Mr. Kirk aided in installing the exhibit and Mr. Matthews had charge of dismembering it and sending the material back to Norman.

Oklahoma only put on two exhibits at the exposition; the agricultural exhibit housed in another building was in charge of Mr. C. A. McNabb. The Oklahoma State building at the fair, which was the headquarters of Secretary Marchant and Oklahoma visitors, was afterwards removed to El Reno where it has since served as the Elks Club. I remember that when Governor Ferguson came to visit the fair at the time of the opening, Mr. Schramm and I, who had been occupying a room at the Oklahoma building, had to go outside the grounds and rustle another place to sleep.

In thinking back over the events, I am convinced that the mineral exhibit and the agricultural exhibit at the St. Louis Exposition were worth many times over what it cost. They helped to put Oklahoma on the map, and while no one will ever know accurately how many people they brought to the State, I have no doubt at all that thousands of people were attracted to Oklahoma on this account.

I will go a step further and say that it is my deliberate judgement that money spent in this kind of advertising is always well spent and Oklahoma will always make a mistake if she does not take advantage of these opportunities.

What a change there has been in the last 24 years from 1904 to 1928. At that time the value of the mineral resources of Oklahoma and Indian Territory approximated $6,000,000 a year. It is now $570,000,000. At that time Oklahoma and Indian Territory together ranked 33rd among the states of the Union in the value of mineral products. Today she ranks second. At that time the oil produced in Oklahoma was only a few thousand barrels a year. Now it is 175,000,000 valued at over $400,000,000. At that time there was practically no natural gas produced. Today the value of natural gas is over $40,000,000 annually. Natural gas gasoline had not been invented at that time. Today the value of this material in Oklahoma is over $40,000,000. In 1904 Oklahoma produced no lead nor zinc. In 1927 the value of these products was over $50,000,000. From nothing to our present eminence all within a quarter of a century. What will the future bring?

Note: The above article was written probably in 1928. The copy from which it is now published was cataloged in the Geology Library January 14, 1936.

Fifth World Petroleum Congress, New York City
May 30th through June 5th, 1959

With approximately 5.000 attending delegates and 1.000 wives from 48 countries and virtually every state of the United States the Fifth World Petroleum Congress met in New York City's big Coliseum for five days of technical session. More than 300 papers were read in one of the official languages, French or English, and were discussed in both languages. The technical papers presented were divided into 11 sections, two of which were geology and geophysics, which met concurrently. The other sections were 1) drilling and production, 2) oil processes and refining, 3) chemicals from petroleum and natural gas, 4) composition, analysis and testing, 5) utilization of petroleum products, 6) engineering equipment and materials. 7) transportation and distribution, 8) operations research, statistics and education, and 9) symposium on applications of atomic energy to the petroleum industry. The Congress sponsored on three floors of the Coliseum an exposition which featured commercial equipment and the services of some 250 leading companies serving the petroleum and petrochemical industries. Among the exhibitors were nearly all of the leading engineering and contracting firms; companies serving the geological and producing sectors of the industry; numerous United States oil companies; and manufacturers of geophysical and geochemical instruments, petrochemicals, chemicals and catalysts, electrical equipment and electronic control instruments. More than twenty

companies from outside the United States participated.

About 60 papers dealing with geological and geophysical problems were presented in two concurrent sections. The subjects ranged from an investigation of modern carbonate deposition in the Gulf of Batabano, Cuba, and evidence of olistostromes in Italy to studies of direct oil detection methods in Russia and gravity measurements in Chile. Geological or geophysical observations concerning part or the whole of the following foreign countries or areas were presented: Alberta, Angola, Argentina, Austria, Belgian Congo, Brazil, Chile, Equatorial French Africa, Gabon, Germany, India, Iran, Israel, Italy, Netherlands New Guinea, Oman, Pakistan, Peru, the Sahara, Sicily, Turkey, U.S.S.R., Venezuela, and Yugoslavia. The *Petroleum Week*, January 23, 1959 lists the papers presented and copies of any paper can be obtained at a cost of twenty-five cents from the Fifth World Petroleum Congress, Inc., 527 Madison Avenue, New York, 22, New York. Geology and Geophysics, Section I, Proceedings of the Congress including discussions of each paper, will be available for $12.50.

Entertainment included a reception at the Waldorf-Astoria, tickets to Radio City Music Hall and to a concert of the New York Philharmonic Orchestra at Carnegie Hall. Fifteen foreign countries and many of the major oil producing states of the United States were represented by newspaper men personally covering the activities of the congress. The *Oil and Gas Journal*, June 8, 1959 issue, reports on the Congress and includes reprints of a few papers presented at the meeting. On page 91, H. D. Ralph tells why the Russians, who wrote 19 papers for the Congress, boycotted the meetings. Primarily the Russian writers did not come because the State Department drew a "crazy quilt pattern" of places and areas on a map of the United States where they could not go in retaliation for the Russians' refusal to let U. S. tourists and businessmen visit important areas in the USSR. In Oklahoma, Osage County and the Panhandle were two such areas.

Status of Survey Publications

Bulletin 79. Petrology of Pennsylvanian sandstones and conglomerates of the Ardmore Basin, by Lynn Jacobsen, 144 pages, 44 figures, 17 tables. May 15, 1959. Bound in blue cloth, $2.00, paper $1.50.

Bulletin 80. Geology of Harper County, Oklahoma, by Arthur J. Myers. with a section of petroleum geology by Louise Jordan, J. Durwood Pate, and Sydney R. Williamson. 108 pages, 20 figures, 3 plates, 1 panel, 4 tables. February 1959, $3.00.

Bulletin 81. Geology of Creek County, Oklahoma, by Malcolm C. Oakes, with a section on petroleum geology, by Louise Jordan. About 130 pages, 20 figures, 3 plates. Available in September. Bound in blue cloth, $3.50, paper $3.00.

Bulletin 82. Stratigraphy and paleontology of the Hunton group in the Arbuckle Mountain region. Part V. Bois d'Arc articulate brachipods, by Thomas W. Amsden. 110 pages, 5 plates, 18 figures, 2 tables. Bound in blue cloth $2.25, paper $1.50.

Bulletin 83. Geology of Pawnee County, by Paul B. Greig. In press, available in November.

Bulletin 84. Stratigraphy and paleontology of the Hunton group in the Arbuckle Mountain region. Part VI. Stratigraphy, by Thomas W. Amsden. In press, available in December.

Bulletin 85. Geology of the Boktukola syncline area of the Ouachita Mountains, by O. B. Shelburne. Available early in 1960.

Bulletin 86. Ground water resources of southern McCurtain County, by L. V. Davis. In press, available in December.

Bulletin 87. Ground water of Canadian County, by Joe L. Mogg, Stuart L. Schoff and E. W. Reed. Probably available March 1960.

Bulletin 88. Geology of Blaine County, by R. O. Fay. Probably available May 1960.

Circular 47. Atoka formation on the north side of the McAlester Basin, by Jack G. Blythe. About 60 pages. July 1, 1959. Bound in blue cloth, $1.25, paper, $0.75.

Circular 48. Cenozoic geology of northern Roger Mills County, Oklahoma, by D. B. Kitts, and A Pliocene vertebrate local fauna from Roger Mills County, by D. B. Kitts and Craig C. Black. 48 pages, 9 figures, 2 plates. July, 1959. Bound in blue cloth, $1.50, paper $1.00.

Circular 49. Microflora of the Flowerpot shale, by L. R. Wilson. In press, available in October.

Circular 50. Geology of northern Latimer County, by Dearl T. Russell. In press, available in October.

Circular 51. Geology of the Cavanal syncline, by Philip K. Webb. Probably available in December.

Guide Book VIII. The composite interpretive method of logging drill cuttings, by John C. Maher. 48 pages, 1 plate, 14 figures, 6 tables. June 18, 1959. $1.50.

Guide Book IX. Guide to Roman Nose State Park, by R. O. Fay. In press, available in August. $1.00.

Guide Book X. Guide to Beavers Bend State Park, by W. D. Pitt. In preparation.

Guide Book XI. Stratigraphic units of Oklahoma. In preparation.