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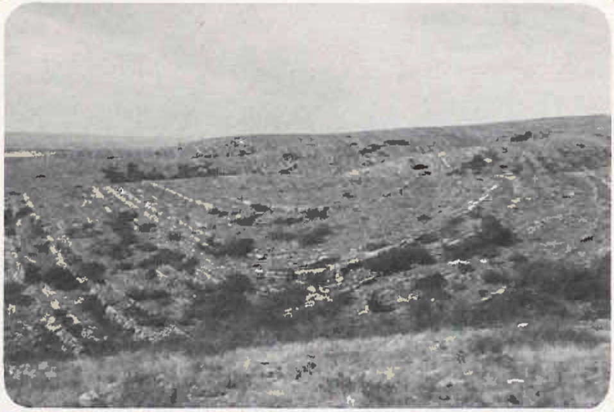

OKLAHOMA GEOLOGY NOTES

VOLUME 29 NUMBER 1 FEBRUARY 1969

Cover Picture

SYNCLINAL FOLD IN KINDBLADE FORMATION

Late Cambrian and Early Ordovician sediments belonging to the Timbered Hills Group, Arbuckle Group, and Viola Limestone crop out on the northeastern flank of the Wichita Mountains in Caddo, Comanche, and Kiowa Counties. The exposures form a linear pattern of rolling hills, hogbacks, and cuestas, aligned in a northwest-southeast direction and parallel to the igneous core of the Wichitas. The rocks are primarily carbonates that were uplifted during the Pennsylvanian in response to the Wichita orogeny and then buried during the Permian. Erosion of the Permian shales and sandstones has left the Cambrian-Ordovician sediments as resistant inliers rising above the flat-lying plains.

The cover photograph shows a minor synclinal fold in limestone of the Ordovician (Canadian) Kindblade Formation (upper part of the Arbuckle Group) in Kiowa County (NE¼ NE¼ sec. 10, T. 5 N., R. 14 W.). The fold occurs as a secondary structure on the northeastern limb of the Rainy Mountain syncline, approximately 6 miles north of the central Wichita complex. Other beds in the upper part of the Arbuckle Group in this area have been highly contorted and faulted. Nearly horizontal Permian beds of the Wichita Formation (Leonardian) underlie the plains, which are shown in the background.

—William B. Barthelman

The Mineral Industry of Oklahoma in 1968*
(Preliminary)

Arel B. McMahan†

Oklahoma mineral production value in 1968 exceeded $1 billion for the second consecutive year, according to the Bartlesville Office of Mineral Resources of the Bureau of Mines, U. S. Department of the Interior. Petroleum and natural gas provided 84.7 percent of the total value. Gains were recorded in value of clays, coal, gypsum, natural-gas liquids, sand and gravel, stone, cement, copper, lime, silver, and volcanic ash. Tripoli was unchanged. Losses in output value were reported in helium, natural gas, crude oil, salt, lead, and zinc.

MINERAL FUELS

Coal.—An increase of more than 27 percent was indicated by preliminary data. Peabody Coal Company began developing a strip mine in Craig County. Coal from the new mine will be shipped to the Kansas City area for use in electric power plants. Howe Coal Company, mining in southeast Oklahoma, made two shipments to Japan for use in coking plants; the coal was transported by unit trains to a Houston, Texas, port. Kerr-McGee Corporation completed one shaft to 1,415 feet at its coal mine near Stigler; a second shaft was begun in June. The company began constructing a 100-ton coking plant that was scheduled for completion early in 1969. John LeMay of Fort Smith, Arkansas, began a strip-mining operation for coal near Sallisaw in Sequoyah County.

Classes started at the Poteau Community College to train 325 to 350 miners for underground work in the Howe Coal Company and Kerr-McGee mines in southeast Oklahoma. The courses are taught by experienced miners from Carlsbad, New Mexico, with technical assistance being furnished by the Bureau of Mines.

Natural gas.—Market value and output of natural gas declined slightly from 1967.

Natural-gas liquids.—Liquids extracted from natural gas exceeded the output for 1967, establishing a new record. Shell Oil Company completed a 75-million-cubic-foot-per-day refrigerated-absorption plant at Seiling in Dewey County that will produce 42,000 gallons of propane per day and 49,000 gallons of gasoline per day. Pan American Petroleum Corporation completed an 80-million-cubic-foot-per-day refrigerated-absorption plant at Elmwood in Beaver County. The company also constructed a 34-million-cubic-foot-per-day refrigerated-absorption plant at Hitchcock in Blaine County. Sunray DX Oil Company completed a 5-million-cubic-foot-per-day plant at Wakita in Grant County. Mustang Gas Products Company let a construction contract for a 125-million-cubic-foot-per-day gas-processing plant at Calumet in Canadian County.

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* This report, U. S. Bureau of Mines Mineral Industry Surveys Report BOMR-223, was prepared December 12, 1968.

† Minerals Specialist, U. S. Bureau of Mines, Bartlesville Office of Mineral Resources, Bartlesville, Oklahoma.

Yearend natural-gas-liquids storage capacity totaled 2,619,357 barrels.

Petroleum.—Although the demand for Oklahoma crude oil con-

TABLE I.—MINERAL PRODUCTION IN OKLAHOMA[1]

MINERAL	1967 QUANTITY	1967 VALUE (THOUSANDS)	1968 (PRELIMINARY) QUANTITY	1968 (PRELIMINARY) VALUE (THOUSANDS)
Clays[2] (thousand short tons)	744	$ 869	752	$ 877
Coal (bituminous) (thousand short tons)	823	4,703	1,050	[3]
Gypsum (thousand short tons)	804	2,266	880	2,665
Helium (thousand cubic feet)	309,100	9,835	331,100	9,146
Lead (recoverable content of ores, etc.) (short tons)	2,727	764	[3]	[3]
Natural gas (million cubic feet)	1,412,952	202,052	1,397,400	201,226
Natural gas liquids:				
Natural gasoline and cycle products (thousand gallons)	568,905	35,846	579,180	37,371
LP gases (thousand gallons)	1,005,633	49,276	1,055,040	49,486
Petroleum (crude) (thousand 42-gallon barrels)	230,749	676,095	226,540	670,558
Salt (thousand short tons)	10	76	15	67
Sand and gravel (thousand short tons)	4,540	5,280	5,130	5,966
Stone (thousand short tons)	16,355	18,932	16,833	19,318
Zinc (recoverable content of ores, etc.) (short tons)	10,670	2,954	[3]	[3]
Value of items that cannot be disclosed: bentonite, cement, copper, lime, silver, tripoli, volcanic ash, and value indicated by footnote 3	----	23,178	----	32,305
Total	----	$1,032,126	----	$1,028,985

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producer).

[2] Excludes bentonite; included with "Value of items that cannot be disclosed."

[3] Included with "Value of items that cannot be disclosed."

tinued strong throughout 1968, the output reported was about 2 percent less than in 1967. The Oklahoma Corporation Commission raised the daily petroleum-allowable production for March to 75 percent of the basic depth-acreage formula. The rate remained unchanged through November but was increased in December to 90 percent.

Fourteen operating refineries in the State had a total daily operating capacity of 443,315 barrels of crude oil and 262,675 barrels of gasoline on January 1, 1968; this was an increase over 1967 capacity. Midland Cooperatives, Inc., announced plans to construct a 70-ton-per-day coking plant at its Cushing refinery; completion was expected early in 1969. Continental Oil Company contracted for a new methyl-ethyl-ketone solvent dewaxing and deoiling plant at Ponca City; capacity will range from 1,280 to 2,116 barrels per day.

HELIUM

The value of helium extracted from natural gas at the Bureau of Mines Keyes plant was 7 percent below that of 1967.* Helium from the Keyes plant is purchased by various Federal agencies or stored underground at Amarillo, Texas.

NONMETALS

Estimated value of nonmetals (cement, clays and bentonite, gypsum, lime, salt, sand and gravel, stone, tripoli, and volcanic ash) produced in 1968 totaled $50.7 million, a $2.1-million increase over 1967. Significant gains were reported in value of all nonmetals except salt† and tripoli. The value of salt output was down; tripoli remained unchanged.

Oklahoma Brick Corporation added a 340-foot tunnel kiln to its Union City plant; capacity was increased to 55 million bricks per year. United Clay Pipe Company began construction of a $2.5-million plant near Seminole.

METALS

Preliminary estimates show a decline in value of metals produced during 1968. A slowdown in production of lead and zinc in the Tri-State district was responsible for the decline in value. Estimates of copper and silver production were increased over those of 1967.

Three horizontal-retort zinc smelters were operated during the year. They were American Metals Climax, Inc., at Blackwell; Eagle Picher Industries, Inc., at Henryetta; and National Zinc Company, Inc., at Bartlesville. Eagle Picher Industries, Inc., closed the Henryetta smelter late in 1968. National Zinc Company, Inc.,, began a $3-million expansion program at its plant in Bartlesville; new facilities will increase slab-zinc capacity and will include a 275-ton-per-day acid plant. The Bartlesville plant, which will handle zinc concentrates from the Tri-State district after closure of the Henryetta smelter, has operated mainly on concentrates from Canada.

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* The decline in value, despite the increase in production, is due to a larger proportion of the 1968 production having gone into storage. Sales were 233.4 million cubic feet at $35 per thousand cubic feet; 97.7 million cubic feet was placed in storage at a value of $10 per thousand cubic feet.

† Despite increases in production, quality factors and market conditions yielded a lower value.

GIPSY Computer Retrieval of Geologic Literature

Phillip W. Blackwell*, Jack L. Morrison†, Wayne E. Smith, Jr.*

For many years, computer-oriented geologists have been utilizing specialized data-reduction systems to assist them in the daily problems associated with the search for gas and oil. Each major oil company has spent hundreds of thousands of dollars preparing specific computer programs for processing numeric geologic data. However, computerized handling of numeric data satisfies only part of the information needs of the geologist. The geologist expects to invest a certain portion of each working day reviewing literature and becoming familiar with current research, but the rapidly increasing volume of literature is making this task more and more time-consuming.

More than three million technological articles are published each year, and the number should double by 1982 (Sandek, 1967). Not all of the published data are useful to the geologist; however, it is becoming increasingly difficult to find those data that are. The abstract journal arose to meet the problem of information-flooding; but there are now more than 300 abstract journals, and these do not cover the entire technological field. Using the digital computer's tremendous power to reduce the volume of literature to a readable amount is a logical step toward solving this problem (Conselman, 1968). Ideally, the reduced literature will contain material that is most relevant to the individual's need.

The Generalized Information Processing System (GIPSY) is a user-oriented data storage and retrieval system developed at the Merrick Computer Center of The University of Oklahoma. Although not primarily a literature-searching system, it has qualities that make it functional and useful in this area. GIPSY was developed by analyst/programmers Phillip W. Blackwell and Wayne E. Smith, Jr., under the direction of James W. Sweeney, director of the center.

GIPSY evolved from the realization that most traditional methods of information retrieval are too limited in their scope. For example, using three as an arbitrary number of words to describe a document, a table (computerized dictionary) can be made to encode a finite number of words "allowable" for an index. As each document enters the system, the index can be adjusted to show the physical address of the document coupled with the code of the allowable index terms it contains. Many systems of this type allow three such terms per document. An index based on biological classification can be used in paleontology to create a conceptually "neat" classification system to locate documents very efficiently; however, the interdisciplinary nature of paleontology creates some problems of terminology that are usually beyond the control of the paleontologists. This instability can cause an index system to be out of date as soon as it is implemented. No matter

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† Oil Information Center, The University of Oklahoma.

how many relations are built into this type of system, it cannot include every term and every possible relationship for every word (Vickery, 1965, p. 151).

GIPSY does not function on preconceived relationships between terms, encoded or otherwise. GIPSY permits the entire content of a document to be available as selection criteria, with the allowance of terms, if necessary, or other such aids as the bibliographer might deem useful. All of this is possible in an unlimited number of conceptually different data items of undetermined (variable) length.

Geological literature was selected as the first test of GIPSY primarily through the cooperation of Olaf Kays, chief of the Office of Systems Research and Development, U. S. Geological Survey, who made available magnetic tapes of the *Abstracts of North American Geology;* and Charles J. Mankin, director of the School of Geology and Geophysics, and L. R. Wilson, George Lynn Cross Research Professor of Geology and Geophysics (both at The University of Oklahoma), who volunteered as initial users of GIPSY for testing. Each was given a 1-hour theoretical lecture and a 30-minute demonstration of the mechanics of using GIPSY to communicate directly with the bibliography. Dr. Wilson commented, after receiving the printout from a 32-minute search required to answer a rather complex question, that it would have taken him an estimated year of casual library browsing to acquire the same information. In another instance, Dr. Wilson discovered certain references containing valuable research data on a specific palynomorph related to his current research. Examples of Dr. Mankin's literature-searching are given later in this article. The results of the tests were extremely encouraging and are currently being used for training purposes.

Each entry in the U. S. G. S. bibliography contains the name of the author, the abstract, date of publication, a citation, and terms. The terms are global words that represent the central concepts of the original article.* Using GIPSY, each of these items of information in the bibliographic entries are accessed by abbreviated names called labels. NAME, ABSTR, DATE, CIT, and TERMS are the labels used in GIPSY for the U. S. G. S. bibliographic entries.

Information, as it is understood in information theory, is a resolution of uncertainty (Meadow, 1967, p. 293). In GIPSY, the position is taken that the uncertainty faced in retrieving information from a certain data base can best be handled by using the scientific method. The hypothesis is expressed as a question posed to the data base, which leads to a dialog sequence such as that shown in figure 1.

A typical question posed to a data base like the U. S. G. S. bibliography might be: "How many abstracts contain reference to oil and Oklahoma?" The conditions of this question would be "oil" and "Oklahoma." The logic involved is AND. In GIPSY, the user would relate the conditions oil and Oklahoma to the label of the bibliographic item called ABSTR, for the abstract.

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* E. g., the word "metal" would be the global term for an article dealing with lead and zinc.

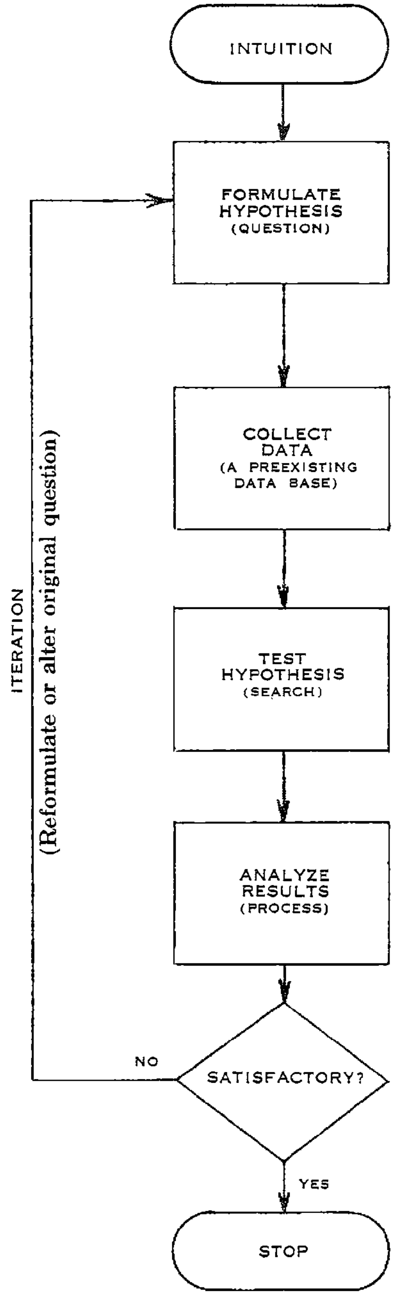


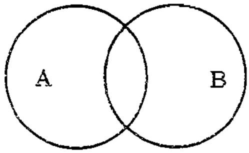
Figure 1. Typical dialog sequence used in GIPSY analyses.

(1) A. ABSTR <OIL>

(2) B. ABSTR <OKLA>

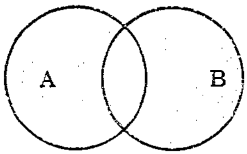
(3) LOGIC A AND B

Line 1 describes a certain condition designated by A. It says that oil should be found in the abstract. One may think of A as denoting the subset of references containing oil somewhere in the abstract. Line 2 says that B should contain Oklahoma (or Okla. or Oklahoman) in the abstract. Line 3 is the logical relationship between the two conditions and states that both A and B must be satisfied for the reference to be selected. This method is similar to coordinate indexing (Becker and Hayes, 1963, p. 46) upon the full text of the bibliographic entry. The coordination is accomplished by Boolean logic. Using Venn diagrams and set notation, the previous question should be shown as:



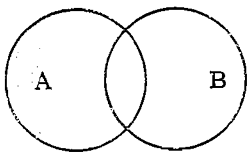
Shaded = $A \cap B$

Here the intersection of two sets A and B form the logical AND operation. Other logical operations are also available with GIPSY. The OR forms the union of the two sets A OR B and could be shown as:



Shaded = $A \cup B$

The NOT operator allows A AND NOT B, shown as:



Shaded = $A \cap \bar{B}$

With these operators to link the conditions together, a very flexible selection criteria can be formed. Once the question is posed, the computer will go about the task of searching for the reference that satisfies the question. At the end of an exhaustive search, a count is provided to show the truth values (the number of times the conditions were met) of the individual conditions and how many references were chosen as fulfilling the logical requirement.

Based on the number of references selected, the user may elect to print them or to enter into a procedure known in GIPSY as "iteration." For example, if the number of references selected based on the previous question was a thousand, the user probably would not care to read a thousand abstracts. In most cases, he would rather take the thousand and ask another question that would constrain the number selected to a readable amount more pertinent to his needs. One way might be to iterate upon the results of the last question in this manner:

A. DATE EQ 1964

LOGIC A

which would mean to select from the thousand oil-in-Oklahoma abstracts only those that were printed in 1964.

The method of iteration allows a dynamic use of the scientific method. Based on the results, a hypothesis may be modified or cast out, as desired. Once a logical end to an analysis is reached, certain processes, chosen by dialog with the computer, may be used to display information retrieved. The references might be sorted into ascending order by author's name and the entire abstract printed. Parts of the references, such as the names and citations or the names and dates, might be listed. The entire procedure is under the control of the researcher through a dialog with the computer and the course of action is not predetermined.

Other more advanced features are available in GIPSY, but these cannot be described here. In substitute, an example of the use of the system is provided by an annotated search done by Dr. Mankin. In the following dialog the user sought information on evaporites and began with the determination of the total number of bibliographic entries that might have useful information.

man (question)	A. TITLE <EVAPORITE> B. Terms <EVAPORITE> LOGIC A OR B	Look for "Evaporite" in terms or title; a subjective question.
machine	SEARCHED 28410 SELECTED 103	(Elapsed time: 5 minutes)
man (iteration)	A. TITLE <PERMIAN> B. TERMS <PERMIAN> C. ABSTR <PERMIAN> LOGIC A OR B OR C	1st iteration: Constraint of subject; look for Permian in the title, terms, or abstract.
machine	SEARCHED 103 SELECTED 17	Note: Only the previously selected references are searched. (Elapsed time: 20 seconds)

man (iteration)	A. TITLE <TEXAS> B. TERMS <TEXAS> C. ABSTR <TEXAS> D. DATE EQ 1964 LOGIC D AND (A OR B OR C)	2nd iteration: Qualifying by geographical location and print date of 1964.
machine	SEARCHED 17 SELECTED 2	(Elapsed time: 3 seconds)

At this point the analysis was terminated. The resulting combined question from the starting point and through the two iterations was: How many abstracts from 1964 refer to evaporites in the Permian in Texas? The answer was that only two abstracts met the total requirements. Dr. Mankin continued as follows:

man (process)	LIST TITLE CIT	An instruction to list the titles and citations of the two selected references.
machine	TITLE:	CARBONATE PETROGRAPHY OF BLAINE FORMATION (PERMIAN), NORTH CENTRAL TEXAS
	CITATION:	AM. ASSOC. PETROLEUM GEOLOGISTS BULL., V. 48, NO. 4, P. 541, 1964.
	TITLE:	PERMIAN SUBSURFACE EVAPORITES IN THE ANADARKO BASIN OF THE WESTERN OKLAHOMA-TEXAS PANHANDLE REGION
	CITATION:	DISSERT. ABS., V. 25, NO. 3, P. 1852-1853, 1964.

The word "evaporite" is not in the title of the first reference listed but appeared in its terms. In the second title, GIPSY was able to locate the word "Texas" within OKLAHOMA-TEXAS. GIPSY is able to scan the text in a discriminating manner similar to that used by the human and hence offers far greater flexibility than a simple, coded keyword system. That is, if a user was interested in "Foraminifera," he would simply enter that word in his question and would not have to look up a code for the word. The philosophy behind this approach is that all items of data within the references are potentially useful and therefore all items should be searchable.

GIPSY is also capable of retrieving information with "open-end" conditions that consist of parts of words, as in the following example:

man	A. CIT	< GEOPHYS>
	B. ABSTR	<ZOIC >
	C. ABSTR	<GRAPHIC >
	LOGIC A AND (B OR C)	

machine	SEARCHED	28410
	SELECTED	6

In this example, the space at the beginning of the first condition, A, indicates a "prefix." In other words, < GEOPHYS> means all words beginning with geophys, such as geophysics and geophysical. The second and third conditions, B and C, indicate a "suffix" comparison. <ZOIC > means all words ending with zoic, such as Mesozoic and Cenozoic. The total question is: "Locate the references in geophysics journals that refer to Mesozoic, Cenozoic, etc., or to topographic, geographic, seismographic, etc." Six references were located and the dialog continued as follows:

man (process)	SORT NAME	This caused the 6 located references to be sorted [alphabetized] by the author's last name.
man (process)	COPY NAME CIT	The names and citations of the 6 references are to be printed out in a tabular format.

machine	ALLINGHAM, JOHN W.	GEOPHYSICS
	ALSUP, S.A. GUYTON J.	GEOPHYSICS
	CHAYES, FELIX	JOUR. GEOPHYS. RESEARCH
	JESPERSEN, ANNA	U.S. GEOL. SURVEY GEOPHYS. INV.
	PRESS, FRANK BIEHLER, SHAWN	JOUR. GEOPHYS. RESEARCH
	WASSERBURG, G.J. ALBEE, A.L.	JOUR. GEOPHYS. RESEARCH

(The citation printouts were edited in the interest of space)

GIPSY provides a method of expressing a question in a form that does not suffer from the ambiguities that might be present if stated in plain English, yet it does not require an intermediate programmer between the geologist and his data. By eliminating the intermediate programmer, the confusion that results when the programmer misunderstands the geologist's question is avoided. In addition, time and money are saved by not having to wait for a specific program to be written to answer a particular question. In general, the system makes possible exhaustive literature searches that can be done in minutes rather than weeks or months.

GIPSY is also as useful for browsing as it is for searching for specific ends. Other areas in which this system has been successfully used are Dr. Wilson's palynological literature collection, museum archiving, medical records, government project reports, and regional and city planning. In addition, the U. S. G. S. headquarters in Washington, D. C., is currently running several applications in water resources, project management, and paleontology.

What would the availability of a system like this mean to a geologist? To the researcher, it becomes a powerful tool for retrospective literature searchers. A bibliography becomes not simply a periodic publication that enables the researcher to scan, by hand, selected keywords and words from titles, but rather a dynamic instrument with which he can quickly perform complex searches. Throughout the development of GIPSY, the prime objective was flexibility, whereby the computer operation is secondary to the intellectual formulation of search strategies.

Mr. William Riedel, a research geologist at Scripps Institute of Oceanography, La Jolla, California, has said that one of the most exciting aspects of GIPSY, from his standpoint, is the introspective research that the system allows the user to undertake. The ability to examine a data base directly and study the contents for validity can be quite valuable. For example, the user is not only able to describe and interpret information obtained with GIPSY, but is also able to describe and interpret the data base as an entity in itself.

A tool such as this would, of necessity, have an impact on education as well. Dr. Mankin has stated that a flexible data storage and retrieval system will greatly affect the doctoral candidate in the pursuit of his degree. With more and better information more rapidly available, the doctoral candidate could undertake more in-depth research.

GIPSY has even greater potential in the establishment of a Geological Information Center. Such a center could contain a large, comprehensive bibliographic data base that would be easily accessible to the entire geologic community. In addition to bibliographic data, numeric data on petroleum and mining, catalogs of paleontologic repositories, paleontologic and stratigraphic nomenclatures, and numerous other specialized forms of information can be made equally accessible within the one system. The versatility of GIPSY makes it possible to consolidate at one installation the most diverse types of data bases than can quickly answer search requests made by mail, telephone, or even remote computer terminal. The kernel of such a center already exists in the many geologic data bases that have been committed to magnetic tapes.

The principal impediment to the consolidation of such information under a unified information system has been the restrictions imposed by highly structured and fixed input procedures and the "one problem, one system" philosophy. Because GIPSY does away with these restrictions, the Merrick Computer Center and the School of Geology and Geophysics are engaged in a joint feasibility study of a Geological Information Center, with the assistance of the Oklahoma Geological Survey. Such a center should prove to be of incalculable value to both industry and the academic community.

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Historic Wilson Rock—A Keota Sandstone Outcrop

Carl C. Branson

In the years of steamboat traffic on the Arkansas River in Oklahoma, such landmarks as Webbers Falls, Frozen Rock, and Short Mountain were important. One of these landmarks was "Flat Rock Ledge," also known as Skin Bayou Bluff, Wilson's Rock, Swallow's

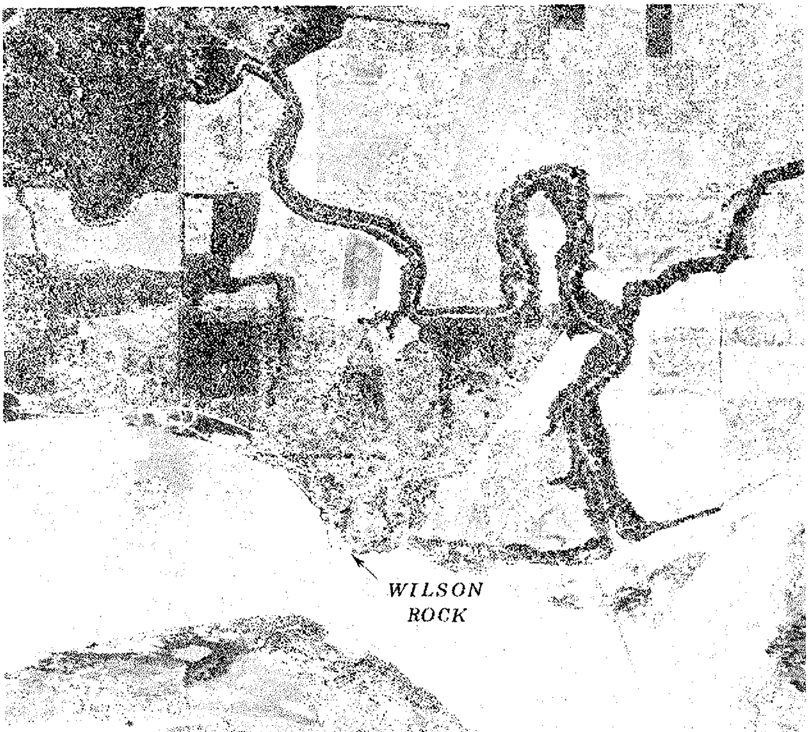

Figure 1. Vertical airplane photograph of Wilson Rock and vicinity.
(U. S. Department of Agriculture photograph by Woltz Studios, Inc.)

Rock, or Wilson Rock. This prominent riverside feature is in NE¼ NW¼ sec. 20, T. 10 N., R. 26 E., Sequoyah County (fig. 2). The feature is an outcrop of the Keota Sandstone Member of the McAlester Formation, Des Moines Series. The sandstone is flat-lying, has bedding in layers a few inches thick, and is medium grained, light gray, calcareous, and micaceous, with markings of indeterminate organisms. The outcrop is flat-topped, eroded to a bedding plane about 12 feet above normal water level. In 1950, 1958, and 1968 (M. Rashid and I examined the rock on August 22), water was against the base of the ledge (fig. 3). The outcrop is about 200 feet across from east to west.

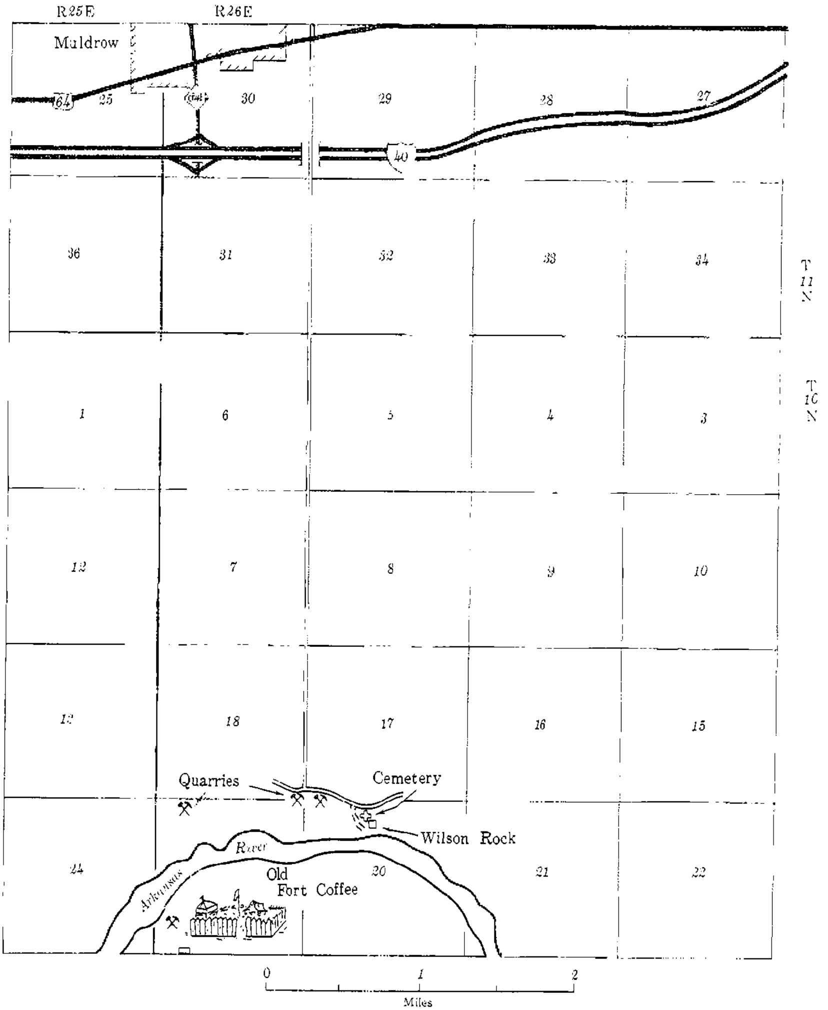

Figure 2. Location map showing route to Wilson Rock.

Figure 3. View of the western segment of Wilson Rock as seen from the eastern segment.
(Photograph by M. Rashid)

It is divided into two flat-topped segments by a wedge-shaped reentrant (fig. 1) bordered by joints and eroded by river action. Wilson Rock is shown on the Fort Coffee 7½-minute topographic quadrangle (1967) to be on a sand flat on the north side of the river.

The sandstone has been quarried from just west of Wilson Rock almost continuously for more than a mile. The rock has been used for groins, jetties, levees, and riprap.

On the surface of the eastern part of Wilson Rock is carved "Wm. Wilson, born 1811" and a handprint above which is "cut 1852." About 30 feet higher than the flat top of Wilson Rock is a small cemetery with about 30 graves. The hill is wooded and has some fine junipers. The rock, hill, and cemetery should be set aside as a public park.

Wilson Rock lies southeast of Muldrow and can be reached by going south on the section-line road that crosses U. S. Highway 64 approximately 0.8 mile east of its junction with State Highway 64B (fig. 2). Proceed 5 miles on the section-line road, then turn southeast to the cemetery, driving about 0.5 mile. From the east edge of the grove, a road leads downhill to the top of the rock.

The Keota Sandstone is the upper member of the McAlester Formation, which consists of five named sandstone members and one named and five unnamed shale members. In Le Flore County, the Keota is 10 to 20 feet thick. The Keota in Wilson Rock (Sequoyah County) is about 20 feet thick (Crumpley, 1949).

Wilson Rock was known as Flat Rock Ledge and in one treaty was the initial point for the boundary line between the Cherokee Nation and Arkansas Territory.

When Sam Houston was in the area, 1829 to 1833, he purportedly married Diana Rogers, possibly a common-law marriage. Her name is recorded in many forms, such as Tiana and Talihina, and she was at various times Mrs. David Gentry (1816-1825?), Mrs. Sam Houston (1830-1833), and Mrs. Samuel D. McGrady (1836-1838). She was supposedly buried in the cemetery at Wilson Rock but probably was buried north of Ft. Gibson. The bones removed from the Wilson Rock cemetery and reinterred in Ft. Gibson National Cemetery are almost certainly those of an unknown person. Gregory and Strickland have written an account of the controversial Diana in their book, *Sam Houston with the Cherokees, 1829-1833.*

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Gregory, Jack, and **Strickland, Rennard**, 1967, Sam Houston with the Cherokees, 1829-1833: Austin, Univ. Texas Press, 206 p.

U. S. Board on Geographic Names Decisions

Big Eagle Creek (not Eagle Creek or Eagle Fork) has been adopted as the name for a 19-mile-long stream that heads in sec. 34, T. 2 N., R. 24 E., and flows southeast through Le Flore and McCurtain Counties to Mountain Fork, sec. 26, T. 1 S., R. 25 E., 2 miles southwest of Smithville.

Cucumber Creek (not Eagle Fork or Eagle Fork Creek) has been adopted as the name for a stream 10 miles long that heads in sec. 2, T. 1 N., R. 26 E., and flows west through Le Flore County to Big Eagle Creek, sec. 8, T. 1 N., R. 25 E., 2.5 miles north of Octavia.

Kullituklo (not Kuli Inla, Kulli, Kulli Inla, or Kulliinla [former decision]) has been adopted as the name for a community 7 miles southeast of Idabel in McCurtain County.

Medicine Lodge River (not Medicine Lodge Creek or Medicine River) has been adopted as the name for a 100-mile-long stream that heads in Kansas in sec. 24, T. 29 S., R. 19 W., and flows southeast, into Oklahoma, to the Salt Fork of Arkansas River, 5 miles north-northeast of Cherokee in Alfalfa County.

Sequoyah (not Sequoya [former decision] or Se-quo-yah) has been adopted as the name for a settlement 5.5 miles northeast of Claremore in Rogers County.

Shady Point (not Shadypoint) has been adopted as the name for a village 3 miles south of Panama in Le Flore County.

OKLAHOMA ABSTRACTS

The University of Texas at Austin

Late Cambrian and Earliest Ordovician Trilobites, Timbered Hills and Lower Arbuckle Groups, Western Arbuckle Mountains, Murray County, Oklahoma

STITT, JAMES HARRY, The University of Texas at Austin, Ph.D. dissertation, 1968.

Trilobites were collected from every fossiliferous bed in two composite sections measured through the Timbered Hills and lower Arbuckle Groups. Forty-four hundred prepared specimens are assigned to ninety-nine species and sixty-seven genera, including two new genera and new species of *Bynumina, Missisquoia, Morosa, Plethometopus, Plethopeltis,* and *Sulcocephalus.*

The oldest tribolites constitute the faunas of the *Elvinia, Taenicephalus,* and *Saratogia* zones of the Upper Cambrian Franconian Stage. A basal *Parabolinoides* subzone is recognized in the *Taenicephalus* zone. A basal *Idahoia lirae* subzone and an overlying *Drumaspis* subzone are recognized in the lower part of the *Saratogia* zone.

The Reagan Sandstone and overlying Honey Creek Limestone comprise the Timbered Hills Group. The *Elvinia* zone occurs in the upper part of the Reagan and the lower part of the Honey Creek, the *Taenicephalus* zone in the middle two-thirds of the Honey Creek, and the *Saratogia* zone in the upper part of the Honey Creek and lower part of the overlying Fort Sill Limestone.

Formations of the Arbuckle Group sampled for trilobites include the Fort Sill Limestone, Royer Dolomite, Signal Mountain Limestone, Butterly Dolomite, and basal McKenzie Hill Limestone (listed in ascending order). No trilobites were recovered from the Royer or Butterly Dolomites. Trilobites from the upper part of the Fort Sill and lower part of the Signal Mountain constitute the fauna of the *Saukia* zone of the Upper Cambrian Trempealeauan Stage. The *Saukia* zone is divided into four subzones: *Rasettia magna, Saukiella junia, Saukiella serotina,* and *Corbinia apopsis* (listed in ascending order).

Trilobites from the upper part of the Signal Mountain Limestone belong to the *Missisquoia* zone, the lowest zone in the Lower Ordovician. Trilobites from the base of the McKenzie Hill Limestone belong to the *Symphysurina* zone, the next highest zone in the Lower Ordovician. The Cambrian-Ordovician boundary lies within the Signal Mountain Limestone, not four hundred feet higher at the base of the McKenzie Hill as previously believed.

OKLAHOMA ABSTRACTS is intended to present abstracts of recent unpublished papers on Oklahoma geology. The editors are therefore interested in obtaining abstracts of formally presented or approved documents, such as dissertations, theses, and papers presented at professional meetings, that have not yet been published.

The trilobites studied are most similar to those of equivalent zones in central Texas.

Abrupt faunal changes at the *Elvinia-Taenicephalus* and *Saukia-Missisquoia* zone boundaries define the Ptychaspid biomere. Rapidly decreasing water temperature is suggested as one factor responsible for the faunal discontinuities that characterize biomere boundaries. A steady temperature decline might decimate the warm-water benthonic cratonic trilobites and simultaneously trigger a replacement migration onto the craton of a basic stock of completely different cold-water benthonic eugeosynclinal trilobites.

Resumption of warmer water conditions introduced selection pressures that caused rapid adaptive first-stage evolution of the new "cratonic" trilobites. Two additional stages of evolution resulted in numerous, abundant, well-adapted species. A last stage, characterized by extinction of many established species and the population explosion of survivors, marks the initiation of another water-temperature decline, ending the biomere.

Oklahoma Academy of Science, 57th Annual Meeting
Tulsa, Oklahoma
December 6-7, 1968

The following are abstracts of papers related to Oklahoma geology presented at the 57th Annual Meeting of the Oklahoma Academy of Science. Permission of the authors and of the Academy to print these abstracts is gratefully acknowledged.

Springs in Northeastern Oklahoma

BINGHAM, ROY H., Water Resources Division, U. S. Geological Survey, Oklahoma City, Oklahoma 73102

Numerous springs in northeastern Oklahoma flow directly from tubular openings in bedrock formations of Mississippian age. Some of the springs flow more than 1,000 gpm (gallons per minute), whereas other springs in the area are only small seeps. The water generally contains less than 500 ppm (parts per million) total dissolved solids throughout the year.

Perennial springs are economically important because the water is at land surface and therefore is readily available for use. Not all springs in northeastern Oklahoma are used. The unused springs, however, are sources of water that help to maintain the base flow of perennial streams, which in turn supply water to towns and industries in the area.

Petrology of Fluviatile Sandstones, Thurman Formation, Coal County, Oklahoma

HARE, BEN D., School of Geology and Geophysics, The University of Oklahoma, Norman, Oklahoma 73069

The middle Desmoinesian Thurman Sandstone crops out over parts of Pittsburg, Hughes, Coal, and Pontotoc Counties. The present

study encompasses the area of outcrop in Hughes and Coal Counties.

Two depositional environments are represented by the Thurman. These are: (1) a marine environment, consisting of nearshore and beach deposits, present in Tps. 3, 4 N., R. 11 E. and parts of T. 3 N., R. 10 E., and (2) a fluviatile environment, represented by rocks in T. 3 N., R. 10 E. This discussion will emphasize the petrology of the fluviatile facies.

The fluviatile depositional environment is subdivided into channel, flood-plain, and levee deposits. The typical channel sandstone, as exposed in sec. 8, T. 3 N., R. 10 E., is medium to coarse grained, moderately sorted, and conglomeratic at its base. Channel deposits grade from festoon cross-bedding at the base to tabular or laminated cross-bedding at the top. This gradation is accompanied by an apparent decrease in grain size.

Mineralogically the sandstones consist of quartz, microcline, oligoclase, chert, muscovite, and fragments of schist and shale. All sandstones have a kaolinitic and illitic clay matrix comprising 5 to 10 percent of the total rock. Twenty-one sandstone samples of the fluviatile environment have been classified, on the basis of E. F. McBride's 1963 classification, as immature to submature quartz arenites.

The flood-plain shales of the Thurman are silty and maroon, and fragments of *Calamites* are common. Clay minerals identified from the flood-plain shales are highly degraded illite, kaolinite, and mixed-layer chlorite-vermiculite.

Landslides on Oklahoma's Highways

HAYES, CURTIS J., Research and Development Division, Oklahoma Highway Department, Oklahoma City 73105

Landslides occur on Oklahoma's highway system every year. Most of these are rotational slump slides, although some rock-flow slides also affect Oklahoma's roadways. The three major factors that work together to cause landslides are earth materials, moisture conditions, and slope. Geologic units that are almost exclusively shale, such as the Johns Valley, Senora, and Boggy Formations, produce considerable amounts of colluvium, which is often made unstable for roadway construction because of precipitation and the length and steepness of the slope.

Conditions can be made stable, or at least more stable, by either avoiding, removing, draining, or changing the slope of the material involved. Moisture is nearly always present in colluvium as either surface water, ground water, or quasi-surface water (water that flows downward within the colluvium). Surface water and free water are commonly drained from the colluvium by perforated metal pipe and paved ditches. Drains for quasi-surface water, which usually flows along the contact of the colluvium and the underlying shale, must be located in such a way as to ensure that all the "quasi-water" coming down the slope is captured. "Benching" through the colluvium into firm bedrock is a common practice, and flattening the embankment and cut slopes also tends to produce more stable conditions.

Geomorphology and Radiocarbon Dates of Tesesquite Valley, Cimarron County, Oklahoma

WILSON, L. R., School of Geology and Geophysics, The University of Oklahoma, and Oklahoma Geological Survey, Norman, Oklahoma 73069

The valley of Tesesquite Creek, a tributary of the Cimarron River several miles east of Kenton, is approximately 11 miles long, and near the mouth it is approximately 1 mile wide. The valley is developed in Cretaceous sandstone. Subsequent to development of the bedrock valley and possibly during Pleistocene (Wisconsin) time, the valley floor was periodically aggraded and degraded. Since 1914, after a period of overgrazing, a new cycle of erosion has produced a vertical-sided channel that is 50 to 300 feet wide and approximately 15 feet deep. The deposits and structural features in the walls of the main channel and its tributaries indicate the following geomorphic history.

(1) The lower 2-mile portion of the creek was impounded as a consequence of sedimentation in the Cimarron River caused by Pleistocene drainage. The result was deposition of a blue clay that contains layers of snails and clams, with elephant, bison, and horse bone fragments. Fossil pollen recovered from the clays are mainly from spruce, pine, oak, Compositae, and grasses. (2) The impounded area was drained, and laminated buff sand, silt, and clay were deposited by an aggrading stream, as can be observed in the high terraces. These deposits contain few bone fragments, but snails are abundant locally. (3) Channel-cutting was resumed, and the process of erosion removed the laminated sediments and some of the underlying blue clay in the center of the valley. (4) A forest developed in the channel and was subsequently buried in the sediments of the next stage. Trees attained diameters up to 3 feet and included species of cottonwood, willow, and hackberry. (Specimens of what may be hackberry wood are poorly preserved and uncertainly identified; however, hackberry fruits are abundant on the forest floor.) Carbon-14 age determinations for six wood samples range from 271 ± 180 to 655 ± 100 years B.P. (5) The channel was refilled, possibly in several stages, by approximately 12 feet of sand silt, clay, and local caliche deposits, which were formed about the bases of living sedges in slack-water areas. This channel-fill contains an abundance of bison bones, as well as a few Indian fire pits and artifacts. (6) Channel-cutting since 1914 is responsible for the present physiography and the exposure of the former valley forest.

The Re-Vivification of the Oklahoma Coal Industry

DOERR, ARTHUR H., Chairman, Department of Geography, The University of Oklahoma, Norman, Oklahoma 73069

Oklahoma's coal production achieved a peak output of almost 5,000,000 tons in 1920. Since that time, in spite of temporary upward oscillations, the production has declined markedly. By 1967 production was less than 1,000,000 tons per year.

This past declining trend is, however, on the threshold of being reversed. The completion of the Howe Coal Company mine near Heavener in January 1968 ushers in a new era of expanded coal production for the State. This mine, which will reach a capacity production of 1,000,000 tons per year in April 1970, when coupled with the new Kerr-McGee mine now being developed near Stigler, will sharply reverse the past trend towards declining production. The Kerr-McGee mine will produce 1,000,000 tons per year by 1971.

Several factors have contributed to this resurgence of the Oklahoma coal industry. Among the most important are a rising demand for low volatile coals in foreign markets (Japan), new low-cost shipping techniques utilizing the unit train (currently) and the Arkansas River Waterway (ultimately), increased fuel and power demands in the United States, the prospects for the production of liquid fuels from coal, and an increased search for other coal uses.

In the judgment of this author, the two new underground mines point to an increasing use of Oklahoma coal reserves buried at considerable depth, a significant economic impact from coal mining in eastern Oklahoma, and a resurgence to or above coal-production levels achieved in the past.

Ostracodes of the Haragan Formation

Evidence indicating that the Haragan Formation closely corresponds in age to the Birdsong Shale of western Tennessee and the Kalkberg and New Scotland Limestones of New York has been presented in *Ostracodes of the Haragan Formation (Devonian) in Oklahoma,* by Robert F. Lundin. Released on December 26, 1968, as Oklahoma Geological Survey Bulletin 116, this 121-page report contains 22 plates, 51 text-figures, and 18 tables. Two new genera and thirteen new species are included in the extensive section of systematic descriptions. Bulletin 116 may be obtained for $6.25 in the hardbound edition and $5.25 in the paperbound edition from the Oklahoma Geological Survey, The University of Oklahoma, 830 South Oval, Room 163, Norman, Oklahoma 73069.

The author, an associate professor of geology at Arizona State University, Tempe, Arizona, has also written OGS Bulletin 108, *Ostracodes of the Henryhouse Formation (Silurian) in Oklahoma.* Professor Lundin's abstract of his new publication follows.

ABSTRACT

Detailed morphologic, ontogenetic, and variation studies of tens of thousands of ostracodes from the Haragan Formation have shown that ostracodes are useful in understanding the stratigraphy of this unit. The content of the fauna indicates that the Haragan Formation is closely related in age to the Birdsong Shale (Helderbergian) of western Tennessee. Likewise, comparison of the fauna with small ostracode collections from the Kalkberg and New Scotland Limestones of New York demonstrates that the Haragan can be correlated with these units.

The geographic and stratigraphic distribution of ostracodes in the Haragan Formation is constant throughout the outcrop area of south-

central Oklahoma. Although geographic variation in abundance of ostracodes occurs, the same species are present in the Criner Hills and western Arbuckle Mountains as are present in the central, eastern, and northeastern exposures of the formation. The stratigraphic distribution of ostracodes in the Haragan shows that all significantly abundant species range throughout or almost throughout the entire formation. No distinct and definite biostratigraphic zones based on ostracodes can be demonstrated for this unit. Throughout its outcrop area, the Haragan Formation represents a distinct stratigraphic unit with a single ostracode fauna devoid of biostratigraphic zones.

The Haragan ostrácode fauna is large and diversified. Fifty-four species (13 new) representing 17 families and 28 genera are present. In number of individuals, the Thlipsuridae, Pachydomellidae, and Bairdiocyprididae dominate the fauna. Among the Beyrichicopina, the Bolliidae, Kirkbyellidae, and Richinidae are well represented. In all, 8 families, 12 genera, and 24 species of Beyrichicopina and 5 families, 11 genera, and 24 species of Metacopina are present. The Kloedenellocopina and Podocopina together contribute 4 families, 5 genera, and 6 species to the fauna.

Comparison of the Haragan ostracode fauna with that of the underlying Henryhouse Formation (Silurian) gives evidence of an unconformity between the two units. The two faunas are one hundred percent distinct at the specific level; not a single species of the 100 present in the combined faunas is common to both units. Further, the faunas are fifty percent distinct at the generic level, and 10 of the 22 families in the combined faunas are restricted to one unit or the other. There is no evidence of a gradational or intermediate fauna between the two distinct faunas recognized. Strata containing the two faunas are nowhere known to interfinger with one another. The strong and abrupt faunal change in the Henryhouse-Haragan sequence, together with local physical evidence and regional lithostratigraphic evidence, clearly indicates that the Silurian-Devonian boundary in south-central Oklahoma is represented by an unconformity.

Present evidence from this study supports the interpretation that the Haragan Formation is a facies of the overlying Bois d'Arc Formation. Most, if not all, of the ostracode species presently known from the Bois d'Arc are also present in the Haragan.

Collections have been made from the Henryhouse-Haragan sequence in all the outcrop areas of these units. The two ostracode faunas thereby obtained are large, diverse, distinct, and readily identifiable. Analysis of these faunas is useful in determining the position of the Silurian-Devonian boundary and in understanding Silurian-Devonian stratigraphic relations at the surface and in the subsurface.

New Theses Added to O. U. Geology Library

The following Master of Science theses were recently added to The University of Oklahoma Geology and Geophysics Library:

Geomagnetic delineation of the basement surface in southeastern McClain and southern Cleveland Counties, Oklahoma, by Arthur J. Blair II.

Heavy mineral analysis of Horn Island, northern Gulf of Mexico, by William Earl Harrison.

Magnetic study of basement configuration in south Cleveland and northeast McClain Counties, Oklahoma, by John W. Marchetti, Jr.

Subsurface analysis of southern Pottawatomie County, Oklahoma, by Kaya Y. Olcay.

Computer analysis of [oil] *production decline curves,* by Victor M. Sanchez S.

Vertical variation in the layered series, Raggedy Mountain Gabbro Group, Kiowa County, Oklahoma, by Nancy Scofield.

ERRATUM

Oklahoma Geology Notes, Volume 28, Number 6

Page 186, line 8: Delete entire line reading "the North Fork . . . . It occurs"

OKLAHOMA GEOLOGY NOTES

Volume 29 February 1969 Number 1

In This Issue

Page

The Mineral Industry of Oklahoma in 1968 (Preliminary)
Arel B. McMahan 3

GIPSY Computer Retrieval of Geologic Literature
Phillip W. Blackwell, Jack L. Morrison, Wayne E. Smith, Jr. 6

Historic Wilson Rock—A Keota Sandstone Outcrop
Carl C. Branson 14

Synclinal Fold in Kindblade Formation 2
U. S. Board on Geographic Names Decisions 17
Oklahoma Abstracts 18
The University of Texas at Austin 18
Oklahoma Academy of Science Meeting 19
Ostracodes of the Haragan Formation 22
New Theses Added to O. U. Geology Library 24