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OKLAHOMA GEOLOGY NOTES

GEORGE D'LLON MORGAN

OKLAHOMA GEOLOGICAL SURVEY • THE UNIVERSITY OF OKLAHOMA • NORMAN, OKLAHOMA

Cover Picture

George Dillon Morgan

SOME MORNING

Put on my shoes when I am dead
    And in my stead
    Walk up ahead;
Put on my shoes and climb a windswept hill.

There loose my dreams when I am gone
    So thru the dawn
    They'll carry on;
There loose my dreams for they'll be vital still.

George Morgan liked to write poetry for his own satisfaction and sometimes read it to his family and close friends. A few days before his death he penned the above lines, which reflect well the character of the man. George was an Oklahoma boy, born at Shawnee, July 31, 1894; he died at San Angelo, Texas, August 18, 1950.

He entered The University of Oklahoma in the fall of 1912 to study law, but he quickly found geology more to his liking and was graduated with a major in geology in 1917. He entered Columbia University in the fall of 1919 and received the M. A. degree in 1920 and the Ph. D. degree in 1924. In the meantime, he had carried out an extensive mapping program in southern Oklahoma under the auspices of the Empire Gas and Fuel Company and the Oklahoma Geological Survey. The results of that program were the basis for his doctoral dissertation. Parts of the results had been published in Circulars 10, 11, and 12 of the Oklahoma Geological Survey. The major part was published as *Geology of the Stonewall Quadrangle, Oklahoma*, Bulletin 2 of the Bureau of Geology. Part of the edition was acquired by the Survey and distributed along with its own publications.

The circulars and the bulletin cover an area critical to a comprehension of the stratigraphy and structure of a much larger area that fans out northward from it. Published at a critical time in the development of petroleum production in Oklahoma, they facilitated the efforts of many geologists who were working in the field for other companies. Thus they influenced the two geologic maps of Oklahoma compiled by Hugh D. Miser, of the U. S. Geological Survey. The first was published in 1926 and the second in 1954.

After 1928 George Morgan lived in San Angelo, Texas, where he was active in the oil business and in civic matters but devoted the greater part of his energy to strengthening the educational system of the state at all levels. In 1936 he was appointed to a six-year term on the Board of Regents of The University of Texas and was elected a member of the State Board of Education in 1948.

The cover photograph was reproduced from the Proceedings Volume of the Geological Society of America for 1951.

—M. C. O.

Mt. Scott Granite, Wichita Mountains, Oklahoma

C. A. Merritt

The granite which forms half of the outcrop area in the eastern and central parts of the Wichita Mountains is here named Mt. Scott Granite after Mt. Scott, which is composed of this rock. It was mapped as Lugert Granite by Taylor (1915) and by Hoffman (1930), but the writer believes sufficient evidence has accumulated to designate it as a separate granite.

It is part of the Wichita Granite Group, a term introduced by Ham, Denison, and Merritt (1964, p. 60) for the assemblage of closely allied granites of the Wichita Mountains and their equivalents in subsurface.

The type locality of Lugert Granite is in the western part of the Wichita Mountains, and no direct correlation can be made between the rocks of that area and those of the eastern Wichita Mountains as the intervening granite outcrops are separated by wide outcrops of Permian sediments. The granites of the two areas resemble each other rather closely in their mineral composition but differ somewhat in textural features. Most of the Mt. Scott Granite is granophyric, whereas the Lugert is not, except locally, especially at contacts. The Mt. Scott usually has elliptical zoned feldspars, whereas this feature is not well developed in Lugert Granite.

Smith (1951) mapped the granite of Snyder Lake area and described the texture as micrographic. Hessa (1964) mapped two granites in Navajoe Mountain, west of Snyder. The older granite is micrographic, at many places has elliptical zoned-feldspar phenocrysts, and closely resembles Mt. Scott Granite. The older granite is intruded by a nonmicrographic younger rock which Hessa considered to be Lugert Granite.

Most of the hills east of Snyder are composed of these same two granites so mixed with one another that at most places it is not practical to map them separately. A few miles to the east of these small hills are granite outcrops in the southwestern part of Wichita Mountains Wildlife Refuge. The granite of these latter outcrops can be traced to Mt. Scott. The older granite of the Snyder area, therefore, is correlated with the Mt. Scott Granite and the younger with the Lugert Granite.

The geology of the Cooperton area was mapped by Taylor (1915) and later by Hull (1951). The hills of this area are composed of a single granite that is highly granophyric, commonly has elliptical zoned phenocrysts of feldspar, and closely resembles the granite 4 miles to the east in Haystack Mountain, sec. 31, T. 5 N., R. 15 W. (Soule, 1951, p. 22). This latter granite can be traced eastward to Mt. Scott. The granite in the Cooperton hills, therefore, is believed to be Mt. Scott Granite.

The Mt. Scott Granite is a leucogranite with a low ferromagnesian content, normally less than 5 percent. It is a one-feldspar granite with microperthite the dominant constituent and free plagioclase minor or absent.

It has a salmon-pink color, speckled with small dark spots of femic minerals on a fresh surface, and it weathers to a reddish color. It is medium grained with a slightly porphyritic appearance. The largest phenocrysts are 2 to 4 mm long, rounded to elliptical, and composed of microperthite. Many of the phenocrysts have an outer rim of micropegmatite (fig. 2), which gives them a two-tone color with a central core of gray or brown and an outer rim of pink or red.

The rock typically is granophyric (fig. 3), but the micropegmatite content varies markedly, being greater at the contacts than in the central part of the mass. The granophyric content ranges from 0 in the Ira Smith quarry near the west gate of the wildlife refuge (sample M-1, table I) to more than 72 percent at the top of Mt. Scott (sample 196, table I).

Hoffman (1930, p. 41) noted the variation in micropegmatite content. He wrote:

> The microperthite is largely microperthite-micropegmatite. The amount is variable being usually higher at the edges of the mass and less toward the center. Some of the periphery specimens contain as much as 87 percent micropegmatite, and in many of the interior samples it is as low as 20 percent.

The average mode of four thin sections of Mt. Scott Granite is micropegmatite 59.4%, microperthite and orthoclase 27.0%, free quartz 9.2%, hornblende 2.4%, titaniferous magnetite 1.6%, sphene 0.4%, traces of apatite, fluorite, biotite, garnet, allanite, chlorite, and augite. The trace of augite is a relict mineral of a small assimilated gabbro inclusion.

The chemical compositions, norms, modes, and differentiation indices of two specimens of Mt. Scott Granite are given in table I.*

Inclusions of country rock are common in the Mt. Scott Granite. The xenoliths are variable in amount but at few places exceed 2 percent of the outcrop. They normally are small, less than 1 inch wide, and many are microscopic. Gabbro and anorthosite of the Raggedy Mountain Gabbro Group (Ham, Denison, and Merritt, 1964, p. 91) are the main rocks intruded by the granite, and most of the inclusions are alteration products of these rocks. A few large inclusions of gabbro and other rock types have been described. One of Meers Quartzite in SW¼ SE¼ sec. 34, T. 4 N., R. 14 W., is 200 feet long and 50 feet

* Sample 196, collected by Gerald W. Chase, is from the top of Mt. Scott (sec. 11, T. 3 N., R. 13 W., Comanche County). The chemical analysis was performed in 1954 by James Markham of the Rock Analysis Laboratory, University of Minnesota.
Sample M-1 was collected by C. A. Merritt and W. E. Ham from the Ira Smith quarry (SW¼ SE¼ SE¼ sec. 4, T. 3 N., R. 15 W., Comanche County). It was analysed chemically by C. O. Ingamells and Doris Thaemlitz, also of the Rock Analysis Laboratory, in 1959; this analysis was financed by a grant from the University of Oklahoma Alumni Development Fund.

TABLE I.—CHEMICAL AND PETROGRAPHIC ANALYSES OF MT. SCOTT GRANITE

(see footnote, opposite page)

CHEMICAL ANALYSES

	SAMPLE 196	SAMPLE M-1
SiO_2	72.04	72.78
Al_2O_3	12.70	12.44
TiO_2	0.47	0.45
Fe_2O_3	2.49	2.31
FeO	1.57	1.53
MnO	0.09	0.09
MgO	0.39	0.31
CaO	1.43	1.29
Na_2O	3.90	3.81
K_2O	4.25	4.32
Rb_2O	0.01	0.01
BaO	0.10	0.13
P_2O_5	0.09	0.08
H_2O^+	0.32	0.16
H_2O^-	0.05	0.00
CO_2	n. d.	0.06
F	n. d.	0.18
		99.95
Less O = F		0.08
Total	99.90	99.87

NORMS

	SAMPLE 196	SAMPLE M-1
Quartz	29.96	31.63
Orthoclase	25.12	25.53
Albite	33.00	32.24
Anorthite	4.60	4.09
Diopside	1.71	0.30
Hypersthene	0.38	0.95
Magnetite	3.61	3.35
Ilmenite	0.89	0.85
Fluorite	--	0.35
Calcite	--	0.14
Apatite	0.20	0.19
Differentiation index*	88.08	89.40

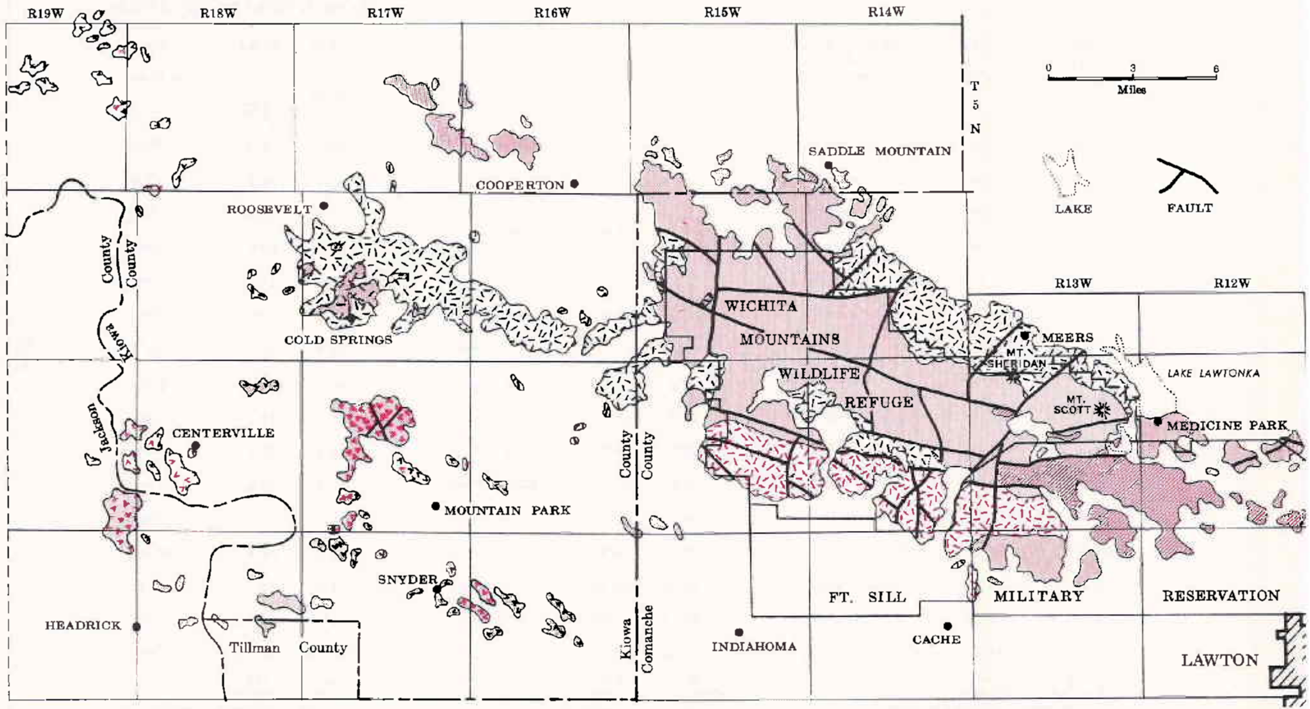
MODES

	SAMPLE 196	SAMPLE M-1
Micropegmatite	72.8[1]	--
Perthite	15.4	59.4
Quartz (free)	3.5	29.3
Plagioclase (free)	2.5(An_{11})	5.3(An_8)
Hornblende	2.1	3.6
Augite	0.6[2]	--
Aegerine	--	tr
Riebeckite	--	0.4
Chlorite	0.9	--
Epidote	0.1	--
Magnetite and ilmenite	2.0	1.4
Hematite	--	tr
Zircon	tr	0.1
Sphene	0.1	0.5
Fluorite	tr	tr
Apatite	tr	tr
Calcite	tr	--
Total quartz	29.6	29.3
Total perthite	62.1	59.4
Total feldspar	64.2	64.7

[1] Quartz 26.1%, perthite 46.7%

[2] Altered basic xenolith?

* Sum of normative quartz, orthoclase, and albite (Thornton and Tuttle, 1960).


R19W
R18W
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FAULT
SADDLE MOUNTAIN
COOPERTON
ROOSEVELT
COLD SPRINGS
WICHITA
MOUNTAINS
WILDLIFE
REFUGE
MEERS
MT. SHERIDAN
LAKE LAWTONKA
MT. SCOTT
MEDICINE PARK
Kiowa County
Jackson County
CENTERVILLE
MOUNTAIN PARK
SNYDER
HEADRICK
Tillman County
Kiowa County
Comanche County
INDIAHOMA
CACHE
FT. SILL
MILITARY
RESERVATION
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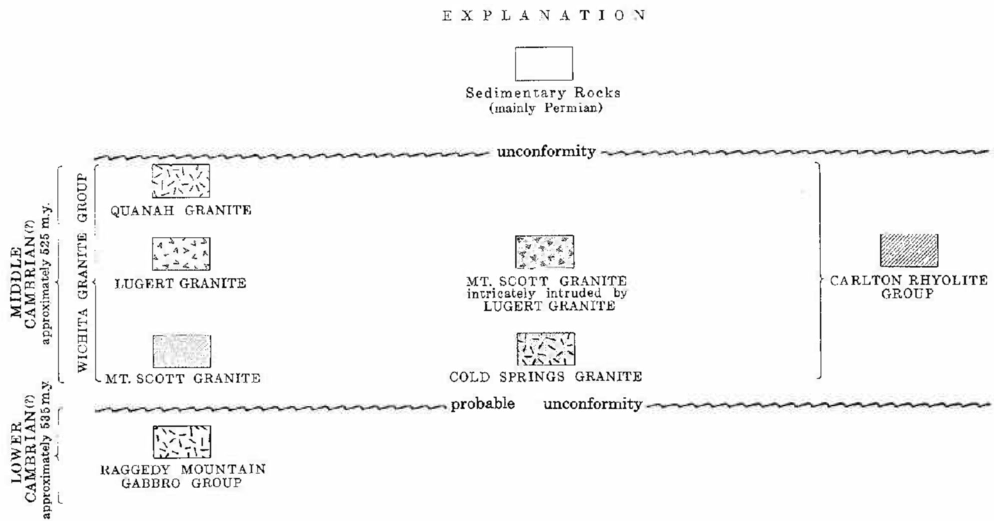

Figure 1. Geologic map of igneous rocks of central and eastern Wichita Mountains, Oklahoma, by C. A. Merritt.

(Base map and faults are from Miser, 1954. Outcrops of Quanah Granite and Cold Springs Granite in Wichita Mountains Wildlife Refuge are from a manuscript map by Gerald W. Chase, Oklahoma Geological Survey. Outcrops of Lugert Granite and undifferentiated Lugert-Mt. Scott Granites were compiled from maps by Merritt, 1958; Hessa, 1964; and Smith, 1951. The map was drafted by Roy D. Davis.)

Figure 2. Photomicrograph of Mt. Scott Granite; specimen from the top of Mt. Scott, SE¼ sec. 11, T. 3 N., R. 13 W., showing a typical elliptical phenocryst of microperthite with a rim of micropegmatite. Crossed nicols, x19.

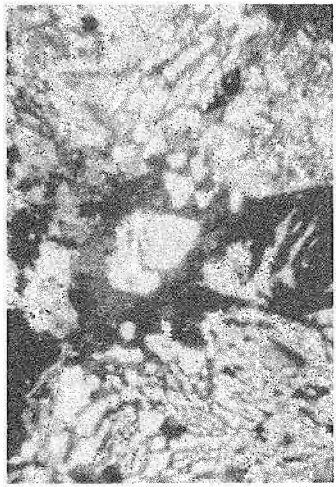

Figure 3. Photomicrograph of Mt. Scott Granite; specimen from Cooperton area, SE¼ NE¼ NW¼ sec. 14, T. 5 N., R. 17 W., showing granophyric texture with cuneiform quartz. Crossed nicols, x19.

wide. Large xenoliths of Carlton Rhyolite several acres in area have been mapped in secs. 4, 10, T. 2 N., R. 13 W.

Locally, as in Cutthroat Gap, sec. 8, T. 4 N., R. 15 W., Mt. Scott Granite magma intruded a microdiorite sill of the Raggedy Mountain Gabbro Group with sufficient force to break it into fragments and then crystallized around the fragments, forming an intrusion breccia. In the Cold Springs area intrusion breccias of this type are common, some of the outcrops extending over many acres. Locally the Mt. Scott Granite magma assimilated the microdiorite, forming a gray hybrid rock known as Cold Springs Granite (Taylor, 1915, p. 71; Walper, 1951, p. 49; Chase, 1950). It is impractical to map the intrusion-breccia phase and the assimilated hybrid rock separately, and both are shown on the map (fig. 1) as Cold Springs Granite.

The Mt. Scott Granite was emplaced as an intrusive sheet which must have had an areal extent of hundreds of square miles, as outcrops of this rock are found in an area of 35 by 25 miles. Granite resembling the Mt. Scott was encountered in several wells north and south of the Wichita Mountains (Ham, Denison, and Merritt, 1964), showing that the sill originally extended a considerable distance beyond the present outcrop area.

The measured thickness of the Mt. Scott Granite is 980 feet on Mt. Scott, but, as the dip of the sill is unknown, the true thickness may be considerably less. In the Stanolind 1 Perdasofpy well, sec. 11, T. 4 N., R. 12 W., a 500-foot-thick granite sill, resembling Mt. Scott Granite, was encountered at 8,000 feet (Ham, Denison, and Merritt, 1964, p. 232). Mt. Scott Granite probably has a thickness of about 500 feet.

The form of the Mt. Scott Granite intrusion can be clearly seen on Mt. Sheridan, which is composed of gabbro with a cap of overlying granite. Trees grow on the gabbro but not on the granite, and the tree line marks the contact. The granite sill dips to the south at approximately 5 degrees. The dip angle, however, may not be the original dip as it may have been tilted by later block faulting. This thick sill of granite can be traced 13 miles from Mt. Sheridan northwestward to sec. 31, T. 5 N., R. 15 W.

The large areal extent of the Mt. Scott intrusive sheet suggests that the conduits through the underlying gabbro-anorthosite were widespread, probably extensive faults. The rising magma probably utilized other openings or weak zones as local conduits. On the east side of Mt. Sheridan a granite plug, completely surrounded by gabbro, rises above Hazel quarry. In Cutthroat Gap, sec. 8, T. 4 N., R. 15 W., a small granite plug with radiating dikes intrudes the surrounding gabbro. The plugs and dikes are interpreted as local feeders of the overlying granite sill. The granite magma broke from one level to another along cross joints or other fissures which offered easier paths.

Thornton and Tuttle (1960) defined differentiation index as the sum of normative quartz, orthoclase, and albite and suggested that it may indicate the degree of differentiation of a magma. The differentiation index of Mt. Scott Granite from the top of Mt. Scott (sample 196) is 88.08 and that from Ira Smith quarry, 15 miles to the west in sec. 4, T. 3 N., R. 15 W., is 89.4. This difference suggests that the latter rock is a slightly later differentiate and possibly was emplaced at a different level. Probably the Mt. Scott Granite forms a multiple sill made up of more than one member.

Xenoliths of Meers Quartzite are found in Mt. Scott Granite in sec. 34, T. 4 N., R. 14 W., and 3 miles to the northeast this same granite forms a sill above gabbro on Mt. Sheridan. The sill dips to the south, indicating that, at least in the area of the wildlife refuge, part of the Mt. Scott Granite sill had a floor of gabbro and a roof of quartzite or sandstone.

In the western part of the Fort Sill Military Reservation (in secs. 4, 10, T. 2 N., R. 13 W.), xenoliths of Carlton Rhyolite, several acres in area, are found in Mt. Scott Granite. The roof of the granite sill in this locality must have been Carlton Rhyolite.

In the Stanolind 1 Perdasofpy well, sec. 11, T. 4 N., R. 12 W., a granite was encountered at 8,000 feet. It was intruded as a sill along the contact of Navajoe Mountain basalt-spilite lavas and the overlying Carlton Rhyolite. This granite resembles the Mt. Scott in texture and composition and probably is the same.

Apparently the granite magma formed sills along several weak zones such as along layers of gabbro-anorthosite, along the contacts between different rock types, such as between basalt-spilite and rhyolite, or gabbro and sandstone, or gabbro and rhyolite. The intrusion or intrusions may have been at various levels, although all were shallow (in the epizone). Also the sills may differ slightly in age. As mentioned above, feeders may have broken across from one level to another.

The xenoliths of Carlton Rhyolite in the Mt. Scott Granite prove that the granite is younger than some of the rhyolites. Rhyolite dikes cut the Mt. Scott Granite in some localities, and the granite is older than some of the rhyolites. The Carlton Rhyolite Group, as defined by Ham, Denison, and Merritt (1964, p. 39), includes all rhyolitic and pyroclastic rocks in the Wichita and Arbuckle Mountains and their equivalents in subsurface. It is at least 4,500 feet thick. The Mt. Scott Granite is younger than the early rhyolites and older than the late rhyolites of this group.

The Quanah Granite was named and mapped by Taylor (1915) and later remapped by Hoffman (1930). Detailed mapping by G. W. Chase (manuscript map, Okla. Geol. Survey) shows that it is composed of more than one granite. The writer believes it is a complex pluton. It is younger that Mt. Scott Granite as it intrudes the latter in several places in sec. 15, T. 3 N., R. 15 W. Thus the Mt. Scott Granite is the oldest granite in the eastern part of the Wichita Mountains.

As previously mentioned, the Lugert Granite is intrusive into the Mt. Scott Granite in the Snyder area. Thus both Lugert Granite and Quanah Granite are younger than the Mt. Scott Granite. Outcrops of the Lugert and Quanah Granites are found in different areas and their relative ages cannot be determined by field relationships.

Calculations from two chemical analyses of Quanah Granite gave an average differentiation index of 95.4, and three chemical analyses of Lugert Granite gave an average of 95.5. These indices indicate that the two granites are closely related in age.

Aegerine and riebeckite are rare in Lugert Granite, but riebeckite occurs as crystals in miarolitic cavities of this rock. Dikes of aegerine-riebeckite granite cut Lugert Granite on Quartz Mountain in sec. 16, T. 5 N., R. 20 W. (Merritt, 1958, p. 51). Aegerine and riebeckite apparently were formed during the hydrothermal stage following the consolidation of the Lugert Granite magma and then later as magma precipitates in granite dikes. These alkaline minerals normally are present in small amounts in Quanah Granite as constituent minerals, and also riebeckite occurs in miarolitic cavities. These mineralogic features suggest that the Quanah Granite is slightly younger than the Lugert Granite.

Lugert Granite intrudes Reformatory Granite as an intrusive sheet on Quartz Mountain, secs. 21, 22, T. 5 N., R. 20 W. (Merritt, 1958, pl. 1). In the Snyder area Lugert Granite intrudes Mt. Scott Granite which earlier had been emplaced as an intrusive sheet. No information is available to indicate the level (top, bottom, or middle) at which the Mt. Scott Granite sill was intruded by the Lugert sill. The top or bottom seems more likely as either zone would be weaker than the middle.

Quanah Granite apparently intruded the Mt. Scott Granite as a complex pluton.

The Mt. Scott Granite is porphyritic with elliptical phenocrysts of microperthite, many of which show embayments due to corrosion. Many of the phenocrysts are zoned with a later rim of feldspar. These features indicate that the phenocrysts were formed at depth and then intruded at higher levels in a liquid-crystal mush. Such a magma would be viscous. The magmatic pressure, however, was sufficient to force this magma into weak horizontal zones. The emplacement probably was a mile below the surface, and the force of the magmatic intrusion was able to form a sill under this relatively thin layer of overlying rocks.

Mt. Scott Granite is intrusive into the lower rhyolites of the Carlton Rhyolite Group, which is more than 4,500 feet thick. These lavas and pyroclastics were poured out or deposited upon the surface, and the intrusion of Mt. Scott Granite magma must have been relatively shallow, possibly a mile below the surface. The emplacement would be in the epizone as defined by Buddington (1959).

The granites and rhyolites of the Wichita Mountains have an age of approximately 525 million years, as determined from radioactive isotopes by Tilton, Wetherill, and Davis (1962). They probably are Middle Cambrian in age.

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Scribe-Drafting at the Oklahoma Geological Survey

The Oklahoma Geological Survey drafting department has recently adopted the scribe-drafting technique for the preparation of colored geologic maps. At the present time, two sets of maps, one of Oklahoma pipelines and another of the Blaine Formation and related units in southwestern Oklahoma, are being prepared by the new technique. An exhibit, consisting of the steps involved in the method, will be on display at the American Association of Petroleum Geologists Mid-Continent Regional Meeting (see page 273). Preliminary work copies of the pipeline maps will be used in the exhibit, which will be supervised and explained by a member of the Survey drafting department.

The scribe-drafting technique is of special value in the preparation of colored geological maps for printing, as it effects savings in time and costs while insuring high quality in the printed map both in accuracy and readability.

In the past, colored maps of the Survey were prepared by drawing a base map in ink, showing the culture, geography, and geological contacts. The inked map would then be photographed and the photographic negative would be used to make a printing plate for the black base upon which the color patterns were to be printed. A major disadvantage of the traditional technique is that the various line elements of the black base conflict with each other, making reading of complex maps difficult. To separate the elements of the base and to print them in different hues by the old method presented drafting and printing problems of some complexity.

Much of the work is made easier by the scribe-drafting technique. In this process, the draftsman works directly upon scribecoat, a dimensionally stable sheet of film covered with an opaque coating. By means of a stylus, the draftsman removes the coating by "scratching" the lines of the map, thus in effect directly producing a negative film from which a printing plate may be made.

The immediate advantage of the scribing technique is the elimination of the need for photographic reproduction of the map and the attendant problems of accuracy of scale and printing register. By the elimination of pen and ink, the drafting can be done at printing scale and lines of more uniform thickness can be more quickly drawn (errors are more easily and quickly corrected by restoring the coating with correcting fluid). One such hand-scribed negative is needed for each color used in a base map. To insure perfect register between negatives the image of one can be transferred to the coating of the next before the latter is scribed.

Mid-Continent Regional Meeting—AAPG

The Tulsa Geological Society will host one of the year's more important geological meetings, the American Association of Petroleum Geologists Mid-Continent Section Regional Meeting, October 13-15, at the Tulsa Civic Assembly Center. Theme for the Tulsa conclave is "Mid-Continent Plays . . . Past and Present." Some 20 papers will be presented by leading geologists from inside and outside the Mid-continent. Participating societies are from Wichita, Ardmore, Oklahoma City, and Amarillo.

Keynote speaker will be Morgan J. Davis, retired board chairman of Humble Oil & Refining Company. Ira H. Cram, vice president and chairman of the executive committee of Continental Oil Company, will speak at the Friday luncheon, October 15.

Many significant wildcat events have taken place in this part of the country since the last regular meeting in Oklahoma City. Oil finders will have an opportunity to hear all about them. The latest equipment and supplies will be on display. Tours of oil-company research laboratories Wednesday afternoon will give explorationists a front-line view of newest developments in the computer world, in palynology, geochemistry, and other new exploration methods; tours will include the research facilities of the Pan American Petroleum Corporation and Sinclair Oil & Gas Company.

One of the displays will be an exhibit of scribe-drafting by the Oklahoma Geological Survey (see page 272).

Among the papers to be presented at the meeting, the following should be of special interest to Oklahoma geologists:

Gas fields from the Hartshorne sand of the Arkoma basin, by Lester L. Wynn

The Oswego Limestone facies change in the Mid-Continent region, by W. E. Richardson

New approaches to Arkoma basin gas exploration, by Charles S. Bartlett, Jr.

The Criner-Payne area, a study in structural growth, by Lloyd Gatewood

Mississippian Osage, northwest Oklahoma platform, by L. O. Ward

The challenge of deep exploration—Chitwood pool, Grady County, Oklahoma, by Lee R. Riley

The Healdton Arbuckle field and its relationship to other potential Arbuckle structure, by Robert C. Larson

Stratigraphic traps in Northwest Quinlan and Cedardale fields, northwest Oklahoma, by Kenneth Holmes

Full information regarding the meeting can be obtained by communicating with Miss S. Grace Hower, Box 2040, Tulsa, Okla. 74102; telephone: 918-LU4-5554.

Petrodus in Oklahoma

Carl C. Branson

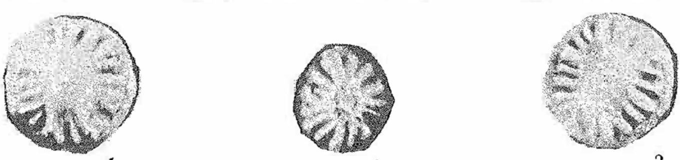
The fossil called *Petrodus* is abundant in some Pennsylvanian rocks in Oklahoma. It occurs in phosphatic nodules of the Excello Shale in Rogers County, in the Wewoka Formation along Lake Okmulgee, in the cap rock of a thin coal bed, and Stovall (1945) reported it from the Wewoka (sec. 33, T. 5 N., R. 8 E., Pontotoc County), the Wetumka (sec. 18, T. 3 N., R. 7 E., Pontotoc County), and the Francis Shale (Ada brick pit). Morgan reported it from the lower part of the Boggy Formation (1924, p. 83, pl. 53, fig. 14). The locality seems to be sec. 7, T. 3 N., R. 8 E., Pontotoc County, in the table on page 83, but on page 238 the locality is given as station 1669, seemingly a printing error for 169, which is in sec. 27, T. 3 N., R. 7 E., Pontotoc County.

Other records are by Weaver (1955, p. 29) from the Boggy of Hughes County, and by Ries (1955, p. 40) from the Wewoka of Okfuskee County. Mr. Mapes of Okmulgee collected one specimen from the basal Wewoka at VFW Point on Lake Okmulgee, Okmulgee County. Specimens are abundant in the two-inch cap rock of a quarter-inch coal seam in the Wewoka in NE¼ NE¼ sec. 2, T. 14 N., R. 12 E., Okmulgee County.

Specimens in our collection are from shale of Higginsville age at C E line sec. 9, T. 21 N., R. 13 E., Rogers County (OU 338, figs. 2, 3), from the Wewoka in SE¼ sec. 1, T. 10 N., R. 10 E., Okfuskee County, Wewoka on the shore of Lake Okmulgee (sec. 18, T. 13 N., R. 12 E.), Boggy Formation of Hughes County (C sec. 6, T. 4 N., R. 11 E.), and Wewoka in sec. 8, T. 13 N., R. 12 E., Okmulgee County.

Our collection also contains specimens of *Petrodus* from Pumpkin Creek Limestone Member of the Big Branch Formation in Johnston County (OU 4548), from the Boggy Shale of Pontotoc County (OU 4547), and from the lower part of the Deese Group in Carter County (OU 4546).

Petrodus was originally named and described by McCoy (1848), with type species *P. patelliformis*. The locality was given only as Carboniferous limestone of Derbyshire. Ford (1964) has located and described a locality which may have been the type locality of the species. He discussed thoroughly the literature and paleoecology. Dr. Ford has



1 *2* *3*

Petrodus occidentalis **Newberry and Worthen, x4.**
Figure 1. A symmetrical granule from the Wewoka Formation.
Figure 2. A small, irregular granule from shale of Higginsville age.
Figure 3. A symmetrical granule from the same bed and locality as that of figure 2.

donated more than 100 specimens to our collection and has sent a piece of dark limestone 0.75 inch thick crowded with *Petrodus*. The lot is cataloged as OU 4544. The locality is Steeplehouse quarry, Wirksworth, Derbyshire.

Newberry and Worthen (1866) described *P. acutus* from basal Desmoinesian rocks of Pike County and *P. occidentalis* from Desmoinesian rocks of St. Clair County, Illinois. Shagreen granules of this type are so variable even in the skin of an individual shark that species are not useful. The Oklahoma forms range from symmetrical grooved cones to compound linear crowns. They indicate in general that the site had a shallow, low-energy marine environment.

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Canadian River

Many place names in Oklahoma are subject to differences of opinion as to correctness or spelling. Many are names of streams, which, because the streams traverse large areas of the State, acquire local names at different places. Thus it is that the Canadian River is called "South Canadian" almost as frequently as it is called "Canadian." Most highway maps, including those of the Oklahoma State Department of Highways, show the stream as Canadian in the western half of the State and South Canadian in the eastern half. The U. S. Board on Geographic Names has recently rendered a decision (Decision List 6501, Decisions for January-March 1965) reaffirming the long-standing practice of the U. S. Geological Survey and the Oklahoma Geological Survey of regarding Canadian as the only correct name. The decision is quoted here:

> **Canadian River:** stream about 900 miles long, heading in the Sangre de Cristo Mountains just north of the Colorado-New Mexico border, at about 37° 00′ 30″ N., 105° 03′ 00″ W., and flowing generally southeastward into New Mexico, then eastward, through Texas and into Oklahoma, to the Arkansas River about 36 miles west of Fort Smith, Arkansas; Colorado, New Mexico, Oklahoma, and Texas; 35° 27′ 20″ N., 95° 02′ 00″ W. Not: Little Red River, Red River, Rio Colorado, South Canadian River, Upper Canadian River.

Heavy-Crude-Oil Reservoirs in Oklahoma

U. S. Bureau of Mines Information Circular 8263, *Heavy crude oil reservoirs in the United States: a survey*, completed in March 1965 by W. D. Dietzman, M. Carrales, Jr., and C. J. Jirik, gives general information on more than 2,000 heavy-oil reservoirs in more than 1,500 fields in 26 states. It is based upon work done in cooperation with the Oil-Recovery Committee of the Independent Petroleum Association of America. Information given on each deposit includes field and formation name, county, average or range of depth, average gravity, average thickness of formation, areal extent where known, number of wells, year of discovery, and cumulative production, if known. All known types of secondary-recovery projects initiated (active and terminated) in the reservoirs are indicated.

In Oklahoma, 99 field areas are listed, but without specific location such as township and range. In as much as some designated fields or districts may include as many as 13 townships, location of the reservoir will be difficult for interested persons not thoroughly familiar with the areas. Quite a few of the field names have been discontinued and have not been on oil- and gas-field maps for as long as 10 years. Now and in the future the location of these areas requires a historical search of maps and records. In all probability, the exact locations of these reservoirs may be obtained from the U. S. Bureau of Mines.

—L. J.

NOTE

The photograph of David White which appeared on the cover of the September 1965 issue of **Oklahoma Geology Notes** was obtained from the U. S. Geological Survey. Special thanks are due H. D. Miser and J. T. Dutro for having responded to our request with utmost promptness and courtesy. We regret having failed to give proper credit at the time.

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