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Silurian Stratigraphy of Northeastern Oklahoma

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SILURIAN STRATIGRAPHY OF NORTHEASTERN OKLAHOMA

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ABSTRACT

This report describes the lithostratigraphy of the Silurian strata in northeastern Oklahoma. The Silurian rocks have a small outcrop area scattered over parts of Adair, Cherokee, and Sequoyah Counties, and they have been traced in the subsurface as far west as eastern McIntosh County. A detailed investigation has been made of these strata at the outcrop, in 7 diamond-core holes, and in 17 rotary and cable-tool holes. This investigation is based upon a field study of the stratigraphic relations and upon a laboratory study of the lithologic characteristics by means of thin sections, insoluble residues, chemical analyses, well cuttings, and electric logs. Substantial fossil collections have been made from some of the Silurian formations, and a few general remarks are given on the biostratigraphic and age relationships, but this report does not include any descriptive paleontology.

All the Silurian rocks in this area have heretofore been referred to a single stratigraphic unit, the St. Clair Formation. The name St. Clair was first applied to a sequence of Silurian strata in the Batesville district of north-central Arkansas and was later introduced into Oklahoma because of the presumed lithologic and faunal similarities. We propose to abandon the name St. Clair in Oklahoma for the following reasons. (1) The outcrops in Oklahoma and Arkansas are separated by about 200 miles in which Silurian rocks are largely buried by younger strata, thus making it impossible to trace the beds directly from one area to the other. (2) The lithologic character and lithostratigraphic sequence of the rocks in these two areas are quite different. (3) The oldest Oklahoma Silurian strata are older than the type St. Clair, and the youngest are probably younger than the type St. Clair. The "St. Clair" of Oklahoma may include some strata which are equivalent in age to the type St. Clair, but the faunal evidence available at this time is inconclusive. We therefore propose to eliminate the name St. Clair in Oklahoma and to divide the Silurian strata into the following formations and members, all new:

Marble City Member Barber Member	} Quarry Mountain Formation
Tenkiller Formation	
Blackgum Formation	(locally includes the Pettit Oölite Member at its base)

The Silurian rocks of northeastern Oklahoma are all carbonate strata with a fairly low insoluble-residue content; in the Quarry Mountain Formation few residues exceed 1 percent, and in the Tenkiller and Blackgum Formations the residues average only 3 to 4 percent, with a maximum of about 10 percent. Some dolomite is present in all the stratigraphic units, and the Barber Member and lower part of the Blackgum Formation are composed largely of finely crystalline dolomite. The over-all pattern of dolomite distribution in the Silurian and Lower Devonian is along well-defined stratigraphic zones, from which we conclude that the $MgCO_3$ was introduced early in the depositional history of these strata. Excluding the more dolomitic parts, these rocks are predominantly grain-supported bioclastic calcarenites with pelmatozoan plates making up a considerable part of the fossil clasts. The matrix may be either lime mud (biomicrite) or crystalline calcite (biosparite). The strata show no evidence of reefs or of organic mounds which were built up above the general level of the surrounding sediments.

The lithostratigraphic sequence in northeastern Oklahoma is quite different from that of the Arbuckle Mountains-Criner Hills province, and we do not believe that the Silurian stratigraphic terminology of the latter is applicable to northeastern Oklahoma.

Many chemical analyses have been prepared from the Silurian rocks; these include numerous $CaCO_3$, $MgCO_3$, and HCl-insoluble residues, as well as some complete analyses, including spectrographic analyses for trace elements. These data are tabulated in the appendix.

INTRODUCTION

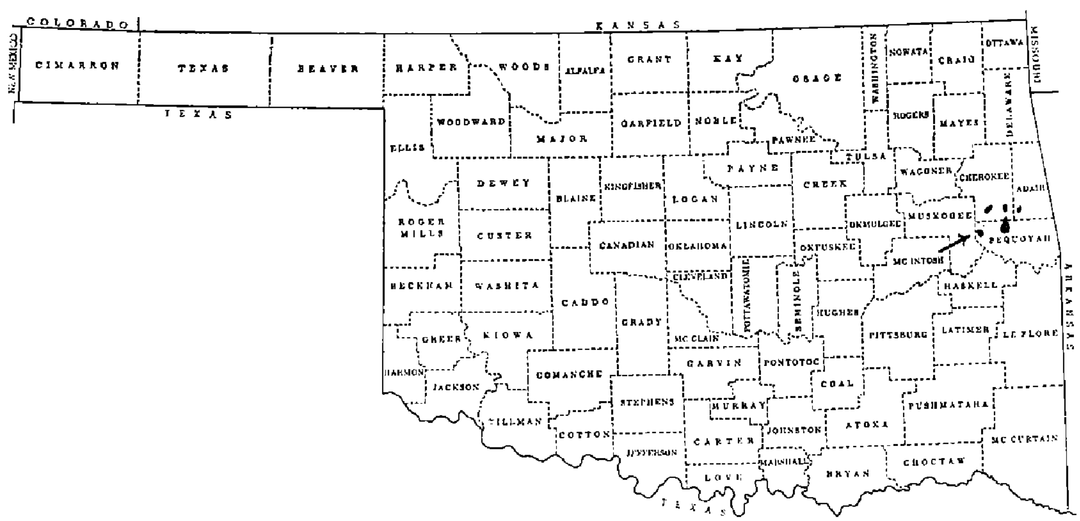
The Silurian rocks of northeastern Oklahoma are exposed in a series of small outcrop belts in the southern parts of Adair and Cherokee Counties and in the northern part of Sequoyah County (text-fig. 1). These strata range in age from Early Silurian (Llandoverian) to Middle or possibly early Late Silurian (Ludlovian). Throughout this area Silurian strata are underlain by the Sylvan Shale of Late Ordovician age (Decker and Huffman, 1953, p. 451). They are separated from the overlying beds by an unconformity so that at different places they may be overlain by the Frisco Formation of Early Devonian age (Deerparkian) (Amsden and Ventress, 1963, p. 41-59), by the Sallisaw Formation of latest Early Devonian age (Esopusian) (Amsden, 1963a, p. 150-162), by the Chattanooga Formation of Late Devonian and Early Mississippian age (Hass, 1956, p. 1, 2, 21, 25), or by the "Boone" limestones and cherts of Mississippian age. For many years the Silurian rocks of northeastern Oklahoma have been referred to as the St. Clair Formation, but we purpose to abandon this name and to divide these strata into the following lithostratigraphic units:

Marble City Member }
Barber Member } Quarry Mountain Formation

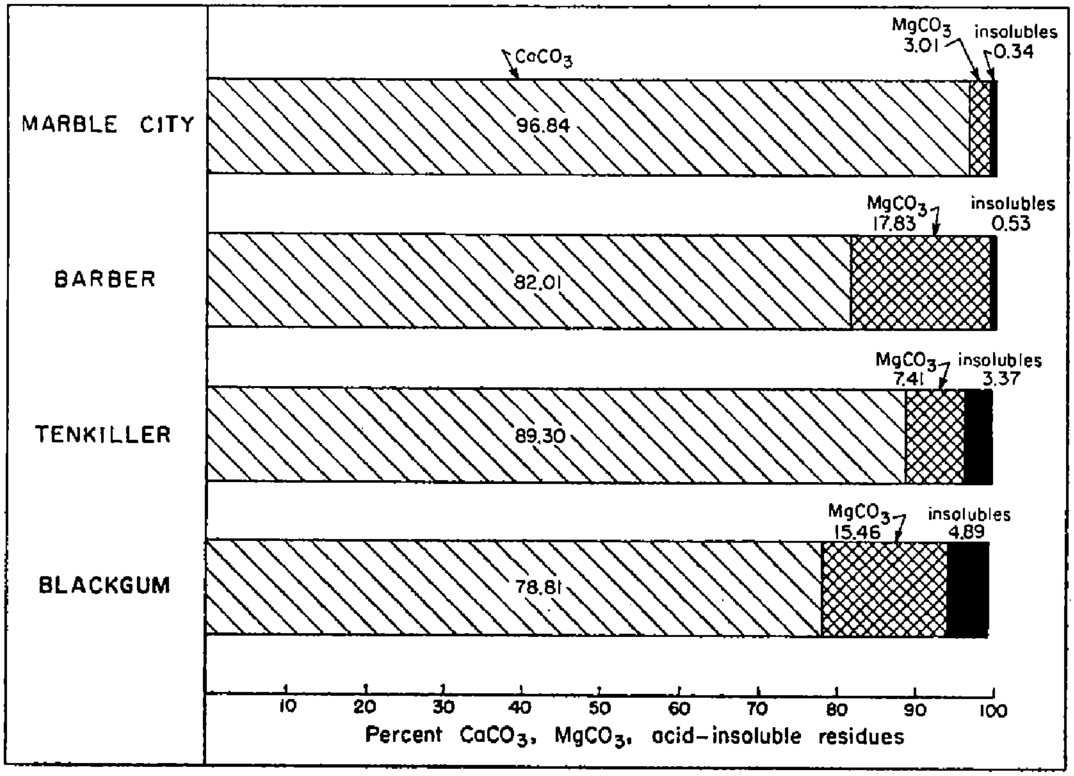
Tenkiller Formation

Blackgum Formation
  Pettit Oölite Member (locally at base)

These are all carbonate rocks with a relatively low acid-insoluble content (text-fig. 2). The Quarry Mountain Formation averages



Text-figure 1. Map showing location of the Silurian outcrop belts in northeastern Oklahoma. See also maps (plates A, B) and text-figure 3.



Text-figure 2. Bar graph comparing the average $CaCO_3$, $MgCO_3$, and HCl acid-insoluble content of the Blackgum Formation, Tenkiller Formation, and Barber and Marble City Members of the Quarry Mountain Formation. These are unweighted arithmetic means compiled from the data given in appendix II. For additional information on the composition of these stratigraphic units, see discussion on lithologic character for each formation and the section on Stratigraphic Distribution of Dolomite.

less than 1 percent acid insolubles; the Tenkiller averages 3.4 percent acid insolubles, and the Blackgum 4.9 percent acid insolubles; the Pettit Oölite Member is commonly silicified and has not been analyzed for acid insolubles or $MgCO_3$. Some $MgCO_3$ is present in all the stratigraphic units (text-fig. 2), although its distribution is irregular. The Marble City Member averages about 3 percent $MgCO_3$, and locally, as in the area now being mined by the St. Clair Lime Company, it is a high-calcium stone of exceptional purity. The Barber Member is largely a finely crystalline calcitic dolomite with an $MgCO_3$ content averaging more than 17 percent. The Tenkiller Formation is a limestone with an average $MgCO_3$ content of 7.4 percent. The upper part of the Blackgum Formation is a limestone with irregular patches of dolomite, whereas the lower part is mostly finely crystalline calcitic dolomite. Excluding the dolomite, these rocks are predominantly grain-supported bioclastic calcarenites, with pelmatozoan plates making up a substantial part of the fossil clasts; the matrix may be either lime mud (biomicrite) or crystalline calcite (biosparite). These Silurian (and Early Devonian) stratigraphic units appear to represent relatively thin sheets of organic debris which spread out on the sea floor, in some places for considerable distances. The strata show no evidence of reefs or of organic mounds built up above the general level of the surrounding sediments.

Surface exposures. — Silurian rocks are exposed in only a few small areas in parts of Sequoyah, Adair, and Cherokee Counties (pls. A, B; text-fig. 3). The largest area is in Sequoyah County, a short distance north of Marble City, along Payne and Walkingstick Hollows, and on the east side of Quarry Mountain. Only the upper part of the Silurian, the Quarry Mountain Formation and a few feet of uppermost Tenkiller beds, crops out in this area (several diamond-core holes are located here). The Marble City Member is well exposed by natural outcrops and in the quarries and underground mines of the St. Clair Lime Company; the Barber Member and part of the Tenkiller Formation are exposed on the south and the east sides of Quarry Mountain. To the north and east of the Marble City belt are a few small, scattered outcrops of Silurian beds; all are restricted to the Marble City Member except for a belt of Barber which crops out along a tributary of Dry Creek, about 3 miles south of the town of Barber. The only other Quarry Mountain outcrop is about 3 miles west of Tenkiller dam, where a few feet of the Marble City Member crops out.

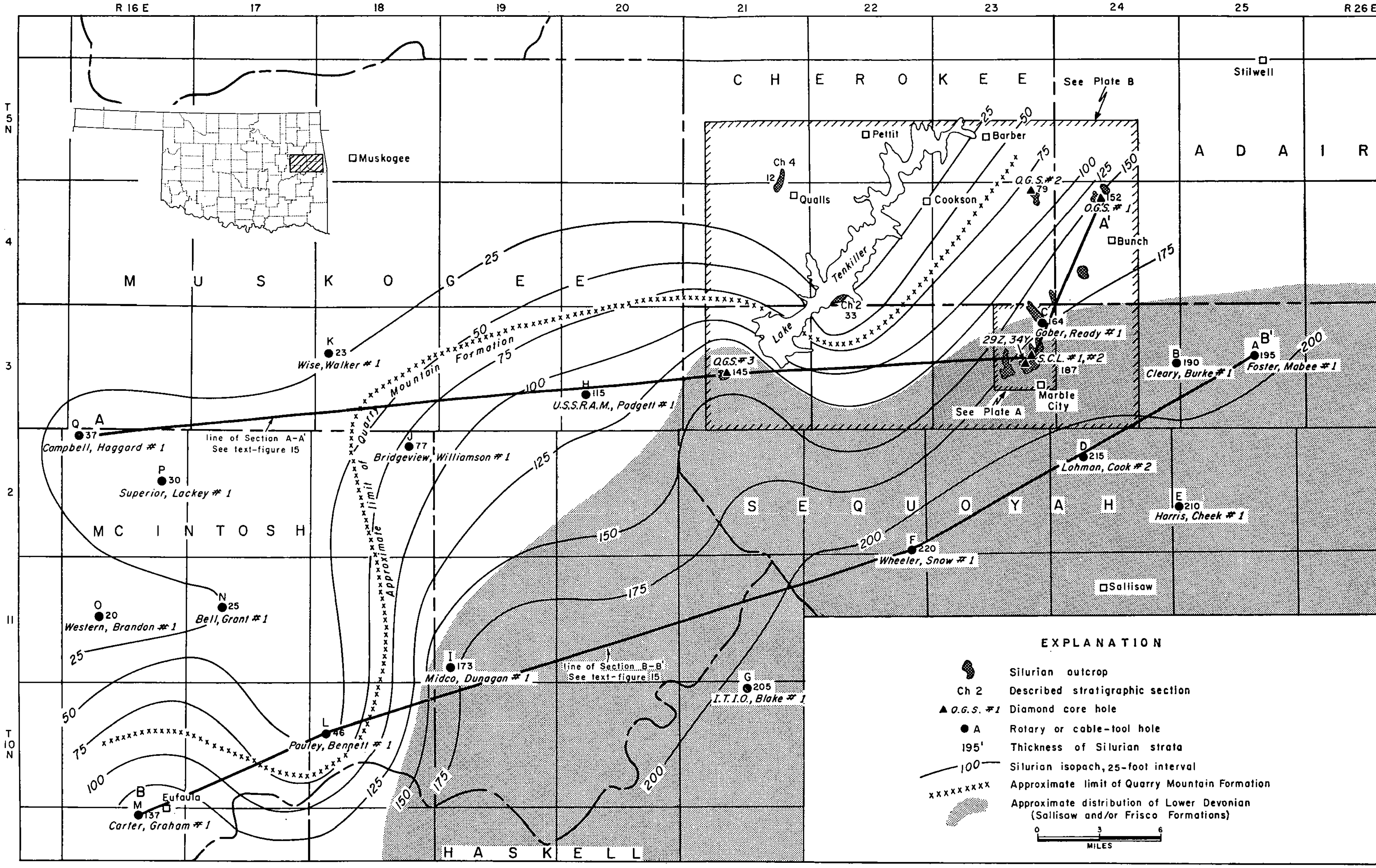
The lower part of the Silurian section is exposed in two areas. One of these is along the southeast shore of Lake Tenkiller, about 3 miles northeast of the dam. The Tenkiller Formation and Blackgum Formation (including the Pettit Oölite) are exposed here, underlain by the Ordovician Sylvan Shale. In this area the Tenkiller is directly overlain by the Chattanooga, the Quarry Mountain Formation having been removed by pre-Chattanooga erosion. The Blackgum, Pettit, and Sylvan are also exposed in a small area near Qualls in Cherokee County. Here pre-Chattanooga erosion has removed all of the Quarry Mountain and Tenkiller Formations, allowing the Sylamore Sandstone to rest upon the Blackgum.

At no place is there a complete and continuous exposure of the entire Silurian section. In all Quarry Mountain outcrop areas the base is not exposed, and in those areas where the Blackgum and Tenkiller are exposed, pre-Chattanooga erosion has removed the Quarry Mountain Formation. The complete section must therefore be determined from a study of surface outcrops plus subsurface information. Fortunately a substantial amount of subsurface information is now available from continuous diamond-drill cores, supplemented by data obtained from rotary and cable-tool cuttings.

Subsurface information. — In the summer of 1962, the Oklahoma Geological Survey had three diamond-core holes drilled through the Silurian strata and into the underlying Ordovician rocks (see Subsurface Investigation). One of these (OGS 1) is in Malloy Hollow, about 2 miles north of Bunch, Adair County (text-fig. 3; pl. B). This hole started about 10 feet below the top of the Marble City Member and cut the Barber, Tenkiller, and Blackgum sections, ending in the Sylvan Shale. The second hole (OGS 2), about 2 miles southeast of Barber, started near the top of the Barber Member and penetrated the Tenkiller and Blackgum Formations, also ending in the Sylvan Shale. A third hole (OGS 3), about 2 miles west of Tenkiller dam, started near the top of the Marble City Member and went through the Silurian and the Upper Ordovician, ending in the Tyner Formation. Several core holes have been drilled in the Marble City area, and Homer Dunlap, general manager of the St. Clair Lime Company, has generously furnished the Oklahoma Geological Survey with cores from this project. Most of these holes were confined to the Quarry Mountain Formation, but two were taken to the Blackgum Formation and one of these went through the Blackgum into Sylvan Shale. Core recovery in all of these holes approached 100 percent. The lithostratigraphic units exposed at the surface can be easily recognized in the cores, and they thus furnish precise and detailed stratigraphic information. These core holes are described in appendix IB.

The diamond-core data have been supplemented by a study of rotary and cable-tool cuttings from holes in Sequoyah, Muskogee, Haskell, and McIntosh Counties (text-fig. 3). The stratigraphic divisions recognized at the surface and in the cores can be recognized in the cuttings, although the information obtained from these wells is not so accurate or detailed as that obtained from the cores. These data are, however, of particular value because they yield information from a relatively large geographic region.

Lithologic terminology. — The Silurian rocks of northeastern Oklahoma are carbonates which only rarely have more than 10 percent acid insolubles and therefore fall almost entirely into the category of Pettijohn's (1957, p. 410) "pure" limestone (or dolomite) and Leighton and Pendexter's (1962, p. 51) limestone (or dolomitic limestone, etc.). The magnesium carbonate content is highly variable and ranges from high-calcium limestone with only a fraction of a percent $MgCO_3$ to calcitic dolomite with as much as 36 percent $MgCO_3$. With slight modification we follow the classification given by Pettijohn (1957, p. 417), Leighton and Pendexter (1962, p. 51), and others, which recognizes limestone, dolomitic



Text-figure 3. Map showing location of Silurian outcrops, diamond-core holes, and rotary and cable-tool holes in northeastern Oklahoma. Silurian outcrop areas are generalized and exaggerated; for more detailed maps see plates A, B. The diamond-core holes and rotary and cable-tool holes are described in the appendices IB, IC.

limestone, calcitic dolomite, and dolomite. In this system the divisions between these categories are:

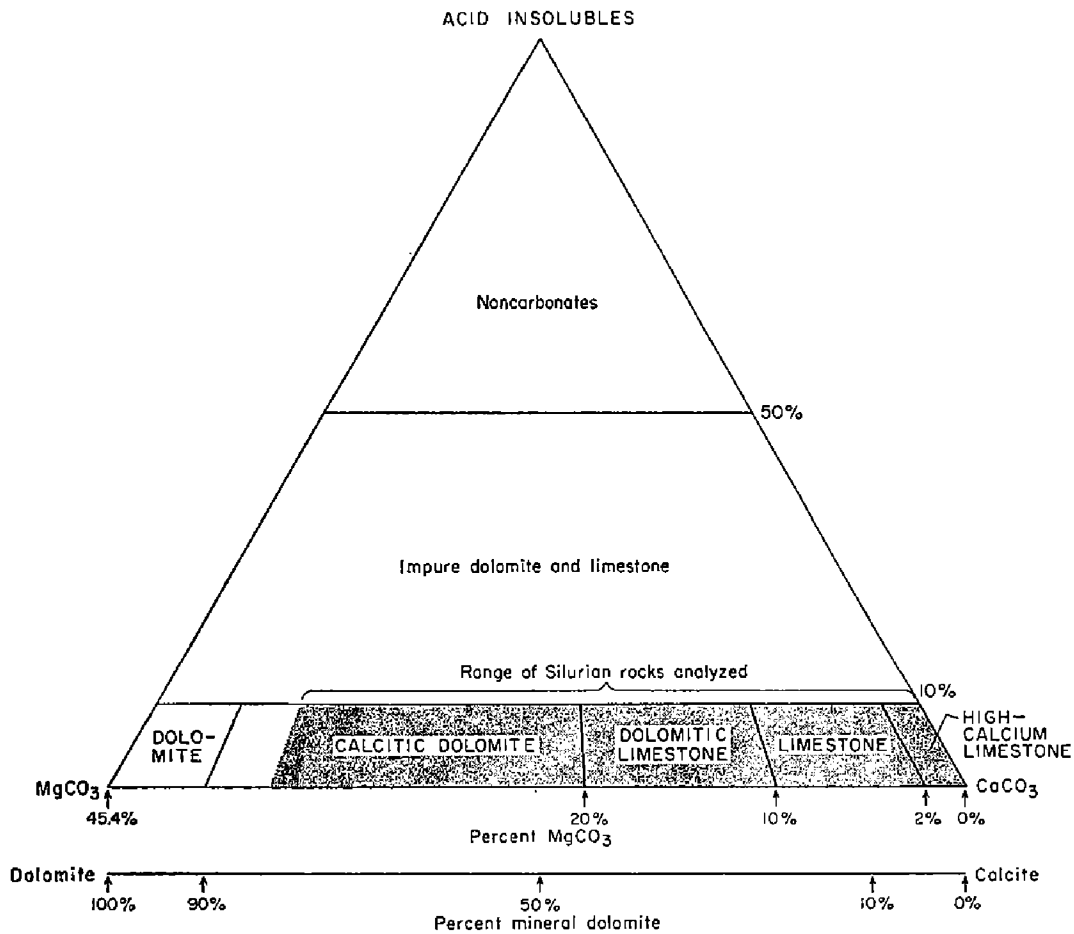
	Percent $MgCO_3$	Percent dolomite
limestone		
	4.4	10
dolomitic limestone		
	22.7	50
calcitic dolomite		
	41.0	90
dolomite		

Our calcium and magnesium data are given as percentages of $MgCO_3$ and $CaCO_3$, rather than as percentages of the minerals dolomite and calcite, and are more conveniently presented on stratigraphic sections and elsewhere using the divisions cited below.

	Percent $MgCO_3$
high-calcium limestone	
	2
limestone	
	10
dolomitic limestone	
	20
calcitic dolomite (no rock tested had more than 37% $MgCO_3$)	

Text-figure 4 shows graphically the classification used in this report, the shaded portions indicating the categories represented by the Silurian rocks described herein.

In describing the texture of these rocks, we use essentially the same terminology as that employed in earlier reports of the senior author (Amsden, 1960, p. 180; 1961, p. 13). Almost all the limestones and dolomitic limestones are bioclastic grain-supported rocks, composed in large part of fossil debris. This fossil debris represents most of the middle Paleozoic invertebrates, but pelmatozoans are especially abundant, along with brachiopods, bryozoans, trilobites, and ostracodes. The matrix may be either sparry calcite or finely divided carbonate, and thus most fall within Folk's (1959, p. 18) categories of biosparite (pl. VII, figs. 2, 6) or biomicrite (pl. VII, figs. 3, 5), or within Dunham's (1962, p. 117) grainstone or packstone. The grain size is determined largely by the fossil fragments; most are calcarenites, with a few ranging into calcirudites or calcilutites. As the magnesium carbonate content increases, the fossil content decreases and the calcitic dolomites are largely finely crystalline dolomite (pl. XII, fig. 2). No reef or reeflike structures have



Text-figure 4. Diagram showing the carbonate terminology used in this report. The stippled areas indicate the range of the Silurian rocks analyzed for this report (see appendix II). The sample with the greatest dolomite content analyzed 36.3 percent $MgCO_3$. One specimen (basal Blackgum) tested 12.06 percent acid insolubles; all others had less than 10 percent.

been observed and there appears to be little or no intergrown skeletal material (boundstone).

St. Clair Limestone. — The name St. Clair has been applied to all the Silurian rocks in northeastern Oklahoma. This name was first used by Penrose (1891, p. 102) for some Ordovician and Silurian limestones exposed in the area near Batesville, Arkansas. In 1892, Williams (p. 281-283) restricted the name to the Silurian limestones overlying the Cason Shale; St. Clair Spring, about 8 miles northeast of Batesville, was designated the type locality. Some years later Miser (1922, p. 29-32) gave a careful description of the St. Clair and mapped it throughout its outcrop area. Miser noted that the St. Clair Limestone was locally overlain by a reddish-gray earthy limestone, which he named the Lafferty Limestone. Throughout much of the Batesville district the Lafferty is absent, and the St. Clair is directly overlain by the Penters Chert or the Boone Chert. Ulrich

(Miser, 1922, p. 32) assigned the Lafferty to the Silurian and correlated it with the Dixon Formation of western Tennessee, but to our knowledge no diagnostic fossils have been obtained from this formation. The St. Clair is richly fossiliferous, and in places excellent fossils can be broken out of the rocks. Ulrich (Miser, 1922, p. 31) assigned this formation to the Niagaran Series* and correlated it with the Rochester Shale and Laurel Limestone. Ulrich and Mesler (1926, p. 244) noted that the fauna as a whole is "much more closely allied to the Silurian fauna of Bohemia than to the usual American, British, and Gotland faunas of the same period," but this observation requires verification, or at least elaboration, by a more careful faunal study. Thomas (1926, 1928) described and illustrated some of the St. Clair brachiopods, Ulrich and Cooper (1936) described and illustrated those brachiopods representing the family Triplesiidae, and Van Ingen (1902, p. 34-72) and Thomas (1929, p. 115-128, pls. 9, 10) described some of the St. Clair trilobites. These are the only publications known to us which describe any considerable part of the St. Clair fauna.

The name St. Clair was introduced into northeastern Oklahoma by Drake (1898, p. 342-346) upon the basis of a geological reconnaissance trip through what was then the northern part of the Indian Territory. It is clear from Drake's text and map that he applied this name to that part of the Silurian and Lower Devonian strata exposed in the outcrop belts situated north of Marble City, northwest of Bunch, and southwest of Barber; compare his map (p. 344) with the map shown in text-figure 3 and plate B of the present report. These are the strata which we assign to the Lower Devonian Sallisaw and Frisco Formations and to the Silurian Quarry Mountain Formation plus a few feet of upper Tenkiller strata. Drake did not discuss the fauna of these strata, and his use of St. Clair apparently was based upon the lithologic similarity between the Oklahoma and Arkansas rocks.

Taff (1905, p. 2), in his study of the Tahlequah quadrangle, continued to use the name St. Clair (as St. Clair Marble). In the Tahlequah area the lower part of the Silurian section is not exposed, and Taff's St. Clair is largely equivalent to the Quarry Mountain Formation, plus the overlying Lower Devonian Sallisaw and Frisco

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* For many years American stratigraphers have considered Niagaran Series and Middle Silurian series as synonymous, and assumed these strata to be equivalent to the Wenlockian (i. e., Middle Silurian) of Great Britain. It is now known that the basal part of the American Niagaran or Middle Silurian series carries fossils of late Llandoverian age (i. e., Early Silurian of European usage) and that the upper part carries fossils of early Ludlovian age (i. e., Late Silurian of European usage). The St. Clair fauna of Arkansas is probably of Wenlockian age.

Formations. This report included a short list of fossils identified by Ulrich. Upon the basis of these fossils Ulrich considered the Oklahoma St. Clair to be precisely equivalent to the St. Clair of Arkansas, assigning both to the Niagaran Series. In later papers, however, Ulrich (1911, p. 559; 1927, p. 32) stated that the St. Clair of the Marble City area was younger than the type St. Clair (the latter being correlated with the Clarita Limestone of the Arbuckle region).

Schuchert (1922, p. 667-670) was the first to recognize that the St. Clair of the Marble City area included Lower Devonian strata (which he referred to the "upper Oriskany white limestone"). Later Cram (1930, p. 548-551) assigned these Lower Devonian beds to the Frisco and Sallisaw Formations (see Amsden, 1961, and Amsden and Ventress, 1963, for a discussion of the lithostratigraphy and biostratigraphy of these formations). Cram continued to use the name St. Clair for the upper part of the Silurian section (Quarry Mountain and Tenkiller Formations) exposed in the outcrop belts north of Marble City. He did not know of the exposures of older Silurian strata near Lake Tenkiller and Qualls, as he stated that the base of the Silurian was not exposed in eastern Oklahoma.

Ham and others (1943) discussed the stratigraphy and chemical composition of the St. Clair Formation in the Marble City area. The St. Clair of these authors is largely equivalent to the Quarry Mountain Formation (mostly Marble City Member) of the present report, although it did include the Frisco Formation at the top and a few feet of the Tenkiller at the base. Some of the chemical data from their report have been included in the present report. The geology of the Marble City area was described in detail by Christian (1953), and the Sallisaw, Frisco, and St. Clair were mapped as separate formations.

Huffman (1953, p. 447) was the first to report that the Sylvan Shale and overlying basal Silurian strata are exposed in northeastern Oklahoma. In a later report (1958, p. 29-33) he described the Lower Silurian rocks which are exposed near Qualls and Blackgum Landing (these are the strata herein referred to the Blackgum Formation and the Tenkiller Formation). Huffman applied the name St. Clair to all the Silurian strata (post-Sylvan pre-Chattanooga) in northeastern Oklahoma and mapped them as a single stratigraphic unit.

The senior author has examined the St. Clair Formation at a number of places in the Batesville district: at the type locality near St. Clair Spring, NE¼ NE¼ sec. 24, T. 14 N., R 6 W.; Cason mine, S½ SW¼ sec. 34, T. 14 N., R. 6 W.; the limestone quarry southwest of Cason mine, NE¼ sec. 4, T. 13 N., R. 6 W.; outcrops northwest of Cason mine, secs. 20, 21, T. 14 N., R. 6 W.; Searcy Spring, SW¼ SW¼ sec. 11, T. 14 N., R. 6 W.; and at Love quarry on the east bank of the White River in Izard County. Throughout this area the St. Clair is a light pinkish-gray to bluish-gray limestone, with the general appearance of thick, massive beds, but which on closer examination, especially of weathered surfaces, will commonly reveal somewhat thinner bedding (pl. I, figs. 1, 4). It is a bioclastic rock, generally with a biomicritic texture, although some beds have a considerable amount of sparry calcite (pl. I, figs. 2, 3). In thin section the fossils have sharp outlines and show little or no evidence of alteration. The rock appears to have a low acid-insoluble content and a low dolomite content (we have not tested any of this rock).

The St. Clair is richly fossiliferous, and the senior author has collected a number of fossils from outcrops in the Batesville district. In addition he has borrowed the large St. Clair brachiopod collections from the U. S. National Museum and plans to describe this brachiopod fauna in the near future. Although much detailed work remains to be done, the study has progressed far enough to give some idea of the major constituents in the fauna. This fauna has a marked similarity to that of the Clarita Member (Chimneyhill Formation) in the Arbuckle region, but faunal evidence bearing upon its correlatives within the Silurian of northeastern Oklahoma is meager. The St. Clair-Clarita faunas are probably Middle Silurian (i. e., Wenlockian) in age.

Apparently the St. Clair is everywhere underlain by the Cason Shale which is generally assigned, on meager evidence, to the Upper Ordovician. Ulrich (Miser, 1922, p. 29) reported Brassfield fossils from the "residual" clays at the top of the Cason Shale, but Miser did not find outcrops of Brassfield Limestone in this area.* All out-

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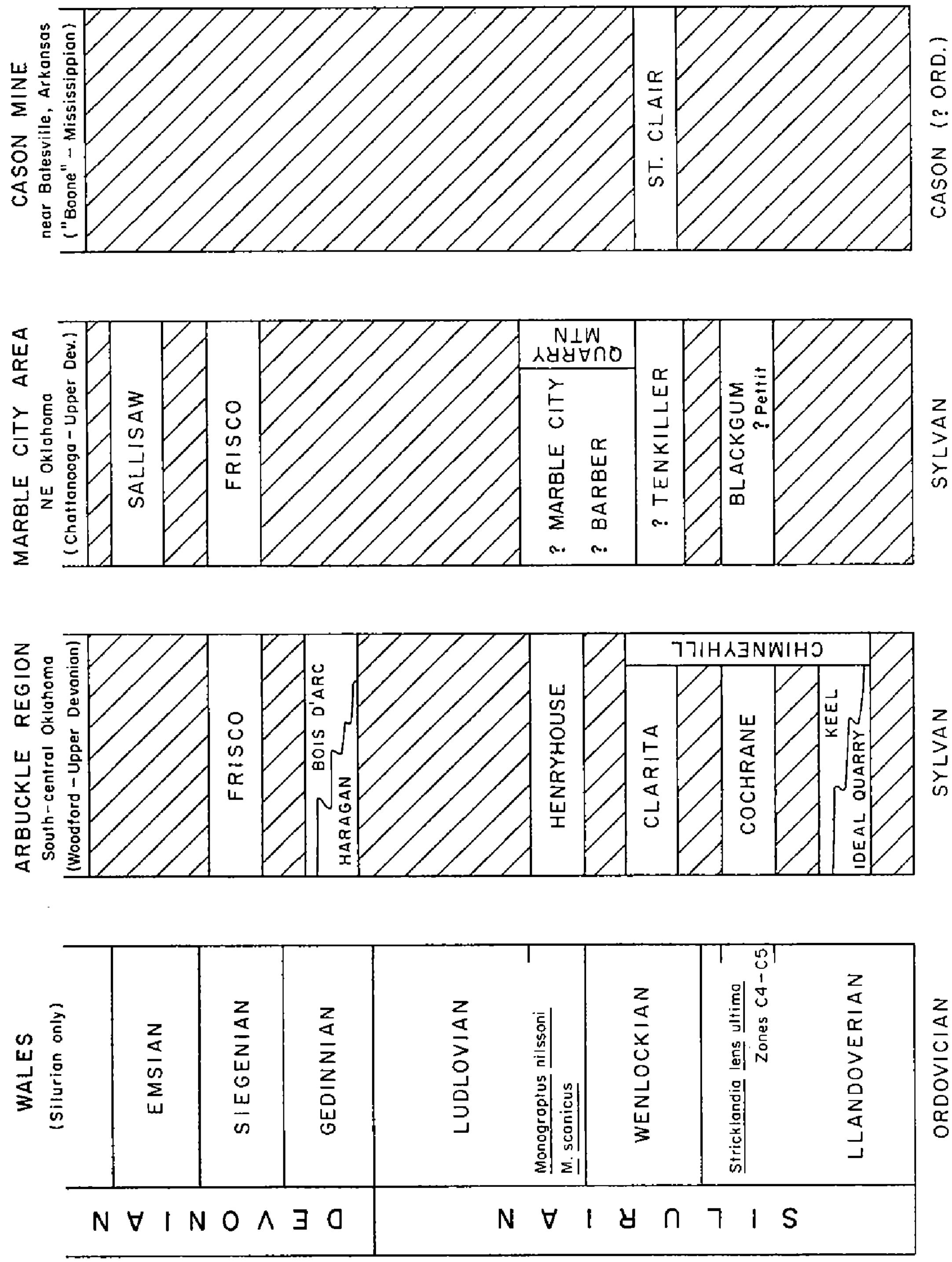
* In 1936 Ulrich and Cooper (p. 346, pl. 48, fig. 23; pl. 50, figs. 11, 14, 16, 17, 20, 21, 24) described a new brachiopod species, *Triplesia alata,* based upon specimens from the Brassfield Formation at several localities in Arkansas. One of their figured specimens (pl. 50, figs. 16, 17, 20, 21) was reported to be from the Brassfield at the Cason mine, but this must be an error as the St. Clair rests directly upon the Cason Shale at this locality (pl. 1, figs. 1, 4). This same specimen was previously illustrated by Miser (1922, pl. 7, fig. 1), who recorded it as coming from the Montgomery mine, located several miles north of the Cason mine. The senior author has studied Ulrich and Cooper's type specimens of *T. alata,* which appear to be conspecific with specimens from the Blackgum Formation (*Microcardinalia triplesiana* beds) of northeastern Oklahoma, and the Cochrane Member (Chimneyhill Formation) of the Arbuckle Mountains region.



Text-figure 5.
(See explanation, opposite page)

crops of the base of the St. Clair examined by Amsden show it resting directly upon the Cason Shale. This contact appears to be sharply defined (pl. I, fig. 4) except in the north cut of the Cason mine (pl. I, fig. 1) where there is strong manganese mineralization of the upper Cason and lower St. Clair. In most places the St. Clair is unconformably overlain by either the Penters Chert or the Boone Chert. Its thickness varies greatly (Miser reported a maximum of 100 feet at the Cason mine) and in places it has been completely removed by pre-Boone erosion (Miser, 1922, pl. 1).

We see no valid lithostratigraphic or biostratigraphic reason for using the name St. Clair in Oklahoma. In the type area the St. Clair Formation is a fairly compact stratigraphic and faunal unit, whereas in Oklahoma it includes several distinct formations, at least some of which have no lithologic or faunal resemblance whatsoever to the type strata.

The oldest Silurian Formation in northeastern Oklahoma is the Blackgum, which is quite unlike the type St. Clair. The Blackgum is a bioclastic limestone, weathering dark gray to almost black, with substantial amounts of chert. It has some acid insolubles, mostly glauconite. Dolomite is scattered through the rock, and, in the lower part, it grades into a crystalline calcitic dolomite. This formation carries a fauna believed to be older than that of the type St. Clair. The brachiopods *Triplesia alata* and *Microcardinalia triplesiana* point to a relationship with the Sexton Creek Limestone of southern Illinois and eastern Missouri, and the Brassfield Limestone of Ohio and adjacent areas. *M. triplesiana* is especially significant because its phylogenetic stage of development closely matches that of *Stricklandia lens ultima* which Williams found in zones C4 and C5 of the upper Llandoverian of Wales (Williams, 1951, p. 87, 103; Boucot and Ehlers, 1963). The age of the Pettit Oölite is unknown. Where present, it is always below the carbonate beds of the Black-

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Text-figure 5. Chart showing the inferred relationship between the Silurian and Early Devonian strata in the Arbuckle Mountains region of south-central Oklahoma, the Marble City area of northeastern Oklahoma, and the type region of the St. Clair Formation near Batesville, north-central Arkansas. Substantial faunal evidence supports the correlation of Blackgum with Cochrane, and Clarita with St. Clair; the indicated relationship of the Marble City, Barber, and Tenkiller faunas with those from the Arbuckles and the type St. Clair is provisional and requires more study. Throughout much of the Batesville district, Arkansas, the St. Clair is directly overlain by the "Boone," but locally the Lafferty Limestone intervenes. In a few restricted areas some Brassfield may be present between the St. Clair and the Cason, but this is not the case at Cason mine (pl. I, figs. 1, 4); faunal evidence bearing upon the age of the Cason Shale is meager. The postulated correlation of these strata with the Silurian sequence in Wales is indicated in the left column; only the Silurian portion is taken from Wales, the Devonian divisions being based upon rocks exposed on the European continent. This chart is not to scale, either in terms of stratigraphic thickness or of time.

gum and above the Sylvan Shale. To our knowledge no oölite is present in the Batesville district.

The Marble City Member of the Quarry Mountain Formation is the youngest Silurian rock present at the surface in northeastern Oklahoma. This is a light-gray to pinkish-gray bioclastic limestone with bedding somewhat more obscure than that in the type St. Clair. It shows some megascopic and microscopic evidence of recrystallization or alteration, and some of the earlier investigators called it a marble. The fossils making up this rock commonly have somewhat obscure outlines, and in this respect the lithology differs from that of the St. Clair and the Tenkiller Formations. It is predominantly a biosparite; irregular bodies of dolomitic limestone are common, and the Marble City grades downward into the Barber Dolomite. The Marble City Member and upper part of the Barber Member have yielded a substantial megafauna. This fauna has not been studied in detail, but enough work has been done to show that it differs from the typical St. Clair in several important respects. These differences may in part reflect slight biofacies variations, but we are inclined to agree with Ulrich's conclusion that the Marble City fauna is younger than that of the type St. Clair.

The type St. Clair is lithologically most similar to the Tenkiller Formation. In color, bedding, and texture the two have much in common, although the Tenkiller undoubtedly has more dolomite. We have no diagnostic megafossils from the Tenkiller and therefore cannot comment on its faunal relationship to the St. Clair.

Our reasons for abandoning the name St. Clair in Oklahoma can be summarized as follows: The Oklahoma and Arkansas outcrops are separated by approximately 200 miles in which Silurian and Devonian rocks are largely covered by younger strata. It is, therefore, impossible to trace the beds from one area to the other by means of surface exposures, and correlation must be established on either lithologic or faunal characteristics. In so far as lithology is concerned, the Oklahoma Silurian sections differ from the Arkansas section in several important respects. The Oklahoma strata comprise several distinct stratigraphic units, of which only one, the Tenkiller Formation, shows any really close lithologic resemblance to the type St. Clair. Moreover, the Oklahoma "St. Clair" includes several faunal units, the oldest of which is certainly older than the type St. Clair, and the youngest of which is in all probability younger than typical St. Clair. The Oklahoma "St. Clair" may include some strata which are correlative with the Arkansas St. Clair, but the evidence for this is at present inconclusive and it therefore seems best to eliminate St. Clair and use only local names which have an unquestionable relationship to their type sections.

The inferred relationships of the Silurian strata in northeastern Oklahoma to those in the Arbuckle Mountains region of south-central Oklahoma and the Batesville district of north-central Arkansas are indicated in text-figure 5.

Present investigation.—The present study is concerned primarily with the lithostratigraphy of the Silurian in northeastern Oklahoma. We are including brief sections on fossils and age for each stratigraphic unit, but the major biostratigraphic relationships will be treated in later papers. The primary basis for the present study is a field investigation of the Silurian and Lower Devonian (post-Sylvan pre-Chattanooga), which includes detailed geologic mapping, description of stratigraphic sections, and collection of fossils and lithologic specimens. The senior author's field work has extended over several years, beginning in the spring of 1959 and continuing into the spring of 1963. During this investigation he has been aided by T. H. Warren and F. H. Manley; in addition he and the junior author have spent considerable time together. Rowland was employed by St. Clair Lime Company for two years, during which time he worked on various aspects of the Quarry Mountain Formation and overlying Devonian rocks. We have jointly studied diamond cores of the Silurian section, and Rowland logged the cuttings of a number of rotary and cable-tool holes.

Our field investigation has been supplemented by a study of numerous thin sections, plus the analyses prepared by John A. Schleicher in the chemical laboratory of the Oklahoma Geological Survey. The analyses have been valuable in furnishing information on the calcium and magnesium distribution in precise percentages rather than as estimates.

Acknowledgments.—We appreciate the help of William E. Ham, with whom we have conferred upon various field and laboratory problems. Also we wish to thank Mr. Homer H. Dunlap and Mr. Terry K. Dunlap, of the St. Clair Lime Company, for furnishing information and cores of the Silurian rocks in the Marble City area.

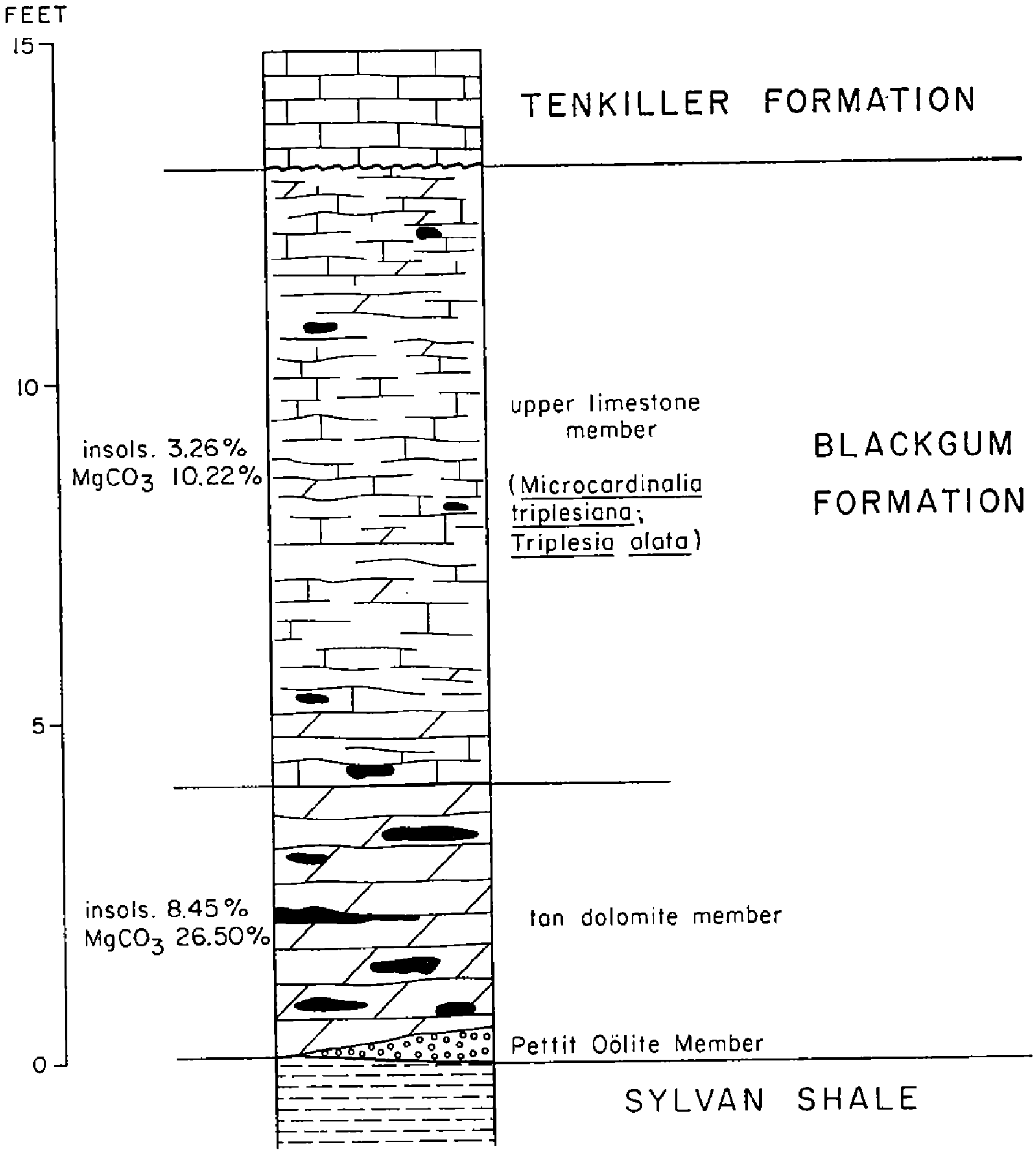
BLACKGUM FORMATION

Blackgum Formation is a new name here proposed for strata formerly referred to the basal part of the "St. Clair Formation" of northeastern Oklahoma (Huffman, 1958, p. 30). The type locality is at Blackgum Landing on the southeast shore of Lake Tenkiller (stratigraphic section Ch2; pl. B; appendix IA). The Blackgum Formation comprises a thin sequence of Lower Silurian carbonate strata which are underlain by the Sylvan Shale (Upper Ordovician) and overlain by the Tenkiller Formation (Middle? Silurian). At the base of this formation, between the lower calcitic dolomites of the Blackgum Formation and the Sylvan Shale, is a locally developed thin oölitic bed, which is here named the Pettit Oölite Member of the Blackgum Formation (pl. III, fig. 2). Overlying the Pettit Oölite or, where that member is absent, the Sylvan Shale is a few feet of tan-weathering dolomite with nodules and elongate lenses of chert, here informally designated the tan dolomite member (pl. IV, fig. 2). Above these strata is a sequence of bioclastic limestones with many irregular bodies of dolomite and some small chert nodules, here informally named the upper limestone member (text-fig. 6). Glauconite is common throughout the tan dolomite and upper limestone members, and is abundant in some beds.

The Blackgum Formation crops out in only two small areas: the type locality at Blackgum Landing and an area west and north of Qualls (pl. B). The exposures at Blackgum Landing are excellent (pls. II, IV) and are easily reached by a gravel road leading north from State Highway 100.

Lithologic character. — The Blackgum Formation constitutes a distinctive lithostratigraphic unit, which is easily distinguished from the underlying Sylvan Shale and the overlying Tenkiller Formation. It has been recognized in both outcrop areas where the lower part of the Silurian section is exposed (Blackgum Landing and near Qualls; pl. B). It is also present and easily recognizable in core holes OGS 1 and OGS 2, and in the St. Clair Lime Company core holes SCL 1, SCL 2; in OGS 3 it is either thin or absent. The Blackgum Formation also can be recognized in cuttings from rotary and cable-tool holes.

Three lithostratigraphic divisions can be recognized at the outcrop and in the diamond-core holes (text-fig. 6): a basal oölite member which is thin and only locally present. This is a distinctive bed, composed dominantly of oölites and sharply marked off from the strata above and below; no oölites have been found in any of the overlying Blackgum beds nor in any of the younger Silurian rocks. Overlying the Pettit Oölite Member is a nonoölitic sequence of carbonate strata in which two divisions can be recognized: a lower, tan-weathering member made up largely of crystalline calcitic dolomite with nodules and irregular lenses of chert, and an upper, bioclastic limestone with irregular bodies of dolomite and only widely scattered chert nodules. The boundary between these two members is not distinct, and they merge one into the other; however, excluding the boundary zone which is only a foot or two thick, these two lithologies are distinct and recognizable in both surface exposures



Text-figure 6. Generalized section showing the stratigraphic divisions recognized in the Blackgum Formation. The Pettit Oölite Member is a formally designated unit, but the upper limestone member and lower tan dolomite member are only informal subdivisions (pls. II, III, IV). The HCl-insoluble-residue and $MgCO_3$ percentages are averages (text-fig. 2; appendix II).

and the diamond cores, as well as in some of the rotary and cable-tool holes.

Thickness and distribution. — The Blackgum Formation is generally present throughout those areas of northeastern Oklahoma where Silurian strata are represented. At the type locality near Blackgum Landing (Ch2) the formation is 13 feet thick, and at least 12 feet is present in the outcrops west of Qualls. In core holes OGS 1, OGS 2, SCL 1, and SCL 2, the Blackgum ranges from 10 to 15 feet in thickness. It may be absent in OGS 3, in which a 6-inch bed immediately overlying the Sylvan may represent the Blackgum (appendix IB).

The Blackgum Formation appears to be widely distributed in the subsurface to the south and east of the Lake Tenkiller area. It is present in all of the rotary and cable-tool holes which were studied for this report (text-fig. 3; appendix IC). The maximum thickness in this area is about 35 feet.

Pettit Oölite Member

The name of this member is taken from the town of Pettit in southern Cherokee County (pl. B; text-fig. 3). However, no exposures are in the immediate vicinity of this town, and the type locality is at stratigraphic section Ch5 about a mile west of Qualls* in Cherokee County (pl. III, fig. 2; pl. B; text-fig. 7).

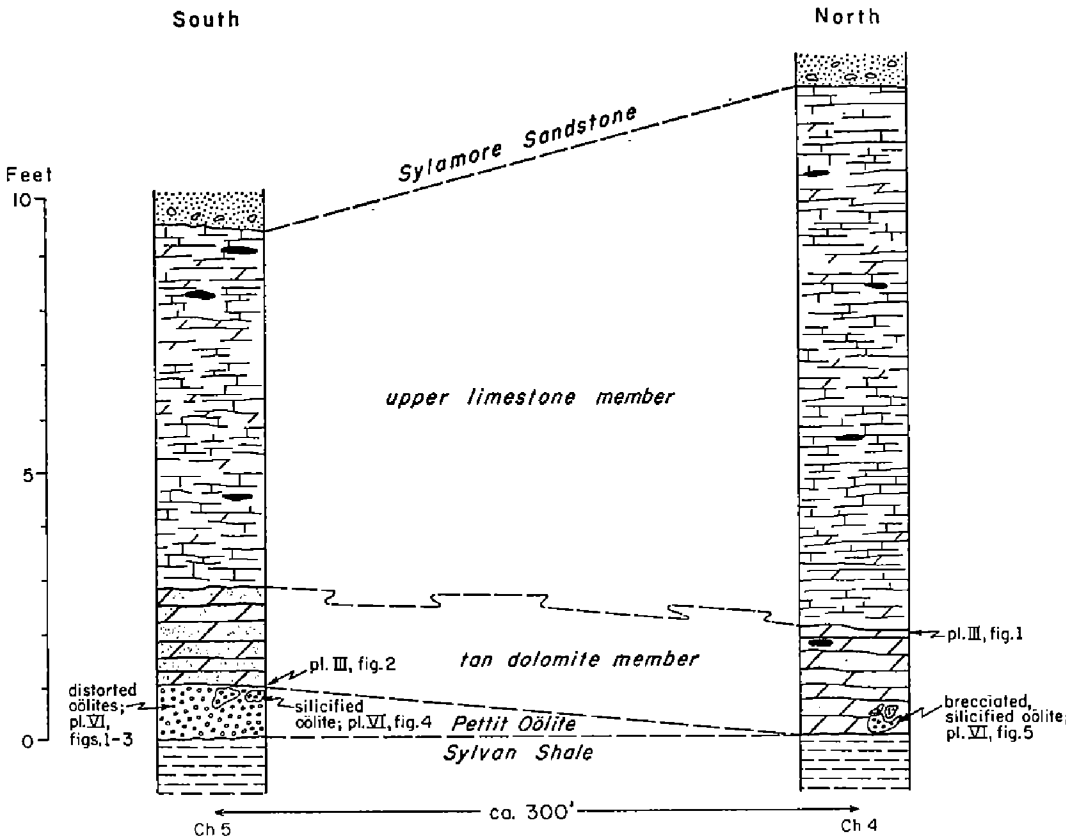
The Pettit Oölite Member is local in its development. Where present, it is thin, less than 2 feet, and occupies a stratigraphic position between the tan dolomite member of the Blackgum Formation and the Sylvan Shale. The Pettit Member is composed predominantly of somewhat irregular to fairly well-rounded oölites set in a sparry calcite matrix. The oölites are mostly less than 2 mm in diameter. Many can be demonstrated to have a nucleus which is a pelmatozoan plate. Fossil debris is sparse and generally has a thin coating of finely divided carbonate. In certain areas, as at stratigraphic section Ch2 (Blackgum Landing), many of the oölites appear to have been broken prior to deposition and cementation (pl. VI, fig. 6). In other places the oölites appear to have been cemented and at least partly indurated before being broken up to make what appears to be a "flat-pebble" or "intraformational" conglomerate; this is the condition in the St. Clair Lime Company core, SCL 2.

Partial or complete silicification of the Pettit Member is com-

* No geographic names are available in the vicinity of section Ch5; Qualls is preoccupied by Quall Limestone.

mon. At Blackgum Landing (Ch2) and in core SCL 2 the entire member is almost completely silicified, whereas in the Qualls area (Ch4, Ch5) only scattered irregular nodules are silicified.

The structure of the oölites at stratigraphic section Ch5, west of Qualls, is unusual and unlike that observed elsewhere in the area. At this location the oölite bed is about 18 inches thick, its contact with the overlying tan dolomite member being well exposed and sharply defined (pl. III, fig. 2). The oölite member is largely carbonate with only small silicified areas. Within the carbonate facies the oölites appear to have been disrupted and squashed, some being hooked into chains by means of elongate tails or apophyses (pl. VI, figs. 1-3). These appear to have a structure identical to that of the oölites recently described and illustrated by Carozzi

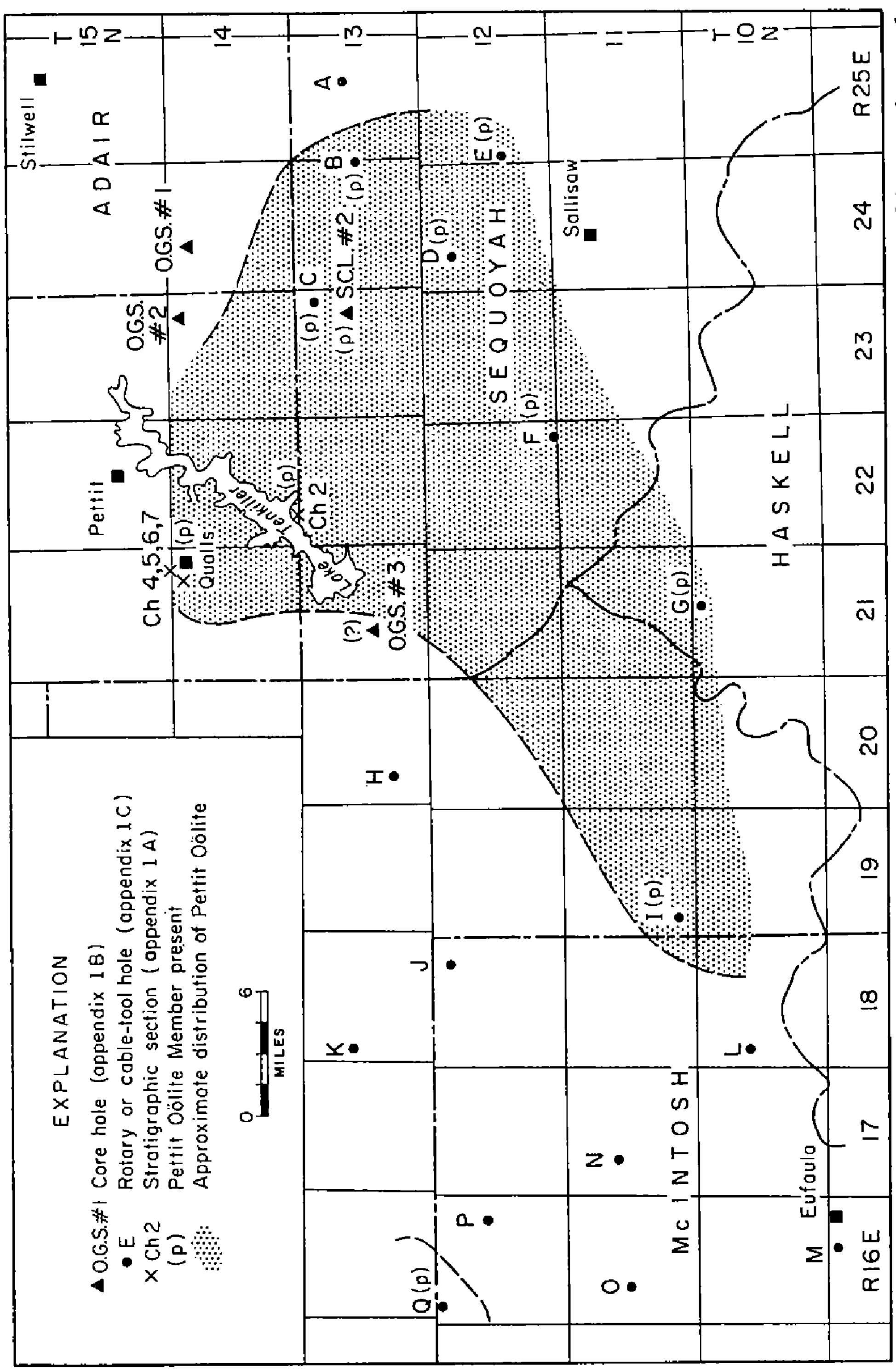


Text-figure 7. Diagram to show the stratigraphic relations of the Blackgum Formation at stratigraphic sections Ch4 and Ch5, located on the southwest bank of a small stream about a mile west of Qualls; SE¼ NW¼ sec. 2, T. 14 N., R. 21 E., Cherokee County, Oklahoma (pl. B). At stratigraphic section Ch5 the base of the Blackgum Formation includes about 18 inches of Pettit Oölite. The contact of the oölite bed with the overlying tan dolomite member is well exposed and sharply defined (pl. III, fig. 2). Most of the Pettit Oölite at Ch5 is carbonate and composed of distorted oölites (pl. VI, figs. 1-3); however, there are nodules of silicified oölites, and these are largely undeformed (pl. VI, fig. 4). At stratigraphic section Ch4, about 300 feet north of Ch5, the tan dolomite member rests directly upon the Sylvan, but there are a few pieces of brecciated and silicified oölites in the basal beds of this member (pl. VI, fig. 5). Throughout this outcrop belt the Blackgum Formation is directly overlain by the Sylamore Sandstone Member of the Chattanooga Formation.

from the Triassic of Europe (1961, p. 263-273; compare his text-fig. 6 to pl. VI, figs. 1-3, of this report). Carozzi believed this structure was due to distortion of the oölites shortly after formation and before cementation, and he concluded that this must have taken place in a subaqueous environment, as the result of the oölites being knocked against one another by strong wave or current action. One feature of particular interest at section Ch5 is the inclusion of nodules of silicified oölites within the carbonate facies which show no evidence of distortion (pl. VI, fig. 4). The presence of these inclusions suggests that silicification took place early in the formation of the oölites.

Relationship of the Pettit Oölite to the overlying and underlying strata. — The stratigraphic relationships of the Pettit Oölite can be observed at Blackgum Landing (Ch2), in the St. Clair Lime Company core SCL 2, drilled in the Marble City area, and in the outcrops west of Qualls (text-fig. 8). At Blackgum Landing the Pettit is represented by a well-defined bed of oölites, about 6 inches thick. Some slumping has occurred at this outcrop and the Pettit cannot be directly observed in place, but there is no doubt that it occupied a position between the tan dolomite member and the Sylvan Shale. Oölites have not been observed in the tan dolomite member of the Blackgum Formation at Ch2, in the higher Blackgum, or in the overlying Tenkiller strata. In core hole SCL 2 the Pettit Oölite is 3 inches thick and is a sharply defined lithostratigraphic unit between the lower dolomite of the Blackgum and the Sylvan Shale.

The stratigraphic relationships in the outcrop belt west of Qualls, at stratigraphic sections Ch4 and Ch5, are somewhat more complex. At Ch5 the relationship is like that at Blackgum Landing and in core SCL 2; the Pettit Oölite is a well-defined lithostratigraphic unit, about 18 inches thick, with a well-marked upper contact (pl. III, fig. 2). Oölites have not been observed in the overlying tan dolomite member or higher Blackgum strata. However, at Ch4, about 300 feet north of Ch5, the relationships are somewhat different. At this outcrop, the tan dolomite is directly in contact with the Sylvan Shale, the only oölite present occurring as small brecciated nodules of silicified oölite in the basal few inches of the tan dolomite. This stratigraphic distribution is illustrated in text-figure 7; a photomicrograph of the brecciated oölites is shown on plate VI, figure 5. Aside from this basal brecciated material, no oölites have been observed in the tan dolomite or higher strata at section Ch4. These relationships suggest that the Pettit is distinctly older than the tan dolomite and that it had been deposited, indurated, and eroded before the tan dolomite was laid down. However, any at-



Text-figure 8. Map showing the distribution of the Pettit Oölite in the Lake Tenkiller area. This map is mostly based upon subsurface data; the member crops out only at stratigraphic section Ch2 on the southeast shore of Lake Tenkiller and in the area around Qualls. We have no information on its distribution in the southeastern part of this region.

tempt to explain the stratigraphic relationships of the Pettit Oölite must be considered provisional because it can be observed at so few places. In any event, the Pettit Oölite makes an easily recognized lithostratigraphic unit which is confined to the post-Sylvan pre-Blackgum part of the section in this area. No clear lithostratigraphic nor biostratigraphic evidence relates this unit to the younger Blackgum strata, and its inclusion as a member within that formation is a matter of convenience. If the Pettit were thick enough to make a mappable unit, it would be treated as a distinct formation.

Distribution. — The Pettit Oölite Member is exposed at Blackgum Landing on Lake Tenkiller (stratigraphic section Ch2, pl. B) and in the outcrops to the west and north of Qualls (stratigraphic sections Ch4 to Ch7, pl. B); it is probably not more than 2 or 3 feet thick throughout this area. The St. Clair Lime Company core SCL 2, in the Marble City area, has 3 inches of Pettit Oölite just above the Sylvan Shale. There may be an inch or so of oölitic material at the base of the Silurian section in core OGS 3; however, the rock is silicified and it is difficult to determine whether the few spherical bodies present were originally oölites. The Pettit Oölite may be recognized in eight of the rotary and cable-tool holes studied. These are:

Well B — Cleary, Burke 1
C — Gober, Ready 1
D — Lohman-Johnson, Cook 2
E — Harris, Cheek 1
F — Wheeler et al., Snow 1
G — I. T. I. O., Blake 1
I — Midco, Dunagan 1
Q — Campbell, Haggard 1

The known distribution of the Pettit Member is shown on the map, text-figure 8. It may be noted that this member appears to be best developed in the western part of the area for which we have data. Unfortunately we have no information on its distribution to the north and to the south of this area.

Fossils and age. — We have no diagnostic fossils from this member and its inclusion within the Silurian is provisional*. It is underlain by the Sylvan Shale, which carries Late Ordovician graptolites, and overlain by limestones and dolomites of the Blackgum Formation, the upper part of which carries Early Silurian (late Lland-

* Oölitic strata bearing Early Silurian fossils are rather widely distributed in the basal part of the Silurian section in the central part of the United States; e. g., the Keel Oölite in the Arbuckle Mountains region of south-central Oklahoma, and the Edgewood Oölite in eastern Missouri and western Illinois.

overian) brachiopods. It seems unlikely that any diagnostic megafossils will be obtained from this member as it is such a thin unit with a limited outcrop area. Microfossils might be obtained from insoluble residues, but we have not investigated this aspect of the Pettit Member.

Tan Dolomite Member

In all outcrop areas and in all core holes penetrating that part of the section, the lower part of the Blackgum carbonate sequence (exclusive of the Pettit Oölite) consists of calcitic dolomite. This rock generally carries a substantial amount of glauconite and also nodules and lenses of chert. It weathers tan to light brown and hence is informally designated the tan dolomite member. This member is well exposed at the type locality of the Blackgum Formation at Blackgum Landing (Ch2; pl. IV, fig. 2; pl. III, figs. 1, 2).

The tan dolomite member is predominantly a calcitic dolomite. Five samples were analyzed for $MgCO_3$; these include the complete tan dolomite interval from core holes OGS 1, OGS 2, and SCL 2, plus two spot samples from the type locality at Blackgum Landing (Ch2). As shown in text-figure 9 (see also text-fig. 10), the $MgCO_3$ content ranges from 20.73 percent to 32.25 percent, averaging 26.50 percent. The $CaCO_3$ content of these samples averaged 62.79 percent. Most of the $MgCO_3$ is finely crystalline dolomite having a fairly uniform texture (pl. V, figs. 5, 6). Some fossil debris, mostly pelmatozoan plates, is present, but for the most part organic material (if originally present) has been largely replaced by dolomite.

The HCl-insoluble-residue content is somewhat higher than that of the overlying member. Analyses of five samples range from 4.43 percent to 12.06 percent, averaging 8.47 percent (text-fig. 9). Much of the insoluble material is spongy silica, presumably representing incipient chert. Rather widely scattered, subangular, detrital quartz grains are also present. Glauconite is present throughout the rock, although its concentration varies; parts of this member have substantial amounts of glauconite (pl. V, fig. 5).

Chert is generally common to abundant in this member. It is a vitreous, light-colored chert showing considerable fossil debris in thin section. The chert is mostly in the form of nodules, lenses, and thin beds, as shown in plate IV, figure 2.

The tan dolomite member may rest on the Sylvan Shale, or it may be separated from that formation by the Pettit Oölite (see discussion under Pettit Oölite Member). It is overlain by and grades into the upper limestone member of the Blackgum Formation. The lithologic change from the tan dolomite member to the upper limestone member primarily involves a reduction in the amounts of dolomite and acid insolubles and an increase in the amount of bioclastic material. However, $MgCO_3$ continues to be common in the upper member, and parts of it are essentially a crystalline dolomite like that of the lower members. Although these two members are reasonably distinct lithostratigraphic units in the area under study, we believe that they are closely related to one another in their depositional history and that the tan dolomite member represents merely the initial, basal facies of the Blackgum carbonate sequence (excluding the Pettit Oölite Member).

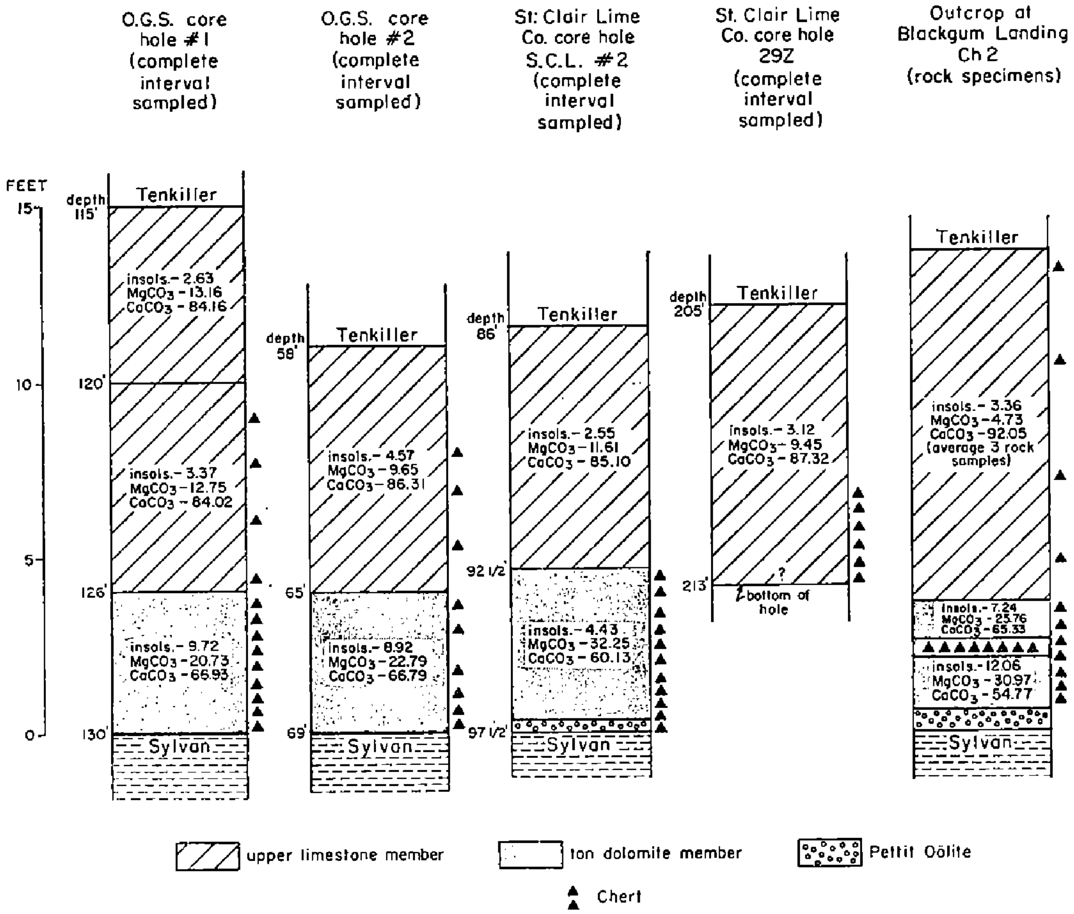
This member is well developed in the outcrops at Blackgum Landing (Ch2; pl. IV, fig. 2) and the outcrops west of Qualls (Ch4, Ch5; pl. III). It has also been recognized in core holes OGS 1, OGS 2, SCL 2. Its thickness ranges from 2 to 5 feet. It can be distinguished in some of the rotary and cable-tool cuttings.

Fossils and age — tan dolomite member. — No diagnostic fossils have been collected from this member, but, as noted above, we believe that it is closely related in age to the upper limestone member which yields Lower Silurian fossils.

Upper Limestone Member

The upper part of the Blackgum Formation, herein designated the upper limestone member, is a thin-bedded, bioclastic limestone with many irregular bodies of dolomite. These dolomite areas weather tan to brown in contrast to the dark blue-gray color of the bioclastic facies, giving the rock a distinctive mottled appearance (pl. II, figs. 1, 2; pl. III, fig. 1). Glauconite is relatively common throughout this member, but chert is sparse. The upper limestone member is well exposed at Blackgum Landing (Ch2) and in the outcrop belt to the west of Qualls (Ch4, Ch5); it is also present in core holes OGS 1, OGS 2, and SCL 2 (text-figs. 6, 7, 9, 10). It can be distinguished in some of the rotary and cable-tool holes.

The upper limestone member is largely a bioclastic limestone. The fossil debris which makes up most of the rock is commonly set in a matrix of finely divided carbonate (pl. V, figs. 3, 4), although some parts have minor amounts of sparry calcite. This rock is primarily grain supported and falls largely within the micrite category of Folk (1959) or the packstone category of Dunham (1962). Much of the fossil material consists of pelmatozoan plates along with some brachiopods, bryozoans, ostracodes, and other forms.



Text-figure 9. Chart showing the stratigraphic distribution of HCl-insoluble residues, $MgCO_3$, and $CaCO_3$ in the Blackgum Formation. The chemical analyses (expressed as percentages) for the core holes are based upon samples of the complete intervals, whereas that for the outcrop at Blackgum Landing (stratigraphic section Ch2) is based upon spot samples. The Pettit Oölite (indicated by open circles) was recognized only in core hole SCL 2 and at Blackgum Landing. The tan dolomite member is shown by a light stipple, and the distribution of chert is indicated by triangles. The locations of the core holes and described stratigraphic section are shown on text-figures 3 and 8; a complete tabulation of the chemical data is given in appendix II.

Stromatoporids and corals, both solitary and colonial, are common in some beds, but no evidence of any reeflike structure is present. Scattered through this bioclastic facies are many irregular, anastomosing bodies of dolomite. These dolomite areas are for the most part free of organic debris and consist of well-formed dolomite crystals of fairly uniform size (pl. V, figs. 1, 2). Scattered dolomite crystals may also be present in the bioclastic facies; however, much of this rock is relatively free of $MgCO_3$.

Eight samples, analyzed for $MgCO_3$, include the complete interval of this member from core holes OGS 1, OGS 2, SCL 2, and 29Z, plus three spot samples from stratigraphic section Ch2 at Blackgum Landing (text-fig. 9; appendix II). The $MgCO_3$ content ranges from 3.02 percent to 13.16 percent, averaging 8.85 percent.

(Note that the $MgCO_3$ is not uniformly distributed through this member but is concentrated in irregular bodies.) The $CaCO_3$ from these eight samples ranges from 84.16 percent to 93.72 percent, averaging 87.88 percent.

The amount of chert decreases upward in the Blackgum Formation, and the uppermost strata are either chert-free or bear only widely scattered, small nodules. Locally the lower beds of the upper limestone member bear a fair amount of chert, but these concentrations generally disappear upward and this member has substantially less chert than has the underlying tan dolomite member (text-fig. 9). The chert is a light-colored vitreous variety, similar to that in the underlying beds.

Eight chert-free samples range from 2.55 percent to 4.57 percent in HCl-insoluble content, averaging 3.26 percent. The residues are composed in large part of glauconite, quartz grains, and fragments of incompletely silicified fossils; they may also include a few arenaceous foraminifers. The glauconite is pale to light green and is mostly in the form of irregular to polylobate grains ranging up to 0.5 mm in diameter; some of the glauconite occurs as internal molds or steinkerns of fossils. Much of the quartz is in the form of small, doubly terminated crystals ranging up to approximately 0.5 mm in length. The residues are largely free of the spongy silica, which is so common in the underlying member. Undoubtedly this scarcity of spongy silica is related to the lesser amount of chert in the upper limestone member.

The upper limestone member is 10 feet thick at Blackgum Landing (Ch2) and 7 to 10 feet thick in the outcrops west of Qualls; it is 11 feet thick in core OGS 1, 7 feet in OGS 2, and 6 feet in SCL 2. In all areas observed it is underlain by the tan dolomite member of the Blackgum Formation (see discussion under that member). At Blackgum Landing and in the core holes, it is overlain by the Tenkiller Formation; the Blackgum-Tenkiller stratigraphic relationship is discussed under the section on the Tenkiller Formation. In the outcrops west of Qualls (Ch4 to Ch7), post-Silurian pre-Chattanooga erosion has removed all of the higher Silurian and Lower Devonian strata, allowing the Sylamore Sandstone to rest directly upon the upper limestone member of the Blackgum Formation.

Fossils and age — upper limestone member. — The upper limestone member is composed largely of fossils, although in most places it is difficult to extract good specimens. We have, however, been able to collect a small shelly fauna from these strata at Blackgum Landing (Ch2) and in the outcrops to the west of Qualls (Ch6).

This fauna includes the brachiopods *Microcardinalia triplesiana* (Foerste) and *Triplesia alata* Ulrich and Cooper*. *M. triplesiana* is of special interest because its phylogenetic stage of development closely matches that of *Stricklandia lens ultima* Williams from zones C4 and C5 of the upper Llandoverian (Williams, 1951, p. 87, 103; Amsden, 1963b, p. 633; Boucot and Ehlers, 1963, p. 49).

We have prepared formic acid residues for a few samples from this member but have observed no conodonts or inarticulate brachiopods. Perhaps a more intensive investigation would yield a small microfauna.

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* Foerste's and Ulrich and Cooper's type specimens are in the U. S. National Museum. The senior author has examined these specimens and compared them directly with the Oklahoma shells.

TENKILLER FORMATION

The Tenkiller is a new formation here proposed for the sequence of evenly bedded, crinoidal limestones which overlie the Blackgum Formation. These strata, together with the underlying Blackgum Formation, were formerly included in the lower part of the "St. Clair Formation" of Oklahoma (Huffman, 1958, p. 30). The type locality is at Blackgum Landing on the southeast shore of Lake Tenkiller (stratigraphic section Ch2; pl. B; appendix IA). In normal sequence the Tenkiller Formation is overlain by the Barber Member of the Quarry Mountain Formation, but locally, as at Blackgum Landing, post-Silurian pre-Chattanooga erosion has removed the higher Silurian and overlying Lower Devonian strata, allowing the Sylamore Sandstone of the Chattanooga to rest directly upon the Tenkiller (pl. B; text-fig. 15).

The Tenkiller Formation crops out in only two small areas in northeastern Oklahoma: the type locality at Blackgum Landing (Ch2) and in a small area north of Marble City, where a few feet of uppermost Tenkiller are exposed beneath the Barber Dolomite Member (pls. A, B). The Tenkiller Formation is also present in core holes OGS 1, OGS 2, OGS 3, SCL 2, and 29Z; in all these cores the Tenkiller is overlain by the Barber Member of the Quarry Mountain Formation. This formation has also been recognized in cuttings from the cable and rotary holes examined.

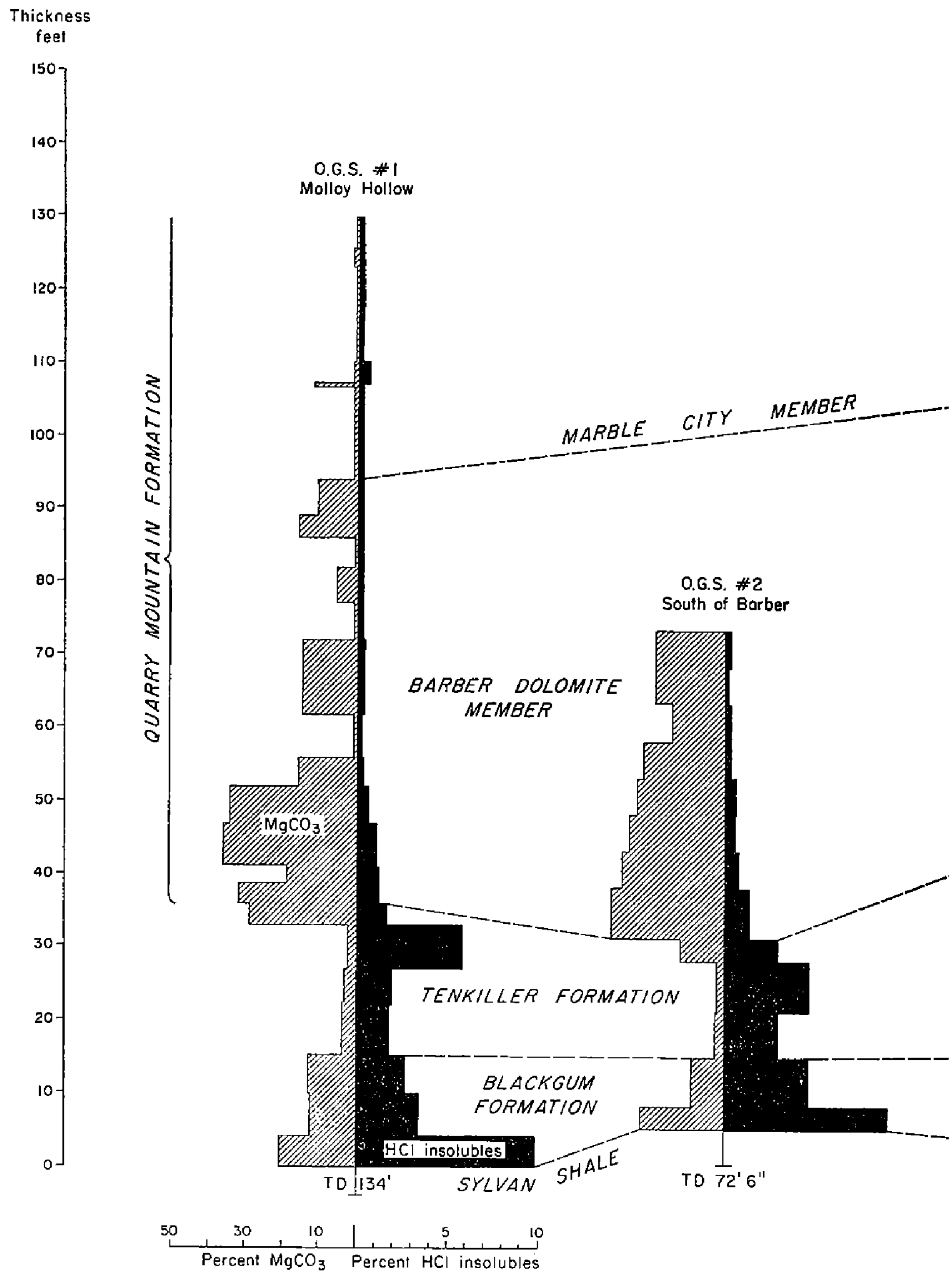
Lithologic character.—The Tenkiller is a bioclastic limestone weathering light to medium gray. On a fresh surface it is a darker gray, commonly with a decided pink cast due to the presence of numerous pink pelmatozoan plates. The Tenkiller is a well-bedded rock, and one of its most distinctive features is its thin (generally less than 6 inches), even, blocky beds, with individual strata persisting laterally for some distance and showing little change in thickness (pl. II, fig. 1; pl. IV, fig. 1). Chert is sparse in the Tenkiller Formation.

The Tenkiller is a bioclastic rock composed largely of fossil debris. The fossils may be set in a matrix of sparry calcite (biosparite or grainstone) or in a matrix of finely divided calcite (biomicrite or packstone). For the most part the biosparite and biomicrite are disposed in layers, beds of biosparite alternating with beds of biomicrite (the conspicuous bedding cited above is largely the result of this feature). In general the bedding is fairly even and uniform (pl. VII, fig. 4), but parts show a fairly well-developed cross-bedding (pl. VII, fig. 1). Irregular, wispy clay partings are also present, some concentrated along stylolite seams, but others appearing to define original bedding.

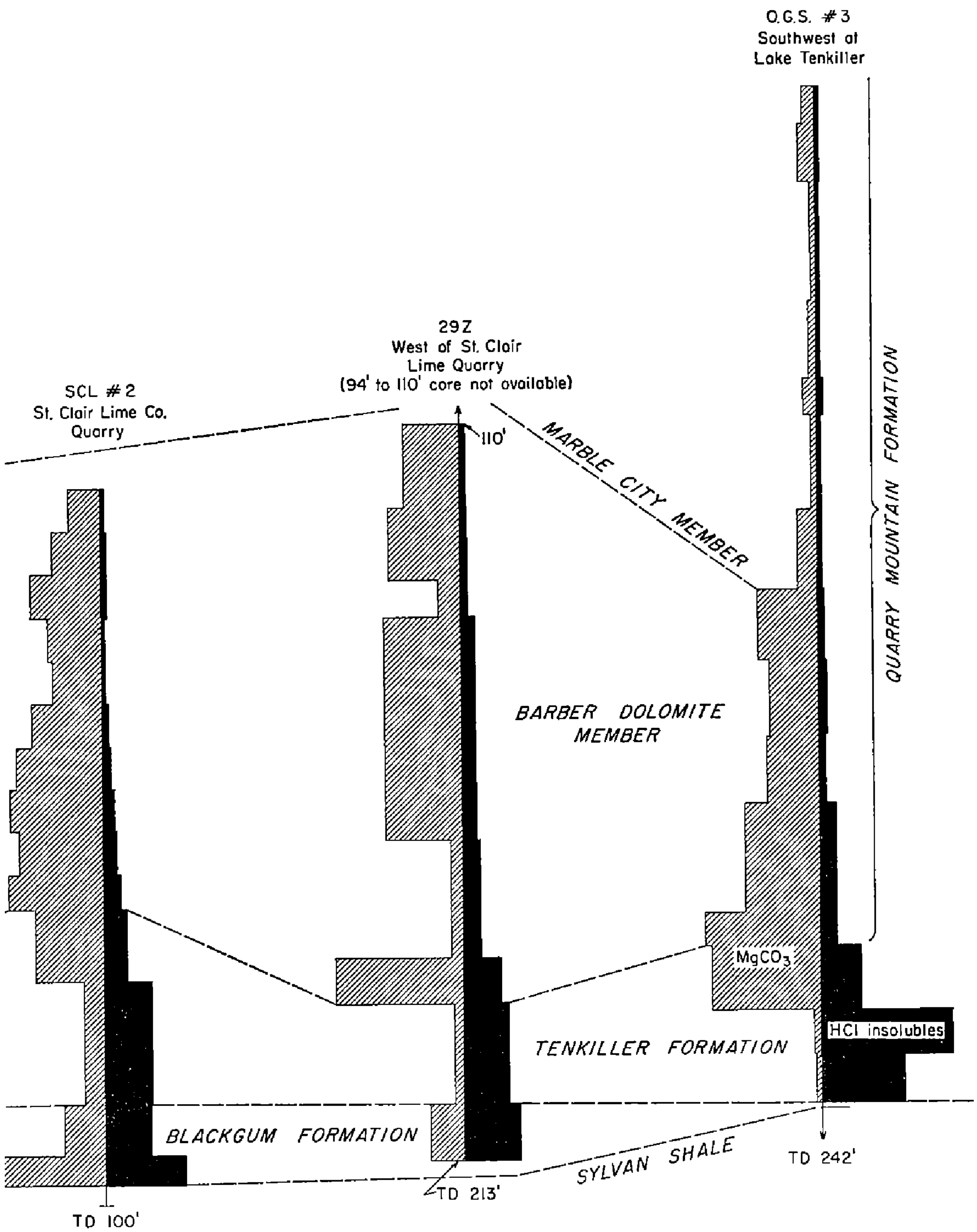
The fossil debris in the Tenkiller is largely pelmatozoan plates, although remains of other organisms, such as brachiopods, ostracodes, bryozoans, and trilobites, contribute subtantially to the rock. Arenaceous foraminifers and conodonts are present. The fossils are clearly defined in thin section, showing little evidence of recrystallization or alteration.

In the five core holes which penetrate the lower part of the Silurian section, Tenkiller strata are overlain by the Barber Member of the Quarry Mountain Formation. In these cores the $MgCO_3$ content was determined from channel samples of the entire formation (text-fig. 10), and these analyses show that in the lower and middle parts of the formation the $MgCO_3$ content averages only 3.9 percent, whereas in the upper part, in the strata just beneath the Barber, the dolomite content increases sharply, averaging 23.18 percent $MgCO_3$; the over-all average for the entire formation is 7.41 percent (text-fig. 2; appendix II). Throughout most of the formation the $MgCO_3$ is present largely as irregular patches of finely crystalline dolomite (pl. IX, fig. 2); however, in the upper part of the formation these areas become more numerous and the rock grades into a crystalline dolomite (see Tenkiller-Barber Relationship). Dolomite is also associated with the sediment-filled cavities (see discussion under Sediment-Filled Cavities). At its type locality (Ch2), the Tenkiller is directly overlain by the Chattanooga Formation. Three rock samples were collected, one from each of the lower, middle, and upper parts of the formation at this locality. The $MgCO_3$ content of these samples is low, ranging from 1.42 to 2.07 percent, suggesting that the upper, strongly dolomitic beds have been removed by post-Silurian erosion.

The Tenkiller Formation has a relatively low HCl-insoluble-residue content. At the type locality (Ch2) three rock samples have residues ranging from 2.02 percent to 7.44 percent, averaging 4.83 percent (appendix II). In the five cores penetrating the Tenkiller Formation, the acid-insoluble content of the upper dolomitic strata which immediately underlie the Barber Member averages 3.91 percent, whereas that of the strata in the middle and lower parts of the formation averages only 1.99 percent; the entire Tenkiller averages 3.37 percent (see text-fig. 2, and Tenkiller-Barber Relationship). The washed residues generally consist largely of quartz, much of which occurs as doubly terminated crystals or as spongy silica, prob-



Text-figure 10. Diagram showing the distribution of HCl-insoluble residues (right side) and $MgCO_3$ (left side) in diamond core holes OGS 1, OGS 2, OGS 3, SCL 2, and 29Z. These analyses are of continuous channel samples; complete information is given in appendix II.


O.G.S. #3
Southwest of
Lake Tenkiller
29Z
West of St. Clair
Lime Quarry
(94' to 110' core not available)
SCL #2
St. Clair Lime Co.
Quarry
110'
MARBLE CITY MEMBER
QUARRY MOUNTAIN FORMATION
BARBER DOLOMITE
MEMBER
$MgCO_3$
HCl insolubles
TENKILLER FORMATION
BLACKGUM FORMATION
SYLVAN SHALE
TD 242'
TD 213'
TD 100'

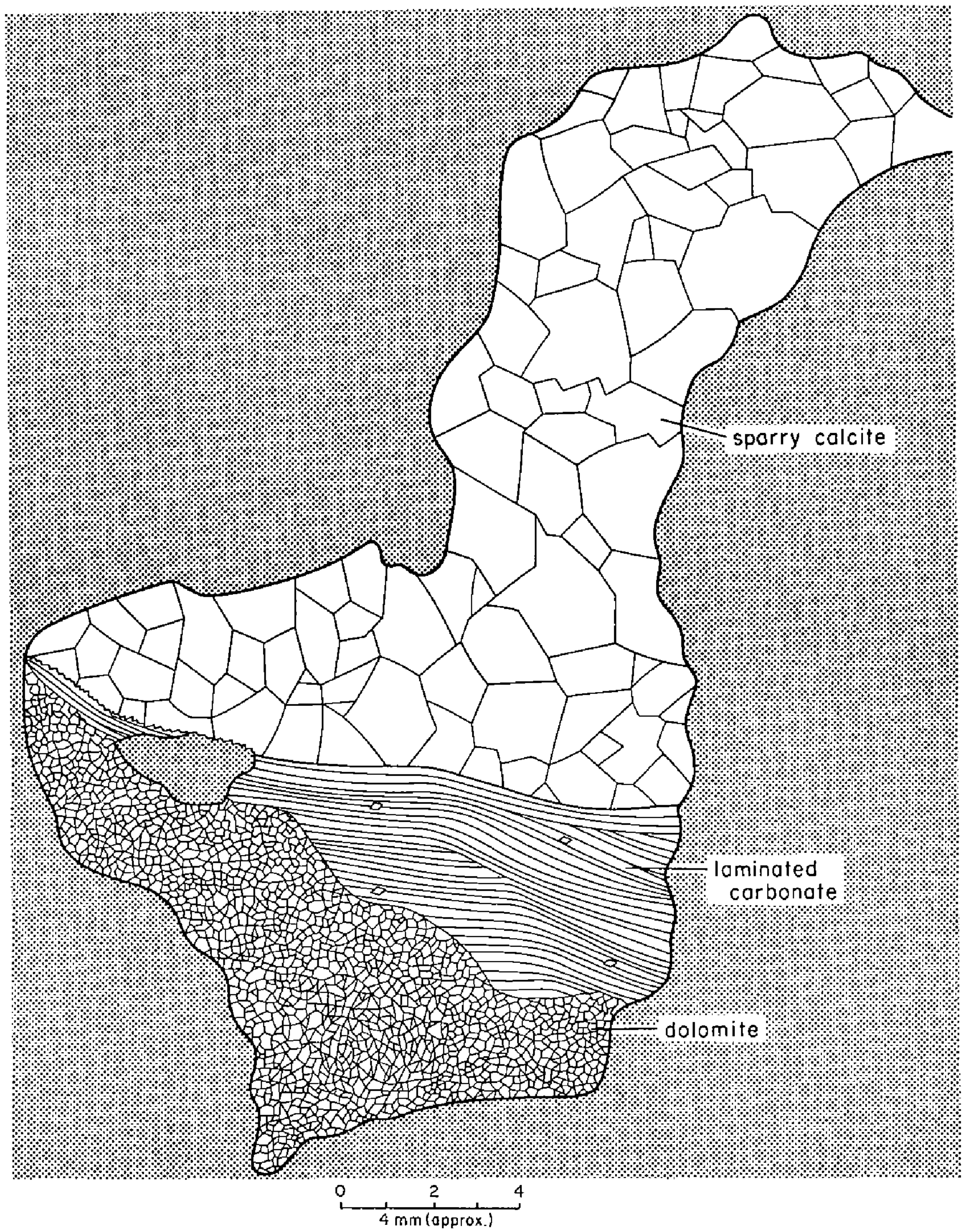
ably representing incompletely silicified fossils and incipient chert. Most residues will have some pyrite crystals and a few arenaceous foraminifers. Glauconite may be present in small amounts. The unwashed residues probably include some clay.

Sediment-filled cavities. — These interesting and somewhat enigmatic structures are relatively common in the Tenkiller Formation. They appear to represent cavities which were later partly filled with sediment, although the exact sequence of events involved in their formation is not clear.

Several characteristic sediment-filled cavities are illustrated on plates VIII, IX, X, and XI. A typical cavity consists of a lower part filled with laminated carbonate and crystalline dolomite and of an upper part composed of sparry calcite (text-fig. 11). The contact between the sparry calcite and the laminated carbonate is sharply defined, and tongues or veinlets of sparry calcite may extend down into the laminated material for a short distance (pl. VIII; pl. IX, fig. 1). On some, the uppermost layer of laminated carbonate has cracked and partly warped away from the rest of the material (pl. X, upper left). The laminated filling consists mostly of thin beds of finely divided calcite with a few scattered dolomite crystals; some show fairly well-developed cross-bedding. The laminated carbonate transects the host rock, with the individual laminae terminating abruptly against the surrounding rock (pl. XI). The laminated calcite is underlain by finely crystalline dolomite, the latter resting on the floor of the cavity. The sequence is thus crystalline dolomite, laminated calcite, and sparry calcite, a pattern which is almost invariably developed (text-fig. 11). However, many cavities have an irregular shape, and, near the perimeter of some, the sparry calcite may be brought into contact with, or nearly into contact with, the dolomite; this is the condition in part of the cavity illustrated in the lower right of plate X.

These structures appear to represent cavities which were developed after deposition and lithification of the Tenkiller Limestone and which were then partly filled with sediment. At some later time the upper part of the cavity was completely filled with sparry calcite. Several features point to such an origin: (1) the laminated calcite appears to be a deposit laid down in well-defined beds; (2) it abuts against the surrounding rock, indicating that it was deposited in cavities which had previously been formed in the Tenkiller Limestone; (3) the surface of the laminated material shows evidence of desiccation and cracking, indicating that it was at least partially lithified before the sparry calcite was introduced. The exact time and place for this sequence of events is not clear. Whether it represents one cycle of uplift or several is not readily ascertained from the available data. Even more puzzling is the crystalline dolomite which occupies the lower part of each cavity. Presumably this material was introduced before the laminated calcite, but the manner of emplacement is not known.

Tenkiller-Barber and Tenkiller-Marble City relationships.—



Text-figure 11. Sketch of the sediment-filled cavity illustrated on plates X and XI. Tenkiller Formation, core hole SCL 2, depth 73 feet; St. Clair Lime Company quarry, Marble City area (pl. A; appendix IB).

The contact of the Tenkiller Formation with the overlying Barber Member of the Quarry Mountain Formation cannot be satisfactorily studied at the surface. At Blackgum Landing (Ch2) the Tenkiller is directly overlain by the Chattanooga Formation, the younger Silurian beds having been removed by post-Tenkiller pre-Chattanooga erosion (pl. B). In the vicinity of Marble City (pl. A) the Tenkiller is overlain by the Barber, but in this area exposures are poor. This contact can, however, be studied in the diamond cores, five of which penetrated the Tenkiller-Barber boundary. These cores have been completely sampled and analyzed for HCl insolubles, $CaCO_3$, and $MgCO_3$ (appendix II).

The Tenkiller-Barber contact displays some interesting features. In core hole 29Z this is a sharply defined boundary, the gray crystalline dolomite of the Barber standing in marked contrast to the bioclastic, pink crinoidal limestone of the Tenkiller. However, in the other four core holes which penetrate this part of the section (OGS 1, OGS 2, OGS 3, SCL 2), both the gray dolomite and pink crinoidal lithology are present in a zone ranging in thickness from 3 to 10 feet. In these four cores the basal Barber is a gray, finely crystalline, calcitic dolomite with 20 to 30 percent $MgCO_3$. Beneath this more or less solid calcitic dolomite are beds in which irregular patches of pink crinoidal limestone are scattered through the dolomite. This grades down into the rock in which the pink crinoidal lithology predominates over the dolomite (pl. IX, fig. 3), and finally into the typical Tenkiller bioclastic limestone; dolomite is present in this lower part but is largely in the form of irregular, wispy areas (pl. IX, fig. 2). We arbitrarily assign the upper, strongly dolomitic zone to the Tenkiller, extending the formation boundary up to include the highest bed containing some recognizable pink crinoidal lithology.

The Tenkiller Formation has substantially more acid insolubles than has the Barber Member, the latter averaging 0.53 percent as compared to 3.37 for the Tenkiller (text-fig. 2). It should, however, be noted that in the lower 30 to 40 feet of the Barber the acid-insoluble content increases progressively (text-fig. 10). With the appearance of the first strata bearing some pink crinoidal lithology, this increase is sharply accelerated.

These relationships suggest that this is a gradational contact and that deposition may have been continuous from Tenkiller time into Quarry Mountain time. Moreover, the dolomites of the Barber merge upward into the limestones of the Marble City (see Barber-Tenkiller Relationship), so there appears to be a complete gradation from Tenkiller through Barber into Marble City. Assuming the magnesium carbonate to be an early-stage dolomite, introduced at the time of deposition, there must have been a progressive increase in the magnesium content of the water during late Tenkiller and early Quarry Mountain time, followed by a return to more normal salinity in Marble City time. This interpretation is to some extent supported by the acid-insoluble content which shows a distribution pattern similar to that of the $MgCO_3$ (text-fig. 10). On the other hand, if magnesium carbonate of the Barber represents a late-stage dolomite, then the contact relationship of the Tenkiller and the Marble City Member of the Quarry Mountain Formation has been obscured by dolomitization. In view of these relationships, it is interesting to compare the Tenkiller and Marble City limestones. These units are similar in several respects. Both are bioclastic limestones with the fossil debris made up largely of pelmatozoan plates. Also the interesting sedimentary features which we interpret as sediment-filled cavities are present in both. However, significant differences exist. The Tenkiller is a thinly and evenly bedded rock in contrast to the more heavily bedded Marble City (cf. pls. IV and XIII). The Tenkiller is composed of interbedded biomicrite and biosparite, whereas the Marble City is predominantly a biosparite (cf. pls. VII and XIV). The acid insolubles, a substantial part of which appears to be terrigenous detritus, are significantly more abundant in the Tenkiller (text-fig. 10). These two formations also show some differences in their minor- and trace-element content (appendix II). The Tenkiller has from 0.01 to 0.07 percent P_2O_5, whereas the Marble City has virtually none. The K_2O content of the Tenkiller (below the upper, transitional beds) ranges from 0.17 to 0.50 percent in contrast to the Marble City, which has a maximum of about 0.04 percent (presumably this is from the mineral glauconite). Except for the sample from core hole 29Z (10 ppm), no barium was detected in the Marble City, whereas the Tenkiller yields from 5 to 150 ppm. Finally the fossil clasts in the Tenkiller are well defined and show little evidence of alteration, whereas those in the Marble City tend to have somewhat obscure boundaries, suggesting some alteration. This last feature may be related to the period (or periods) of weathering and solution which followed deposition of the Silurian rocks, but the other characters cited are largely, if not entirely, primary and appear to represent differences in the environment of deposition. The age relationships are suggested in text-figure 5. For further discussion see Stratigraphic Distribution of Dolomite.

Tenkiller-Blackgum relationship. — The Tenkiller is lithologically different from the Blackgum, and the contact between the two is sharply defined. The Tenkiller is a light-gray bioclastic calcarenite with many pink pelmatozoan plates. It is an evenly and conspicuously bedded rock, the beds being made up largely of alternating layers of biomicrite and biosparite. Glauconite and chert are only sparingly present. In contrast the upper limestone member of the Blackgum Formation is a dark-gray, obscurely bedded biomicrite with many irregular areas of lighter colored dolomite. Glauconite is common to abundant, and some chert is present in the upper part, becoming abundant in the lower tan dolomite member. The insoluble-residue and $MgCO_3$ contents are, on the whole, higher in the upper limestone member of the Blackgum than in the Tenkiller (and much higher in the tan dolomite member).

The Tenkiller-Blackgum contact is exposed at Blackgum Landing (Ch2), where it is well marked by differences in color, bedding characteristics, and texture (pl. II, fig. 1). This contact is also easily recognized in diamond-core holes OGS 1, OGS 2, SCL 2, and 29Z. OGS 3 is the only core hole penetrating this part of the section in which the stratigraphic relations are in question; between typical Tenkiller and the Sylvan Shale is 6 inches of cherty and glauconitic limestone which is referred with question to the Blackgum (see discussion, appendix IB, OGS 3).

The interpretation of the Tenkiller-Blackgum relationship is complicated by the restriction of surface exposures. However, we believe that deposition was interrupted for a period of time prior to the start of Tenkiller deposition. Throughout this area the Tenkiller and Blackgum appear to be distinct lithostratigraphic units, which everywhere maintain the same relative position with respect to one another. At no place have we found any evidence that the Blackgum grades upward, or laterally, into the Tenkiller. Moreover, the Blackgum ranges widely in thickness, and in the area just west of Lake Tenkiller dam it is extremely thin or absent.

Thickness and distribution. — The Tenkiller is a relatively thin lithostratigraphic unit which has a restricted outcrop area in northeastern Oklahoma but which is rather widely distributed in the subsurface. It is 20 feet thick at the type locality (Ch2) on the southeast shore of Lake Tenkiller; it is 27 feet thick in core hole SCL 2, 22 feet thick in OGS 3, 21 feet thick in OGS 1, 16 feet thick in OGS 2, and 14 feet thick in 29Z.

The Tenkiller Formation is present in most of the rotary and cable-tool holes studied for this report (appendix IC; text-fig. 3). It can generally be distinguished from the underlying Blackgum Formation by means of the cuttings, although in a few holes, especially where the combined Blackgum-Tenkiller interval is thin, it is somewhat difficult to recognize. The thickness ranges from 0 to 40 feet (well H).

Fossils and age.—The Tenkiller is a bioclastic rock, but we have been unable to extract satisfactory megafossils. The only good exposures of this formation are at Blackgum Landing (Ch2), and here the rock generally breaks through rather than around the fossils. Formic acid residues from Tenkiller samples at Blackgum Landing yield conodonts and arenaceous foraminifers. A preliminary examination of these fossils suggests a similarity with the microfauna from the Clarita Member of south-central Oklahoma and the St. Clair Formation of Arkansas, but this similarity needs to be verified by a careful study (Amsden, 1963b, p. 635). No satisfactory megafossils or microfossils were obtained from any of the Tenkiller cores.

QUARRY MOUNTAIN FORMATION

The Quarry Mountain is a new formation proposed for those high-purity limestones and calcitic dolomites which were formerly included in the upper part of the "St. Clair Formation" of Oklahoma (Huffman, 1958, p. 30). The Quarry Mountain Formation is underlain by the Tenkiller Formation (new) and unconformably overlain by Devonian or Mississippian strata. This formation comprises two members, both new: an upper Marble City Member, which is predominantly limestone with some beds of dolomitic limestone and calcitic dolomite, and a lower Barber Member, which is mostly dolomitic limestone and calcitic dolomite (text-figs. 10, 15; pls. A, B; appendix I). The contact between these two members is not well defined and the two appear to be, at least in part, a facies of one another. Nevertheless, substantial evidence from both the surface and the subsurface shows that almost everywhere in the area studied the lower part of the Quarry Mountain Formation is strongly dolomitic. The type locality for the Quarry Mountain Formation is on the east side of Quarry Mountain, in the quarry of the St. Clair Lime Company, SE¼ SE¼ NE¼ sec. 14, T. 13 N., R. 23 E., Sequoyah County (pl. A). The base of the formation (lower part of the Barber Member) is not exposed in this quarry, but diamond-core hole SCL 2 penetrated the entire Silurian and ended in the Sylvan and so a complete section is known (see core holes SCL 1, SCL 2, appendix IB). The entire Quarry Mountain Formation (and uppermost Tenkiller Formation) is brought to the surface about half a mile south of the St. Clair Lime Company quarry. This is the only place where the basal beds of the Quarry Mountain crop out*, but unfortunately the exposures are poor.

The upper (Marble City) member of the Quarry Mountain Formation is well exposed in the area north and west of Marble City (pl. A). Locally the upper part of this member is a high-calcium stone of exceptional purity, which has been extensively quarried and mined, resulting in many artificial exposures. This member is also exposed near Bunch in Adair County (pl. B; see also core hole OGS 1, appendix IB). The upper part of the Barber Member is exposed in the Marble City area, along a stream bed

* Basal Silurian strata crop out at Blackgum Landing on Lake Tenkiller and in the vicinity of Qualls, but in these areas post-Silurian pre-Chattanooga erosion has removed the Quarry Mountain, leaving only the Tenkiller and Blackgum Formations (see Ch2, Ch4, appendix IA).

about 3 miles southeast of Barber, Cherokee County (pl. B; core hole OGS 3, appendix IB). The only other outcrop of Quarry Mountain is about 3 miles west of Tenkiller dam (pl. B), where a few feet of uppermost Marble City Limestone is exposed (core hole OGS 3, appendix IB). This formation can be distinguished in rotary and cable-tool cuttings (text-fig. 3; appendix IC).

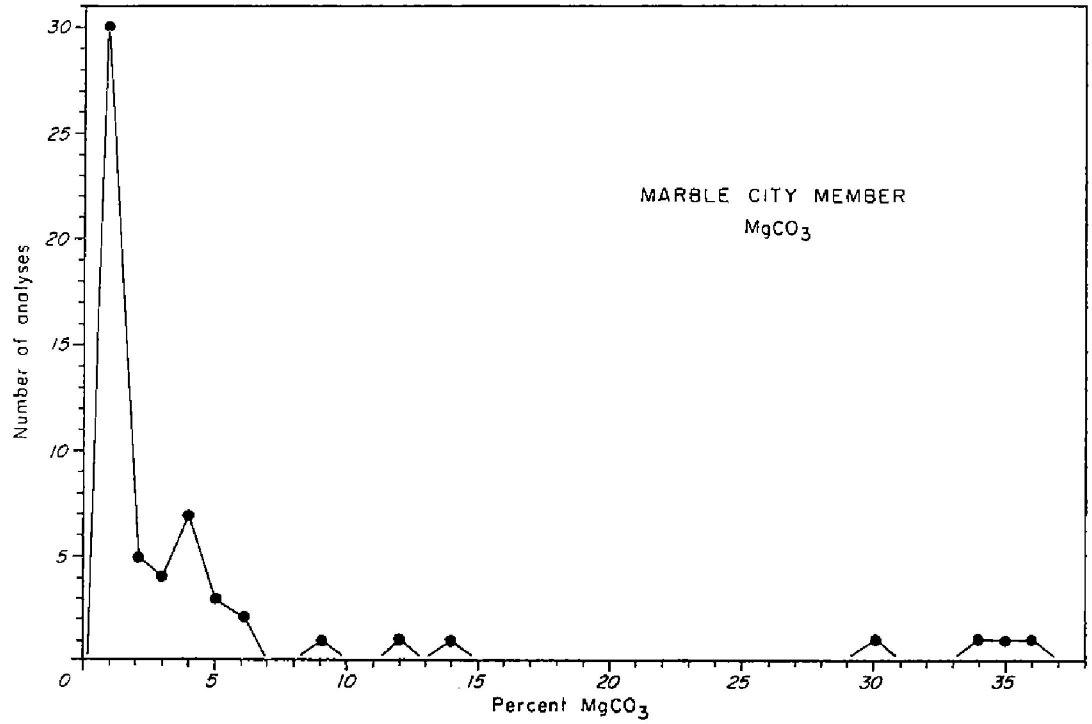
The Quarry Mountain Formation is 154 feet thick at the type locality (based on surface exposures plus data from core hole SCL 2); it is 116 feet thick at core hole OGS 1 near Bunch; 52 feet thick at OGS 2 south of Barber (in this area the Marble City Member has been removed by post-Silurian erosion); 123 feet thick at OGS 3 west of Tenkiller dam. The greatest thickness we have found is in wells E and F (appendix IC), in the southeastern part of the area studied, where the Quarry Mountain is 185 to 190 feet thick. To the north and west of these wells the formation thins, owing largely to post-Lower Devonian erosion, and it is absent over a large region lying to the north and west of Lake Tenkiller (text-fig. 3).

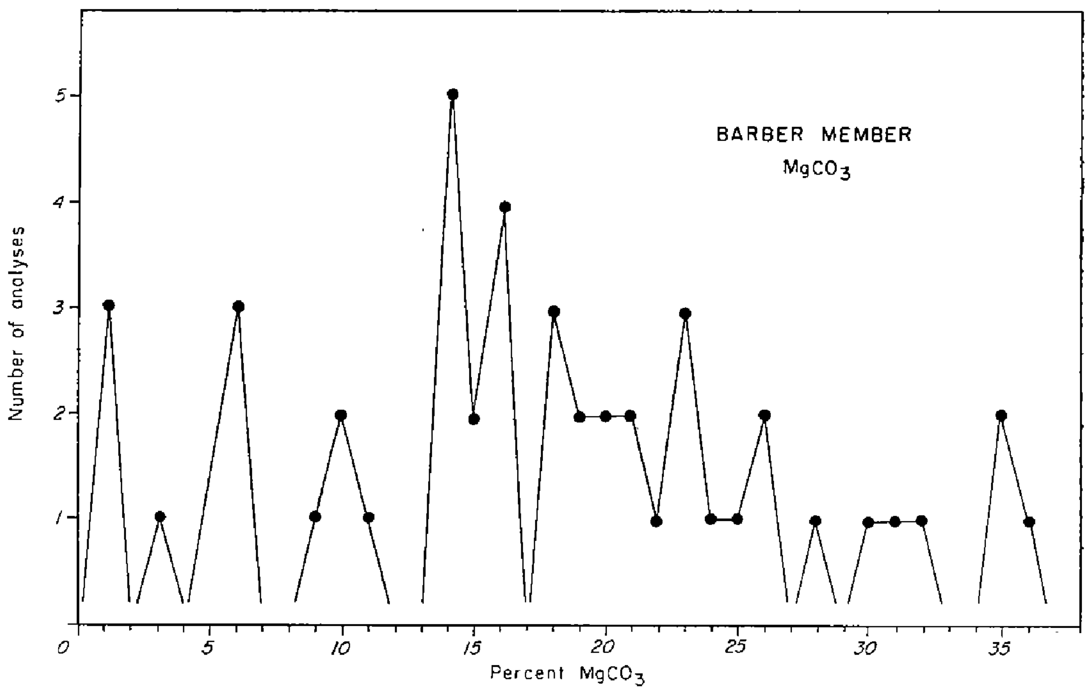
Barber Member

The Barber Member is a new name herein proposed for the lower dolomitic Quarry Mountain strata. The type locality is situated along a small tributary of Dry Creek in Cherokee County, about 3 miles southeast of Barber; SE¼ NW¼ NE¼ sec. 2, T. 14 N., R. 23 E. (pl. B; stratigraphic section Ch3 and core hole OGS 3, appendices IA, IB). This member is characteristically a dolomitic limestone with numerous beds of calcitic dolomite, and it is distinguished from the overlying Marble City Member upon the basis of its higher $MgCO_3$ content (see below under Barber-Marble City Relationship). The Barber Member is exposed at the surface in only three small areas: (1) the type locality southeast of Barber, (2) in the lower part of the St. Clair Lime Company quarry, and (3) about half a mile south of this quarry (pls. A, B). In the first two of these localities only a few feet of the Barber is exposed, but in the outcrops southwest of the quarry the entire member and underlying Tenkiller Formation are brought to the surface, although the exposures in this area are poor. The Barber Member is penetrated by core holes OGS 1, OGS 2, OGS 3, SCL 2, and 29Z; it can also be recognized in the subsurface upon the basis of cuttings from rotary and cable-tool holes (text-fig. 3; appendix IC).

Lithologic character.—The Barber is a dolomitic carbonate that weathers light to medium gray. The bedding on weathered surfaces and in the cores tends to be obscure (pl. XII, fig. 1). Chert has not been observed in this member.

The Barber is composed in large part of finely crystalline dolomite. Its $MgCO_3$ content ranges from about 1 percent up to 36 percent; the arithmetic mean is almost 18 percent, and the rock

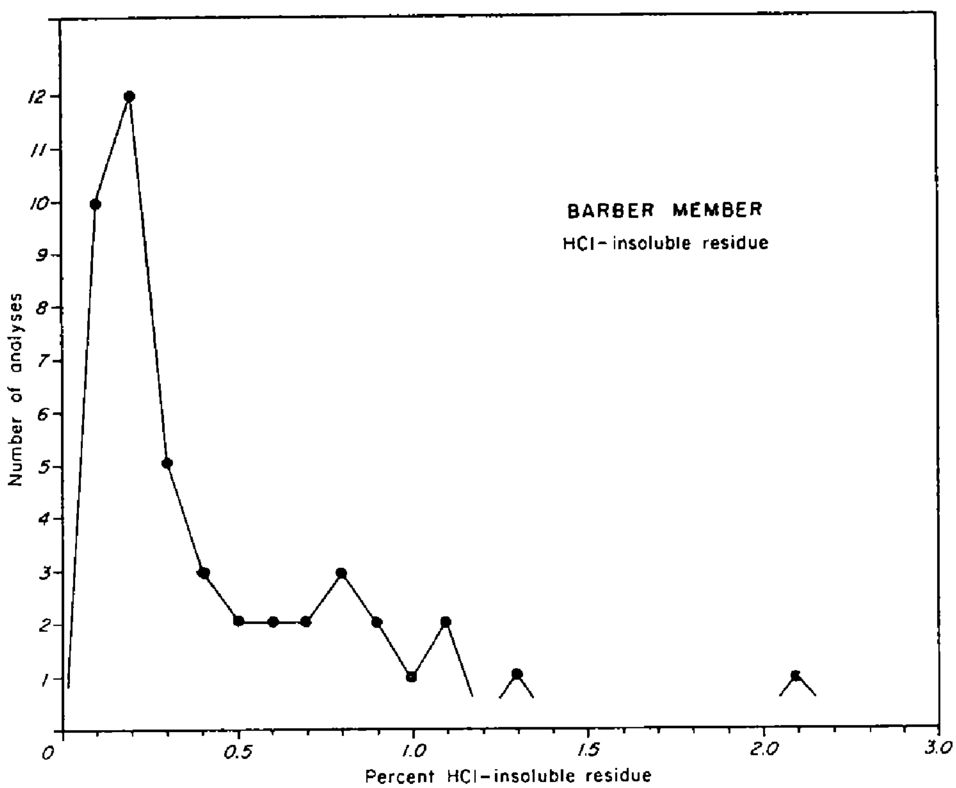




Text-figure 12. Frequency diagram showing the range of $MgCO_3$ in the Marble City Member (above) and Barber Member (below) of the Quarry Mountain Formation. The 46 Barber analyses are channel samples taken from cores; these are unweighted and the intervals sampled differ considerably in thickness. The 58 Marble City analyses include both channel samples of cores, as well as individual rock specimens collected from the upper 30 feet of the member (Amsden, 1961, p. 114-115). See also text-figures 2, 10, 15, and 19 and the stratigraphic sections on plates A and B; the data are tabulated in appendix II.

is mostly dolomitic limestone and calcitic dolomite (text-fig. 2). The frequency range of $MgCO_3$ content is shown in text-figure 12 and the stratigraphic distribution in text-figures 10, 15 and plates A, B (complete chemical data are given in appendix II). Scattered through the more dolomitic parts are beds with a fairly low $MgCO_3$ content. These beds are bioclastic limestone with texture and composition similar to those of the overlying Marble City Member; with an increase in dolomitic content, the edges of fossil fragments in the bioclastic facies become "corroded," and, as the rock passes into a crystalline calcitic dolomite, the organic debris is largely obliterated (pl. XII, figs. 2, 3; pl. XVIII, fig. 4). For additional information on the Barber Dolomite see the sections on Barber-Marble City Relationship, and Stratigraphic Distribution of Dolomite.

The Barber has a low acid-insoluble-residue content. The 46 analyses given in the frequency diagram (text-fig. 13) range from 0.1 to 2.1 percent, averaging 0.53 percent. The amount of insolubles increases downward, although it rarely exceeds 1 percent, even in the basal portions of this member. This increase may be observed in the chemical data given in appendix II (which is arranged strati-



Text-figure 13. Frequency diagram showing the range of HCl-insoluble residues in the Barber Member of the Quarry Mountain Formation. All analyses are of channel samples taken from cores; these are unweighted and the intervals sampled differ considerably in thickness (appendix II). Forty-six analyses are represented (see also text-figs. 2, 10).

graphically) and is graphically illustrated in text-figure 10. The distribution of acid insolubles is discussed at greater length in the chapter on the Tenkiller Formation.

The acid insolubles are mostly subangular, clear quartz grains and tiny pyrite crystals. In some samples glauconite is fairly common. The residues fall largely in the silt-size range, with only a few grains exceeding 0.06 mm in diameter. Some beds show evidence of minor silicification, possibly associated with stylolite seams.

Barber-Marble City relationship. — The Quarry Mountain Formation comprises a sequence of high-purity carbonates overlying the Tenkiller Formation and underlying Devonian or Mississippian strata. The acid-insoluble content of these rocks is low, averaging less than 0.5 percent; the amount of insolubles does increase downward, but even in the lowest beds it rarely exceeds 1 percent. Throughout the area studied, the upper part of this sequence is mostly limestone and the lower part mostly dolomitic limestone. This stratigraphic distribution of limestone versus dolomite is the basis for dividing the Quarry Mountain into an upper Marble City Member (mostly limestone) and a lower Barber Member (mostly dolomitic limestone). The Marble City-Barber contact is placed at that point where the $MgCO_3$ content generally exceeds 10 percent, although it should be noted that this dividing point is quite arbitrary. Using this system, a fairly well-defined lithologic distinction can be maintained in all areas of outcrop and in those subsurface areas for which chemical data are available (core holes OGS 1, OGS 2, OGS 3, SCL 1, SCL 2, 29Z; see text-figs. 10, 15; pls. A, B). Furthermore, this division can be recognized in rotary and cable-tool holes (text-figs. 3, 15), where the dolomite content was visually estimated on the basis of well cuttings (appendix IC). It should be emphasized that this system does not produce a sharp distinction between Marble City Limestone and Barber Dolomite; beds of dolomitic limestone, or even calcitic dolomite, are present throughout the Marble City, even in the uppermost strata, and conversely beds of limestone are present in the Barber.* In the field the Barber-Marble City contact is not sharply defined and is difficult to map; we show it in two places on the Marble City map (pl. A), but it is not well marked in either area. Nevertheless, this is a useful stratigraphic division because, wherever examined, the lower part of the Quarry Mountain Formation is strongly dolomitic, whereas the upper part is predominantly limestone. This rela-

* Wells E, F, and G (appendix IC; text-figs. 3, 15) have considerable amounts of dolomite in the upper part of the Marble City Member.

tionship is discussed further in Stratigraphic Distribution of Dolomite.

Barber-Tenkiller relationship. — The Barber-Tenkiller relationship is discussed under Tenkiller Formation.

Thickness and distribution. — The Barber Member is widely distributed throughout the area studied. It crops out near Marble City (pl. A) and in the type area southeast of Barber (pl. B). A part or all of this member was penetrated in core holes OGS 1, OGS 2, OGS 3, SCL 2, 29Z, and 34Y. The Barber has been recognized in all rotary and cable-tool holes in which the Quarry Mountain Formation is present (text-figs. 3, 15).

The Barber Member is approximately 52 feet thick at the type locality* (based upon surface exposures plus data from core hole OGS 2; see appendices IA, IB); it is about 80 feet thick at the quarry of the St. Clair Lime Company (surface exposures plus data from core hole SCL 2; see appendices IA, IB); it is 50 feet thick in core hole OGS 3, west of Lake Tenkiller dam (appendix IB). The thickness of this member in the cable-tool and rotary wells (text-fig. 3) ranges from 10 feet (wells H, M) to 80 feet (well C). This considerable range in thickness is undoubtedly due to the fact that the Barber Member, at least in its upper part, is a facies of the lower part of the Marble City; the dolomitic strata of the Barber quite clearly grade both upward and laterally into the more calcareous strata of the Marble City (see Stratigraphic Distribution of Dolomite).

Fossils and age. — The only fossils which we have found in the Barber come from the upper part. A fairly large collection of megafossils was obtained in situ from the lowest strata exposed in the quarry of the St. Clair Lime Company and is from the upper few feet of the member (S18 and S18A, pl. A; appendix IA). This fauna has not been studied in detail, but at least the brachiopods are similar to, if not identical with, those collected from the Marble City Member, including the uppermost strata. See discussion of Fossils and Age under Marble City Member.

Marble City Member

The Marble City Member is a new name herein proposed for the upper limestone portion of the Quarry Mountain Formation. The type locality is in the quarry of the St. Clair Lime Company, about 1.5 miles north of Marble City, SE¼ SE¼ NE¼ and

* The Marble City member is absent in this area, having been removed by post-Silurian pre-Chattanooga erosion.

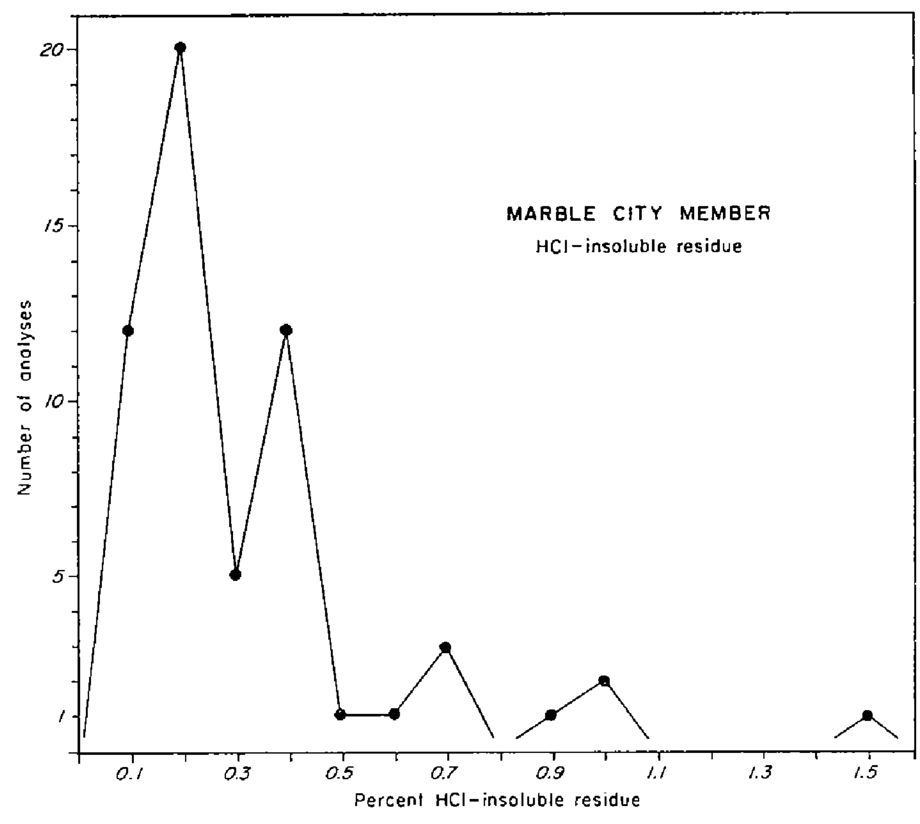
NE¼ NE¼ SE¼ sec. 14, T. 13 N., R. 23 E., Sequoyah County (see pl. A, pl. XIII; core hole SCL 1; appendices IA, IB). This member is characteristically a bioclastic limestone with some beds of dolomitic limestone and calcitic dolomite, and is distinguished from the underlying Barber Member by its lower $MgCO_3$ content. The Marble City Member is well exposed at a number of places in the type area just north of Marble City (pl. A); in this region the natural exposures are supplemented by a number of quarries and the two underground mines of the St. Clair Lime Company. The upper part of this member is also exposed at a few places near Bunch, Adair County (pl. B; OGS 1; appendices IA, IB). The only other outcrop is west of Lake Tenkiller dam, where a few feet of uppermost Marble City strata are exposed (pl. B; OGS 3; appendices IA, IB). The Marble City Member is penetrated by core holes OGS 1, OGS 3, SCL 1, 29Z, and 34Y; it can also be identified in the cuttings from rotary and cable-tool holes (pl. XVIII, fig. 3; text-figs. 3, 15; appendix IC).

Lithologic character.—The Marble City is predominantly pale-gray to pinkish-gray limestone, weathering medium to dark gray. The more dolomitic beds have a finer texture and weather dark gray to brownish gray. This member commonly has rather thick beds, up to about 2 feet (pl. XIII; Amsden, 1961, pls. II, VI).

The Marble City is largely a biosparite, although some parts have considerable amounts of micrite cement. The fossil clasts are mostly pelmatozoan plates (pl. XIV, figs. 1, 2), but some beds also have many brachiopods, bryozoans, trilobites, and other forms (pl. XIV, figs. 3, 6; pl. XV). The fossils have not been extensively fragmented, and fairly good specimens may be collected where the rock is friable enough to allow the matrix to break around the specimen. Many of the brachiopod shells are articulated, and the organic debris does not appear to have undergone much breakage before or during deposition. However, in thin section the boundary between fossil and matrix is commonly not sharply defined, suggesting some recrystallization or other alteration of the organic material after deposition (pl. XV, fig. 2).

The Marble City is a carbonate rock of exceptional purity. The HCl-insoluble-residue content is uniformly low, averaging about 0.3 percent (text-figs. 2, 10). The greatest amount of residue in any specimen tested is 1.5 percent, and the mode falls well below 0.5 percent (text-fig. 14). The residues are mostly silt-size subangular quartz. Small pyrite crystals are commonly present and some residues carry glauconite.

The Marble City is mostly a limestone with low $MgCO_3$ content, and in places, as in the area around the St. Clair Lime Company quarry (pl. A), it is a high-calcium limestone (text-fig. 4; appendix II), which has been extensively mined and quarried as a source of lime. The average $MgCO_3$ content for the entire member is about 3 percent (text-fig. 2), and the mode is about 1 percent (text-fig. 12). However, beds of dolomitic limestone are fairly common in the Marble City Member, and some of these grade into calcitic dolomite with as much as 36 percent $MgCO_3$. Most of the magnesium carbonate is present in the form of finely crystalline dolomite; in those beds where the $MgCO_3$ does not exceed 10 percent or so, the dolomite largely occupies the place of the sparry calcite matrix (pl. XIV, fig. 4), but, as the $MgCO_3$ content increases, the entire rock grades into crystalline dolomite (pl. XIV, fig. 5). The dolomitic limestone and calcitic dolomite are irregularly distributed through the Marble City, and beds of calcitic dolomite are present at the very top of the member (e. g., stratigraphic section S9; Amsden, 1961, p. 102-104). The field relations show plainly that the dolomites and limestones of the Marble City are facies of



Text-figure 14. Frequency diagram showing the range of HCl-insoluble residues in the Marble City Member of the Quarry Mountain Formation. The analyses include channel samples taken from cores (appendix II) plus rock samples from the upper 20 feet of the member (Amsden, 1961, p. 114-115); the analyses are unweighted and the intervals sampled differ considerably in thickness. Fifty-eight analyses are represented (see also text-figs. 2, 10).

one another, with complete lateral gradation from low- to high-magnesium limestone (Amsden, 1961, p. 21-22). It is also clear that the dolomite bodies are elongate in the plane of the bedding, and there can be little doubt that, however the $MgCO_3$ originated, its basic control is the bedding and not some transgressing feature such as faulting. The inferred distribution of dolomite is shown on plates A, B and text-figure 15, and is discussed further in Stratigraphic Distribution of Dolomite.

Sediment-filled cavities. — Sediment-filled cavities are common in the Marble City and, for the most part, conform to the pattern of those previously described from the Tenkiller Formation. Like those in the Tenkiller, they appear to represent sediment deposited in a previously formed cavity. The sediment, which is finely divided carbonate, is laminated and may show some cross-bedding (pl. XV, fig. 3). This laminated carbonate is predominantly calcite but may include scattered dolomite crystals, or, less commonly, layers of crystalline dolomite. The layered sediment abuts against the surrounding rock and is almost everywhere at least partly overlain by sparry calcite. Some are underlain by fairly well-developed areas of crystalline dolomite. Many of the sediment-filled cavities in the Marble City appear to have undergone some later solution, and it is not uncommon to find the laminated carbonate bodies cut off at the top and bottom by stylolite seams; in the latter instance the laminated material may be underlain as well as overlain by sparry calcite. We believe the Marble City structures originated in much the same way as did those in the Tenkiller Formation.

Post-Marble City unconformity. — The Marble City strata, which are the youngest Silurian rocks exposed in northeastern Oklahoma, are unconformably overlain by various Devonian and younger strata. In different places this member is overlain by: the Lower Devonian Frisco Formation (Deerparkian); the Lower Devonian Sallisaw Formation (Esopusian); the Upper Devonian Sylamore Sandstone Member of the Chattanooga Formation; or the Mississippian "Boone" Formation (pls. A, B; Amsden, 1961, p. 22). Prior to Devonian deposition the Marble City beds were uplifted and subjected to subaereal erosion, during which time a considerable amount of rock was removed and a surface of some relief developed (Amsden, 1961, p. 37-39). Much solution occurred at this and later times, producing many fissures and cavities which were subsequently filled with sediment deposited during Frisco and later Devonian time.*

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* Considerable solution is known to have taken place in the upper Marble City beds both in pre-Frisco (Early Devonian) time and in pre-Sylamore (Late Devonian) time, because fissures filled with Frisco sediment and fissures filled with Sylamore

Some of the sediment-filled cavities are quite large and may extend down into the Marble City for as much as 30 feet. The upper part of the Marble City Member also has cavities which are only partly filled with coarse-crystalline calcite. A number of these cavities may be observed in the old mine of the St. Clair Lime Company, some of which are as much as 4 feet in diameter; at least the larger ones appear to be confined to the upper 10 feet of the Marble City. In places the coarse spar associated with the cavities includes sphalerite and galena, and small vugs filled with light oil have been reported (Huffman, 1958, p. 30). Finally, some fairly large caves have developed in the upper part of the Marble City Member. The largest known to us is Cottonwood Cave on the north side of Walkingstick Hollow, about 2 miles north of the St. Clair Lime Company quarry (NW¼ SW¼ sec. 1, T. 13 N., R. 23 E.; pl. A); this cave is at least 1,000 feet long, with some rooms up to 60 feet wide (Curtis, 1959, p. 142). Another somewhat smaller cave is in the uppermost Marble City beds in the outcrop belt about 0.5 mile north of diamond-core hole OGS 1, in the approximate center of sec. 4, T. 14 N., R. 24 E., Adair County (pl. B). During these periods of uplift, erosion, and solution a great many stylolites were developed in the Marble City, so that this member shows much microscopic as well as megascopic evidence of solution (pl. XVII, fig. 1). Some of this solution is known to have taken place during Late Silurian and Devonian time, but some may be much later, possibly associated with the present cycle of erosion.

Alteration in the upper part of the Marble City Member.— The upper part of the Marble City Member and the overlying Frisco Formation are well exposed in the mine of the St. Clair Lime Company (stratigraphic section S13, pl. A). In the upper 10 feet or so of this member the typical pink crinoidal limestone has irregular patches of a light-gray fine-textured rock. In thin section these patches commonly appear as fine-granular limestone in which the fossils are only faintly outlined (pl. XVI, fig. 3); the transition from the pink bioclastic texture is generally abrupt (pl. XVI, fig. 1). The acid-insoluble, $MgCO_3$, and $CaCO_3$ contents of these two rock types are similar (see explanation, pl. XVI). These fine-grained gray areas may represent a primary feature of the rock, such as a calcisiltite or algal deposit, but we are inclined to interpret them as secondary, produced by post-depositional alteration, because the fossils have faint, indistinct outlines (pl. XVI, fig. 3), and some

sandstone can be observed in the upper Marble City Member (Amsden, 1961, p. 22, 37-42, 58, 63-66). We also suspect some pre-Sallisaw solution, but have not positively identified any Sallisaw-filled fissures. Later periods of solution may also have occurred.

appear to have been subjected to considerable "corrosion" (pl. XVII, figs. 2, 3). This rock seems to be most satisfactorily explained as the result of recrystallization, which tends to produce a more finely crystalline matrix. We are, however, unable to offer any suitable explanation as to the precise mechanism involved. It certainly took place prior to the deposition of the Devonian as the Frisco rocks are not affected (pl. XVI, fig. 1); perhaps it was produced during the period of pre-Devonian weathering and solution. In any event it appears to be confined to the uppermost Marble City strata as these structures have not been observed in any of the lower beds, either at the surface or in the cores.*

Marble City-Barber relationship.—This is discussed under the Barber Member.

Marble City-Tenkiller relationship.—This is discussed under the Tenkiller Formation.

Thickness and distribution.—The Marble City Member is well exposed in the Marble City area, both by natural exposures and in various quarries and mines (pl. A). The upper Marble City strata also crop out near Bunch and in a small area west of Lake Tenkiller (pl. B). This member is penetrated by core holes SCL 1, 34Y, 29Z, OGS 1, and OGS 3. It can be recognized in the cuttings from rotary and cable-tool holes (text-fig. 3; appendix IC).

The Marble City Member is 63 feet thick at the type locality in the quarry of the St. Clair Lime Company (SCL 1, appendix IB). It is 57 feet thick at core hole 34Y, 69 feet thick at 29Z, 58 feet thick at OGS 1, and 73 feet thick at OGS 3. The maximum thickness recorded by us is 160 feet in well A; from this thickness it ranges down to zero, having been removed by post-Silurian erosion in some areas (text-figs. 3, 15; appendices IB, IC).

Fossils and age.—We have made substantial collections of megafossils from the Marble City Member. This fauna is predominantly brachiopods and trilobites, along with some bryozoans, mollusks, corals, and other forms. The brachiopod fauna is fairly large and varied, and quite well preserved. This fauna has not been studied in detail, but it is clearly Silurian in age, and a preliminary survey points to some similarity with early Upper Silurian faunas such as that of the Henryhouse. It differs in several respects from the type St. Clair brachiopod fauna, and we believe the latter formation is somewhat older than the Marble City. The senior author plans to make a detailed study of the Marble City brachiopods.

* The fossil clasts throughout the Marble City Member tend to have somewhat obscure outlines; however, the gray "altered" areas discussed above seem to be confined to the upper few feet.

STRATIGRAPHIC DISTRIBUTION OF DOLOMITE

A detailed petrologic study of the dolomites in the Silurian and Early Devonian rocks of northeastern Oklahoma is beyond the scope of the present report. However, in the course of the present investigation, we have assembled a considerable amount of information on the stratigraphic and geographic distribution of magnesium carbonate in these rocks, and, as this appears to have a bearing on the time at which the magnesium was introduced, it is summarized below. Further details on dolomite content are given in the section on Lithologic Character for each of the formations described in the present report.

The dolomitic strata in the rocks under investigation have been studied in the field, in peels and thin sections, and by chemical analysis. Chemical analyses giving the HCl-insoluble-residue, $CaCO_3$, and $MgCO_3$ contents have been prepared from samples taken at the surface outcrops and from subsurface cores. The surface data consist of analyses of spot samples collected by the senior author from described stratigraphic sections (Amsden, 1961, p. 113-116; stratigraphic section Ch2, appendix IA, this report), and some channel samples reported in Oklahoma Geological Survey Mineral Report 16 (Ham and others, 1943, p. 16-19). The most detailed and complete analytical data are based on the diamond cores; each core was split lengthwise, half being saved for study and the other half used for analysis (appendix II). The cuttings from the rotary and cable-tool holes examined for this report were not chemically analyzed, the $MgCO_3$ content being determined by visual inspection (appendix IC).

The $MgCO_3$ may be present as small dolomite crystals scattered through the matrix (pl. XIV, fig. 4; pl. XVIII, fig. 5), or as small, irregular areas of crystalline dolomite (pl. V, figs. 1, 2; pl. IX, fig. 2), as distinct beds, or as lithostratigraphic units having appreciable thickness and lateral persistence (i. e., the tan dolomite member of the Blackgum Formation or the Barber Member of the Quarry Mountain Formation; text-figs. 10, 15; pls. A, B). Considerable evidence shows that this dolomite is at least in part a replacement mineral. Thin sections show that the dolomite in those beds with a low magnesium carbonate content is present as small well-formed crystals scattered through the matrix (pl. XIV, fig. 4). As the $MgCO_3$ content increases, the matrix becomes mostly crystalline dolomite and the fossil clasts appear to have "corroded" boundaries (pl. XII, fig. 3), and finally, as the rock grades into a calcitic dolomite, the fossil clasts largely disappear and the rock becomes a crystalline dolomite (pl. XII, fig. 2; pl. XIV, fig. 5; pl. XVIII, fig. 4).

To some extent the dolomitic areas are a facies of the non-dolomitic parts. Both in thin section (pl. V, figs. 1, 2) and in the field (Amsden, 1961, p. 20-21; see also text-fig. 15 and pls. A, B of this report) a lateral gradation from high- to low-magnesium stone can be demonstrated. For example, the beds of high-magnesium stone in the Marble City Member are lenticular bodies* which pass laterally into low-magnesium stone. Nonetheless, any satisfactory explanation of the origin of the dolomite must take into account a conspicuously overriding stratigraphic control or zonation of its distribution.

The stratigraphic control of dolomite distribution is as marked in the Lower Devonian strata as it is in the Silurian strata. These rocks are well exposed and easily studied in the area just north of Marble City (pl. A). The youngest Silurian unit, the Marble City Member, is primarily a limestone, but carries beds of calcitic dolomite, even in its upper part. This member is generally overlain by the Lower Devonian Frisco Formation, which has a uniformly low $MgCO_3$ content and which is in turn overlain by the late Lower Devonian Sallisaw Formation, which in places has a high magnesium content. Thus in some places the Frisco Limestone is directly overlain and underlain by high-magnesium strata. This is the situation at stratigraphic section S9 in Payne Hollow (pl. A), where the Frisco, with less than 2 percent $MgCO_3$, is underlain by the Marble City Member, the uppermost beds of which have slightly more than 35 percent $MgCO_3$, and is overlain by the Sallisaw with 26.49 percent $MgCO_3$. In this connection it should be noted that the Frisco is a bioclastic limestone with basic textural characteristics similar to those of the Marble City; this relationship is discussed in the senior author's paper, *Stratigraphy of the Frisco and Sallisaw Formations (Devonian) of Oklahoma* (Amsden, 1961, p. 69-73, 115; appendix; pl. XI).†

The major concentration of dolomite in the Silurian sequence of northeastern Oklahoma is also along fairly marked lithostratigraphic zones. This is well shown in the Blackgum Formation. The

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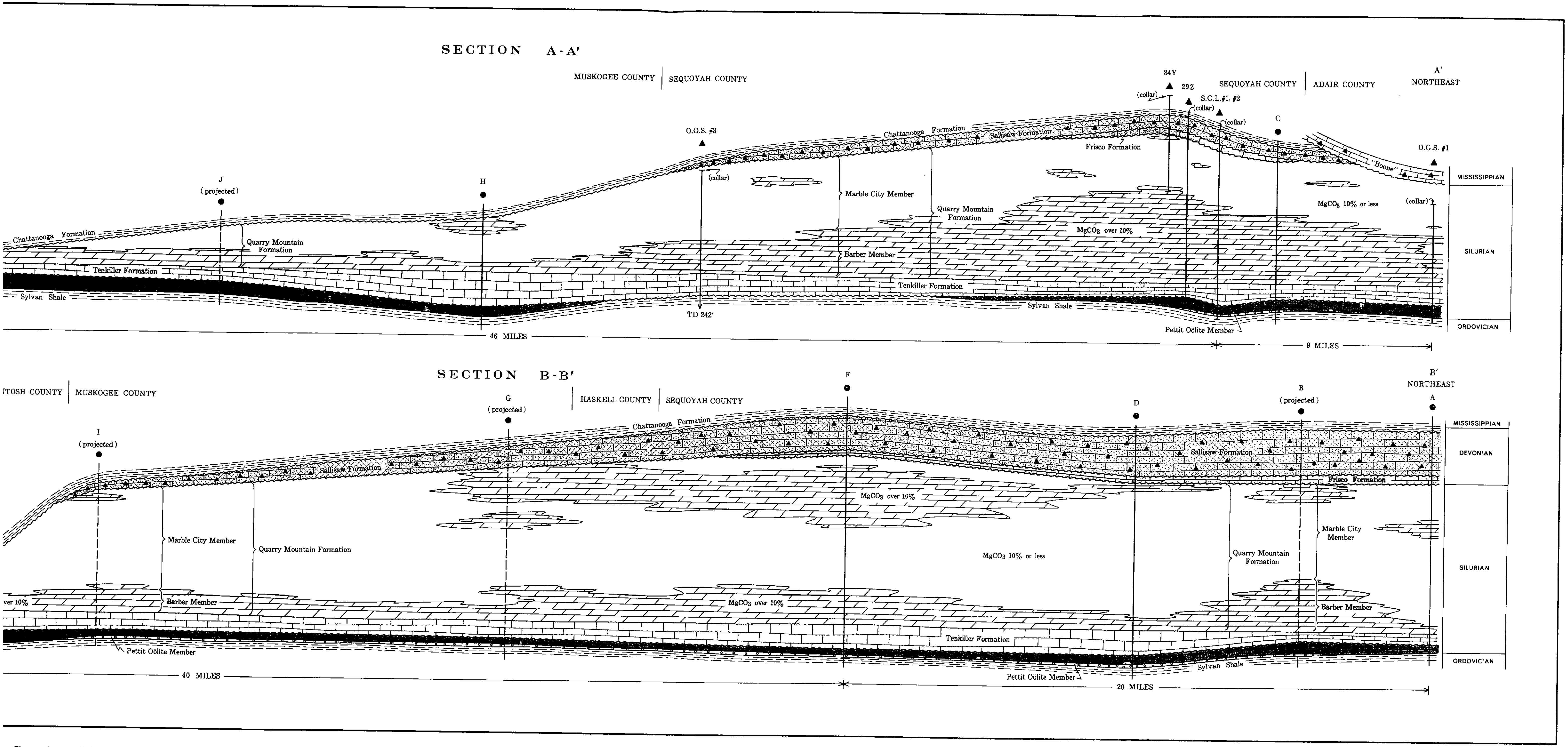
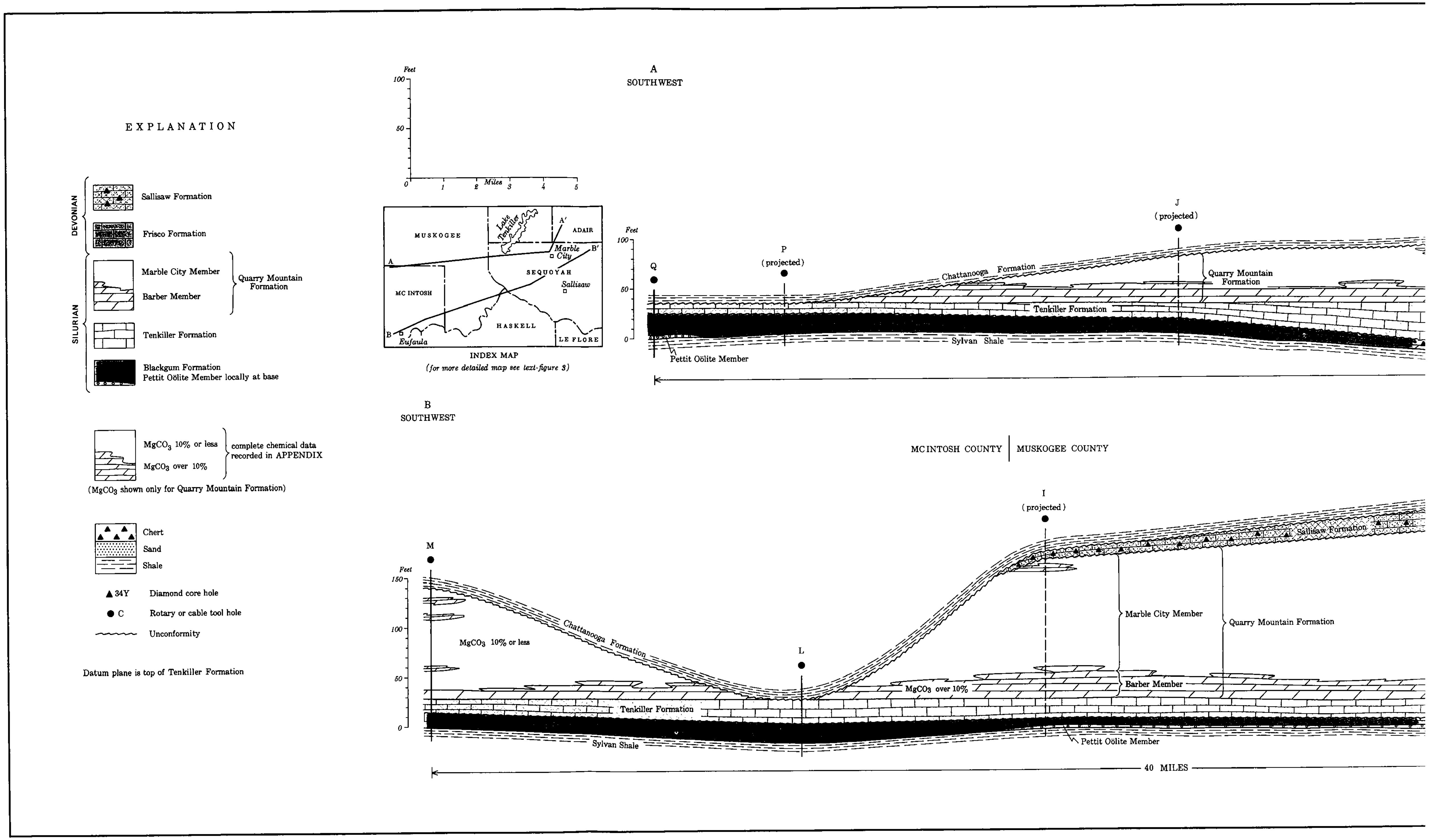
* The larger dolomitic areas are in large part conformable bodies which lie in the plane of the bedding; see discussion under Marble City Member, Lithologic Character.

† In the senior author's 1961 publication all the Silurian strata in northeastern Oklahoma are referred to the "St. Clair Formation"; thus "upper St. Clair" = Marble City Member of the present report.



Stratigraphic sections in northeastern Oklahoma showing the distribution of dolomite in the Quarry Mountain Formation.



Text-figure 15. Stratigraphic sections in northeastern Oklahoma showing the lower part of this formation (excluding the Pettit Oölite Member, which is locally present at the base) consists of 2 to 4 feet of tan-weathering, calcitic dolomite with an $MgCO_3$ content ranging from 20 to 32 percent (text-figs. 6, 9, 10). The overlying Blackgum limestone member has a sharply reduced magnesium content, the $MgCO_3$ ranging from 3 to 13 percent. The boundary between these two lithostratigraphic units is reasonably well defined (pl. III, fig. 1), and these divisions can be recognized in all areas of outcrop and in core holes OGS 1, OGS 2, and SCL 2.

The Tenkiller Formation has only irregular patches of dolomite (pl. IX, fig. 2), but the overlying Quarry Mountain Formation has a well-developed basal dolomite member. The lower Barber Member of this formation is a calcitic dolomite with some beds of dolomitic limestone, whereas the upper Marble City Member is mostly limestone with lenses of dolomitic limestone and calcitic dolomite. The boundary between these two members is gradational, and to some extent they are facies of one another; nevertheless, throughout the area studied the strata immediately overlying the Tenkiller limestones are strongly dolomitic, followed by a sequence of limestones with only scattered dolomite beds. The distribution of dolomite in the Quarry Mountain Formation is shown in the stratigraphic sections on plates A and B, and in text-figure 15.

This arrangement indicates a pronounced stratigraphic control of the distribution of magnesium carbonate in the Silurian and Lower Devonian strata. The basal Blackgum (excluding the Pettit Oölite), is a dolomite, followed by the upper Blackgum and Tenkiller beds which are basically limestone with only irregular patches of crystalline dolomite; overlying the Tenkiller is the Barber calcitic dolomite, followed by the Marble City limestones bearing only scattered dolomite areas. In the Marble City area the Silurian strata are generally overlain by the Lower Devonian Frisco Formation, which has an extremely low $MgCO_3$ content and which is in turn overlain by the Sallisaw Formation, which is in places strongly dolomitic. This pronounced layering, or stratigraphic zonation, of limestone and dolomite suggests that the $MgCO_3$ is mostly a primary feature of the rock, in the sense that its genesis is closely tied in with the depositional history of these strata. If it represented a "secondary," or late-stage, dolomitization, introduced after all of these formations had been deposited, the dolomite would be more uniformly distributed through the rock; it would be about as abundant in the upper Blackgum and Tenkiller beds as in the lower Blackgum and Barber strata. Certainly the abrupt termination of the dolomitic strata below and *above* the Frisco is difficult to reconcile with an hypothesis of late-stage dolomitization*. To us the overall pattern of dolomite distribution is most reasonably explained by assuming that most of the magnesium was introduced into the sediment at or near the time of deposition. Since a considerable part of the dolomite appears to be a replacement mineral, it is necessary to assume that an early-stage replacement occurred during or shortly after deposition. If this explanation is correct, the concentration of magnesium in the sea water must have fluctuated considerably during Silurian and Early Devonian times, periods of high magnesium concentration alternating with periods of reduced concentration. This hypothesis does not require that all the dolomite developed in this manner. Some dolomitic portions, such as the irregular patches in the Tenkiller or Marble City, may represent $MgCO_3$ which was reconcentrated after the close of Silurian deposition (but prior to Frisco deposition) and which would thus to some degree mask the presumed original distribution pattern.

* It might be postulated that something in the composition and/or texture of certain units inhibited dolomitization by magnesium-bearing waters; however, these are all bioclastic carbonates with texture and composition sufficiently similar to make such an explanation appear unlikely.

SUBSURFACE INVESTIGATION

Our surface investigation has been augmented through a study of subsurface stratigraphy by means of rotary and cable-tool cuttings, supplemented by electric logs, and by the use of diamond cores. The latter have been of special value because they give a complete and continuous section of the strata penetrated, furnishing information which is of the same order of precision as that supplied by surface exposures. Moreover, the diamond cores furnish data on the lithologic character and relationships of strata which are either not exposed, or only poorly exposed, at the surface. The information obtained from a study of rotary and cable-tool cuttings is not as complete or reliable as that obtained from diamond cores; however, it has been possible to trace the major stratigraphic units over a considerable area in the subsurface (text-fig. 3). It should be emphasized that these wells are correlated with the surface outcrops (and diamond cores) of northeastern Oklahoma, and not with the strata exposed in the Arbuckle Mountains region of south-central Oklahoma; this is discussed below.

Diamond cores. — We are utilizing the information from seven diamond-core holes which penetrated a part or all of the Silurian rocks in this area. These cores, which are described in detail in appendix IB, include core holes OGS 1, OGS 2, and OGS 3, drilled for the Oklahoma Geological Survey, and SCL 1, SCL 2, 29Z, and 34Y, drilled for the St. Clair Lime Company and generously given to the Survey by Homer Dunlap. The locations of these core holes are shown on plates A and B, and text-figure 3.

Diamond cores are of particular value in northeastern Oklahoma because at no place in this region can a complete Silurian section, from the Blackgum Formation through the Marble City Member, be observed. In the Lake Tenkiller and Qualls areas, where the Sylvan, Blackgum, and Tenkiller Formations are exposed, post-Silurian erosion has removed the overlying Quarry Mountain strata; in the Marble City and other areas where the Quarry Mountain Formation is exposed, present-day erosion has not breached the Silurian rocks deeply enough to expose the base. These cores furnish a complete and easily studied Silurian section.

All these cores are of value in defining the lithostratigraphy of this area, but OGS 2 and SCL 2 are especially useful because they furnish information on exposures which are herein designated type sections for new stratigraphic units. Core hole SCL 2 was drilled in the floor of the St. Clair Lime Company quarry (pl. A), starting in the upper part of the Barber Member and ending in the Sylvan Shale. This quarry is the type locality of the Quarry Mountain Formation, and, as the base of the formation is not exposed at this place, core SCL 2 is invaluable in furnishing a complete section, including the underlying formations. Core hole OGS 2 is at the type locality of the Barber Member. The base of this member is not exposed in this area, and this core thus serves to bring out the relationship between the Barber and underlying Silurian formations. The lithostratigraphic units cut by these and the other core holes can be easily correlated with one another and with the surface exposures.

Rotary and cable-tool holes.—We have studied 17 rotary and cable-tool holes located in Haskell, Sequoyah, Muskogee, and McIntosh Counties. These wells (lettered A to Q) are described in appendix IC, and their locations are shown in text-figure 3. The basic data were obtained from a detailed examination of the cuttings, including the preparation and study of some thin sections (pl. XVIII); we have also examined the electric logs for these wells, although in this type of stratigraphic section these are of less value than the cuttings*. The Silurian sequence in northeastern Oklahoma is almost entirely carbonates, the acid-insoluble content only rarely exceeding 10 percent. The lithostratigraphic distinction between the various units recognized is based mostly upon such features as texture, bedding characteristics, color, presence or absence of chert, and $MgCO_3$ content. These features, excluding the bedding, can generally be recognized in the cuttings, and we have been able to trace satisfactorily the major lithostratigraphic units recognized at the surface and in the cores as far east as McIntosh County (text-fig. 3).

It should be emphasized that our correlation is with the stratigraphic section which crops out in northeastern Oklahoma, rather than with that in the Arbuckle Mountains province. The Silurian and Lower Devonian lithostratigraphic and biostratigraphic sequences in these two areas exhibit substantial differences, and, in our opinion, the erroneous correlations introduced by some previous investigators stem in part from the attempt to apply the Arbuckle Mountains lithostratigraphic divisions to the rocks in northeastern Oklahoma.

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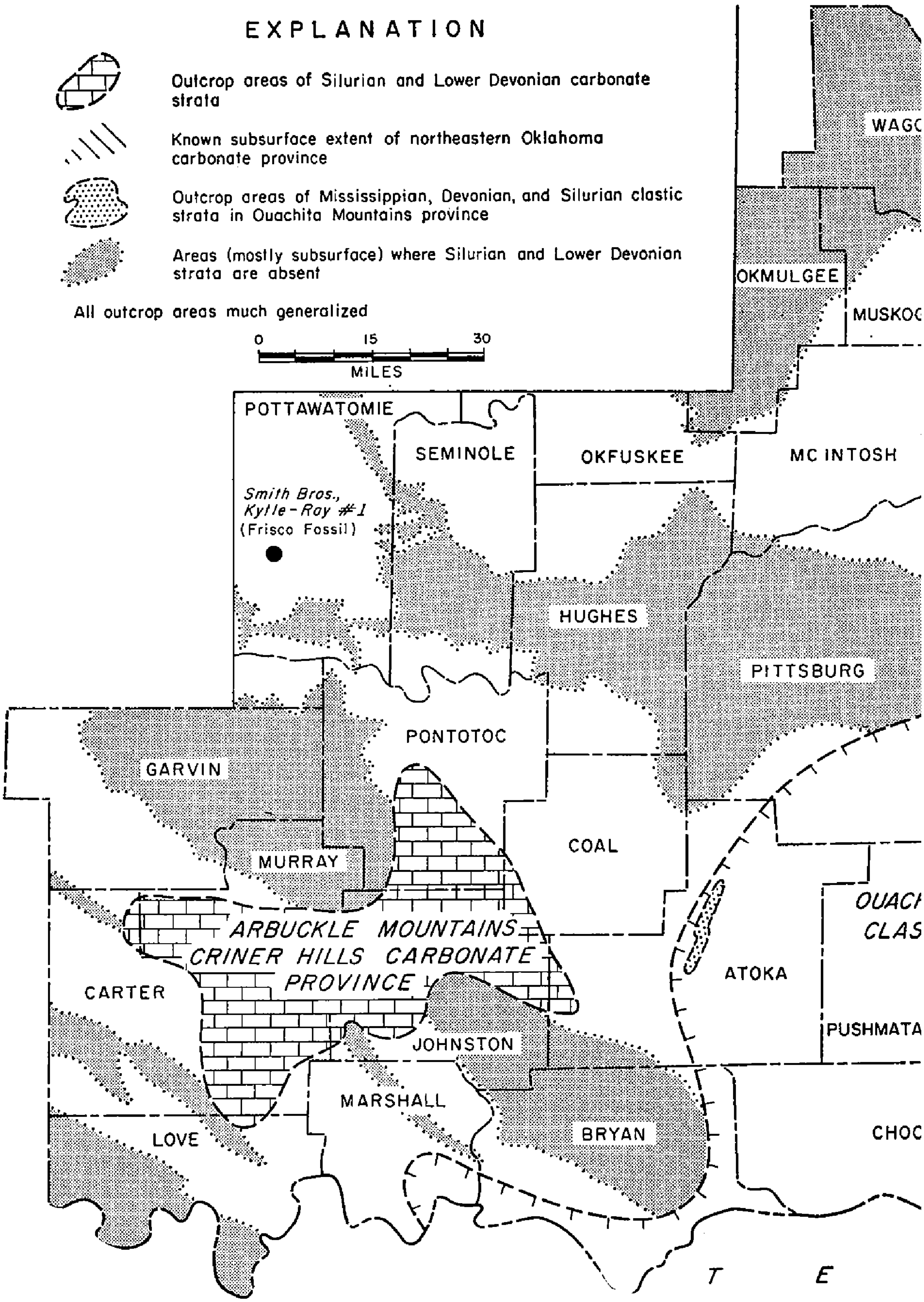
* Electric logs are most useful when combined with a study of the cuttings. They can be used effectively to determine the top of the Sylvan Shale, or base of the Chattanooga, and, to a lesser extent, may also reflect stratigraphic units within the Silurian and Lower Devonian carbonate sequence. For example, the Tenkiller-Blackgum stratigraphic interval (as determined by means of cuttings) is generally marked on the electric log by an increase in the resistivity curve (this part of the section shows a moderate increase in acid insolubles; text-fig. 10); however, it is not possible to separate Tenkiller from Blackgum on the basis of these logs.

SILURIAN AND LOWER DEVONIAN STRATA OF NORTHEASTERN OKLAHOMA COMPARED WITH THE ARBUCKLE MOUNTAINS-CRINER HILLS PROVINCE

Silurian and Devonian strata crop out in three separate areas of Oklahoma: in the Arbuckle Mountains-Criner Hills of south-central Oklahoma; in Sequoyah, Cherokee, and Adair Counties of northeastern Oklahoma; and in the Ouachita Mountains of southeastern Oklahoma (text-fig. 16). In the Ouachita region two clastic formations are referred to the Silurian: the Blaylock Sandstone and the Missouri Mountain Shale. Early Silurian (middle Llandoverian) graptolites have been found in the Blaylock Sandstone in Arkansas (Miser and Purdue, 1929, p. 45; Decker, 1936, p. 309; Ruedemann, 1947, p. 97). In Oklahoma the basal beds of this formation are reported to carry Late Ordovician graptolites (Pitt and Spradlin, 1964, p. 11); the overlying Blaylock beds are presumed to be Silurian, although no diagnostic fossils have been reported. To our knowledge no diagnostic fossils have been reported from the Missouri Mountain Shale, and its reference to the Silurian is based upon stratigraphic position only. We have not studied the Ouachita stratigraphic section, and our comments will be confined to the Silurian and Lower Devonian strata which are exposed in the Arbuckles and in northeastern Oklahoma.

The rocks of the Arbuckle-Criner Hills and Northeastern Oklahoma provinces have been intensively studied, and a substantial body of lithostratigraphic and biostratigraphic data upon which to base a comparison is now available. The strata in both areas are similar in being platform-type deposits, consisting of an incomplete and thin sequence of beds with a total thickness generally less than 400 feet. The rocks in these two areas are also similar in being entirely carbonates. In the Arbuckle-Criner region the strata are mostly limestone, the average $MgCO_3$ content of the various stratigraphic units being less than 5 percent (Amsden, 1960, p. 15, text-figs. 3, 19); only in a few places does the magnesium content range into a dolomitic limestone and then it is local. In contrast, the $MgCO_3$ content of the northeastern Oklahoma strata have substantially more $MgCO_3$ (text-figs. 2, 4, 19), and some units, such as the lower member of the Blackgum Formation and the Barber Member of the Quarry Mountain Formation, are largely dolomitic limestones and calcitic dolomites.

Significant lithostratigraphic and biostratigraphic differences are


EXPLANATION
Outcrop areas of Silurian and Lower Devonian carbonate strata
Known subsurface extent of northeastern Oklahoma carbonate province
Outcrop areas of Mississippian, Devonian, and Silurian clastic strata in Ouachita Mountains province
Areas (mostly subsurface) where Silurian and Lower Devonian strata are absent
All outcrop areas much generalized
0 15 30
MILES
WAGC
OKMULGEE
MUSKOG
POTTAWATOMIE
SEMINOLE
OKFUSKEE
MC INTOSH
Smith Bros., Kytle-Ray #1 (Frisco Fossil)
HUGHES
PITTSBURG
PONTOTOC
GARVIN
COAL
MURRAY
OUACI
CLAS
ARBUCKLE MOUNTAINS-CRINER HILLS CARBONATE PROVINCE
ATOKA
CARTER
JOHNSTON
PUSHMATA
MARSHALL
LOVE
BRYAN
CHOC
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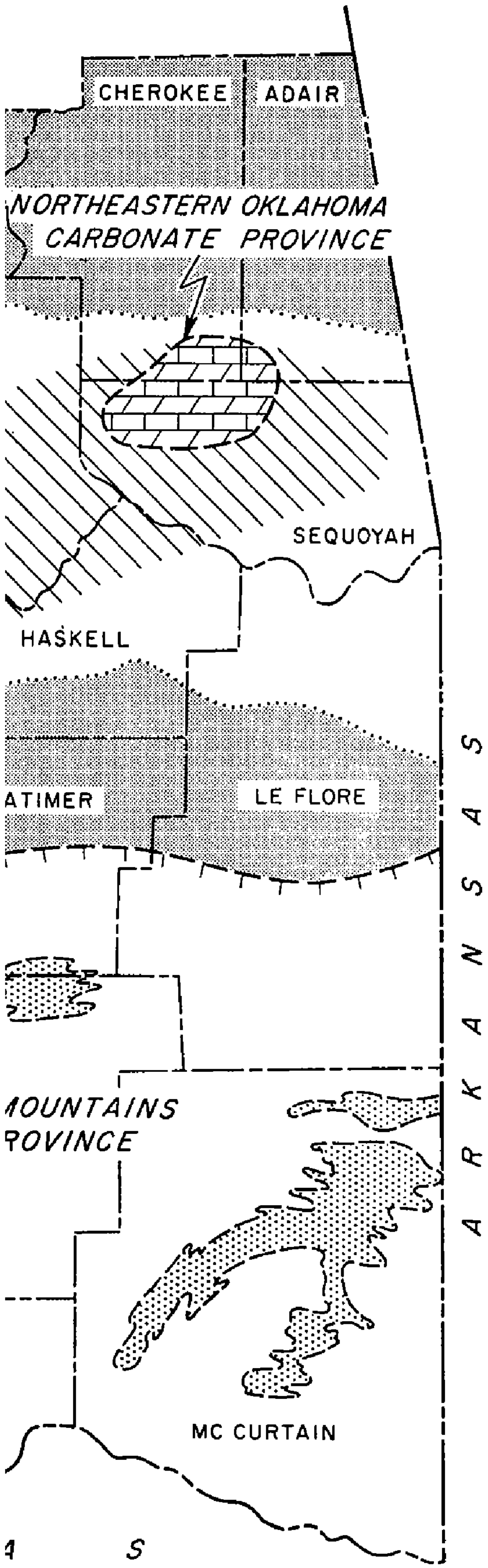


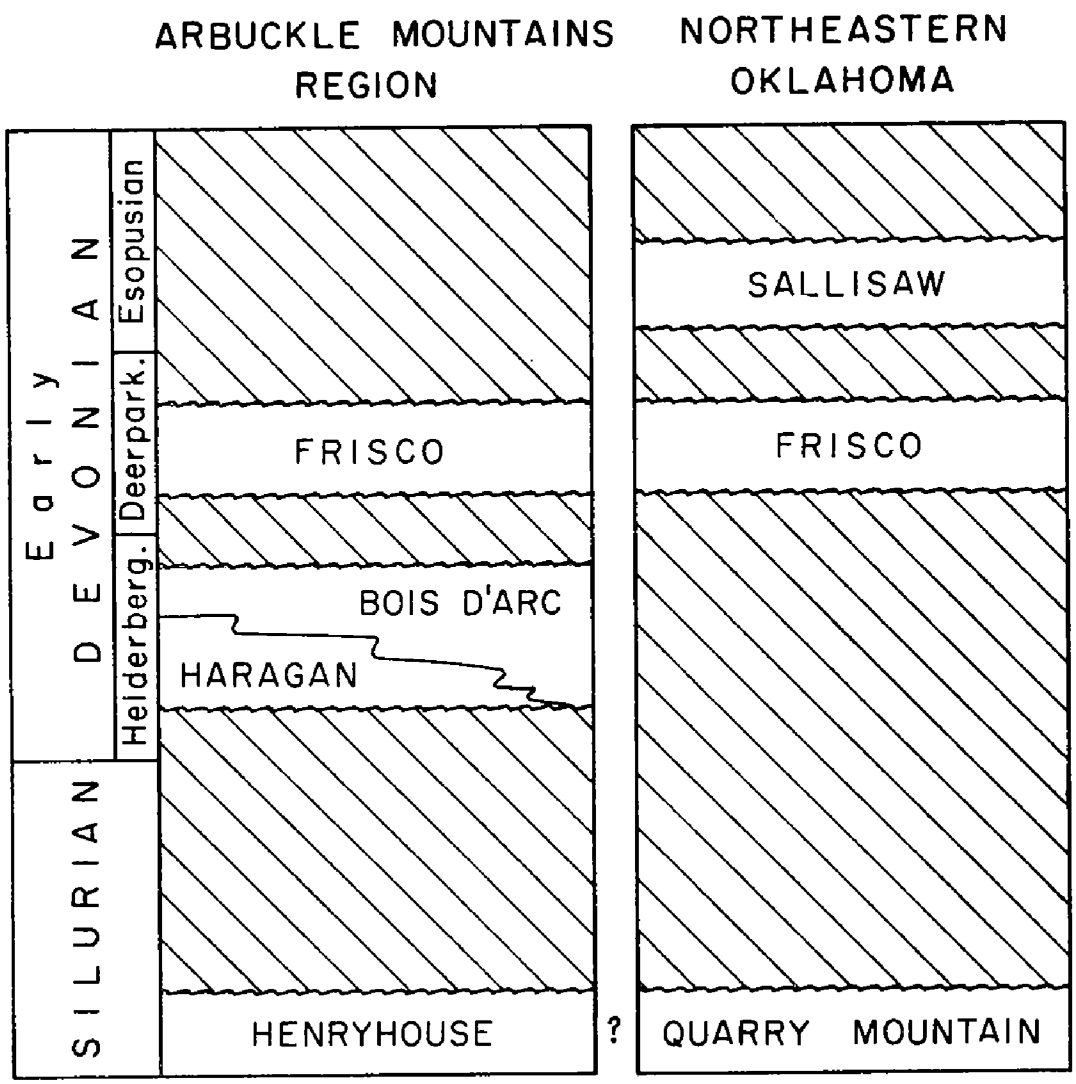
Text-figure 16. Map showing outcrop areas of Silurian and Early Devonian carbonate strata in the Arbuckle Mountains-Criner Hills and northeastern Oklahoma regions, and the Mississippian, Devonian (Arkansas Novaculite), and Silurian (Missouri Mountain Shale and Blaylock Sandstone) strata of the Ouachita Mountains province. All outcrop areas are much generalized; more detailed maps of the northeastern Oklahoma area are given on plates A and B and text-figure 3 of this report, and of the Arbuckle Mountains-Criner Hills region on panel I of Amsden (1960); the Ouachita outcrops are taken from the *Geologic Map of Oklahoma* (Miser, 1954). Those areas, mostly in the subsurface, where Silurian and Lower Devonian strata have been removed by post-Early Devonian erosion are shown in light stipple; in most of these areas the Woodford or Chattanooga Formations rest on Ordovician or older strata. The Smith Bros., 1 Kytle-Ray well in Pottawatomie County yielded a well-preserved Frisco brachiopod (Amsden and Huffman, 1958, p.74).

observable between the Lower Devonian strata of the Northeastern Oklahoma province and the Arbuckle Mountains region. In the eastern part of the Arbuckle region the youngest Lower Devonian formation is the Frisco, which has a substantial Deerparkian fauna (Amsden and Ventress, 1963), overlain by the Woodford Shale, ranging from Late Devonian to Mississippian in age, and underlain by the Bois d'Arc-Haragan Formations with a large Helderbergian fauna (Amsden, 1958a, 1958b). The Frisco of this area is a bioclastic calcarenite, locally grading into a calcirudite; it is underlain by the Bois d'Arc, the upper part of which is a calcarenite with marly partings (Fittstown Member), grading downward (and laterally) into cherty marlstone (Cravatt Member) and marlstone (Haragan Formation), the latter having an insoluble-content range of up to 30 percent with an average of 16 percent (Amsden, 1960, p. 89, 99-101). The Frisco Formation of northeastern Oklahoma has a lithologic and faunal composition like that of the Frisco in the Arbuckle region. In this area, however, there is no lithostratigraphic nor biostratigraphic counterpart to the Bois d'Arc-Haragan strata, the Frisco being directly underlain by the Quarry Mountain, a carbonate formation with a low acid-insoluble content and bearing a large Silurian fauna. Moreover, the Frisco Formation in northeastern Oklahoma is overlain by the Sallisaw Formation, which is an arenaceous carbonate bearing a late Early Devonian (Esopusian) fauna. Text-figure 17 is a comparison of the Lower Devonian strata of these two provinces.

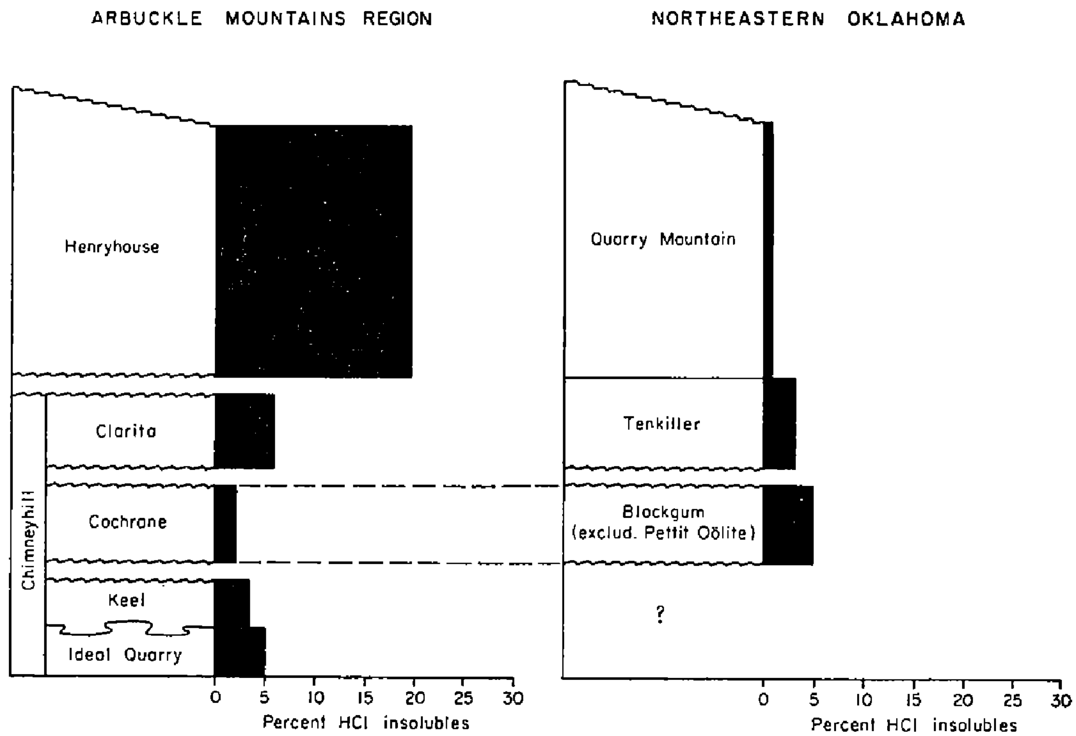
Significant differences also exist between the Silurian strata of these two regions. In our opinion the Blackgum Formation is closely related in age to the Cochrane Member of the Chimneyhill Formation*, although their lithostratigraphic differences are sufficient to merit the use of different stratigraphic names. The Cochrane is a light-gray bioclastic limestone with few acid insolubles, most of which are in the form of glauconite (text-fig. 18); the $MgCO_3$ content is also low, averaging less than 1 percent (text-fig. 19). Chert is locally present. On the other hand, the Blackgum Formation (excluding the Pettit Oölite) of northeastern Oklahoma includes a substantial amount of dolomite and is divisible into two strati-

* The Chimneyhill Formation of the Arbuckle Mountains-Criner Hills province is composed of three discrete lithostratigraphic and biostratigraphic units: Clarita Member, Cochrane Member, and Keel-Ideal Quarry Members (the Ideal Quarry Member is the basal facies of the Keel). These are limestones, but otherwise they have distinct lithologic characters. They are believed to represent three different periods of deposition ranging from Lower into Middle Silurian time, interrupted by periods of emergence when induration and removal of some rock by erosion occurred (Amsden, 1962, p. 1503-1506, text-figs. 1, 3, 5).

graphic units: a lower, tan-weathering crystalline dolomite, and an upper, dark-gray limestone member (glauconite is common in both units). The upper member has many irregular areas of crystalline dolomite, so that even this part has substantially more $MgCO_3$ than has any part of the Cochrane (text-fig. 19); these dolomite areas weather lighter than the limestone, thus giving the rock a distinctive mottled appearance (pl. III, fig. 1). Nodules and lenses of chert are common in the Blackgum, especially in the lower tan dolomite member (pl. IV, fig. 2). Locally the Pettit Oölite Member is present at the base of the Blackgum; this member occupies the same relative stratigraphic position as the Keel-Ideal Quarry Members of the Chimneyhill Formation (see discussion under Pettit Oölite Member). Overlying the Blackgum Formation is the Tenkiller, which



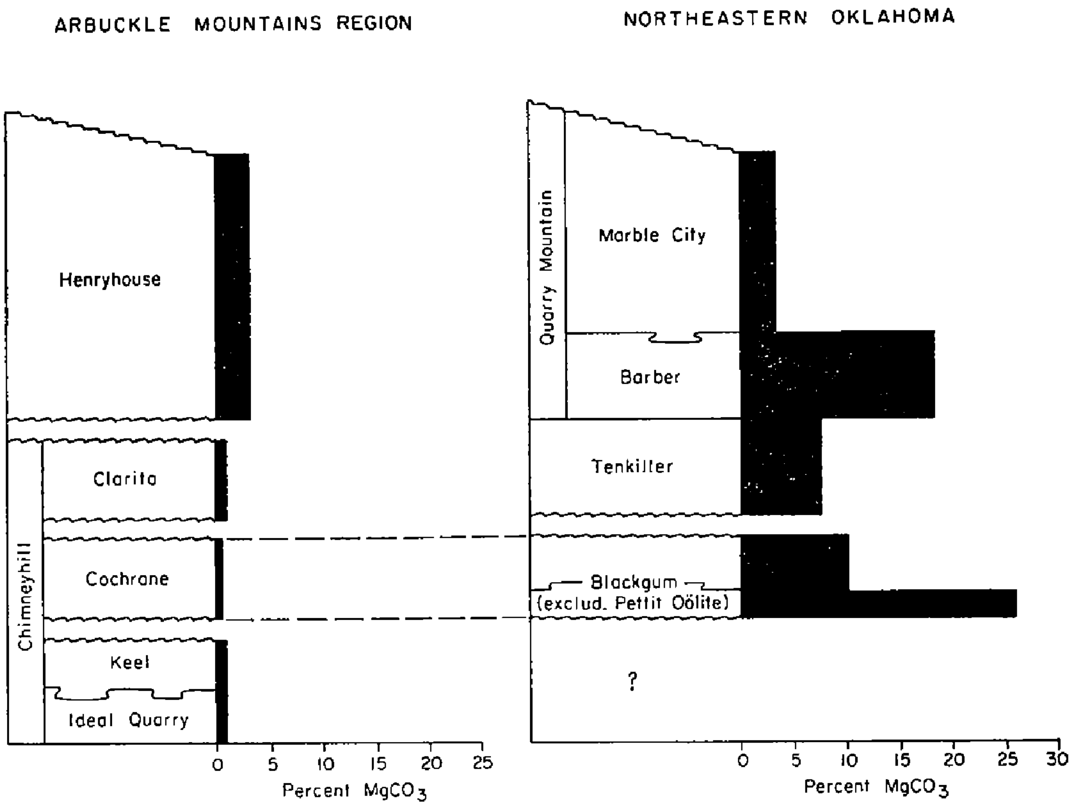
Text-figure 17. Chart comparing the Early Devonian (pre-Woodford and pre-Chattanooga) strata of the Arbuckle Mountains-Criner Hills province with Early Devonian strata in northeastern Oklahoma. The Henryhouse is the youngest Silurian formation in the Arbuckle province, and the Quarry Mountain is the youngest in northeastern Oklahoma; however, these may not be of exactly the same relative age.



Text-figure 18. Diagram comparing the HCl acid insolubles in the Silurian strata of the Arbuckle Mountains region with the Silurian strata of northeastern Oklahoma. The percentages given are arithmetic averages based upon the analyses given in the appendices of the present report and of Amsden (1960). The thicknesses of the different stratigraphic units vary greatly, and the vertical scale employed gives only a rough approximation of the relative thicknesses. The Cochrane and Blackgum units are believed to be closely related in age, but the precise age of the Tenkiller-Quarry Mountain strata has not been determined and their relationship with the Clarita and Henryhouse is in question. Note that the Silurian rocks of northeastern Oklahoma have no lithostratigraphic counterpart to the Henryhouse marlstone, and in fact those strata occupying the same relative stratigraphic position as that of the Henryhouse (Quarry Mountain Formation) are high-purity carbonate rocks averaging less than a half percent acid insolubles. The Pettit Oölite Member occupies the same relative stratigraphic position as that of the Keel-Ideal Quarry beds, but we have no information pertaining to its age; no chemical analyses are available on this member.

is an evenly bedded bioclastic calcarenite. This formation has some lithostratigraphic resemblance to the Clarita Member of the Arbuckle region, although the latter has substantially less dolomite than has the Tenkiller (text-fig. 19); furthermore, no structure in the Clarita resembles the sediment-filled cavities of the Tenkiller. However, the major difference between the Silurian sequence in the Arbuckle region and that of northeastern Oklahoma is in the upper part of the section. In the Arbuckle-Criner province the Clarita Member is overlain by the Henryhouse Formation*, which is a marlstone with an acid-insoluble content ranging up to almost 45 percent, and

* Locally in the Arbuckle province, post-Henryhouse pre-Devonian erosion has removed the Henryhouse Formation, thus bringing the Clarita into direct contact with the Lower Devonian (Haragan or Bois d'Arc Formations); for example, this is the situation at stratigraphic section P9, near Coal Creek in Pontotoc County (Amsden, 1960, p. 279; Amsden, 1961, p. 98, text-fig. 25).



Text-figure 19. Diagram comparing the $MgCO_3$ content in the Silurian strata of the Arbuckle Mountains region with the Silurian strata of northeastern Oklahoma. The percentages given are arithmetic averages based upon the analyses given in the appendix II and in Amsden (1960). The thicknesses of the different stratigraphic units vary greatly, and the vertical scale employed gives only a rough approximation of the relative thicknesses. The Cochrane and Blackgum units are believed to be closely related in age, but the precise age of the Tenkiller-Quarry Mountain strata has not been determined and their relationship with the Clarita and Henryhouse is in question. The two divisions shown for the Blackgum represent the lower tan dolomite member and the upper limestone member. No chemical analyses are available for the Pettit Oölite Member.

averaging 20 percent (Amsden, 1960, p. 68, text-fig. 20). These insolubles are largely silt-size, subangular quartz detritus and are clearly a primary part of the rock, introduced at the time of deposition. Generally the marlstones have a low fossil content and are mostly mudstones or wackestones, with a texture quite unlike the grain-supported fabric characterizing most of the Silurian and Lower Devonian rocks of the Oklahoma carbonate provinces. None of the Silurian (or Devonian) strata in the Northeastern Oklahoma province bears any lithologic resemblance to the marlstones of the Henryhouse (or Haragan) of the Arbuckle-Criner province. In northeastern Oklahoma the Quarry Mountain Formation, directly overlying the Tenkiller, has an average insoluble-residue content of less than 0.5 percent (text-fig. 18) and, of 85 samples tested, only 5 yielded insoluble residues in excess of 1 percent (text-fig. 10; appendix II). The Quarry Mountain Formation may be closely related in age to the Henryhouse Formation, and thus the high-purity carbonates of northeastern Oklahoma would be in part, or entirely, a contemporaneous lithofacies of the Henryhouse marlstones, but certainly no part of the Silurian or Lower Devonian strata in northeastern Oklahoma has any lithologic resemblance to the marlstones of the Arbuckle region*.

The Silurian and Lower Devonian rocks of the Arbuckle-Criner province (Ideal Quarry to Frisco, inclusive) have for many years been combined in a stratigraphic unit, the Hunton Group. The lithostratigraphic (and biostratigraphic) sequence of the Silurian and Lower Devonian strata in northeastern Oklahoma is sufficiently different from the Arbuckle province to make the use of Hunton Group in this area objectionable. There does not appear to be any need to lump these stratigraphic units into a superformational unit.

Several subsurface investigators have studied the Silurian and Lower Devonian strata in the carbonate province of northeastern Oklahoma. Most of these stratigraphers have tried to use the stratigraphic terminology of the Arbuckle Mountains-Criner Hills province, although England (1961, p. 84) noted that the "Hunton" formations in this northeastern area are quite different from those in the Arbuckle region. Perhaps the most extensive attempt at a subsurface study of Oklahoma Silurian and Lower Devonian rocks is that made by Shannon in 1962. This author included maps (1962, text-figs. 10, 12) showing his ideas on distribution and correlation of the Silurian and Devonian strata throughout much of Oklahoma. According to him, the stratigraphic sequence in northeastern Oklahoma, except for the Frisco Formation, is essentially the same as that

* Silurian and Lower Devonian strata of northeastern Oklahoma are geologically separated by considerable distances from other outcrop areas exposing strata of the same general age. It is nót possible to trace these strata by means of surface outcrops into other areas, and even in the subsurface the Silurian strata in the northeastern province are fairly well isolated (text-fig. 16). Under these circumstances we believe the stratigraphic terminology should be locally derived unless compelling lithostratigraphic and biostratigraphic evidence shows that stratigraphic units which crop out in separate provinces represent contemporaneous deposits laid down in the same seaway; as, for example, the Frisco Formation of the Arbuckle Mountains region and the Frisco Formation of northeastern Oklahoma (Cram, 1930, p. 550; Huffman, 1958, p. 33; Amsden and Ventress, 1963, p. 33-38). Correlation of strata between isolated provinces strictly upon the basis of lithology is unreliable as the effects of facies changes, unconformities, etc. generally cannot be evaluated. We also believe the extension of lithostratigraphic names into new regions solely upon the basis of faunal data is unsatisfactory. At the present time, fossils are the only reliable means of determining relative age, and regional or world-wide correlatives of sedimentary rocks, but this method encounters many problems and introduces many uncertainties; thus revisions in age assignments and in correlations often become necessary in the light of new faunal information. There would seem to be little merit in involving the local lithostratigraphic terminology of an area such as northeastern Oklahoma with the problems concerned in faunal correlation, and we think the extension of formation names such as Henryhouse and St. Clair into this area is unsatisfactory and should be avoided.

present in the Arbuckle-Criner Hills province. In Sequoyah and nearby counties he recognized the following formations:

Mississippian		"Kaskaskia" Sequence
Upper Devonian		
Lower Devonian	Bois d'Arc Formation Haragan- Henryhouse Formations (undifferentiated)	Hunton Group
Silurian	Chimneyhill Formation	
Ordovician	Sylvan Shale	

In our opinion this extension of Arbuckle terminology into northeastern Oklahoma is not in accord with the stratigraphic evidence, either as determined from a study at the surface, or in the subsurface. Furthermore, at least in some instances, it is clearly not in accord with the correlations established on faunal evidence. The Lower Devonian rocks of northeastern Oklahoma are represented by two well-defined lithostratigraphic and biostratigraphic units, the Frisco Formation and the Sallisaw Formation (text-fig. 17). No lithostratigraphic or biostratigraphic equivalents of the Bois d'Arc Formation are present in northeastern Oklahoma (Amsden, 1962, p. 1504; Amsden and Ventress, 1963, p. 22), and in fact no Helderbergian fauna has ever been reported from northeastern Oklahoma (Schuchert, 1922, p. 665-670; Cram, 1930, p. 550; Huffman, 1958, p. 29-36; Amsden, 1963, p. 19-24). There are no lithostratigraphic nor biostratigraphic equivalents of the Haragan Formation and no lithostratigraphic equivalent of the Henryhouse marlstone; in fact, the marlstone lithology of the Arbuckle region is not represented in any part of the northeastern Oklahoma Silurian and Devonian strata (text-fig. 18). Correlatives of some, possibly all, of the Chimneyhill members are represented in northeastern Oklahoma, but their lithologic character is sufficiently different to make the use of Arbuckle terminology uncertain and objectionable (see footnote, p. 66). We believe that the subsurface strata in this region, at least for that part shown on the map in text-figure 3, can be satisfactorily correlated with the nearby surface exposures by a careful use of well cuttings aided by electric logs, and accordingly we strongly recommend the use of northeastern Oklahoma stratigraphic terminology.

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PLATES I-XVIII

Outcrops and Thin Sections of Silurian Rocks

Plate I

Figures 1-4. St. Clair Formation near Batesville, Arkansas

1, 4. St. Clair Formation (above) and Cason Shale (below) at the Cason mine, north of Batesville, Independence County, Arkansas (S½ SW¼ sec. 34, T. 14 N., R. 6 W.). Figure 1 shows the outcrops in the north cut; hammer head marks St. Clair-Cason Shale contact. Figure 4 is a view of the outcrops in the west cut; hammer head marks the St. Clair-Cason contact.

2, 3. Photomicrographs of the St. Clair Limestone. Each bar represents 1 mm. Figure 2 shows the biomicrite texture which is common in the St. Clair; St. Clair Spring, NE¼ NE¼ sec. 24, T. 14 N., R. 6 W., Independence County, Arkansas. Figure 3 illustrates a specimen with sparite matrix (small quantity of micrite matrix present in lower part) from the Cason mine.

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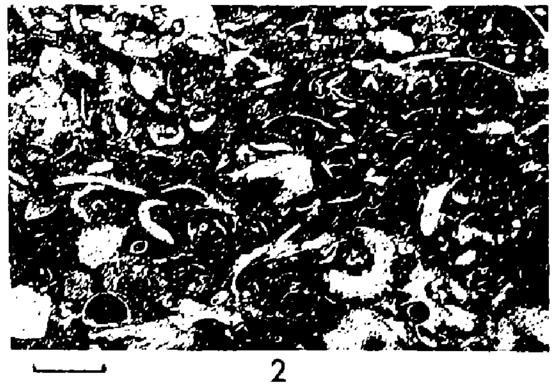

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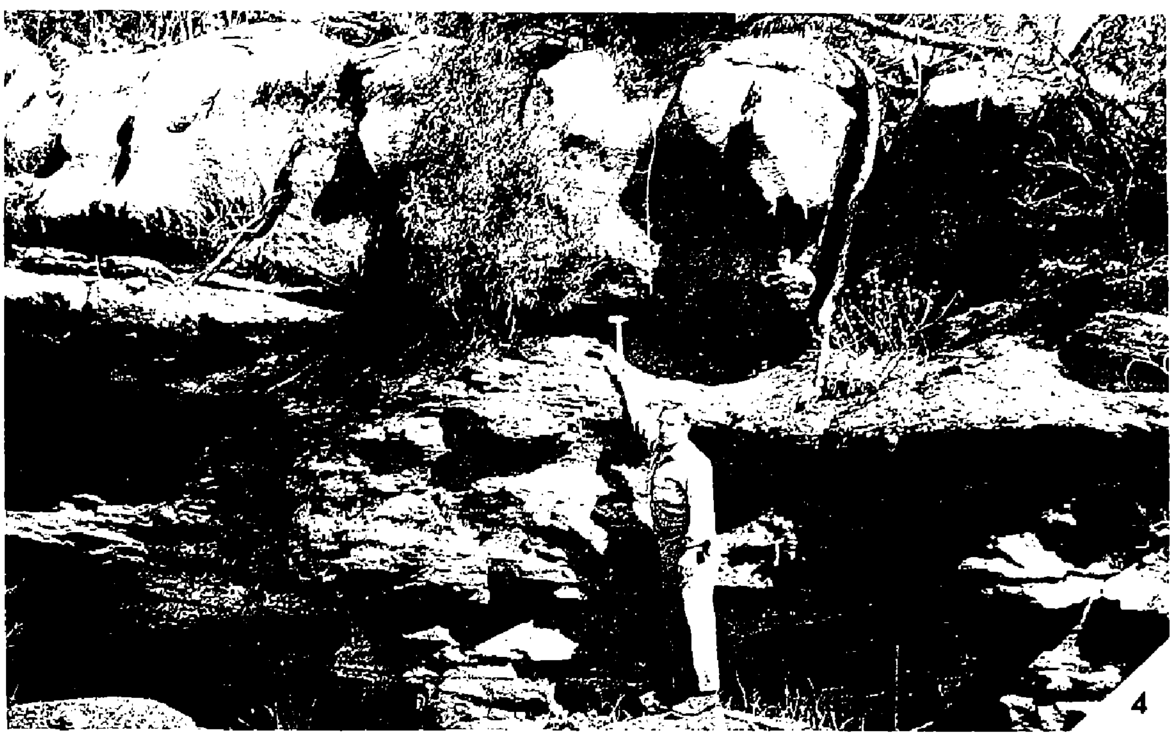

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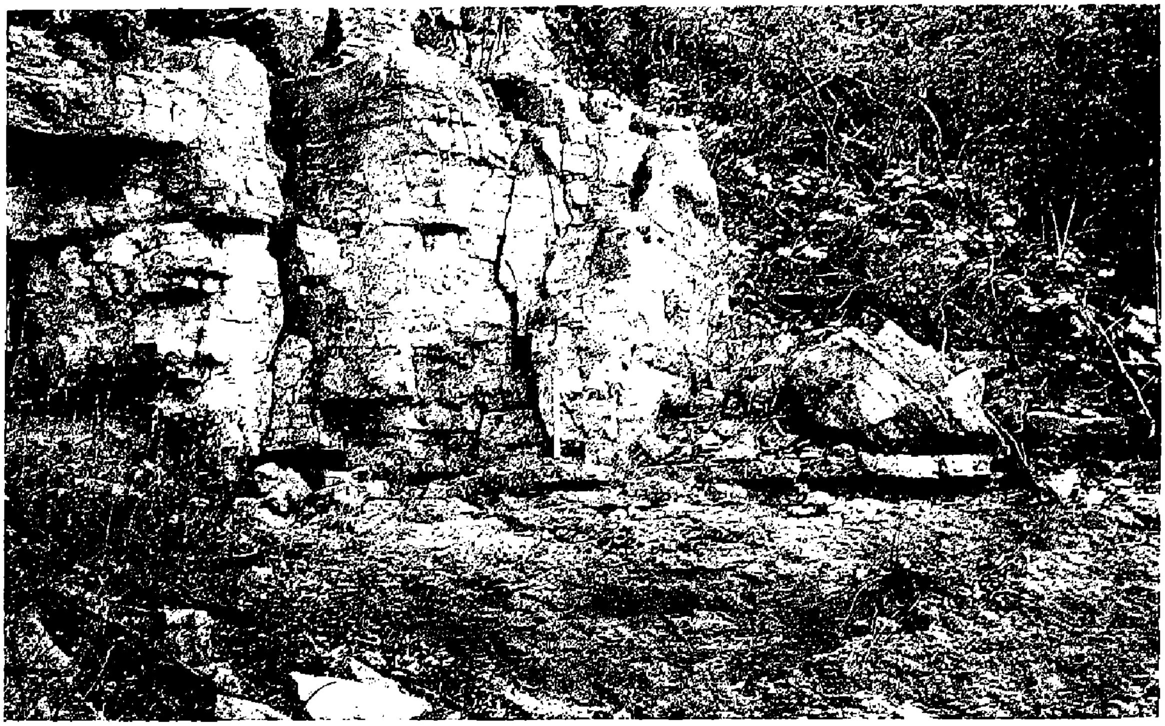

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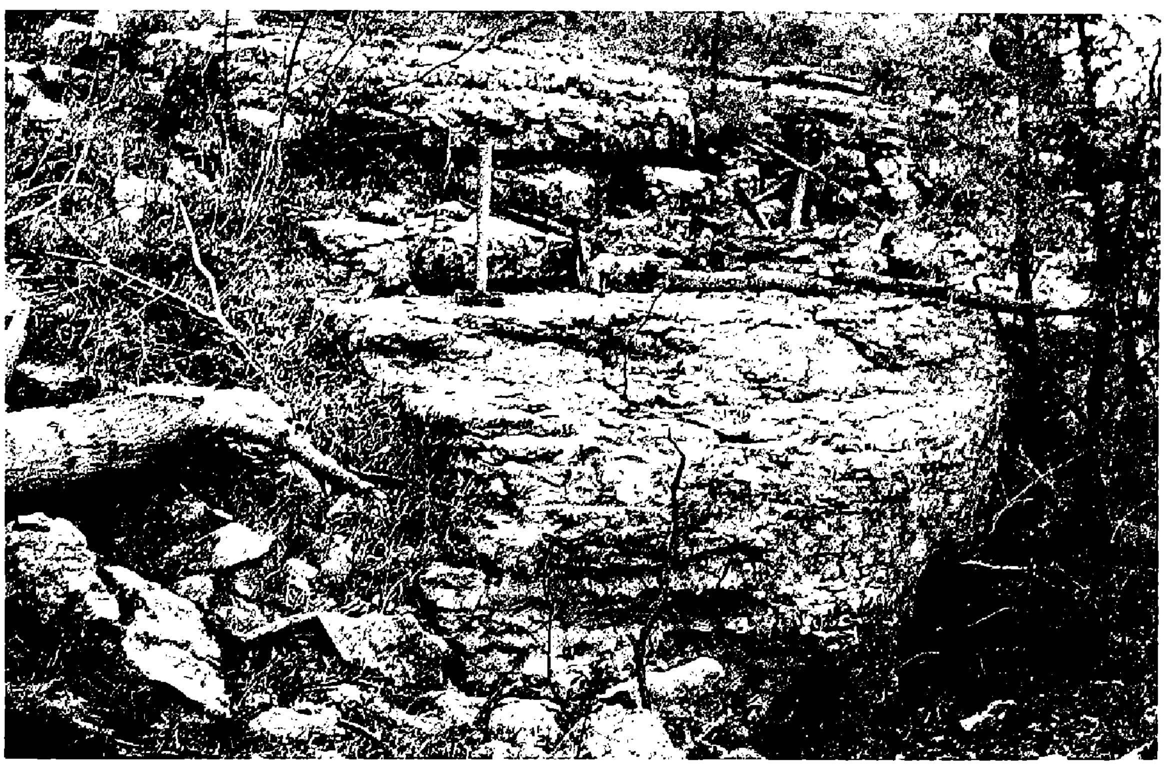

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Plate II

Figures 1, 2. Tenkiller and Blackgum Formations

Figure 1. Tenkiller Formation (above) and Blackgum Formation (below) at stratigraphic section Ch2, Blackgum Landing on the southeast shore of Lake Tenkiller; hammer head rests upon the contact. The outcrop is a few hundred feet northeast of the landing.

Figure 2. Blackgum Formation at stratigraphic section Ch2, Blackgum Landing on the southeast shore of Lake Tenkiller. Upper limestone member; highest bed shown is near top of the formation. The exposures are a short distance southeast of the outcrop shown in figure 1.

Plate III

Figures 1, 2. Blackgum Formation

Figure 1. Blackgum Formation, stratigraphic section Ch4, on the southwest bank of a small stream about a mile west of Qualls. Arrow points to contact of upper limestone with tan dolomite member.

Figure 2. Blackgum Formation; arrows mark contact of Pettit Oölite Member (below) with tan dolomite member (above). Note nodules of oölitic chert just below and to the right of the coin. Stratigraphic section Ch5, about a mile west of Qualls, and about 100 yards south of the outcrops shown in figure 1. Photomicrographs of this oölite are on plate VI, figures 1-4.

1

2

1

2

PLATE IV

Figures 1, 2. Tenkiller and Blackgum Formations

Figure 1. Tenkiller Formation, stratigraphic section Ch2, Blackgum Landing on the southeast shore of Lake Tenkiller; the outcrop is a short distance northeast of the landing.

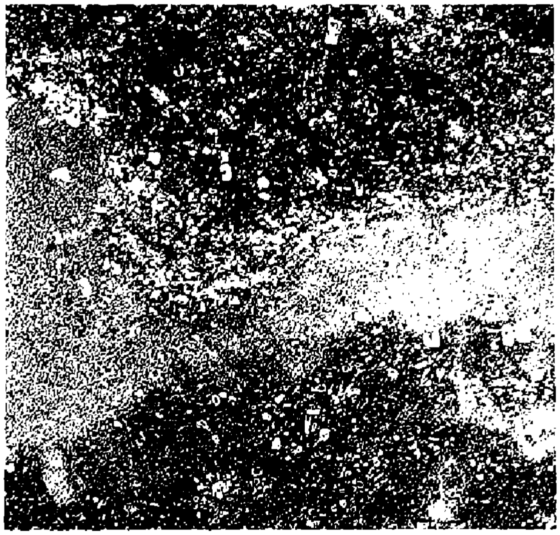
Figure 2. Blackgum Formation, stratigraphic section Ch2, Blackgum Landing on the southeast shore of Lake Tenkiller; large block, slumped slightly out of place. Arrow marks approximate contact of upper limestone member with lower tan dolomite member. Chert bed in lower part is unit B.

PLATE V

Figures 1-6. Blackgum Formation

(Each bar represents 1 mm)

1. Blackgum Formation, upper limestone member; biomicrite with irregular areas of finely crystalline dolomite. Stratigraphic section Ch7, about a mile northwest of Qualls. Outcrops of this member are illustrated on plate II, figure 2, and plate III, figure 1.
2. Blackgum Formation, upper limestone member; biomicrite with patches of finely crystalline dolomite (pl. II, fig. 2; pl. III, fig. 1). Stratigraphic section Ch2-D(2), about 5 feet below Blackgum-Tenkiller contact; Blackgum Landing, southeast shore of Lake Tenkiller.
3. Blackgum Formation, upper limestone member; biomicrite with little dolomite. Stratigraphic section Ch2-D(3), upper two feet of the Blackgum Formation; same locality as figure 2.
4. Blackgum Formation, upper limestone member; biomicrite with little dolomite. Diamond core SCL 2, depth 88 feet, 9 inches; St. Clair Lime Company quarry. Oriented thin section, top up.
5. Blackgum Formation, tan dolomite member; crystalline dolomite with much glauconite (rounded, dark-gray bodies) and pyrite (black areas). Oriented thin section, top up. Diamond core OGS 2, depth 69 feet; about 3 miles southeast of Barber.
6. Blackgum Formation, tan dolomite member; typical crystalline dolomite with few or no fossils (pl. IV, fig. 2); enlarged about 25 times. Stratigraphic section Ch2-A, Blackgum Landing, southeast shore of Lake Tenkiller.



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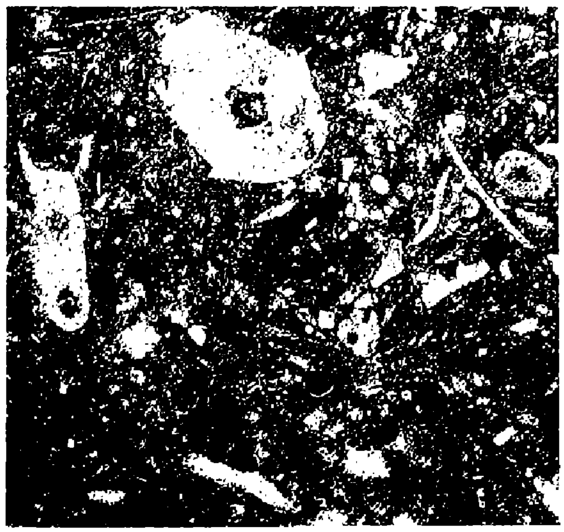

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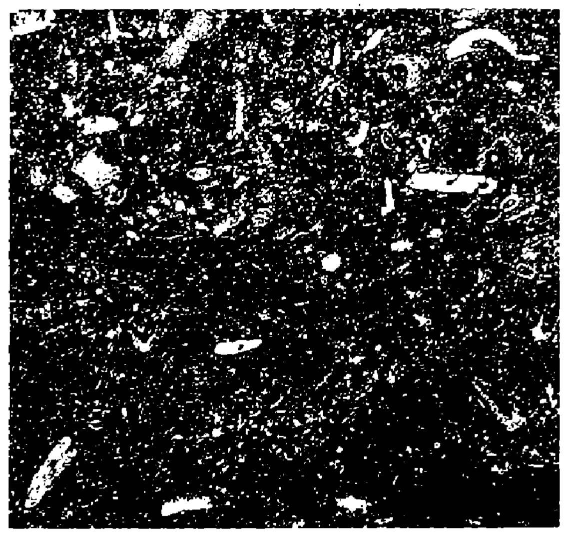

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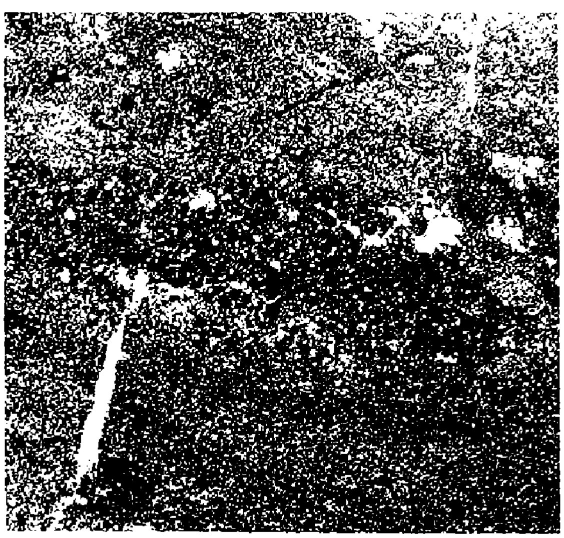

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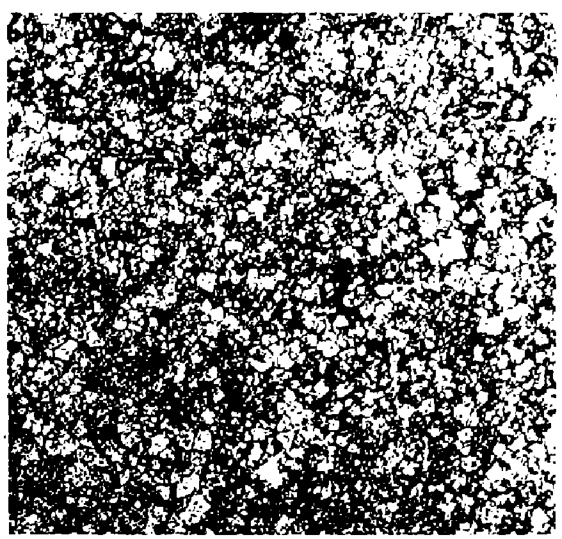

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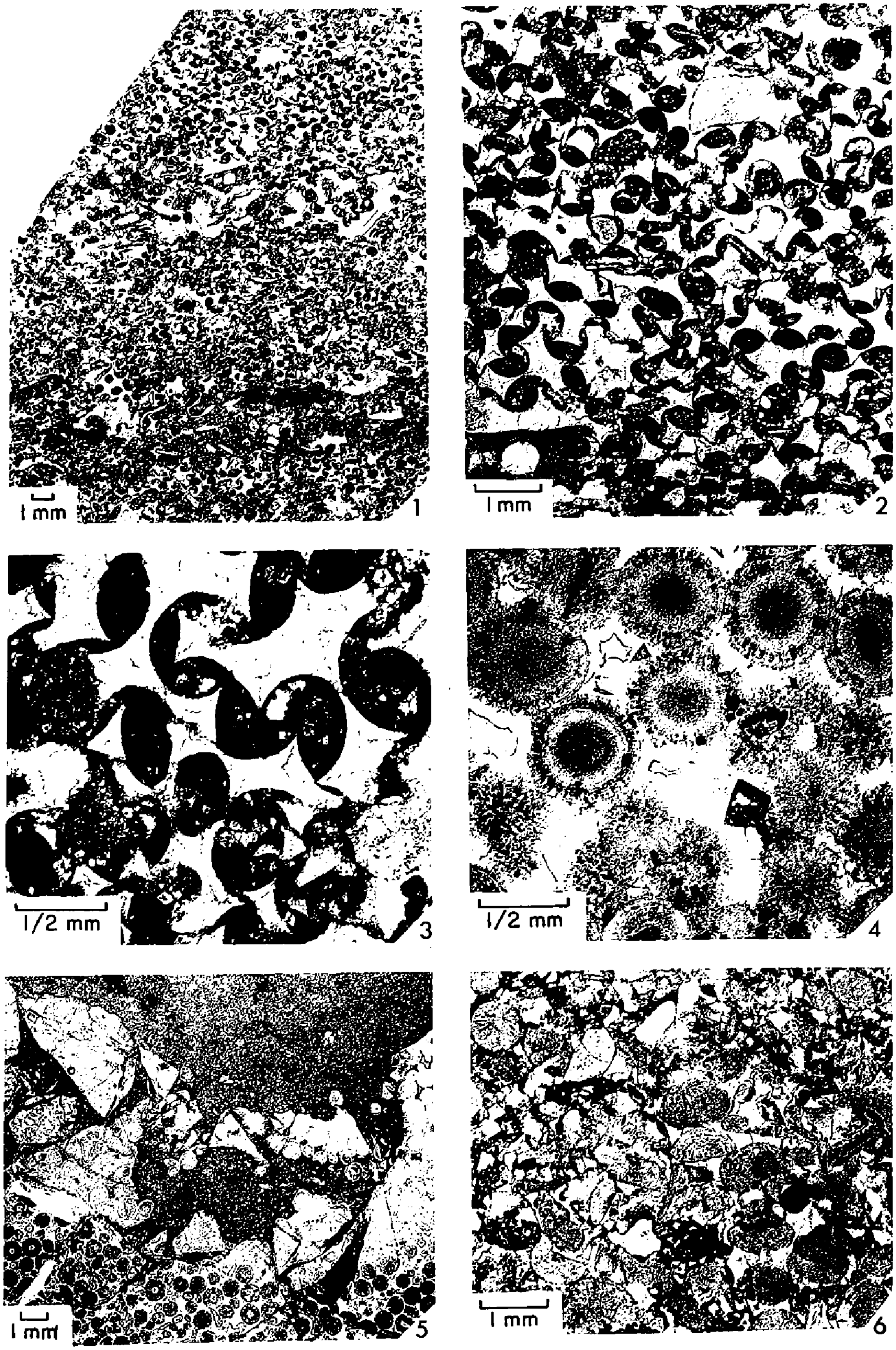

1 mm
1
1 mm
2
1/2 mm
3
1/2 mm
4
1 mm
5
1 mm
6

Plate VI

Figures 1-6. Blackgum Formation, Pettit Oölite Member

1-3. Blackgum Formation, Pettit Oölite. Three views of the same thin section showing distorted oölites at different magnifications. These structures are similar to those illustrated by Carozzi (1961, fig. 6). The specimen from which this thin section was cut analyzes: $CaCO_3$ 81.20%; $MgCO_3$ 7.53%; acid insolubles 9.66%. Stratigraphic section Ch5, about a mile west of Qualls. The outcrop from which this specimen was obtained is illustrated on plate III, figure 2, and text-figure 7.

4. Blackgum Formation, Pettit Oölite. Photomicrograph of a thin section cut from a nodule of silicified oölite enclosed in the calcareous facies of the Pettit which is composed of the distorted oölites illustrated in figures 1-3 (outcrop illustrated on pl. III, fig. 2 and text-fig. 7). Stratigraphic section Ch5, about a mile west of Qualls.

5. Blackgum Formation; brecciated and silicified nodule of Pettit Oölite enclosed in the basal beds of the tan dolomite member (stratigraphic relationships are illustrated in text-fig. 7). Stratigraphic section Ch4, about a mile west of Qualls.

6. Blackgum Formation, Pettit Oölite Member; silicified oölites, many of which appear to have been broken prior to deposition and cementation. Stratigraphic section Ch2, Blackgum Landing, southeast shore of Lake Tenkiller.

PLATE VII

Figures 1-6. Tenkiller Formation

(Each bar represents 1 mm)

1-3. Tenkiller Formation, stratigraphic section Ch2-E (about 8 feet above base), Blackgum Landing on Lake Tenkiller. Figure 1 is a photomicrograph covering almost an entire thin section which shows interbedded (and crossbedded) biomicrite and biosparite. Figure 2 is an enlarged view (upper right part of fig. 1) of the biosparite. Figure 3 is an enlarged view (lower center of fig. 1) of the biomicrite.

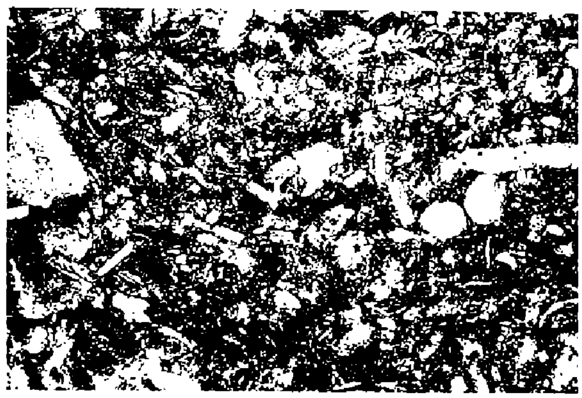
4-6. Tenkiller Formation, diamond core OGS 2, south of Barber; depth 57 feet (near base of formation). Figure 4 is a photomicrograph covering almost an entire thin section and showing interbedded biomicrite and biosparite. Figure 5 is an enlarged view (upper left corner of fig. 4) of the biomicrite. Figure 6 is an enlarged view (lower central part of fig. 4) of the biosparite. Oriented thin sections, top up.

1

2

3

4



5

6


1 mm

Plate VIII

Tenkiller Formation

Tenkiller Formation, diamond core SCL 2, depth 72 feet, 7 inches (about 14 feet above base of formation); St. Clair Lime Company quarry, about a mile north of Marble City. Photomicrograph of a sediment-filled cavity showing the typical sequence of crystalline dolomite, finely divided and laminated calcite, and sparry calcite. An enlarged view of this section is illustrated on plate IX, figure 1; see also plates X, XI, and text-figure 11. Oriented thin section, top up.

Plate IX

Figures 1-3. Tenkiller Formation

(Each bar represents 1 mm)

1. Tenkiller Formation, diamond core SCL 2, St. Clair Lime Company quarry, about a mile north of Marble City; depth 72 feet, 7 inches (approximately 14 feet above base of formation). This is an enlarged view of a part of the sediment-filled cavity illustrated on plate VIII. Oriented thin section, top up.
2. Tenkiller Formation, diamond core OGS 3, southwest of Lake Tenkiller; depth 140 feet (near base of formation). Photomicrograph showing one of the irregular areas of crystalline dolomite (finely and uniformly textured areas). Oriented thin section, top up.
3. Tenkiller Formation, diamond core SCL 2, St. Clair Lime Company quarry, north of Marble City; depth 62 feet. Photomicrograph of an oversize thin section from the upper part of the formation, near the Tenkiller-Barber contact, showing the typical pink biosparite (light-colored areas) mixed with areas of fine-crystalline dolomite, bearing scattered fossils (dark-colored areas). Oriented thin section, top up.

1

2

3


4 mm

PLATE X

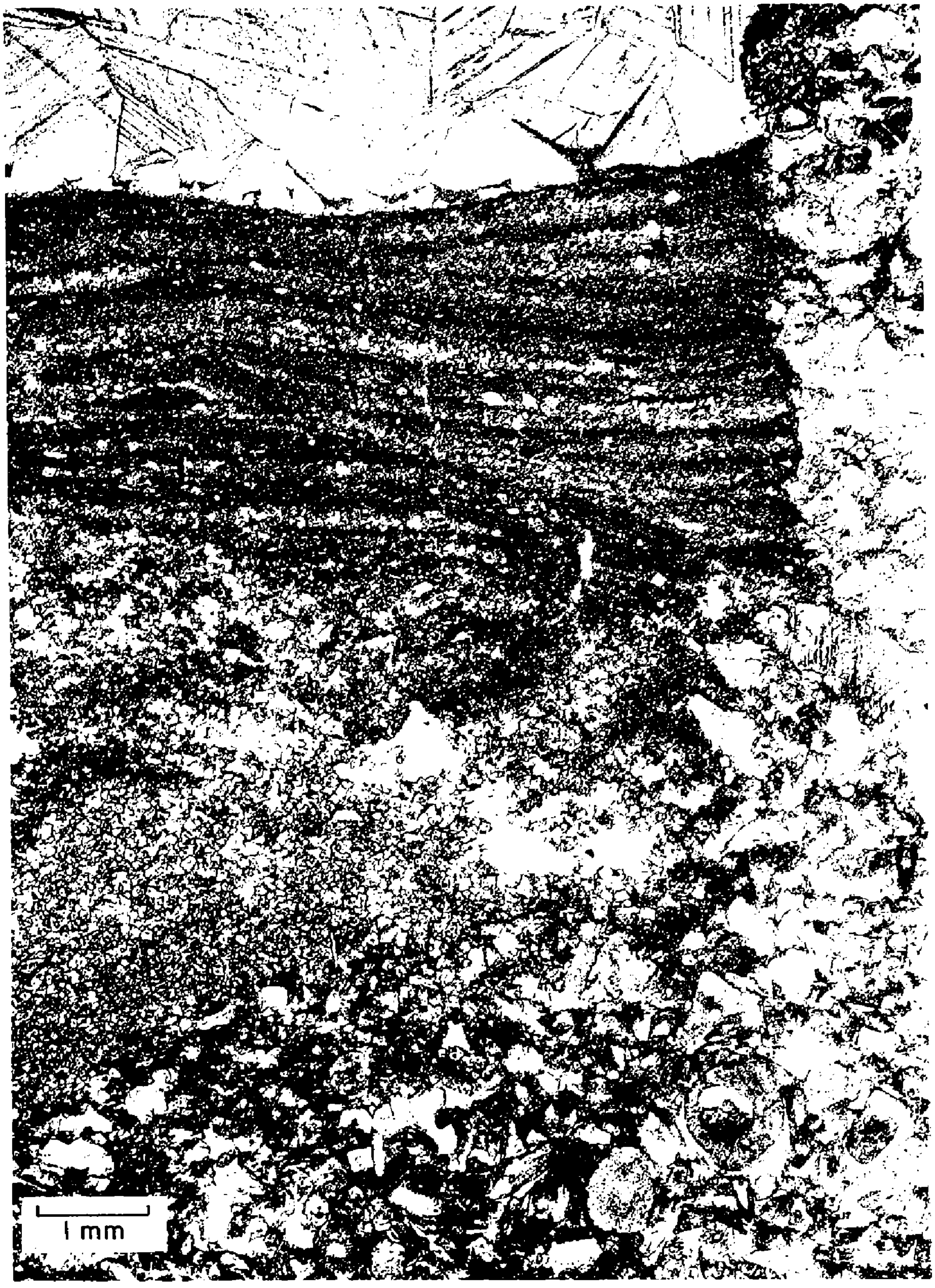
Tenkiller Formation

Tenkiller Formation, diamond core SCL 2, St. Clair Lime Company quarry north of Marble City; depth 73 feet (about 14 feet above base of the formation). Photomicrograph showing several sediment-filled cavities. An enlarged view of the cavity in the lower right is shown on plate XI; see also labelled sketch, text-figure 11. Oriented thin section, top up.

Plate XI

Tenkiller Formation

Tenkiller Formation, diamond core SCL 2, St. Clair Lime Company quarry, north of Marble City; depth 73 feet (about 14 feet above base of the formation). Enlarged view of a part of a sediment-filled cavity shown on plate X; see also labelled sketch, text-figure 11. Oriented thin section, top up.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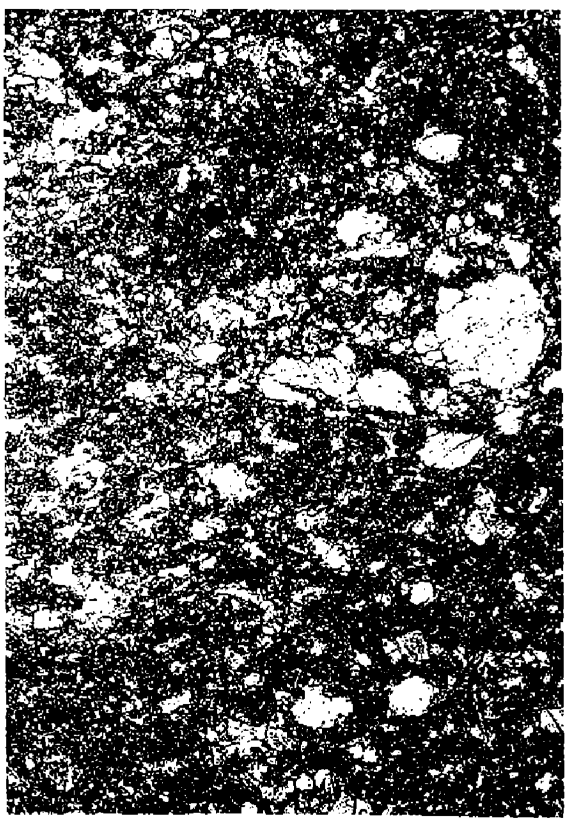


2

3

Plate XII

Figures 1-3. Barber Member, Quarry Mountain Formation

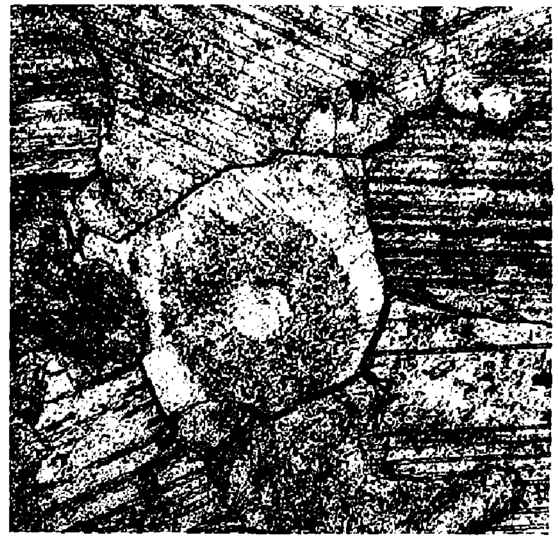
1. Barber Member at the type locality, southeast of Barber, Cherokee County, Oklahoma (SE¼ NW¼ NE¼ sec. 2, T. 14 N., R. 23 E.). This is stratigraphic section Ch3; diamond-core hole OGS 2 started at the lower left edge of the outcrop shown in this picture. The handle of the hammer shown on the upper ledge is 15 inches long.
2. Photomicrograph of a thin section from the Barber Member, diamond core OGS 2, depth 6 feet. This is largely crystalline dolomite. Oriented thin section, top up; bar represents 1 mm. Location same as figure 1.
3. Photomicrograph of a thin section from the Barber Member, diamond core OGS 2, depth 17 feet. Finely crystalline dolomite with scattered remnants of fossils. Oriented thin section, top up; bar represents 1 mm. Location same as figure 1.

Plate XIII

Quarry Mountain Formation

Quarry Mountain Formation at the type locality in the St. Clair Lime Company quarry (west face), SE¼ SE¼ NE¼ sec. 14, T. 13 N., R. 23 E., Sequoyah County, Oklahoma. This shows the entire Marble City Member; Frisco strata are present at the top, and the Barber Member makes up the lower few feet of the quarry wall (T. L. Rowland points to the approximate position of the Marble City-Barber contact). Diamond-core holes SCL 2 and SCL 1 were drilled a short distance to the left of the locality. SCL 2 started in the floor of the quarry, and SCL 1 started in the Chattanooga Formation (above the highest exposed bed), penetrating the strata shown in this picture. Chemical analyses of these cores are given in appendix II.

1



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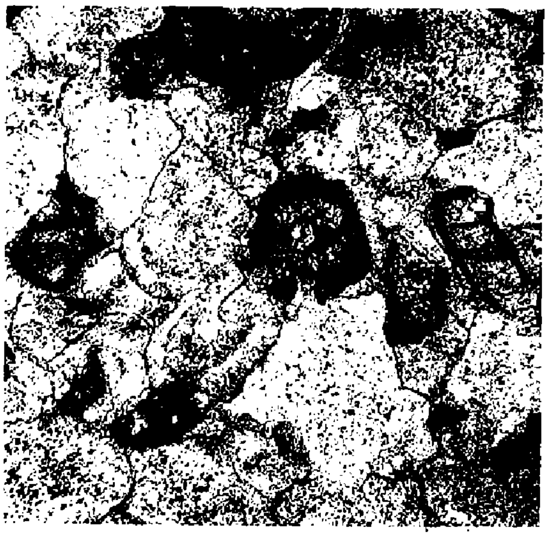

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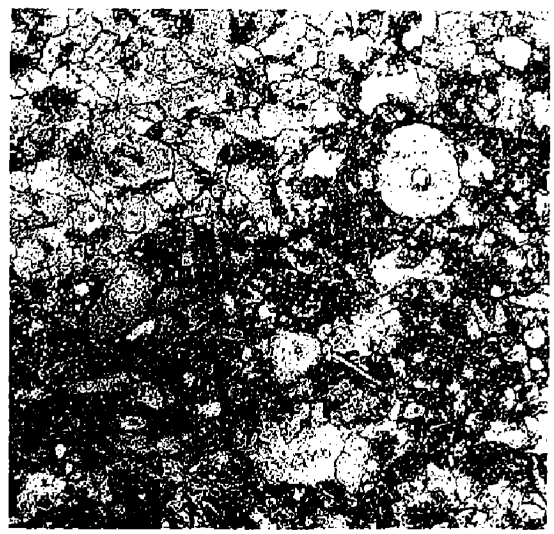

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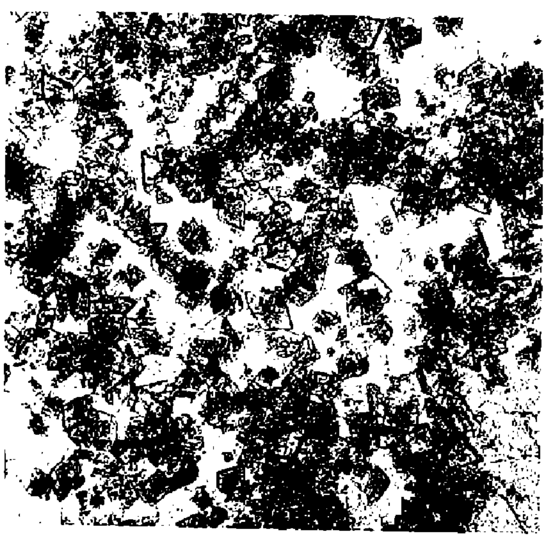

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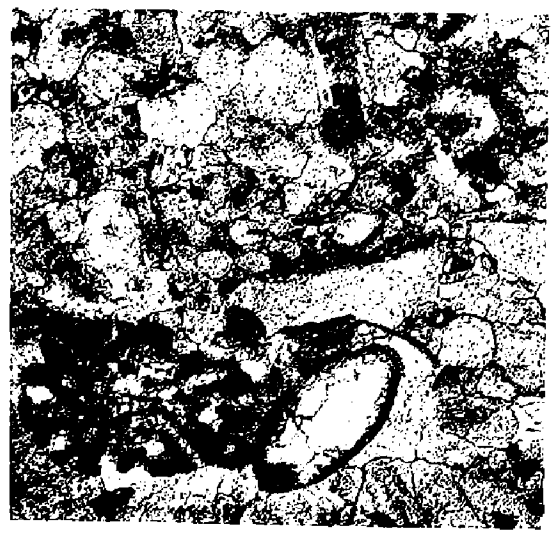


6

Plate XIV

Figures 1-6. Marble City Member, Quarry Mountain Formation

(Each bar represents ½ mm)

1, 2. Photomicrographs showing the typical pelmatozoan biosparite texture. Upper 20 feet of the Marble City Member, stratigraphic section S1-A, Sallisaw Creek, north of Marble City (from Amsden, 1961, pl. 7, figs. 1, 3).

3. Photomicrograph of a specimen with scattered bryozoan fragments in addition to the pelmatozoan debris. Upper 30 feet of the Marble City Member, just north of the St. Clair Lime Company quarry, NE¼ SE¼ NE¼ sec. 14, T. 13 N., R. 23 E. (from Amsden, 1961, pl. 7, fig. 4).

4. Photomicrograph of a dolomitic biosparite in the Marble City Member. The finely granular matrix is crystalline dolomite. Diamond core OGS 3, depth 42 feet. Oriented thin section, top up.

5. Photomicrograph of a specimen from a dolomite bed ($MgCO_3$, 35.5%) in the upper 2 feet of the Marble City Member. Stratigraphic section S9-B, Payne Hollow, north of Marble City (from Amsden, 1961, pl. 7, fig. 6).

6. Photomicrograph of the Marble City biosparite in fossil locality Ad-1*, near diamond-core hole OGS 1, north of Bunch.

PLATE XV

Figures 1-3. Marble City Member, Quarry Mountain Formation

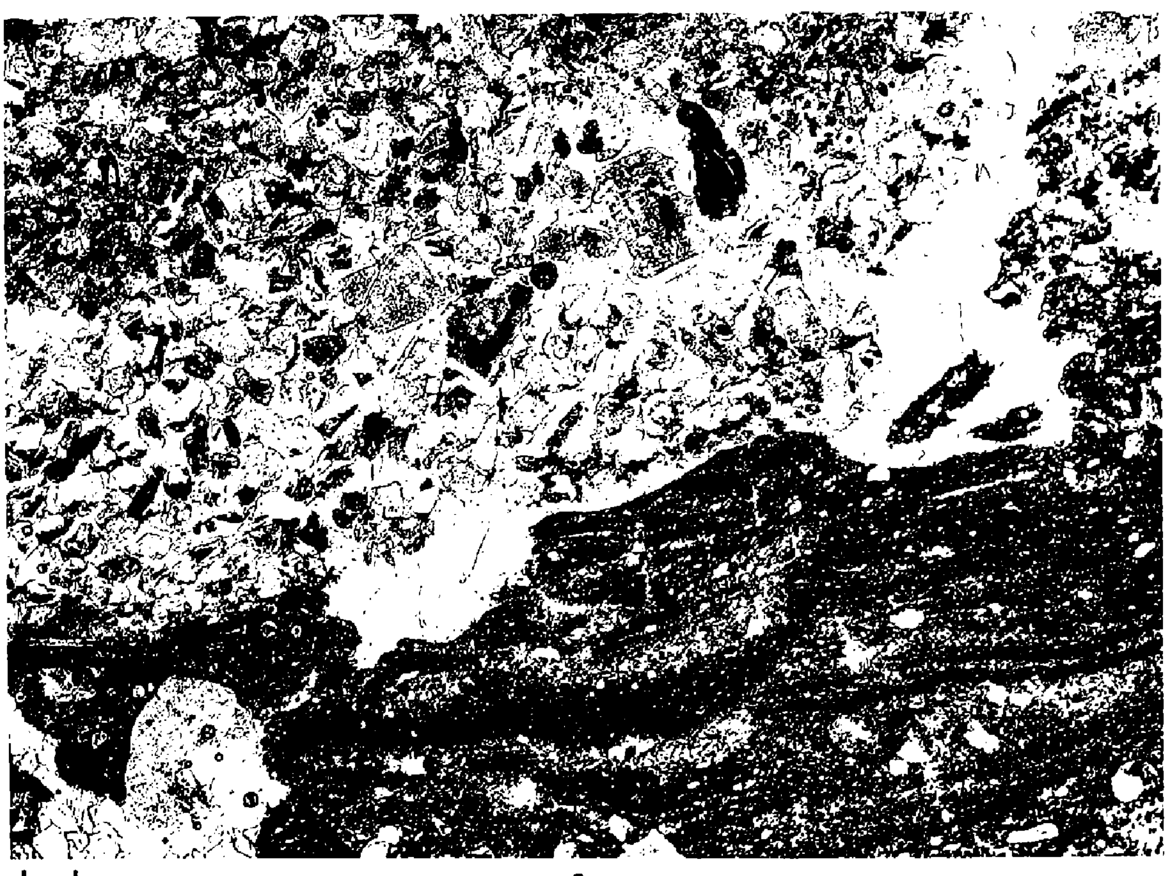
(Each bar represents 1 mm)

1, 2. Photomicrographs showing characteristic texture and fossil preservation of the Marble City biosparite. The bed from which this specimen was obtained carries a varied fauna, including many brachiopods, trilobites, and bryozoans. Figure 2 is an enlargement of a part of figure 1. Upper 20 feet of the Marble City Member at fossil locality Ad-1*, near core hole OGS 1, north of Bunch.

3. Photomicrograph showing one of the laminated carbonate bodies in the Marble City. The laminated carbonate includes some layers of crystalline dolomite. Compare with plates VIII, IX, X, and XI. Diamond core OGS 3, west of Lake Tenkiller dam; depth 4 feet. Oriented thin section, top up.

1

2



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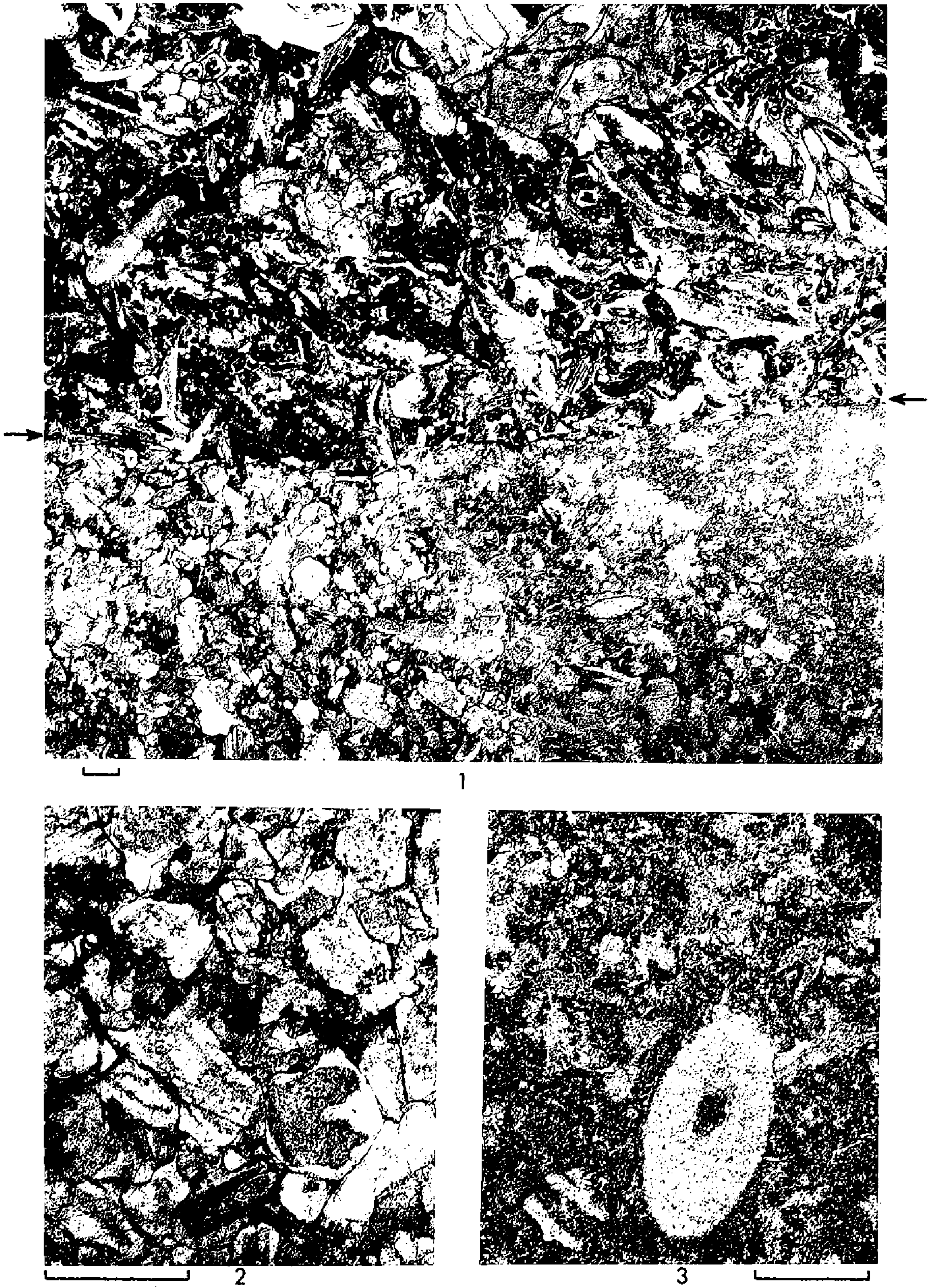


1 2 3

Plate XVI

Figures 1-3. Frisco Formation (Lower Devonian) and Marble City Member, Quarry Mountain Formation

(Each bar represents 1 mm)

1. **Photomicrograph showing the Frisco-Marble City contact (arrows). The Marble City Limestone on the lower left is typical pink biosparite, whereas on the right it is in the gray finely crystalline facies. St. Clair Lime Company mine (S-13, old mine, tunnel J north of 17), NE¼ SE¼ sec. 14, T. 13 N., R. 23 E., Sequoyah County, Oklahoma. Oriented thin section, top up.**
2. **Enlarged view of the Marble City pink biosparite shown in the lower left of figure 1.**
3. **Enlarged view of the gray finely crystalline facies shown in the lower right of figure 1.**

   Analyses of the specimen from which this thin section was prepared gave the following results:

Frisco Formation		
$MgCO_3$	2.12%	
$CaCO_3$	88.53%	
acid insolubles	9.35%	(by subtraction)
Marble City Member pink biosparite		
$MgCO_3$	0.89%	
$CaCO_3$	98.97%	
acid insolubles	0.31%	(by analysis)
gray finely crystalline limestone		
$MgCO_3$	0.91%	
$CaCO_3$	98.43%	
acid insolubles	0.47%	(by analysis)

PLATE XVII

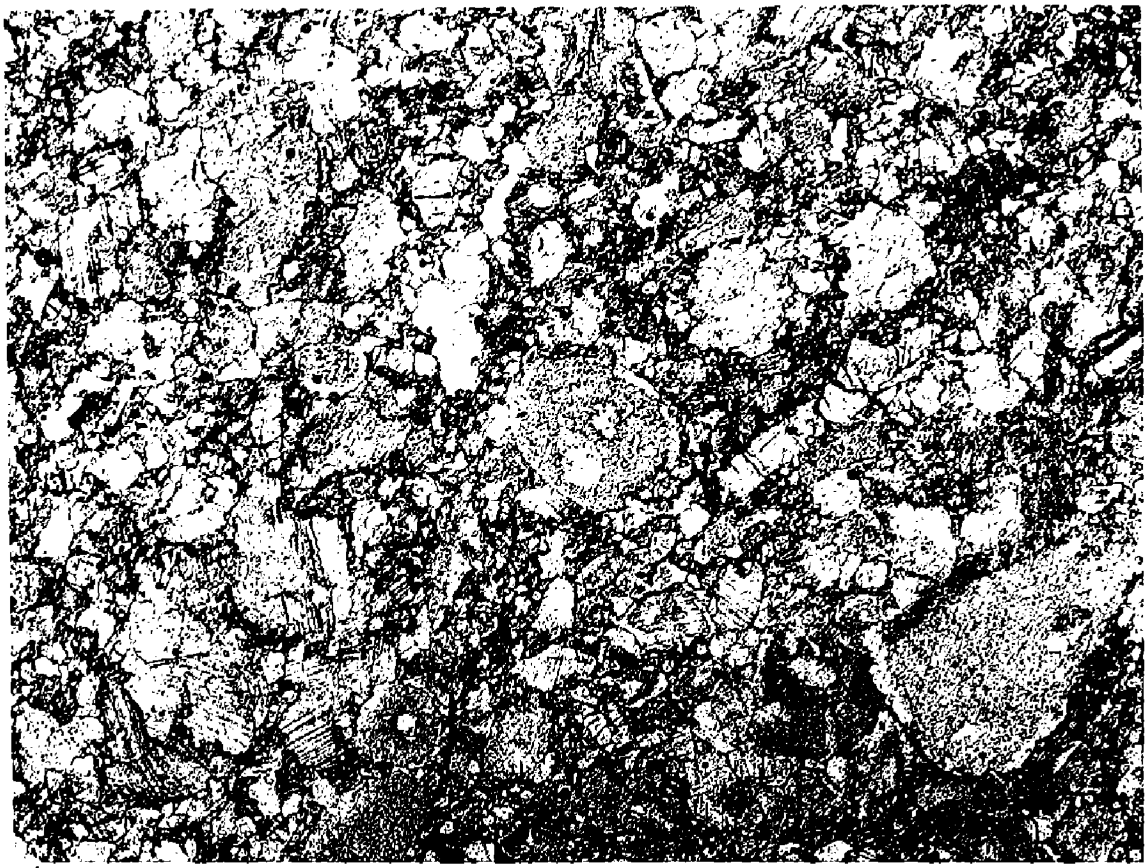
Figures 1-3. Marble City Member of the Quarry Mountain Formation

1. **Photomicrograph of the pink pelmatozoan limestone of the Marble City Member. This specimen shows considerable solution, a feature which is common in the upper part of this member in the Marble City area. Upper 10 feet of the Marble City Member, St. Clair Lime Company (S-13, old mine, tunnel J north of 17), NE¼ SE¼ sec. 14, T. 13 N., R. 23 E., Sequoyah County, Oklahoma.**

2, 3. **Enlarged views of the gray finely crystalline limestone showing "corroded" pelmatozoan plates. Same horizon and locality as figure 1.**

Analyses of the specimens from which these thin sections were cut give the following results:

	pink pelmatozoan limestone (fig. 1)
$MgCO_3$	0.64%
$CaCO_3$	98.10%
acid insolubles	0.96%
	gray finely crystalline limestone (figs. 2, 3)
$MgCO_3$	0.91%
$CaCO_3$	97.91%
acid insolubles	0.97%



1 mm

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2

3

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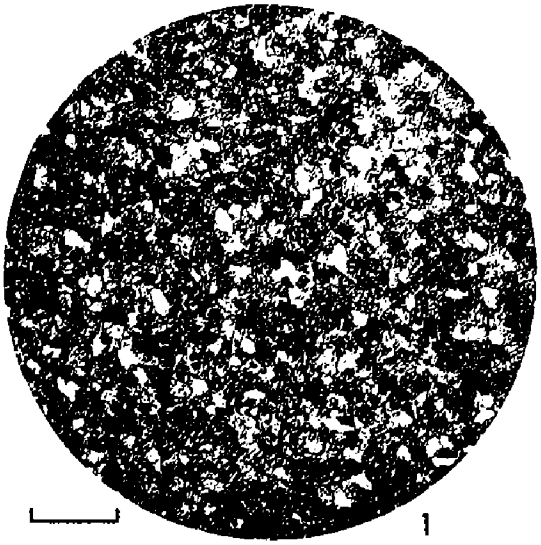

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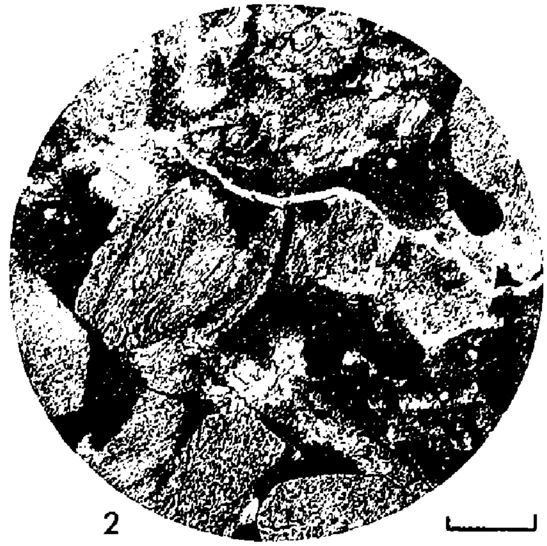

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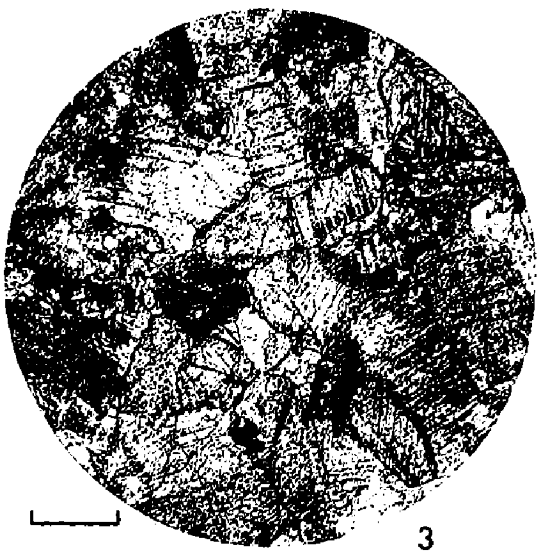

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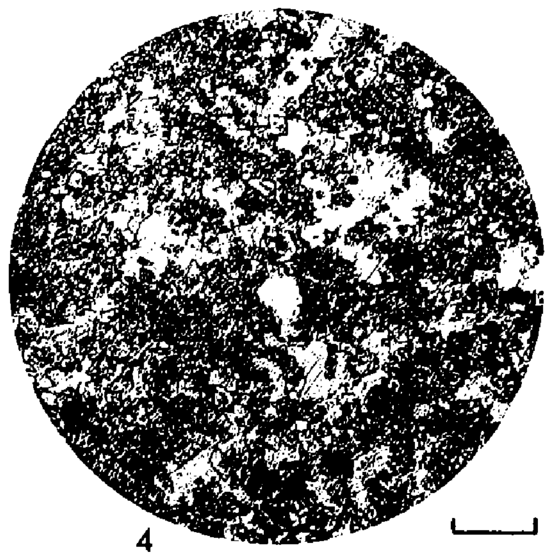

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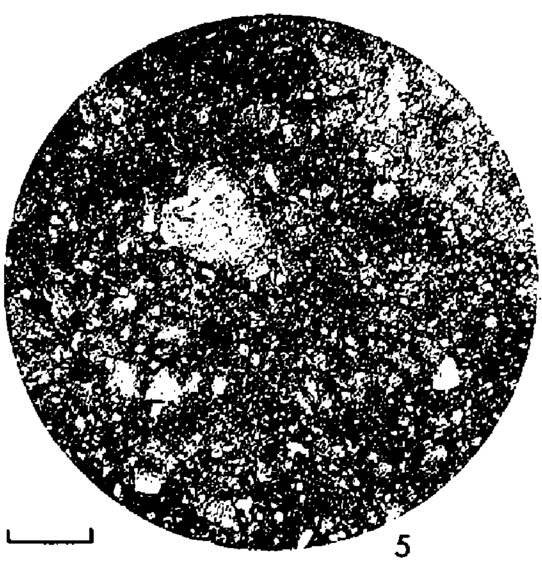

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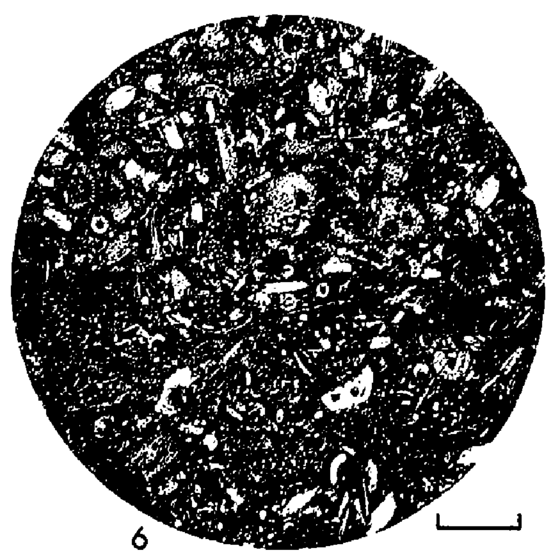

6

PLATE XVIII

Figures 1-6. Photomicrographs of thin sections prepared from rotary and cable-tool cuttings; wells described in appendix IC

(Each bar represents ½ mm)

1. Sallisaw Formation (Lower Devonian); Harris, 1 Cheek (well E), depth 2,970 to 2,975 feet; NE¼ NE¼ SW¼ sec. 19, T. 12 N., R. 25 E., Sequoyah County, Oklahoma. Compare with plate 11, figure 3, of Amsden (1961).
2. Frisco Formation (Lower Devonian); Harris, 1 Cheek (well E), depth 3,010 to 3,015 feet; same location as figure 1. Compare with plate 9, figures 5, 6, of Amsden (1961).
3. Marble City Member, Quarry Mountain Formation; Foster, 1 Mabee (well A), depth 940 to 950 feet; SW¼ SW¼ NE¼ sec. 15, T. 13 N., R. 25 E., Sequoyah County, Oklahoma. Compare with plate 7, figures 1-4, of Amsden (1961).
4. Barber Member, Quarry Mountain Formation; Harris, 1 Cheek (well E), depth 3,185 to 3,190 feet; same location as figure 1.
5. Blackgum Formation, Carter, 1 Graham (well M), depth 4,780 to 4,785 feet; NW¼ SE¼ NE¼ sec. 3, T. 9 N., R. 16 E., McIntosh County, Oklahoma. Compare with plate V, figures 2-4.
6. Tenkiller Formation; Johnson, 2 Cook (well D), depth 940 to 945 feet; C SW¼ NE¼ sec. 8, T. 12 N., R. 24 E., Sequoyah County, Oklahoma. Compare with plate VII, figures 3, 5.

APPENDICES

The appendices are divided into two parts: (I) Stratigraphic Data and (II) Chemical Data. The section on Stratigraphic Data is further subdivided into three parts: (A) *Surface stratigraphic sections and collecting localities,* (B) *Diamond-core holes,* (C) *Rotary and cable-tool holes.*

Appendix I. Stratigraphic Data

The stratigraphic data upon which this report is based were obtained primarily from a study of surface outcrops and diamond cores, supplemented by information from rotary and cable-tool holes. The Silurian outcrop areas are shown on the maps, plates A and B, and text-figure 3. These maps give the locations of all described stratigraphic sections, fossil-collecting localities, diamond-core holes, and rotary and cable-tool holes.

Appendix IA

Surface Stratigraphic Sections and Collecting Localities

This report is based upon 22 partial or complete stratigraphic sections and 8 collecting localities. Fifteen of the stratigraphic sections, covering the upper part of the Quarry Mountain Formation and overlying Lower Devonian strata, are described in the appendix of Amsden (1961); these are in the Marble City area (locations given on pl. A) and include the following:

S1 (f) * — Big bend of Sallisaw Creek, about ¾ mile north of Marble City.
S2 (f) — About ¼ mile west of Trott quarry.
S3 (f) — Trott quarry, about ½ mile north of the St. Clair Lime Company quarry.
S4 (f) — Walkingstick Hollow in the northern part of the Marble City area.
S5 (f) — About 600 feet south of the St. Clair Lime Company quarry.
S6 — About ¼ mile southwest of the St. Clair Lime Company quarry.
S6A — Southwest of the St. Clair Lime Company quarry between S6 and S5.
S7 — About ¼ mile northwest of the St. Clair Lime Company quarry.
S8 — Payne Hollow, in the southwestern part of the Marble City area.
S9 (f) — Payne Hollow, just north of the Independent Gravel Company quarry.
S10 — Payne Hollow, about ⅛ mile northeast of the Independent Gravel Company quarry.
S11 — Payne Hollow, about ¼ mile north of the Independent Gravel Company quarry.
S12 (f) — About 1 mile north of the St. Clair Lime Company quarry.
S13, S13A — St. Clair Lime Company mine (old mine).
S14 — Payne Hollow, about ¼ mile north of the Independent Gravel Company quarry.

* Stratigraphic sections from which Silurian fossils were collected are marked with an (f). Most collections are from the upper part of the Marble City Member; one collection (S18) is from the upper part of the Barber Member.

The following six stratigraphic sections are described herein:

- Ch1 — Walkingstick Hollow, just north of the Marble City area, Cherokee Co. (pl. B).
- Ch2 (f) — Blackgum Landing, southeast shore of Lake Tenkiller, Cherokee Co. (pl. B).
- Ch3 — About 3 miles southeast of Barber, near diamond-core hole OGS 2, Cherokee Co. (pl. B).
- Ch4 — About 1 mile west of Qualls, Cherokee Co. (pl. B; text-fig. 7).
- Ch5 — About 1 mile west of Qualls, Cherokee Co.; this section is approximately 300 feet south of Ch4 (pl. B; text-fig. 7).
- Ch7 — About 1 mile north of Qualls, Cherokee Co. (pl. B).

The following 10 Silurian collecting localities are described in this appendix (marked with an asterisk):

- S15* — North end of Walkingstick Hollow, Sequoyah Co. (pl. A).
- S16* — Walkingstick Hollow, about ½ mile east of stratigraphic section S4 and well C; Sequoyah Co. (pl. A).
- S17* — About ¼ mile northwest of the Trott quarry, Sequoyah Co. (pl. A).
- S18*, S18A* — St. Clair Lime Company quarry, Sequoyah Co. (pl. A).
- S19* — Payne Hollow, about ½ mile southwest of the Independent Gravel Company quarry, Sequoyah Co. (pl. A).
- S20* — Payne Hollow, Independent Gravel Company quarry, Sequoyah Co. (pl A).
- S21* — About 3 miles southwest of Lake Tenkiller dam, Sequoyah Co.; near site of diamond-core hole OGS 3 (pl. B).
- Ch6* — About 1 mile west of Qualls, Cherokee Co.; approximately 100 yards south of stratigraphic section Ch5 (pl. B).
- Ad1* — Malloy Hollow, about 2 miles north of Bunch, Adair Co.; near site of diamond-core hole OGS 1 (pl. B).

Stratigraphic Section Ch1

Southeastern Corner of Cherokee County

This is an outcrop in the bed of the creek along Walkingstick Hollow, a few hundred feet north of the Cherokee-Sequoyah county line; SW¼ SE¼ sec. 35, T. 14 N., R. 23 E. (pl. B). At this outcrop the Sylamore Sandstone Member of the Chattanooga Formation is exposed in contact with the Marble City Member of the Quarry Mountain Formation. The contact is quite irregular, and long "tongues" or "veins" of Sylamore extend down into the Marble City, which is here dolomitic. Locally small remnants of Sallisaw may be present, but throughout most of this area pre-Chattanooga erosion has removed the Lower Devonian strata, allowing the Sylamore to rest directly upon the Silurian beds.

Stratigraphic Section Ch2

Blackgum Landing, Southeast Shore of Lake Tenkiller

Section described and collected by T. W. Amsden, T. L. Rowland, and T. H. Warren in October 1960; additional fossils collected by T. W. Amsden, A. J. Boucot, and T. L. Rowland, September 15, 1962. It is on the shore of Lake Tenkiller, about 300 feet northeast of the road that leads to the landing; SW¼ SE¼ sec. 32, T. 14 N., R. 22 E., Cherokee County (pl. B).

This is the type locality for the Blackgum and Tenkiller Formations. The strata are well exposed and have only a gentle dip; some minor faulting and slumping are present in this area. The Sylvan Shale is exposed at the edge of the lake; it is overlain by the Blackgum Formation (with the Pettit Oölite Member at its base) and the Tenkiller Formation, the Tenkiller-Blackgum contact being well exposed at this locality. In this area the Quarry Mountain Formation has been removed by post-Silurian erosion, allowing the Chattanooga Formation to rest directly upon the Tenkiller (see stratigraphic sections on pl. B and text-fig. 15). Photographs and photomicrographs of these strata appear on plates II, IV, V, VI, VII.

Chemical analyses of rock specimens (not channel samples) are given below and in appendix II.

TENKILLER FORMATION

(total 20 feet)

E. *Lithology:* Medium-gray to pinkish-gray, bioclastic limestone in even, blocky beds up to 8 or 10 inches (pl. II, fig. 1; pl. IV, fig. 1). Much of this rock is a calcarenite, but it contains layers of coarse, crinoidal limestone; crinoid plates are commonly pink, giving the rock its pink cast. ...... 20 feet

Thin sections (pl. VII, figs. 1-3) show this rock to be composed of interbedded biosparite and biomicrite. The fossils are mostly pelmatozoan plates, but many other fossil groups are represented; the fossil clasts generally have sharply defined boundaries. Some glauconite is present, especially in the lower part.

The acid-insoluble content of this rock is moderate; three analyses average 4.8 percent. Unwashed residues probably include some clay; washed residues generally include considerable amounts of pyrite and some small quartz crystals and quartz druse; subangular quartz grains may also be present, mostly less than 0.2 mm. Minor amounts of glauconite may be present. Some beds have arenaceous foraminifers.

The $MgCO_3$ content is low; three analyses average 1.7 percent.

Chemical Data

Specimen	*Acid insolubles*	*$CaCO_3$*	*$MgCO_3$*
Ch2-E(3) upper 5 feet	5.04%	93.71%	1.70%
Ch2-E(2) 8 feet above base	7.44	91.39	1.42
Ch2-E(1) 3 feet above base	2.02	95.75	2.07

The Tenkiller is distinguished from the underlying Blackgum Formation (upper limestone member) by the following characteristics: its even, blocky beds are in marked contrast to the thin, irregular beds of the Blackgum (cf. pl. II, figs. 1, 2); the Blackgum lacks the interbedded biomicrite and biosparite texture which is so common in the Tenkiller; the Tenkiller is lighter in color and lacks the irregular dark mottling of the Blackgum (see below); the Tenkiller has a lower dolomite content than has the upper limestone member of the Blackgum Formation (and much lower than the lower tan dolomite member), and also a reduced glauconite and chert content (chert is uncommon in the Tenkiller and none was observed at Ch2). The Tenkiller-Blackgum contact is well defined and exposed at several places in this area; it shows some minor undulations.

Fossils: No megafossils collected from this formation. Acetic and formic acid residues yield conodonts and arenaceous foraminifers.

BLACKGUM FORMATION
(total 13 feet)

Upper Limestone Member
(total 10 feet)

D. *Lithology:* Dark-gray, glauconitic limestone with many irregular areas of tan-weathering dolomite (to 2 or 3 inches); bedding irregular, up to 3 inches (pl. II, fig. 2). Small nodules of vitreous chert. Thin sections show that the limestone is mostly biomicrite, with only small patches of biosparite; much pelmatozoan debris, but also including a considerable amount of shelly material (pl. V, fig. 3). Scattered through the limestone are irregular areas of fine-crystalline dolomite with only minor fossil debris (pl. V, fig. 2). Glauconite present in small grains scattered through the limestone and dolomite. Acid-insoluble content moderate; three specimens average 3.4 percent. These specimens average 4.7 percent $MgCO_3$ (specimens include both the limestone and dolomite areas). ...... **10 feet**

Chemical Data

Specimen	*Acid insolubles*	*$CaCO_3$*	*$MgCO_3$*
Ch2-D(3) upper 2 feet	3.13%	93.72%	3.02%
Ch2-D(2) 5 feet above base	4.09	89.88	6.54
Ch2-D(1) 2 feet above base	2.84	92.55	4.64

The insoluble residues include much dark-green glauconite, mostly in polylobate grains or as fossil steinkerns. Considerable quartz druse and some small, doubly terminated quartz grains; few angular quartz grains; some spongy silica, possibly representing incipient chert.

This unit is sharply marked off from the overlying Tenkiller Formation. Its lower contact with the underlying tan dolomite member is not so sharply defined; the upper limestone member differs mainly in having a reduced dolomite content (contact illustrated on pl. IV, fig. 2). The precise thickness of unit D is difficult to measure, partly because of slumping and partly because of the gradational lower contact.

Fossils: A small megafauna collected; includes cephalopods, trilobites, corals, bryozoans, brachiopods, and stromatoporids. Of special interest for regional correlation is the presence of well-preserved specimens of *Microcardinalia triplesiana* (Foerste) and *Triplesia alata* (Ulrich and Cooper).

Tan Dolomite Member
(total 3 feet)

C. *Lithology:* Tan-weathering, glauconitic, calcitic dolomite with nodules of vitreous chert. This is mostly finely crystalline dolomite locally grading into a bioclastic limestone. The chert is fossiliferous; fossils with somewhat ragged outlines; dolomite crystals in the chert. .... 1 foot

The dolomite content is variable; one specimen (Ch2-C tested 25.76% $MgCO_3$ and 7.24% acid insolubles (appendix II). The acid residues include a considerable amount of glauconite, mostly in polylobate grains, but with some fossil steinkerns; also quartz druse and small quartz crystals.

This unit appears to grade into the overlying limestone member; upper and lower contacts are illustrated on plate IV, figure 2.

Fossils: No megafossils collected; formic acid residues not checked.

B. *Lithology:* Tan, vitreous chert. Thin sections show a fossiliferous chert, the fossils largely replaced by finely crystalline quartz. Well-formed dolomite crystals scattered through the chert. This appears to be a bed or elongate lens of chert; its texture is like that of the overlying and underlying chert nodules. Illustrated on plate IV, figure 2. ..... 6 inches

Fossils: None collected.

A. *Lithology:* Tan-weathering, glauconitic, calcitic dolomite with nodules of vitreous chert. This interval mostly finely crystalline dolomite (pl. V, fig. 6). One rock specimen (Ch2-A) analyzed 12.06% acid insolubles and 30.97% $MgCO_3$ (appendix II). .... 1.5 feet

The dolomite and chert of unit A are similar to units B and C; A separated from C by the chert bed or elongate lens of unit B.

Fossils: No megafossils collected. No microfossils recovered from acetic or formic residues.

Pettit Oölite Member
(total 6 inches)

Lithology: Silicified oölite. Many of the oölites broken before or during deposition and cementation. Illustrated on plate VI, figure 6. ..... 6 inches

Considerable slumping has occurred in this area and it is difficult to find this thin oölite in place; however, this bed appears quite clearly to occupy a stratigraphic position between the tan dolomite member of the Blackgum Formation and the Sylvan Shale; no oölites observed in any of the overlying strata.

Fossils: No fossils collected from this bed.

SYLVAN SHALE

Green clay exposed at the water's edge.

Stratigraphic Section Ch3

Southeast of Barber

This is the type locality of the Barber Member of the Quarry Mountain Formation. It is at the north end of the outcrop belt which extends along a tributary of Dry Creek, about 3 miles southeast of Barber, Cherokee County; SE¼ NW¼ NE¼ sec. 2, T. 14 N., R. 23 E. (pl. B). This outcrop is largely dolomite and represents the Barber Member of the Quarry Mountain Formation. At the north end of this belt, in the vicinity of stratigraphic section Ch3, the Barber is believed to be directly overlain by the Chattanooga Formation (Devonian-Mississippian); however, at the south end of this belt the St. Joe Formation (Mississippian) is believed to overlie the Silurian (Huffman, 1958, pl. 4).

Diamond-core hole OGS 2 is at the north end of this outcrop, the collar of the hole being in the bed of the stream. Stratigraphic section Ch3 starts at the lowest exposure of the Barber Dolomite, just at the collar of core hole OGS 2, and extends up to the highest exposure, a stratigraphic interval of about 10 feet (pl. XII, fig. 1). In the vicinity of stratigraphic section Ch3 the strata overlying the Barber Dolomite are poorly exposed, although some Chattanooga Shale is believed to be present. Diamond-core hole OGS 2 penetrated 42 feet of Barber Dolomite (this hole continued through the underlying Tenkiller and Blackgum Formations, into the Sylvan Shale), giving the member a total thickness of approximately 52 feet.

QUARRY MOUNTAIN FORMATION

Barber Member

(10 feet exposed; plus 42 feet in core hole OGS 2)

Lithology: Medium-gray weathering, calcitic dolomite. Bedding obscure (pl. XII, fig. 1). Thin sections (from OGS 2) show this rock to be largely finely crystalline dolomite with varying amounts of fossil debris; fossil clasts appear to have "corroded" boundaries (pl. XII, figs. 2, 3). This rock has a low acid-insoluble content, ranging from 0.1 to 0.6 percent; the $MgCO_3$ ranges from 14.6 to 30.64 percent (based upon analyses of the core from OGS 2; see appendix II).	10 feet (exposed)

Base not exposed; see description of core hole OGS 2 for the lower part of the Barber Member, and the underlying formations.

Fossils: None collected.

Stratigraphic Section Ch4

West of Qualls

This section described by T. W. Amsden and T. L. Rowland, April 1961 and March 1963. It is on the southwest bank of a small stream, about a mile west of Qualls; SE¼ NW¼ sec. 2, T. 14 N., R. 21 E., Cherokee County (pl. B). Some faulting and slumping have occurred at this locality, but the Blackgum Formation is completely exposed, being overlain by the Chattanooga Formation and underlain by the Sylvan Shale. Strata have only a gentle dip. Huffman (1953, p. 450) and Decker and Huffman (1953, p. 451) reported *Dicellograptus complanatus* from the Sylvan Shale at or near this section. A photograph of the Blackgum Formation at this locality is shown on plate III, figure 1, and a photomicrograph of the Pettit Oölite is on plate VI, figure 5. The stratigraphic relationships at Ch4 and Ch5 are illustrated in text-figure 7.

This is probably the section described by Mondy (1950, p. 24, fig. 6); Mondy referred the sandstone overlying the Blackgum Formation (which he called St. Clair) to the Sallisaw Formation, but we believe it is the Sylamore Sandstone Member of the Chattanooga Formation.

CHATTANOOGA FORMATION
Sylamore Sandstone Member

Lithology: Quartz sandstone with an inch or so of conglomeratic material at its base; conglomerate includes some silicified brachiopod fragments. The quartz sandstone is medium to coarse grained and slightly calcareous. This rock is overlain by dark shale. .... 1 foot

This rock has the typical lithologic characteristics of the Sylamore Sandstone.

BLACKGUM FORMATION
(total 12 feet)

Upper Limestone Member

Lithology: Dark bioclastic limestone with irregular areas of tan-weathering dolomite; the dolomite makes an irregular, anastomosing network through the limestone (pl. III, fig. 1). Nodules of vitreous chert. Thin sections show the limestone is mostly a biomicrite with much crinoidal debris; dolomite is finely crystalline and largely free of fossil debris; chert has scattered dolomite crystals. Glauconite present in both the limestone and dolomitic facies. The contact with the underlying tan dolomite member is illustrated on plate III, figure 1. ...... 10 feet

Fossils: None collected.

Tan Dolomite Member (including Pettit Oölite)

Lithology: Tan-weathering, calcitic dolomite (pl. III, fig. 1). Thin sections show this rock to be mostly finely crystalline dolomite with only widely scattered fossils. In the lower 6 inches of this unit are fractured or brecciated nodules of silicified oölite; these appear to be remnants of the Pettit Oölite (see text-fig. 7 and pl. VI, fig. 5). No oölites observed in any of the overlying strata. .... 2 feet

Fossils: None collected.

SYLVAN SHALE

Green clay.

Stratigraphic Section Ch5
West of Qualls

Section described by T. W. Amsden and T. L. Rowland, April 1961. It is on the southwest bank of a small stream, approximately 100 yards south of Ch4 and about a mile west of Qualls, Cherokee County; SE¼ NW¼ sec. 2, T. 14 N., R. 21 E. A photograph of this outcrop is on plate III, figure 2, and photomicrographs are on plate VI, figures 1-4. The stratigraphic relationships at Ch4 and Ch5 are illustrated on text-figure 7.

This is the type locality of the Pettit Oölite Member.

CHATTANOOGA FORMATION

Dark shale with basal Sylamore Sandstone.

BLACKGUM FORMATION
(9 feet exposed)

Upper Limestone Member

Lithology: Dark limestone with irregular patches of tan-weathering dolomite. Nodules of vitreous chert. Thin sections show this rock to be a biomicrite with irregular areas of finely crystalline dolomite. Considerable amount of glauconite present. Lithologically this unit closely resembles the upper limestone member at section Ch4 with which it is almost certainly correlative. ...... 7 feet

Fossils: None collected.

Tan Dolomite Member

Lithology: Tan-weathering calcitic dolomite with some glauconite. Thin section shows this is mostly finely crystalline dolomite with only widely scattered fossils; some quartz grains and much glauconite. The contact with the underlying Pettit Oölite is sharply defined (pl. III, fig. 2). ...... 1 foot

Fossils: None collected.

Pettit Oölite Member

Lithology: Dark-gray oölite. Oölites present in at least two distinct facies; a carbonate facies and as silicified nodules (pl. III, fig. 2; text-fig. 7). The carbonate oölites have a distinctive texture, appearing to be distorted or deformed as shown in figures 1-3 of plate VI. The oölites in this facies are preserved in some dark, fine-grained material which commonly shows little or no concentric or radial structure; a few of the undeformed oölites in this group show faint traces of radial or concentric structures. Well-formed dolomite crystals are common in the deformed as well as the whole oölites. The matrix enclosing the distorted oölites is largely sparite (these deformed or distorted oölites have a remarkable resemblance to those described by Carozzi, 1961, fig. 6). The silicified oölite nodules, which appear to be more or less enclosed in the carbonate facies, are undeformed as shown in plate VI, figure 4; this facies also has well-formed dolomite crystals. ...... 1 foot

Fossils: None collected.

Covered (probably Sylvan Shale)

Collection Ch6*
West of Qualls

Described below under collecting localities.

Stratigraphic Section Ch7

Northwest of Qualls

Section described by T. W. Amsden and T. L. Rowland, April 25, 1961. It is about a mile northwest of Qualls, SE¼ SE¼ sec. 35, T. 15 N., R. 21 E., Cherokee County (pl. B). The exposures at this section, and throughout this outcrop belt, are not very good. There are outcrops of typical Blackgum lithology, mostly the upper limestone member, overlain by the Sylamore Sandstone Member of the Chattanooga Formation, and underlain, at least locally, by the Pettit Oölite Member. No Sallisaw or Frisco strata observed in this area, and the Blackgum is apparently everywhere overlain by the Chattanooga. Probably some minor faulting is present in this belt; the strata have only a gentle dip.

Photomicrograph of the Blackgum Formation on plate V, figure. 1.

Covered

CHATTANOOGA FORMATION

Sylamore Sandstone Member

Lithology: Brown-weathering, medium to coarse quartz sandstone. Slightly calcareous. Overlying strata covered. ...... 1 foot

Remarks: This appears to be typical Sylamore lithology, although it is slightly calcareous; no basal conglomerate observed. No Sallisaw-type lithology observed here.

BLACKGUM FORMATION

Upper Limestone Member

Lithology: Dark-gray limestone with much tan-weathering dolomite. The limestone is a biomicrite with some glauconite and numerous, irregular areas of finely crystalline dolomite (pl. V, fig. 1). ...... 4 feet

Remarks: This rock has a substantial amount of tan-weathering dolomite, more than is common in the upper limestone member. The base of this section is covered, but elsewhere in this outcrop belt Pettit Oölite is present, ranging up to 3 or 4 feet.

Covered

Collection S15*

Walkingstick Hollow

Collection of megafossils made by T. W. Amsden, T. L. Rowland, and T. H. Warren, October 10, 1960. This collection came from the upper 25 feet of the Marble City Member (Quarry Mountain Formation), from outcrops along the stream bed and on the east side of the stream in Walkingstick Hollow, in the Marble City area; NE¼ NE¼ NE¼ sec. 2, T. 13 N., R. 23 E., Sequoyah County (pl. A). At this locality about 25 feet of the Marble City is exposed beneath the Sylamore Sandstone Member of the Chattanooga Formation. This is mostly pale pinkish-gray bioclastic limestone with a few dolomitic beds. Fossil collections from the following strata:

Sylamore Sandstone Member

(exposed in contact with the Marble City Member)

Marble City Member

S15-D. Upper 2 feet of the Marble City Limestone.

S15-C. 2 to 5 feet below top of member; large megafauna collected in situ.

S15-B. 5 to 15 feet below top of member; this interval includes a few dolomitic beds.

S15-A. 15 to 25 feet below top of member; this interval exposed along the stream bed.

Collection S16*
Walkingstick Hollow

Collection of megafossils made by T. W. Amsden, T. L. Rowland, and T. H. Warren, October 11, 1960. This collection came from the upper part of the Marble City Member (Quarry Mountain Formation), about 10 feet below the Marble City-Sylamore Sandstone contact. This locality is in the Marble City area, on the north side of Walkingstick Hollow, a short distance north of the stream; NW¼ SW¼ SE¼ sec. 1, T. 13 N., R. 23 E., Sequoyah County (pl. A). The upper 20 or 25 feet of the Marble City is well exposed in this area; it consists mostly of light pinkish-gray bioclastic limestone with some dolomitic beds.

Collection S17*
North of St. Clair Lime Company Quarry

Collection of megafossils from the Marble City Member (Quarry Mountain Formation) made by T. W. Amsden, T. L. Rowland, and T. H. Warren, October 11, 1960. This collection came from a bed about 3 feet below the Marble City-Sylamore Sandstone contact. It is on the south rim of a small abandoned quarry; NE¼ SW¼ SW¼ sec. 12, T. 13 N., R. 23 E., Sequoyah County (pl. A). About 20 feet of Marble City bioclastic limestone is exposed in this quarry, the uppermost strata being in contact with the Sylamore Sandstone. The light pinkish-gray to gray limestone contains a few dolomitic beds.

Collections S18* and S18A*
St. Clair Lime Company Quarry

Two collections of megafossils made by T. W. Amsden, T. L. Rowland, and T. H. Warren, October 11-12, 1960. These collections are from the upper 20 feet of the Barber Member (Quarry Mountain Formation), in the deepest part of the St. Clair Lime Company quarry, about 1.5 miles north of Marble City; SE¼ SE¼ NE¼ sec. 14, T. 13 N., R. 23 E., Sequoyah County (pl. A). The floor of this quarry is approximately 95 feet below the Quarry Mountain-Frisco contact; the west face of the quarry gives a complete exposure of the upper part of the Barber Member and all of the overlying Marble City Member, as well as of the Lower Devonian Frisco and Sallisaw Formations (pl. XIII). Diamond-core hole SCL 1 penetrated this part of the section; core hole SCL 2 started in the floor of the quarry and extended down to the Sylvan Shale (see map and stratigraphic section, pl. A; appendix IB). This quarry is the type locality of the Quarry Mountain Formation and of the Marble City Member.

The fossils came from a light-gray to tannish-gray dolomitic limestone. The Barber-Marble City contact lies about 20 feet above the floor of the quarry; it is exposed but not well marked, being defined by a change from dolomitic limestone to limestone. Collection S18* is from the northwest corner of the quarry and came from a bed in situ 6 or 7 feet above the quarry floor; it is a rather large collection with many brachiopods and some bryozoans, trilobites, and other groups. Collection S18A* is from a site about 200 feet southeast of S18* and came from loose blocks out of an "island" of rock left on the quarry floor.

Collection S19*
West of Payne Hollow

Collection of megafossils from the Marble City Member (Quarry Mountain Formation) made by T. W. Amsden, T. L. Rowland, and T. H. Warren, October 12, 1960. This locality is on the south side of a small stream flowing northeastward into Payne Hollow, about 1.5 miles west of Marble City and ½ mile southwest of the Independent Gravel Company quarry; SE¼ SW¼ NE¼ sec. 22, T. 13 N., R. 23 E., Sequoyah County (pl. A). The upper 25 to 30 feet of the Marble City Member is fairly well exposed in this area and consists mostly of light-gray to pinkish-gray limestone with some beds of dolomitic limestone. The collection was made from loose blocks about 12 feet (stratigraphically) below the highest Marble City bed; the Silurian is directly overlain by the Sallisaw, although the exposures are not very good at this locality.

Collection S20*
Independent Gravel Company Quarry

Collection of megafossils made from the Marble City Member by T. W. Amsden, T. L. Rowland, and T. H. Warren, October 12, 1960. This locality is in the abandoned quarry of the Independent Gravel Company, on the east side of the stream in Payne Hollow, about 1.5 miles northwest of Marble City; NE¼ NW¼ NE¼ sec. 22, T. 13 N., R. 23 E., Sequoyah County (pl. A). The floor of the quarry is 55 feet (stratigraphically) below the Quarry Mountain-Frisco contact; the Marble City Member is mostly light-gray to pinkish-gray limestone with some beds of dolomitic limestone. Most of the collection came from loose blocks of Marble City on the quarry floor; these came from beds 30 to 55 feet below the contact. A small collection was made in situ from a bed just above the quarry floor.

Collection S21*
West of Lake Tenkiller Dam

This is a collection of megafossils from the Marble City Member (Quarry Mountain Formation) made by T. W. Amsden, T. L. Rowland, and T. H. Warren, October 13, 1960. It is about 3 miles west of Lake Tenkiller dam, in the bed of a small stream just west of the section-line road; SE¼ SE¼ NE¼ sec. 20, T. 13 N., R. 21 E., Sequoyah County (see map and sections, pl. B; this is only a few feet west of the site of diamond-core hole OGS 3). Only 6 to 8 feet of uppermost Marble City Limestone exposed in this outcrop belt; this is mostly pinkish-gray bioclastic limestone with a few dolomitic beds. Collection S21* came from a loose block of Marble City Limestone about 3 feet below the Marble City-Sallisaw contact. See description of core hole OGS 3 (appendix IB).

Collection Ch6*
West of Qualls

Collection made by T. W. Amsden and T. L. Rowland, April 24, 1961, and T. W. Amsden, A. J. Boucot, and T. L. Rowland, September 15, 1962. This is a small outcrop of the upper limestone member of the Blackgum Formation on the west bank of a small stream, about 100 yards south of Ch5; SE¼ NW¼ sec. 2, T. 14 N., R. 21 E., Cherokee County (pl. B). A small collection of megafossils made, including some excellent specimens of the brachiopod *Microcardinalia triplesiana* Foerste. The lithologic character of the rock is similar to that of the upper limestone member at Ch5 and Ch4.

Collection Ad1*
Malloy Hollow

Collection of megafossils from the Marble City Member (Quarry Mountain Formation) made by T. W. Amsden, T. L. Rowland, and T. H. Warren, October 14, 1960. This is in a small abandoned quarry just north of the road along Malloy Hollow, about 2 miles north of Bunch; SW¼ SE¼ SW¼ sec. 4, T. 14 N., R. 24 E., Adair County (see map and sections, pl. B; this collection from within a few feet of the collar of diamond-core hole OGS 1). Twenty-two feet of Marble City Limestone is exposed beneath the "Boone" Formation. This is mostly light-gray to pinkish-gray limestone with a few dolomitic beds. Two thin sections made from rock specimens at this locality; these show a biosparite with considerable amounts of pelmatozoan material, but also with brachiopods, bryozoans, ostracodes, and other forms (photomicrographs on pl. XIV, fig. 6; pl. XV, figs. 1, 2). Collection Ad1* came from a block of Marble City Limestone 15 feet (stratigraphically) below the Marble City-"Boone" contact (see description of core hole OGS 1, appendix IB).

Appendix IB

Diamond-Core Holes

The stratigraphic and chemical data from seven diamond-core holes are incorporated in this report. Three were drilled for the Oklahoma Geological Survey: OGS 1, in Malloy Hollow, western Adair County; OGS 2, southeast of Barber in eastern Cherokee County; OGS 3, west of Lake Tenkiller dam in northern Sequoyah County (pl. B, text-fig. 3). Four diamond-core holes were drilled by the St. Clair Lime Company and the cores generously given to the Oklahoma Geological Survey by Homer Dunlap, general manager of the company; SCL 1 and SCL 2 were drilled in the quarry of the St. Clair Lime Company, and 29Z and 34Y are about ½ mile southwest of the quarry (pl. A). The holes drilled for the Oklahoma Geological Survey are NX cores (2⅛″) and those drilled for the St. Clair Lime Company are AX cores ($1\frac{13}{16}$″), with the exception of SCL 1, which is EX (approximately $\frac{13}{16}$″).

Each core was sawed lengthwise into two unequal parts, the larger part being retained for lithostratigraphic study (these are in the Core Library of The University of Oklahoma with the exception of SCL 1, which has been completely destroyed) and the smaller part being used for chemical analyses (appendix II). In the process of studying these cores, 105 standard and oversize thin sections were prepared; photomicrographs of selected thin sections are illustrated on the following plates:

Marble City Member	pl. XIV, figs. 4, 6; pl. XV, fig. 3.
Barber Member	pl. XII, figs. 2, 3.
Tenkiller Formation	pl. VII, figs. 4-6; pl. VIII; pl. IX, figs. 1-3; pl. X; pl. XI.
Blackgum Formation	pl. V, figs. 4, 5.

The structure in the area drilled is relatively simple and the beds have only a gentle dip, generally less than 5 degrees. Core recovery was excellent, approaching 100 percent for most holes.

Diamond-core hole OGS 1
Malloy Hollow

This hole was drilled for the Oklahoma Geological Survey by the Joy Manufacturing Company, August 20-23, 1962. It is beside a small quarry on the east side of a country road along Malloy Hollow, about 2 miles north of Bunch; SW¼ SE¼ SW¼ sec. 4 (1,580 feet from W line, 170 feet from S line), T. 14 N., R. 24 E., Adair County (pl. B). It starts in the upper part of the Marble City Member (Quarry Mountain Formation), the collar being approximately 22 feet (stratigraphically) below the "Boone"-Marble City contact; the top of the Sylvan Shale (Ordovician) was penetrated at a depth of 130 feet, and the total depth is 134 feet. The Marble City and Barber Members of the Quarry Mountain Formation, Tenkiller Formation, Blackgum Formation, and Sylvan Shale are present in this hole. Casing was set at 4 feet (2½ feet of large core recovered) and from 0 to 7 feet approximately 6 feet of core was recovered; below this, core recovery was essentially 100 percent (mostly continuous core). The bedding is at, or nearly at, right angles to the long axis of the core throughout this hole.

Fossil collection Ad1* from the Marble City Member was made at this locality; it came from a bed about 7 feet (stratigraphically) above the collar of OGS 1.

Chemical analyses of this hole are given in appendix II, pages 160 and 166.

See text-figure 10; stratigraphic section A-A′, text-figure 15; stratigraphic section A-A′, plate B.

This is an NX core; approximately 2⅛ inches in diameter.

Depth (feet)

QUARRY MOUNTAIN FORMATION
(depth, 0-94 feet; total thickness, 116 feet)

Marble City Member
(depth, 0-36 feet; total thickness, 58 feet)

0 - 8 *Lithology:* Light-gray biosparite; much pelmatozoan material. A few irregular areas of finely crystalline dolomite. High-purity limestone; acid insolubles average 0.23%, $MgCO_3$ averages 0.98%.

Thin section at 7′.

Remarks: Approximately 22 feet of Marble City strata between the top of this hole and the "Boone"-Marble City contact.

8 - 20 *Lithology:* Light pinkish-gray bioclastic limestone. Mostly biosparite, but with some beds of biomicrite. Fossil debris largely

Depth (feet)

pelmatozoan plates, but with some bryozoans and other forms. Numerous sediment-filled cavities in this interval. This is a high-purity limestone with acid insolubles averaging 0.14%, and $MgCO_3$ averaging 0.44%.

Thin sections at 9′, 14′.

Remarks: This interval differs from the overlying and underlying units mainly in its pinkish color (much of this color is from pink pelmatozoan plates) and numerous sediment-filled cavities. The latter commonly show considerable solution and many are cut off above and below by stylolite seams.

20 - 36 *Lithology:* Light-gray bioclastic calcarenite; mostly micrite cement, but with some areas of sparite cement. Fossils largely pelmatozoan plates. This is a high-purity limestone except for a 6-inch stringer of dolomitic limestone (12.6% $MgCO_3$) at 23-23.5′; excluding this layer, the $MgCO_3$ content averages 0.72% and the acid insolubles, 0.23%.

Remarks: The Marble City Member is distinguished from the underlying Barber upon the basis of dolomite content; the Marble City is a high-calcium stone, except for a thin bed or two of dolomitic limestone, whereas the upper part of the Barber is a dolomitic limestone with some beds of limestone, grading downward into calcitic dolomite (text-fig. 10).

Barber Member

(depth, 36-94 feet; total thickness, 58 feet)

36 - 78 *Lithology:* Alternating layers of light-gray bioclastic calcarenite and gray dolomitic limestone. The bioclastic limestone is largely a pelmatozoan limestone similar to that of the overlying Marble City Member; the $MgCO_3$ content is low, generally less than 1%. The dolomitic limestone is a bioclastic rock, largely pelmatozoan debris, with a matrix which is partly spar and partly finely crystalline dolomite; the $MgCO_3$ content ranges up to almost 17%. This is a high-purity carbonate in which acid insolubles average 0.19%.

Thin section at 76′.

Remarks: The overlying Marble City Member is almost entirely a high-calcium limestone, whereas this upper part of the Barber consists of alternating layers of high-calcium limestone and dolomitic limestone. The distribution of dolomite and of acid insolubles is illustrated in text-figure 10; see also appendix II.

78 - 94 *Lithology:* Light-gray finely crystalline calcitic dolomite (crystals generally less than 1 mm). Some fossil clasts, mostly pelmatozoan plates, are scattered through the dolomite; these have irregular outlines and appear "corroded." The $MgCO_3$ content of this interval averages 30.8% and the acid insolubles, 0.95%.

Thin sections at 76′, 78′, 87′, 89′, 90′.

Remarks: The acid-insoluble and $MgCO_3$ contents of the Barber increase downward; see text-figure 10 and appendix II.

Depth (feet)

TENKILLER FORMATION

(depth, 94-115 feet; total thickness, 21 feet)

94 -115 *Lithology:* Pink to orange-pink bioclastic calcarenite. Well-marked beds, bedding defined largely by alternating thin layers of biosparite and biomicrite; some partings of greenish-gray argillaceous material, at least in part concentrated along stylolite seams. The fossil clasts in the biosparite are well preserved and have sharp outlines; much pelmatozoan material (mostly orange-pink), but many other biologic groups also represented. Sediment-filled cavities present; a typical cavity consists of a basal layer of crystalline dolomite, overlain by finely laminated calcite and then spar (described and illustrated in the text). Irregular areas of finely crystalline dolomite are scattered throughout this interval; in the upper 3 feet the dolomite content increases sharply (to 29.5% $MgCO_3$) and this interval appears to grade into the overlying Barber calcitic dolomite. Excluding the upper 3 feet, this interval averages 3.5% $MgCO_3$; acid insolubles, 2.7%.

Thin sections at 95′, 99′, 104′, 109′, 112′.

Remarks: In the upper 3 feet the crystalline dolomite content increases sharply, the bioclastic content decreases sharply, and this interval appears to merge into the Barber Dolomite (text-fig. 10); we arbitrarily assign this to the Tenkiller Formation because the bioclastic portions are so much like the underlying lithology. Excluding this upper part, the Tenkiller is a distinctive lithostratigraphic unit characterized by its orange-pink color, well-defined bedding, and sediment-filled cavities; the fossil clasts are excellently preserved and have sharply defined outlines. The insoluble residues are somewhat higher in content than in the overlying Barber Member; 2.7% compared to 0.95% for the basal part of the Barber (text-fig. 10). Some glauconite is present, but this is not a conspicuous part of the rock.

BLACKGUM FORMATION

(depth, 115-130 feet; total thickness, 15 feet)

Upper Limestone Member

(depth, 115-126 feet, total thickness, 11 feet)

115 -120 *Lithology:* Greenish-gray bioclastic calcarenite with numerous small irregular grains of glauconite (generally less than 1 mm). Bedding obscure. This is mostly a biomicrite, the fossil clasts being well preserved and with sharp outlines; much pelmatozoan debris, but other biologic groups well represented. Crystalline dolomite scattered through the rock; this may occur as single crystals, or as irregular patches of crystalline dolomite (crystals generally range from 0.05 to 0.1 mm); $MgCO_3$ content, 13.16%. Acid-insolubles content, 2.63%, much of this being glauconite.

Thin sections at 116′, 120′.

Remarks: This unit differs from the overlying Tenkiller in its increased glauconite content, poorly defined bedding, and reduced biosparite content. No chert observed.

Depth (feet)	
120 -126	*Lithology:* Greenish-gray bioclastic glauconitic calcarenite like above. Nodules of medium- to light-gray chert; mostly vitreous, but some porous tripolitic chert; glauconite also present in the chert. Chert finely crystalline and fossiliferous. Irregular areas of finely crystalline dolomite; $MgCO_3$ content, 12.75%; acid insolubles, 3.37%. Thin section at 126′. *Remarks:* Like 115′-120′ interval above except for the presence of chert. This is the uppermost occurrence of chert in the hole.

Tan (weathering) Dolomite Member
(depth, 126-130 feet, total thickness, 4 feet)

126 -130	*Lithology:* Gray glauconitic calcitic dolomite with lenses and nodules of chert. Dolomite finely crystalline; individual crystals rarely exceed 0.1 mm. Fossils scattered through the dolomite, mostly pelmatozoan plates; fossils have "corroded" boundaries and are in part replaced by dolomite. Glauconite common, in irregular grains up to 1 mm or so in diameter; present in both the dolomite and the chert. Chert finely crystalline, fossiliferous. $MgCO_3$ content (excluding chert), 20.73%; acid-insolubles content of the chert-free, or largely chert-free, dolomite, 9.72%. Considerable amount of pyrite present. Thin sections at 128′, 130′. *Remarks:* The basal 2 inches of this interval is a bed (lens?) of chert with widely scattered, irregular bodies which range up to 1 mm or so in diameter; in thin section many have a more or less rounded outline. These are now preserved as finely crystalline quartz, show no internal structure, and have hazy or obscure boundaries. Possibly they were originally oölites, but, as now preserved, thėy show no trace of concentric or radial structure. This bed occupies the position of the Pettit Oölite.

SYLVAN SHALE
(depth, 130-134 feet; end of hole)

130 -134	*Lithology:* Dark-green shale. This shale is separated from the Blackgum Formation by a ½-inch seam of pyrite. Total depth 134′.

Diamond-core hole OGS 2
Southeast of Barber

This hole is situated at the type locality of the Barber Member of the Quarry Mountain Formation (stratigraphic section Ch3). It was drilled for the Oklahoma Geological Survey by the Joy Manufacturing Company, August 24-25, 1962. This hole started on an outcrop of Barber in the bed of a small stream flowing north into Dry Creek, about 3 miles southeast of Barber, Cherokee County; SE¼ NW¼ NE¼ sec. 2 (1,400 feet from E line, 1,050 feet from N line), T. 14 N., R. 23 E. (pl. B). This is the lowest exposure of the Barber Member at stratigraphic section Ch3 (appendix IA; pl. XII, fig. 1). The collar of OGS 2 is in the upper part of the Barber, 10 feet below the highest exposures of this member (covered above; see description of stratigraphic section Ch3); the top of the Sylvan Shale (Ordovician) was penetrated at 69 feet and the total depth is 72.5 feet. The Barber Member, Tenkiller Formation, Blackgum Formation, and Sylvan Shale are represented in this core. A few inches of core was lost in the upper 3 feet; below this core recovery was essentially 100 percent (mostly continuous core). The bedding is obscure in the Barber Member, but it is well defined in the Tenkiller Formation, where it makes an angle with the long axis of the core ranging from 85 degrees to almost 90 degrees, indicating a dip of 5 degrees or less.

Chemical analyses of this core are given in appendix II, pages 161 and 166.

Photomicrographs are on plate XII, figures 2, 3. See also text-figure 10 and stratigraphic section A-A′, plate B.

This is an NX core; approximately 2⅛ inches in diameter.

Depth (feet)

QUARRY MOUNTAIN FORMATION
(depth, 0-42 feet; total thickness, approximately 52 feet; no Marble City strata present)

Barber Member
(depth, 0-42 feet; total thickness, approximately 52 feet)

0 - 15 *Lithology:* Light-gray dolomitic limestone. Fossils, mostly pelmatozoan plates, are common and are set in a matrix which is largely finely crystalline dolomite (few crystals exceed 0.1 mm). Fossil outlines irregular, and they appear "corroded" by the enclosing dolomite (pl. XII, figs. 2, 3). $MgCO_3$ averages 17.45%. This is a high-purity carbonate, the acid-insolubles content averaging only 0.16%.

Thin section at 6′.

Remarks: Rock is partly iron stained and appears to be weathered to a depth of 12 or 13 feet.

15 - 42 *Lithology:* Light-gray calcitic dolomite. Some fossils, mostly pelmatozoan plates, are present in this interval, but in many of the beds they appear to have been largely replaced by finely crystalline dolomite. Stylolite seams are common. $MgCO_3$ in this interval averages 26.29%; acid insolubles, 0.65%.

Thin sections at 17′, 25′, 42′.

Remarks: This interval is a crystalline dolomite similar to the overlying beds (0-15′) from which it differs mainly in its reduced fossil content and increased $MgCO_3$ content. Here, as elsewhere, the acid-insoluble content of the Barber shows a slight, but distinct, downward increase, reaching its maximum at the base of the member; see text-figure 10.

TENKILLER FORMATION
(depth, 42-58 feet; total thickness, 16 feet)

42 - 58 *Lithology:* Orange-pink to dull pinkish-gray bioclastic calcarenite. Thinly and, for the most part, evenly bedded; bedding defined in large part by alternating layers of biomicrite and biosparite (pl. VII, fig. 4); some thin, irregular, argillaceous partings. Pelmatozoan plates are the predominant fossil clasts, but many other groups are represented, including ostracodes, bryozoans,

Depth (feet)

trilobites, and brachiopods; fossils well preserved and with sharp outlines (pl. VII, figs. 5, 6). Sediment-filled cavities present (see description and illustrations in text). Irregular, wispy layers of crystalline dolomite are sparsely distributed through this interval; in the upper 3 feet the dolomite content increases sharply (12.8% $MgCO_3$), and the rock merges into the overlying Barber Dolomite. Excluding the upper 3 feet, this interval averages 2.6% $MgCO_3$. A small nodule of chert at 53 feet; no other chert observed. Acid-insolubles content averages 3.8%. A few grains of glauconite observed in thin sections.

Thin sections at 43′, 51′, 52′, 53′, (2 sections), 54′, 57′.

Remarks: In the upper 3 feet of this interval the crystalline dolomite content increases sharply, the fossil content decreases markedly, and the Tenkiller bioclastic calcarenite grades into the Barber Dolomite. We have arbitrarily assigned this upper 3 feet to the Tenkiller because the bioclastic parts are so much like those of the underlying beds. Excluding this upper part, the Tenkiller is a distinctive lithostratigraphic unit which is quite unlike the Barber. Note that the insoluble-residue content of the Tenkiller is noticeably higher than that in the Barber; 3.8% compared to 0.65% for the basal Barber beds (text-fig. 10).

BLACKGUM FORMATION
(depth, 58-69 feet; total thickness, 11 feet)

Upper Limestone Member
(depth, 58-65 feet; thickness, 7 feet)

58 - 65 *Lithology:* Dark-gray to greenish-gray bioclastic calcarenite with much glauconite in irregular grains up to 1 mm or so in diameter. Bedding generally obscure; a few irregular, thin argillaceous partings. This is almost entirely biomicrite with pelmatozoan fragments being the predominant fossil clasts. Irregular nodules of light- to dark-gray chert present in the lower 3 feet; chert fossiliferous. Irregular areas of finely crystalline dolomite present. $MgCO_3$, 9.6%; acid insolubles, excluding chert, 4.5%.

Thin sections at 59′, 61′.

Remarks: This interval is distinguished from the overlying Tenkiller Formation by its darker color, obscure bedding, and increased glauconite content. In addition, the Tenkiller has much biosparite interbedded with the biomicrite, whereas this rock is almost entirely biomicrite. Chert is uncommon in the Tenkiller but common in the lower part of this member.

Tan (weathering) Dolomite Member
(depth, 65-69 feet; total thickness, 4 feet)

65 - 69 *Lithology:* Dark-gray glauconitic calcitic dolomite. Mostly finely crystalline dolomite with many grains of glauconite (pl. V, fig. 5), $MgCO_3$, 22.7%; acid insolubles (excluding chert), 8.9%. A few fossils, mostly pelmatozoan plates, are scattered through the dolomite; fossils have ragged outlines and appear "corroded." Nodules of light- to dark-gray chert.

Depth (feet)

Thin sections at 67′, 69′ (2 sections).

Remarks: The contact with the underlying Sylvan Shale is sharply defined; small veins of Blackgum extend down into the Sylvan.

SYLVAN SHALE
(depth, 69-72.5 feet; end of hole)

69 - 72.5 *Lithology:* Green shale.

Total depth 72.5 feet.

Diamond-core hole OGS 3
West of Lake Tenkiller Dam

This hole was drilled for the Oklahoma Geological Survey by the Joy Manufacturing Company, August 27-30, 1962. It is on the west edge of the north-south section-line road, SE¼ SE¼ NE¼ sec. 20 (2,410 feet from N line), T. 13 N., R. 21 E., Sequoyah County (pl. B). This hole started on an outcrop of the upper Marble City (Quarry Mountain Formation), about 3 feet below the top of the member. Much Sallisaw float in this area indicates that this formation is present between the Marble City and the overlying Sylamore Sandstone Member of the Chattanooga Formation (Amsden, 1960, p. 45). Core hole OGS 3 penetrated the Marble City and Barber Members of the Quarry Mountain Formation, the Tenkiller Formation, and 6 inches of strata tentatively referred to the Blackgum Formation; the top of the Sylvan Shale (Ordovician) was reached at 142.5 feet. It was drilled through the Sylvan Shale, "Fernvale" Formation, and Fite Formation, ending in the Tyner Formation; bottom is at 242 feet; descriptions of the Ordovician formations are included. Core recovery approached 100%; below the first few feet it was mostly continuous core. Bedding is fairly well defined in the Tenkiller and Sylvan Formations, where it makes an angle with the long axis of the core ranging from 85 degrees to almost 90 degrees, indicating a dip of 5 degrees or less.

Fossils S21* were collected from an outcrop of the Marble City Member only a few feet from the collar of OGS 3.

Chemical analyses of this core, including those of the Ordovician formations, are given in appendix II, pages 162 and 166.

Photomicrographs are on plate XIV, figure 4, and plate XV, figure 3. See also text-figure 10 and stratigraphic section B-B′, plate B.

This is an NX core; approximately 2⅛ inches in diameter.

Depth (feet)

QUARRY MOUNTAIN FORMATION
(depth, 0-120 feet; total thickness, 123 feet)

Marble City Member
(depth, 0-70 feet; total thickness, 70 feet)

0 - 13 *Lithology:* Pale-gray to pale pinkish-gray bioclastic calcarenite. Mostly biosparite with minor biomicrite; pelmatozoan plates are the predominant fossil clasts, some with a pink color which gives the rock its pink cast. Some sediment-filled cavities present (pl. XV, fig. 3). Irregular stringers of finely crystalline dolomite;

Depth (feet)

$MgCO_3$ content averages 3.9%. This is a high-purity carbonate, acid-insolubles content averaging 0.25%.

Thin section at 4′.

Remarks: The bedding in this interval, as in the rest of the Marble City Member, is poorly defined.

13 - 30 *Lithology:* Pale pinkish-gray bioclastic calcarenite. Biosparite mixed with some biomicrite; the latter irregularly distributed through the sparite rather than in well-defined beds. Pelmatozoans are the predominant fossils, but other groups, such as brachiopods, bryozoans, and trilobites, are common. Some sediment-filled cavities present. $MgCO_3$ content low, averaging 1.04%. Acid-insolubles content averages 0.12%.

Thin sections at 20′, 28′.

Remarks: This interval similar to the overlying strata except for its reduced $MgCO_3$ content. Some beds have a considerable amount of shelly debris in addition to the pelmatozoan plates.

30 - 70 *Lithology:* Light-gray, mottled with brownish-gray, bioclastic calcarenite; biosparite with irregular areas of biomicrite. The fossil clasts are largely pelmatozoan plates. Sediment-filled cavities present. Irregular stringers and patches of finely crystalline dolomite (pl. XIV, fig. 4). $MgCO_3$ averages 3.2%; acid insolubles, 0.18%.

Thin sections at 32′, 42′, 50′, 55′, 69′.

Remarks: The brownish mottling in this rock appears to be in part micrite cement and in part crystalline dolomite; in addition there may be some alteration or recrystallization of the fossil clasts to a finely crystalline carbonate, but it is difficult to separate this from the replacement by fine dolomite crystals. The Marble City-Barber contact is marked mainly by a change from a limestone to a dolomitic limestone; see appendix II and text-figure 10.

Barber Member

(depth, 70-120 feet; thickness, 50 feet)

70 - 90 *Lithology:* Light-gray dolomitic limestone. This interval is largely made up of fossil clasts, mostly pelmatozoan plates, set in a matrix of finely crystalline dolomite (few individual crystals exceed 0.1 mm in width); the amount of fossil debris is variable; some beds have an increased dolomite content and a correspondingly reduced fossil content. The fossil boundaries are commonly irregular and appear to be "corroded"; $MgCO_3$ content averages 15.3%. This is a high-purity carbonate, the acid-insolubles content averaging 0.31%.

Thin section at 75′.

Remarks: This interval is distinguished from the overlying Marble City Member by its greater dolomite content.

90 -120 *Lithology:* Light-gray calcitic dolomite. Mostly finely crystalline dolomite (few individual crystals exceed 0.1 mm in width) with

Depth (feet)

scattered fossil clasts; latter with ragged outlines, at least partly replaced by dolomite. $MgCO_3$ averages 22.7%; acid insolubles, 0.63%.

Thin sections at 94′, 107′, 115′.

Remarks: The Quarry Mountain Formation shows a progressive, but irregular, increase in dolomite content toward its base; the lower part of the Marble City Member averages 3.2% $MgCO_3$, the upper Barber 15.3% $MgCO_3$, and the lower Barber 22.7% $MgCO_3$; see appendix II and text-figure 10. As the dolomite content increases, the fossil content decreases. These changes appear to be the result of fossil replacement by dolomite; at least the outer areas of many fossils are replaced by crystalline dolomite. Acid-insolubles content also increases toward the base of the Barber; the upper part averages 0.3% insolubles and the lower part 0.6% (text-fig. 10).

TENKILLER FORMATION

(depth, 120-142 feet; total thickness, 22 feet)

120 -129 *Lithology:* Light-gray calcitic dolomite with irregular areas of pink bioclastic calcarenite. The bioclastic portions are largely biosparite, the more common clasts being orange-pink pelmatozoan plates; this lithology is irregularly distributed through the finely crystalline dolomite, being most abundant from 120′ to 122′. From 122′ to 129′ the rock is largely gray crystalline dolomite with scattered fossils; most are pelmatozoan plates (not pink) with irregular, "corroded" boundaries. $MgCO_3$ content, 30.8%; acid insolubles, 2.25%.

Thin sections at 121′, 129′.

Remarks: This unit appears to grade into the overlying strata, the typical pink crinoidal lithology of the Tenkiller merging into, and being engulfed by, the calcitic dolomite of the Barber; we arbitrarily place the contact at the highest bed bearing some of the pink biosparite.

129 -142 *Lithology:* Orange-pink to medium-gray bioclastic calcarenite. Beds fairly thin and well defined throughout most of this interval, the bedding being defined largely by alternating layers of biosparite and biomicrite; some thin (less than ¼″) greenish-gray irregular argillaceous partings. Fossil clasts well preserved and with sharp outlines; pelmatozoans abundant, but many other groups, such as ostracodes, bryozoans, brachiopods, and trilobites, are common. A few irregular stringers of crystalline dolomite present. $MgCO_3$ averages 1.84%; acid insolubles, 0.6%. Thin sections show one or two small areas where the carbonate cement has been replaced by crystalline silica. Minor glauconite present.

Thin sections at 133′, 135′, 136′, 138′, 140′, 142′ (contact of Tenkiller and Blackgum).

Remarks: This interval has somewhat more biomicrite than has the Tenkiller at most places, but otherwise is typical for the formation. The bioclastic calcarenites of the Tenkiller differ

Depth (feet)

somewhat from the bioclastic calcarenites of the Marble City Member; the fossil clasts of the Tenkiller have well-preserved internal structure and sharply defined outlines, whereas in the Marble City many of the clasts have obscure outlines and not such well-preserved internal structure, suggesting some alteration.

? BLACKGUM FORMATION
(depth, 142-142.5 feet; total thickness, 0.5 foot)

142 -142.5 *Lithology:* Medium-gray glauconitic bioclastic calcarenite with small nodules of chert. The cement in the bioclastic material is largely micrite, and the fossil clasts are mostly pelmatozoan plates. Some irregular patches and stringers of finely crystalline dolomite. Chert is vitreous, fossiliferous. Glauconite abundant, in irregular grains up to 1 mm or so in diameter.

Thin sections at 142′ (contact with overlying bed), 142.5′ (contact with underlying Sylvan Shale).

Remarks: This interval is so thin that it is difficult to be certain of its lithostratigraphic identity; however, it has the typical Blackgum lithologic characters, including abundant glauconite and nodules of chert. The upper contact with the Tenkiller and the lower contact with the Sylvan Shale are sharply defined.

SYLVAN SHALE
(depth, 142.5-187 feet; total thickness, 44.5 feet)

142.5-187 *Lithology:* Greenish-gray shale, with much pyrite.
Remarks: This interval was not analyzed.

"FERNVALE" LIMESTONE
(depth, 187-207 feet; total thickness, 20 feet)

187 -207 *Lithology:* Light brownish-gray bioclastic calcarenite locally grading into a calcirudite; scattered pink pelmatozoan plates give the rock a pinkish cast in places. Biosparite with only small, scattered areas of biomicrite. Pelmatozoan plates common, along with many brachiopods, trilobites, bryozoans, and many other forms. $MgCO_3$ content low, averaging 0.60%. Acid-insolubles content averages 4.15%; in the lower 6 inches the content includes some rounded quartz grains up to ½ mm or so in diameter, which are uncommon or absent above.

Thin sections at 187′ (contact with Sylvan Shale), 193′, 207′ (contact with underlying Fite).

Remarks: The upper 2 or 3 inches of the "Fernvale" has a considerable amount of pyrite and thin stringers of argillaceous material like that present in the overlying Sylvan Shale. The lower contact is sharply defined, the coarse bioclastic limestone of the "Fernvale" being in sharp contrast to the dense sublithographic limestone of the Fite. Irregular areas of "Fernvale" extend several inches down into the Fite; these appear to represent crevices in the Fite which were later filled from above with "Fernvale" sediment; these bodies include rounded quartz grains which are similar to those present in the basal "Fernvale" and which do not appear to be present in the Fite. Chemical analyses of the "Fernvale" are given in appendix II.

Depth (feet)

FITE LIMESTONE
(depth, 207-227 feet; total thickness, 20 feet)

207 -217 *Lithology:* Pale yellowish-brown to yellowish-gray sublithographic limestone. Most of this unit is very fine-grained carbonate; parts suggest a pellet limestone and other parts suggest algal material, but most appears as a dense, dark carbonate. Scattered megafossils present, some being concentrated in beds approaching a bioclastic limestone. Most of the fossils appear to represent shelly debris, snails, ostracodes, brachiopods, and other forms; pelmatozoan plates are uncommon or absent. Fine-crystalline dolomite is scattered through this rock, mostly as discrete crystals, but in places as layers or beds of more or less solid crystalline dolomite. We have no analyses of this rock, but the over-all $MgCO_3$ content is low, probably well below 10%. Acid-insolubles content not analyzed, but it is low, probably less than 5%; mostly very fine quartz crystals (less than 0.05 mm), and crystal aggregates along with some clay; no rounded sand grains observed.

Thin sections at 207′ (contact with "Fernvale"), 212′, 214′.

Remarks: The dense dark sublithographic Fite Limestone with scattered fossils is quite unlike the overlying "Fernvale" biosparite. This interval is similar to the underlying beds, from which it is distinguished by its lower dolomite content.

217 -227 *Lithology:* Light-gray strongly dolomitic sublithographic limestone. The limestone is dark and very fine grained, like that of the overlying strata. Abundant dolomite crystals are scattered through the limestone; some are dispersed like plums through a pudding, and others are concentrated into irregular stringers and layers; $MgCO_3$ content averages 21.22%. Some scattered fossils; only ostracodes identified in thin section, but others probably also represented. Acid-insolubles content averages 3.10%; largely tiny quartz crystals (mostly less than 0.05 mm) and crystal aggregates along with some clay. No large rounded quartz grains observed.

Thin section at 221′.

Remarks: It appears probable that this is the dolomitic unit which at the surface has been included in the Tyner rather than in the Fite. Huffman (1958, p. 22) stated: "Limestone is restricted to the uppermost Tyner where a buff dense finely crystalline dolomitic limestone immediately underlies the Fite limestone." However, upon the basis of this core, we prefer to refer these dolomitic strata to the Fite because their basic lithologic character is like that of the overlying Fite rather than that of the underlying Tyner. This unit is essentially the same as the overlying strata (207′-217′), differing only in its increased dolomite content. Both intervals are dense sublithographic limestones with fairly low insolubles (less than 5%), composed mainly of fine quartz crystals along with some clay; crystalline dolomite is present in varying amounts in both. In contrast, the underlying

Depth (feet)

beds are sandy (quartz) dolomites; the insolubles range from 20% to 30% and are made up in large part of rounded quartz grains ranging up to almost 1 mm in diameter. We have not studied surface exposures of this rock, and it may be that these Tyner sandstones are interbedded with the above-mentioned dolomite; however, no evidence of this occurs in the OGS 3 core, and therefore we provisionally include it within the Fite.

TYNER FORMATION
(depth, 227-242 feet; end of hole)

227 -237 *Lithology:* Medium- to light-gray sandy (quartz) calcitic dolomite. This is in large part finely crystalline dolomite with rounded quartz grains up to about 1 mm; $MgCO_3$ averages 28.29%. Acid-insolubles content, mostly quartz detritus, averages 21.29%. Some thin beds (less than ¼ inch) of finer, darker material (clay?). No fossils observed.

Remarks: The quantity of insolubles (largely quartz detritus) appears to vary considerably, and we estimate that some beds probably have less than 10%. This unit is similar to the underlying beds, from which it differs mainly in having a reduced amount of quartz detritus. For a comparison with the overlying beds, see under Fite (217′-227′) above.

237 -242 *Lithology:* Light-gray to medium-gray, sandy, calcitic dolomite. Largely crystalline dolomite with rounded quartz grains up to about 1 mm. Some thin (less than ¼ inch) irregular dark-gray partings, probably with considerable clay. No fossils observed. $MgCO_3$ averages 28.75%; acid insolubles, 31.11%.

Thin section at 237′ (contact with overlying unit).

Total depth, 242 feet.

Diamond-core hole SCL 1
St. Clair Lime Company Quarry

This hole was drilled for the St. Clair Lime Company in 1953 under the supervision of W. E. Ham. It is immediately west of the St. Clair Lime Company quarry, the type locality for the Quarry Mountain Formation and the Marble City Member; the drill site is a few feet west of the present quarry face, NE¼ NE¼ SE¼ sec. 14 (600 feet from E line, 2,500 feet from S line), T. 13 N., R. 23 E., Sequoyah County (pl. A). It started in the Chattanooga Formation and penetrated the Sylamore Sandstone Member (Upper Devonian), Sallisaw Formation (Lower Devonian), Frisco Formation (Lower Devonian), and Marble City Member of the Quarry Mountain Formation, ending in the upper part of the Barber Member; total depth 100 feet. The strata penetrated by the drill are exposed in the quarry face (see pl. XIII). A part of the rock cored was subsequently mined; see stratigraphic section A-A′, plate A; stratigraphic section B-B′, plate B; and text-figure 15. The bedding is not well defined in this core, but strata exposed in the quarry suggests a dip of about 5 degrees or less (see diamond-core hole SCL 2).

This core was first studied by W. E. Ham and M. E. McKinley, who sawed it in half lengthwise and had one half analyzed by The Sharp-Schurtz Company, Lancaster, Ohio. In 1962, T. W. Amsden and T. L. Rowland studied the remaining half and had the rock from 22 feet to 100 feet analyzed in the chemical laboratories of the Oklahoma Geological Survey (all the Silurian portion of this core has been destroyed). The latter chemical analyses are given in appendix II; pages 163 and 166.

This is an EX core; approximately $\frac{13}{16}$ inch in diameter.

0-4.2 feet, no core

Depth (feet)

CHATTANOOGA FORMATION
Sylamore Sandstone Member

4.2- 4.8 *Lithology:* Coarse quartz sandstone.

Remarks: On plate A, stratigraphic section A-A′, the collar of SCL 1 is shown as being just below the base of the Chattanooga Formation; this is in error, as the hole actually started just above the base of this formation.

SALLISAW FORMATION
(depth, 4.8-17.6 feet; total thickness, 12.8 feet)

4.8- 17.6 *Lithology:* Arenaceous dolomitic limestone with nodules of light-colored chert. Core shows scattered cross sections of fossils, including identifiable sections representing the brachiopod *Amphigenia* sp. (Amsden, 1963, p. 187-192, text-fig. 50).

Remarks: Typical Sallisaw lithology (see Amsden, 1960, p. 47-54).

FRISCO FORMATION
(depth, 17.6-22 feet; total thickness, 4.4 feet)

17.6- 22 *Lithology:* Light- to medium-gray bioclastic calcarenite. The upper 2 feet is mostly a pelmatozoan biosparite; below this it includes much shelly debris. $MgCO_3$ content only 0.64% (analysis from The Sharp-Schurtz Company).

Remarks: Upper and lower contacts of the Frisco are sharply defined. The shelly facies in the lower part of this interval includes some areas of small fossil debris, probably representing the fines flushed out of the broken shelly material (calcilutite facies of Amsden, 1960, p. 30, 31). At 20 feet is a 3-inch stringer of sandy dolomite, which may be a part of the Frisco or may represent a "tongue" of Sallisaw filling a crevice in the Frisco.

QUARRY MOUNTAIN FORMATION
(depth, 22-100 feet; end of hole)

Marble City Member
(depth, 22-85 feet; total thickness, 63 feet)

22 - 50 *Lithology:* Pale-gray to pinkish-gray bioclastic calcarenite. Mostly biosparite with much pelmatozoan material. This is a high-calcium limestone; $MgCO_3$ content averages 0.60%; acid insolubles, 0.37%.

Remarks: This interval is separated from the underlying strata entirely upon the basis of its reduced $MgCO_3$ content.

50 - 85 *Lithology:* Pale-gray to pinkish-gray bioclastic calcarenite. Similar to unit above, but with irregular stringers of crystalline dolomite. $MgCO_3$ averages 3.68%; acid insolubles, 0.27%.

Depth (feet)

Remarks: The boundary with the underlying Barber Member is not well marked, being based entirely on the dolomite content; the contact is placed where the $MgCO_3$ content increases from 5.6% to 10.1% (see appendix II).

Barber Member
(depth, 85-100 feet; end of hole)

85 - 96 *Lithology:* Pale-gray bioclastic calcarenite with stringers and irregular areas of crystalline dolomite. This interval falls just within the category of dolomitic limestone (text-fig. 4). $MgCO_3$ averages 10.1%; acid insolubles, 0.17%.

96 -100 *Lithology:* Pale-gray bioclastic calcarenite. Similar to unit above but with less dolomite; $MgCO_3$ averages 6.49%; acid insolubles, 0.29%.

Remarks: This interval appears to represent a lens of limestone within the upper part of the Barber dolomitic limestones; see core hole SCL 2 and stratigraphic section A-A′, plate A.

The bottom of hole SCL 1 is slightly above the level of the floor of the St. Clair Lime Company quarry and the analysis of this core (22′-100′) thus furnishes chemical data which closely approximate the character of the rock exposed in the quarry face (pl. XIII).

Total depth, 100 feet.

Diamond-core hole SCL 2
St. Clair Lime Company Quarry

This hole was drilled by the St. Clair Lime Company in December 1960, and the core was generously donated to the Oklahoma Geological Survey by Homer Dunlap, general manager of the company. The hole started in the bottom of the St. Clair Lime Company quarry (about ⅛ mile east of core hole SCL 1), which is the type locality for the Quarry Mountain Formation and the Marble City Member; NE¼ NE¼ SE¼ sec. 14 (200 feet from E line, 2,575 feet from S line), T. 13 N., R. 23 E., Sequoyah County (pl. B). The hole collars in the upper part of the Barber Member of the Quarry Mountain Formation, approximately 95 feet below the Frisco-Quarry Mountain contact, and penetrates the Tenkiller and Blackgum Formations, including the Pettit Oölite, ending in the upper part of the Sylvan Shale; total depth, 100 feet. This hole and SCL 1 furnish cores representing almost the entire Silurian; SCL 1 cored the Marble City Member and uppermost Barber Member (strata which are exposed in the quarry face), and SCL 2 cored most of the Barber Member and all of the Tenkiller and Blackgum Formations, leaving only a small stratigraphic interval between the bottom of SCL 1 and the top of SCL 2 which was not cored. The stratigraphic relationship between these two holes is shown in stratigraphic section A-A′, plate A, and stratigraphic section B-B′, plate B. Except for this small stratigraphic interval, chemical analyses have been made for the entire Silurian section. Core recovery was nearly 100 percent.

It is difficult to get accurate bedding attitudes on the Marble City and Barber beds, but the dip of the strata in the quarry is gentle, probably about 5 degrees or less. In the Tenkiller Formation the dip still does not exceed

5 degrees; however, in the lower part of the core, in the Blackgum-Pettit-Sylvan interval, the dip steepens to about 10 degrees (this may be only a local feature, associated with the Pettit).

This core was studied by T. W. Amsden in January 1961, and selected portions of the core removed for analysis. In the fall of 1962, the core was restudied, and, at that time, the entire core was sawed lengthwise and the complete Silurian interval analyzed. These analyses are given in appendix II, pages 163 and 166.

This is an AX core; approximately $1\frac{3}{16}$ inches in diameter.

Photomicrographs are on plate V, figure 4; plate VIII; plate IX, figures 1, 3; plate X; plate XI. See also text-figure 10; stratigraphic section A-A′, text-figure 15; stratigraphic sections A-A′, plate A, and B-B′, plate B.

Fossils from S18* and S18A* were collected from the Barber Member, only a few feet above the collar of SCL 2.

Depth (feet)

QUARRY MOUNTAIN FORMATION
(depth, 0-59 feet; total thickness, 154 feet)

Barber Member
(depth, 0-59 feet; total thickness, approximately 79 feet)

0 - 6 *Lithology:* Pale-gray to tannish-gray bioclastic limestone with considerable amount of dolomite. Fossils largely pelmatozoan plates (few if any are pink). The matrix is in part spar, but includes much finely crystalline dolomite; the rock in this interval is near the category of dolomitic limestone, the $MgCO_3$ content being 9.3%. Acid insolubles low, average 0.11%; much of the insolubles in the form of small quartz crystals, along with some pyrite; glauconite uncommon.

Thin sections at 1.5′, 6′.

Remarks: The Marble City-Barber contact lies about 20 feet stratigraphically above the collar of SCL 2; this boundary drawn upon the basis of dolomite content (see under SCL 1 and S18*, S18A*).

6 - 36 *Lithology:* Pale-gray dolomitic limestone. Fossil clasts, predominantly pelmatozoan plates, are common; their boundaries are commonly ragged and they appear to be in part replaced by dolomite. Much of the matrix is finely crystalline dolomite, few individual crystals exceeding 0.1 mm in width. The $MgCO_3$ in this interval averages 16.8%; acid insolubles, 0.18%.

Thin sections at 16′, 26′, 34′.

Remarks: This interval is similar to the overlying strata except for its increased dolomite content and reduced fossil content.

36 - 59 *Lithology:* Pale-gray calcitic dolomite. Mostly finely crystalline dolomite, few individual crystals larger than 0.1 mm in width. Some fossil clasts scattered through the rock, mostly pelmatozoan plates; fossil outlines are ragged and appear to be in large part replaced by dolomite. The $MgCO_3$ in this interval averages 24.8%; acid insolubles, 0.64%.

Thin sections at 42′, 51′, 56′.

Remarks: This interval is distinguished from the strata above

Depth (feet)

by its higher dolomite content. The $MgCO_3$ increases downward in the Barber Member, from less than 10% to about 25% (see appendix II and text-fig. 10); this increase in dolomite is accompanied by a corresponding decrease in fossil content.

TENKILLER FORMATION
(depth, 59-86 feet; total thickness, 27 feet)

59 - 69 *Lithology:* Mixture of pink bioclastic calcarenite and light-gray dolomitic limestone. The bioclastic portions are largely pelmatozoan biosparite, with many of the pelmatozoan plates being orange-pink. The dolomitic portions are mostly finely crystalline dolomite with scattered pelmatozoan plates; the latter generally have little or no color and have "corroded" outlines. These two rock types are not interlayered along well-defined beds but are distributed in irregular bodies or patches. The crystalline dolomite is the predominant rock type; average $MgCO_3$ content 19.5%. Acid-insolubles content averages 1.2%; much in the form of small quartz crystals.

Thin sections at 60′4″, 61′, 62′.

Remarks: This interval appears to be transitional between the light-gray crystalline dolomite of the Barber Member and the pink bioclastic calcarenite of the Tenkiller. In the uppermost layers the rock is mostly dolomite with small patches of the bioclastic lithology; farther down the bioclastic rock type predominates and the dolomite appears as small patches (pl. IX, fig. 3). We arbitrarily draw the Barber-Tenkiller contact at the highest appearance of the pink bioclastic calcarenite.

69 - 86 *Lithology:* Moderate-red to reddish-gray bioclastic calcarenite. Composed in large part of interbedded biosparite and biomicrite. The fossil clasts have well-preserved internal structure and sharp outlines. Fossils represent a wide range of organisms, but pelmatozoans are the dominant element; many of these are orange-pink to red, giving the rock its over-all red color. Much shelly debris represented; brachiopods and ostracodes are especially abundant, along with trilobites, bryozoans, and other forms. Many well-preserved sediment-filled cavities present, being especially abundant from 72 to 75 feet; these are described in the text and several are illustrated on plates VIII to XI and on text-figure 11. Irregular patches of crystalline dolomite are scattered through this interval, and almost all of the sediment-filled cavities have a layer of crystalline dolomite at the bottom (see pl. XI); $MgCO_3$ content averages 5.6%. Acid-insolubles content fairly low, averaging 2.6%; mostly small, elongate quartz crystals and crystal aggregates. Sparse, scattered grains of glauconite in some beds, but this is an uncommon mineral in this interval.

Thin sections at 69′6″, 71′6″, 72′7″ 73′, 73′6″, 79′, 82′, 84′9″, 85′8″.

Remarks: This is an easily distinguished lithostratigraphic unit characterized by reddish color (resulting from many orange-pink

Depth (feet)

pelmatozoan plates), interbedded biosparite and biomicrite, well-preserved fossil clasts, and numerous sediment-filled cavities. Acetic acid residues yield conodonts, most of which are single cones; these have not been studied in detail, but a preliminary examination points to a similarity with the conodonts in the Clarita Member (Chimneyhill Formation) of the Arbuckle Mountains province.

BLACKGUM FORMATION

(depth, 86-97.25 feet; total thickness, 11.25 feet)

Upper Limestone Member

(depth, 86-93 feet; total thickness, 7 feet)

86 - 93 *Lithology:* Medium-gray to medium greenish-gray glauconitic limestone. Mostly a biomicrite with much pelmatozoan debris; fossil boundaries in many parts of this rock tend to be obscure. Considerable amount of crystalline dolomite present as scattered crystals and small irregular patches; $MgCO_3$ averages 11.6%. Acid-insolubles content averages 2.5%; much of this is a pale- to medium-green glauconite in the form of small polylobate grains or fossil steinkerns. Some small, elongate quartz crystals and crystal aggregates.

Thin sections at 87′, 88′9″, 90′2″, 90′4″, 93′.

Remarks: This member of the Blackgum Formation is distinguished from the overlying Tenkiller by: (1) change in color from reddish gray to a greenish gray, (2) obscure bedding, (3) marked reduction in biosparite content, (4) less sharply defined fossil clasts, (5) increased glauconite content, (6) increased dolomite content, (7) absence of sediment-filled cavities.

Tan (weathering) Dolomite Member

(depth, 93-97 feet; total thickness, 4 feet)

93 - 97 *Lithology:* Medium-gray glauconitic calcitic dolomite with nodules of light-gray chert. Most of this rock is finely crystalline dolomite, the individual crystals generally less than 0.1 mm in width; few scattered fossils, mostly pelmatozoan plates. $MgCO_3$ averages 32.2%. Acid-insolubles content (excluding chert) averages 4.43%; much of this is light- to medium-green glauconite, mostly as aggregates of angular pieces, but with some polylobate grains. Chert vitreous, fossiliferous.

Thin sections at 93′7″, 96′2″, 97′ (contact with Sylvan Shale).

Remarks: The boundary with the overlying limestone member is not sharply defined; this member differs in its increased dolomite content and in the presence of chert. The contact with the underlying Pettit Oölite Member is sharply defined; no oölites have been observed in any of the Silurian strata above the Pettit.

Pettit Oölite Member

(depth, 97-97.25 feet; total thickness, 0.25 feet)

97 - 97.25 *Lithology:* Gray silicified oölite. Both matrix and oölites preserved almost entirely in crystalline silica; a little carbonate matrix remains in a few places along with scattered dolomite

Depth (feet)

rhombs. Few oölites exceed 1 mm in diameter. Most oölites have fairly well-rounded cross sections, and many show at least some remnant of radial and concentric structure; some fossil debris present, mostly pelmatozoan plates. This rock includes flat pebbles (up to 30 mm by 3 mm) set in a silicified matrix like the surrounding oölites; these pebbles are well defined and their oölites sharply cut off against the enclosing oölitic material. Also some of the individual oölites are broken. No analysis made of this interval.

Thin sections at 97′ (contact with overlying Blackgum Dolomite), 97′3″ (contact with underlying Sylvan Shale).

Remarks: The pebbles described above appear to represent an intraformational, flat-pebble conglomerate. Following deposition and at least partial induration of some oölitic material, the rock was partly broken up by current and/or wave action, producing broken oölites and flat pebbles of oölitic material. This was followed by further deposition of oölites so that the previously disrupted fragments were buried in more oölites and matrix. Presumably silicification took place at some time after the close of oölite deposition. This unit is sharply set off from the overlying and underlying strata and its inclusion within the Blackgum Formation is a matter of convenience; it is everywhere too thin to be satisfactorily treated as an independent formation.

SYLVAN SHALE

(depth, 97.25-100 feet; end of hole)

97.25-100 *Lithology:* Medium-green calcareous shale.

Total depth, 100 feet.

Diamond-core hole 29Z

Southwest of the St. Clair Lime Company Quarry

This hole was drilled by the St. Clair Lime Company in April 1962, and the core (from 110 feet to 213 feet) was generously donated to the Oklahoma Geological Survey by Homer Dunlap, general manager of the company. It is about ⅓ mile southwest of the St. Clair Lime Company quarry, a short distance west of the new mine opening; SE¼ NE¼ SW¼ sec. 14 (2,375 feet from W line, 1,650 feet from S line), T. 13 N., R. 23 E., Sequoyah County (pl. A). Presumably hole 29Z started in the Chattanooga Formation; no core was recovered in the upper 18 feet, the first rock being the Sallisaw Formation at 18 feet to 20.5 feet. It penetrated the Sallisaw, Frisco (Lower Devonian), Quarry Mountain, and Tenkiller Formations, ending in the Blackgum Formation; total depth, 213 feet. The upper 110 feet of this core was previously studied and then discarded, and thus was not available for study by the Oklahoma Geological Survey. That part of the interval from 28 feet to 89 feet was analyzed for the St. Clair Lime Company by the Shilstone Testing Laboratory, the results being made available to the Oklahoma Geological Survey (see appendix II); from 89 to 110 feet no analyses were made, but T. L. Rowland visually estimated that the Marble City Limestone extended down to 95 feet, at which point the dolomitic limestone of the Barber appeared. The core from 110 feet to 122 feet was analyzed in the laboratory of the Oklahoma Geological Survey. These analyses are given in appendix II, pages 164 and 166 (see also text-figs. 10, 15; pl. A).

Bedding is well defined in the Tenkiller Formation, where it makes an angle with the long axis of the core, ranging from 84 degrees to 89 degrees, indicating a dip of 6 degrees or less. Below 18 feet, core recovery was nearly 100 percent.

This is an AX core; approximately $1\frac{3}{16}$ inches in diameter.

0-18 feet, no core

Depth (feet)

SALLISAW FORMATION

(depth, 18-20.5 feet)

18 - 20.5 *Lithology:* Gray arenaceous dolomitic limestone with nodules of chert.

Remarks: Studied by T. L. Rowland; the Oklahoma Geological Survey does not have this part of the core.

FRISCO FORMATION

(depth, 20.5-25.5 feet; total thickness, 5 feet)

20.5- 25.5 *Lithology:* Gray bioclastic limestone.

Remarks: Studied by T. L. Rowland; the Oklahoma Geological Survey does not have this part of the core.

QUARRY MOUNTAIN FORMATION

(depth, 25.5-191 feet; total thickness, 165.5 feet)

Marble City Member

(depth, 25.5-95 feet [estimated]; approximate thickness, 69.5 feet)

25.5- 28 *Lithology:* Light-gray bioclastic dolomitic limestone.

Remarks: T. L. Rowland studied this for the St. Clair Lime Company; a visual estimate based on Lemberg stain indicated considerable amount of dolomite and this interval was not analyzed. The Oklahoma Geological Survey does not have this part of the core.

28 - 89 *Lithology:* Light-gray bioclastic calcarenite. This is a high-calcium limestone; the $MgCO_3$ averages 1.34%; acid insolubles, 0.49%.

Remarks: This part of the core analyzed for the St. Clair Lime Company by the Shilstone Testing Laboratory (see appendix II); Oklahoma Geological Survey does not have the core.

89 - 95 *Lithology:* Light-gray bioclastic limestone.

Remarks: The St. Clair Lime Company did not have this portion of the core analyzed, but T. L. Rowland, upon the basis of Lemberg stain, visually estimated about 2.5% $MgCO_3$. The Marble City-Barber contact is drawn upon the basis of his visual estimate of the distribution of dolomite in the 89′-110′ interval. The Oklahoma Geological Survey does not have this part of the core.

Barber Member

(depth, 95 feet [estimated] to 191 feet; total thickness, approximately 96 feet)

95 -110 *Lithology:* Light-gray dolomitic limestone.

Depth (feet)	
	Remarks: The St. Clair Lime Company did not have this part of the core analyzed, but T. L. Rowland, upon the basis of Lemberg stain, visually estimated about 20% $MgCO_3$. The Marble City-Barber contact is based upon his visual estimate of the distribution of dolomite in the 89′-110′ interval. The Oklahoma Geological Survey does not have this part of the core.
110 -132	*Lithology:* Light-gray dolomitic limestone. This is a bioclastic limestone (much pelmatozoan debris) with numerous stringers and irregular areas of finely crystalline dolomite; $MgCO_3$ averages 17.9%; acid insolubles, 0.33%.
	Remarks: This portion of the core furnished to the Oklahoma Geological Survey; one half analyzed (see appendix II) and the other half stored in the Core Library of The University of Oklahoma.
132 -137	*Lithology:* Light-gray bioclastic calcarenite. $MgCO_3$ averages 5.72%; acid insolubles, 0.26%.
	Remarks: This interval separated from the beds above and below upon the basis of its reduced dolomite content. This portion of the core furnished to the Oklahoma Geological Survey; one half analyzed (see appendix II) and the other half stored in the Core Library of The University of Oklahoma.
137 -168	*Lithology:* Light-gray calcitic dolomite. This rock is largely finely crystalline dolomite with scattered fossils, most of which are pelmatozoan plates. $MgCO_3$ averages 21.43%; acid insolubles, 0.76%.
	Remarks: This interval distinguished from the overlying and underlying strata by its high dolomite content. This portion of the core furnished to the Oklahoma Geological Survey; one half analyzed (see appendix II) and the other half stored in the Core Library of The University of Oklahoma.
168 -185	*Lithology:* Pale-gray bioclastic limestone. Pelmatozoan plates are common, but some beds with much shelly debris including many bryozoans, some brachiopods, trilobites, and other forms. $MgCO_3$ averages 3.5%; acid insolubles, 0.90%. Thin sections at 173′, 179′.
	Remarks: The Barber in this hole is unusual in that it has a considerable amount of low-magnesium stone in its lower part (see appendix II and text-fig. 10). This portion of the core furnished to the Oklahoma Geological Survey; one half analyzed and the other half stored in the Core Library of The University of Oklahoma.
185 -191	*Lithology:* Light-gray calcitic dolomite. Largely finely crystalline dolomite with widely scattered fossils. $MgCO_3$ averages 35.8%; acid insolubles, 2.13%.
	Remarks: Note that the insoluble residues increase downward in the Barber Member (appendix II; text-fig. 10). This portion of the core furnished to the Oklahoma Geological Survey; one half analyzed and the other half stored in the Core Library of The University of Oklahoma.

Depth (feet)

TENKILLER FORMATION

(depth, 191-205 feet; total thickness, 14 feet)

191 -205 *Lithology:* Pinkish-gray bioclastic calcarenite. Largely alternating beds of biosparite and biomicrite. Fossil clasts predominantly pelmatozoan plates, but many other groups also represented. No sediment-filled cavities observed. A few irregular areas of finely crystalline dolomite; $MgCO_3$ content averages 2.69%; acid insolubles, 2.51%.

Remarks: The Tenkiller-Barber contact in this core is unusual in being sharply defined, the pink bioclastic limestones of the Tenkiller terminating abruptly against the light-gray Barber calcitic dolomites; in most places there is a zone of intermixed biosparite and crystalline dolomite. This portion of the core furnished to the Oklahoma Geological Survey.

BLACKGUM FORMATION

(depth, 205-213 feet; end of hole)

205 -213 *Lithology:* Dark greenish-gray glauconitic bioclastic calcarenite, with nodules of chert in the lower 3 feet. Irregular areas of finely crystalline dolomite; $MgCO_3$ averages 9.45%; acid-insolubles content averages (excluding chert) 3.12%. Glauconite grains, generally less than 1 mm in diameter, extremely abundant in parts of this interval.

Remarks: Typical Blackgum lithology. The appearance of chert in the lower 3 feet suggests that the end of this hole is near the base of the Blackgum, as chert is most abundant in the basal part of this formation. This part of core furnished to the Oklahoma Geological Survey.

Total depth, 213 feet.

Diamond-core hole 34Y

Southwest of the St. Clair Lime Company Quarry

This hole was drilled by the St. Clair Lime Company in April 1962, and the core (22-116 feet) was generously donated to the Oklahoma Geological Survey by Homer Dunlap, general manager of the company. It is about ½ mile west of the St. Clair Lime Company quarry and about ¼ mile west of the new mine opening; SW¼ NE¼ SW¼ sec. 14 (1,850 feet from W line, 1,450 feet from S line), T. 13 N., R. 23 E., Sequoyah County (pl. A). Hole 34Y started in the Chattanooga Formation and penetrated the Sallisaw and Frisco Formations (Lower Devonian), ending in the upper part of the Barber Member of the Quarry Mountain Formation. No core was recovered in the first 14 feet; from 14 feet to 22 feet the rock was Chattanooga Shale, this part being examined and discarded by the St. Clair Lime Company. The core from 22 feet to 116 feet (bottom) was saved and donated to the Oklahoma Geological Survey; this part was sawed in half lengthwise and one part stored in the Core Library of The University of Oklahoma. The core from 41.5 feet to 116 feet was analyzed in the chemical laboratory of the Oklahoma Geological Survey (appendix II, page 165; text-fig. 15; pl. A).

Bedding in the Marble City makes an angle with the long axis of the core ranging from 83 to 87 degrees, indicating a dip of 7 degrees or less.

Between 23 feet and 34 feet, 3.5 feet of core was lost; below 34 feet recovery was nearly 100 percent.

This is an AX core; approximately $1\frac{3}{16}$ inches in diameter.

0-14 feet, no core

Depth (feet)

CHATTANOOGA SHALE

(depth, 14-22 feet)

14 - 22 *Lithology:* Dark brown-black shale.

Remarks: The Oklahoma Geological Survey does not have this core.

Sylamore Sandstone Member

(depth, 22-23 feet)

22 - 23 *Lithology:* Quartz sandstone with many small pebbles of brownish phosphatic material.

Remarks: The Oklahoma Geological Survey has the core from 22 feet to the bottom of the hole.

SALLISAW FORMATION

(depth, 23-34 feet; total thickness, approximately 11 feet)

23 - 34 *Lithology:* Arenaceous dolomitic limestone. Core shows scattered cross sections of fossils, including identifiable sections of the brachiopod *Amphigenia* sp. (see Amsden, 1963a, p. 187-192, text-fig. 50).

Remarks: 3.5 feet of core was lost between 34 and 38 feet so that the position of the Frisco-Sallisaw contact may be incorrectly located by as much as 3.5 feet.

FRISCO FORMATION

(depth, 34-41.5 feet; total thickness, approximately 7.5 feet)

34 - 41.5 *Lithology:* Gray bioclastic calcarenite interbedded with bioclastic calcilutite. The fossils include much shelly debris, but some parts have substantial amounts of pelmatozoan material.

Remarks: See above under Sallisaw Formation for comments on the position of the Frisco-Sallisaw boundary. This interval was not analyzed, but Lemberg staining indicates a low $MgCO_3$ content.

QUARRY MOUNTAIN FORMATION

(depth, 41.5-116 feet; end of hole)

Marble City Member

(depth, 41.5-98 feet; total thickness, 56.5 feet)

41.5- 46 *Lithology:* Light-gray dolomitic limestone. Mostly bioclastic limestone with much pelmatozoan debris. Considerable amount of finely crystalline dolomite; $MgCO_3$ averages 14.37%; acid insolubles, 0.94%.

Remarks: This represents a lens of dolomitic rock in the upper part of the Marble City Limestone; see stratigraphic section A-A′, plate A.

46 - 74 *Lithology:* Light-gray to pinkish-gray bioclastic calcarenite. Much of this rock is a pelmatozoan biosparite, but other fossil forms

Depth (feet)	
	also represented. Some sediment-filled cavities. The dolomite content of this interval is, for the most part, quite low; $MgCO_3$ averages 1.00% (excluding the 1-inch bed of calcitic dolomite at 51 feet); acid insolubles, 0.69%.
	Remarks: This rock is largely high-calcium stone, with less than 1% $MgCO_3$; at 51 feet is a 1-inch bed with 29.91% $MgCO_3$, and from 68 to 72 feet the $MgCO_3$ averages 2.90% (see appendix II).
74 - 98	*Lithology:* Light-gray to pinkish-gray bioclastic calcarenite. Mostly biosparite but with some thin beds of biomicrite. Similar to overlying beds but with increased dolomite content; $MgCO_3$ averages 5.28%; acid insolubles, 0.17%.
	Remarks: This interval distinguished from the overlying strata by its increased dolomite content.

Barber Member

(depth, 98-116 feet; end of hole)

98 -110	*Lithology:* Pale-gray dolomitic limestone. This is a bioclastic rock with much finely crystalline dolomite; $MgCO_3$ averages 18.39%; acid insolubles, 0.08%.
	Remarks: The Barber-Marble City contact is not a well-defined lithostratigraphic boundary, the two being separated upon the basis of their dolomite content; the lower Marble City beds have from 4% to 8% $MgCO_3$, and the upper Barber strata about 18%.
110 -116	*Lithology:* Pale-gray calcitic dolomite. Largely finely crystalline dolomite with scattered fossils, mostly pelmatozoan plates. $MgCO_3$ averages 23.67%; acid insolubles, 0.11%.
	Remarks: This is typical Barber lithology.

Total depth, 116 feet.

Appendix IC

Rotary and Cable-Tool Holes

T. L. Rowland

Rock cuttings of Silurian and Lower Devonian strata were studied from seventeen wells in Sequoyah, northwestern Haskell, McIntosh, and southeastern Muskogee Counties (text-fig. 3). The geographic location of each well is given in the introductory remarks accompanying the sample descriptions. The wells are assigned letters A through Q, as follows:

A T. Jack Foster, 1 Mabee
Sec. 15, T. 13 N., R. 25 E.
Sequoyah County

B W. B. Cleary, 1 Burke
Sec. 13, T. 13 N., R. 24 E.
Sequoyah County

C T. L. Gober, 1 Ready
Sec. 1, T. 13 N., R. 23 E.
Sequoyah County

D Lohman-Johnson Drilling Company, 2 Cook
Sec. 8, T. 12 N., R. 24 E.
Sequoyah County

E Bruce Harris, 1 Cheek
Sec. 19, T. 12 N., R. 25 E.
Sequoyah County

F Wheeler et al., 1 Snow
Sec. 36, T. 12 N., R. 22 E.
Sequoyah County

G Indian Territory Illuminating Oil Company, 1 Blake
Sec. 3, T. 10 N., R. 21 E.
Haskell County

H United States Smelting Refining and Mining Company, 1 Padgett
Sec. 29, T. 13 N., R. 20 E.
Muskogee County

I Midco Oil Corporation, 1 Dunagan
Sec. 31, T. 11 N., R. 19 E.
Muskogee County

J Bridgeview Coal Company, 1 Williamson
Sec. 2, T. 12 N., R. 18 E.
McIntosh County

K J. S. Wise, 1 Walker
Sec. 18, T. 13 N., R. 18 E.
Muskogee County

L Ed Pauley, 1 Bennett
Sec. 18, T. 10 N., R. 18 E.
McIntosh County

M Carter Oil Company, 1 Graham
Sec. 3, T. 9 N., R. 16 E.
McIntosh County

N Bell Oil and Gas Company, 1 Grant
Sec. 17, T. 11 N., R. 17 E.
McIntosh County

O Western Oil and Gas Company, 1 Brandon
Sec. 17, T. 11 N., R. 16 E.
McIntosh County

P Superior Oil Company, 1 Lackey
Sec. 14, T. 12 N., R. 16 E.
McIntosh County

Q W. T. Campbell, 1 Haggard
Sec. 6, T. 12 N., R. 16 E.
McIntosh County

Numerous wells penetrating the Silurian and Lower Devonian strata have been drilled in this area, but only those with the best sample quality were chosen for investigation. Wells were omitted in which samples were mislabeled, critical intervals were missing, or cavings from the upper part of the hole masked the intervals of study.

This study is based primarily on a microscopic examination of well cuttings, including some thin sections prepared from selected rock chips. The examination was exclusively concerned with the lithologic character of the cuttings and thin sections, no taxonomic faunal data of any kind being utilized. The investigation was supplemented by the use of electric logs, which are available for all except wells B, C, G, I, L, and K (a radioactivity log was obtained for well K). Selected wells are graphically illustrated on text-figure 15, and photomicrographs of some thin sections are on plate XVIII.

Dipmeter surveys are not available for the wells studied, and therefore only the apparent thickness of the Silurian and Lower Devonian units is given. For the most part the surface strata have a dip of 10 degrees or less, although steeper dips are developed locally. To what extent these local structures influence the determination of the subsurface thicknesses of the Silurian and Devonian rocks is uncertain. We are, however, inclined to think this effect is negligible because the thicknesses determined in the wells are comparable to those found at the surface and in the diamond cores.

Correlation.—The major lithostratigraphic units recognized at the surface exposures and in the diamond cores are also recognized with reasonable certainty in the well cuttings; these include the Chattanooga Shale, Sallisaw Formation, Frisco Formation, Marble City and Barber Members of the Quarry Mountain Formation, Tenkiller Formation, Blackgum Formation (including the Pettit Oölite Member), and the Sylvan Shale. It should be emphasized that this correlation is based upon an examination of well cuttings and thin sections prepared from well cuttings, supplemented by electric logs. Except for the Chattanooga and Sylvan Shales, these lithostratigraphic divisions cannot be distinguished solely upon the basis of electric logs.

Determination of dolomite and insoluble-residue contents.—The dolomite content of the samples was determined by the following method: the carbonate rock was treated with a 50-percent solution of formic acid and the dolomite visually estimated according to the following reactions:

(1) dolomite—no reaction to weak reaction.

(2) calcitic dolomite—reacts strongly but the rock does not break down.

(3) dolomitic limestone—reacts strongly and the rock breaks down, leaving a substantial residue of dolomite crystals.

(4) limestone—reacts strongly and the rock breaks down, leaving at most a small residue of dolomite crystals.

We estimate that the division between (4) limestone and (3) dolomitic limestone (text-fig. 4) falls at about 10 percent $MgCO_3$, and this is the basis for the limestone-dolomite distribution shown in text-figure 15.

The acid insolubles were determined by digesting the rock in a 20-percent solution of HCl and visually estimating the percentage of residue. If no percentage is noted in a description, little or no residue was left.

In using this report it should be kept in mind that the carbonate data given for the rotary and cable-tool wells represent a different degree of precision from that given for the diamond cores. The $CaCO_3$, $MgCO_3$, and acid-insoluble contents of the latter were determined by chemical analyses, whereas in the well cuttings these have been determined solely by visual estimation.

Twenty-two thin sections of rock cuttings were prepared from the following wells of the units and at the depths indicated:

Well	*Stratigraphic Unit*	*Depth (feet)*	*Thin-section designation*
A	Sallisaw Formation	870-880	A-1
	Marble City Member	940-950	A-2*
B	Blackgum Formation	770-780	B-1
D	Tenkiller Formation	940-945	D-1*
E	Sallisaw Formation	2970-2975	E-1*
	Frisco Formation	3010-3015	E-2*
	Barber Member	3185-3190	E-3*
F	Frisco Formation	1025-1030	F-1
G	Marble City Member	2324-2334	G-1
	Tenkiller Formation	2398-2402	G-2
H	Marble City Member	924	H-1
	Barber Member	960-970	H-2
	Tenkiller Formation	980-990	H-3
I	Sallisaw Formation	2324-2325	I-1
	Barber Member	2460-2467	I-2
	Pettit Oölite	2494-2500	I-3
J	Barber Member	2250-2255	J-1
	Blackgum Formation	2275-2290	J-2
L	Tenkiller Formation	4028-4035	L-1
M	Marble City Member	4675-4680	M-1
	Blackgum Formation	4780-4785	M-2*
P	Blackgum Formation	2960-2965	P-1

* Illustrated on plate XVIII.

WELL A

T. Jack Foster, 1 Mabee

This well is in SW¼ SW¼ NE¼ sec. 15, T. 13 N., R. 25 E., Sequoyah County, 10 miles east of the Marble City outcrop area (text-fig. 3). The well was drilled in 1959 with rotary tools and the collar elevation is 1,335 feet. Cuttings were examined from 850 to 1,120 feet in intervals of 10 feet, and the sample quality is good. The positions of three samples are questionable. The interval 880-890 contains typical Marble City rock types, whereas samples above and below consist of Sallisaw lithology. Owing to this, the top of the Frisco was 900 feet sample depth and the Marble City, 910 feet; however, the electric log suggests that the Sallisaw-Frisco contact may be at 890 feet, substantiating the sample observation that interval 880-890 is mislabeled. The sample interval 920-930 contains siltstone and chert which do not resemble either Silurian or Lower Devonian rock types. This may be attributed to careless sampling methods or cavings from up the hole. From 1,060 to 1,070 feet, 20% of the sample contains typical Sallisaw lithology, most probably explained as cavings. Lower Devonian rocks are approximately 45? feet thick (855-890?) and consist of the Sallisaw Formation 35? feet (855?-890?; this thickness was estimated from the electric log because 850-860 contained Chattanooga and Sallisaw) and Frisco Formation 10 feet (900?-910?; the top of the Frisco may be 890 feet, as explained above). Silurian rocks are 195 feet thick (910?-1,105? feet; text-fig. 3) and comprise four units: Quarry Mountain Formation 170? feet (910?-1,080), Marble City Member 160 feet (910?-1,070; the actual thickness may be 170 feet and the top 900 feet, as explained above) and Barber Member 10 feet (1,070-1,080), Tenkiller Formation, and Blackgum Formation 20 feet

(1,080-1,100; the electric log suggests a thickness of 25 feet, as the top of the Sylvan Shale was estimated at 1,105 feet). The Pettit Oölite is absent or too thin to detect in the well cuttings. Sylvan Shale was encountered in sample 1,100-1,110. The electric log suggests the top at 1,105 feet. Two thin sections were prepared from the following intervals: Sallisaw Formation 870-880 and Marble City Member 940-950 (pl. XVIII, fig. 3). Cuttings in this well were not investigated for insoluble residues.

The sequence of the following description is that of the sample labels.

Depth (feet)	*Thickness (feet)*	
		CHATTANOOGA FORMATION: Black and brown pyritic shale.
		SALLISAW FORMATION: 35? feet (855?-890?). Thickness approximated from the electric log, as sample 850-860 contained Chattanooga and Sallisaw. The top of the Frisco also estimated from the electric log, as explained above. Gray to dark-gray, medium- to fine-crystalline arenaceous calcitic dolomite; light-gray to gray arenaceous dolomitic limestone; gray to white opaque to semitranslucent chert.
850-860	10	Shale, black, brown, pyritic; dolomite, calcitic, arenaceous, gray to dark-gray, medium-crystalline; in part glauconitic; chert, gray, opaque, 25%; shale 50%; dolomite 25%.
860-870	10	Limestone, dolomitic, arenaceous, light-gray to gray; in part glauconitic.
870-880	10	Dolomite, slightly arenaceous, gray to dark-gray, medium- to fine-crystalline; chert, gray, opaque, 50%; thin section (A-1).
880?-890?	10	Limestone, light-pink to off-white, trace crinoidal; dolomite, gray, fine-crystalline, 10%; this sample is probably mislabeled, as explained above.
890-900	10	Dolomite, light-gray, fine-crystalline; in part glauconitic; chert, white, semitranslucent to opaque, some with pyrite, 55%.
900-910	10	FRISCO FORMATION: 10 feet (900-910). Frisco is present in the samples from 900-910, but the electric log suggests the top may be at 890 feet, as explained above. Light-gray fossiliferous limestone.
		QUARRY MOUNTAIN FORMATION: 170 feet (910-1,080). Exact thickness may be 180 feet, as explained above.
		Marble City Member: 160 feet (910-1,070). Exact thickness may be 170 feet, as sample 880-890 is possibly mislabeled. Light-pink to off-white crinoidal limestone; gray fine-crystalline dolomite.
910-920	10	Limestone, light-pink to off-white, crinoidal; dolomite, gray, fine-crystalline, 2%

Depth (feet)	*Thickness (feet)*	
920?-930?	10	Siltstone, fine-grained, calcitic, brown, mottled; chert, tan, opaque, 2%; sample out of place, as this siltstone does not resemble either Silurian or Lower Devonian rock types.
930-940	10	Limestone, light-pink to off-white, crinoidal; dolomite, gray, fine-crystalline, 2%.
940-950	10	Limestone, pink to off-white, crinoidal; trace of dolomite as above; thin section (A-2) (pl. XVIII, fig. 3).
950-960	10	Dolomite, gray, fine-crystalline.
960-970	10	Limestone, light-pink to off-white, crinoidal; in part dolomitic; dolomite, gray, fine-crystalline, 35-40%.
970-980	10	Limestone as above; dolomite as above, 10-15%.
980-1,020	40	Limestone, pale-pink to off-white to white, crinoidal; in part dolomitic; trace of dolomite as above.
1,020-1,060	40	Limestone, off-white to white, crinoidal; in part dolomitic.
1,060-1,070	10	Limestone as above; dolomite, gray, medium- to fine-crystalline, glauconitic, arenaceous, 15-20%; the dolomite is typical Sallisaw lithology and is present possibly as cavings from above.
1,070-1,080	10	*Barber Member:* 10 feet (1,070-1,080). Gray fine-crystalline dolomite.
1,080-1,090	10	TENKILLER FORMATION: Light-pink to pink, gray to light-gray, off-white crinoidal limestone; in part dolomitic and glauconitic; some with abundant pyrite and orange crinoidal material. Exact thickness uncertain, as sample 1,090-1,100 contains both Tenkiller and Blackgum lithology.
1,090-1,100	10	BLACKGUM FORMATION: Gray to dark-gray fine-crystalline glauconitic dolomitic limestone; gray to dark-gray fine-crystalline dolomite; white, semi-translucent chert; only one piece found. Thickness uncertain, as sample interval 1,090-1,100 contains 35% Tenkiller limestone; 50% Blackgum limestone; 15% Blackgum dolomite.
1,100-1,120	20	SYLVAN FORMATION: Thickness not determined, as the samples were studied only to 1,120 feet. Electric log suggests the top at 1,105 feet. Green to gray-green shale.

WELL B

W. B. Cleary, 1 Burke

This well is in SE¼ SE¼ SE¼ sec. 13, T. 13 N., R. 24 E., Sequoyah County, about 7 miles east of Marble City (text-fig. 3). The well was drilled with rotary tools in 1959. An electric log was not run and the collar elevation is not available. Cuttings were studied from 510 to 790 feet in intervals of 10 feet, and the sample quality is good. Lower Devonian rocks are approximately 60? feet thick (520-580) and consist of the Sallisaw Formation 50? feet (520?-570; exact thickness is uncertain as sample 520-530 contains both Sylamore and Sallisaw) and Frisco Formation 10 feet (570-580). Silurian rocks are 190 feet thick (580-770 feet; text-fig. 3) and comprise five units: Quarry Mountain Formation 170 feet (580-750), Marble City Member 110 feet (580-690) and Barber Member 60 feet (690-750), Tenkiller Formation, Blackgum Formation, and Pettit Oölite 20? feet (750-770?; exact thickness is uncertain as Blackgum, Pettit, and Sylvan are present in sample 770-780). One thin section was prepared from the Blackgum Formation in sample interval 770-780.

Depth (feet)	*Thickness (feet)*	
		CHATTANOOGA FORMATION:
510-520	10	Shale, black, brown, pyritic.
		Sylamore Sandstone: Coarse-grained subangular to subrounded unconsolidated sand. Thickness uncertain, as Sylamore is present with Sallisaw in sample 520-530.
		SALLISAW FORMATION: 50? feet (520-570). Exact thickness uncertain, as Sallisaw and Sylamore are present in sample 520-530. Tan to light-gray arenaceous glauconitic dolomitic limestone; light-gray to off-white fine-crystalline arenaceous calcitic dolomite; gray to white arenaceous opaque chert.
520-530	10	Sand, coarse-grained, subangular to subrounded, unconsolidated, 50%; limestone, dolomitic, glauconitic, arenaceous, light-tan to tan to gray; 10-15% residue consisting of quartz and glauconite.
530-540	10	Limestone as above; chert, gray, opaque, 10-15%.
540-550	10	Dolomite, calcitic, arenaceous, light-gray, glauconitic, fine-crystalline; 10-15% residue consisting of quartz and glauconite; chert, white, arenaceous, gray, opaque, 40-50%.
550-560	10	Dolomite as above; chert as above, 10-15%.
560-570	10	Dolomite, calcitic, arenaceous, light-gray to off-white, glauconitic, fine-crystalline; 10-15% residue consisting of quartz and glauconite; chert, white, arenaceous, gray, opaque, 80-85%.
570-580	10	FRISCO FORMATION: 10 feet (570-580). Light-gray to off-white fossiliferous limestone; abundant crinoid and other skeletal debris.
		QUARRY MOUNTAIN FORMATION: 170 feet (580-750).
		Marble City Member: 110 feet (580-690). Off-white to white to pink crinoidal limestone, in part dolo-

Depth (feet)	Thickness (feet)	
		mitic; light-gray to gray fine-crystalline dolomite, in part calcitic.
580-590	10	Dolomite, light-gray, fine-crystalline.
590-600	10	Dolomite as above; limestone, off-white to pink, crinoidal, 10-15%.
600-610	10	Limestone, off-white to white to pink, crinoidal; abundant pink crinoidal material; dolomite, as above, 20-25%.
610-630	20	Limestone, off-white to white, pink, crinoidal; abundant crinoidal debris.
630-690	60	Limestone as above, except in part dolomitic and less pink crinoidal; dolomite, calcitic, white to light-gray, medium- to fine-crystalline, 5-10%.
		Barber Member: 60 feet (690-750). Light-gray fine- to medium-crystalline dolomite.
690-700	10	Dolomite, medium- to fine-crystalline, gray to light-gray; limestone, as above, 5-10%.
700-710	10	Dolomite, as above.
710-720	10	Dolomite, as above; limestone, as above, 25%.
720-730	10	Dolomite, as above; limestone, as above, 35%.
730-750	20	Dolomite, gray, fine-crystalline.
750-760	10	TENKILLER FORMATION: Off-white to light-gray to pink dark-gray crinoidal pyritic limestone; in part dolomitic and abundant orange crinoidal material. Thickness uncertain, as Tenkiller and Blackgum are present in sample 760-770.
		BLACKGUM FORMATION:
760-770	10	Light-gray fine-crystalline glauconitic dolomite; tan to brown fine-crystalline glauconitic dolomite; gray pyritic limestone; gray opaque chert. Thickness uncertain, as sample interval 760-770 contains 20% Tenkiller limestone; 75% Blackgum dolomite; 5% Blackgum chert.
770-780	10	*Pettit Oölite:* Gray to dark-gray oölite; very few pieces found. Some rounded silicified oölite? present. A thin section of this oölite? was prepared (B-1). This material resembles the fractured and silicified oölite found at Ch2. Thickness uncertain as sample interval 770-780 contains 20% Blackgum dolomite, 20% Blackgum chert, 60% Sylvan shale.
780-790	10	SYLVAN FORMATION: Thickness not determined, as the samples were only studied to 790 feet. Sylvan was first encountered in sample 770-780. Gray-green to green shale. Sample interval 780-790 contains only Sylvan shale.

WELL C

T. L. Gober, 1 Ready

This well is in NW¼ SW¼ SW¼ sec. 1, T. 13 N., R. 23 E., Sequoyah County, about 1½ miles north of the St. Clair Lime Company quarry (pl. A and text-figs. 3, 15). The well was drilled in 1961 with cable tools. No elevation or electric log was run. Cuttings were studied from 0 to 201 feet in erratic intervals, and the sample quality is good. Only Silurian rocks are present, as the well was spudded in alluvial deposits overlying the Marble City Member (Lower Devonian strata are present in this area). Silurian rocks are 164 feet thick (20-184 feet; text-fig. 3) and comprise five units: Quarry Mountain Formation 140 feet (20-160), Marble City Member 61 feet (20-81) and Barber Member 79 feet (81-160), Tenkiller Formation, Blackgum Formation, and Pettit Oölite 24 feet (160-184). Individual thicknesses of the Tenkiller and Blackgum are uncertain, as sample 171-175 contains both units. Sylvan Formation was encountered in sample 184-192 feet. Samples were missing from 114-126 feet.

Depth (feet)	*Thickness (feet)*	
0- 20	20	ALLUVIAL DEPOSITS: Unconsolidated fine- to coarse-grained subangular to well-rounded sand; with fragments of chert and light-colored limestone.
		QUARRY MOUNTAIN FORMATION: 140 feet (20-160).
		Marble City Member: 61 feet (20-81). Off-white to pink crinoidal limestone; in part dolomitic; gray fine-crystalline dolomite.
20- 22	2	Limestone, off-white to pink, crinoidal; abundant crinoidal debris.
22- 30	8	Limestone, off-white to pink, crinoidal; abundant crinoidal debris; in part dolomitic; dolomite, gray, fine-crystalline, 10%.
30- 33	3	Limestone, as above; dolomite, as above, 20%.
33- 35	2	Limestone, as above; dolomite, as above, 15%.
35- 40	5	Limestone, as above, more pink crinoidal; trace of dolomite, as above.
40- 66	26	Limestone, pink to off-white, crinoidal; abundant crinoidal debris.
66- 81	15	Limestone, pink to off-white, crinoidal; in part dolomitic.
		Barber Member: 79 feet (81-160). Light-gray to gray fine-crystalline dolomite; in part calcitic. No sample from 114-126 feet.
81-114	33	Dolomite, light-gray to gray, fine-crystalline; in part calcitic.
114-126	12	Samples missing.
126-151	25	Dolomite, light-gray to dark-gray, fine-crystalline.

Depth (feet)	*Thickness (feet)*	
151-160	9	Dolomite, as above; slight trace of Tenkiller limestone.
160-175	15	TENKILLER FORMATION: Light-gray to gray to pink pyritic limestone; abundant orange crinoidal material, 1-3% residue. Thickness uncertain, as sample interval 171-175 contains 60% Tenkiller limestone and 40% Blackgum limestone.
		BLACKGUM FORMATION:
175-180	5	Gray to dark-gray glauconitic dolomitic limestone, 55%; light-gray fine-crystalline glauconitic dolomite, 10%; clear white to gray opaque chert, 35%. Thickness uncertain, as both Tenkiller and Blackgum are present in sample 171-175.
180-184	4	*Pettit Oölite:* Gray to dark-gray silicified oölite. Thickness uncertain, as sample interval 180-184 contains 55% Blackgum dolomite; 45% Blackgum chert mixed with abundant silicified oölite.
184-201	17	SYLVAN FORMATION: Thickness not determined, as samples were only studied to 201 feet. Gray-green to green shale.

WELL D

Lohman-Johnson, 2 Cook

This well is in C SW¼ NE¼ sec. 8, T. 12 N., R. 24 E., Sequoyah County, about 5 miles southeast of Marble City (text-figs. 3, 15). The well was drilled in 1949 with rotary tools, and the collar elevation is 640 feet. Cuttings were studied from 750 to 980 feet in intervals of 5 feet, and the sample quality is good. Upon the basis of the electric log, White (1956, pl. III; 1958, pl. III) assigned the Penters-upper Hunton to the section recognized as the Sallisaw in this well and the remaining section to the St. Clair-lower Hunton undifferentiated. The top of the Sallisaw Formation was estimated from the electric log, as the samples were missing from 0 to 750 feet. Lower Devonian rocks are approximately 40? feet thick (715?-755) and consist of the Sallisaw Formation 40? feet (715?-755; top estimated from the electric log) and Frisco Formation (thickness uncertain, as it is present with Marble City in sample 755-760). Silurian rocks are approximately 215 feet thick (755?-970 feet; text-fig. 3) and comprise five units: Quarry Mountain Formation 172? feet (755?-927?), Marble City Member 160? feet (755?-915; exact thickness uncertain, as Frisco and Marble City are present in sample 755-760) and Barber Member 12? feet (915-927?; exact thickness uncertain, as Barber and Tenkiller are present in sample 925-930 and the contact can only be estimated on the electric log), Tenkiller Formation 28? feet (927?-955; thickness uncertain, as Barber and Tenkiller are present in sample interval 925-930), Blackgum Formation 15 feet (955-970), and Pettit Oölite (thickness uncertain, as it is present with Blackgum in sample 965-970). Sylvan Shale was encountered in sample 970-975. One thin section was prepared of the Tenkiller Formation from sample interval 940-945 (pl. XVIII, fig. 6).

Depth (feet)	Thickness (feet)	
750-755	5	SALLISAW FORMATION: 40? feet (715?-755; top estimated from the electric log). Only 5 feet of Sallisaw was examined, as the samples were missing from 0 to 750 feet. Gray to dark-gray fine-crystalline arenaceous dolomite, 15-20%; residue consisting of quartz grains, 35-40%; white arenaceous opaque chert, 60-65%.
		FRISCO FORMATION: Thickness uncertain, as it is present with Marble City in sample interval 755-760. Light-gray to dark-gray fossiliferous limestone.
		QUARRY MOUNTAIN FORMATION: 172? feet (755?-927?; exact thickness uncertain, as Frisco and Marble City are present in sample 755-760; Barber and Tenkiller are mixed in sample 925-930.
		Marble City Member: 160? feet (755?-915; exact thickness uncertain as explained above). Off-white to pink crinoidal limestone; in part dolomitic; gray to light-gray fine-crystalline calcitic dolomite.
755-760	5	Limestone, light-gray to dark-gray, fossiliferous, 10% Frisco; limestone, off-white to pink, crinoidal; abundant crinoidal debris.
760-765	5	Dolomite, calcitic, light-gray to gray, fine-crystalline; limestone, as above, 15-20%.
765-770	5	Limestone, off-white to pink, crinoidal; abundant pink crinoidal material; dolomite, as above, 5%.
770-775	5	Limestone, dolomitic, off-white to pink, crinoidal; abundant pink crinoidal material.
775-810	35	Limestone, off-white to pink, crinoidal; in part dolomitic; abundant pink crinoidal material.
810-820	10	Limestone, off-white to white; in part dolomitic; abundant pink crinoidal material; limestone, white, chalky, 1-2% residue, 20%.
820-830	10	Limestone, as above except more dolomitic; no white chalky limestone present.
830-840	10	Limestone, dolomitic, white to off-white; limestone, white, chalky, 1-3% residue, 20%.
840-850	10	Limestone, as above, except some pink crinoidal; no white chalky limestone.
850-860	10	Limestone, white to off-white, in part slightly dolomitic; some pink crinoidal material.
860-870	10	Limestone, as above, except more dolomitic.
870-875	5	Limestone, as above, except dolomitic content lower.
875-880	5	Limestone, as above, except more dolomitic.

Depth (feet)	*Thickness (feet)*	
880-910	30	Limestone, off-white to white, in part slightly dolomitic; abundant pink crinoidal material.
910-915	5	Limestone, as above, except more dolomitic.
		Barber Member: 12? feet (915-927?; thickness uncertain, as Barber and Tenkiller are present in sample 925-930). Gray fine-crystalline calcitic dolomite.
915-920	5	Dolomite, calcitic, gray, fine-crystalline; limestone, as above, 20%; limestone, dolomitic, gray to tannish, 10%, probably cavings from up the hole.
920-925	5	Dolomite, as above.
925-930	5	Dolomite, as above, 75%; limestone, gray to pinkish; in part dolomitic; some orange crinoidal material, 25% Tenkiller.
930-955	25	TENKILLER FORMATION: Gray to pink crinoidal limestone; in part dolomitic; abundant orange crinoidal material. Thickness uncertain as sample 925-930 contains both Barber and Tenkiller as described above. Thin section (D-1) was prepared from sample interval 940-945 (pl. XVIII; fig. 6).
		BLACKGUM FORMATION: 15 feet (955-970).
955-965	10	Light-gray fine-crystalline glauconitic calcitic dolomite; brown to tan argillaceous fine-crystalline dolomite, 3-5% residue; clear white to gray opaque chert; gray glauconitic limestone.
965-970	5	*Pettit Oölite:* Gray, dark-gray oölite. Thickness uncertain, as sample interval 965-970 contains a few pieces of oölite mixed with brown to tan fine-crystalline argillaceous dolomite, 15%; light-gray fine-crystalline glauconitic calcitic dolomite, 75%; gray to white clear opaque chert, 15%; all from the Blackgum Formation.
970-980	10	SYLVAN FORMATION: Thickness not determined, as samples were examined only to 980 feet. Sylvan encountered in sample 970-975 and consists of gray-green to green shale.

WELL E
Bruce Harris, 1 Cheek

This well is in NE¼ NE¼ SW¼ sec. 19, T. 12 N., R. 25 E., Sequoyah County, about 10 miles southeast of Marble City (text-fig. 3). The well was drilled with rotary tools in 1958, and the collar elevation is 586.5 feet. Cuttings were examined from 2,940 to 3,240 feet in intervals of 5 feet, and the sample quality is fair. England (1961, pl. III) assigned Henryhouse and Chimneyhill to this well upon the basis of electric logs. Lower Devonian rocks are 75 feet thick (2,945-3,020) and consist of the Sallisaw Formation 60 feet (2,945-3,005) and Frisco Formation 15 feet (3,005-3,020). Silurian rocks are 210 feet thick (3,020-3,230 feet; text-fig. 3) and comprise five units: Quarry Mountain Formation 183? feet (3,020-3,203?), Marble City Member 135 feet (3,020-3,155) and Barber Member 48? feet (3,155-3,203?; the approximate Barber-Tenkiller contact was estimated from the electric log as both units appear in sample 3,200-3,205), Tenkiller Formation, Blackgum Formation, and Pettit Oölite 27? feet (3,203?-3,230; approximate top of the Tenkiller was estimated from the electric log and individual thicknesses of Tenkiller and Blackgum are uncertain as both appear in sample 3,220-3,225). The upper portion of the Marble City Member (3,020-3,040; 3,055-3,070) contains a substantial amount of dolomite. The Sylvan Shale was encountered in sample 3,230-3,235. Three thin sections were prepared from the following intervals: Sallisaw Formation, 2,970-2,975; Frisco Formation, 3,010-3,015 feet; Barber Member, 3,185-3,190 feet. Photomicrographs of these thin sections are on plate XVIII, figures 1, 2, 4.

Depth (feet)	*Thickness (feet)*	
2,940-2,945	5	CHATTANOOGA FORMATION: Black and brown pyritic shale.
		SALLISAW FORMATION: 60 feet (2,945-3,005). Fine- to medium-crystalline gray to dark-gray to gray arenaceous glauconitic dolomitic limestone; clear translucent to semitranslucent white arenaceous chert. Thin section (E-1) 2,970-2,975 (pl. XVIII, fig. 1).
2,945-2,950	5	Dolomite, arenaceous, gray to dark-gray, medium- to fine-crystalline, glauconitic; 15-20% residue consisting of quartz and glauconite; chert, clear, translucent to semitranslucent, 30-35%.
2,950-2,955	5	Limestone, dolomitic, arenaceous, glauconitic, gray to light-gray; 10% residue consisting of quartz and glauconite; chert, as above, 10%, some gray opaque.
2,955-2,960	5	Dolomite, calcitic, arenaceous, white, fine-crystalline; 5% residue consisting of quartz and glauconite; chert, arenaceous, white; some with dolomite rhombs and glauconite, 55%.
2,960-2,965	5	Sandstone, dolomitic, glauconitic, gray to light-gray, medium- to fine-grained; chert, as above, 10%.
2,965-2,970	5	Dolomite, calcitic, arenaceous, glauconitic, fine-crystalline, gray to light-gray; 10% residue consisting of quartz and glauconite; chert, as above, 15%.
2,970-2,975	5	Dolomite, as above; 15% residue consisting of quartz and glauconite; chert, white, opaque, arenaceous; some with dolomite rhombs, 55%; thin section (E-1) (pl. XVIII, fig. 1).
2,975-2,980	5	Limestone, dolomitic, arenaceous, gray; 10% quartz residue; chert, as above, 50%.
2,980-2,995	15	Chert, white, arenaceous; some with dolomite rhombs, some calcitic.
2,995-3,000	5	Limestone, dolomitic, arenaceous, glauconitic, light-

Depth (feet)	*Thickness (feet)*	
		gray; 10% quartz residue; chert, as above, 35-40%.
3,000-3,005	5	Limestone, as above; chert, as above, 30%.
3,005-3,020	15	FRISCO FORMATION: 15 feet (3,005-3,020). Fossiliferous, off-white to light-gray limestone; some glauconitic. Thin section (E-2) 3,010-3,015 feet (pl. XVIII, fig. 2).
		QUARRY MOUNTAIN FORMATION: 183? feet (3,020-3,203?; Barber-Tenkiller contact estimated from the electric log, as both are present in sample 3,200-3,205).
		Marble City Member: 135 feet (3,020-3,155). Off-white to pink crinoidal limestone; in part dolomitic; light-gray fine-crystalline dolomite, in part calcitic.
3,020-3,025	5	Dolomite, light-gray to gray, fine-crystalline; in part slightly calcitic.
3,025-3,030	5	Dolomite, light-gray to gray to dark-gray, medium- to fine-crystalline; slight trace of limestone.
3,030-3,040	10	Dolomite, as above, in part more calcitic; limestone, off-white, 5%.
3,040-3,045	5	Limestone, off-white to white; some pink crinoidal material; dolomite, as above, 10%.
3,045-3,050	5	Limestone, as above; more pink crinoidal material; some gray limestone; dolomite, as above, 5%.
3,050-3,055	5	Limestone, as above; dolomite, as above, 5%.
3,055-3,070	15	Dolomite, light-gray to gray, fine-crystalline; limestone, as above, 5%.
3,070-3,075	5	Limestone, dolomitic, off-white to white; some pink crinoidal material; dolomite, as above, 15%.
3,075-3,090	15	Dolomite, light-gray to gray, fine-crystalline; slight trace of limestone, as above.
3,090-3,095	5	Limestone, dolomitic, off-white to white; some pink crinoidal material; dolomite, as above, 40%.
3,095-3,110	15	Limestone, as above, except no dolomitic limestone; trace of dolomite, as above.
3,110-3,150	40	Limestone, off-white to white to pale-pink; abundant pink crinoidal material; in part dolomitic; slight trace of dolomite as above; some white chalky limestone.
3,150-3,155	5	Limestone, as above, except dolomitic; limestone, white chalky, 35%.
		Barber Member: 48? feet (3,155-3,203?; top of the Tenkiller estimated from the electric log, as both Tenkiller and Barber are present in sample 3,200-3,205). Light-gray to off-white medium- to fine-

Depth (feet)	Thickness (feet)	
		crystalline dolomite; in part calcitic. Thin section (E-3) 3,185-3,190 feet (pl. XVIII, fig. 4).
3,155-3,160	5	Dolomite, light-gray to off-white to white, medium- to fine-crystalline; in part calcitic; limestone, as above, 15-20%.
3,160-3,200	40	Dolomite, light-gray to off-white to white, medium- to fine-crystalline; in part calcitic in samples, 3,185-3,195 only.
3,200-3,205	5	Dolomite, as above, 85%; limestone, as described below, 15%.
3,205-3,225	20	TENKILLER FORMATION: Limestone, light-gray to gray, off-white; abundant orange crinoidal material, in part dolomitic; pyrite abundant. Exact thickness uncertain, as the top was estimated from the electric log and both Tenkiller (40%) and Blackgum (60%) are present in sample 3,220-3,225.
		BLACKGUM FORMATION:
3,225-3,230	5	Gray to dark-gray glauconitic limestone; in part dolomitic; off-white opaque chert; trace of brown to tan fine-crystalline dolomite. Exact thickness uncertain, as both Tenkiller and Blackgum are present in sample 3,220-3,225. Sample 3,220-3,225 contains 40% Tenkiller and 60% Blackgum.
		Pettit Oölite: One piece of gray Pettit Oölite found mixed with gray to dark-gray glauconitic limestone; in part dolomitic; off-white opaque chert, 15%; trace of brown to tan fine-crystalline dolomite; some limestones contain large rounded quartz grains or silicified oölite.
3,230-3,240	10	SYLVAN FORMATION: Thickness not determined, as samples were studied only to 3,240 feet. Gray-green to green shale first encountered in sample 3,230-3,235. Sample 3,235-3,240 contains only Sylvan shale.

WELL F

Wheeler et al., 1 Snow

This well is in C SE¼ SW¼ sec. 36, T. 12 N., R. 22 E., Sequoyah County, about 11 miles southwest of Marble City (text-figs. 3, 15). The well was drilled in 1959 with rotary tools, and the collar elevation is 517.6 feet. Cuttings were studied from 960 to 1,260 feet in intervals of 5 feet, and the sample quality is good. Twenty feet of Sylamore Sandstone was encountered in samples 965-985. Lower Devonian rocks are 45 feet thick (985-1,030) and consist of the Sallisaw Formation 40 feet (985-1,025) and Frisco Formation 5 feet (1,025-1,030). Silurian rocks are 220 feet thick (1,030-1,250 feet; text-fig. 3) and comprise five units: Quarry Mountain Formation 190? feet (1,030-1,220?), Marble City Member 155 feet (1,030-1,185) and

Barber Member 35? feet (1,185-1,220?; Barber-Tenkiller contact was approximated from the electric log as both units are present in sample 1,220-1,225), Tenkiller Formation, Blackgum Formation, and Pettit Oölite 30? feet (1,220-1,250; top of the Tenkiller estimated from the electric log and individual thickness of Tenkiller and Blackgum uncertain, as both are present in sample 1,235-1,240). The upper portion of the Marble City Member (1,040-1,095) consists largely of dolomite. The Sylvan Shale was encountered in sample 1,250-1,255. One thin section was prepared of the Frisco Formation from sample interval 1,025-1,030.

Depth (feet)	*Thickness (feet)*	
		CHATTANOOGA FORMATION:
960-965	5	Black and brown pyritic shale.
		Sylamore Sandstone: 20 feet (965-985). Gray subangular to subrounded dolomitic calcitic glauconitic phosphatic sandstone; 50-60% residue consisting of quartz and glauconite, coarse- to medium-grained.
965-970	5	Sandstone, gray, coarse- to medium-grained, subangular to subrounded; in part dolomitic; trace of fine-grained gray sand.
970-985	15	Sandstone, dolomitic, calcitic, medium- to fine-grained, glauconitic, phosphatic; 50-60% residue consisting of quartz and glauconite; abundant black phosphatic material.
		SALLISAW FORMATION: 40 feet (985-1,025). Gray to light-gray arenaceous glauconitic limestone; off-white fine-crystalline arenaceous calcitic dolomite; light-gray to off-white to white arenaceous opaque chert.
985-990	5	Limestone, dolomitic, arenaceous, glauconitic, gray to light-gray; 3% residue consisting of quartz and glauconite.
990-995	5	Limestone, as above; dolomite, calcitic, off-white, fine-crystalline, 50%.
995-1,000	5	Dolomite, calcitic, fine-crystalline, off-white.
1,000-1,005	5	Dolomite, as above; chert, gray, opaque, 15%; trace of limestone, gray to dark-gray, mottled, fine-crystalline, dolomitic.
1,005-1,015	10	Dolomite, calcitic, arenaceous, fine-crystalline, off-white to light-gray; in part fossiliferous, 3-5% quartz residue.
1,015-1,020	5	Dolomite, as above; chert, gray, off-white, white, arenaceous, 50-60%.
1,020-1,025	5	Chert, light-gray, off-white to white, arenaceous, opaque.
1,025-1,030	5	FRISCO FORMATION: 5 feet (1,025-1,030).

Depth (feet)	Thickness (feet)	
		Light-gray to gray, off-white, fossiliferous limestone; in part glauconitic. Thin section (F-1) 1,025-1,030.
		QUARRY MOUNTAIN FORMATION: 190? feet (1,030-1,220?; Barber-Tenkiller contact was estimated from the electric log, as both are present in sample 1,220-1,225).
		Marble City Member: 155 feet (1,030-1,185). Off-white to white to pink crinoidal limestone; in part dolomitic; light-gray fine-crystalline dolomite; in part calcitic.
1,030-1,035	5	Limestone, off-white to white to pinkish, crinoidal; abundant crinoidal debris.
1,035-1,040	5	Limestone, as above; trace of gray fine-crystalline dolomite.
1,040-1,095	55	Dolomite, light-gray, fine-crystalline; in part calcitic, only in samples 1,040-1,045 and 1,060-1,075.
1,095-1,100	5	Dolomite, as above; in part calcitic; trace of limestone, off-white to pinkish.
1,100-1,105	5	Dolomite, as above; limestone, as above, 10%.
1,105-1,110	5	Dolomite, as above, except calcitic; limestone, white dolomitic, 40%.
1,110-1,115	5	Limestone, as above, 60%; dolomite, as above, 40%.
1,115-1,165	50	Limestone, off-white to white, pinkish, crinoidal; abundant crinoidal debris; in part dolomitic.
1,165-1,185	20	Limestone, as above, except not dolomitic.
		Barber Member: 35? feet (1,185-1,220?; Barber-Tenkiller contact approximated from the electric log, as both are present in sample 1,220-1,225). Off-white to white medium- to fine-crystalline calcitic dolomite; gray fine-crystalline dolomite.
1,185-1,190	5	Dolomite, off-white to white, calcitic; limestone, as above, 40%.
1,190-1,195	5	Dolomite, as above; limestone, as above, 20%.
1,195-1,215	20	Dolomite, as above, except less calcitic.
1,215-1,220	5	Dolomite, light-gray, fine-crystalline; abundant white fine-crystalline dolomite.
1,220-1,225	5	Dolomite, as above, 80%; limestone, light-gray to off-white, in part dolomitic, abundant orange crinoidal material, 20% (Tenkiller).
1,225-1,240	15	TENKILLER FORMATION: Off-white to light-gray crinoidal limestone; in part dolomitic; pyritic; abundant orange crinoidal material. Thickness uncertain, as Barber and Tenkiller are both present in

Depth (feet)	*Thickness (feet)*	
		sample 1,225-1,230, and sample 1,235-1,240 contains Tenkiller limestone mixed with Blackgum limestone described below.
		BLACKGUM FORMATION:
1,240-1,245	5	Gray to dark-gray dolomitic glauconitic limestone, 15%; light-gray fine-crystalline glauconitic dolomite, 60%; brown to tan argillaceous fine-crystalline dolomite; gray to white opaque chert, 25%. Thickness uncertain, as Tenkiller and Blackgum are present in sample 1,235-1,240.
1,245-1,250	5	*Pettit Oölite:* Abundant gray to dark-gray silicified oölite, mixed with dolomite as above, 55%; brown to tan fine-crystalline argillaceous dolomite, 10-15%; residue, 15%; dark-gray opaque chert, 30%. Thickness uncertain as Pettit is mixed with Blackgum in this sample.
1,250-1,260	10	SYLVAN FORMATION: Thickness not determined, as the samples were studied only to 1,260 feet. Sylvan encountered in sample 1,250-1,255. Green to gray-green shale.

WELL G

Indian Territory Illuminating Oil Company, 1 Blake

This well is in C SW¼ NW¼ sec. 3, T. 10 N., R. 21 E., Haskell County, about 15 miles south of the Lake Tenkiller dam (text-figs. 3, 15). The well was drilled in 1930 with cable tools, and the collar elevation is 760 feet. An electric log was not run. Cuttings were examined from 2,175 to 2,424 feet in erratic intervals, and the samples are excellent. Samples were missing from 2,192 to 2,196 feet. Frezon (1962, pls. I, II), upon the basis of sample examination, recognized the Sallisaw Formation and assigned the remaining rocks to the St. Clair undifferentiated. Lower Devonian rocks consist of the Sallisaw Formation 24 feet thick (2,185-2,209); the Frisco Formation is either missing or too thin to detect in the cuttings. Silurian rocks are approximately 205? feet thick (2,209-2,414? feet; text-fig. 3) and comprise five units: Quarry Mountain Formation 171? feet (2,209-2,380?), Marble City-Barber undifferentiated 171? feet (2,209-2,380?; thickness uncertain as Marble City-Barber and Tenkiller are present in sample 2,379-2,386), Tenkiller Formation, Blackgum Formation, and Pettit Oölite, 35 feet (2,380?-2,414; individual thickness of each unit uncertain as Marble City-Barber and Tenkiller are present in sample 2,379-2,386, and Blackgum is mixed with Sylvan in sample 2,407-2,417). The Marble City-Barber sequence is undifferentiated because the Barber is poorly defined. The upper part (2,209-2,248) is composed largely of dolomite, whereas the lower part consists of limestone and dolomitic limestone. A zone of highly dolomitic limestone is present from 2,364-2,380? feet. This may possibly represent the Barber. The Sylvan Shale was encountered in sample 2,407-2,417. Two thin sections were prepared from the following intervals: Marble City-Barber sequence, 2,324-2,334, and Tenkiller Formation, 2,398-2,402.

Depth (feet)	Thickness (feet)	
2,174-2,185	11	CHATTANOOGA FORMATION: Black and brown pyritic shale.
		SALLISAW FORMATION: 24 feet (2,185-2,209). Light-gray glauconitic fine-crystalline calcitic dolomite; dark-gray dolomitic limestone; clear white opaque arenaceous chert.
2,185-2,188	3	Dolomite, calcitic, arenaceous, light-gray, fine-crystalline; in part glauconitic; 10-15% residue; chert, clear, white, arenaceous, 50%.
2,188-2,190	2	Dolomite, as above, 40%; chert, as above, 60%.
2,190-2,192	2	Dolomite, as above, 30%; chert, as above, 70%.
2,192-2,196	4	Sample missing.
2,196-2,204	8	Chert, white, clear, arenaceous, opaque, 90%; dolomite, as above, 10%.
2,204-2,209	5	Dolomite, calcitic, arenaceous, glauconitic, fine-crystalline, light-gray, 10-15% residue; limestone, dark-gray, dolomitic, arenaceous, 5-10% residue, 25%; chert, as above, 10-15%.
		QUARRY MOUNTAIN FORMATION: 171? feet (2,209-2,380?; thickness uncertain as Marble City and Barber are present with Tenkiller in sample 2,379-2,386).
		Marble City Member-Barber Member undifferentiated: 171? feet (2,209-2,380?; thickness uncertain as Marble City and Barber are present with Tenkiller in sample 2,379-2,386). Marble City-Barber sequence is undifferentiated because the Barber is poorly defined. Off-white to white pinkish crinoidal limestone; in part dolomitic; light-gray fine-crystalline dolomite; in part calcitic.
2,209-2,214	5	Dolomite, light-gray, fine-crystalline; in part calcitic.
2,214-2,220	6	Dolomite, as above; limestone, dolomitic, off-white, some crinoidal, 30%.
2,220-2,248	28	Dolomite, light-gray, fine-crystalline; in part calcitic.
2,248-2,256	8	Limestone, dolomitic, white to off-white, some pink crinoidal.
2,256-2,264	8	Dolomite, calcitic, fine-crystalline, light-gray; limestone, as above, 45-50%.
2,264-2,268	4	Dolomite, as above; limestone, as above, 5%.
2,268-2,275	7	Limestone, off-white to white, some pink crinoidal, dolomitic; dolomite, as above, 30-35%.
2,275-2,278	3	Limestone, as above, 50%; dolomite, as above, 50%.
2,278-2,289	11	Limestone, as above, abundant pink crinoidal, 75%;

Depth (feet)	Thickness (feet)	
		dolomite, as above, 25%.
2,289-2,334	45	Limestone, off-white to white to pinkish; abundant pink crinoidal debris; in part slightly dolomitic; thin section (G-1) 2,324-2,334.
2,334-2,352	18	Limestone, as above, except dolomitic.
2,352-2,364	12	Limestone, as above, except only in part dolomitic.
2,364-2,379	15	Limestone, highly dolomitic, off-white to white; dolomite, calcitic, gray, fine-crystalline, 2-3%.
2,379-2,386	7	Limestone, as above, 50%; dolomite, as above, 5%; limestone, off-white to gray to light-gray, in part dolomitic, abundant orange crinoidal debris, some with pyrite and glauconite, 45% (Tenkiller).
2,386-2,402	16	TENKILLER FORMATION: Off-white to light-gray to gray, dark-gray, tan, pink limestone with abundant orange crinoidal material; in part dolomitic and pyritic; extremely glauconitic in sample 2,392-2,398. Thickness uncertain, as Tenkiller is present with Marble City-Barber in sample 2,379-2,386. Thin section (G-2) was prepared from sample interval 2,398-2,402.
		BLACKGUM FORMATION:
2,402-2,407	5	Light-gray fine-crystalline glauconitic dolomite; gray opaque to clear chert; off-white glauconitic dolomitic limestone, 10%; brown to tan fine-crystalline argillaceous dolomite. Thickness uncertain, as it is present with Sylvan in sample 2,407-2,417.
2,407-2,417	10	*Pettit Oölite:* Thickness uncertain, as only a few pieces of gray to dark-gray oölite found, mixed with Blackgum dolomite and chert as described above. Sample 2,407-2,417 contains approximately 15% gray to gray-green shale.
2,417-2,424	7	SYLVAN FORMATION: Thickness not determined as the samples were studied only to 2,424 feet. Gray to gray-green shale.

WELL H

United States Smelting Refining and Mining Company, 1 Padgett

This well is in C NW¼ NW¼ sec. 29, T. 13 N., R. 20 E., Muskogee County, about 8 miles west of the Tenkiller dam (text-figs. 3, 15). The well was drilled in 1958 with rotary tools, and the collar elevation is 595 feet. Cuttings were studied from 890 to 1,040 feet in intervals of 10 feet, and the sample quality is good. Lower Devonian rocks are absent in this well (text-figs. 3, 15). Silurian rocks are 115 feet thick (905?-1,020? feet; text-fig. 3) and comprise four units: Quarry Mountain Formation 65? feet (905?-970; Chattanooga-Marble City contact was estimated from the electric log, as both are present in sample 900-910), Marble City Member 55? feet

(905?-960; top of the Marble City estimated from the electric log, as it is present with Chattanooga in sample 900-910) and Barber Member 10 feet (960-970), Tenkiller Formation 40 feet (970-1,010), and Blackgum Formation 10? feet (1,010-1,020?; Blackgum-Sylvan contact approximated from the electric log, as both are present in sample 1,020-1,030). The upper part (900-920) of the Marble City contains a substantial amount of dolomite. The Sylvan Shale was encountered in sample 1,020-1,030, and the top was estimated from the electric log at 1,020 feet. Three thin sections were prepared from the following intervals: Marble City Member, 924; Barber Member, 960-970; Tenkiller Formation, 980-990.

Depth (feet)	*Thickness (feet)*	
890-900	10	CHATTANOOGA FORMATION: Black and brown pyritic shale.
		QUARRY MOUNTAIN FORMATION: 65? feet (905?-970; Chattanooga-Marble City contact approximated from the electric log, as both are present in sample 900-910).
		Marble City Member: 55? feet (905?-960; top of the Marble City estimated from the electric log). Off-white to white to pink crinoidal dolomitic limestone; off-white to light-gray medium- to fine-crystalline calcitic dolomite. Thin section (H-1) was prepared from circulated sample at 924 feet.
900-910	10	Shale, black, brown, pyritic, 60%; dolomite, calcitic, off-white to light-gray, medium- to fine-crystalline, 25%; limestone, off-white, some pink, dolomitic, some crinoidal, 15%.
910-920	10	Dolomite, as above; limestone, as above, 10%.
920-940	20	Limestone, off-white to white, dolomitic; abundant pink crinoidal debris; interval 920-930 has 5 circulated samples; 924, 15 and 30 minutes; 929, 15 and 30 minutes; and 930, 15 minutes.
940-960	20	Limestone, as above, except slightly dolomitic; dolomite, gray, fine-crystalline, 2-3% in sample 950-960.
960-970	10	*Barber Member:* 10 feet (960-970). Light-gray to gray fine-crystalline dolomite; thin section (H-2) was prepared from 960-970.
		TENKILLER FORMATION: 40 feet (970-1,010). Light-gray to dark-gray pink light-tan limestone; abundant orange crinoidal and pyritic material; in part dolomitic.
970-980	10	Limestone, light-gray, pink, gray; in part dolomitic; some orange crinoidal material and pyritic material.
980-990	10	Limestone, as above, more dark-gray and pyritic; some greenish material with pyrite; thin section (H-3) was prepared from 980-990.

Depth (feet)	*Thickness (feet)*	
990-1,000	10	Limestone, gray to dark-gray, pink to light-tan; abundant pyrite; some glauconite; abundant orange crinoidal material; in part dolomitic; abundant greenish material.
1,000-1,010	10	Limestone, light-gray to gray, pink; abundant orange crinoidal debris, some glauconite and pyrite; in part dolomitic.
1,010-1,020	10	BLACKGUM FORMATION: 10? feet (1,010-1,020?; Blackgum-Sylvan contact estimated from the electric log, as both are present in sample 1,020-1,030). Tan to brown fine-crystalline partly silty argillaceous dolomite.
1,020-1,040	20	SYLVAN FORMATION: Thickness not determined, as samples were studied only to 1,040 feet. Gray to gray-green shale. Trace of dolomite, as above, in sample 1,020-1,030.

WELL I
Midco Oil Corporation, 1 Dunagan

This well is in SE¼ SE¼ NE¼ sec. 31, T. 11 N., R. 19 E., Muskogee County, about 9 miles northeast of Eufaula (text-figs. 3, 15). The well was drilled in 1938 with cable tools, and the collar elevation is 810 feet. An electric log was not run. Cuttings were examined from 2,315 to 2,504 feet in erratic intervals, and the sample quality is good. Frezon (1961, pls. I, II), upon the basis of sample examination, recognized the Sallisaw Formation and assigned the remaining rocks to the St. Clair undifferentiated. Lower Devonian rocks consist of the Sallisaw Formation 5 feet thick (2,322-2,327); the Frisco Formation is absent or too thin to detect in the well cuttings. Silurian rocks are 173 feet thick (2,327-2,500 feet; text-fig. 3) and comprise five units: Quarry Mountain Formation 144? feet (2,327-2,471?), Marble City Member 133 feet (2,327-2,460) and Barber Member 11? feet (2,460-2,471?; thickness uncertain as Barber and Tenkiller are mixed in sample 2,467-2,471), Tenkiller Formation, Blackgum Formation, and Pettit Oölite 29? feet (2,471-2,500; thickness of each unit uncertain as Barber and Tenkiller are mixed in sample 2,467-2,471, Tenkiller and Blackgum are mixed in sample 2,479-2,486, Blackgum and Pettit in sample 2,494-2,500). The Sylvan Shale was encountered in sample 2,500-2,504. Three thin sections were prepared from the following intervals: Sallisaw Formation, 2,324-2,325; Barber Member, 2,460-2,467; Pettit Oölite, 2,494-2,500.

Depth (feet)	*Thickness (feet)*	
2,315-2,322	7	CHATTANOOGA FORMATION: Black and brown pyritic shale. Trace of Sallisaw chert and dolomite in sample 2,320-2,322.
		SALLISAW FORMATION: 5 feet (2,322-2,327). Light-gray to tan fine-crystalline arenaceous dolomite; clear white arenaceous chert. Thin section (I-1) was prepared from sample 2,324-2,325.
2,322-2,324	2	Dolomite, arenaceous, light-gray to tan, fine-crystal-

Depth (feet)	Thickness (feet)	
		line; 10-15% residue; chert, clear, white, arenaceous, opaque, 20-25%.
2,324-2,325	1	Dolomite, as above, 20-25%; chert, as above, 75-80%; thin section (I-1) was prepared from this interval.
2,325-2,327	2	Dolomite, as above, 40%; chert as above, 60%.
		QUARRY MOUNTAIN FORMATION: 144? feet (2,327-2,471?; thickness uncertain, as Barber and Tenkiller are mixed in sample 2,467-2,471).
		Marble City Member: 133 feet (2,327-2,460). Off-white to white to pink crinoidal limestone; in part dolomitic; light-gray fine-crystalline dolomite; in part calcitic.
2,327-2,331	4	Limestone, slightly dolomitic, off-white to white, abundant pink crinoidal.
2,331-2,340	9	Limestone, dolomitic, off-white to white, abundant pink crinoidal.
2,340-2,345	5	Limestone, as above, only in part dolomitic.
2,345-2,366	21	Limestone, off-white to white, abundant pink crinoidal; in part slightly dolomitic.
2,366-2,372	6	Limestone, as above, except more dolomitic.
2,372-2,390	18	Limestone, off-white to white, abundant pink crinoidal; in part slightly dolomitic.
2,390-2,433	43	Limestone, off-white to white; in part slightly dolomitic; some pink crinoidal material.
2,433-2,447	14	Limestone, dolomitic, off-white to white; some pink crinoidal material.
2,447-2,454	7	Limestone as above; dolomite, gray to light-gray, calcitic, fine-crystalline, 5-10%.
2,454-2,460	6	Limestone, as above; dolomite, as above, 15-20%.
		Barber Member: 11? feet (2,460-2,471?; thickness uncertain as Barber and Tenkiller are present in sample 2,467-2,471). Light-gray to gray fine-crystalline calcitic dolomite. Thin section (I-2) was prepared from sample 2,460-2,467.
2,460-2,467	7	Dolomite, light-gray to gray, fine-crystalline, calcitic; thin section (I-2) was prepared from this interval.
2,467-2,471	4	Dolomite, as above; 15-20% Tenkiller, as described below.
2,471-2,486	15	TENKILLER FORMATION: Gray to light-gray pinkish tan limestone; abundant orange crinoidal and pyritic material; in part dolomitic; abundant greenish pyritic material; 3-4% residue. Thickness uncertain,

Depth (feet)	Thickness (feet)	
		as sample interval 2,479-2,486 contains 5-10% Blackgum limestone, as described below.
		BLACKGUM FORMATION:
2,486-2,494	8	Dark-gray glauconitic limestone; light-gray fine-crystalline glauconitic dolomite; brown to dark-brown fine-crystalline argillaceous dolomite; gray to dark-gray opaque chert. Thickness uncertain, as it appears with Tenkiller in sample 2,479-2,486. Sample 2,486-2,494 contains only dark-gray glauconitic limestone, with a trace of light-gray fine-crystalline glauconitic dolomite.
2,494-2,500	6	*Pettit Oölite:* Gray to dark-gray silicified and non-silicified oölite mixed with light-gray fine-crystalline glauconitic dolomite; gray to dark-gray opaque chert, 15%; brown to dark-brown fine-crystalline argillaceous dolomite, 5-10% residue, 15%; thin section (I-3) was prepared from this interval.
2,500-2,504	4	SYLVAN FORMATION: Thickness not determined as the samples were studied only to 2,504 feet. Green to gray-green shale.

WELL J
Bridgeview Coal Company, 1 Williamson

This well is in SE¼ NW¼ SE¼ sec. 2, T. 12 N., R. 18 E., McIntosh County, about 18 miles west of Lake Tenkiller dam (text-figs. 3, 15.) The well was drilled in 1958 with rotary tools, and the collar elevation is 518 feet. Cuttings were studied from 2,200 to 2,300 feet in intervals of 5 feet, and the sample quality is good. Lower Devonian rocks are absent in this well (text-figs. 3, 15). Silurian rocks are 77 feet thick (2,210-2,287? feet; text-fig. 3) and comprise four units: Quarry Mountain Formation 50? feet (2,210-2,260?), Marble City Member 30 feet (2,210-2,240) and Barber Member 20? feet (2,240-2,260?; thickness uncertain as Barber and Tenkiller are present in sample 2,260-2,265; the contact was estimated from the electric log at 2,260?), Tenkiller Formation, and Blackgum Formation 27? feet (2,260?-2,287?; thickness of each unit uncertain as Barber and Tenkiller are present in sample 2,260-2,265 and Blackgum and Sylvan are mixed in sample 2,285-2,290). Sylvan Shale was encountered in sample 2,285-2,290, and the Blackgum-Sylvan contact was estimated at 2,287? from the electric log. Two thin sections were prepared from the following intervals: Barber Member, 2,250-2,255, and Blackgum Formation, 2,275-2,290.

Depth (feet)	Thickness (feet)	
2,200-2,210	10	CHATTANOOGA FORMATION: Black and brown pyritic shale.
		QUARRY MOUNTAIN FORMATION: 50? feet (2,210-2,260?; Barber-Tenkiller contact estimated on the electric log as both are present in sample 2,260-2,265).
		Marble City Member: 30 feet (2,210-2,240). Off-

Depth (feet)	Thickness (feet)	
		white to pink crinoidal dolomitic limestone; light-gray fine-crystalline, calcitic dolomite.
2,210-2,215	5	Limestone, off-white, dolomitic; some pink crinoidal; dolomite, gray, fine-crystalline, calcitic, 15%.
2,215-2,220	5	Limestone, highly dolomitic, off-white to light-tan; trace of dolomite, as above.
2,220-2,230	10	Limestone, as above, except less dolomitic and abundant pink crinoidal material.
2,230-2,240	10	Limestone, as above, except highly dolomitic; trace of gray fine-crystalline dolomite in sample 2,235-2,240.
		Barber Member: 20 feet (2,240-2,260?; Barber-Tenkiller contact estimated from the electric log as both are present in sample 2,260-2,265). Light-gray fine-crystalline dolomite; in part calcitic. Thin section (J-1) was prepared from sample 2,250-2,255.
2,240-2,260	20	Dolomite, light-gray, fine-crystalline; in part calcitic; thin section (J-1) was prepared from this interval.
2,260-2,265	5	Dolomite, as above; 35-40% Tenkiller limestone present as described below.
2,265-2,275	10	TENKILLER FORMATION: Light-gray to gray to pink pyritic limestone; in part dolomitic; abundant orange crinoidal material; 2-4% residue. Thickness uncertain, as Tenkiller is mixed with Barber in sample 2,260-2,265; contact estimated from the electric log.
		BLACKGUM FORMATION: Light-gray to gray glauconitic fine-crystalline calcitic dolomite; clear white to dark-gray opaque chert; brown to tan argillaceous fine-crystalline dolomite. Thickness uncertain, as Blackgum and Sylvan are both present in sample 2,285-2,290, and the contact was estimated from the electric log at 2,287. Thin section (J-2) was prepared from interval 2,275-2,290.
2,275-2,280	5	Dolomite, light-gray, fine-crystalline, calcitic glauconitic; trace of dark-gray limestone; chert, clear, white to dark-gray, opaque, 20-25%.
2,280-2,285	5	Dolomite, as above, except more glauconitic; chert, as above, 10-15%.
2,285-2,290	5	Dolomite, dark-gray, fine-crystalline, highly glauconitic, 40%; dolomite, brown to tan, argillaceous, fine-crystalline, 20%; chert, as above, 20%; shale, gray to green, 20%.
2,290-2,300	10	SYLVAN FORMATION: Thickness not determined, as the samples were studied only to 2,300 feet. Gray to green shale.

WELL K
J. S. Wise, 1 Walker

This well is in SW¼ SW¼ NE¼ sec. 18, T. 13 N., R. 18 E., Muskogee County, about 21 miles west of Lake Tenkiller dam (text-fig. 3). The well was drilled in 1958 with cable tools, and the collar elevation is 602 feet. A radioactivity log was run. Cuttings were studied from 2,025 to 2,075 feet in erratic intervals, and the sample quality is excellent. Lower Devonian rocks are absent in this well (text-fig. 3). Silurian rocks are 23 feet thick (2,038-2,061 feet; text-fig. 3) and consist of only the Tenkiller Formation and the Blackgum Formation. Thicknesses of individual units are uncertain because the Tenkiller and Blackgum are mixed in sample 2,038-2,042. Sylvan Shale was encountered in sample 2,061-2,070. The Tenkiller-Blackgum contact is not distinguishable on the radioactivity log.

Depth (feet)	*Thickness (feet)*	
2,025-2,038	13	CHATTANOOGA FORMATION: Brown and black pyritic shale.
2,038-2,042	4	TENKILLER FORMATION: Light-gray to off-white orange-crinoidal limestone, 1-3% residue; trace of dark-gray limestone; 65% Tenkiller in sample; light-gray to off-white glauconitic dolomite, 15%; white, opaque chert, 10% Blackgum. Thickness uncertain, as Tenkiller is mixed with Blackgum dolomite and chert in this sample.
		BLACKGUM FORMATION: Light-gray to off-white fine-crystalline calcitic glauconitic dolomite; gray to dark-gray to tan fine-crystalline glauconitic dolomitic limestone; white to gray opaque chert. Thickness uncertain, as it is present with Tenkiller in sample 2,038-2,042.
2,042-2,046	4	Dolomite, light-gray to off-white, fine-crystalline, calcitic, glauconitic; chert, white to light-gray, opaque, 30-35%; trace of dark-gray dolomitic limestone.
2,046-2,050	4	Dolomite, as above, 55%; chert, as above, 40%; limestone, as above, 5%.
2,050-2,053	3	Dolomite, as above, 50%; chert, as above, 40%; limestone, as above, 10%.
2,053-2,061	8	Limestone, gray to dark-gray to tan, dolomitic, glauconitic, 40%; dolomite, gray, fine-crystalline, glauconitic, calcitic, 40%; chert, white to gray, opaque, 20%.
2,061-2,075	14	SYLVAN FORMATION: Thickness not determined, as the samples were studied only to 2,075 feet. Green to gray shale.

WELL L
Ed Pauley, 1 Bennett

This well is in C SE¼ NE¼ sec. 18, T. 10 N., R. 18 E., McIntosh County, about 9 miles northeast of Eufaula (text-figs. 3, 15). The well was drilled in 1951 with cable tools, and the collar elevation is 669 feet. An electric log was not run. Cuttings were examined from 4,000 to 4,100 feet in erratic intervals, and the sample quality is excellent. Frezon (1962, pls. I, II) assigned these rocks to the St. Clair undifferentiated upon the basis of sample examination. Lower Devonian rocks are absent in this well (text-figs. 3, 15). Silurian rocks are 46 feet thick (4,028-4,074 feet; text-fig. 3) and consist of only the Tenkiller Formation and Blackgum Formation. Individual thickness of each unit is uncertain because both the Tenkiller and Blackgum are present in sample 4,047-4,055. Sylvan Shale was encountered in sample 4,074-4,085. One thin section was prepared of the Tenkiller Formation from sample 4,028-4,035.

Depth (feet)	*Thickness (feet)*	
4,000-4,028	28	CHATTANOOGA FORMATION: Black and brown pyritic shale.
		TENKILLER FORMATION: Gray to dark-gray pyritic limestone; some orange crinoidal material; light-gray to clear, opaque to semiopaque chert. Thickness uncertain, as Tenkiller is present with Blackgum in sample 4,047-4,055. Thin section (L-1) was prepared from sample 4,028-4,035.
4,028-4,035	7	Limestone, gray to dark-gray, pyritic; some orange crinoidal material, 5% residue. Thin section (L-1) was prepared from this interval.
4,035-4,047	12	Limestone, as above; chert, light-gray to clear, opaque to semiopaque, 5%.
4,047-4,055	8	Limestone, as above, 35-40%; limestone, dark-gray, dolomitic, glauconitic, 20%; dolomite, light-gray to gray, fine-crystalline, 25%; chert, gray, opaque, 15% (Blackgum).
		BLACKGUM FORMATION: Dark-gray glauconitic dolomitic limestone; gray to dark-gray fine-crystalline glauconitic calcitic dolomite; dark-gray to gray to clear, opaque to semiopaque chert. Thickness uncertain, as it is present with Tenkiller in sample 4,047-4,055.
4,055-4,065	10	Limestone, dark-gray, dolomitic, glauconitic, 35%; dolomite, light-gray to gray, fine-crystalline, 40%; chert, gray to dark-gray to clear, opaque to semiopaque, 20-25%.
4,065-4,074	9	Dolomite, light-gray to gray, calcitic, fine-crystalline, glauconitic, 55%; chert, dark-gray to gray to clear, opaque to semiopaque, 45%; trace of brown fine-crystalline dolomite.
4,074-4,100	26	SYLVAN FORMATION: Thickness not determined, as the samples were studied only to 4,100 feet. Gray to gray-green shale.

WELL M
Carter Oil Company, 1 Graham

This well is in NW¼ SE¼ NE¼ sec. 3, T. 9 N., R. 16 E., McIntosh County, about 2 miles west of Eufaula (text-figs. 3, 15). The well was drilled with rotary tools in 1951, and the collar elevation is 713 feet. Cuttings were studied from 4,650 to 4,800 feet in intervals of 5 feet, and the sample quality is good. Frezon (1962, pls. I, II) assigned rocks in this well to the St. Clair undifferentiated upon the basis of sample examination. Lower Devonian rocks are absent in this well (text-figs. 3, 15). Silurian rocks are 137 feet thick (4,655-4,792? feet; text-fig. 3) and comprise four units: Quarry Mountain Formation 109? feet (4,655-4,764?), Marble City Member 100 feet (4,655-4,755) and Barber Member 9? feet (4,755-4,764?; contact estimated from the electric log as Barber and Tenkiller are present in sample 4,760-4,765), Tenkiller Formation, and Blackgum Formation 28? feet (4,764?-4,792?). Individual thicknesses of Tenkiller and Blackgum are uncertain, as Barber and Tenkiller are present in sample 4,760-4,765, Tenkiller and Blackgum are mixed in sample 4,770-4,775, and Blackgum and Sylvan are present in sample 4,790-4,795. The Sylvan Shale was encountered in sample 4,790-4,795 and the electric log indicates the top at 4,792 feet. The Barber Member is thin, consisting of only 9 feet of dolomite. Two thin sections were prepared from the following intervals: Marble City Member, 4,675-4,680, and Blackgum Formation, 4,780-4,785. The photomicrograph of the thin section from the Blackgum Formation is on plate XVIII, figure 5.

Depth (feet)	*Thickness (feet)*	
4,650-4,655	5	*Sylamore Sandstone:* Dolomitic medium-grained sandstone.
		QUARRY MOUNTAIN FORMATION: 109 feet (4,655-4,764?; Barber-Tenkiller contact estimated from the electric log, as both are present in sample 4,760-4,765).
		Marble City Member: 100 feet (4,655-4,755). Off-white to white pink-crinoidal limestone; in part dolomitic; gray fine-crystalline dolomite. Thin section (M-1) was prepared from sample 4,675-4,680.
4,655-4,660	5	Limestone, off-white; some pink crinoidal material; in part dolomitic.
4,660-4,665	5	Limestone, as above; trace gray fine-crystalline dolomite.
4,665-4,670	5	Limestone, off-white, dolomitic; some pink crinoidal material; dolomite, gray, fine-crystalline, 40-45%.
4,670-4,675	5	Limestone, as above; dolomite, as above, 3-5%.
4,675-4,690	15	Limestone, off-white; abundant pink crinoidal material; in part dolomitic; dolomite, gray, fine-crystalline, 15-20%; thin section (M-1) was prepared from sample 4,675-4,680.
4,690-4,695	5	Limestone, as above; dolomite, as above, 5%.

Depth (feet)	*Thickness (feet)*	
4,695-4,700	5	Limestone, as above; trace of dolomite, as above.
4,700-4,710	10	Limestone, off-white to white; in part slightly dolomitic; abundant pink crinoidal; dolomite, gray, fine-crystalline, 3-5%.
4,710-4,715	5	Limestone, as above, except more dolomitic; dolomite, as above, 5-10%.
4,715-4,720	5	Limestone, as above; dolomite, as above, only a trace.
4,720-4,725	5	Limestone, as above; except more dolomitic; dolomite as above, 3-5%.
4,725-4,730	5	Limestone, as above; dolomite, as above, only a trace.
4,730-4,750	20	Limestone, as above, except more dolomitic; dolomite, as above, 5%.
4,750-4,755	5	Limestone, off-white to white, highly dolomitic; dolomite, as above, 5%.
		Barber Member: 9? feet (4,755-4,764?; Barber-Tenkiller contact estimated from the electric log, as both are present in sample 4,760-4,765). Gray fine-crystalline calcitic dolomite.
4,755-4,760	5	Dolomite, calcitic, gray, fine-crystalline.
4,760-4,765	5	Dolomite, as above, 65%; limestone, gray to reddish, in part dolomitic, 35% (Tenkiller).
		TENKILLER FORMATION: Gray to dark-gray pinkish pyritic limestone; in part dolomitic and containing abundant orange crinoidal material. Thickness uncertain, as Barber and Tenkiller are both present in sample 4,760-4,765 and Tenkiller and Blackgum are mixed in sample 4,770-4,775. Samples were circulated at 4,775 for 15, 30, 60, 90, and 120 minutes. Samples 15, 30, and 60 minutes contain Tenkiller limestone. Samples 90 and 120 minutes contain Blackgum dolomite.
4,765-4,770	5	Limestone, light-gray to gray to dark-gray, pink; in part dolomitic; abundant orange crinoidal material; pyritic, 5-10% residue.
4,770-4,775	5	Limestone, as above; circulated at 4,775 for 15, 30, 60, 90, and 120 minutes; samples 15, 30, 60 minutes contain limestone as above; samples 90 and 120 minutes contain light-gray glauconitic calcitic dolomite (Blackgum).
		BLACKGUM FORMATION: Light-gray glauconitic calcitic dolomite; brown to tan fine-crystalline argillaceous dolomite; dark-gray glauconitic limestone; clear light-gray opaque chert. Thickness uncertain, as Blackgum is present with Tenkiller in sample 4,770-

Depth (feet)	*Thickness (feet)*	
		4,775 and Sylvan in sample 4,790-4,795. Thin section (M-2) was prepared from sample 4,780-4,785 and the photomicrograph is on plate XVIII, figure 5.
4,775-4,780	5	Limestone, dark-gray, glauconitic, 65%; dolomite, calcitic, light-gray, glauconitic, 35%.
4,780-4,785	5	Limestone, as above, 15%; dolomite, as above, 60%; chert, clear, light-gray, opaque, 25%; thin section (M-2), plate XVIII, figure 5.
4,785-4,790	5	Limestone, as above, 10%; dolomite, as above, 55%; chert, as above, 30%; dolomite, brown to tan, fine-crystalline, argillaceous, glauconitic, 5%.
4,790-4,795	5	Dolomite, brown to tan, argillaceous, 15%; chert, gray, opaque, 15%; shale, gray to green, 70%.
4,795-4,800	5	SYLVAN FORMATION: Thickness not determined, as the samples were studied only to 4,800 feet. The top of the Sylvan estimated from the electric log at 4,792 feet as it is present with Blackgum in sample 4,790-4,795. Gray to green shale.

WELL N
Bell Oil and Gas Company, 1 Grant

This well is in C S½ SE¼ NE¼ sec. 17, T. 11 N., R. 17 E., McIntosh County, about 10 miles northeast of Eufaula (text-fig. 3). The well was drilled in 1959 with rotary tools, and the collar elevation is 664 feet. Cuttings were examined from 2,785 to 2,835 feet in intervals of 5 feet, and the sample quality is good. Lower Devonian rocks are absent (text-fig. 3). Silurian rocks are 25? feet thick (2,795-2,820? feet; text-fig. 3) and consist of only the Tenkiller Formation and the Blackgum Formation. Individual thickness of each unit is uncertain, as Tenkiller and Blackgum are both present in sample 2,795-2,800, and Blackgum and Sylvan are present in sample 2,820-2,825. The Blackgum-Sylvan contact was estimated from the electric log at 2,820 feet. Blackgum present with Sylvan in sample 2,820-2,825 is attributed to sample lag or cavings. The Tenkiller-Blackgum contact cannot be distinguished on the electric log.

Depth (feet)	*Thickness (feet)*	
2,785-2,795	10	CHATTANOOGA FORMATION: Black and brown pyritic shale.
		TENKILLER FORMATION: Gray to light-gray dolomitic limestone. Thickness uncertain, as it is present with Blackgum in sample 2,795-2,800.
2,795-2,800	5	Limestone, dolomitic, gray to light-gray, 35%; dolomite, light-gray, fine-crystalline, 55%; chert, gray to light-gray, opaque, 10% (Blackgum).
		BLACKGUM FORMATION: Light-gray to gray fine-crystalline glauconitic dolomite; brown to tan fine-crystalline argillaceous dolomite; gray to dark-

Depth (feet)	Thickness (feet)	
		gray glauconitic limestone; gray to white opaque chert. Thickness uncertain, as it is present with Sylvan in sample 2,820-2,825.
2,800-2,805	5	Limestone, gray to dark-gray, dolomitic, glauconitic, 5-8% residue, 20%; dolomite, slightly calcitic, gray to light-gray, fine-crystalline, glauconitic, 40%; chert, gray to white, opaque, 40%.
2,805-2,810	5	Limestone, as above, 20%; dolomite, as above, 60%; chert, as above, 20%.
2,810-2,815	5	Limestone, as above, 10%; dolomite, as above, 55%; chert, as above, 35%; trace of brown to tan fine-crystalline dolomite.
2,815-2,820	5	Limestone, as above, 10%; dolomite, as above, 60%; chert, as above, 30%.
2,820-2,825	5	Dolomite, brown to tan, fine-crystalline, argillaceous, 60%; chert, as above, 10%; shale, gray to gray-green, 30% (Sylvan).
2,825-2,835	10	SYLVAN FORMATION: Thickness not determined as the samples were studied only to 2,835 feet. Gray to gray-green shale. Top of the Sylvan was estimated from the electric log at 2,820 feet.

WELL O

Western Oil and Gas Company, 1 Brandon

This well is in SE¼ NW¼ SE¼ sec. 17, T. 11 N., R. 16 E., McIntosh County, about 10 miles north of Eufaula (text-fig. 3). The well was drilled in 1959 with rotary tools, and the collar elevation is 639.5 feet. Cuttings were studied from 3,450 to 3,490 feet in intervals of 10 feet, and the sample quality is good. Lower Devonian rocks are absent in this well (text-fig. 3). Silurian rocks are 20 feet thick (3,460-3,480 feet; text-fig. 3) and consist of only the Blackgum Formation. This thickness is taken from the samples. The electric log suggests a Blackgum thickness of 11? feet (3,425-3,436). This discrepancy may be attributed to sample lag or mislabeling of the sample containers. The Sylvan Shale was encountered in sample 3,480-3,490, but the electric log suggests the top may be at 3,436.

Depth (feet)	Thickness (feet)	
3,050-3,060	10	CHATTANOOGA FORMATION: Black and brown pyritic shale.
		BLACKGUM FORMATION: 20 feet sample thickness (3,460-3,480), 11? feet electric-log thickness (3,425-3,436). Top of the Blackgum estimated on the electric log at 3,425 feet but the samples suggest the top at 3,460 feet. Blackgum-Sylvan contact estimated on the electric log at 3,436 but the samples suggest the contact at 3,480 feet. Gray to dark-gray dolomitic glauconitic limestone; clear to gray opaque chert; light-gray fine-crystalline dolomite.

Depth (feet)	*Thickness (feet)*	
3,460-3,470	10	Limestone, gray to dark-gray, dolomitic; 5-8% residue; chert, clear to gray, opaque, 5-10%.
3,470-3,480	10	Limestone, gray to dark-gray, dolomitic, glauconitic; 5-8% residue; chert, dark-gray, gray, clear, opaque, 30-35%; trace light-gray fine-crystalline dolomite.
3,480-3,490	10	SYLVAN FORMATION: Thickness not determined, as the samples were studied only to 3,490 feet. The electric log suggests the top of the Sylvan at 3,436 feet but samples suggest the top at 3,480 feet. Gray to gray-green shale.

WELL P
Superior Oil Company, 1 Lackey

This well is in SE¼ SE¼ NE¼ sec. 14, T. 12 N., R. 16 E., McIntosh County, about 17 miles north of Eufaula (text-figs. 3, 15). The well was drilled in 1959 with rotary tools, and the collar elevation is 642 feet. Cuttings were examined from 2,930 to 2,980 feet in intervals of 10 and 5 feet, and the sample quality is good. Lower Devonian rocks are absent in this well (text-figs. 3, 15). Silurian rocks are 30 feet thick (2,940-2,970 feet; text-fig. 3) and consist of only the Tenkiller Formation and the Blackgum Formation. Individual thickness of Tenkiller and Blackgum is uncertain owing to the presence of both in sample 2,940-2,950. The contact cannot be distinguished on the electric log. The Sylvan Shale was encountered in sample 2,970-2,975. One thin section was prepared of the Blackgum Formation from sample 2,960-2,965.

Depth (feet)	*Thickness (feet)*	
2,930-2,940	10	CHATTANOOGA FORMATION: Black and brown pyritic shale; 10% of the sample contains Sylamore sandstone.
		TENKILLER FORMATION: Gray to tan limestone; abundant orange crinoidal material. Thickness uncertain, as it is present with Blackgum in sample 2,940-2,950.
2,940-2,950	10	Limestone, gray to tan; abundant orange crinoidal material; 5% residue; 50% of sample Tenkiller; limestone, dark-gray, glauconitic, 10%; dolomite, light-gray, fine-crystalline, 25%; chert, gray to white, opaque, 15% (Blackgum).
		BLACKGUM FORMATION: Limestone, dolomitic, gray to dark-gray, glauconitic; light-gray to gray fine-crystalline dolomite; brown to tan fine-crystalline dolomite; white to gray opaque chert. Thickness uncertain, as it is present with Tenkiller in sample 2,940-2,950. Thin section (P-1) was prepared from sample 2,960-2,965.
2,950-2,960	10	Limestone, dolomitic, gray to dark-gray, glauconitic,

Depth (feet)	*Thickness (feet)*	
		3% residue, 40%; dolomite, light-gray to gray, fine-crystalline, 35%; chert, white to gray, opaque, 25%.
2,960-2,965	5	Limestone, as above, 25%; dolomite, as above, 40%; chert, as above, 35%; thin section (P-1) was prepared from this interval.
2,965-2,970	5	Dolomite, light-gray to gray, fine-crystalline; in part glauconitic; 70%; chert, white, gray, opaque, 30%; trace of brown to tan fine-crystalline dolomite.
2,970-2,980	10	SYLVAN FORMATION: Thickness not determined, as the samples were studied only to 2,980 feet. Gray-green shale.

WELL Q
W. T. Campbell, 1 Haggard

This well is in NW¼ NW¼ NE¼ sec. 6, T. 12 N., R. 16 E., McIntosh County, about 20 miles north of Eufaula (text-figs. 3, 15). The well was drilled in 1955, and the elevation is not available. Cuttings were studied from 3,070 to 3,130 feet in intervals of 10 feet, and the sample quality is good. Lower Devonian rocks are absent in this well (text-figs. 3, 15). Silurian rocks are 37? feet thick (3,090?-3,127? feet; text-fig. 3) and consist of only the Tenkiller Formation, Blackgum Formation, and Pettit Oölite. This thickness was taken from the electric log. The samples suggest the top of the Silurian rocks at 3,080 and the base in sample interval 3,110-3,120. This discrepancy may be attributed to mislabeling of the sample containers, careless sampling methods, or misreading of the electric log. Individual thicknesses of Tenkiller, Blackgum, and Pettit are uncertain owing to presence of Tenkiller and Blackgum in sample 3,080-3,090 and of Blackgum, Pettit, and Sylvan in sample 3,110-3,120. Sylvan Shale was encountered in sample 3,110-3,120, but the electric log suggests the top at 3,127 feet.

Depth (feet)	*Thickness (feet)*	
3,070-3,080	10	CHATTANOOGA FORMATION: Black and brown pyritic shale.
		TENKILLER FORMATION: Light-gray to gray limestone, with abundant orange crinoidal material. Thickness uncertain, as it is present with Blackgum in sample 3,080-3,090. The top of the Tenkiller was found to be 3,080 in the samples but 3,090? on the electric log.
3,080-3,090	10	Limestone, light-gray to gray; abundant orange crinoidal material; 1-2% residue; 45% Tenkiller in the sample; limestone, light-gray to dark-gray, highly glauconitic; 2-3% residue, 55% (Blackgum).
		BLACKGUM FORMATION: Light-gray to dark-gray dolomitic glauconitic limestone; light-gray to dark-gray brown fine-crystalline dolomite; gray to dark-gray opaque chert. Thickness uncertain, as it is

Depth (feet)	*Thickness (feet)*	
		present with Tenkiller in sample 3,080-3,090 and with Sylvan in sample 3,110-3,120.
3,090-3,100	10	Limestone, light-gray to gray, dolomitic, glauconitic; chert, gray to light-gray, opaque; 3-5%.
3,100-3,110	10	Limestone, as above, 45%; dolomite, light-gray to dark-gray, 25-30%; chert, gray, opaque, 20-25%.
		Pettit Oölite: Gray to dark-gray oölite. Thickness uncertain as it is mixed with Blackgum and Sylvan in sample 3,110-3,120.
3,110-3,120	10	Dolomite, light-gray, brown to tan, fine-crystalline; in part glauconitic, 65%; chert, gray to dark-gray to light-gray, opaque, 35%; few pieces of dark-gray to gray oölite present.
3,120-3,130	10	SYLVAN FORMATION: Thickness not determined, as the samples were studied only to 3,130 feet. Samples suggest the top of the Sylvan between 3,110-3,120 feet, but the top was estimated from the electric log at 3,127 feet. Gray-green shale.

Appendix II. Chemical Data

Listed herein are the chemical analyses from diamond cores OGS 1, OGS 2, OGS 3, SCL 1, SCL 2, 34Y, and 29Z. Also included are analyses of spot samples from stratigraphic section Ch2. These analyses were prepared in the chemical laboratory of the Oklahoma Geological Survey by John A. Schleicher. Additional analyses of Silurian and Early Devonian rocks have been published by Ham and others (1943) and Amsden (1961). The chemical data given in Amsden for the "St. Clair Formation" are for strata herein referred to the upper part of the Marble City Member of the Quarry Mountain Formation. Most of the chemical data given in Ham and others for the "St. Clair" are from the Marble City Member, but locally they appear to have included some Frisco and Sallisaw strata (Devonian) at the top, and some of the Barber Member at the base.

The diamond cores were prepared in the following manner. Each core was sawed lengthwise into unequal parts, the larger part being retained for study and permanent file, and the smaller part used for chemical analysis. The sawed cores were first studied to determine their lithologic character and then assigned to the lithostratigraphic divisions herein recognized. One half of each core was stained with Lemberg stain and a visual estimate was made of the distribution of calcite and dolomite. Upon the basis of this visual examination, the various formations and members were further subdivided into smaller units for chemical analysis. The smaller parts of the sawed cores were then collected into sample lots representing these different subdivisions; each sample was crushed in a jaw-crusher to approximately ¼-inch fragments, split by means of a riffle splitter to approximately two pounds, and ground in a Braun pulverizer until it would pass a 60-mesh screen*. The diamond-core analyses given on the following pages thus represent continuous and complete channel samples of the Silurian rocks penetrated.

The diamond cores are represented by two different sets of chemical data.

(1) Analyses giving only the HCl-insoluble-residue, $CaCO_3$, and $MgCO_3$ contents. These represent the most complete stratigraphic sampling and were prepared by digesting the pulverized sample in dilute HCl and then analysing the soluble portion by titration to determine total calcium and magnesium, which were then converted to equivalent $CaCO_3$ and $MgCO_3$. The acid insolubles, $CaCO_3$, and $MgCO_3$ are reported as percentages. Schleicher reports that the precision of this method is on the order of 0.1% or better.

(2) Complete analyses, including trace elements, of larger stratigraphic intervals. Weighted samples were prepared by combining portions of the samples representing the smaller intervals as follows. The pulverized samples were thoroughly mixed and then combined by taking 1 gram for each foot in each sample which was to be included. These were then analysed for the following: $CaCO_3$, $MgCO_3$ (see above), SiO_2, R_2O_3, Fe_2O_3, Al_2O_3,

* Pulverizing to this size gives maximum solubility; samples which are crushed to pieces only 3 or 4 mm or smaller generally yield greater insoluble-residue contents.

P_2O_5, K_2O, S, and loss on ignition (LOI). These are reported as percentages. In addition, a semiquantitative emission spectrochemical analysis was performed on the composite samples by use of artificial external standards to determine the trace elements present. These are reported in parts per million; reproducibility is estimated at 20 to 30 percent.

In addition to the cores, we include analyses of spot samples collected from stratigraphic section Ch2 on the shore of Lake Tenkiller. These represent rock samples (not channel samples) collected from the Blackgum and Tenkiller Formations. These are given as percentages.

Illustrations depicting the distribution of acid insolubles, $MgCO_3$, and $CaCO_3$ in the various Silurian lithostratigraphic units appear in text-figures 2, 4, 9, 10, 12, 13, 14, 15, 18, and 19, and in plates A and B (stratigraphic sections).

The lithostratigraphic descriptions and exact geographic locations of the diamond cores and stratigraphic sections are given in appendices IA and IB; locations are shown on plates A and B, and text-figure 3.

Diamond Core OGS 1
Malloy Hollow
(see text-fig. 10)

Formation or Member	*Depth (feet)*	*HCl Insolubles (%)*	*$CaCO_3$ (%)*	*$MgCO_3$ (%)*	*Total (%)*
Marble City Member	2	0.22	99.49	0.51	100.22
	4- 8	0.24	98.81	1.46	100.51
	8- 14	0.15	99.59	0.22	99.96
	14- 20	0.14	99.42	0.66	100.22
	20- 23	0.48	98.94	0.98	100.40
	23- 23.5	0.34	87.31	12.60	100.25
	23.5- 28	0.26	99.26	0.77	100.29
	28- 33	0.20	99.41	0.47	100.08
	33- 36	0.18	99.47	0.70	100.35
Barber Member	36- 41	0.18	88.89	11.30	100.37
	41- 44	0.21	83.37	16.71	100.29
	44- 48	0.15	99.52	0.58	100.25
	48- 53	0.21	94.34	5.92	100.47
	53- 58	0.15	99.57	0.80	100.52
	58- 68	0.25	85.14	14.65	100.04
	68- 74	0.15	99.78	0.63	100.56
	74- 78	0.29	83.27	16.91	100.47
	78- 83	0.59	64.39	35.21	100.19
	83- 89	0.99	63.15	36.27	100.41
	89- 91	1.10	80.17	19.11	100.38
	91- 94	1.12	66.74	32.68	100.54
Tenkiller Formation	94- 97	1.62	69.17	29.59	100.38
	97-103	4.75	92.79	2.83	100.37
	103-108	1.83	94.81	3.48	100.12
	108-115	1.68	94.50	4.06	100.24
Blackgum Formation	115-120	2.63	84.16	13.16	99.95
	120-126	3.37	84.02	12.75	100.14
	126-130	9.72	66.93	20.73	97.38*
Sylvan Shale (Ord.)	130-134	No analyses			

* Appreciable acid-soluble iron.

Diamond Core OGS 2
Southeast of Barber
(see text-fig. 10)

Formation or Member	*Depth (feet)*	*HCl Insolubles (%)*	*$CaCO_3$ (%)*	*$MgCO_3$ (%)*	*Total (%)*
Barber Member	0- 5	0.20	81.35	18.90	100.45
	5-10	0.12	81.33	18.85	100.30
	10-15	0.17	85.52	14.62	100.31
	15-20	0.24	78.20	22.02	100.46
	20-25	0.51	75.52	24.58	100.61
	25-30	0.53	73.84	26.08	100.45
	30-35	0.66	71.22	28.13	100.01
	35-42	1.30	68.47	30.64	100.41
Tenkiller Formation	42-45	2.89	84.64	12.81	100.34
	45-52	5.60	92.35	2.34	100.29
	52-58	2.91	94.55	2.90	100.36
Blackgum Formation	58-65	4.57	86.31	9.65	100.53
	65-69	8.92	66.79	22.79	98.50*
Sylvan Shale (Ord.)	69-72.5	No analyses			

* Soluble iron 1.41%.

Diamond Core OGS 3
West of Lake Tenkiller Dam
(see text-fig. 10)

Formation or Member	*Depth (feet)*	*HCl Insolubles (%)*	*$CaCO_3$ (%)*	*$MgCO_3$ (%)*	*R_2O_3 (%)*	*Total (%)*
Marble City Member	0- 5	0.24	95.95	3.75		99.94
	5- 13	0.26	95.83	4.17		100.26
	13- 23	0.15	98.94	1.21		100.30
	23- 30	0.09	99.21	0.87		100.17
	30- 41	0.10	98.02	2.15		100.27
	41- 46	0.25	96.29	3.79		100.33
	46- 59	0.16	98.74	1.41		100.31
	59- 70	0.20	94.83	5.49		100.52
Barber Member	70- 80	0.25	83.85	16.43		100.53
	80- 90	0.38	86.06	14.14		100.58
	90-100	0.27	85.80	14.47		100.54
	100-115	0.82	77.63	21.78		100.23
	115-120	0.80	67.66	31.89		100.35
Tenkiller Formation	120-129	2.25	67.10	30.82		100.17
	129-135	7.36	90.38	2.01	0.18	99.93
	135-142	4.63	93.61	1.67	0.22	100.13
? Blackgum Formation	142-142.5	No analyses				
Sylvan Shale (Ord.)	142.5-187	No analyses				
"Fernvale" Formation	187-197	5.36	93.45	0.57	0.49	99.87
	197-207	2.94	95.76	0.64	0.55	99.89
Fite Limestone	207-217	No analyses				
	217-227	3.10	75.72	21.22	0.51	100.55
Tyner Formation	227-237	21.29	49.19	28.29	1.59	100.36
	237-242	31.11	38.36	28.75	1.27	99.49

Diamond Core SCL 1
St. Clair Lime Company Quarry

Formation or Member	*Depth (feet)*	*HCl Insolubles (%)*	*$CaCO_3$ (%)*	*$MgCO_3$ (%)*	*Total (%)*
Frisco Formation (Dev.)	17.6- 22	No analyses			
Marble City Member	22- 30	0.26	98.94	0.76	99.96
	30- 40	0.19	99.50	0.47	100.16
	40- 50	0.66	98.81	0.57	100.04
	50- 60	0.37	96.53	3.50	100.40
	60- 70	0.29	96.99	2.86	100.14
	70- 79	0.22	97.79	2.32	100.33
	79- 81	0.24	95.73	4.10	100.07
	81- 85	0.25	94.61	5.61	100.47
Barber Member	85- 90	0.17	90.07	10.16	100.40
	90- 96	0.17	90.20	10.13	100.50
	96-100	0.29	93.30	6.49	100.08

Diamond Core SCL 2
St. Clair Lime Company Quarry
(see text-fig. 10)

Formation or Member	*Depth (feet)*	*HCl Insolubles (%)*	*$CaCO_3$ (%)*	*$MgCO_3$ (%)*	*R_2O_3 (%)*	*Total (%)*
Barber Member	0- 6	0.11	90.44	9.36		99.91
	6- 12	0.16	85.54	14.29		99.99
	12- 18	0.23	79.62	20.10		99.95
	18- 24	0.13	84.57	15.33		100.03
	24- 30	0.15	85.08	14.70		99.93
	30- 36	0.25	80.22	19.59		100.06
	36- 42	0.43	76.08	23.70		100.21
	42- 48	0.56	73.93	25.61		100.10
	48- 54	0.70	76.07	23.39		100.16
	54- 59	0.90	72.66	26.52	0.14	100.22
Tenkiller Formation	59- 69	1.20	79.46	19.50		100.16
	69- 86	2.63	91.51	5.65		99.79
Blackgum Formation	86- 93	2.55	85.10	11.61	0.62	99.88
	93- 97	4.43	60.13	32.25	2.61	99.42
Pettit Oölite	97- 97.25	No analyses				
Sylvan Shale (Ord.)	97.25-100	No analyses				

Diamond core 29Z

Southwest of St. Clair Lime Company Quarry

(see text-fig. 10)

Formation or Member	*Depth (feet)*	*HCl Insolubles (%)*	*$CaCO_3$ (%)*	*$MgCO_3$ (%)*	*Total (%)*
No core recovered	0- 18				
Sallisaw Formation	18- 20.5	No analyses			
Frisco Formation	20.5- 25.5	No analyses			
Marble City Member	25.5- 28	No analyses			
	28- 59	0.60*	98.96*	0.87*	100.43*
	59- 89	0.38*	98.19*	1.81*	100.38*
	89- 95	No analyses			
Barber Member	95-110	No analyses			
	110-122	0.31	84.41	15.72	100.44
	122-132	0.36	79.86	20.08	100.30
	132-137	0.26	94.26	5.72	100.24
	137-168	0.76	78.10	21.43	100.29
	168-185	0.90	95.65	3.52	100.07
	185-191	2.13	62.05	35.80	99.98
Tenkiller Formation	191-205	2.51	94.71	2.69	99.91
Blackgum Formation	205-213	3.12	87.32	9.45	99.89

* Analysis by Shilstone Testing Laboratory for the St. Clair Lime Company.

Diamond core 34Y
Southwest of St. Clair Lime Company Quarry

Formation or Member	Depth (feet)	HCl Insolubles (%)	$CaCO_3$ (%)	$MgCO_3$ (%)	Total (%)
No core recovered	0- 14				
Chattanooga Formation	14- 23	No analyses			
Sallisaw Formation	23- 34	No analyses			
Frisco Formation	34- 41.5	No analyses			
Marble City Member	41.5- 46	0.94	85.08	14.37	100.39
	46- 51	0.39	99.32	0.60	100.31
	*51	0.69	69.98	29.91	100.58
	†51- 57	0.40	99.39	0.67	100.46
	57- 64	1.52	97.91	0.67	100.10
	64- 68	0.97	98.93	0.54	100.44
	68- 72	0.66	96.83	2.90	100.39
	72- 74	0.19	99.46	0.63	100.28
	74- 80	0.44	94.89	5.02	100.35
	80- 83	0.10	96.78	3.55	100.43
	83- 95	0.10	91.83	8.56	100.49
	95- 98	0.06	96.40	4.00	100.46
Barber Member	98-110	0.08	81.57	18.39	100.04
	110-116	0.11	76.26	23.67	100.04

* 1-inch-thick bed.
† Analysis does not include 1-inch bed above; analysed interval begins at 51′1″.

Stratigraphic section Ch2
Blackgum Landing, Lake Tenkiller

Analyses of rock specimens (not channel samples); for detailed stratigraphic information see pages 91-94.

Formation or Member	Sample No.	HCl Insolubles (%)	$CaCO_3$ (%)	$MgCO_3$ (%)	R_2O_3 (%)	Total (%)
Tenkiller Formation	Ch2-E(3)	5.04	93.71	1.70		100.45
	Ch2-E(2)	7.44	91.39	1.42		100.25
	Ch2-E(1)	2.02	95.75	2.07		99.84
Blackgum Formation						
upper limestone member	Ch2-D(3)	3.13	93.72	3.02		99.87
	Ch2-D(2)	4.09	89.88	6.54		100.51
	Ch2-D(1)	2.84	92.55	4.64		100.03
tan dolomite member	Ch2-C	7.24	65.33	25.76	1.57	99.90
	Ch2-A	12.06	54.77	30.97	2.11	99.91

Complete Chemical Analyses of Diamond Cores

FORMATION OR MEMBER	DEPTH (FEET)	WET ANALYSIS (PERCENT)													SPECTROGRAPHIC ANALYSIS (PARTS PER MILLION)										
		$CaCO_3$	$MgCO_3$	CaO	MgO	SiO_2	R_2O_3	Fe_2O_3	Al_2O_3	P_2O_5	S	K_2O	LOI	Total	B	Cu	Pb	Mn	Ag	Ni	Cr	Ba	Sr	Mo	Na*
DIAMOND CORE OGS 1																									
Marble City	4- 36	99.38	0.64	55.68	0.31	0.02	0.15	0.11	0.04		0.02		44.08	100.26	tr	tr		100					200		
Barber	36- 74	92.15	7.70	51.63	3.68	0.02	0.21	0.14	0.07		0.03	0.01	44.60	100.18	tr	2		200		0.5			200		
Barber	74- 94	70.07	29.40	39.26	14.06	0.28	0.47	0.25	0.22	tr	0.13	0.06	45.88	100.14		3		500		1		5	200		x
Tenkiller	94- 97	72.16	26.67	40.43	12.75	0.72	0.73	0.32	0.41	0.02	0.08		45.40	100.13	tr	5	5	500		2		10	500		
Tenkiller	97-115	93.81	3.70	52.56	1.77	1.42	0.93	0.28	0.65	0.07	0.10	0.25	43.10	100.20	tr	2	10	700		5		150	500		x
Blackgum	115-130	79.33	15.18	44.45	7.26	3.92	1.51	0.85	0.66	0.16	0.15	0.20	42.59	100.24	tr	15	20	1,000		25	6	50	200	2	x
DIAMOND CORE OGS 2																									
Barber	0- 42	75.93	23.42	42.54	11.20	0.27	0.37	0.19	0.18	tr	0.01	0.05	45.68	100.12	10	2	2	250					200		
Tenkiller	42- 45	84.47	12.86	47.33	6.15	1.58	1.11	0.36	0.75	0.01	0.07		43.68	99.93	tr	2	10	100				15	200		x
Tenkiller	45- 58	92.76	2.78	51.97	1.33	3.22	1.06	0.35	0.71	0.05	0.17	0.41	41.96	100.17	5	1	4	200		tr	<3	100	300		x
Blackgum	58- 69	82.22	11.81	46.07	5.65	4.26	1.73	1.00	0.73	0.18	0.34	0.19	41.81	100.23	0.5	5	5	300		1	<3	20	200		x
DIAMOND CORE OGS 3																									
Marble City	0- 70	96.97	2.76	54.33	1.32	0.07	0.19	0.09	0.10		tr	0.01	44.07	99.99	3	10	3	500	1				100	tr	
Barber	70-120	81.30	18.26	45.55	8.73	0.11	0.31	0.19	0.12	tr	0.03	0.02	45.43	100.18	2	10	2	100	tr			5	50		
Tenkiller	120-129	67.07	30.51	37.58	14.59	1.15	0.99	0.35	0.64	tr	0.08	0.30	45.46	100.15	3	10	2	100	tr	tr	<3	20	50		x
Tenkiller	129-142	91.54	1.90	51.29	0.91	4.03	1.51	0.74	0.77	0.06	0.41	0.50	41.25	99.96	tr	10	10	100	tr	1		5	100		x
DIAMOND CORE SCL 1																									
Marble City	22- 50	99.20	0.54	55.58	0.26	0.18	0.17	0.08	0.09		0.02	0.01	43.89	100.11	0.5	1	1	100		tr			50	1	x
Marble City	50- 79	96.90	2.91	54.29	1.39	0.12	0.18	0.12	0.06		0.04	0.04	44.06	100.12	2	5	3	250		tr			75	1	x
DIAMOND CORE SCL 2																									
Barber	0- 59	80.08	19.58	44.87	9.36	0.14	0.24	0.14	0.10		0.01	0.02	45.36	100.00	2	1	2	100	tr	tr			25		
Tenkiller	59- 86	86.44	11.02	48.43	5.27	0.97	1.22	0.55	0.67	0.02	0.23	0.17	43.88	100.19	0.5	3	5	200	tr	0.5		40	75	tr	x
Blackgum	86- 97	77.46	18.24	43.40	8.72	2.27	1.89	1.26	0.63	0.18	0.06	0.20	43.71	100.43	0.5	1	2	400		tr		10	100		x
DIAMOND CORE 29Z																									
Marble City	28- 59	98.43	0.65	55.15	0.31	0.22	0.33	0.22	0.11		0.15		44.11	100.27	2	2	2	100		tr	3	10	100	400	x
Marble City	59- 89	97.95	1.72	54.88	0.82	0.19	0.13	0.07	0.06		0.03		44.18	100.23	2	10	10	200					50	200	x
Barber	110-168	80.60	19.10	45.16	9.13	0.17	0.37	0.21	0.16	tr	0.10	0.01	45.22	100.16	5	15	2	400		tr			40	75	x

* Qualitatively only.
Tr Trace.

Trace Elements in Surface Samples of Tenkiller Formation

(Concentrations given in parts per million)

Location	*SW-SE 14 13N-23E*	*SE 32 14N-22E*	*SE 32 14N-22E*	*SE 32 14N-22E*
Sample No.		*Cb2-E(3)*	*Cb2-E(1)*	*Cb2-E(?)*
Analysis No.	*646*	*647*	*648*	*649*
Ba	20	20	10	5
Sr	400	300	250	100
B	0.2	0.3	0.3	0.1
Mn	200	300	300	300
Pb	10	5	3	10
Ni	1	3	5	3
Mo	tr	tr	0.5	tr
Ag	tr	tr	0.1	0.1
Cr	tr	tr	tr	nil

(**Boldface** indicates a main reference)