

Calloway Creek Limestone and Ashlock and Drakes Formations (Upper Ordovician) in South-Central Kentucky

By GORDON W. WEIR, ROBERT C. GREENE, and GEORGE C. SIMMONS

CONTRIBUTIONS TO STRATIGRAPHY

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CONTRIBUTIONS TO STRATIGRAPHY

CALLOWAY CREEK LIMESTONE AND ASHLOCK AND DRAKES FORMATIONS (UPPER ORDOVICIAN) IN SOUTH-CENTRAL KENTUCKY

By GORDON W. WEIR, ROBERT C. GREENE, and GEORGE C. SIMMONS

ABSTRACT

Upper Ordovician rocks in south-central Kentucky are divided into lithologically distinct formations chiefly on the basis of contrasts in their mudstone and limestone content. From the top of the Garrard Siltstone to the top of the Ordovician are three newly defined map units; in ascending order, these are the Calloway Creek Limestone and the Ashlock and Drakes Formations.

The Calloway Creek Limestone is chiefly gray thin-bedded fossiliferous fine- to medium-grained limestone having partings and seams of greenish-gray shale; the lower part of the formation includes greenish-gray thin-bedded limy siltstone. The Calloway Creek ranges from about 80 to 130 feet in thickness.

The lower part of the Ashlock Formation is chiefly greenish-gray very sparsely fossiliferous limy and dolomitic mudstone; the middle part consists of bluish- and light-gray fossiliferous aphanitic to medium-grained and silty limestone; the upper part consists of greenish-gray unfossiliferous limy and dolomitic mudstone overlain by gray thin-bedded fossiliferous micrograined, medium-grained, and silty limestone. The Ashlock Formation ranges from about 125 to 145 feet in thickness.

The Drakes Formation is chiefly grayish-green unfossiliferous limy and dolomitic mudstone; the upper part contains thin beds of yellowish-gray sparsely fossiliferous fine-grained dolomitic limestone. The Drakes Formation ranges from about 120 to 150 feet in thickness.

INTRODUCTION

Geologic mapping and stratigraphic studies show the need for new names for lithologic divisions of the Upper Ordovician rocks in south-central Kentucky (figs. 1 and 2). Previous stratigraphic nomenclature (fig. 3), developed by stratigraphers during the early part of this century, was largely concerned with paleontological divisions of Upper Ordovician strata near Cincinnati, Ohio, and in southeastern Indiana. The development of the nomenclature of the Upper Ordovician rocks of Ohio and Indiana is beyond the scope of this paper, but it has been recently reviewed by Gutstadt (1958, p. 518-521), Weiss and Norman

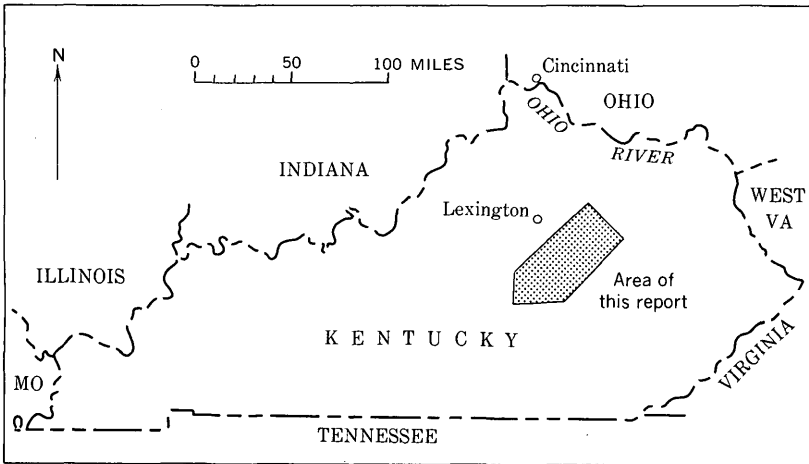


FIGURE 1.—Area of this report.

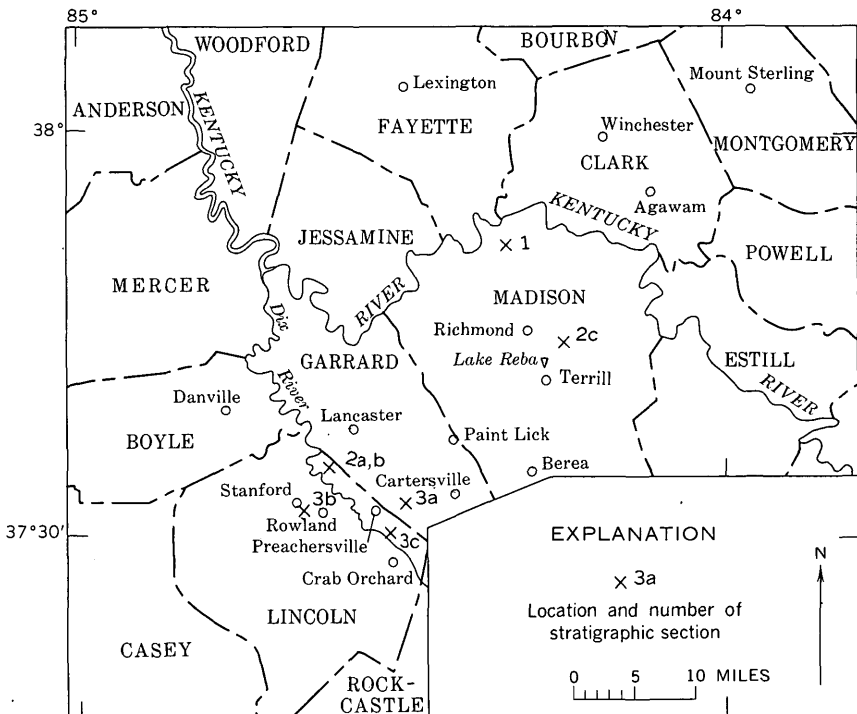


FIGURE 2.—Locations of stratigraphic sections in south-central Kentucky: 1, Calloway Creek; 2a, Ashlock Cemetery West; 2b, Ashlock Cemetery; 2c, Lake Reba; 3a, East Fork of Drakes Creek; 3b, Rowland West; 3c, Preachersville Southeast.

(1960), and Fox (1962, p. 622-628). These authors pointed out that there has been much confusion between faunal units and rock units. Most of the named divisions in Ohio and Indiana were characterized by their fossils rather than lithology. The names of these divisions, called formations and members, were applied in south-central Kentucky to presumed time-equivalent units whose fossils or stratigraphic relations were similar to those of named divisions in Ohio and Indiana.

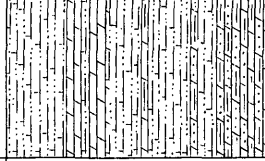
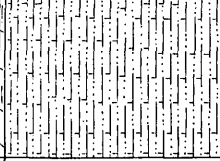



Whatever the suitability of the previous nomenclature in Ohio and Indiana, the stratigraphic names used there are inadequate for the Upper Ordovician rocks of south-central Kentucky because the lithology of this part of the section changes markedly between the two regions. The Upper Ordovician section in south-central Kentucky contains more mudstone, argillaceous limestone, and micrograined to fine-grained limestone than the approximately equivalent section near the Ohio River.

The inadequacy of the nomenclature of the Cincinnati area for Upper Ordovician rocks of central Kentucky was long ago suspected by Foerste (1912, p. 22), who had earlier introduced many of the Ohio and Indiana names into Kentucky:

Owing to the considerable lithological and accompanying faunal differences between the Cincinnati strata as exposed in Ohio and Indiana, and their approximate stratigraphical equivalents in central Kentucky, it may prove convenient, locally, to recognize only the greater subdivisions of the Cincinnati strata, as proposed at the typical section, at Cincinnati, Ohio, and to adopt a somewhat different set of subdivisions southward.

The following names of stratigraphic units whose type localities are in Ohio and Indiana and which have been applied to units in central Kentucky (fig. 3) are inappropriate for the Upper Ordovician lithologic divisions in south-central Kentucky: Fairview, Fairmount, McMillan, Mount Auburn, Arnheim, Oregonia, Waynesville, Whitewater, and Liberty. To this list is added the name Sunset, applied to a unit whose type locality is in northeast-central Kentucky. These names have been used for stratigraphic units whose limits are defined by their fossils or whose typical lithology is not present in south-central Kentucky. The names Garrard, Tate, and Gilbert are retained for rock-stratigraphic units whose type localities are in south-central Kentucky; these units are more fully defined later in this report.

The strata in the south-central part of the State are divided into lithologically distinct formations and members chiefly on the basis of contrasts between mudstone and limestone. The proposed nomenclature (fig. 3) includes three formations that are defined in this paper; these are, in ascending order, the Calloway Creek Limestone, and Ashlock and Drakes Formations. The type sections of these formations are described in measured sections 1 (p. D20), 2b (p. D24), and 3a (p. D30).

NOMENCLATURE Used by Palmquist and Hall (1960, 1961)	LITHOLOGY	NOMENCLATURE Used in this report	THICK- NESS (FEET)	GENERALIZED DESCRIPTION
RICHMOND GROUP		Preachersville Member	55-95	Silty mudstone as below and thin beds of argillaceous dolomitic limestone, yellowish-gray; relatively thick bed of dolomitic limestone near base, locally contains abundant fossils
				Silty mudstone, limy to dolomitic, grayish-green, thin-bedded, weathers yellowish gray; few megafossils
Waynesville limestone		Rowland Member	40-60	
Arnheim formation		Reba Member	10-25	Limestone, chiefly medium-grained, silty, gray, thin-bedded, fossiliferous
McMillan formation		Terrill Member	5-15	Limy shale, greenish-gray, platy; few megafossils
Gilbert limestone member of Foerste (1912)		Stingy Creek Member	5-15	Silty limestone and limy siltstone, fossiliferous grading at top to limy mudstone
		Gilbert Member	10-20	Limestone, aphanitic to medium-grained, bluish-gray, thin-bedded, fossiliferous

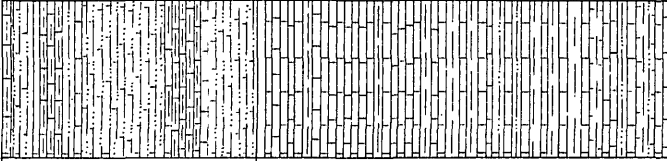
MAYSVILLE GROUP		ASHLOCK FORMATION		Tate Member		125-145	30-80	Chiefly limy mudstone, greenish-gray, laminated to medium-bedded; few megafossils; grading at top to argillaceous limestone	Limestone, fine- to coarse-grained, gray, fossiliferous, 4-to 8-ft thick
McMillan formation	Tate member as used by Foerste (1912)			CALLOWAY CREEK LIMESTONE		80-130		Limestone, chiefly fine- to medium-grained, gray, thin-bedded; fossiliferous; seams and partings of shale; thin beds of gray limy siltstone near base	
Fairview formation	Fairmount limestone member								

FIGURE 3.—Columnar section and nomenclature of Upper Ordovician rocks overlying the Garrard Siltstone in south-central Kentucky.

This report is based in large part on the geological mapping of Kentucky being conducted by the U.S. Geological Survey in cooperation with the Kentucky Geological Survey. Areas not currently being mapped were studied by the writers chiefly in late 1963 and early 1964. Of special help was the information contributed by E. R. Cressman, J. L. Gualtieri, W. L. Peterson, and F. A. Schilling, all of the U.S. Geological Survey.

GARRARD SILTSTONE

The Garrard Siltstone¹ (Campbell, 1898; Nosow and McFarlan, 1960, p. 43) underlies the Calloway Creek Limestone. The Garrard, named for Garrard County, Ky., is chiefly limy siltstone and minor mudstone and limestone. The siltstone is gray and very limy where fresh, but in most outcrops it is weathered yellowish brown where much of the carbonate has been leached out. Most beds are 6 to 24 inches thick; thicker beds are commonly contorted. Many of the beds are obscurely laminated. The interbedded mudstone and limestone are mostly in lenses a few inches thick and a few feet to a few tens of feet long. Fossils are sparse except for brachiopods in sporadic lenses of limestone. The Garrard Siltstone is a moderately resistant unit that is about 10 to 100 feet thick in the area between Danville and Mount Sterling.

CALLOWAY CREEK LIMESTONE

The Calloway Creek Limestone is here named for Calloway Creek in north-central Madison County, Ky. The type section (measured section 1, p. D20) was described from roadcuts of Interstate Highway 75, beginning about 0.4 mile south of the Kentucky River and extending southward to a point 0.6 mile north of Kentucky Highway 388 (fig. 4).

The Calloway Creek Limestone is composed chiefly of limestone with interbedded shale and minor siltstone. The characteristic appearance of the formation in fresh cuts is shown in figure 5. Limestone, which makes up about 70 to 80 percent of the formation, is mostly gray, fine to medium grained, and in uneven beds 0.1 to 0.3 feet thick. Greenish-gray limy shale makes up about 15 to 25 percent of the formation and is interbedded with the limestone as partings or seams and, near the base, as thin sets as much as 0.5 feet thick. Limy siltstone

¹ The Paint Lick Bed of Foerste (1906, p. 212), probably named for outcrops near the village of Paint Lick in Garrard County, was said to be the lower, more massive part of the Garrard (Foerste, 1909, p. 293, and 1912, p. 17, 49; McFarlan, 1943, p. 24; Nosow and McFarlan, 1960, p. 43). Mapping of the Garrard Siltstone in Garrard County and near Paint Lick shows no extensive divisions of the Garrard. The original definition of the Garrard by Campbell (1898), though generalized, is useful. The name Paint Lick is a later synonym of Garrard and is not used in this report.

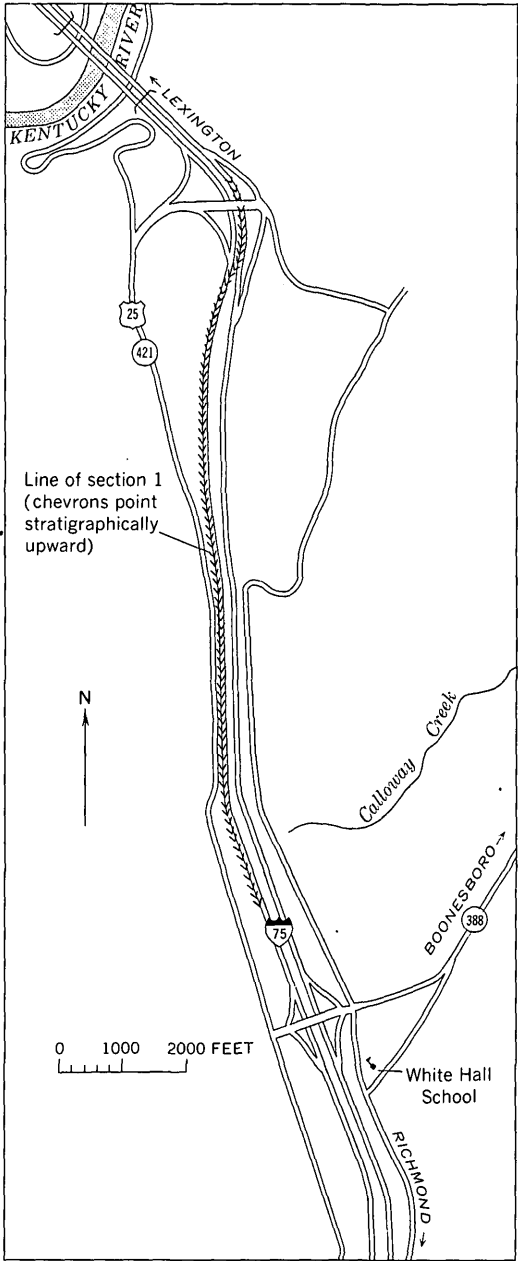


FIGURE 4.—Location of type section of the Calloway Creek Limestone, Madison County, Ky.



FIGURE 5.—Characteristic interbedding of granular limestone with seams and partings of shale near middle of the Calloway Creek Limestone. Type section of the Calloway Creek Limestone (measured section 1), roadcut on southbound lanes of Interstate Highway 75 about 1.5 miles south of the Kentucky River in Madison County, Ky.

makes up about 5 percent of the Calloway Creek and is in even beds less than 0.5 feet thick which are intercalated with shale and limestone in the lower third of the formation. The siltstone is gray to greenish gray, weathers yellowish brown, and resembles siltstone in the Garrard Siltstone. The formation is very fossiliferous. Brachiopods and bryozoans are the most abundant and conspicuous megafossils.

CONTACTS

The Calloway Creek Limestone is transitional with the underlying Garrard Siltstone and the overlying Ashlock Formation. The lower contact is placed so that all relatively persistent beds of limestone are included in the Calloway Creek. The contact generally lies above all siltstone beds more than 0.5 feet thick. The upper contact is placed so as to separate muddy limestone of the Calloway Creek from limy mudstone of the Ashlock.

EXTENT, THICKNESS, AND PROBABLE CORRELATIVES

The Calloway Creek Limestone has been mapped in Garrard and Madison Counties and has been recognized in sections from near Stan-

ford to near Mount Sterling. The formation is about 125 feet thick at its type locality and ranges from about 80 to 130 feet in thickness. Previous workers have correlated the beds here included in the Calloway Creek Limestone with the Fairmount Limestone Member of the Fairview Formation of the Cincinnati area (McFarlan and Goodwin, 1930).

ASHLOCK FORMATION

The Ashlock Formation is here named for the Ashlock Cemetery near U.S. Highway 27 about 0.1 mile north of the Dix River in north-eastern Lincoln County, Ky. The type section (measured section 2b, p. D24) was described from outcrops along the north bank of the Dix River and in roadcuts of U.S. Highway 27 north of the river (fig. 6).

The lower part of the Ashlock Formation is chiefly limy and dolomitic mudstone; the middle part is chiefly limestone and argillaceous limestone; and the upper part is greenish-gray unfossiliferous limy and dolomitic mudstone overlain by gray thin-bedded fossiliferous silty, granular limestone. Southwest of Richmond the formation is divisible into five members, which are in ascending order, the Tate, Gilbert, Stingy Creek, Terrill, and Reba Members.

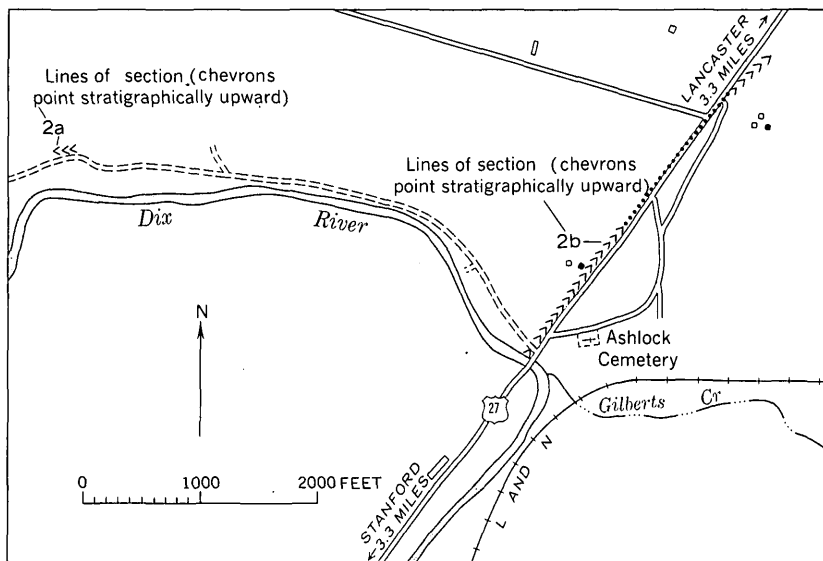


FIGURE 6.—Locations of type (2b) and reference (2a) sections of the Ashlock Formation, Lincoln County, Ky.

TATE MEMBER

The Tate Member, here designated as the basal member of the Ashlock Formation, was originally described as the Tate "layer" (Foerste, 1906, p. 212), later as the Tate Member of the McMillan Formation (Foerste, 1912, p. 48). It was probably named for outcrops along Tate Creek about 3 miles northwest of Richmond, Ky. Foerste (1912, p. 48) stated that the Tate was typically exposed in Madison County, but he did not describe a type section. The description for the Tate Member at the Ashlock Cemetery section (measured section 2b, p. D25) is representative of the lithology of the member.

The Tate Member is chiefly greenish-gray laminated to thin-bedded sparsely glauconitic, limy to dolomitic mudstone commonly grading at the top to argillaceous limestone (fig. 7). Purplish-gray medium-grained limestone, similar to limestone in the overlying Gilbert Member, occurs as a locally conspicuous unit, a few feet thick, about 10 to 15 feet below the top of the Tate.

About 5 to 15 feet above the base of the Tate is a persistent set, about 4 to 8 feet thick, of thin beds of olive-gray fine- to coarse-grained silty limestone containing silicified large brachiopods and bryozoans. This

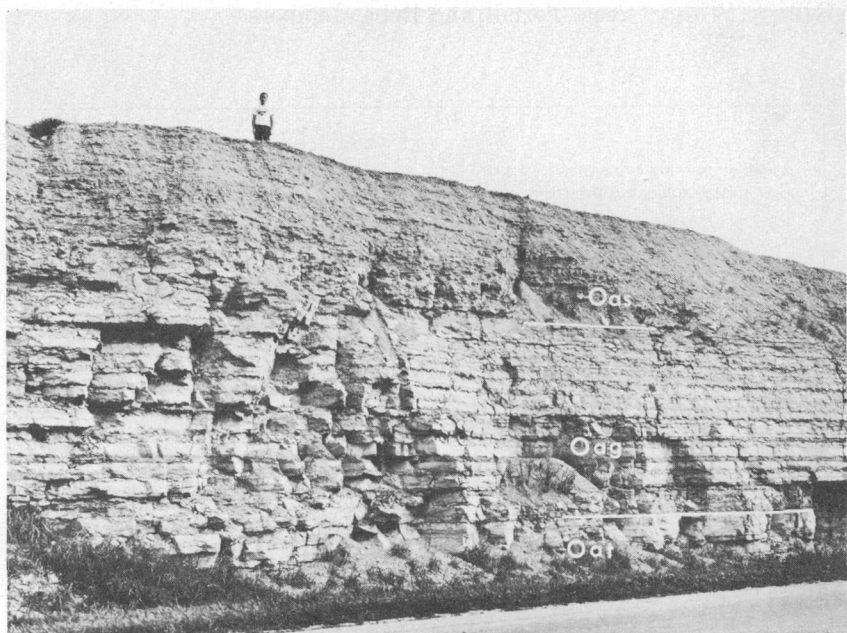


FIGURE 7.—Characteristic appearance in fresh cuts of the Tate Member (Oat), Gilbert Member (Oag), and Stingy Creek Member (Oas) of the Ashlock Formation. Type section of the Ashlock Formation, east side of U.S. Highway 27 about 0.5 mile north of the Dix River in Lincoln County, Ky. (See measured section 2b for description of units.)

unit, shown in figure 8, is a useful marker bed in south-central Kentucky and is here named the Back Bed of the Tate Member for representative outcrops along Back Creek in central Garrard County; the outcrop described in the Ashlock Cemetery section (measured section 2b, p. D26) is typical.



FIGURE 8.—Back Bed (below pick) of the Tate Member of the Ashlock Formation. Back Bed is light-gray fossiliferous limestone; rest of the Tate Member is chiefly greenish-gray limy mudstone. Roadcut on turnoff to Kentucky Highway 388 from northbound lanes of Interstate Highway 75, Madison County, Ky.

The Tate Member generally forms a moderate slope with light-colored platy fragments of mudstone. At the base of the member and just above the Back Bed many of the fragments are of silicified mudstone. The Back Bed and locally a few limy units in the upper part of the member form minor ledges. The member contains few megafossils except for brachiopods and bryozoans in the Back Bed.

The Tate Member south of the Kentucky River ranges from about 30 to 80 feet in thickness. Its maximum known thickness is near Lancaster; north and northeast of Richmond the upper part of the member grades to limestone and merges with an unnamed argillaceous and granular limestone member of the middle part of the Ashlock Formation. The Tate, including the Back Bed, has been identified in outcrops as far north as Mount Sterling.

GILBERT MEMBER

The Gilbert Member, here assigned to the Ashlock Formation, was named by Foerste (1912, p. 18, 23), probably for the village of Gilbert or for Gilberts Creek in northeastern Lincoln County, Ky. The member was sketchily defined by Foerste, but as used near Gilberts Creek by McFarlan and others (1927) and by McFarlan (1929) the name applies to a thin resistant sequence of limestone with partings of limy siltstone. The outcrop shown in figure 7 at the Ashlock Cemetery section (measured section 2b, p. D25) about 1 mile west of Gilbert is typical of the Gilbert Member. The limestone is bluish to olive gray, aphanitic to medium grained, and in crinkly beds a few inches thick. Gray limy siltstone occurs as partings and seams less than 1 inch thick. The member contains abundant well-preserved megafossils, chiefly brachiopods and bryozoans. The member is about 15 feet thick near Gilbert and ranges from about 10 to 20 feet in thickness. North and northeast of Richmond the Gilbert loses its identity as it grades laterally into an unnamed unit of nonresistant argillaceous and granular limestone.

STINGY CREEK MEMBER

The Stingy Creek Member of the Ashlock Formation is here named for representative outcrops of silty limestone and limy siltstone in roadcuts of Kentucky Highway 39 near Stingy Creek; the outcrop shown in figure 7 at the Ashlock Cemetery section (measured section 2b, p. D25) is typical. The limestone is chiefly medium light gray, fine to medium grained, and silty. It is obscurely thin bedded, partly in lenticles about an inch thick and a few inches long, and contains abundant brachiopods and bryozoans. The limy siltstone is chiefly light bluish gray and is gradational with the limestone with which it is interbedded. The Stingy Creek Member ranges from about 5 to 15 feet in thickness.

Northeast of Richmond it cannot be separated from the underlying part of the Ashlock Formation.

The Stingy Creek Member is transitional for a few feet with the overlying Terrill Member. The contact separates rock that is dominantly limestone from that above which is mainly mudstone.

TERRILL MEMBER

The Terrill Member is here named for outcrops near the settlement of Terrill, 4 miles south of Richmond. The type section of the member (measured section 2c, p. D28) is well exposed along Kentucky Highway 52 about 2 miles east of Richmond; the Ashlock Cemetery section (measured section 2b, p. D24) contains representative outcrops.

The Terrill is mainly composed of greenish-gray laminated limy or dolomitic mudstone as shown in figure 9. Weathered outcrops of the mudstone yield abundant small platy fragments. Many bedding surfaces are covered by ripple marks or mud cracks. The basal few feet of the member is a limy silty mudstone lacking distinct bedding. The member contains few megafossils. Bryozoans and brachiopods occur sparsely in the basal mudstone; and, locally, small chertified stromatolites occur near the top of the member. The Terrill Member ranges from about 5 to 15 feet in thickness and has been recognized in sections from near Stanford to near Winchester.

REBA MEMBER

The Reba Member is here named for its typical outcrops near Lake Reba on Kentucky Highway 52 about 2 miles east of Richmond (measured section 2c, p. D28); the Ashlock Cemetery section contains representative outcrops (measured section 2b, p. D24). The Reba Member is composed of micrograined limestone at the base, overlain by more or less silty, medium-grained limestone that at the top commonly grades into argillaceous limestone, as shown in figure 10. Limestone in the lower 2 to 6 feet of the member is commonly in ledge-forming beds as much as a foot thick, characteristically gray to grayish green, and aphanitic and micrograined to very fine grained; this limestone generally lacks megafossils but contains sparse ostracodes and abundant cylindrical markings a few millimeters across and a few centimeters long. Most of the limestone is fine to medium grained, has silty patches and partings, and is in uneven beds a few inches thick. Bedding is less distinct near the top where the limestone is more silty. The fine- to medium-grained limestone and argillaceous limestone contain abundant fossils, chiefly bryozoans and brachiopods. The member ranges from about 10 to 25 feet in thickness and has been recognized in sections from near Stanford to near Winchester.

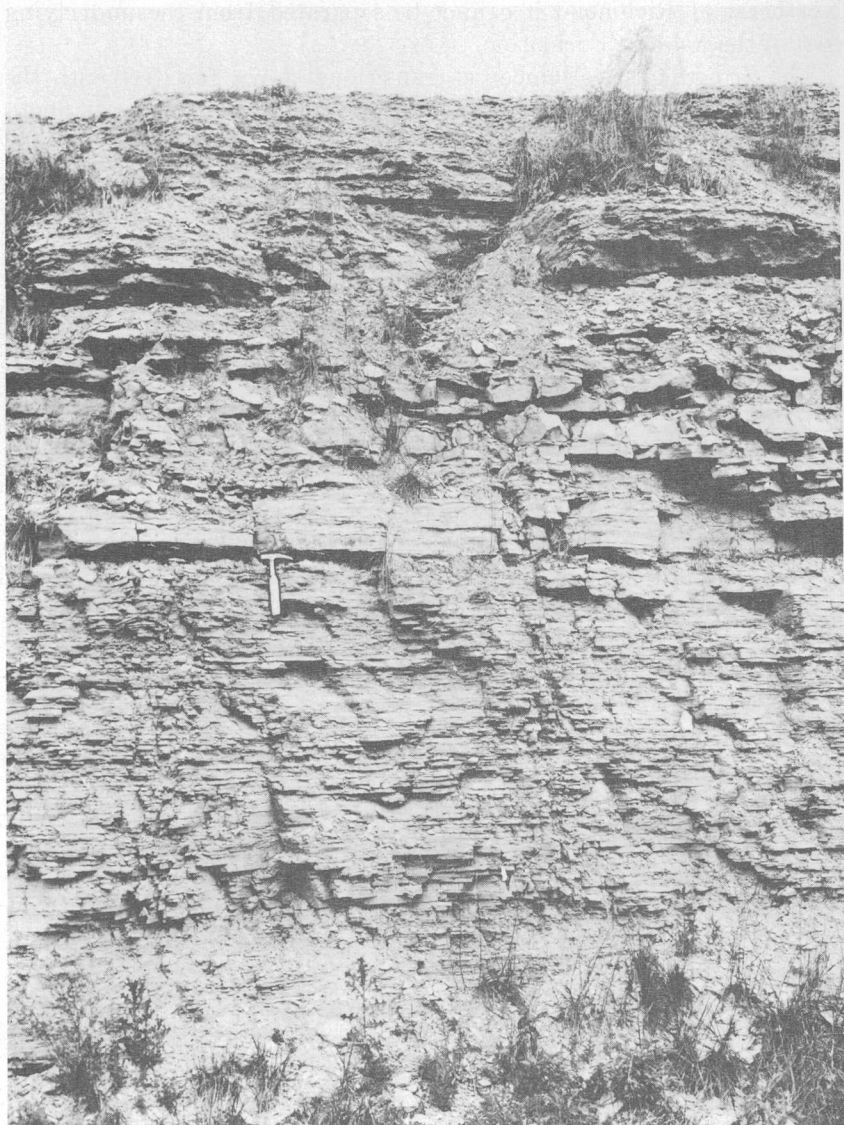


FIGURE 9.—Terrill and Reba Members of the Ashlock Formation. Below pick is greenish-gray laminated mudstone of the Terrill Member. Above pick is the Reba Member; at the base about 3 feet of micrograined limestone grading above to medium-grained limestone and silty limestone. Type section of the Ashlock Formation, U.S. Highway 27, about 3 miles south of Lancaster, Ky. (See measured section 2b for additional description of units.)

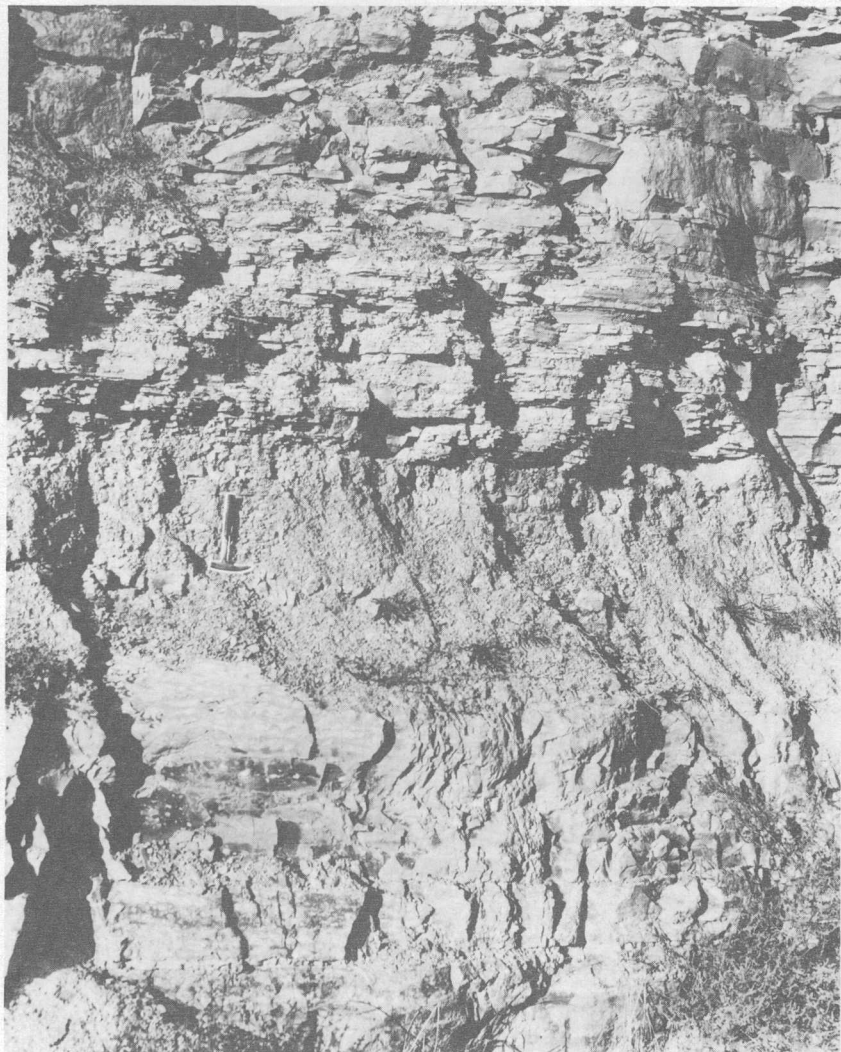


FIGURE 10.—Contact between the Reba Member of the Ashlock Formation and the Rowland Member of the Drakes Formation. Contact at pick head; silty limestone of the Reba Member below pick; transitional hackly weathering limy mudstone at pick assigned to the Rowland Member, platy-weathering limy mudstone about 1 foot above pick, characteristic of the Rowland Member. Lake Reba section about 2 miles east of Richmond, Madison County, Ky. (See measured section 2c for additional description of units.)

UPPER CONTACT

The lithologies of the Ashlock Formation and overlying Drakes Formation are transitional for several feet. As shown in figure 10 and described in measured sections 2b (p. D24), 2c (p. D28), and 3b (p. D33), the upper part of the Reba Member of the Ashlock Formation is fossiliferous argillaceous limestone. In many places the top few inches of the Reba is made up of hackly weathering limy mudstone with partings and lenticles of fossiliferous limestone; above it is similar mudstone but without the limestone lenticles. The top of mudstone containing limestone lenticles or, where this mudstone is absent, the top of argillaceous limestone is the upper contact of the Ashlock Formation. Limy mudstone above the contact is hackly weathering for a thickness of a few inches to a few feet and is gradationally or sharply overlain by platy weathering mudstone characteristic of the Rowland Member of the Drakes Formation.

EXTENT, THICKNESS, AND PROBABLE CORRELATIVES

The Ashlock Formation has been mapped in parts of Lincoln, Garrard, Madison, Estill, and Clark Counties and has been recognized in sections from near Stanford to near Mount Sterling. It ranges from about 125 to 145 feet in thickness.

Previous workers have correlated the beds here included in the Ashlock Formation with the McMillan and Arnheim Formations of Ohio (Palmquist and Hall, 1961, pl. 1). The Tate and Gilbert Members together were correlated with the Bellevue and Corryville Members of the McMillan, and the unit here named the Stingy Creek Member of the Ashlock was correlated with the Mount Auburn Shale Member of the McMillan (Nosow and McFarlan, 1960, p. 45, 46). Most of what is here called the Terrill Member has been referred to the Sunset Member of Foerste (1910) of the Arnheim, and most of what is here called the Reba Member has been referred to the Oregonia Member of Foerste (1910) of the Arnheim (McFarlan and Goodwin, 1930; Nosow and McFarlan, 1960, p. 47).

DRAKES FORMATION

The Drakes Formation is here named for Drakes Creek in southern Garrard County. The type section (measured section 3a, p. D30) was described from outcrops along and near a dirt road connecting Preachersville and Cartersville, beginning near the East Fork of Drakes Creek (fig. 11).

The Drakes Formation is divisible into two members, the Rowland Member below and the Preachersville Member above.

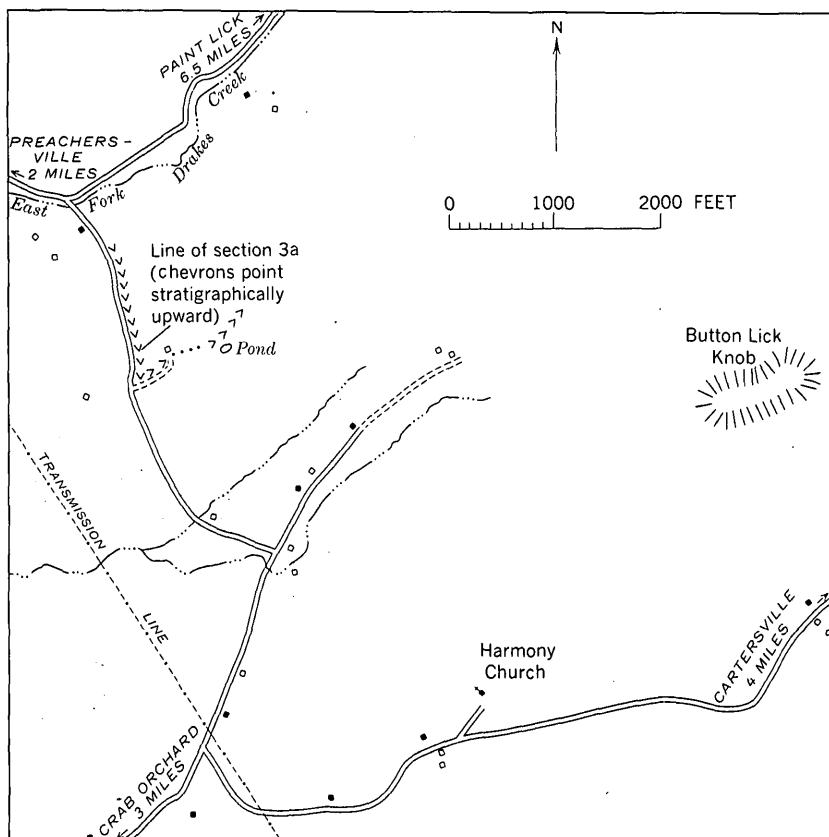


FIGURE 11.—Location of type section (3a) of the Drakes Formation, Garrard County, Ky.

ROWLAND MEMBER

The Rowland Member is here named for typical outcrops 1.3 miles west of Rowland on U.S. Highway 27 on the outskirts of Stanford, Ky. (measured section 3b, p. D32). It is chiefly composed of grayish-green dolomitic or limy, sparsely glauconitic silty mudstone (fig. 10). The mudstone is obscurely bedded in fresh roadcuts but weathers readily to platy fragments a fraction of an inch thick and a few inches across. Many bedding surfaces are covered by ripple marks or mud cracks. Megafossils are absent or very sparse. The member is nonresistant, crops out poorly, and forms smooth slopes. The Rowland Member ranges from about 40 to 60 feet in thickness and has been recognized in sections from near Stanford to near Winchester.

PREACHERSVILLE MEMBER

The Preachersville Member is here named for typical outcrops exposed on Kentucky Highway 39 about 2 miles southeast of Preachersville, Ky. (measured section 3c, p. D33.) It is similar to the Rowland Member but contains 10 to 20 percent argillaceous, fine-grained dolomite or dolomitic limestone in resistant beds, a few inches to a few feet thick (fig. 12); commonly, the thicker beds are near the base of the member. Some of the dolomitic beds contain abundant poorly preserved bryozoans and sparse brachiopods. Because the dolomite beds are fairly resistant, the member has a much more ledgy outcrop than the underlying Rowland Member. In part of northern Madison County, and more sporadically in Lincoln County, the base of the member is marked by as much as 6 feet of fossiliferous limestone containing abundant colonial corals and stromatoporoids. The Preachersville Member ranges from 55 to 95 feet in thickness and has been recognized in sections from near Stanford to near Mount Sterling.

UPPER CONTACT

In most of south-central Kentucky the Drakes Formation is in sharp contact with the overlying Brassfield Dolomite of Early Silurian age. The basal few feet of the Brassfield is commonly silty dolomite with streaks and patches of yellowish-gray mudstone derived from the underlying Drakes. Exceptionally, as 1 mile north of Berea on U.S. Highway 25, the basal few feet of the Brassfield is breccia containing fragments, as much as 4 inches across, of dolomitic mudstone derived from the Drakes Formation. In parts of south-central Kentucky, as near Stanford, Silurian rocks are missing, and the Drakes is unconformably overlain by the Boyle Limestone or New Albany Shale of Devonian age.

EXTENT, THICKNESS, AND PROBABLE CORRELATIVES

The Drakes Formation has been mapped in parts of Lincoln, Garrard, Clark, Madison, and Estill Counties and has been recognized in exposures from near Stanford to near Winchester. The formation is uncommonly well displayed in cuts along the Louisville and Nashville Railroad south of Agawam about 6 miles southeast of Winchester. The Drakes ranges from about 120 to 150 feet in thickness. The beds here included in the Rowland Member of the Drakes Formation were correlated with the Waynesville Limestone of Ohio, and

the beds in the Preachersville Member of the Drakes were correlated with the Whitewater and Liberty Formations of Ohio and Indiana (Palmquist and Hall, 1961, pl. 1).



FIGURE 12.—Characteristic outcrop of the Preachersville Member of the Drakes Formation, showing interbedded ledgy fine-grained limy dolomite and hackly weathering limy and dolomitic mudstone. Roadcut on east side of U.S. Highway 27, about 2 miles south of Stanford, Lincoln County, Ky.

MEASURED SECTIONS

SECTION 1.—*Calloway Creek*

[Type section of the Calloway Creek Limestone; reference section of the Garrard Siltstone. Section measured in roadcuts along Interstate Highway 75 starting 0.4 mile south of the bridge over the Kentucky River and continuing southward for about 2 miles to a point 0.6 mile north of the Kentucky Highway 388 (Boonesboro road) overpass over Interstate 75, Madison County, Ky. (Richmond North and Ford quadrangles). (See fig. 4.) Measured with Jacob staff, Abney level, and tape by G. C. Simmons and P. E. Cassity, June 1963]

Ashlock Formation (incomplete):

Tate Member (incomplete):

12. Limestone, not measured.

Thickness
(feet)

11. Shale, medium-gray (N4)², weathering grayish-green
(5G 6/2)----- 9.0

Calloway Creek Limestone:

10. Limestone, medium-gray (N5), medium-grained; in uneven beds mostly 0.2 to 0.3 ft thick but as much as 1.0 ft thick. Contains numerous inclusions, partings, and a few seams, as much as 0.1 ft thick, of greenish-gray (5GY 6/1 and 5G 6/1) shale. Upper 5 ft very argillaceous and grades into overlying shale of Tate Member of Ashlock Formation. Abundant fossils including brachiopods and bryozoans----- 15.8
9. Limestone (75 percent) interbedded with shale (25 percent). Limestone is medium gray (N5), medium grained, in uneven beds as much as 0.5 ft thick; numerous greenish-gray argillaceous inclusions. Shale is medium light gray (N6) to greenish gray (5G 6/1), limy, in partings and beds as much as 0.2 ft thick. Abundant brachiopods and bryozoans ----- 13.1
8. Limestone (70 percent) interbedded with shale (30 percent). Two varieties of limestone are present. The more abundant limestone is medium light gray (N6) to medium dark gray (N4), finely mottled with white, very fine to medium grained; abundant greenish-gray argillaceous inclusions; fossiliferous. The less abundant limestone is medium dark gray (N4), very fine grained; fossils sparse. Both varieties of limestone are in uneven beds which average 0.2 ft in thickness and reach a maximum thickness of 0.5 ft. Shale is medium gray (N5) to greenish gray (5G 6/1), limy, in beds as much as 0.2 ft thick. Abundant fossils, especially brachiopods and bryozoans----- 21.4
7. Limestone (80 percent) interbedded with shale (20 percent). Limestone is medium gray (N5) to medium dark gray (N4), fine grained, in uneven beds 0.1 to 1.5 ft thick. Numerous greenish-gray argillaceous inclusions and partings. Shale is greenish gray (5G 6/1), limy. Abundant brachiopods and bryozoans----- 12.1

² Color names with numbers based on color chart by Goddard and others (1948).

CALLOWAY CREEK LIMESTONE, ASHLOCK AND DRAKES FORMATIONS D21

SECTION 1.—*Calloway Creek*—Continued

Calloway Creek Limestone—Continued

Thickness
(feet)

6. Limestone (60 percent) interbedded with siltstone (20 percent), and shale (20 percent). Limestone is light gray (N7) to medium dark gray (N4), light shades predominating, fine to medium grained, in uneven beds 0.3 to 0.4 ft thick. Numerous greenish-gray argillaceous and silty inclusions and partings. Siltstone is greenish gray (5G 6/1), limy, in beds as much as 0.3 ft thick. Shale is greenish gray (5G 6/1), limy, in beds 0.1 to 0.2 ft thick. Abundant fossils, chiefly in limestone, include brachiopods, bryozoans, and sparse crinoid columnals; many fossils are fragmental.----- 24.3
 5. Limestone (60 percent) interbedded with shale (40 percent). Limestone is light gray (N7) to medium dark gray (N4), lighter shades predominating, very fine to medium grained, in uneven beds as much as 1.0 ft thick. Abundant greenish-gray argillaceous inclusions. Shale is medium light gray (N6) to grayish green (5G 6/1), limy, in part silty, in beds as much as 0.5 ft thick. Abundant brachiopods and bryozoans ----- 13.9
 4. Limestone (50 percent) interbedded with siltstone (25 percent) and shale (25 percent). Limestone is medium light gray (N6) to medium dark gray (N4) and greenish gray (5G 6/1), fine to medium grained, in uneven beds as much as 0.5 ft thick. Siltstone is greenish gray (5GY 6/1) and weathers to dark yellowish brown (10YR 4/2) and dusky yellowish brown (10YR 2/2). Siltstone layers increase in number and in thickness toward the base of the unit; beds from less than 0.1 ft thick near the top to 0.5 ft thick near the base. Shale is medium light gray (N6) to grayish green, limy, in beds as much as 0.4 ft thick. Abundant fossils, mostly brachiopods.
- NOTE.—This interval is not completely exposed in the line of the measured section. Description is partly taken from exposures on a tributary to Smith Fork of Calloway Creek about 1,000 ft to the east of Interstate Highway 75----- 22.9

Total Calloway Creek Limestone----- 123.5

SECTION 1.—*Calloway Creek*—Continued

Garrard Siltstone:

Thickness
(feet)

3. Siltstone (95 percent) interbedded with shale (5 percent). Siltstone is light greenish gray (5GY 7/1); weathers pale yellowish brown (10YR 4/2) to dusky yellowish brown (10YR 2/2) in natural exposures. The fresher rock contains abundant interstitial calcium carbonate making up as much as 25 percent of the rock. The more weathered dark to dusky-yellowish-brown rock is not calcareous, has lighter specific gravity, and is punky. Beds are 0.3 to 3 ft thick; in general, the thicker beds occur toward the base of the unit; some beds are contorted. Shale is greenish gray (5GY 6/1) in partings and beds as much as 0.2 ft thick. Unit contains less than 5 percent limestone in thin lenses as much as 10 ft long and 0.2 ft thick; limestone is very light gray (N8) to medium gray (N5) and contains flakes and inclusions of siltstone and shale; moderately fossiliferous, chiefly brachiopods----- 12.3
2. Siltstone, light-greenish-gray (5GY 7/1), weathering pale-yellowish-brown (10YR 6/2). Where more intensely weathered is dark yellowish brown (10 YR 4/2) to dusky yellowish brown (10YR 2/2). Calcareous where not intensely weathered. Siltstone beds 0.3 to 8 ft thick with thicker beds toward base. Beds locally separated by thin shaly partings; a few beds in the lower 10 ft contain limestone stringers. Contorted beds common, characterized by flow rolls, rounded masses with complexly curved internal layering. Base gradational with limestone, shale, and siltstone of underlying unit; contact placed at top of highest persistent limestone bed of underlying formation; basal bed of Garrard is as much as 8 ft thick----- 21.7

Total Garrard Silstone----- 34.0

CALLOWAY CREEK LIMESTONE, ASHLOCK AND DRAKES FORMATIONS D23

SECTION 2a.—*Ashlock Cemetery West*

[Reference section of the Ashlock Formation showing basal unit of the Ashlock Formation. Section measured along north bank of Dix River beginning 0.8 mile west of U.S. Highway 27, about 4 miles north of Stanford, Lincoln County, Ky. (Standford quadrangle). (See fig. 6.) Measured with Jacob staff and tape by G. W. Weir and J. C. Dills. October 1962.]

Ashlock Formation (incomplete) :

Tate Member (incomplete) :

Thickness
(feet)

5. Mudstone, limy and silty, greenish-gray (5GY 7/1), weathering greenish-gray (5GY 6/1); contains common to abundant flakes, 2 to 10 mm across, of bright-green clay mineral (glauconite?). Laminated to very thin bedded, 0.05 to 0.5 in. thick; smooth bedding surfaces; sparse irregular ripple marks about 27 ft above base; yields platy fragments 1 to 4 in. across; no megafossils. Thickness given is top of good outcrop; rest of Ashlock Formation is mostly covered. (See measured section 2b, p. D24.)----- 34.0
4. Limestone, light-gray (N7) to yellowish-gray (5Y 8/1), very fine grained, silty to coarse-grained. Partly in very thick sets with obscure bedding and partly in thin sets 1 to 2 ft thick with obscure layering a few inches thick; several limy shale partings, most conspicuous one is about 1 ft below top. Fossils common, chiefly large brachiopods, in part silicified. This unit is the Back Bed of the Tate Member, same as unit 2 of Ashlock Cemetery section----- 4.7
3. Mudstone, limy (95 percent) and silty limestone (5 percent). Limy mudstone is chiefly yellowish gray (5Y 7/2), laminated to very thinly bedded (0.05 to 1.0 in. thick); yields platy fragments; forms steep slope; common fine- to medium-sized fossil fragments, large bryozoans common about 3 to 4 ft above base. Silty limestone is yellowish gray to pale yellowish brown (10YR 6/2), very fine grained; sparse brachiopods; forms rough to smooth rounded ledge; occurs as single bed 0.5 ft thick, 5.5 ft below top of unit----- 11.6

Measured Ashlock Formation (incomplete)----- 50.3

Calloway Creek Limestone (incomplete) :

2. Limestone (90 percent) and limy shale (10 percent). Limestone is light gray (N7), chiefly fine to very fine grained and silty; becomes more silty upward, top 1 ft argillaceous and shaly weathering; in fairly even to slightly wavy beds 2 to 4 in. thick. Interbedded with 1- to 3-in. thick irregular seams of limy and silty shale containing lenticles and partings of limestone. Contact with overlying limy mudstone fairly sharp----- 9.0
1. Limestone (90 percent) and limy shale (10 percent), light-gray (N7) to medium-gray (N5), chiefly very fine grained to fine-grained and argillaceous, in uneven beds, commonly 1 to 4 in. thick. Fossils common, chiefly brachiopods. Partly covered; base of local exposure along road----- 8.5

Measured Calloway Creek Limestone (incomplete)----- 17.5

SECTION 2b.—*Ashlock Cemetery*

[Type section of the Ashlock Formation and of the Gilbert and Stingy Creek Members of the Ashlock Formation and of the Back Bed of the Tate Member of the Ashlock Formation. Measured chiefly along U.S. Highway 27 beginning at Dix River beneath bridge just west of mouth of Gilberts Creek and about 500 ft southwest of Ashlock Cemetery, Lincoln County, Ky., about 4 miles northeast of Stanford and 1 mile west of Gilbert (Lancaster quadrangle). (See fig. 6.) Measured with Jacob staff and tape by G. W. Weir and R. C. Greene, November 1961]

Drakes Formation (incomplete):

*Thickness
(feet)*

Rowland Member (incomplete):

15. Mudstone, limy and cherty, weathered to yellowish soil containing rectangular plates, 2 to 4 in. across, of white cherty shale weathering brownish gray and chips of grayish-yellow (5Y 8/4) limy and silty shale; unfossiliferous. Basal contact poorly exposed. Not measured; about 5 ft present; top of local exposure. Units 14b and 15 described from outcrops along abandoned road east of third roadcut north of Dix River.

Ashlock Formation:

Reba Member:

- 14b. Limestone (50 percent) and silty limestone (50 percent). Limestone is greenish gray (5GY 6/1) to light olive gray (5Y 6/1); weathered rock is about same colors; fossils common to abundant, chiefly brachiopods and bryozoans; mostly in thin beds $\frac{1}{2}$ to 2 in. thick and interbedded with silty limestone. Silty limestone is light greenish gray (5GY 6/1); weathered rock is same color and grayish yellow orange (10YR 8/6); in beds less than 2 in. thick; poor fissility; brachiopods and bryozoans common to abundant. At top is a few inches of greenish-gray (5GY 6/1) limy mudstone with partings of limestone; contains abundant small bryozoans. Whole unit forms steep rubbly, fossil-strewn slope in third roadcut north of bridge----- 12.4
- 14a. Limestone, light-olive-gray (5Y 6/1), aphanitic to micro-grained; mostly in even beds 2 to 4 in. thick; abundant cylindrical markings about $\frac{1}{8}$ in. in diameter and 1 to 2 in. long perpendicular to bedding, no megafossils. Resistant, forms projecting ledge. Transitional with coarser grained limestone above; top rather arbitrary. Units 11 through 14a described from east side of third roadcut north of the Dix River----- 2.6
- Total Reba Member----- 15.0

Terrill Member:

13. Mudstone, limy and silty, moderate-olive (10Y 7/2); upper part more limy than near base, very thin bedded, fissile along bedding; unfossiliferous except for sparse silicified stromatolites at top; in natural outcrops forms low slope littered with platy fragments. Upper 1 ft more limy, somewhat gradational into Reba Member; upper contact placed at conspicuous parting plane below first thick limestone bed of unit 14a-- 10.3

CALLOWAY CREEK LIMESTONE, ASHLOCK AND DRAKES FORMATIONS D25

SECTION 2b.—*Ashlock Cemetery*—Continued

Ashlock Formation—Continued

Terrill Member—Continued

Thickness
(feet)

- | | |
|---|-----|
| 12. Mudstone, silty and sandy, greenish-gray (5GY 6/1) and light-greenish-gray (5GY 7/1); weathered rock is same colors; noticeable color contrast with underlying unit; much very fine sand admixed with silt; forms blocky ledge with irregular partings becoming more regular and very thin bedded upward; sparse large cylindrical bryozoans----- | 1.3 |
| 11. Mudstone, silty and limy, medium-greenish-gray (5GY 5/1); a single bed with a hackly surface due to irregular fractures; sparsely fossiliferous, contains a few brachiopods and bryozoans ----- | 1.2 |

Total Terrill Member-----	12.8
---------------------------	------

Stingy Creek Member :

- | | |
|---|------|
| 10. Siltstone, limy (50 percent) and limestone (50 percent). Siltstone is dusky yellow (5Y 6/4), light bluish gray (5B 7/1), and moderately yellowish brown (10Y 5/4); limy, grading to silty limestone; very poor fissility. Limestone is medium light gray (N6); medium to coarse grained and silty; mostly in lumpy beds less than 3 in. thick. Limestone is about equal to siltstone in lower part of unit but less abundant and in more widely spaced beds in upper part. Whole unit very fossiliferous, contains chiefly brachiopods and bryozoans; less resistant than underlying unit; forms fossil-strewn slopes. Units 9 and 10 described from second roadcut north of the Dix River----- | 14.2 |
|---|------|

Total Stingy Creek Member-----	14.2
--------------------------------	------

Gilbert Member :

- | | |
|--|------|
| 9. Limestone with partings of limy siltstone, bluish-gray (5B 6/1), and light-olive-gray (5Y 6/1), weathering grayish-orange-brown (10YR 7/2), mostly fine grained, in part aphanitic; siltstone mostly in partings, less than 1 in. thick, in crinkly bedding planes that are a few inches apart. Abundant fossils, chiefly brachiopods and bryozoans; also scattered gastropods, cephalopods, and crinoid fragments; fossils are locally silicified----- | 15.5 |
|--|------|

Total Gilbert Member-----	15.5
---------------------------	------

Tate Member (incomplete) :

- | | |
|---|------|
| 8. Mudstone, silty, grading upward to argillaceous limestone. Silty mudstone is yellowish gray (5Y 7/2); contains much coarse silt; very limy with clusters of white calcite crystals. Argillaceous limestone is yellowish gray (5Y 7/2) and light olive gray (5Y 6/1), medium and fine grained. Unit is in even beds 6 to 12 in. thick, forms smooth rounded ledges, and contains sparse brachiopods and bryozoans. Units 6, 7, and 8 described from first roadcut north of Dix River----- | 11.0 |
|---|------|

SECTION 2b.—*Ashlock Cemetery*—Continued

Ashlock Formation—Continued

Tate Member (incomplete)—Continued

Thickness
(feet)

7. Limestone, purplish-gray (5P 6/1) to medium-light-gray (N6), medium- to coarse-grained; small clusters and vugs of white coarsely crystalline calcite; beds 2 to 4 in. thick with crinkly surfaces separated by partings, less than 1 in. thick, of silty limestone that weather to knobby ledges; common brachiopods and bryozoans. Unit is similar to Gilbert Member, unit 9 above. Forms conspicuous dark band in fresh cuts. 2.5
6. Mudstone, limy and silty (60 percent), and silty limestone (40 percent). Unit is greenish gray (5GY 6/1), weathers greenish gray (5G 6/1) and light olive gray (5Y 6/1); micrograined, fine grained and silty, purest limestone at base and top of unit; common to abundant scattered flakes of bright-green clay mineral (glauconite?), flakes mostly 2 to 5 mm across. Bedding planes commonly 6 in. to 2 ft apart. Conspicuous continuous parting plane 1.8 ft below top; forms near-vertical cliff in fresh roadcuts, but nearby weathered outcrops form rounded ledges less than 1 ft thick. Very sparse fragments of brachiopods and bryozoans.----- 15.1
5. Covered. (For description of rocks in this interval see measured section 2a, p. D23, Ashlock Cemetery West.) Units 1 through 5 measured up cliff bordering Dix River.----- 21.4
4. Limy mudstone (75 percent) and argillaceous limestone (25 percent); both medium grained; mudstone laminae are 1 to 25 mm thick, limestone beds about 1 in. thick in sets as much as 0.4 ft thick; forms steep, stepped slope littered with thin platy fragments.----- 7.1
3. Mudstone, limy, greenish-gray (5GY 7/1); weathered rock is same color; in smooth laminae 1 to 20 mm thick. Scattered limy concretions, irregular discoidal lumps, a few inches in maximum diameter; fragments of brachiopods and bryozoans. Sparse large (0.5-in. diam) cylindrical bryozoans scattered through mudstone. Unit nonresistant, forms recess ----- 3.2
2. Limestone, light-olive-gray (5Y 6/1) and light-gray (N7), weathering yellowish-gray (5Y 7/2), very fine to medium-grained and silty. Basal 1.3 ft consists of lenticles, 1 in. thick and 3 in. long, of medium-grained limestone in very thin bedded silty limestone matrix; very fossiliferous with large brachiopods. Middle 1.3 ft same as below but bedding less distinct. Shaly at top; fossils locally silicified; upper 1.1 ft is thin bedded with wavy bedding planes, unfossiliferous. Unit is Back Bed of Tate Member.----- 3.7

CALLOWAY CREEK LIMESTONE, ASHLOCK AND DRAKES FORMATIONS D27

SECTION 2b.—*Ashlock Cemetery*—Continued

Ashlock Formation—Continued

Tate Member (incomplete)—Continued

Thickness
(feet)

1. Mudstone, limy and dolomitic, greenish-gray (5G 6/1), weathering about grayish-yellow-green (5GY 7/2); in laminae and very thin beds as much as ½ in. thick; forms stepped cliff. About 5 ft exposed to bed of Dix River; estimated total thickness based on exposures about 1 mile west of highway. (See measured section 2a, p. D23, for description of fully exposed unit and of contact with underlying Calloway Creek Limestone.)----- 11.6

Total Tate Member----- 75.6

Total Ashlock Formation----- 133.1

SECTION 2c.—*Lake Reba*

[Type Section of the Terrill and Reba Members of the Ashlock Formation. Measured in roadcuts along Kentucky Highway 52; beginning about 2 miles east of Richmond, Madison County, Ky. (Moberly quadrangle). Measured with Jacob staff and tape by R. C. Greene and G. C. Simmons, December 1962; additional description by G. W. Weir, January 1964]

Drakes Formation (incomplete):

Preachersville Member (incomplete):

Thickness
(feet)

9. Mudstone (65 percent) and dolomitic limestone (35 percent). Mudstone is greenish gray (5GY 6/1); in even beds or sets of beds 1 to 6 in. thick, probably laminated in part; bedding generally obscure. Limestone is dolomitic and argillaceous, greenish gray (5GY 6/1), very fine to fine-grained; argillaceous patches and streaks; in even beds, 0.2 to 12 in. thick, thicker near top; makes up about 10 percent of unit near base, increasing to about 70 percent near top. Very sparse poorly preserved bryozoans. Thickness approximate; difference in altitude is 26.4 ft; dip is about ½° E. (approx) along line of section----- 30
8. Limestone, dolomitic and in part argillaceous, very pale yellowish brown (10YR 7/2) and medium-dark- to medium-light-gray (N4-6) and greenish-gray (5GY 6/1); weathered rock is same colors, faintly mottled grayish green and grayish orange; very fine grained; argillaceous to medium grained; coarser near top; in even beds 3 to 12 in. thick; forms resistant ledge. Sparse poorly preserved bryozoans----- 4.6

Measured Preachersville Member (incomplete; approximate)----- 35

SECTION 2c.—*Lake Reba*—Continued

Drakes Formation (incomplete)—Continued

Rowland Member:

Thickness
(feet)

- | | |
|---|-----|
| 7. Covered----- | 5 |
| 6c. Mudstone, limy, light-olive- to greenish-gray (5Y, 5GY, 5G 6/1); sparse patches of green clay mineral (glauconite?); evenly laminated to very thin bedded in sets a fraction of an inch to as much as 18 in. thick; mostly splits along sets ¼ to ½ in. thick. No fossils seen. As a whole, nonresistant but more resistant than underlying unit; forms minor overhang at base. Thickness approximate; difference in altitude is 28.2 ft; dip is about ½° E. (approx) on line of section----- | 35 |
| 6b. Mudstone, greenish-gray (5GY 6/1); bedding obscure; mostly nonfissile except for rough partings near top; face is coarsely hackly with many small angular and curving surfaces; along with underlying unit forms recess. Grades through a few inches into overlying unit, which unit resembles except for lack of bedding; basal contact sharp. No fossils seen-- | 2.3 |
| 6a. Shale, limy, dark-greenish-gray (5GY 5/1); sparse glauconite(?); roughly laminated; weathered outcrop yields abundant fine chips; nonresistant; very sparse brachiopod(?) fragments at base; gradational through about 1 in. at base-- | .9 |

Total Rowland Member (approximate)-----	43
---	----

Measured Drakes Formation (incomplete; approximate)-----	78
--	----

Ashlock Formation (incomplete):

Reba Member:

- | | |
|---|-----|
| 5. Limestone, argillaceous, light-olive- to greenish-gray (5Y, 5GY 5/1); minutely mottled with green clay mineral (glauconite?); fine grained. In even sets mostly 1 to 2 ft thick with obscure beds 2 to 3 in. thick. Moderately resistant; base locally forms minor overhang. Fossils common, mostly brachiopods and bryozoans----- | 7.2 |
| 4c. Mudstone (70 percent) and limestone (30 percent). Mudstone is limy, medium dark gray (N4), roughly laminated, in sets 1 to 12 in. thick; no fossils seen. Limestone is medium gray (N5) to dark olive gray (5Y 3/1), fine grained, argillaceous, in lensing beds a few inches thick, mostly in basal 1 ft of unit. Unit nonresistant; forms recess----- | 2.7 |
| 4b. Limestone (90 percent) and mudstone (10 percent). Limestone is medium gray (N5) and dark olive gray (5Y 3/1), aphanitic to coarse grained but mostly medium and coarse grained, fossil fragmental, sparse greenish-gray glauconite(?), and sparse pyrite. In even beds 2 to 12 in. thick, decreasing in thickness upward. Fossils common to abundant, low-spined gastropods especially abundant, brachiopod fragments common. Mudstone is dark gray (N3), limy; roughly laminated as partings and thin interbeds as much as 2 in. thick; unfossiliferous----- | 3.0 |

CALLOWAY CREEK LIMESTONE, ASHLOCK AND DRAKES FORMATIONS D29

SECTION 2c.—*Lake Reba*—Continued

Ashlock Formation—Continued

Reba Member—Continued

Thickness
(feet)

4a. Limestone, medium-light-gray (N6); mottled and streaked with light-gray (N7); aphanitic to fine-grained, mostly micrograined; sparse pyrite. Basal bed is 1.1 ft thick, overlain by sets of laminae and thin beds as much as 3 in. thick. Markedly resistant, base is prominent ledge. Mostly unfossiliferous except for sparse fragments of bryozoans and brachiopods; ostracodes common in top layer; basal bed and some other layers characterized by fucoidal markings, nearly vertical cylinders of medium-light-gray fine-grained material in aphanitic matrix.....	2.6
Total Reba Member.....	15.5

Terrill Member:

3. Mudstone, limy, greenish-gray (5GY 6/1 and 5G 6/1); mostly laminated and splitting smoothly along sets a fraction of an inch thick, but a few sets as much as 6 in. thick resemble unlaminated unit below; weathered outcrop yields abundant plates. Near top, 0.5 to 2.0 ft below contact, beds are very limy, grading toward micrograined limestone of overlying unit; top 0.5 ft is grayish-brown shale. Fossils absent except for sparse small fragments in limy beds near top	8.5
2. Mudstone, limy, light-olive- to greenish-gray (5Y-, 5GY 6/1), streaked and mottled with brownish-gray (5YR 4/1), weathering light-olive-gray to pale-olive (5Y-, 10Y 6/2); sparse fine-grained, greenish glauconite(?). A single set with faint irregular thin bedding, which is less distinct than bedding in overlying or underlying units. Weathers to an irregular face with smooth curving surfaces; nonresistant, forms recess. Base marked by 1 to 2 in. of dark-gray claystone, mostly plastic, water saturated. Fossils sparse, a few small cylindrical bryozoans.....	2.5
Total Terrill Member.....	11.0

Stingy Creek Member (incomplete):

1. Limestone, argillaceous, medium-gray (N5), less commonly olive-gray (5Y 5/1), fine-grained, silty and clayey; roughly laminated in obscure sets 2 to 4 in. thick. Fossils common, mostly brachiopods and bryozoans. Base of local exposure...	9.5
Measured Ashlock Formation (incomplete).....	36.0

SECTION 3a.—*East Fork of Drakes Creek*

[Type section of the Drakes Formation. Measured about 5 miles due west of Cartersville and about 1 mile west of Button Lick Knob, Garrard County, Ky. Paint Lick quadrangle). Section begins about 500 ft southeast of East Fork of Drakes Creek and thence along dirt road connecting with road along Harmons Lick; at top of first hill (alt 1,014 ft) section measured along westward-trending ridge. (See fig. 11.) Measured with Jacob staff and rule by G. W. Weir and J. C. Dills, October 1962]

	<i>Thickness (feet)</i>
Brassfield Dolomite (incomplete; Silurian):	
11. Dolomite and limy dolomite, grayish-orange (5Y 8/4), streaked very dusky red (10R 2/2) and moderate-reddish-brown (10R 4/6); commonly coated with pale-yellowish-brown (10YR 6/2); fine to medium grained. Mostly weathered to dark-yellowish-orange (10YR 6/6) residuum which forms a sharp, conspicuous contact with the grayish-yellow soil of unit 19. Not measured; only about 5 ft present on hilltop; about 0.3 mile west of this point, Brassfield Dolomite is well exposed and is about 20 ft thick.	
Drakes Formation (Ordovician):	
Preachersville Member:	
10. Shale, silty, pale-greenish-yellow (10Y 8/2); in very thin beds 0.2 in. thick. Poorly exposed; mostly weathered to grayish-yellow (5Y 8/4) soil; nonresistant, forms gentle slope-----	17.0
9. Dolomite, limy and silty, grayish-orange (10YR 7/4), weathering grayish-yellow (5Y 8/4); in thin beds 1 in. thick; weathers to small irregular chunks; more resistant than overlying unit. In part very poorly exposed; probably contains some shaly siltstone-----	8.0
8. Dolomite, silty; probably similar to underlying unit but poorly exposed; probably contains much limy or dolomitic mudstone. At top is a bed of bryozoan silty dolomite that is yellowish gray (5Y 7/2) and spotted dark yellowish orange (10YR 6/6); finely crystalline, silty and very fine sandy; about 50 percent of the rock is made up of branching bryozoans, 1 to 4 mm in diameter; bed is 0.5 ft thick. (Section offset along top of this bryozoan dolomite bed—across small saddle east of barn to outcrops on point below stock pond.)--	11.5
7. Dolomite, silty, grayish-yellow (5Y 8/4) to light-gray (N7), fine-grained, very fine sandy, in thin beds a few inches thick; forms minor bench; abundant very small bryozoans at top---	1.3
6. Covered; grayish-yellow soil-----	6.3
5. Mudstone, dolomitic and silty (50 percent), and limy mudstone (50 percent); very poorly exposed. Dolomitic silty mudstone is light gray (N7), in thin beds 1 to 2 in. thick and interbedded with limy mudstone. Limy mudstone is pale olive (10Y 6/2), clayey, poorly laminated; somewhat plastic when wet -----	21.2

CALLOWAY CREEK LIMESTONE, ASHLOCK AND DRAKES FORMATIONS D31

SECTION 3a.—*East Fork of Drakes Creek*—Continued

Drakes Formation (Ordovician)—Continued

Preachersville Member—Continued

Thickness
(feet)

4. Mudstone and dolomitic to argillaceous dolomite, light-gray (N7) to medium-gray (N6), weathering yellowish-gray (5Y 7/2 and 5Y 8/1), silty, in part limy; bedding obscure but lacks even bedding of underlying unit. Weathered surface has irregular nodular appearance suggestive of fossil markings; contains small nodules and streaks of light-orange calcite and dolomite, a few with sphalerite, perhaps recrystallized fossil material; no fossils seen. Fairly resistant, forms rough ledge----- 9.0

Total Preachersville Member----- 74.3

Rowland Member:

3. Mudstone, limy, light-greenish-gray (5G 7/1) and grayish-yellow-green (5GY 7/2), weathering pale-olive (10Y 6/2); mostly limy, a few beds dolomitic, probably clayey in part as in 6-in.-thick bed about 20 ft above base. Unit appears unstratified internally in fresh cuts but weathers to thin beds less than 1 in. thick; ripple marks noted about 40 ft above base, mud cracks on slabs in float. Weathered outcrop yields platy fragments a fraction of an inch to several inches in diameter. Exposed in roadcut, little natural outcrop. No fossils seen----- 52.4
2. Mudstone, clayey; mostly covered on line of section. At base is seam of plastic claystone that is pale yellowish green (10GY 7/2) and a few inches thick; rest of unit is covered by platy debris from overlying unit. About 1,100 ft north of main line of section, most of this interval is well exposed and consists chiefly of mudstone that is light greenish gray (5GY 7/1) to greenish gray (5GY 6/1), very silty, and dolomitic to slightly limy; sparse dark-green spots of glauconite(?); appears structureless where fresh but is obscurely laminated and, where weathered, parts readily along smooth planes $\frac{1}{4}$ to $\frac{1}{2}$ in. apart; yields platy fragments about $\frac{1}{4}$ in. thick and several inches in diameter; unfossiliferous. Basal 2.5 ft is clayey mudstone, generally similar to mudstone described but finer grained, more poorly bedded, and less fissile; sparse fragments of brachiopods in basal foot----- 8.3

Total Rowland Member----- 60.7

Total Drakes Formation----- 135.0

Ashlock Formation (incomplete):

Reba Member (incomplete):

1. Limestone, medium-light-gray (N6) and yellowish-gray (5Y 8/1); fine to medium grained, very argillaceous in top 5 ft; in rough-surfaced beds a few inches thick; abundant brachiopods and bryozoans. Not measured; about 15 ft exposed locally.

SECTION 3b.—Rowland West

[Type section of the Rowland Member of the Drakes Formation. Measured in roadcuts along U.S. Highway 27 on outskirts of Stanford, about 1.2 miles west of Rowland, Lincoln County, Ky. (Stanford quadrangle). Measured with Jacob staff and rule by G. W. Weir, July 1964]

Drakes Formation (incomplete) :

Thickness
(feet)

Preachersville Member (incomplete) :

8. Limestone, dolomitic, grayish-orange (10YR 7/4), mottled light-olive-gray (5Y 5/1); weathered rock is about same color; commonly coated dark-olive-gray (5Y 3-4/1); very fine to fine grained; sparse scattered clusters, a fraction of an inch across, of orange and white coarsely crystalline calcite. In rough beds a few inches to about 1 ft thick with seams of mudstone as much as 2 in. thick; forms prominent ledge about 1 ft thick at base; minor, less prominent ledges above. Only basal foot well exposed near hilltop; thickness approximate----- 5.0

Rowland Member :

7. Mudstone, dolomitic, light-greenish-gray (5GY 8/1) and yellowish-gray (5Y 7/2), weathering about grayish-orange (10YR 7/3) and pale-greenish-yellow (10Y 8/2); mostly silt probably with interstitial clay, and flakes of claystone a fraction of an inch across; in thin even beds a fraction of an inch to an inch thick; no megafossils. Less dolomitic, less resistant than underlying or overlying unit. Poorly exposed on gently slope----- 4.0
6. Mudstone, dolomitic, chiefly yellowish-gray (5Y 7/2), in part mottled dark-yellowish-gray (5Y 6/2), argillaceous, very fine grained; some beds probably argillaceous dolomite; in even beds $\frac{1}{2}$ to 2 in. thick; cleaves along smooth partings $\frac{1}{4}$ to 1 in. apart; no megafossils; mottling perhaps of organic origin. More resistant than underlying and overlying units; forms ledge at top of roadcut, forms slope in natural outcrop----- 3.0
5. Mudstone, limy and dolomitic, greenish-gray (5Y 6/1), weathering yellowish-gray (5Y 7/2), argillaceous, very fine grained; some beds probably argillaceous limestone and dolomite with flakes and partings of mudstone; laminated and in even beds a fraction of an inch to several inches thick; splits along smooth partings a fraction of an inch to an inch apart; no megafossils----- 29.0
4. Mudstone, limy, greenish-gray (5GY 6/1), weathering light-olive-gray (5Y 6/1) and yellowish-gray (5Y 7/2), argillaceous, very fine grained; some beds probably argillaceous limestone; dark-green glauconite(?) common near base; discontinuous siliceous white band, 0 to 2 in. thick, about 8.5 ft above base; laminated and in thin even beds commonly $\frac{1}{4}$ to 1 in. thick, a few beds several inches thick; bedding obscure in fresh cuts but brought out by weathering; cleaves readily along smooth partings $\frac{1}{8}$ to 1 in. apart; weathered outcrop yields plates and blocks; no megafossils noted. Top placed at top of hackly weathering interval 1 to 3 ft thick, forming minor niche. More resistant than underlying unit but along with units 8, 9, and 10 forms moderate slope----- 22.1

CALLOWAY CREEK LIMESTONE, ASHLOCK AND DRAKES FORMATIONS D33

SECTION 3b.—Rowland West—Continued

Drakes Formation (incomplete)—Continued

Rowland Member—Continued

Thickness
(feet)

3. Mudstone, greenish-gray (5GY 6/1), slightly limy; dark-green glauconite(?) common; crudely laminated; weathers to small chips; no megafossils; nonresistant, forms niche below more resistant mudstone of unit 7----- 0.9

Total Rowland Member----- 59

Measured Drakes Formation (incomplete)----- 64

Ashlock Formation (incomplete):

Reba Member (incomplete):

2. Mudstone (75 percent) and limestone (25 percent). Mudstone is greenish gray (5GY 6/1), limy, crudely laminated; weathers to small chips. Limestone is argillaceous, greenish gray (5GY 6/1), very fine grained, intermixed with mudstone; fossils fragmental; common grayish-green clay mineral (glauconite?); in lenticles $\frac{1}{8}$ to $\frac{1}{4}$ in. thick and a few inches long scattered through mudstone; very fossiliferous, contains abundant fine to very coarse fragments of bryozoans and brachiopods. Nonresistant unit, forms fossil-strewn slope. Presence of limestone differentiates this unit from overlying unit; contact placed at top of limestone lenticles interstratified with mudstone----- 1.0
1. Limestone, argillaceous, greenish-gray (5G 6/1); weathered rock is about same color; poorly sorted, very fine to coarse grained, but mostly fine to medium grained; intermixed with 10 to 40 percent mudstone; obscurely bedded, probably in crenulated beds 1 to 3 in. thick. Very fossiliferous, chiefly bryozoans and brachiopods. Nonresistant, weathers to fossil-strewn rubbly slope. Not measured; about 10 ft exposed in highway cut and ditch.

SECTION 3c.—Preachersville Southeast

[Type section of the Preachersville Member of the Drakes Formation. Measured southward in gully and roadcuts along Kentucky Highway 39 beginning about 2 miles southeast of Preachersville, Lincoln County, Ky. (Lancaster quadrangle.) Measured with Jacob staff and rule by G. W. Weir, July 1964. Thicknesses adjusted for local dip of 2° SE.]

Brassfield Dolomite (incomplete; Silurian):

10. Limestone, dolomitic, pale-grayish-orange (10YR 8/4), with streaks of dark-yellowish-orange (10YR 6/6); very fine to fine grained; in rough beds several inches thick; no fossils noted. Mostly weathered to moderate-yellowish-brown (10YR 5/4) soil with scattered blocks a few inches to a few feet across. Not measured; residuum is about 3 ft thick on hilltop at end of section about 800 ft southeast of starting point.

SECTION 3c.—*Preachersville Southeast*—Continued

Drakes Formation (incomplete; Ordovician):

Preachersville Member:

Thickness
(feet)

9. Shale, silty and probably dolomitic, moderate- to pale-greenish-yellow (10Y 7-8/2); in smooth even laminae and thin beds as much as 1 in. thick; very fissile along bedding planes; nonresistant, forms gentle slope. No fossils noted----- 20
8. Mudstone (80 percent) and limy argillaceous dolomite (20 percent). Mudstone is light greenish gray (5GY 7/1), slightly limy, mostly obscurely bedded, in part laminated; hackly weathering yielding small chunks commonly $\frac{1}{8}$ to $\frac{1}{2}$ in. across; no megafossils noted; curly markings $\frac{1}{8}$ in. across and several inches long resembling worm tracks in lower part of unit; makes up lower $\frac{2}{3}$ of unit and interbedded with dolomite in top $\frac{1}{3}$. Dolomite is limy, argillaceous, pale grayish orange (10YR 8/2) and light greenish gray (5GY 7/1), very fine grained, in even beds about 1 in. thick; no fossils noted. Unit forms slope with ledgy top----- 4.5
7. Dolomite (70 percent) and mudstone (30 percent). Dolomite is argillaceous and limy, yellowish gray (5Y 7/2) to grayish orange (10YR 7/3), chiefly very fine and fine grained, with streaks of greenish-gray mudstone; in somewhat rough beds $\frac{1}{4}$ to $1\frac{1}{2}$ in. thick; sparse poorly preserved cylindrical bryozoans in a few thin beds. Mudstone is dolomitic, light greenish gray (5GY 7/1) to yellowish gray (5Y 8/1); common to abundant intermixed fine-grained dolomite; in obscure and irregular, lumpy discontinuous beds commonly $\frac{1}{4}$ to $1\frac{1}{2}$ in. thick; closely interstratified with dolomite; no fossils noted. Whole unit relatively resistant, sets of beds of dolomite form ledges----- 15.5
6. Mudstone, dolomitic; similar to dolomitic mudstone in overlying unit 7; nonresistant, forms slope; very sparse poorly preserved small cylindrical bryozoans----- 6
5. Dolomite (50 percent) and mudstone (50 percent). Dolomite is argillaceous, yellowish gray (5Y 7/2-8/1) and medium gray (N5), and pale orange (10YR 7/2), very fine to fine grained, silty; intermixed streaks and patches of mudstone; slightly limy, with clusters, $\frac{1}{8}$ to $\frac{1}{2}$ in. across, of pale-yellowish-orange calcite crystals; mostly in fairly even beds 1 to 3 in. thick; base marked by uneven bed 4 to 8 in. thick; muddier parts contain common "worm" markings, about $\frac{1}{8}$ in. across, emphasized by slight color contrasts; very sparse poorly preserved bryozoans. Mudstone is dolomitic, greenish gray (5GY 6-7/1); contains intermixed grayish-orange (10YR 7/3) stringers and patches of very fine grained dolomite; obscurely bedded; hackly weathering; common "worm" markings and very sparse very poorly preserved small cylindrical bryozoans and small fragments of brachiopods (?). Whole unit relatively resistant; beds of dolomite form minor ledges----- 16
4. Mudstone, dolomitic, grayish-green (5G 6-7/1); similar to mudstone in unit 5; less resistant than underlying or overlying unit----- 11

CALLOWAY CREEK LIMESTONE, ASHLOCK AND DRAKES FORMATIONS D35

SECTION 3c.—*Preachersville Southeast*—Continued

Drakes Formation (incomplete; Ordovician)—Continued

Preachersville Member—Continued

Thickness
(feet)

3. Mudstone, limy (50 percent), grading to fossiliferous argillaceous limestone (35 percent) and, at top, grading to dolomitic mudstone (15 percent); yellowish gray (5Y 8/2), greenish gray (5GY 6/1 and 5G 6/1); weathered rocks are same colors and light olive gray (5Y 6/1) and light greenish gray (5G 7/1). At base is about 1 ft of poorly bedded unfossiliferous limy mudstone, overlain by about 2 ft of very limy mudstone containing common to abundant lenticles, a few inches long and less than an inch thick, of fossiliferous argillaceous limestone, grading to fossiliferous argillaceous limestone with a few seams of mudstone and in top 1 ft grading to unfossiliferous resistant dolomitic mudstone; separated from dolomitic mudstone of unit 4 by conspicuous parting, commonly iron stained. Bedding generally obscure throughout unit. Limy rocks sparsely to abundantly fossiliferous; most conspicuous are colonial corals, as much as 2 ft across in layer about 2 ft below top of unit; smaller colonial corals and stromatoporoids common about 2.5 ft below top; brachiopods and bryozoans, sparse to very abundant beginning about 2 ft above base and continuing to about 1.5 ft below top. Unit generally nonresistant, upper half of unit more resistant than lower half.----- 5.5
2. Limestone, argillaceous, olive-gray (5Y 5/1) to greenish-gray (5GY 6/2), weathering light-olive-gray (5Y 7/1), to light-greenish-gray (5GY 7/1), chiefly very fine grained, silty, probably clayey in part; small geoidal clusters, $\frac{1}{4}$ to 1 in. across, of coarsely crystalline white calcite; a single set of rough beds $\frac{1}{4}$ to $2\frac{1}{2}$ in. thick, many bedding planes discontinuous; forms small but prominent rough ledge. Sparse very fine and fine-grained fossil fragments of brachiopods bryozoans (?)----- 1.5

Total Preachersville Member----- 80

Rowland Member (incomplete) :

1. Mudstone, chiefly yellowish-gray (5Y 8/1), in places grayish-yellowish-green (5GY 6-7/2); weathered rock is same colors or darker, approximately pale olive (10Y 6/1); slightly to very limy, silty; in even laminae and thin beds as much as 2 in. thick; fissile, cleaving along smooth partings $\frac{1}{4}$ to 1 in. apart; nonresistant, forms slope; outcrop yields chips and small plates, a fraction of an inch to a few inches across, and irregular blocks commonly about $\frac{1}{4}$ in. thick and 1 to 3 in. long; no fossils seen. In part poorly exposed; about 75 percent of interval is outcrop. Base of section is base of local exposure.----- 13

Measured Rowland Member (incomplete)----- 13

Measured Drakes Formation (incomplete)----- 93

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