Harrodsburg Limestone In Kentucky

By E. G. SABLE, R. C. KEPFERLE, *and* W. L. PETERSON

CONTRIBUTIONS TO STRATIGRAPHY

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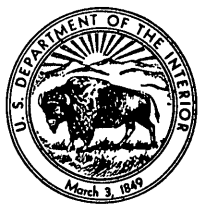

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HARRODSBURG LIMESTONE IN KENTUCKY

By E. G. Sable, R. C. Kepferle, and W. L. Peterson

ABSTRACT

The Harrodsburg Limestone (Mississippian) in northwest-central Kentucky consists of 20 to 50 feet of light-gray coarse-grained fossil-fragmental limestone and minor silty limestone. It underlies the Salem Limestone, overlies the Borden Formation, and includes the Leesville and Guthrie Creek Members of the Lower Harrodsburg of P. B. Stockdale and the Harrodsburg (restricted) as used by him.

INTRODUCTION

The name Harrodsburg Limestone was given (Hopkins and Siebenthal, 1897) to a unit of predominantly carbonate rocks of Mississippian age in Indiana and was subsequently used in Kentucky. A few revisions have been made of the formation boundaries in both States. Recent stratigraphic studies by the authors as part of the cooperative mapping program of the U.S. Geological Survey and the Kentucky Geological Survey have indicated the need for a further, though minor, revision of the lower contact in Kentucky.

This report redefines the Harrodsburg Limestone in Kentucky, reviews its nomenclatural history, describes its lithologic character and stratigraphic relationships, and includes a reference section. At this section the boundaries of the Harrodsburg Limestone as herein defined can be readily seen, and the boundaries of other Mississippian units of earlier workers can be located with the aid of their published descriptions.

HISTORY OF NOMENCLATURE

The development of stratigraphic nomenclature in northwest-central Kentucky for units pertinent to this report is shown in figure 1. Geographic features in Kentucky and U.S. Geological Survey topographic quadrangles that are referred to herein are shown in figure 2.

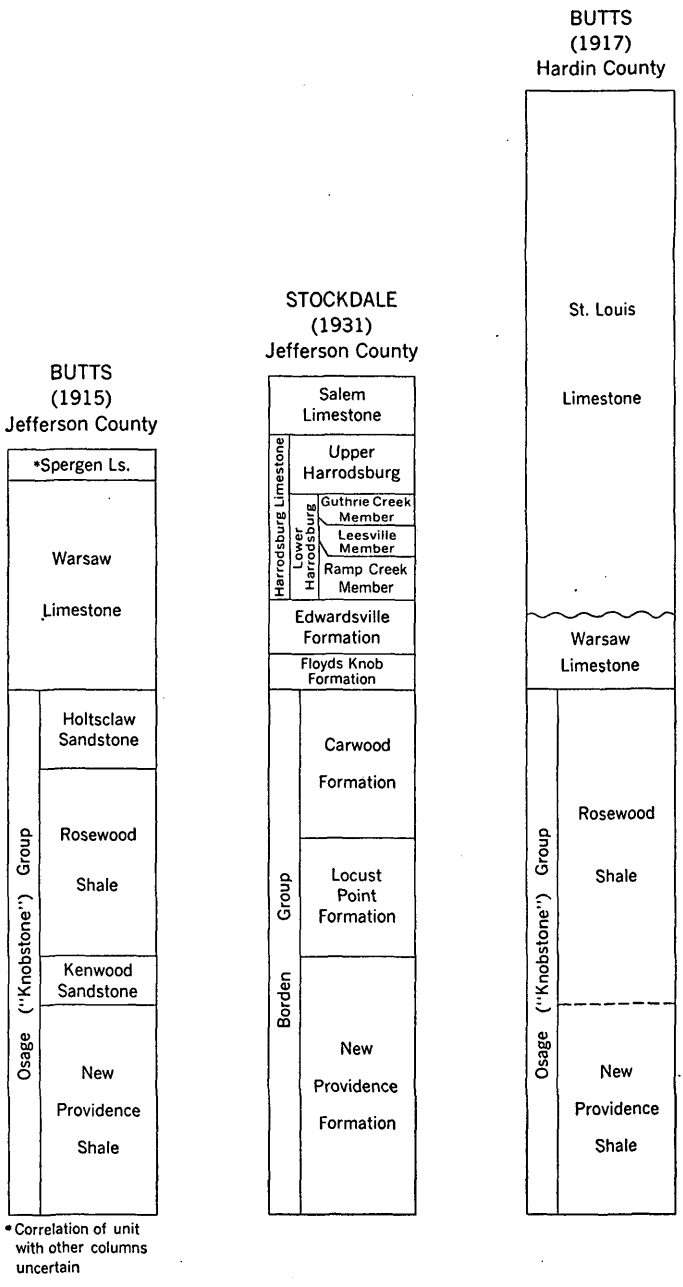

FIGURE 1.—Stratigraphic nomenclature of selected Mississippian units in northwest-central Kentucky.

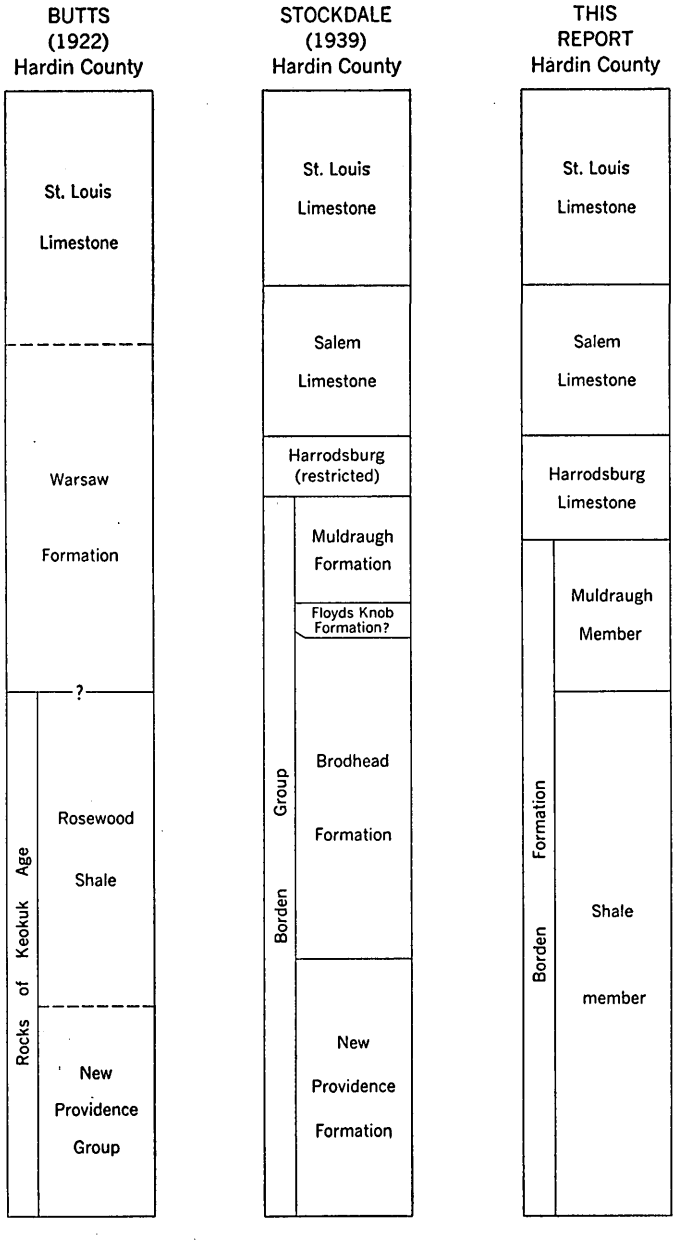

FIGURE 1.—Continued.

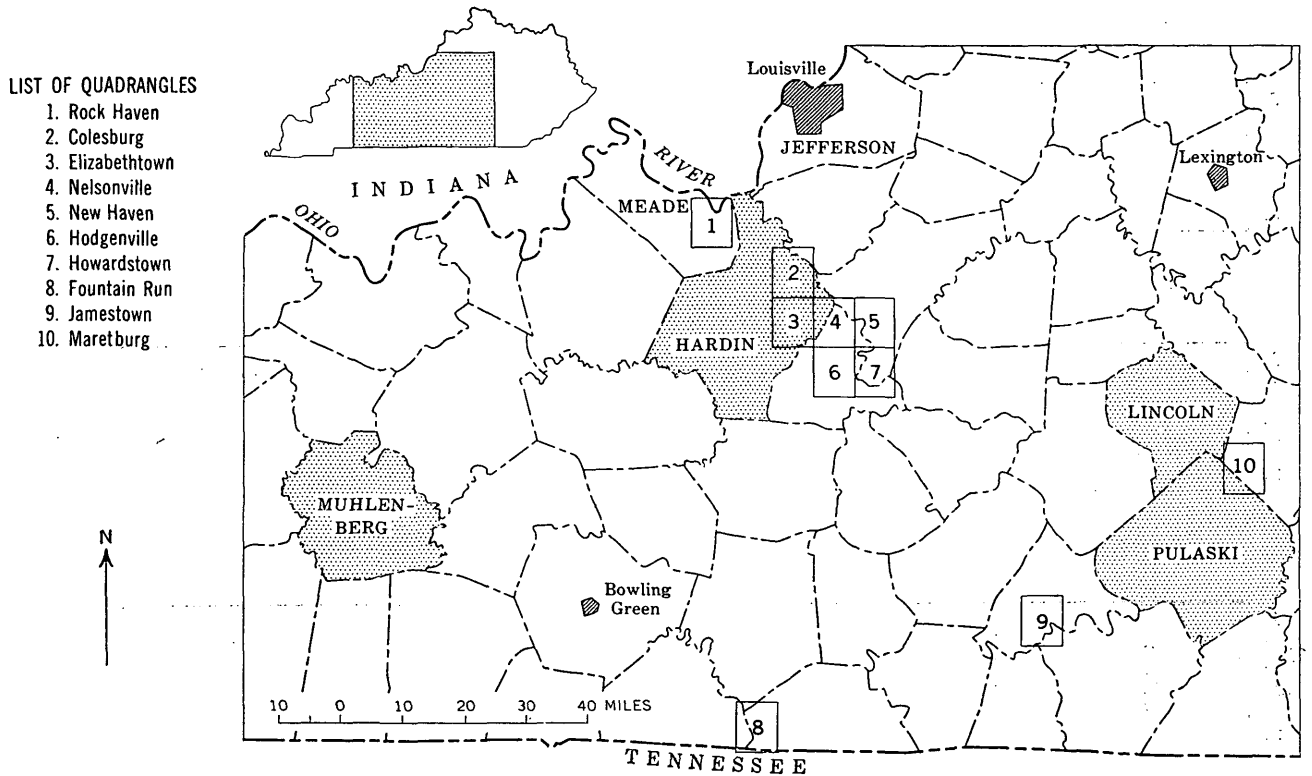

FIGURE 2.—Map of central Kentucky showing counties and topographic quadrangles referred to in this report.

As originally defined in Indiana the Harrodsburg Limestone (Hopkins and Siebenthal, 1897, p. 296) included a variable thickness of carbonate rocks between the Bedford oolitic limestone (Spergen Limestone of former usage or Salem Limestone of later reports) and the Knobstone Group (Borden Group of later reports). Stockdale divided the Harrodsburg in Indiana (Stockdale, 1929) and in Jefferson County, Ky. (Stockdale, 1931, pl. 2), into the Lower and Upper Harrodsburg and further subdivided his Lower Harrodsburg into three new members (ascending): the Ramp Creek, Leesville, and Guthrie Creek Members. Stockdale (1931, p. 311) suggested, however, that in Indiana the Ramp Creek Member might be better considered as a part of the Borden Group and the Leesville as the basal member of the Harrodsburg. This is practically the present usage of the Indiana Geological Survey (H. H. Gray, Indiana Geol. Survey, written commun., 1965) which restricts the Harrodsburg Limestone to Stockdale's Upper Harrodsburg and to his Guthrie Creek and Leesville Members of the Lower Harrodsburg. The Harrodsburg Limestone as recognized in Indiana has been the Harrodsburg as originally defined less the lower beds which Stockdale called Ramp Creek.

In Kentucky, Butts (1917, p. 26–32; 1922, p. 89–120, pl. 50, section 6) included the carbonate and shaly rocks between the St. Louis Limestone and Rosewood Shale in the Warsaw Formation, which he correlated with the type Warsaw of western Illinois. In Jefferson County, Ky., Butts (1915, p. 157–163) had earlier identified as Warsaw the beds between the Spergen Limestone and Holtsclaw Sandstone (fig. 1). The Warsaw of Butts (1917, 1922) included rocks correlative with the Harrodsburg Limestone as originally defined in Indiana, as well as younger strata correlative with the Salem (Spergen) Limestone which he (1922, p. 119–120) considered to be a facies of the Warsaw. This usage of Warsaw in Kentucky was not continued by Stockdale (1939, p. 57, 153, 193, 206, 226, 229) who assigned these rocks to units in the upper part of the Borden Group, to the Harrodsburg Limestone as restricted in Kentucky by Stockdale, and to the Salem Limestone. Stockdale (1939, p. 224 and pl. 25) equated the Harrodsburg (restricted) with the Upper Harrodsburg of Indiana and placed the three members of his former Lower Harrodsburg in the Muldraugh Formation of the Borden Group in Kentucky. Recent mapping by the authors indicates that Stockdale's Upper Harrodsburg and his Guthrie Creek and Leesville Members of the Lower Harrodsburg are recognizable in the northernmost exposures of Meade and Hardin

Counties and together form a persistent unit which has been traced by mapping in the Rock Haven, Colesburg, Elizabethtown, Nelsonville, New Haven, Hodgenville, and Howardstown quadrangles.

HARRODSBURG LIMESTONE REDEFINED IN KENTUCKY

As here defined the Harrodsburg Limestone (Mississippian) in Kentucky is mostly light- to yellowish-gray coarse- to medium-grained fossil-fragmental limestone, in part silicified and cross-laminated. Clear calcite cement, scattered glauconite(?) grains, and interbedded thin lenses of silty limestone are also characteristic features. In northwest-central Kentucky the fossil-fragmental limestone makes up the upper (Harrodsburg restricted of Stockdale) and lower (Leesville Member of Stockdale) parts of the formation; these are separated in many localities by a relatively thin unit of fine-grained, silty dolomitic limestone (Guthrie Creek Member of Stockdale). Where Guthrie Creek lithology is absent, however, the upper and lower parts of the Harrodsburg cannot be mapped separately. Fossils include very abundant bryozoan fragments in the uppermost part of the formation, locally abundant spiriferoid and productid brachiopod shells and shell fragments in the upper and lower parts, locally common echinoid fragments in the lower part, and common to abundant crinoidal debris in all fossil-fragmental limestone. The thickness of the Harrodsburg in northwest-central Kentucky ranges from 20 to 50 feet; the range in thickness seems to be mostly due to variations in the lower and middle parts.

The Harrodsburg Limestone forms conspicuous ledges and is conformably overlain by the Salem Limestone. The basal beds of Salem, which generally are poorly resistant, are either dark limy shale, fine-grained dolomitic limestone, or brown-weathering fossil-fragmental limestone (in northwest-central Kentucky). The Harrodsburg overlies, in part unconformably, the generally moderately resistant Muldraugh Member of the Borden Formation (as described by G. W. Weir, written commun., 1964). The Muldraugh consists mostly of fine-grained, silty, siliceous carbonate rock, but locally it contains light-gray coarse-grained limestone like that in the Harrodsburg. Abundant chert in the uppermost Muldraugh beds aids in distinguishing the Muldraugh from the Harrodsburg in many localities.

A description of the Round Hollow, Hardin County, section is given below. This section includes exposed Mississippian strata ranging from the Muldraugh Member of the Borden Formation to the lower part of the St. Louis Limestone and is a reference section for the Harrodsburg Limestone in northwest-central Kentucky.

ROUND HOLLOW SECTION

[Includes reference section of Harrodsburg Limestone. Measured along U.S. Highway 31W and 60 in Round Hollow 7 miles southwest of West Point, Hardin County, Ky. (Fort Knox quad., Carter Coordinates 6 and 15, R–43). Alt at base approx 440 ft. Units 1 to 4 measured on east side of highway; units 5 to 26, on west side. Measured by R. C. Kepferle and E. G. Sable, August 1962. Color designations are based on the "Rock-Color Chart" of the National Research Council (Goddard and others, 1948)]

	Thickness (feet)
Top of exposure.	
St. Louis Limestone:	
26. Limestone, dolomitic(?), detrital, medium-grained with 50 percent very fine grained matrix; light olive gray (5*Y* 6/1); weathers yellowish gray (5*Y* 7/2); conchoidal fracture	5.0
25. Limestone and carbonaceous shale. Limestone like that in unit 26 but very fine grained, dense; basal 2.3 ft is ledge forming. Shale in two beds less than 0.5 ft thick, dusky brown (5*Y* 2/2), papery to fissile; contains small crinoid fragments and brachiopod shells	3.1
24. Dolomite, as in unit 23, but has more abundant chert as lenses and joint fillings as much as 0.3 ft thick. Chert is dense, aphanitic, pale yellowish brown (10*YR* 6/2); weathers to "chalky" very pale yellowish orange (10*YR* 8/2), with prismatic fracture. Shale partings within and at base of unit	10.0
23. Dolomite, very fine grained, sugary-textured, pale-yellowish-brown (10*YR* 6/2); weathers "chalky" grayish yellow (5*Y* 8/4) to pale yellowish orange (10*YR* 8/6); evenly laminated to gently cross-laminated; contains lenses of fossil debris in lower 5 ft, small quartz- and gypsum-filled geodes, chert as lenses and irregular nodules. Lacks partings; weathers spally. Lower contact mostly a sharp uneven, wavy surface, but units 22 and 23 locally appear to be interlensing	18.5
Thickness (incomplete), St. Louis Limestone	36.6
Salem Limestone:	
22. Limestone, argillaceous, and limy shale, intergraded. Limestone is predominant, olive gray (5*Y* 4/1) to light olive gray (5*Y* 6/1), mostly fine grained but has lenses of medium-grained fossil-detrital limestone; uppermost beds mostly medium grained; planar laminated to gently cross-laminated with hackly to conchoidal fracture. Fossils include small brachiopods, crinoid debris, small horn corals (*Hapsiphyllum*(?)), and *Endothyra* sp. Shale is dark gray, fissile; in planar beds as much as 0.5 ft thick. Lower 0.8 ft is a persistent layer of grayish-brown (5*YR* 3/2) to moderate-brown (5*YR* 3/4) fissile shale and shaly limestone, weathering dusky yellowish brown (10*YR* 2/2). Unit appears to thicken northward to a possible maximum of 50 ft; thicknesses shown where measured along highway. Basal contact abrupt on wavy surface having 0.5 ft relief	20.5–27.5
21. Limestone, like unit 22, but generally medium grained, fossil fragmental, and pelletal. Beds massive, 0.5 to 2 ft thick. Weathered surfaces pitted; contain bryozoans, brachiopods, small horn corals (*Hapsiphyllum*(?)), and small crinoid columnals. Thin shaly bed at base	10.0

Salem Limestone—Continued	Thickness (feet)
20. Limestone and minor interbedded limy shale. Limestone is similar to that in unit 19, mostly a coquina of bryozoan fragments, brachiopod shell fragments, small horn corals, and crinoid debris; beds range from 0.1 to 2 ft, average 0.5 ft in thickness, are in part silicified, and contain scattered gypsum-filled geodes as much as 8 in. in diameter. Upper few feet includes fine-grained limestone. Shaly beds as much as 0.5 ft thick, average 0.1 ft	13.0
19. Limy shale and limestone interbedded. Shale is like that in unit 18, estimated at 70 percent of unit in sets of beds as much as 5 ft thick; contains bryozoan remains and other fossil fragments, and thin lenses of limestone. Limestone is medium gray (*N* 5) to olive gray (5*Y* 4/1); weathers to brownish gray; medium grained; contains abundant bryozoan and brachiopod fragments and lesser amounts of crinoidal debris in beds as much as 1.5 ft thick, having irregular silicified lenses in which chert is medium dark gray (*N* 4) to medium light gray (*N* 6), is mottled, and weathers to bluish hues. Contains scattered quartz-lined geodes	19.5
18. Shale, limy, in part silty, olive-gray (5*Y* 4/1); weathers medium light gray (*N* 6) or light olive gray (5*Y* 6/1) with whitish efflorescence. Partings generally less than ¼ in. thick, fissile in upper 5 ft. Contains scattered quartz- and gypsum-filled geodes; bryozoan fragments. Lower contact abrupt	14.1
Total thickness, Salem Limestone	80±

Harrodsburg Limestone:	
17. Limestone, in resistant beds as much as 4 ft thick; mostly fossil fragmental, medium to coarse grained, yellowish gray (5*Y* 7/2), with reddish cast; weathers light gray (*N* 7) to medium gray (*N* 5), in part iron stained; gently cross-laminated; scattered greenish grains (glauconite?) in lower part. Abundant brachiopod fragments occur throughout unit, very abundant spiriferoid brachiopods in lower few feet; coquina of bryozoan fragments in upper 7 ft. Contains lenses of silicified limestone; stylolitic partings. Discontinuous lenses(?), as much as 3 ft thick, of silty to very fine grained geode-bearing limestone occur about 11 ft below top. Basal contact seems abrupt, but in detail basal few inches grade downward into underlying unit. This unit is the Harrodsburg (restricted) of Stockdale (1939)	18.8
16. Limestone, silty, argillaceous; contains scattered crinoid columnals, shell fragments, and bryozoan remains. Grades downward into underlying unit	1.5

Harrodsburg Limestone—Continued	*Thickness (feet)*
15. Dolomite(?), silty, weakly calcitic, yellowish gray (5*Y* 7/2); weathers same to light olive gray (5*Y* 6/1) and pale yellowish orange (10*YR* 8/6). Faintly laminated, weathers spally, contains abundant quartz-lined geodes as much as 6 in. in diameter. Interlensed with crinoidal limestone like that in unit 11, as much as 2.5 ft thick, and lenses of irregularly banded chert, very pale orange (10*YR* 8/2), dense. Units 15 and 16 correlated with the Guthrie Creek Member of the Lower Harrodsburg of Stockdale (1929) in Indiana	4.8
14. Limestone, predominantly crinoidal, medium- to coarse-grained, in resistant beds as much as 2 ft thick; yellowish gray (5*Y* 7/2); weathers light gray (*N* 7), in part silicified and medium light gray (*N* 6). Shaly limestone interbeds less than 0.5 ft thick. Contains scattered greenish grains and quartz-lined geodes as much as 6 in. in diameter in lower 3 ft. Basal contact abrupt and undulatory. This unit is correlated with the Leesville Limestone Member of the Lower Harrodsburg of Stockdale (1929) in Indiana	7.8
Total thickness, Harrodsburg Limestone	33±
Borden Formation:	
Muldraugh Member:	
13. Limestone, dolomitic(?) to silty dolomite(?) similar to unit 11, grading upwards to medium-dark-gray (*N* 4) silty shale in upper 1 ft. Not well exposed in roadcuts but crops out in streambed west of highway	7±
12. Limestone, crinoidal, medium- to coarse-grained, medium-light-gray (*N* 6); weathers pale yellowish brown (10*YR* 6/2 to light gray (*N* 7); in single ledge-forming bed	1.1–1.5
11. Dolomite(?), silty, medium-gray (*N* 5) and medium-dark-gray (*N* 4); weathers medium light gray (*N* 6) to grayish orange (10*YR* 7/4) and pale yellowish orange (10 YR 8/6); wavy laminae, blebs of quartz, spally to irregular hackly fracture, and few crinoidal lenses to 0.5 ft thick. Coarse-grained limestone lens in upper 0.5 ft, similar to unit 12	5.8
10. Limestone, fine- to medium-grained, partly crinoidal, in part silicified, in a resistant ledge. Basal contact abrupt on gently undulatory surface of underlying unit	1.7
9. Shale, silty, slightly limy (dolomitic?), olive-gray (5*Y* 3/2) and dark-gray (*N* 3), micaceous; weathers medium light gray (*N* 6 with whitish efflorescence. Grades in part laterally to dense, very fine grained in part cherty limestone containing scattered fossil fragments	2.0–2.6
8. Limestone, crinoidal, similar to unit 14, but without shaly interbeds; ledge former; contains greenish grains, silicified lenses, stylolites; crinoid columnals less than ¼ in. in diameter; few spiriferoid brachiopod fragments. Basal contact abrupt	6.6

Borden Formation—Continued Muldraugh Member—Continued	Thickness (feet)
7. Limestone, dolomitic(?), fine-grained siliceous (60 percent), interlensed with medium- to coarse-grained crinoidal to semicrinoidal limestone (40 percent). Shaly partings and silicified limestone in irregular bands common. Wavy laminae in finer grained limestone	13.0
6. Limestone, interlensed and interbedded with dolomitic(?) limestone. Crinoidal limestone is fine to medium grained, crinoid columnals averaging ⅛ in. in diameter; light olive gray (5*Y* 6/1) to medium gray (*N* 5) where silicified. Very fine grained dolomitic(?) limestone about 2 ft thick in middle part. Scattered large crinoid columnals, brachiopod fragments, and horn corals in float	6.4
5. Limestone, dolomitic, with very fine grained matrix and less than 50 percent crinoid fragments as much as ½ in. in diameter, and scarce brachiopod fragments. Weathered yellowish gray (5*Y* 7/2)	1.8
4. Limestone, crinoidal, fine-to medium-grained, pale-brown (10*YR* 5/2) to pale-yellowish-brown (10*YR* 6/2); contains irregular rounded chert masses as much as 6 in. in diameter	0.8–1.0
3. Limestone, dolomitic(?), silty, very fine grained, shaly, poorly resistant. Weathers to yellowish-brown hues	11.5
2. Dolomite, limestone, and minor shale, interbedded. Dolomite is silty to argillaceous, light olive gray (5*Y* 5/2) to (5*Y* 6/1) to greenish gray (5*GY* 6/1); weathers to yellowish brown and orange hues; wavy laminations, spally to hackly weathering. Limestone, crinoidal, coarse-grained; in discontinuous beds less than 2 ft thick, in part silicified. Upper 7 ft of unit, crinoidal limestone with very coarse fragments predominant. Scattered syringothyrid brachiopods and large horn corals about 5 ft above base. Contains scattered quartz-filled geodes as much as 2 in. in diameter. In general, crinoid fragments smaller and better sorted than those in underlying unit. Basal contact abrupt and in part truncates bedding of underlying unit	35.0
1. Limestone, biostromal(?), and minor interbedded shale. Limestone is a crinoidal coquina, very coarse grained; white to yellowish-gray crinoid columnals, as much as 1 in. in diameter, make up about 50 to 80 percent of rock; matrix is clear crystalline to coarse-grained fragmental; general color is grayish orange pink (5*YR* 7/2) and very pale orange (10*YR* 8/2); weathers very light gray (*N* 8) to pale yellowish brown (10*YR* 6/2) and is limonite stained; beds generally 0.5 to 2 ft thick, in part silicified. Coarsely crossbedded, general dip 10° ESE. Interbedded thin clay shale beds and lenses are light greenish gray (5*GY* 8/1) to greenish gray (5*GY* 6/1) and contain crinoid columnals. Unit in part grades laterally to greenish-gray very fine grained limestone. Contains few brachiopod fragments. Base of exposure	16.0
Thickness (incomplete), Borden Formation, Muldraugh Member	110±

CORRELATIONS

The presence of Harrodsburg Limestone and correlative units elsewhere in Kentucky is interpreted from surface and subsurface data. In southeast-central Kentucky the Harrodsburg has been recognized as far east as central Lincoln and Pulaski Counties (Stockdale, 1939, p. 211, 227, pl. 6). Here crinoidal limestone less than 10 feet thick may represent only the upper part of the Harrodsburg of west-central Kentucky. In eastern Lincoln County and in adjoining counties to the east and northeast, the Muldraugh Member of the Borden Formation, the Harrodsburg Limestone, and the Salem Limestone grade into argillaceous limestone, siltstone, and shale of the Renfro Member of the Borden Formation (Schlanger, 1965). In south-central Kentucky the lower beds of the map unit designated as Salem and Warsaw Limestones (Hamilton, 1963) or Warsaw Limestone (Thaden and Lewis, 1962) during the current mapping program, although not lithologically identical with the Harrodsburg, are probably correlative with part or all of the Harrodsburg. These beds are interpreted to interfinger with the uppermost beds of the underlying Fort Payne Formation in some southern areas; the uppermost beds of the Fort Payne, therefore, may be time equivalents of the Harrodsburg.

In the western Kentucky subsurface the Harrodsburg Limestone is a discrete unit in western Hardin and Meade Counties (Kepferle and Peterson, 1964; Moore, 1964), but in some areas, such as Muhlenberg County, beds called Warsaw (Rose, 1963, p. 28) that are probably correlative with the Harrodsburg are difficult to separate from the overlying Salem Limestone. Scattered well-log descriptions and surface mapping (Rogers, 1963) indicate, however, that strata with lithologies characteristic of the Harrodsburg Limestone occur in what is generally called Warsaw Limestone as far west as the Illinois border.

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