

THE FAUNA AND CORRELATION OF THE McCRANEY LIMESTONE OF IOWA AND ILLINOIS

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ABSTRACT. Recent collections of fossils from the McCraney limestone in Iowa and Illinois and study of several sections of the Kinderhook strata along the Mississippi River have yielded new facts concerning the age and relationship of the terrane. Evidences cited favor the correlation of the McCraney with the Louisiana formation. Faunally, lithologically and stratigraphically the two terranes seem to be members of the same body of limestone.

INTRODUCTION

IN the basal Kinderhook beds of Iowa and Illinois occurs the McCraney limestone, generally lithographic, and with characteristic physical appearance. Its stratigraphic position with reference to other Kinderhook beds and its correlation have been subject to various interpretations in the past. The present paper, the result of investigations made for the Iowa Geological Survey in 1946-47 and the writer's own studies, presents new evidence which may aid in settling the problem satisfactorily.

In northeast Missouri in the vicinity of the Mississippi River and in west-central Illinois a similar limestone has long been known and its extensive fauna studied by several investigators. It was called the Louisiana limestone by Keyes (1892, p. 289). Rowley described the formation as it occurs in Pike County, Missouri, and gave diagnoses and illustrations of many of its fossils. Weller (1914) described and illustrated many of its brachiopods. Williams has lately given a monographic survey of the formation and of its fauna. He considered the formation to be lower Mississippian in age and gave a complete summary of the evidence therefor.

The Louisiana limestone has generally been considered to be a member of the Kinderhook series of the Mississippian system. Recently Branson and Branson and Mehl, chiefly on the basis of the occurrence of the conodont genus, *Icriodus*, have suggested that the limestone is upper Devonian in age.

The McCraney limestone in the Kinderhook sections at Burlington and Kinderhook has been studied by a number of

geologists. Keyes (1895, p. 437) considered it as distinct from the Louisiana limestone which he states feathers out before reaching the Burlington area. Weller (1900, p. 79) in his studies of the fauna of the Kinderhook suggested that the McCraney (bed 4 of Burlington section) "may be considered with a fair degree of certainty, as the northern extension of the Louisiana limestone". But later (1901, p. 209) he casts doubt on this conclusion by stating that the bed in question "had little or nothing to suggest its correlation with the Louisiana limestone".

Moore studied this limestone at Kinderhook, Illinois, and at Burlington, Iowa, and came to the conclusion (1928, p. 21) that it and the Louisiana limestone were distinct terranes. Consequently he termed the lithographic limestone at Kinderhook, Illinois, the McKerney from a creek nearby and included it along with the English River siltstone and Maple Mill shale as members of the Hannibal formation. The name was later found to be more properly McCraney (Weller and Sutton, 1940, p. 784).

Laudon (1931, p. 369) in his studies of the Kinderhook beds of Iowa designated the McCraney limestone as the *Paraphorhynchus* zone of the North Hill member of the Hampton formation. He rejected the correlation of the limestone with the Louisiana stating that "the fauna, however, shows definitely that this is not true." He suggested (p. 371) its lithologic similarity to upper ledges of the Chouteau at Newark, Missouri. However the fauna of this bed as listed by Moore (1928, p. 63, zone 4) shows few or no typical McCraney fossils.

Williams (1943) gave in considerable detail the various opinions of and evidence for and against the correlation of the McCraney with the Louisiana and he concluded with Moore and Laudon that the McCraney is younger than Louisiana. He stated, however, that the correlations of Moore are based on incomplete evidences, many of them conflicting. He suggested that new facts will have to be discovered in order to correlate the Kinderhook beds at Kinderhook, Illinois, at Louisiana, Missouri and at Burlington, Iowa, with any degree of assurance.

L. A. Thomas (1949) has recently discussed the McCraney and Louisiana limestones incidental to his study of conodonts of several Mississippian formations of southeast Iowa. He

concludes that the McCraney cannot be correlated with the Louisiana limestone on grounds which to the present writer are not established beyond dispute.

The foregoing summary is sufficient to indicate the present confusion in the minds of geologists regarding the age and correlation of various strata near or above the Devon-Mississippian boundary. Different lines of evidence apparently have led to divergent opinions of the stratigraphic position of the same formation. Especially is this true of the McCraney-Louisiana problem. The writer has recently secured evidences, both stratigraphic and faunal, which lead him to correlate the two beds. The faunal evidence is considered first.

Fauna of the McCraney Limestone

A few macrofossils were collected by H. G. Hershey and the writer in the quarry north of Kinderhook, Illinois, where the McCraney lies directly beneath the Burlington limestone and above the English River siltstone. A few others were found in the limestone in outcrops farther to the north. In general, search for macrofossils in the Illinois area proved disappointing. Therefore, samples of shaly and weathered material were collected from between layers of the McCraney in several localities. The first is from the larger quarry in the NE 1/4 sec. 15, T. 4 S., R. 7 W., the second from an outcrop on the first creek north of Pigeon Creek and the last two from two places in Seehorn Hollow in SE 1/4 NW 1/4, sec. 31, T. 3 S., R. 7 W. and .2 mi. down the creek.

The complete fauna secured in Illinois from the McCraney is as follows:

Macrofossils

Syringothyris hannibalensis (Swallow)

This may be *S. halli* which differs, as Weller remarks, only in size.

Chonetes ornatus Shumard

Dozens on slabs embedded in matrix.

Paraphorhynchus striatocostatum (M. & W.)

Crushed examples poorly preserved, but showing the typical external markings.

Rhynchopora pustulosa (White)

Avonia pyidata (Hall)

This species is reported by Weller.

Microfauna

Locality 1, Kinderhook quarry

Selenella pediculus Rowley*Ambocoelia louisianaensis* Williams

Crinoid columnals

Locality 2, first creek north of Pigeon Creek

Selenella pediculus Rowley*Ambocoelia louisianaensis* Williams*Crania dodgei* Rowley

Echinoid spines

Blastoid plates

Crinoid columnals

Locality 3, Seehorn Hollow

Selenella pediculus Rowley*Ambocoelia louisianaensis* Williams*Crania dodgei* Rowley*Chonetes ornatus* Shumard*Schuchterella louisianaensis* Williams

One small example with large ribs is placed in the species.

Strophalosia beecheri Rowley*Ambocoelia minuta* White*Hybochilocrinus americanus* Rowley

A dozen well-preserved examples, some showing plates and oral structures.

Platycrinus radials*Poteriocrinus?* basals

Common echinoderm fragments including crinoid columnals; echinoid spines, striated and similar to those in Louisiana limestone; sievelike holothuroid plates; blastoid ambulacra and plates similar to those illustrated by Williams as *Mesoblastus*.

Ostracodes

The McCraney limestone at Burlington, Iowa, has been investigated by Weller (1900) and Van Tuyl (1928). The first lists these macrofossils:

Chonopectus fischeri (N. and P.)*Paraphorhynchus striatocostatum* (M. and W.)*Allorhynchus heteropsis* (Win.)*Rhynchonella unica* Winchell*Rhynchopora pustulosa* (White)

Syringothyris halli Winchell

Chonetes gregarius Weller

Van Tuyl adds

Allorisma sp.

Schizodus sp.

Chonetes sp.

The writer found *Chonetes ornatus* Shumard to be rather abundant in a quarry on the south side of North Hill, at Burlington, Iowa. Samples of interlayer material were collected at the North Hill and Starr Cave localities. Only the samples from the latter place proved to carry recognizable fossils. From them were recovered:

Selenella pediculus Rowley

Ambocoelia minuta White

Bembexia minimus Rowley

Crinoid columnals

Echinoid spines

The species, though few in number, are similar to those secured from the McCraney beds at Kinderhook, Illinois, and indicate that the McCraney beds at Burlington are correctly correlated with those in the latter area.

In Franklin county, Iowa, a limestone similar in appearance to the McCraney and having the same stratigraphic situation was recently studied by the writer. It has a fauna demonstrating that it is the northward extension of the McCraney limestone of the Burlington area. Macrofossils are common and well preserved and the following species were identified:

Dictyoclostus sp.

Linoproductus ovatus (Hall)

Paraphorhynchus striatocostatum (M. and W.)

Camarotoechia cf. *tuta* Miller

Rhynchopora rowleyi Weller

Syringothyris hannibalensis (Swallow)

Cranaena sp.

Schellwienella sp.

Chonopectus fischeri (N. and P.)

Torynifer sp. A mold of an exterior.

Grammysia hannibalensis Shumard

Bellerophon sp.

Platyceras sp.*Aviculopecten* cf. *marbuti* Rowley

Samples also were collected of the interlayer material and were found to carry a fairly good microfauna. Among the forms are:

Ambocoelia minuta White*Ambocoelia louisianaensis* Williams, common.*Selenella pediculus* Rowley, common.*Chonetes ornatus* Swallow, a brachial valve.*Allorhynchus* cf. *currei* Rowley, a small example.

Crinoid columnals, common.

Crinoid plates of two types, including *Platycrinus* sp.

Blastoid remains similar to *Mesoblastus* sp.

Echinoid spines and plates.

Holothuroid plates.

Fauna of the Louisiana Limestone

The Louisiana limestone at Hannibal and Louisiana, Missouri, was studied at intervals over several years and a small fauna collected. Additional examples of a number of species were given to the writer by the late R. R. Rowley as well as nearly a pint of washed interlayer material abounding in microforms. The exposure of Louisiana near the Methodist Church at Hamburg, Illinois, yielded many fossils in a short period of time. Especially prolific is the microfauna secured there which contains a number of minute species described by Rowley and Williams. Many of these species are represented by dozens of well-preserved specimens. These collections have served as a source of comparative material in the study of the McCraney fauna.

Correlation of the McCraney Limestone

The fauna of the McCraney beds was compared with those of the various Kinderhook formations of the Upper Mississippi valley and with those of other terranes whose places in the Mississippian system have been questioned. Only one fauna was found to display any considerable similarity in specific and faunal composition. This is the fauna of the Louisiana limestone of Missouri and Illinois.

A critical review of the McCraney species shows that with

few exceptions they all occur in the Louisiana limestone. *Rhynchopora pustulosa* (White) probably equals *R. rowleyi* Williams and *Syringothyris halli* is near if not actually the same as *Syringothyris hannibalensis* (Swallow). Two notable exceptions are *Linoproductus ovatus* (Hall) and *Chonopectus fischeri* (N. and P.). The latter also occurs in the English River sandstone and in the Maple Mill shale. However, in these formations it has been reported only from Iowa and its absence from the limestone farther south is not remarkable. *Linoproductus ovatus* has been found only in the most northern occurrence of the McCraney limestone in Franklin county, Iowa, and is not present in the Burlington area. Its absence, then, in the southern McCraney outcrops is not surprising.

While the extensive macrofauna of the Louisiana limestone is mostly lacking in the McCraney, the species in common to the two terranes appears to be highly significant. The Louisiana limestone is notably barren in many localities, especially in the Hannibal region where Williams (1943, p. 23) noted his failure to obtain fossils. The major portion of the Louisiana beds is relatively unfossiliferous compared to the basal portion according to Moore (1928, p. 45). Therefore, the sparseness of the fauna of the McCraney, if the two formations are correlatives, may be explained in that it is the upper portion rather than the lower fossiliferous part of the Louisiana that is represented in the McCraney limestone of Iowa and Illinois. Again the McCraney limestone has scarcely been explored for fossils and may be expected to yield additional specimens on further search. On the other hand the macrofauna of the McCraney cannot be said to be as closely related to that of any other formation as it is to that of the Louisiana.

The evidence afforded by microfossils is even more emphatic in support of the correlation of the McCraney with the Louisiana. The occurrence and preservation of the microfossils is the same in the two terranes and appear to add weight to the suggestion that they are one limestone. The fauna in each is secured by collecting the shaly interlayer material from between otherwise barren beds of limestone. All species thus far secured from the McCraney and identified, namely, *Ambocoelia minuta* White, *Ambocoelia louisianaensis* Williams, *Selenella pediculus* Rowley, *Chonetes ornatus* Shumard, *Crania*

dodgei Rowley, *Bembexia minima* Rowley, *Schuchertella louisianaensis* Williams, *Strophalosia beecheri* Rowley and *Mesoblastus* sp. are found elsewhere only in the Louisiana limestone. Perhaps more important is the occurrence in the McCraney of the characteristic microcrinoid, *Hybochilocrinus americanus* (Rowley). The identification was kindly verified by Dr. Marvin Weller. Hitherto it has only been found in a shale parting in the Louisiana limestone at Louisiana, Missouri. The only other species described from North America occurs in the Chouteau limestone of Missouri and differs sufficiently to be readily distinguished from the Louisiana form. Other echinodermal remains are common in the McCraney and resemble some of those seen in the Louisiana. Among them are examples of plates of *Platycrinus* and possibly of *Poteriocrinus*.

STRATIGRAPHIC EVIDENCE

The McCraney limestone was described and named by R. C. Moore (1928, p. 21) from outcrops near Kinderhook, Illinois, the type locality of the Kinderhook series. The name is derived from McCraney creek, a stream a mile or so north of Kinderhook. An extensive disused quarry a mile or so northwest of the road junction displays the Kinderhook beds in a section identical with that noted by Meek and Worthen in 1861 in their description of the Kinderhook. Moore correlated the limestone with a nearly identical formation at Burlington, Iowa.

The McCraney limestone is rather thin and somewhat irregularly bedded. The major portion of the rock is usually lithographic in texture and light gray. Thin seams of clay or clayey material may occur between the layers. Portions of the rock adjacent to the bedding planes are often irregularly dolomitic and buff as contrasted with the remainder. The irregular distribution of the dolomitic buff portions gives a vertical face of the limestone a typical mottled appearance. In this feature and in its lithology the McCraney differs but little from the Louisiana limestone.

In thickness the McCraney formation varies from a feather edge near New Canton, Illinois, to about ten feet at the Pigeon Creek schoolhouse about eight miles north of Kinderhook and to twenty-five farther north. At the plant of the Marblehead

Limestone Co. the McCraney (Kansas Geol. Soc. Guidebook, 1941, p. 74) is reported to be about forty-seven feet thick. In Iowa it is about six to twelve feet thick in the region of Burlington and is at least ten feet thick in Franklin county.

The McCraney limestone extends northward along the bluffs of the Mississippi from a point a mile north of New Canton, Illinois, until it passes beneath river level about ten miles south of Quincy. It next appears at the surface near Burlington, Iowa, and extends northward along the west wall of the Mississippi valley to the southern part of Louisa county. Thence it occurs intermittently in the south wall of the Iowa river valley to Wellman, Iowa. A considerable gap in the outcrop, generally due to erosion, but partly to burial beneath glacial drift, occurs in the area between Iowa and Franklin counties. A small area in Geneva township and an outlier north of Maynes Creek in Franklin county are the northernmost surface occurrences of the McCraney limestone.

The McCraney seems to have been considered a distinct terrane by Moore chiefly because at Kinderhook, Illinois, it overlies a massive siltstone. This he correlated with the Hannibal formation in its more southerly exposures in the east wall of the Mississippi valley. If this correlation is correct, then the lithographic limestone, McCraney, could not be the same as the lithographic limestone, the Louisiana, lying below the Hannibal at Hannibal and Louisiana, Missouri. However, the writer does not regard as established beyond doubt the equivalency of the siltstone below the McCraney with the Hannibal above the Louisiana.

The stratigraphy of the beds involved may be profitably reviewed by first noting the strata in the Burlington region of Iowa. The well-known and much-studied Prospect Hill section of Iowa is as follows:

8. Burlington limestone	25 ft.
7. Wassonville limestone	5
6. Oolite	3-4
5. Prospect Hill siltstone	5
4. McCraney limestone	10
3. Oolite and shell limestone	1
2. English River siltstone	18
1. Maple Mill shale	25+

There is no doubt about the designation of the beds below the McCraney limestone as they can be traced into the type

sections of these formations on the English River in Washington county, Iowa. The strata of this section dip below river level south of Burlington and next appear in the east wall of the Mississippi valley below Quincy, Illinois.

The Mississippian section near Kinderhook, Illinois is approximately:

4. Burlington limestone	25+ ft.
3. McCraney limestone	10
2. English River siltstone	30
1. Maple Mill shale	40+

There seems to be general agreement among geologists regarding the designation of the beds below the McCraney (Kansas Geol. Soc. Guidebook, 1941, p. 72). Weller (1905, p. 623) has found in the siltstone a fauna which he definitely states is English River. Several terranes between the Burlington and McCraney limestone are absent in the immediate vicinity of Kinderhook. However, a few miles to the northward a siltstone comes in between them and there appears little doubt that it is the southern extension of the Prospect Hill siltstone of Iowa. It also differs but little from the upper part of the Hannibal as seen in the western part of Hannibal, Missouri (Kansas Geol. Soc. Guidebook, 1941, p. 66).

At Hannibal, Missouri, about 16 miles west of Kinderhook, is a well-known section:

3. Burlington limestone	100 ft.
2. Hannibal shale and siltstone	70 ft.
1. Louisiana limestone	30 ft.

In the region of Hannibal a considerable thickness of shale is seen (Williams, 1943, p. 24; Grohskopf, Hinchey and Greene, p. 15) below the Louisiana in several places.

The next important section is at Hamburg, Illinois, along the creek in the south part of town.

7. Burlington limestone	
6. Shale and sandy shale (Hannibal)	75 ft.
5. Glen Park sandy dolomite and oolite	12
4. Louisiana limestone	5
3. Shale (Saverton)	1
2. Cedar Valley limestone	5
1. Silurian	20

Bed 3 is a dark shale and is thought by some geologists to be Saverton. Bed 6 apparently is Hannibal and is the terrane which Moore states can be traced into the English River

siltstone of the Kinderhook section. If true then the McCraney limestone must be younger and a separate designation would be warranted.

Since the Kinderhook beds concerned are exposed almost continuously in the east valley wall of the Mississippi and in tributary valleys from Kinderhook to Hamburg, an examination was made at a number of places which seemed to be critical in working out the stratigraphic relationships of the beds or where the rocks were best exposed and more accessible. Several observations were made of sections which appear to cast doubt on the correlation of the Hannibal and English River siltstones.

In the south bank of the first creek (Wild Cat Hollow) north of Belleview, Illinois, about a half mile east of the highway is an important section.

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| 2. Louisiana limestone, lithographic with dolomite partings | 30 ft.+ |
| 1. Siltstone, bluish, massively bedded, base not exposed, English River | 6 ft.+ |

Louisiana limestone with typical fossils occurs at Hamburg about eleven miles south, and Belleview is across the river and southeast of the type locality of the Louisiana limestone at Louisiana, Missouri. Moore states (1928, p. 45) that the Louisiana limestone is present in Calhoun county, Illinois, and Williams (1943, p. 9) maps it as present in the county to the north as well. Consequently it appears certain that the upper terrane of the section is Louisiana limestone. The siltstone at the base is strikingly similar to the English River beds and the section duplicates some seen near Burlington, Iowa. If the siltstone is not the English River it is an hitherto undescribed terrane.

In the hill on the north side of the same valley and adjacent to the highway is another and more extended section.

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|---|---------|
| 3. Limestone, Louisiana | 3-4 ft. |
| 2. Siltstone, English River | 4-5 ft. |
| 1. Shale, Maple Mill, mostly covered | 15 ft. |

The section is continued about 100 yards farther north on the same hill.

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| 5. Burlington limestone | 30 ft.+ |
| 4. Shale, Hannibal | 70 ft.+ |
| 3. Limestone, Louisiana | 15-20 ft. |

The same section was also observed at a place a mile south

of the county line. It will be noted that the Hannibal beds of the Hamburg section occur here in full force above the Louisiana limestone. Consequently the siltstone below, which the writer believes to be English River, appears to be a distinct terrane. Although the Glen Park beds are not seen in these sections, they are commonly present in a number of places as far north as Rockport.

Along the second creek north of Atlas (Jim Town Branch) about a half mile east of the highway is a good section showing the relationship of the Glen Park to the beds above.

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| 4. Siltstone, Hannibal, blue, massively bedded, grading into bed below; higher beds upstream more shaly | 5-6 ft.+ |
| 3. Shale, Hannibal, blue, elsewhere brown or intermottled with blue | 4 ft. |
| 2. Dolomite, Glen Park, buff, upper surface irregular | 1-2 ft. |
| 1. Limestone, Glen Park, oolitic; conglomeratic, pebbles of lithographic limestone, well rounded; dipping downstream; massively bedded above, weathering into thin plates below | 5-6 ft. |

Some distance downstream is a shale, apparently Maple Mill, as both English River and Louisiana formations have feathered out some miles to the southward.

At Rockport, Illinois, in an extensive ravine in the south part of town the same beds are again seen.

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| 3. Shale and siltstone, Hannibal, blue | 10 ft.+ |
| 2. Dolomite, Glen Park, blue when unweathered, buff, massively bedded, fossiliferous, sharp contact with shale below | 6 ft.+ - |
| 1. Shale, Maple Mill, considerable thickness, has two thin widely-separated layers of limestone | 30 ft.+ |

In the north part of Rockport in a ravine a block north of the church is another section as follows, (thickness estimated):

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|---|---------|
| 6. Burlington limestone | 6 ft.+ |
| 5. Siltstone, massive, wormlike markings 2-3 feet of shale at top, Hannibal? | 20 ft. |
| 4. Siltstone and shale, mostly covered | 15 ft. |
| 3. Shale, blue, mostly covered | 10 ft. |
| 2. Siltstone, massively bedded, resistant, fossiliferous, forming a declivity, English River? | 15 ft. |
| 1. Covered interval above road | 30 ft.+ |

A block of Glen Park oolite, not in place, indicates that it is present as well. The possibility exists that more than one siltstone is present here, but this can only be assured when the position of the Glen Park is known definitely.

The McCraney limestone north of Kinderhook has siltstone above and English River siltstone and Maple Mill shale below. The same stratigraphic positions of these beds are seen in the case of the Louisiana at Bellevue. Since the lithology of the Louisiana and the McCraney is identical (Weller 1905, p. 624) and the fauna apparently the same, it seems probable that the two terranes are members of the same limestone body. In support of this is the observation of Weller and Sutton (1940, p. 785) that the two limestones have never been seen in the same section. S. E. Harris, Jr. (1947) has recently studied samples of wells from northeast Missouri and southern Iowa and has apparently traced the Louisiana limestone into

Moore* 1935	Standard Section	Present Paper	
Burlington	Burlington	Burlington	
Wassonville	Sedalia	Wassonville	
— Oolite	Chouteau	— Oolite	
Prospect Hill		— Oolite	
Mc Craney		— Oolite	
English River	Hannibal	Prospect Hill	
Maple Mill	Glen Park	— Oolite	
	Louisiana	Mc Craney	
	Saverton	— Oolite	English River
		— Oolite	English River
		— Oolite	Maple Mill

Figure—1 Correlation of Lower Mississippian of southeastern Iowa and northwestern Illinois discussed in this paper.

* Moore, R.C., 1935, Ninth Annual Field Conference, Kansas Geological Society, page 245.

the McCraney. He has recognized the McCraney in Iowa as Louisiana. The isopach map of the Louisiana limestone by Williams (1943, p. 9) also favors this interpretation of the relationship between the Louisiana and the McCraney.

The Glen Park sandy dolomite and oolite can be traced almost continuously northward from Hamburg to Rockport. It lies on Louisiana at first, then on Maple Mill as the English River and Louisiana beds were eroded or were never deposited in the region between Rockport and north of Belleview. The Glen Park is seen at several places in Rockport but appears to end abruptly there, as it is not seen in section beyond to New Canton.

The stratigraphy of the lower Mississippian formations in the east wall of the Mississippi valley may be summarized from the sections given above and from outcrops not mentioned (fig. 1).

The Maple Mill shale of the Kinderhook section appears to be traceable almost continuously along the Mississippi bluffs into the Saverton shale at Hamburg. From a thickness of one foot at the latter place it increases in thickness to the northward, becomes less fissile, less black, more grayish and merges with the typical Maple Mill shale. As the base was not observed in most places, the thickness is unknown except at Hamburg. In no place did the writer observe this basal Kinderhook shale to unite with the Hannibal beds.

The English River siltstone rises gradually to the southward from Kinderhook and comes to underlie the Burlington limestone as the McCraney feathers out just north of New Canton. It may continue southward nearly as far as Rockport but at that place and beyond it has been removed so that Glen Park lies on Maple Mill. The English River siltstone is apparently absent for a considerable distance and next reappears a mile or so north of Belleview. In the south side of the valley of the first creek north of that place, it occurs immediately below Louisiana limestone, has its typical lithology, and is six feet thick with the base not exposed. This section is similar to some in the Kinderhook area of Illinois. The fact that both English River and Hannibal may be seen in the same section north of Belleview would seem to show that they are not correlatives. The siltstone disappears north of Ham-

burg as the shale beneath simultaneously thins to a thickness of one foot.

The thick body of shale above the Glen Park beds at Hamburg, apparently Hannibal, becomes more silty so that at Rockport it is a thick body of siltstone lying on Glen Park. It may continue northward and overlap on English River. It would be difficult to distinguish them in the same section because of their lithologic similarity without Glen Park or Louisiana between. On the other hand the Hannibal may disappear to the northward of Rockport either through erosion or nondeposition. The abrupt disappearance of the Glen Park just north of Rockport lends credence to the possibility that the Hannibal does likewise. The writer was not able to trace the beds from Rockport to New Canton but does not believe that the Hannibal can be traced into the English River. The two terranes may occur, one above the other north of Rockport and would be hard to separate because of their lithologic similarity without the presence of formations which elsewhere occur between them. The possibility of confusion and variable interpretations of the beds north of Rockport is evident. On the other hand Harris (1947) states that there is subsurface information at hand that the Prospect Hill of Iowa thickens to the south and southeastward of Burlington until it merges with the Hannibal of Missouri. The siltstone above the McCraney north of Kinderhook, Illinois, would appear to be Hannibal.

The Burlington limestone can be traced continuously from Kinderhook to Hamburg, Illinois, as in the case of the Maple Mill. This is true also in Iowa where the Burlington and Maple Mill are continuous over large areas and enclose between them a number of discontinuous formations as the English River, Louisiana, Prospect Hill and others.

CONCLUSIONS

1. The lithologic and faunal similarity and apparently identical stratigraphic position of the McCraney and the Louisiana strata lead to the conclusion that they are portions of the same body of limestone. This substantiated by tracing the Louisiana in subsurface in northern Missouri into the McCraney in Iowa (Harris, 1947).

2. The extent of the Louisiana limestone is thus much greater

than hitherto recognized, as its outcrops range from Franklin county, Iowa to Hardin county, Illinois.

3. The McCraney limestone is not a member of the Hannibal formation. Since the name Louisiana has precedence, the term McCraney may well be dropped.

If it is granted that the McCraney and Louisiana limestones are parts of the same formation it follows that the siltstones which lie above and below are different formations.

4. The English River siltstone is not a member of the Hannibal formation. This is favored by the difference in the faunas of the two terranes as appears in a study of Moore's lists (1928, p. 53). An inspection of the table of Hannibal species collected at Louisiana, Missouri, (disregarding the columns of collections at Rockport and Pleasant Hill which are Glen Park) shows that only five occur in the English River siltstone. This proportion is not large considering their similar lithology which is indicative of the same ecological environment. Also, fossils of these siltstones being molds exclusively are sometimes difficult to identify accurately. Finer differences are often obscured or lost. Faunally the English River is more definitely related to the Louisiana and Maple Mill in Iowa (Weller 1905, pp. 624-5).

5. The Hannibal formation is represented in Iowa and in the Kinderhook region of Illinois by the Prospect Hill siltstone. The macrofauna of the Prospect Hill is quite similar to that of the Hannibal as Moore states (1928, p. 21). This correlation is further strengthened by a study of Prospect Hill conodonts by Youngquist and Patterson who found them to be similar to those of the Hannibal. Furthermore the Prospect Hill has many species in common with the Northview sandstone of southwestern Missouri. That formation is said by Weller (1905, p. 633) to be equal to the Hannibal. Likewise the Prospect Hill may be traced below the surface into Hannibal beds (Harris, 1947).

6. The Maple Mill shale is apparently traceable in Illinois from Kinderhook south into the Saverton shale at Hamburg. They appear to be parts of the same body of shale. If so, Maple Mill has precedence by twenty-five years. The fauna of the Saverton in Missouri is related to the fauna of the Louisiana and the same is true of the fauna of the McCraney and the Maple Mill. The latter is not a member of the Han-

nibal formation as is shown by its fauna and stratigraphic position.

7. An early Mississippian age for the Louisiana limestone is indicated by its fauna and its stratigraphic situation above English River siltstone and Maple Mill shale, recognized by geologists generally as basal terranes of that system. Williams has recently considered at length the evidences for the assignment of the Louisiana to the Mississippian and his arguments need not be repeated here. A few comments on the fauna, inclusive of that of the McCraney, may be added. The Louisiana fauna as a whole has few of the aspects of any Devonian fauna known to the writer. None of the larger invertebrate species occurs in any known Devonian formation. Few, if any, of the distinctive genera of macrofossils of the Upper Devonian of the Mississippi valley are found in the Louisiana.

On the other hand Williams found that a number of Louisiana species do occur in recognized Mississippian formations. Five are present in the Prospect Hill siltstone at Burlington, four in the English River siltstone, four in the Glen Park beds, five in the Chouteau limestone, nine in the Waverly beds of Ohio and five in the Hannibal beds. It is true that many of the characteristic productids of the Mississippian are absent in the Louisiana. However, *Avonia*, represented by *Avonia pyxidata* (Hall) is present therein. It is not a true *Productella* as it lacks the high cardinal areas of that Devonian genus and has in addition radial plications on the front of the valve of many specimens. Others are quite smooth but this is readily explained by assuming that the developing genus had not yet attained its mature characteristics so early in the Mississippian. The presence of *Linoproductus ovatus* (Hall), a species with an extended range in the Mississippian and occurring in the northernmost exposures of the Louisiana limestone in Iowa, is highly indicative of the post-Devonian age of the terrane. The presence of *Chonopectus*, *Torynifer* and *Paraphorhynchus* is further support for this assignment.

The Maple Mill shale and the English River siltstone below the Louisiana limestone in Iowa include such genera of productids as *Linoproductus*, *Dictyoclostus* and *Krotovia*. In Franklin county, Iowa, the Louisiana overlies the Chapin bed which has an extensive Mississippian fauna as listed by Laudon (1931, p. 393, *Cyathaxonia* zone). If the McCraney and

Louisiana beds are the same, it appears nearly conclusive that the latter is Mississippian.

Branson and Mehl have placed the Louisiana limestone in the Upper Devonian. Apparently this placement is based on evidence afforded chiefly by conodonts and by its stratigraphic relationships with the Grassy Creek shale. The writer believes that the usefulness of conodonts as stratigraphic markers has as yet not been completely determined. Likewise it is uncertain how much weight should be attached to them as evidence of geologic age, especially if conflicting with that given by other groups of fossils.

Branson and Mehl (1939) list five genera of conodonts as diagnostic of Devonian age. One, *Icriodus*, occurs in the Louisiana limestone with a macrofauna which Williams regards as Mississippian. In this opinion the writer is in full agreement since, as shown, above, the affinities of the Louisiana larger fossils are with those of the McCraney which are definitely Mississippian. The characteristic and unique microcrinoid, *Hybochilocrinus americanus* (Rowley), occurs in both terranes. Is not the evidence of age given by this crinoid as good as that of *Icriodus*?

Similarly L. A. Thomas lists the five conodont genera as present in the Maple Mill shale of Iowa and accordingly places the formation in the Devonian. The macrofauna, however, is plainly related to the Mississippian rather than to Devonian faunas. For instance the brachiopod *Chonopectus* occurs in the Maple Mill, in the English River and in the Louisiana (McCraney) of Iowa. Caster also lists it in the fauna of the Mississippian Corry sandstone of northeastern Pennsylvania. Moreover, besides faunal relationships the contact between the Maple Mill and the English River siltstone is a gradational one and does not appear to the writer to be intersystemic.

The Upper Devonian limit of the geologic ranges of these genera of conodonts does not seem to be established beyond reasonable doubt. The genera, *Ancyrodella*, *Polylophodonta* and *Palmatolepis* are said by Branson and Mehl (1933) to be present in the Bushberg of Missouri but are thought by them to be contaminants. *Ancyrognathus* is listed by Branson (1938, p. 334) in the Hannibal shale. *Palmatolepis* and *Icriodus* are said by C. L. Cooper to be present in the Upper New Albany

beds, generally regarded as Mississippian. This author has recently discussed these genera (1948, p. 103) and casts some doubt on their importance as decisive Devonian markers. Others may yet be found to occur in formations higher than Devonian as some Mississippian formations have as yet been incompletely explored for conodonts.

8. The Kinderhook succession in the Upper Mississippi valley seems to be as follows: 1. Maple Mill shale, 2. English River siltstone, 3. Louisiana limestone, 4. Hannibal shale and siltstone, 5. Chouteau limestone.

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