The St. Louis and Ste. Genevieve Limestones of Harrison County, Indiana

PRESTON MCGRAIN, Indiana University

Introduction

Purpose. The purpose of this paper is to present the results of a detailed study of the St. Louis and Ste. Genevieve limestones in the central and western portions of Harrison County, Indana. The very nature of the problem made it necessary to limit the area studied. References to other areas may be made for the purpose of emphasis or explanation.

Since little attention has been given to the detailed stratigraphy of these limestone formations an effort is made to afford a clearer and more definite understanding of them. More specifically it is presented to show the thickness of each formation, important lithologic and faunal characteristics, and persistent units which can be used as mappable horizons.

Location. Harrison County lies in the extreme south central portion of Indiana. It is bounded on the southeast, south, and southwest by the Ohio River, on the west by Big Blue River and Crawford County, on the north by Washington County, and on the east by Floyd County. The area under consideration in this paper contains approximately 250 square miles and comprises parts of congressional Townships 1 and 5 South, Range 2 East, Townships 1 and 6 South, Range 3 East, Townships 1 to 6 South, Range 4 East, and all of congressional Townships 2 to 5 South, Range 3 East. Corydon, the county seat, is located in the approximate geographic center of the county.

Indiana highways 33, 62, and 64 cross the area in an east-west direction, and Indiana highway 135 crosses it in a north-south direction. Numerous other roads of various degrees of improvement cross the area described. The Southern Railroad approximately parallels highway 64 in the north central part of the region. The L., N. A., and C Railroad, a branch line of the Southern Railroad, extends 8 miles from the main line to Corydon.

Physiography. Central Harrison County lies almost wholly within the karst Mitchell plain developed in the St. Louis and Ste. Genevieve limestones (Fig. 1). The more typical karst area is a plain with little local relief. This expansive karst plain is gently rolling to flat and is marked with innumerable sinkhole depressions. The topography produced by the deeply intrenched Ohio and Blue rivers, and Indian and Buck creeks which flow across the upland sinkhole plain provides the greatest relief. These main streams are practically without surface tributaries. Most of the drainage of the karst enters numerous sinkholes and passes

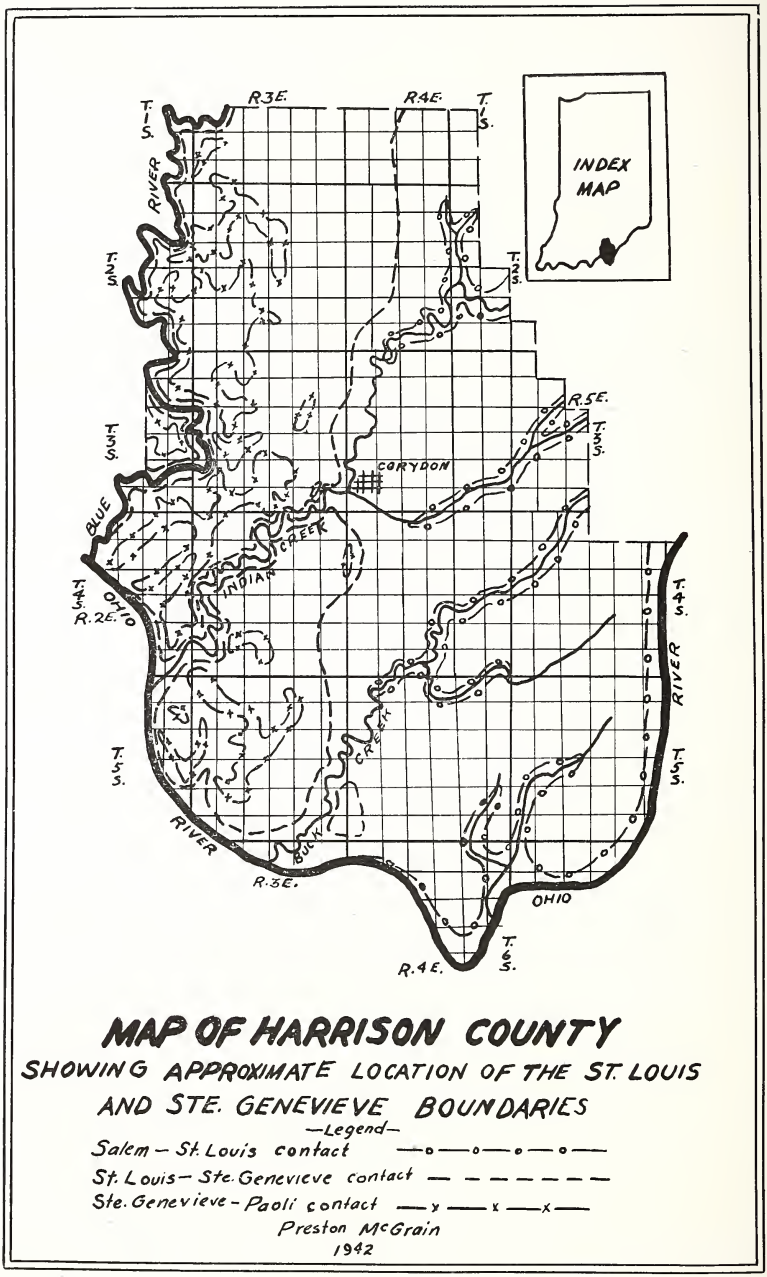
R.3E.
R.4E.
T. 1 S.
INDEX MAP
OHIO RIVER
T. 2 S.
R.5E.
T. 3 S.
CORYDON
BLUE
CREEK
INDIAN
T. 4 S.
R. 2 E.
OHIO
RIVER
T. 5 S.
T. 6 S.
MAP OF HARRISON COUNTY
SHOWING APPROXIMATE LOCATION OF THE ST. LOUIS AND STE. GENEVIEVE BOUNDARIES
—Legend—
Salem – St. Louis contact
St. Louis – Ste. Genevieve contact
Ste. Genevieve – Paoli contact
Preston McGrain
1942

Fig. 1.

through underground routes to the main streams. Evidences of underground drainage are the existence of many springs along the deeply set valleys and also the presence of many caverns. The Mitchell plain is essentially a regional slope which is inclined westward at the rate of approximately 20 feet per mile as compared with the bed rock itself which dips at the rate of 30 to 35 feet per mile to the west.

The western portion of Harrison County lies in the eastern edge of the Crawford Upland. Hills and ridges capped by sandstones of the Chester series rise 100 to 200 feet above the karsted limestone plain in the eastern portion of the area. The extreme western part of Harrison County exhibits topography typical of the Crawford Upland. The region is a well dissected upland of considerable relief. Many of the valleys in this hilly area are bottomed in the limestone and possess karst features. Malott (1939) called this type of valley *karst valley*. Numerous springs and caves are also found in this area. Harrison Spring (formerly called Wilson Spring), reported to be the largest spring in Indiana, issues from a deep pit in the St. Louis limestone in the NE quarter of Sec. 19, T. 3 S., R. 3 E.

Stratigraphy

Age and Nomenclature. Considerable difference of opinion has arisen regarding the age assignment of the Ste. Genevieve limestone. The age of the St. Louis and Ste. Genevieve has been set as Meramecian by Wilmarth (1928) although Ulrich (1904) included the Ste. Genevieve in the Chester group. In recent years voluminous literature has appeared on the correlations of the formations of the Chester group and classification of the Ste. Genevieve limestone in the Mississippi Valley region. There has been little question as to the age of the main body of the St. Louis limestone (Fig. 2).

The names Mitchell, St. Louis, Barren, Lithostrotion limestone, Cavernous limestone, Lawrence-Crawford (part), Concretionary limestone, Middle limestone (part), Paoli (in part), and Mammoth Cave formation have been applied to the St. Louis-Ste. Genevieve sequence in Indiana. Siebenthal (1897), believing that the limestones between the well known building stone (Salem) and the Chester clastics could not be correlated with the St. Louis limestone, as had been the case prior to this time, named the sequence Mitchell limestone from the town of Mitchell, Lawrence County, Indiana. The name Mitchell was used in this comprehensive sense for many years, chiefly because the series of limestone units are difficult to separate into mappable units. The feature that perhaps adds most to the difficulty is the fact that most of the St. Louis, Ste. Genevieve, and Paoli formations form a karst plain rather deeply buried in the residual clay. Ulrich (1911) correlated the Mitchell with both St. Louis and Ste. Genevieve. The name Paoli was first proposed by Elrod (1899) for the upper part of the limestone sequence which is now practically equivalent to the Ste. Genevieve and the lowest limestone member of the Chester. This name, however, has been restricted by Cumings (1922) for the extreme top of the Mitchell; it is the lowest member of the Chester series in Indiana and underlies the Mooretown sandstone. The present writer would follow the sugges-

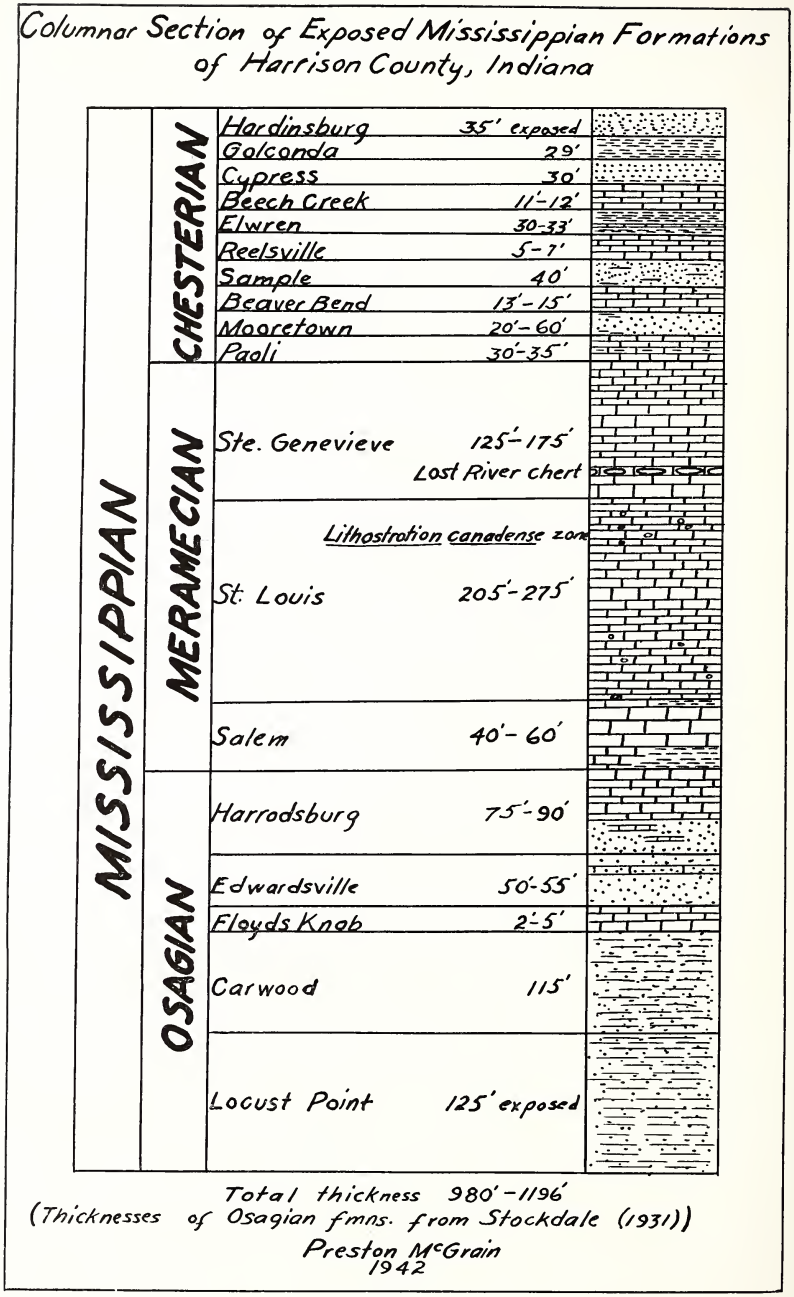
Columnar Section of Exposed Mississippian Formations of Harrison County, Indiana
MISSISSIPPIAN
CHESTERIAN
Hardinsburg 35' exposed
Golconda 29'
Cypress 30'
Beech Creek 11'-12'
Elwren 30-33'
Reelsville 5-7'
Sample 40'
Beaver Bend 13'-15'
Moorefown 20'-60'
Paoli 30'-35'
MERAMECIAN
Ste. Genevieve 125'-175'
Lost River chert
Lithostrotion canadense zone
St. Louis 205'-275'
Salem 40'-60'
OSAGIAN
Harrodsburg 75'-90'
Edwardsville 50'-55'
Floyds Knob 2'-5'
Carwood 115'
Locust Point 125' exposed
Total thickness 980'-1196'
(Thicknesses of Osagian fmns. from Stockdale (1931))
Preston McGrain
1942

Fig. 2.

tions of Butts (1918) and Cumings (1922) to discard the term Mitchell and return to the long established names St. Louis and Ste. Genevieve.

General Lithologic Characteristics of the St. Louis Limestone. *Nature of Sediments.*—The St. Louis in Harrison County is primarily a well jointed, thin-bedded limestone. One set of joints runs in a general north-south direction; the second set of joints, aligned approximately normal to the first, runs east and west. Both sets of joint planes are essentially vertical.

The St. Louis limestone ranges in texture from the extremely fine-grained lithographic stone which breaks with conchoidal fracture and shows no macroscopic grains to rather dense beds which have the particles plainly visible. The greater portion of the formation can be classed as medium to fine grained. A few of the strata are extremely crystalline; others show few traces of crystals; and the two extremes may occur in the same section. In some instances the beds contain many fossils, whereas in others no traces of organic remains are determinable. In general, however, macroscopically determinable organic matter constitutes only a small portion of the St. Louis.

Argillaceous material, though not abundant, is common in the St. Louis both as impurities in the limestone and as thin layers of blue, gray, or green shale between the strata, especially in the lower part.

Dolomite is also common in the St. Louis. Although none of the strata appears to be highly magnesian, local concentrations of dolomite in the form of druses are present near the top of the St. Louis in dolomitic limestone strata.

One of the most striking features about the St. Louis is the presence of great amounts of chert and flint scattered throughout the formation. The St. Louis chert is largely in the form of nodules but lenses and stringers are also present. At various horizons, especially near the top, there are local concentrations of nodules. The lower St. Louis is not characteristically as cherty as the middle and upper portions of the formation. On the weathered outcrop these nodules and lenses project beyond the limestone surface in irregular knobs and layers (Fig. 3).

Fig. 3. Concentration of chert in the upper St. Louis along highway 62, 5½ miles west of Corydon, Sec. 19, T. 3 S., R. 3 E.

Color of the Rocks.—The color of the St. Louis limestones on the fresh surface ranges from light to dark gray or nearly black, the greater portion of the formation being a medium gray color. The presence of magnesian or argillaceous material occasionally causes a deviation from the gray and the result is usually blue-gray, green-gray, brown-gray or tan.

Impurities in the form of iron compounds give yellow and red colors, and much of the St. Louis which is ordinarily gray on the fresh fracture becomes buff or reddish-brown on exposure, due to the oxidation of the ferrous iron which it contains.

Bedding.—The St. Louis can best be described as a thin-bedded limestone formation. Most of the strata range from a few inches to 2 or 3 feet in thickness. However, due to its hard, dense character it might appear massive on the outcrop. The strata, especially on the weathered outcrop, are usually marked by sharp bedding planes. Occasionally a well laminated bed is found but these are not common. The bedding planes are frequently in the form of stylolites. They are so numerous that this feature can be called an important characteristic of the St. Louis formation. In size they range from a fraction of an inch to several inches.

Several patterns of ripple marks have been observed in the upper half of the formation. Crossbedding is apparently absent in the St. Louis. It can be generally stated that the absence of crossbedding is an important negative feature in contrast to the Ste. Genevieve above and the Salem below.

Paleontology of the St. Louis. Although the St. Louis limestone is abundantly fossiliferous at several horizons, it is difficult to obtain identifiable specimens from the hard, dense beds, and its fauna is little known. Many fossils may be obtained from the chert associated with the limestone.

Probably the most important guide fossil to the St. Louis is the massive colonial coral *Lithostrotion canadense* (Fig. 4). It is readily

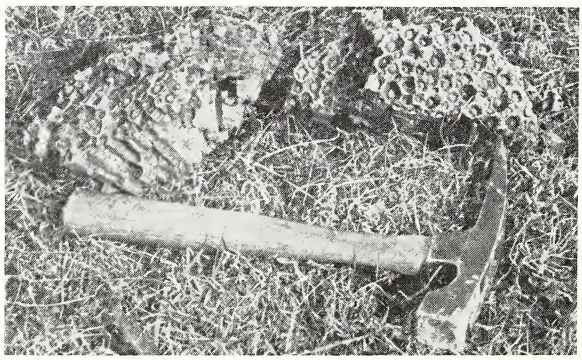

Fig. 4. Silicified *Lithostrotion canadense* from the St. Louis residuum near Corydon.

silicified and is a common constituent of the St. Louis residuum. In Harrison County this index fossil is not only limited to the St. Louis formation but it is also restricted to a single horizon within the St. Louis. This horizon is usually located 22 feet below the St. Louis-Ste. Genevieve contact and is so consistent over most of the area that it can be used for mapping purposes (Fig. 5). An exception was seen in the extreme southern portion of the area where the interval thickens to 37 feet. The silicified *Lithostrotion canadense* protrudes beyond the surface of the weathered limestone outcrop and is easily distinguished. On the fresh rock surface it can be recognized by the lighter color and the structure of the corallites.

Another species, *Lithostrotion proliferum*, is common in the St. Louis, especially in the upper part. It was not seen above nor below the St. Louis. This coral is readily silicified and can be collected in abundance from the residual material.

Bryozoa is also common in the St. Louis. Several genera, including *Fenestella*, may often be abundant, sometimes forming most of a single layer. Brachiopods constitute a large portion of the St. Louis fauna. Among the brachiopods the following genera have been recognized: *Productus*, *Spirifer*, *Echinoconchus*, and *Schuchertella*. Other fossils include *Melonechinus multiporus*, *Syringopora*, crinoids, and other specimens as yet unidentified.

General Lithologic Characteristics of the Ste. Genevieve Limestone. *Nature of Sediments.*—That the Ste. Genevieve is similar to the St. Louis in many respects is obvious in view of the difficulty in recognizing and differentiating these formations in the past. This description of the Ste. Genevieve will show some of these similar as well as contrasting characteristics.

The Ste. Genevieve in Harrison County is a jointed, thick- and thin-bedded limestone. Like the underlying St. Louis limestone there are two sets of joints, usually vertical, and are aligned approximately north and south, and east and west. Unlike the St. Louis, however, some of the joint planes are not vertical but cut the bedding planes obliquely, often in a very striking manner. This feature can hardly be called a distinct characteristic although it has been observed at numerous localities.

The Ste. Genevieve limestone ranges in texture from lithographic to material containing calcite grains the size of small shot. Strata of various degrees of crystallinity are common. In fact it might be said that as a whole the Ste. Genevieve is considerably more crystalline than the subjacent St. Louis. Throughout much of its extent the Ste. Genevieve is more or less oolitic, and this characteristic is an important one in differentiating it from the St. Louis. Some of the oolitic beds are hard and dense and the oolitic character can be seen only on close inspection. Contrasted with this, other beds of the oolite are coarse textured, resist fracture, and the spheroidal bodies are conspicuous, standing out prominently on weathered surfaces and being plainly apparent on freshly broken surfaces. The oolitic layers may also contain small fossils or fossil fragments. These layers are usually crystalline in character.

The Ste. Genevieve limestone is, as a whole, a strikingly pure limestone. Argillaceous material is present but not common. Shale beds are rare and the clayey material is usually in the form of argillaceous limestone. Dolomite is also present, particularly in the lower portions of the formation. Here the dolomitic strata commonly contain dolomite druses.

Flint and chert probably constitute the greatest impurity in the Ste. Genevieve. Although it is not notably a cherty formation, numerous layers and nodular masses of flint and chert do occur, particularly in the lower part. The most notable occurrence of chert in the Ste. Genevieve is the Lost River chert of Elrod (1899). This is not chert in the true sense of the word but rather is highly fossiliferous, siliceous limestone which, on being exposed to the weathering agencies, is leached of its calcium carbonate. In some cases the lime is completely replaced by siliceous material. This chert ranges in thickness from several inches to 3 feet. Occasionally not one but two such chert horizons occur, separated

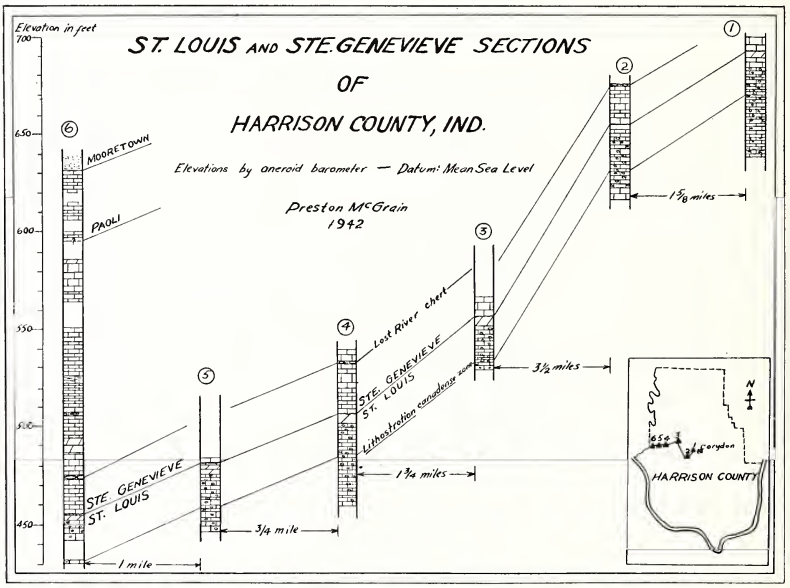

Fig. 5.

by about 2 feet of limestone. This chert is usually easy to recognize and is consistently found 15 to 22 feet above the base of the Ste. Genevieve (Fig. 5). At another horizon the oolitic limestone is silicified and the resulting chert preserves the oolites which are also silicified. In the middle Ste. Genevieve strata of the western portion of Harrison County there is a concentration of beds of black flint of high quality. Nodules and irregular masses of flint are also present in the Ste. Genevieve, and are most common in the lower beds.

No sandstone was observed in the Ste. Genevieve in Harrison County, but locally sand grains occur in the mass of limestone.

Color of the Rocks.—Because of the general lack of impurities the Ste. Genevieve is a light colored stone. The color of the limestones on the fresh surface ranges from pure white to medium gray, the greater portion of the formation being a light gray color. The presence of argillaceous or magnesian material colors the stone blue-gray, green-gray, brown-gray or buff. Frequently the surface is stained reddish brown due to the oxidation of the ferrous iron which the formation contains. The presence of iron is also evidenced by the red color of the residual material. The Ste. Genevieve is quite noticeably lighter colored limestone than the St. Louis. Although this characteristic does not hold true for each individual bed it does apply to the formation as a whole.

Bedding.—The Ste. Genevieve limestone is both a thick- and thin-bedded formation. The strata range from a few inches to more than 6 feet. It is generally massive appearing, more so than the St. Louis. The strata are usually marked by sharp bedding planes. And, like the St. Louis bedding planes, they are often in the form of stylolites.

Fig. 6. Cross-bedding in the upper Ste. Genevieve limestone along highway 62, 2¼ miles northwest of Corydon, Sec. 27, T. 3 S., R. 3 E.

Cross-bedding is a conspicuous feature of the Ste. Genevieve formation (Fig. 6). Although the presence of cross-bedding is not an infallible criterion for distinguishing this formation from the subjacent St. Louis it is an important characteristic. The cross-bedded strata are usually oolitic stone. Quite often this structural feature is made visible on surfaces etched by weathering.

Weathering of the Rocks.—Chemical agents are the dominant factors in the weathering of the Ste. Genevieve rocks. As in the St. Louis, solution in the Ste. Genevieve takes place mainly along the joints and bedding planes, thus weathering it to a cavernous condition. Wyandotte Cave, which is located in Crawford County less than two miles from the Harrison-Crawford county boundary line, is developed almost entirely in this limestone. The thin-bedded, hard, fine-grained beds of the Ste. Genevieve limestone weather much like most of the St. Louis, but the

exposed massive, oolitic and granular-crystalline strata are characteristically pitted, honeycombed and rounded.

Paleontology of the Ste. Genevieve. Fossils are also difficult to obtain from this massive limestone formation and consequently its fauna has never been thoroughly collected.

Platycrinus penicillus has long been recognized in the Eastern Interior Basin as a guide fossil to the Ste. Genevieve. In Harrison County the small, elliptical, spiny plates of this crinoid were never seen by the writer in the overlying Chester formations or in the underlying St. Louis. Because of its restricted occurrence it was used frequently to identify the Ste. Genevieve in the field. The Lost River chert, previously mentioned under Lithologic Characteristics of the Ste. Genevieve, is highly fossiliferous. It can, perhaps, be best described as containing a brachiopod and fenestellid fauna. The fauna of the rest of the Ste. Genevieve includes *Syringopora*, *Pentremites*, productids, and crinoids.

Stratigraphic Boundaries. In order to ascertain the thicknesses of the St. Louis and Ste. Genevieve limestones it was first necessary to establish the limits of these formations. Since little detailed work has been done on the internal stratigraphy or upon their boundaries in Indiana, much detailed study in the field on these formations was imperative.

Salem-St. Louis Contact.—Although the Salem-St. Louis contact is not always sharp the limestones themselves can be recognized on the basis of both lithologic and faunal differences. The hard, generally massive, crystalline, sometimes cross-bedded Salem limestone is quite different from the thin-bedded, cherty, argillaceous, non-crystalline lower St. Louis. They are often easily distinguished by the manner in which they weather. The weathered surface of the Salem is characteristically pitted and honeycombed while the thin-bedded, argillaceous lower St. Louis assumes a shaly appearance when exposed to the weathering agencies. In Harrison County the lower portion of the Salem is noticably shaly and fossiliferous. This horizon correlates with the Somerset member of the Salem of Stockdale (1939). Another shaly zone was observed at the top of the Salem in a road cut one-half mile west of the village of Crandall. Faunally, the Salem is best characterized by a foraminifer *Endothyra baileyi*.

St. Louis-Ste. Genevieve Contact.—The contact of the St. Louis and Ste. Genevieve limestones has received little study. In fact the difficulty in picking out a contact has caused much delay in the proper delimitation of these formations in Indiana (Fig. 7). The division, when indicated, was placed by many geologists at the upper limit of the Lost River chert horizon. This idea seemed to hold in Indiana literature until 1931 when Malott, speaking of solution features in the Lost River region, placed the base of the Ste. Genevieve limestone some 15 or 20 feet below the Lost River chert. The same year, Bates, quoting Malott, states that the division between the St. Louis and the Ste. Genevieve limestones in Indiana is not at the Lost River chert horizon but at an unconformity 10

to 20 feet below the Lost River chert. He adds that Malott's evidence in support of this conclusion are oolitic beds and the fossil crinoid *Platycrinus penicillus*, a form thought to be restricted to the Ste. Genevieve, below the Lost River chert; and also the absence of *Lithostrotion canadense* and *L. proliferum* in or immediately below the chert zone.

Fig. 7. Contact of the St. Louis and Ste. Genevieve limestones in a road cut along highway 62, 5 miles west of Corydon, Sec. 20, T. 3 S., R. 3 E., marked by head of hammer.

Since oolites seem to be a very important characteristic of the Ste. Genevieve it is common practice to place the St. Louis-Ste. Genevieve contact more or less arbitrarily below the lowest prominent oolitic beds. Butts (1918) and J. M. Weller (1931) recognized the prominence and importance of the oolites as a distinctive lithologic feature in nearby Kentucky. As arbitrary as it might seem to be, this basis for division is not only very convenient but also is in harmony with the other criteria. With one exception the lowest oolitic bed ranged from nothing to 1½ to 2 feet above the top of the St. Louis. An oolitic bed, thought to be in place, was observed along a road at the top of the Ohio River bluff in Sec. 6, T. 6 S., R. 4 E., and was estimated to be 50 to 60 feet below the top of the St. Louis. Further observations failed to reveal the St. Louis beds of similar lithology in Harrison County. Neither was this bed found at a correlative position at any other point along the Ohio River.

The elliptical, spiny crinoid plate of *Platycrinus penicillus*, mentioned previously, was also used successfully by Butts (1918) and J. M. Weller (1931) in Kentucky for a distinguishing faunal marker. In Harrison County, Indiana, the writer found this diagnostic fossil in the lowest of the Ste. Genevieve beds but never in the St. Louis strata.

Besides these characteristics, much of the Ste. Genevieve differs from the St. Louis in being much lighter in color. This change is noticable at the contact. The St. Louis is dull gray, medium to fine-grained limestone contrasted with the white or whitish gray, crytalline Ste. Genevieve. In a number of places where the contact is well exposed over some considerable distance the contact is noticably undulating or wavy.

Another distinction, although not as striking nor as useful, is the difference in the manner in which these two formations weather. Because of its physical as well as chemical properties the Ste. Genevieve often weathers to a rounded surface. Honeycombed surfaces due to differential solution are common. This feature, however, is not nearly so well developed in the Ste. Genevieve as it is in the Salem limestone.

The *Lithostrotion canadense* zone, restricted to the St. Louis, and the Lost River chert horizon near the base of the Ste. Genevieve provide excellent clues for the location of the contact.

Ste. Genevieve-Paoli Contact.—The unconformity which separates the Ste. Genevieve and the Paoli is the most conspicuous stratigraphic break noted in this study. It is expressed in Harrison County as a reworked and recemented limestone conglomerate or breccia 1 to 3 feet thick. This brecciated zone was observed on Pilot Knob, NW quarter Sec. 36, T. 3 S., R. 3 E.; at the west end of a railroad tunnel in Sec. 21, T. 2 S., R. 3 E.; in a quarry in the W half Sec. 10, T. 4 S., R. 2 E.; and along the bluff overlooking the Ohio River in Sec. 11, T. 5 S., R. 2 E.

A thin calcareous sandstone is sometimes found at the base of the Paoli immediately overlying the brecciated zone. This horizon in Harrison County varies from nothing to 2 inches in thickness and possibly represents the Aux Vases sandstone of the Illinois section.

Lithologically the Paoli and the Ste. Genevieve limestones are similar in many respects and the boundary must be distinguished faunally and by the presence of the brecciated zone. The Paoli usually contains two calcareous shale breaks, either of which may contain many Chester fossils. In a road cut or quarry face these horizons are easily recognized and immediately suggest the Paoli formation.

Paoli-Mooretown Contact.—Because the brecciated zone described above is recognized with great difficulty on weathered outcrops and because talus and residual material often hide this marker it is often necessary to locate the top of the Paoli in order to approximate the position of the Ste. Genevieve-Paoli contact. The Mooretown is a sandstone and its position may frequently be ascertained by its influence upon the topography. It ranges in thickness from 20 to 60 feet in Harrison County. It is a coarse grained, iron stained sandstone, and is sometimes strongly cross-bedded. Markings of the plant fossil *Stigmaria* are frequently present and serve to characterize this sandstone formation. Its base is 30 to 35 feet above the Ste. Genevieve-Paoli contact.

Thickness of the Formations. The best exposures of the St. Louis are found along Indian Creek, Buck Creek, and the Ohio River. The Ste. Genevieve is also well exposed along portions of Indian Creek and the Ohio River as well as Blue River. The very nature of the rocks has limited the number of exposures satisfactory for ascertaining thicknesses. Because of the deep mantle of residual material which covers most of the area, well records, when present, are of little aid. The relatively low relief, the position with respect to overlying resistant beds, and the great thickness made the St. Louis the more difficult of the two to compute.

As far as the writer knows, there has never been any measurement of the St. Louis or Ste. Genevieve in Harrison County. Ashley (1903) gives the following description of the thickness of the Mitchell:

> Perhaps the best estimate of the thickness of the Mitchell (in southern Indiana) was made at Corydon. The top of the Mitchell is found in Pilot Knob at 265 feet above the creek, according to barometer. The bottom of the Mitchell is last seen at the quarry four miles east of Pilot Knob. The average dip of the strata along the Airline railway, a few miles north, is found to be approximately 33 feet to the mile. If the same dip holds between the foot of Pilot Knob and the quarry the bottom of the Mitchell should be 100-125 feet below the stream at the foot of the Knob, allowing for the descent of the stream, or between 350-400 feet below the top of the Mitchell in the Knob.

The writer measured the Paoli at Pilot Knob and found it to be 30 feet thick. The interval between the Lost River chert and the base of the Paoli is 104 feet. Assuming the Lost River chert to be 15 to 20 feet above the St. Louis the thickness of the Ste. Genevieve is 120 to 125 feet thick at this point. It follows, if Newsom's figures are correct, that the St. Louis is 205 to 245 feet thick.

The thickest St. Louis section observed by the writer was along the Ohio River in the W half of Sec. 6, T. 6 S., R. 4 E. Here 229 feet of St. Louis strata were observed from the valley level to the top of the River bluff. Alluvium in the valley and a thick blanket of residuum capping the upland prevented the ascertainment of the full thickness of this formation. Since this section reached neither the *Lithostrotion canadense* zone in the upper St. Louis nor the Salem formation it is the opinion of the writer that the total thickness of the St. Louis is 265 to 280 feet in the extreme southern portion of Harrison County.

The thickest section of Ste. Genevieve, 173 feet, was observed down the river from the above section in Sec. 14, T. 5 S., R. 2 E. Although the underlying St. Louis strata were not exposed it is thought that the lowest exposed beds represent the base of the Ste. Genevieve formation. Another complete Ste. Genevieve section may be seen near the Harrison-Crawford county boundary in Sec. 26, T. 3 S., R. 2 E. (Fig. 5, Stratigraphic section 6). The Ste. Genevieve formation at this locality is 141 feet thick.

Conclusions

It has been the aim of this paper to afford a more precise picture of the St. Louis and Ste. Genevieve formations in Harrison County, Indiana; to bring to light certain fundamental characteristics of these formations which may apply to other areas; and to link the Middle Mississippian stratigraphy of extreme southern Indiana with previously studied areas.

This paper has attempted to show that the St. Louis and Ste. Genevieve are distinct and separate formations and, as such, may be mapped in the field. Zones and definite horizons within these formations were also recognized as mappable units. Most conspicuous of these were the *Lithostrotion canadense* zone in the upper St. Louis, and the Lost River chert in the lower Ste. Genevieve. The writer has used both horizons for mapping structure and has found them highly satisfactory. Other units were recognized locally but time did not permit the determination of the extent of these horizons. Of the two formations the Ste.

Genevieve undoubtedly has the most horizons which can be traced from one locality to another.

Because of reasons previously given the thicknesses of the St. Louis and Ste. Genevieve formations were difficult to obtain. From the data gathered in the field it was found that the formations thicken southward and westward. However, in view of our knowledge of these formations in counties north and west of Harrison County this is not a surprising fact. As far as the writer is aware, the exposed St. Louis and Ste. Genevieve in Indiana attain their maximum thicknesses in southern Harrison County.

The unconformity between the Ste. Genevieve and the Paoli represents the most conspicuous stratigraphic break observed in this study. Another unconformity, although not as conspicuous, is the boundary between the St. Louis and the Ste. Genevieve.

References

Ashley, G. H., (1903). *Geology of the Lower Carboniferous Area of Southern Indiana,* 27th Ann. Rept., Ind. Dept. of Geol. and Nat. Res., pp. 77-78.

Bates, R. E., (1932). *Underground features of Sinking Creek, Washington County, Indiana,* Proc. Ind. Acad Sci., **41**:263-268.

Butts, Charles, (1918). *Descriptions and correlations of the Mississippian formations of Western Kentucky,* Ky. Geol. Surv.

Cumings, E. R., (1922). *Nomenclature and description of the formations of Indiana,* Handbook of Indiana Geology, pp. 403-570.

Elrod, M. N., (1899). *The geologic relations of some St. Louis caves and sinkholes,* Proc. Ind. Acad. Sci. **8**:258-267.

Malott, C. A., (1932). *Lost River at Wesley Chapel Gulf, Orange County, Indiana,* Proc. Ind. Acad. Sci. **41**:258-316.

————————, (1939). *Karst valleys,* Bull. Geol. Soc. Amer. **50**:1984.

Siebenthal, C. E. (and Hopkins, T. C.), (1897). *The Bedford oolitic of Indiana,* 21st Indiana Report, pp. 291-427.

Stockdale, P. B., (1931). *The Borden rocks of Southern Indiana,* Ind. Geol. Surv., Publication No. 98, Plate 2.

————————, (1939). *Lower Mississippian rocks of the East-Central Interior,* Geol. Soc. Amer., Special Paper No. 22.

Ulrich, E. O., (1911). *Revision of the Paleozoic systems,* Bull. Geol. Soc. Amer., Vol. 22, Plate 29.

Weller, J. M., (1931). *Paleontology of Kentucky: Paleontology of the Mississippian system,* Ky. Geol. Surv. ser. 6, Vol. 36.

Wilmarth, M. Grace, (1925). *The geological time classification of the United States Geological Survey,* U. S. Geol. Surv., Bull. 769.