THE CHOUTEAU LIMESTONE IN CENTRAL MISSOURI.

by

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CHAPTER I

INTRODUCTION

Statement of the Problem

The Chouteau limestone has been studied in detail in central Missouri where it crops out from around Sedalia in Pettis county northeastward to the town of Louisiana on Mississippi River. South of Sedalia only a few outcrops have been located and the formation is not well known. The writer, therefore, undertook as her problem a detailed study of the Chouteau limestone south of Sedalia. The problem resolved itself into the following points:

1. To trace the formation southward from Sedalia.
2. To study its lithologic, stratigraphic, and structural characteristics.
3. To study its fauna.
4. To make a comparative study of the Chouteau limestone of the region to the south of Sedalia with that to the north.

General Geology of the Region

Within the area studied, the rocks range from Cambrian to Pennsylvanian in age. The stratigraphic position and relation of the Chouteau limestone to the other formations present in the region is shown in Table I. This relationship, however, holds true only for central Missouri. Elsewhere the Kinderhook series - to which the Chouteau limestone belongs - is much more complicated. See Table II.

Table I

Formations Exposed in the Region

Era	System	Series	Formation	Thickness	Lithology
PALEOZOIC	Pennsylvanian	Lower? Des Moines	Cherokee	Few feet	Blue shale Ferruginous sandstone
	Mississippian	Osage	Warsaw	15-20 ft. present	Chert light shale
			Burlington	0-150 ft	Crystalline limestone
		Kinderhook	Chouteau	20-60 ft	
			Sylamore or Phelps	0-6 in	
	Devonian	Middle	Cooper	15-30 ft	Hard dove-colored limestone Conchoidal Fracture
	Ordovician	Canadian	St. Peter	0-150	Fine grained white sandstone
			Jefferson City	200-300	Gray dolomite
			Roubidoux	100-200	Gray crystalline Dolomite
	Cambrian	Ozarkian	Gasconade	300	Dolomite and sandstone
			Proctor	60	Gray Dolomite

Table II. Classification of Kinderhook Formations in Missouri

Southwestern Missouri	Central Missouri	Northeastern Missouri
Pierson	Chouteau	Chouteau
Northview		Hannibal
Chouteau		Louisiana
Eureka or Noel, with Sylamore	Sylamore or Phelps	Saverton and Grassy Creek

Definition

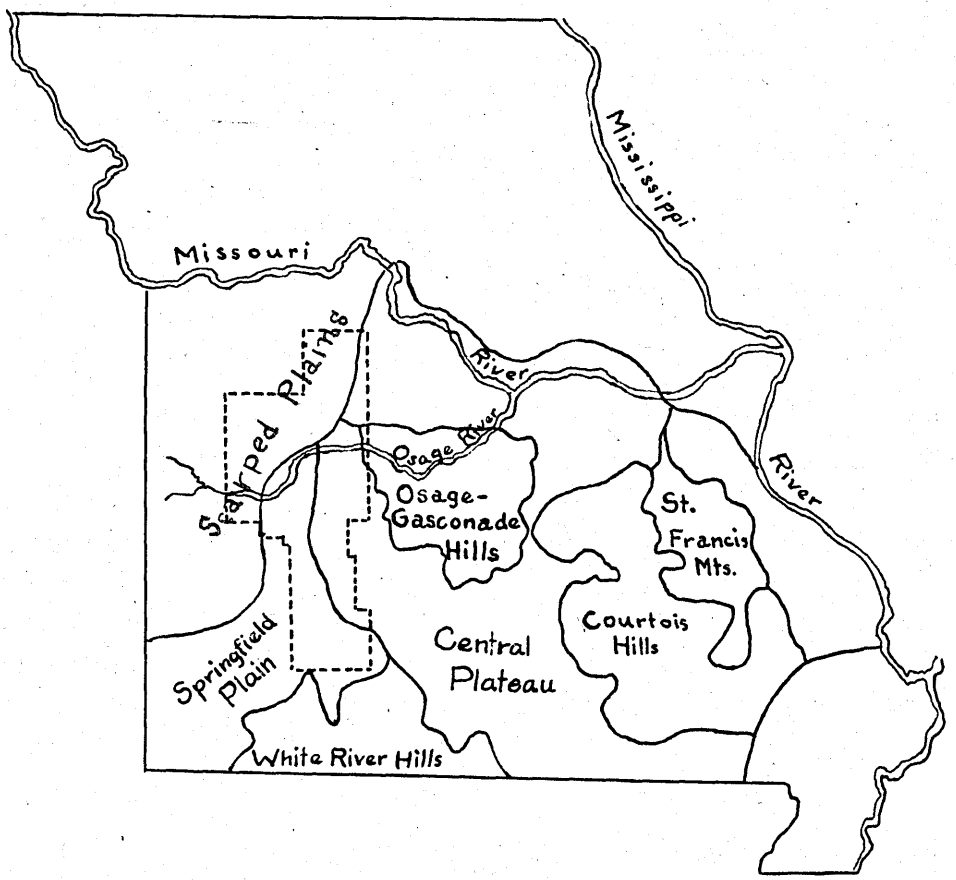
The Chouteau limestone was defined and named as early as 1853 by Professor Swallow, who found its beds well developed at Chouteau Springs in Cooper county.[1] Swallow recognized two divisions of the Chouteau limestone. The upper division consists of forty to fifty feet of thick-bedded, brownish-gray, silico-magnesian limestone which contains very few fossils. At many places in central Missouri this upper portion is entirely absent. The lower part is a fine-grained, compact, blue to drab limestone which breaks with a conchoidal fracture and occurs in irregular, thin beds. This lower division is present throughout most of central Missouri and is often quite fossiliferous, containing a characteristic Kinderhook fauna.

Location of the Area

The area examined by the writer includes parts of Pettis, Benton, Henry, St. Clair, Polk, and Green counties in central Missouri, and extends nearly to the southern boundary of the state. See Plate I.

1. Swallow, G. C., Geology of Missouri: The 1st and 2nd Annual Reports of the Geological Survey of Missouri, p. 101-103, 1855.

LOCATION OF THE THESIS AREA WITH RELATION TO THE PHYSIOGRAPHIC PROVINCES



Thesis area [---]

Topography of the Area

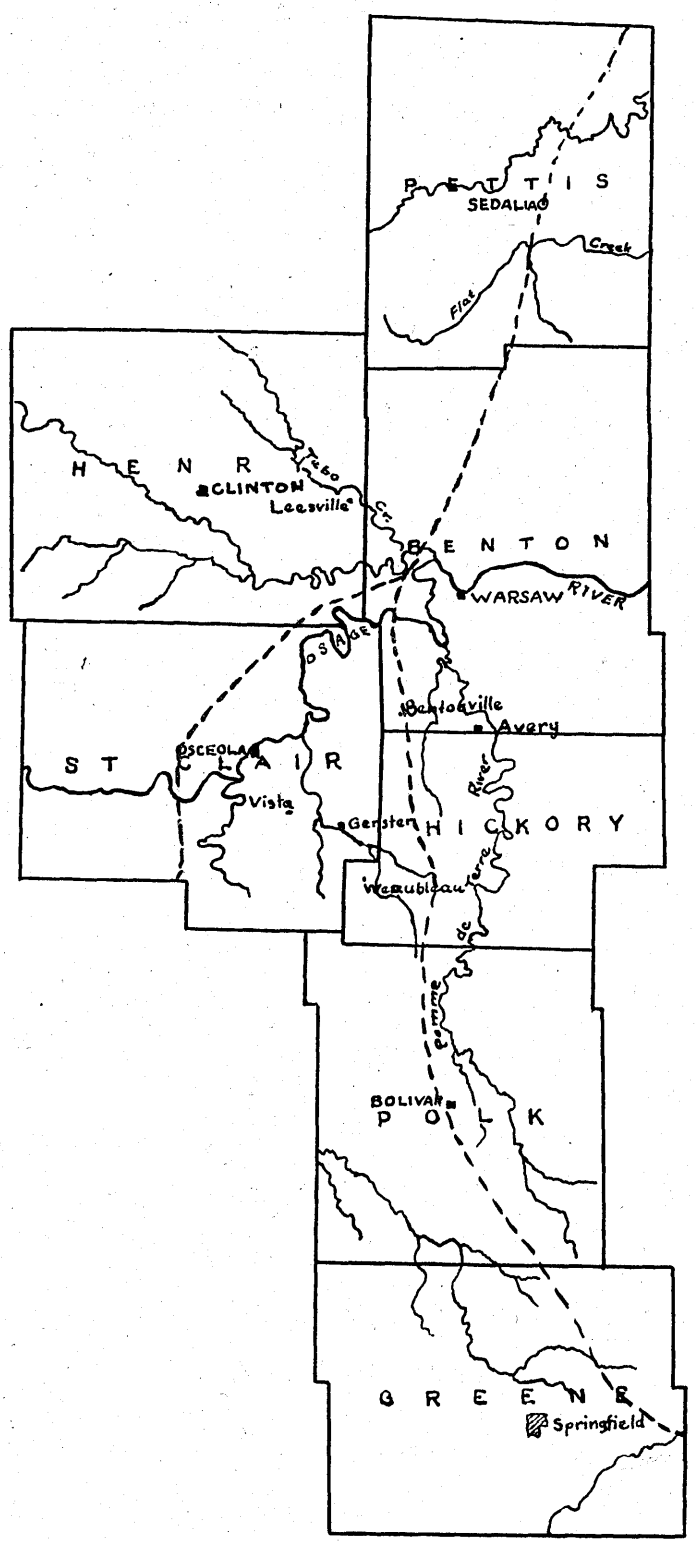
Most of the area lies within three plateau regions, namely, the Scarped Plains, the Springfield Plain and the Central Plateau. Plate I shows the relation of these physiographic provinces both to the area studied and to the other divisions of the Ozark Highland.[2]

The Scarped Plains is the westernmost province of the area. See Plate II. Of the three provinces, this is the lowest, with a general elevation of 800 to 850 feet. It is underlain by rocks of Mississippian and Pennslyvanian age, the former outcropping mainly along the eastern edge, and forming the Burlington escarpment. On the Scarped Plains which are still in their topographic youth, the relief in general is low, ranging from 100 to 200 feet. Because of this low relief, outcrops of the Chouteau limestone are difficult to find except where one or two of the larger streams, as Teboe Creek and its tributaries, cut deeper into the plateau surface.

The Springfield Plain occupies the western part of the lower half of the area. Its general elevation varies from 1,000 feet in the northern part to 1,300 feet in its southern portion. Around Springfield the surface of the plain is level, but becomes more and more dissected northward as Osage River is approached. Much of the Springfield Plain is maturely dissected and the Mississippian rocks which are present in most of the area are thus well exposed.

2. Sauer, C. O., The geography of the Ozark highland of Missouri: Geographical Society of Chicago, Bull. 7, p. 62. 1920.

PLATE II.



RELATION OF PHYSIOGRAPHIC PROVINCES

TO THE THESIS AREA.

The third province which forms the western part of the Central Plateau is underlain mostly by Ordovician and younger rocks. It is the most highly dissected of the three regions and has a relief of 250 to 300 feet. Rocks of Mississippian age are present in that part of the region which is west of Warsaw and of Pomme de Terre River. Because of the mature dissection of the region, outcrops are numerous.

Drainage of the Area

The greater part of the area is drained by Osage River and its tributaries. Osage River flows through St. Clair and Benton counties and on into the hilly country to the east where it joins Missouri River just beyond Jefferson City. Grand River and one of its tributaries, Teboe Creek, drain a considerable area in Henry and western Benton counties. Extending through the center of the area in a north and south direction, the Pomme de Terre sends the drainage northward to the Osage. The Weableau is a smaller tributary which drains the Gerster-Weableau district. In Greene county the Sac River is the chief stream.

Only one exception to the Osage River system of any importance is encountered in the area. Flat Creek drains the southern part of Pettis county and flows northward to join Missouri River by a more direct route than if it were to flow southward and join the Osage.

To approach any of the rivers or streams mentioned, except Flat Creek, is to get at once into a very rugged country where bluffs are numerous and outcrops abundant.

Culture of the Area

The area is traversed by the following railroads: The Missouri, Kansas and Texas; the Kansas City, Clinton and Springfield; the St. Louis and Southeastern, and two branches of the Missouri Pacific. All of these railroads are confined to the northern and western parts of the area and much of the interior of the region cannot be reached except by other means.

The greater part of the area is now becoming quite accessible by the new roads which are being built all over the state. Highways connect Sedalia with Warrensburg and Kansas City on one side, and with St. Louis on the other. Sedalia is also connected with Springfield by two good gravel roads, one leading southwest to Clinton and Osceola, the other more direct through Bolivar. Most of the smaller towns are connected by roads that are at least passable.

The Missouri Highway Commission issues annually numbered highway maps which should be secured before going into the region. The highways usually follow the divides, thus avoiding the rougher country. It is often necessary, therefore, in locating outcrops to leave the main road. When this is done, information concerning the roads should be secured by asking more than one person if possible.

Hotel and tourist accomodations are fair, varying with the locality. It is highly advisable, however, to be prepared for camping at all times, especially when leaving the highway. Even provisions are hard to obtain in some of the more secluded districts.

Field Work and Methods

The field work which forms the basis for this report was done during July and August, of 1926 and July, 1926. The trips were made in an ordinary Ford car equipped with a one-ton truck body which was arranged conveniently for camping without a tent. A Truxel axle or "Mountain Gear" was added to the equipment of the car during the second field season. This added gear proved of considerable help in climbing the steep, rough and numerous hills in the region. Due to the roughness of the flint covered roads, extra tubes and spare tires had to form a major part of the accessory equipment of the car.

The work was begun by observing the Kinderhook section in the Missouri, Kansas and Texas railroad quarry at Sweeney, fifteen miles northeast of Sedalia. At this locality the entire central Missouri Kinderhook series with its stratigraphic relations to the Burlington limestone above and the Devonian formations below is exposed in the quarry face one-hundred and twenty feet high. At Sedalia the Chouteau limestone was located and traced southward. During the second summer the type section at Chouteau Springs was also visited.

In tracing the Chouteau limestone southward from Sedalia, as many outcrops as possible were located. A combined use was made of the State Highway map, the topographic quadrangles of the area and the large areal geologic map of Missouri, issued in 1922 by the Missouri Geological Survey. The relation between roads, topography, and areal geology was in this way determined. When an outcrop was once located,

its thickness was measured by means of a hand level or rule; notes were taken on the lithology, thickness and structure, and fossils were collected from each bed and labelled with the corresponding bed number. The specimens were packed immediately in cardboard boxes or sacks and given a locality name. As soon as possible a wooden box was secured, the material packed, and shipped direct to the laboratory. This kept the load as light as possible on the car, and insured the safe keeping of the specimens.

Acknowledgments

The writer is indebted to Dr. R. C. Moore of the Kansas State Geological Survey for suggesting the problem presented in this thesis, for advice in planning the field work, and especially for aid in the identification of the fossils. The writer is also indebted to Dr. Walter H. Schoewe, Associate Professor of Geology at the University of Kansas, for the many suggestions and helpful criticisms in the writing of this report. Special thanks are due also to the writer's father who accompanied her into the field and made it possible to carry on the necessary field work.

CHAPTER II

HISTORY OF GEOLOGIC INVESTIGATION IN CENTRAL MISSOURI AND ADJOINING AREAS

In one of the earliest reports of the Missouri Geological Survey, Professor G. C. Swallow described a succession of strata which he found best developed near Chouteau Springs, in Cooper County.[1] To these strata he gave the name "Chouteau limestone." Because of the apparent Devonian aspects of the fauna present in this limestone, Swallow believed it to be of Devonian age, and included it along with two other formations into a group which he called the "Chemung Group." This group he considered the equivalent of the Chemung series of the Devonian strata in New York. At the time the report was published the formations included in Swallow's "Chemung Group" had already been observed in Marion, Cooper, Boone, Moniteau, Benton, St. Clair and Polk counties.[2]

Swallow, in his report for the south-western branch of the Pacific railroad published in 1859, makes no mention of the Chouteau limestone, but reports the occurrence of the Chemung group in St. Louis, Webster, Green, Taney, Stone, Lawrence, Newton and McDonald counties.[3]

1. Swallow, G. C., The 1st and 2nd Annual Reports of the Geological Survey of Missouri, p. 102, 1855.

2. ibid, p. 103.

3. Swallow, G. C., Geological Report of the country along the line of the southwestern branch of the Pacific Railroad of Missouri, p. 16, 1859.

When the county reports of the Missouri Geological Survey for 1855 to 1871 were published, the Chemung Group had been accepted as comprising part of the stratigraphic sequence. Mention is made in this report of the Chouteau limestone of the group occurring in Warren,[4] Morgan,[5] Saline,[6] and St. Genevieve[7] counties.

About 1873, Broadhead noted outcrops of the Couteau limestone in Cedar[8] and Howard[9] counties. In the same report he also renamed the "Chemung Group" the Chouteau Group, after the principal limestone member present.[10] This led to confusion in the literature later, where careless writers used the term "Chouteau" without properly designating whether they referred to the group or to the formation.

It is in Broadhead's report also, that doubt is thrown on the Chemung age of these formations, including the Chouteau limestone.[11] Broadhead does not commit himself on the matter of age, but merely states that paleontological work seems to throw doubt on the assumption that the Chemung Group of Missouri is equivalent to the Chemung series of New York.

4. Broadhead, G. C., Reports on the Geological Survey of the State of Missouri, 1855-71, p. 45, 1873.

5. Ibid, p. 141.

6. Ibid, p. 174.

7. Ibid, p. 295.

8. Broadhead, G. C., Report on the Geological Survey of the State of Missouri for 1873-74, p. 67, 1874.

9. Ibid, p. 182

10. Ibid, p. 26

11. Ibid, p. 26.

The paleontological work mentioned was that of Meek and Worthen which had been done sometime previous to this, in 1861. Not only had they changed the name of the group from Chemung to Kinderhook, but had also expressed the opinion that these strata were Lower Carboniferous in age.[12]

Between 1895 and 1905, a number of studies were made on the fauna and stratigraphy of the strata included in the Kinderhook group. The men most active in this work were Williams, Rowley, Keyes, and Weller. As the various Kinderhook formations are very local, and as these men were studying the succession at various places, there was much controversy on the subject.

Rowley devoted himself mainly to studying the faunas of these beds, and comparing them with the fauna of the Burlington limestone, just above, which he also studied.[13] He describes a number of new genera and species from the Chouteau limestone and related formations, but of most importance are his determinations of the ranges of some of the fossils.

12. Meek, F. B., and Worthen, A. H., Illinois Geological Survey: Vol. 1, p. 108-110, 1866.

13. Rowley, R. R., Range of Chouteau fossils, American Geologist: Vol. 12, p. 49-50, 1893.

Two new genera and some new species of fossils from the Upper Paleozoic Rocks of Missouri, American Geologist: Vol. 27, p. 343-355, 1901.

New species of fossils from the sub-Carboniferous rocks of northeastern Missouri, American Geologist: Vol. 29, p. 303-310, 1902.

Missouri paleontology (descriptions of Echinodermata and other fossils), American Geologist: Vol. 35, p. 301-311, 1905.

In collaboration with Keyes, Rowley made a study of the faunas at Louisiana, Missouri.[14] In the paper presenting their results, the importance of studying separately the faunas of the separate beds of the Kinderhook group, is emphasized.[15] This was an important step forward in studying the relationships of the Chouteau limestone, as formerly collections had been made very carelessly from miscellaneous beds. Some attempts at correlation and of age determinations for the whole Kinderhook group were also made. Keyes and Rowley proved to their own satisfaction at least, the Carboniferous age of the Chouteau limestone. They believed, however, that the other members of the Kinderhook group were Devonian in age, and thus seemingly verified the previous conclusions of Swallow and others.[16] That they were wrong in this latter assumption, is due mainly to a misinterpretation of the evidence presented.

About this time Keyes was State Geologist of Missouri and under his direction studies of the geology of various counties in Missouri were made by Broadhead,[17] Marbut,[18] Shepard[19] and others. The Chouteau limestone and the Chouteau or

14. Keyes, C. R. and Rowley, R. R., Vertical Range of Fossils at Louisiana (Mo.), Iowa Academy of Science; Pr.4,p 26-40, 1897

15. Ibid, p. 37.

16. Ibid, p. 40.

17. Broadhead, G.C., Reports on Boone County and the Ozark uplift, Missouri Geological Survey; Vol. 12, pt 3,p380, 1898.

18. Marbut, C.F., Description of the Calhoun sheet, Missouri Geological Survey; Vol. 12, pt. 2, p. 160, 1898.

19. Shepard, E. M., A Report on Greene county, Missouri Geological Survey: Vol. 12, pt. 1, p. 13-245, 1898

the Kinderhook group are both mentioned in these reports.

By this time the entire group had been recognized by most geologists as being Lower Carboniferous in age, thus confirming the opinion expressed by Meek and Worthen in 1861 and reaffirmed by them in 1866.[20] Shepard at this time made an extensive study of the geology in Greene county and found the Kinderhook succession there apprently quite different from the Kinderhook farther north.[21]

Meanwhile, Williams and Weller had not been idle. In 1855, Weller published an article on the fauna of the Kinderhook.[22] The term Chouteau is used in the article, but this term as Weller explains is considered by him to be interchangeable with the term Kinderhook and the fauna of the entire Kinderhook group is discussed as a unit in the paper. Weller, as had Keyes and Rowley in their study at Louisiana, came to the conclusion that the Kinderhook fauna was Devonian in age, and that while it is not equivalent to the Chemung of New York, is really contemporaneous with it.[23]

20. Meek, F. B. and Worthen, A. H., Illinois Geological Survey: Vol. I, p. 108-110, 1866.

21. Shepard, E. M., A report on Greene county, Missouri Geological Survey: Vol. 12, Pt. 1, p. 13-245, 1898.

22. Weller, Stuart, A Circum-insular Paleozoic fauna, Journal of Geology: Vol. 3, p. 903-917, 1895.

23. Ibid, p. 916, 1895.

The following year this conclusion was refuted very successfully by Williams, who proved conclusively that the fauna is Carboniferous in affinities rather than Devonian.[24] Williams made few contributions to the study of the Chouteau limestone and this is the most important one, but it alone is invaluable. This paper caused the change in opinion already mentioned as to the age of the Kinderhook group. Weller also was convinced of the Carboniferous age of the series, for in his paper on "The Classification of the Mississippian Series" published in 1898, he includes the Kinderhook group or series as the basal member of his Mississippian.

Two years later, Weller published the first of an important series of studies on the Kinderhook formations.[26] These studies were probably a direct result of the recognition of the fact that the Kinderhook fauna is not a single fauna but is composed of several faunas.[27] Although no certain one of these studies was concerned with the fauna of the Chouteau

24. Williams, H. S., On the Origin of the Chouteau Fauna, Journal of Geology:, Vol. 4, p. 285, 1896.

25. Weller, Stuart, Classification of the Mississippian Series, Journal of Geology: Vol. 6, p. 303-314, 1898.

26. Weller, Stuart, Kinderhook Faunal Studies.
I. St. Louis Academy of Science: Tr. 9, p. 9-51, 1899.
II. St. Louis Academy of Science: Tr. 10, p. 57-129, 1900.
III. St. Louis Academy of Science: Tr. 11, p. 147-214, 1901.
IV. St. Louis Academy of Science: Tr. 16, p. 435-471, 1906.
V. Geological Society of America: Bull. 20, p. 265-332, 1909.

27. Weller, Stuart, Kinderhook Faunal Studies I, St. Louis Academy of Science: Tr. 9, p. 9, 1899.

limestone, the general relations of the Kinderhook series were much better understood after their publication. Correlations on the basis of fauna mainly are made in these papers between various members of the Kinderhook in different localities. New genera and species typical of the Kinderhook, and some of the Chouteau limestone are described. A short discussion of the Chouteau limestone is included in the study of the Fern Glen fauna.[28] In this discussion, Weller points out particularly that the Chouteau limestone cannot be regarded always as merely the uppermost member of the Kinderhook series. In central Missouri it actually comprises most of the Kinderhook series. See Table II. Up until this time much error in the use of the word Chouteau has been prevalent, part of it being due to the above fact which was not understood. By his faunal study of the Kinderhook, Weller cleared up many points of stratigraphy and of correlation which had troubled students of the Kinderhook for years. He had attempted earlier to correct the sequence of Kinderhook formations in southern Missouri as described by Shepard,[29] and these faunal studies proved that his earlier interpretation had been essentially correct.[30]

28. Weller, Stuart, Kinderhook Faunal Studies V, Geological Society of America: Bull. 20, p. 321-322, 1909.

29. Shepard, E. M., A Report on Green county and the Ozark uplift, Missouri Geological Survey: Vol. 12, p. 13, 1898.

30. Weller, Stuart, Correlation of the Kinderhook formations of Southwestern Missouri, Journal of Geology:, Vol. 9, p. 130-148, 1901.

Since the publication of the faunal studies of Weller, little mention has been made of the Chouteau limestone in literature, although in some of the more recent county reports of the Missouri Survey, it has been described in those counties where it occurs.[31]

In 1916, Keyes added two contributions to the literature. One of these articles is more or less a review of material already published on the Chouteau limestone.[32] The other is the beginning of the investigation of an interesting problem; the determination of the extent of the Chouteau fauna outside of the Missouri and Illinois areas and of the Kinderhook fauna throughout the world.[33]

The following year, Raymond C. Moore, then a student under Weller at Chicago, wrote a thesis on "The Stratigraphy of the Kinderhook group in western Illinois and Missouri" in which the Chouteau limestone was of course included. This paper was published in abstract only.[34]

Weller made one more very important contribution to the literature concerning the Chouteau limestone. In a monograph on the Mississippian, brachiopods are included

31. Rowley, R. R., Geology of Pike County, Missouri Bureau of Geology and Mines: Vol. 8, (2), p. 36, 1907.

32. Keyes, C. R., Terranal affinities of the Original Chouteau limestone, Iowa Academy of Science: Pr. 23, p. 113, 1916.

33. Keyes, C. R., Wide areal extent of the Chouteau limestone, Science, n.s., Vol. 44, p. 68, 1916.

34. Moore, R. C., "The stratigraphy of the Kinderhook group in western Illinois and Missouri," Illinois Academy of Science: Tr. 9, p. 211, 1917.

plates and descriptions of all of the important fossil species to be found in the Mississippian rocks of the interior, including those of the Chouteau limestone.[35] To any student of the Chouteau fauna this book is an invaluable reference.

The most recent mention of the Chouteau limestone has been made by Greger in "The Devonian of central Missouri" where he gives sections of the Chouteau at several localities where it occurs just above the Devonian.[36] In a bulletin published by Branson, a general summary of the relations and characters of the Chouteau limestone of Missouri is given.[37]

35. Weller, Stuart, Monograph of the Mississippian Brachiopoda of the Mississippi valley basin, Illinois Geological Survey Monograph I, 1914.

36. Greger, D. K., Devonian of central Missouri, American Journal of Science: Vol. 50, p. 20-24, 1920.

37. Branson, E. B., Geology of Missouri, Missouri University Bulletin 19, No. 15, p. 66, 1918.

CHAPTER III

THE CHOUTEAU LIMESTONE OF THE THESIS AREA

Definition

The Chouteau limestone of central Missouri may be defined as a buff to blue, fine-grained, dense, hard limestone from 30 to 50 feet thick. It occurs in thin irregular beds, and contains a characteristic Kinderhook fauna. At some localities this formation is divided into an upper and lower member.

Immediately overlying the Chouteau limestone is the Burlington limestone. The latter is a massively bedded, coarsely crystalline limestone, and is easily identified by the abundance of crinoid remains of which it is mainly composed.

The Chouteau limestone rests conformably upon the Phelps formation which is a thin and variable bed of light green sandstone that at some places grades into a conglomerate of the same color.

Areal Extent

The Chouteau limestone crops out along the eastern edge of the Scarped and Springfield plains. The outcrop forms an irregular narrow belt around the edges of these upland areas and is never more than a mile or two wide in an east-west direction.

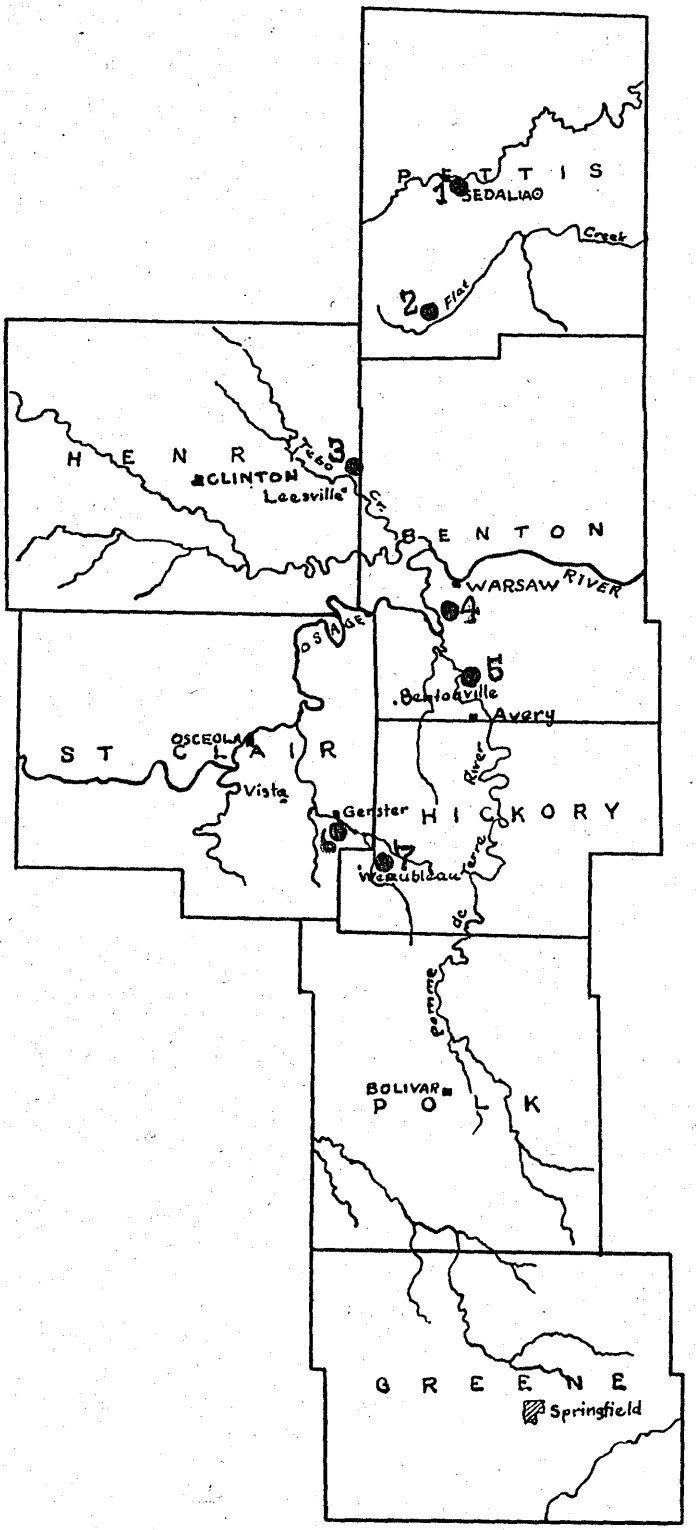


PLATE III. LOCATION OF SECTIONS

Section 1 - Dresden section
2 - Flat Creek "
3 - Leesville "
4 - Warsaw "
5 - Avery "
6 - Gerster "
7 - Weableau "

The Chouteau limestone can be traced southward from Chouteau Springs in Cooper county to Weableau in Hickory county. Outcrops occur in southern Pettis, eastern Henry, southern Benton, eastern St. Clair, and central Hickory counties. See Plate III.

The upper member is absent at the Flat Creek exposure, at Leesville, and at Warsaw. It is present, but not well exposed at Avery and Gerster. The lower member is present at all of the localities.

Description

The Chouteau limestone of central Missouri consists of two members. The upper of these is a buff colored, massively bedded, magnesian limestone which is usually unfossiliferous, but which contains cherty concretions, geodes, and veins of calcite, or nodules of iron pyrites. This member is most typically developed near Sedalia and is locally known as the Sedalia limestone.[1]

The lower member is a blue to buff, fine-grained, pure, and highly fossiliferous limestone which occurs in thin irregular beds. Numerous shale partings are usually present and irregular lenses or bands of chert are common.

Outcrops of the Chouteau limestone are extremely difficult to find. It usually occurs at the base of nearly vertical cliffs formed by the weathering of the massive Burlington limestone, and is often covered by the talus slopes

1. Moore, R. C., Stratigraphy of the Kinderhook Group in western Illinois and Missouri - unpublished manuscript.

formed from the large amount of chert weathered out of the higher formation. Where the Chouteau limestone is the surface formation, it forms low rounded hills or benches with a deep soil covering.

The Chouteau limestone decreases gradually from 60-70 feet in thickness in northern Pettis county to less than 20 feet in central Hickory county.

Before tracing the Chouteau limestone southward from Sedalia, the type locality at Chouteau Springs and the Missouri, Kansas and Texas quarry at Sweeney were visited. A description of the sections observed at those places is included in the text for purposes of comparison and correlation with other sections found.

Section at Chouteau Springs - At Chouteau Springs both members of the Chouteau limestone are present, the formation reaching a total thickness of 70 feet. The upper member is the typical buff colored magnesian limestone and is barren of fossils. The lower member, however, is extremely fossiliferous.

Only the lower beds of the upper member and a part of the lower member were observed by the writer, and the nature of the contacts is not known. These beds have been fully described by Swallow.[1]

Section at Sweeney - South of the type locality, at Sweeney, over sixty feet of Chouteau limestone is exposed in the face of the Missouri, Kansas and Texas quarry. The beds are similar

1.Swallow, G. C., 1st and 2nd Annual Reports, Missouri Geological Survey, p. 101, 1853.

of those at Chouteau Springs, but can be observed more in detail than at the type locality where the only exposures are scattered along the stream beds.

The upper member is 37 feet thick. Although it is usually unfossiliferous, some highly fossiliferous shale partings of 1/4 to 1/2 inch in thickness were found between the massive limestone beds. Here the upper member passes quickly into the lower one.

The lower member is made up of a number of beds of varying character, the upper ones characterized by shale partings and a somewhat magnesian composition, the lower ones by the presence of chert seams and lenses, and a more massive bedding. The lower beds are separated from the dove colored Devonian limestone by 2 to 5 inches of Phelps sandstone.

Section at Sweeney Missouri[1]

	Feet	Inches
Burlington limestone:		
Limestone, bluish-gray, coarsely crystalline, crinoidal, very massively bedded	35	
Limestone, light blue, magnesian, middle part shaly	5	6
Sedalia limestone:		
Limestone, light blue, magnesian, fine-grained, very massive, chert in bands	37	6
Chouteau limestone:		
Limestone, bluish drab, slightly mottled, compact, with sharply conchoidal fracture. Beds thin, nodular, separated by wavy shale partings	2	
Limestone, drab, fine, granular, fracture sub-conchoidal, beds rather massive, slightly magnesian	3	3
Limestone, bluish gray, compact, with sharply conchoidal fracture, with thin nodular beds, chert in discontinuous bands. Persistent shale seam 3 ft. 9 in. from base	8	9

1. Moore, R. C., Stratigraphy of the Kinderhook Group in western Illinois and Missouri - unpublished manuscript.

Chouteau limestone (contd.)	Feet	Inches
Limestone, grayish brown, fine granular, mottled with small elongate patches of dark bluish gray, probably organic in origin. Chert seam at top.	1	7
Limestone, brownish drab, darker than above, dense compact with sharply conchoidal fracture. Thin uneven layers with wavy shale partings, occasional calcite veins and fillings.	1	5
Limestone, brownish gray, fine-grained, dense, rather massively bedded. Persistent chert band at top.	2	8
Limestone, light buff to gray, fine grained, characterized by rather uniform, even beds, 2 to 6 inches in thickness which are separated by thin shale parting. Persistent prominent shale bands at top and bottom.	5	6
Phelps sandstone:		
Sandstone, light green, calcareous, shaly, rather uniform texture and very persistent	1	2
Devonian limestone:		
Limestone, brownish drab, very compact, dense, with sharply conchoidal fracture, massive. A lighter, more dove-colored rock than the Chouteau limestone.	19	

Section at Dresden - West of Sedalia, near Dresden, the Chouteau limestone was observed along the banks of Big Muddy Creek. Both members are present and are typically developed. The top of the upper member is very cherty here, and a special feature of interest at this locality is the presence of many large chert geodes filled with crystalline calcite and a tarlike substance resembling petroleum residue. The upper 6 to 8 feet of this member was observed underlying 2 feet of red soil containing numerous fossil corals and a large amount of chert. A little to the north of this exposure and at a higher elevation is an outcrop of Burlington limestone.

An outcrop of the lower member of the Chouteau limestone occurs at the base of the same hill near the top of which the upper member is exposed. Only 8 to 10 feet of the lower member crops out in the bed of the stream, the rest being covered by slide and soil forming the hill slope, but it is probable that nearly its maximum thickness is present here. The lower member is a dense hard, fine-grained limestone weathering to a buff or gray, and resembles very closely similar outcrops in the stream beds in the vicinity of Chouteau Springs. All of the lower beds exposed are very fossiliferous. The fossils, as are those at Chouteau Springs, are filled with crystalline calcite, so that they often break along the calcite cleavage planes when an attempt is made to extract them from the surrounding harder rock. The section at Dresden is as follows:

Section at Dresden

	Feet	Inches
Burlington limestone:		
Limestone, blue, coarsely crystalline, even-grained, composed of crinoid remains	5	6
Chouteau limestone:		
Upper member:		
Limestone, hard, flinty, buff to blue with very cherty portion. The top beds contain large chert nodules filled with crystalline calcity and a tarry substance resembling petroleum residue. Fossils absent	6-8	
Soil	20-25	
Lower Member:		
Limestone, hard, pure, blue to gray, in thin irregular beds. Highly fossiliferous		

Section on Flat Creek - Eight or nine miles south of Dresden, on Flat Creek, is another outcrop of Chouteau limestone. Only the lower two or three feet of the lower member is exposed, overlying the same Devonian limestone that is present at Sweeney. The Phelps sandstone was not observed, but as it is generally very thin in this part of the country, it is probably covered by the foot or so of soil which separates the exposed beds of the Chouteau limestone from the top of the Devonian limestone. The lowest beds exposed are very hard, dense and blue, and are fairly fossiliferous, although the fossils are not so abundant as at Dresden. Above these lower blue beds is exposed a foot or so of gray, coarse-grained limestone containing an abundance of crinoid stems. Superficially these beds appear to resemble the Burlington limestone. Upon closer examination, however, they are seen to weather into thin laminae, which is not characteristic of the Burlington. The limestone is also not so coarsely crystalline, and the crinoid remains are finer and smaller than those present in the Burlington limestone. These beds are much softer than the other beds of the Chouteau limestone. The section exposed on Flat Creek is as follows:

Section on Flat Creek

	Feet	Inches
Chouteau limestone: Limestone, gray crinoidal, with poorly preserved fossils		
Two beds of hard blue limestone in thin beds	3	
One foot of soil (covers Phelps ss.?)	1	
Devonian limestone: Massive, dove-colored rock, with extremely sharp conchoidal fracture. Calcite		

Devonian contd.	Feet	Inches
crystals scattered through it. No fossils. Only top exposed	5	

Section at Leesville - Because of the low relief in the region just south of Sedalia, outcrops are extremely difficult to find. Most of the country is very level, the soil deep, and the streams seldom cut through this soil mantle. No other outcrop of the Chouteau limestone was found until Leesville, 15 miles to the southwest, was reached. This outcrop is in the valley of Teboe Creek, at the base of a Burlington Bluff. Only a small part of the section is exposed, and this is found in several scattered outcrops.

Two and a half feet of the upper beds of the lower member are exposed at the base of the bluff. The bottom of the Burlington is marked here by a massive yellow ledge containing an abundance of typical Burlington brachiopods. The green shale below was not observed, but a foot of soil intervenes between the yellow Burlington limestone and the exposed portion of the Chouteau limestone. The Chouteau limestone exposed is part of the upper-most beds of the lower member, the upper member being entirely absent at this locality. The beds exposed are of an extremely hard, brittle, fine-grained blue limestone in the characteristic irregular thin beds. Well preserved fossils are abundant, although rather difficult to extract because of the extreme hardness of the rock. East of this exposure, in the bed of a gully five feet lower, about two more feet of the limestone crops out. This bed is of a hard, dense, blue limestone with an abundance of chert in bands and lenses as is

present in the lower beds at Sweeney. Although so little of the section is exposed, it is extimated that at least 15-20 feet of the Chouteau limestone is present in this region. The lower contact was not found, but the beds observed are typical of the Chouteau limestone of the region to the north, and it is highly probable that the lower member is developed here to nearly its average thickness. The section at Leesville follows:

Section at Leesville

	Feet	Inches
Burlington limestone:		
Typical gray Burlington limestone in a bluff face. Lower 2 feet a heavy yellow ledge with numerous fossils	10	
Soil (Green shale not observed)	1	
Chouteau limestone:		
Limestone, hard, blue with sharp fracture. Fossils well preserved and fairly numerous	2	6
Soil	5	
Hard, blue limestone with abundant chert in thin irregular bands, metallic ring to weathered fragments	2	6
Soil	?	
Limestone, hard, blue, fossils rare, fracture sharp	1	
Gray, crinoidal limestone	2	

Section at Warsaw - Two exposures of Chouteau limestone were found at Warsaw, ten miles or so east of Leesville. One of these exposures at Laird's Bluff southwest of the town of Warsaw, is the most complete section of the lower member found. Here it was possible to study the Chouteau limestone bed by bed and to obtain a complete fauna.

Forty or fifty feet of Burlington limestone forms a nearly vertical bluff at the foot of which is a comparatively gentle slope to the river. The base of the Burlington is marked here as at Sweeney and Dresden by two heavy ledges of a very hard, dark, siliceous limestone divided by a foot or more of green shale. The upper bed is light blue to tan gray in color, thinly bedded, and contains numerous shale partings. Two prominent chert bands are present, one three feet below the top, the other at the base of the bed. A persistent shale band was noted four feet below the top of the bed, the entire thickness of the bed being 5 feet.

Below the chert band the limestone changes rapidly. This is the most fossiliferous part of the entire section, and also contains the most representative Chouteau fauna. In lithology this bed also resembles most closely, the typical lower beds at Chouteau Springs, and at Dresden. The limestone is lighter in color than at those places, approaching a blue-gray, but is very fine-grained, dense and hard with a sharp fracture. A fairly persistent shale band occurs one foot above the bottom of the bed which attains a thickness of 4 feet. A chert band marks its lower limit.

The bed immediately below exhibits great variability. It is a fine grained, shaly limestone varying considerably in hardness. Cherty concretions in irregular lensing beds are present, and shale partings are numerous. The limestone is dense, fine-grained, dark in color and contains no fossils.

Several irregular beds follow in which shale partings are numerous. The limestone also is high in shale content, and chert bands are not uncommon. These beds are sparsely fossiliferous.

The next series of beds is distinguished from the rest of the section by their crinoidal character. The limestone is blue gray, crinoidal, massive, and with numerous shale partings. These beds weather into thin laminae and are similar to the gray crinoidal beds found southwest of Sedalia.

The two lower beds of the section are of dark, fine-grained, blue limestone and have the same general appearance as the lower blue beds also observed at Flat Creek. The bottom bed is iron stained, and the fairly abundant fossils are highly oxidized. The lowest bed rests upon 1 to 1-1/2 inches of light green shaly sandstone, the Phelps sandstone. Below the Phelps is a massive gray siliceous limestone of probably Ordovician age. The section at Warsaw is as follows:

Section at Warsaw

	Feet	Inches
Burlington limestone: Crinoidal, coarsely crystalline, very fossiliferous	40-50	
Massive limestone, very hard and dense, blue to tan, fine grained. Typical Burlington fossils.	2-3	
Green shale		1
Bed 1 - Massive limestone, same in appearance as bed just above the green shale. Fossils are mingled Burlington and Chouteau species. Transition bed.	2-3	

Chouteau limestone:	Feet	Inches
Bed 2 - Irregular thin bedded limestone, shale partings common. Limestone tan-gray, fine grained, dense	3	
Persistent chert band of dull blue to tan. Fossiliferous		4
Beds 3 and 4 - Tan-gray limestone, fine grained, sharp fracture		8
Shale band		1
Hard, tan-gray limestone, very fine grained, dense, with sharp fracture		6-10
2nd chert band		3
Bed 5 - Tan-gray limestone, irregularly bedded, very fine grained, dense, hard, shaly in some beds. Fossils abundant and most characteristic of the Chouteau fauna.	4	
Chert band 3		3
Bed 6 - Fine grained, shaly limestone, varying in hardness. Contains cherty concretions in irregular lensing beds. Shale partings numerous. Limestone very dark, dense and fine grained. No fossils.	3	
Beds 7 and 8 - Very muddy limestone, fine grained, soft. Fossils scarce	3	
Fine grained, tan limestone, harder than the bed above	2-1/2 to 3 ft.	
Chert band 4		
Bed 9 - Blue limestone, fairly hard and dense. In thin uneven layers	3	
Bed 10 - Tan-gray limestone, very similar in texture to that in Bed 9.	2 to 2-1/2 ft.	
Thin bedded nodular limestone, light colored, soft muddy	1	
Bed 11 - Crinoidal limestone, but denser than the Burlington. This varies quite markedly in amount of crinoidal matter present. Tan to blue, massive	1	

	Feet Inches
Thin shaly layer Crinoidal limestone	2
Shaly layer Dense crinoidal limestone	1
Shaly layer Limestone, light to dark, blue, dense, very hard, sharp fracture	1
Prominent shale band	
Bed 12 - Limestone, gray, medium grain, dense, less crinoidal than the bed above	4-1/2
Bed 13 - Massive limestone, dark gray, dense, slightly crinoidal	1
Chert band Cherty limestone, very hard, fracture sharp. Fossil from this and Bed 12 highly oxidized	1 to 1-1/2 ft.
Phelps sandstone: Thin band of very fine grained, light green sandy shale. Varies in thickness	3
Ordovician limestone: Massive gray sandy limestone. Very siliceous	1

Section at Avery - At Avery, about 7 miles due south of Warsaw, five or six feet of the Chouteau limestone was found exposed on the banks of Pomme de Terre River. The full section is present but all of it is not well exposed.

The beds exposed are the three lower beds of the lower member. The bottom one is a massive ledge 2 feet thick, of a dark blue to reddish limestone which is fine grained and hard, and breaks with a conchoidal fracture. Above it is another massive ledge of similar texture and appearance. The third bed is of gray to buff crinoidal limestone weathering in thin laminae. These beds correspond to the lower beds at Warsaw and at Flat Creek.

The lowest bed rests conformably upon the Phelps sandstone which here consists of a green shale, sand, and conglomerate successively and is much thicker than is usual farther north. The section is as follows.

Section at Avery

	Feet	Inches
Burlington limestone		
Chouteau limestone		
Lower Member: Yellow crinoidal limestone, very sharp fracture		6
Gray, crinoidal limestone, weathered in thin layers. Green coloring in places.	1-1/2	
Massive ledge	1-1/2	
Chert band Massive limestone, blue, hard, dense, conchoidal fracture	2	
Phelps sandstone: Green shale, light	6"-1'	
Conglomerate, light green sand matrix		12-14
Sandstone, white and mottled green	?	

Section at Gerster - At Gerster 12-14 miles southwest of Avery, the Phelps sandstone and Chouteau limestone are surface formations, the width of outcrop of the two being possibly 1/2 mile wide. Southwest of the town of Gerster and where the Collins road crosses Weableau Creek, there are 20 feet of Chouteau limestone between the base of the Burlington and the top of the Phelps. These beds are not well exposed, but are very similar in appearance to those found at Weableau, which are described in the next paragraph.

Section at Weableau - At Weablaau about 25 feet of Chouteau limestone is exposed. The upper 18-20 feet of this is hard, buff colored, magnesian limestone. Most of it is unfossiliferous with the exception of the uppermost bed which contains an abundance of fossil corals of only one species. These massive beds grade slowly into the lower irregular thin beds of gray to blue, hard limestone occupying the lower 6 or 8 feet of the section. The gradation is accomplished by an increase in the shale content of the lime, an apparent gradual lessening of the magnesian content, the appearance of numerous crinoid fragments, the appearance of chert in irregular bands, and a rather rapid appearance of a fossil fauna which here consists mainly of pentremites and crinoids.

These lower beds consist of thin bedded shaly limestone with numerous shale bands and some chert in bands. The lower contact is not exposed but the total thickness observed is about 25 feet. Probably only a few feet were not exposed, making the section as much as 30 feet in thickness. The following section is exposed:

Section at Weableau.

	Feet Inches
Burlington limestone:	
Typical crinoidal Burlington limestone	4-5
Bluish gray muddy limestone at the base of the Burlington	1 1/2-2
Shale, gray to green	2
Heavy ledge of limestone, same as above shale in appearance	1 1/2-2

	Feet	Inches
Chouteau limestone:		
Upper Member: Dense, hard, buff-colored limestone, with conchoidal fracture. Numerous calcite geodes and veins common. Unfossiliferous except for the top bed which contains numerous specimens of one species of small coral	18-20	
Lower Member: Thin bedded limestone of transitional lithologic character		
Shale band		
Massive ledge with numerous pentremites	3	1/2-4
Chert band		
Beds of similar character, slightly harder	2-3	

Summary - A study of the sections just described indicates several progressive changes in the character of the Chouteau limestone. The most noticeable of these is the decrease in thickness from north to south. This decrease is indicated in the following table.

Chouteau Springs	70 ft.
Sweeney	60
Dresden	30-40
Flat Creek	
Leesville	20-25
Warsaw	35
Avery	25-30
Gerster	20
Weableau	25-30

This thinning takes place through a gradual decrease, and that of the lower member at least is due to the original deposition, and not to later erosion. At Leesville and Warsaw the beds present all appear to belong to the lower member. There is reason to believe, however, that the entire section at Warsaw does not belong to the lower member, but that the upper beds which contain a slightly different fauna may belong to the bottom of the upper member, or represent transition beds between them. The absence of the full section may be due to erosion.

There is a gradual increase in shale content in the limestone. The muddy appearance of some of the beds increases southward and more beds take on this aspect. At Gerster and Weableau the entire formation is shaly.

The lower beds become lighter in color near the southern extension of the limestone, due to this change in shale content, and more beds become crinoidal.

The sections correlate fairly well, particularly the lower beds, those beds having similar lithologic character usually containing similar faunas.

Structure

Like all of the formations on the northern slope of the Ozark highland, the Chouteau limestone has a regional dip to the north. In Pettis county it outcrops at about 750 feet but farther south it occurs at a slightly higher elevation. At most places only this slight regional dip affects the beds, which appear to be practically horizontal.

In the region about Weableau and Gerster some exceptional local dips were observed, the one at Weableau amounting to nearly 15 feet to the northwest. The strata also dip northwest at Gerster and at about the same angle. Farther north the formation is entirely undisturbed.

The formation is wedge shaped, thinning gradually from 50-60 feet at Chouteau Springs to less than 20 feet at Gerster. This amounts to a decrease of about 10 inches per mile.

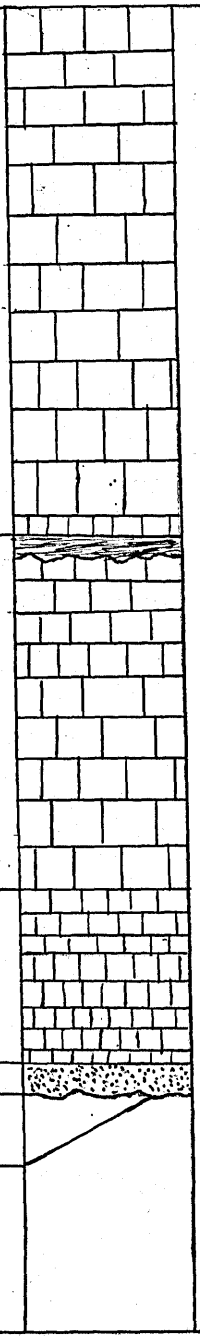
The upper member is massively bedded and contains geodes of calcite and cherty concretions, while the lower member occurs in thin irregular beds and contains lenses and bands of chert and cherty concretions.

Stratigraphic Position

The Chouteau limestone is the principal limestone of the Kinderhook group, which is lower Mississippian in age. In central Missouri, the formation comprises all of the Kinderhook group, except that represented by the Phelps sandstone at the base. The Chouteau limestone rests conformably upon the Phelps sandstone which in turn shows progressive overlap in its relation to younger beds. The top of the Chouteau limestone is separated from the Burlington limestone of early Osage time by an unconformity marked by a light green shale. These relations remain constant throughout central Missouri. See Plate IV.

GENERALIZED SECTION OF FORMATIONS IN CENTRAL MISSOURI

Series	Group		Th.
MISSISSIPPIAN	OSAGE	Burlington Limestone	60'
	KINDERHOOK	Chouteau Limestone Upper Member	35'
		Lower Member	
		Phelps Sandstone	2"-1'
Devonian		Devonian Limestone	?
ORDOVICIAN		Ordovician Limestone	?



CHAPTER IV

THE FAUNA OF THE CHOUTEAU LIMESTONE

In making a study of the Chouteau limestone, it was located in the field mainly by its stratigraphic position, lithology, and general appearance. A careful bed by bed collection of fossils was made, however, at each of the localities described in Chapter III. The purpose of these collections was two-fold: First, to study the fauna of the Chouteau limestone in general throughout the area, and, second, to make a comparative study of the fauna of the Chouteau limestone found at the various localities, and for purposes of correlation.

When the specimens had been identified, it was found that the faunal observations checked with the field observations as to the identity of the limestone studied. Each of the faunas studied was made up mainly of typical Kinderhook species, and contained at least some of the species which are considered as being peculiar to the Chouteau limestone. An examination of the following faunal lists will verify this opinion.

Fauna at Dresden

The following species were obtained at Dresden:

Streptorhynchus tenuicostatum
Chonetes geniculatus
Productus arcuatus
Rhipidomella missouriensis
Schizophoria chouteauensis
Camarotoechia tuta Miller
Camarotoechia chouteauensis Weller
Shumardella obsolens Hall
Dielasma chouteauensis
Spirifer lousianensis
Brachythyris peculiaris Shumard
Reticularia cooperensis

All of these species are common Kinderhook species. Camarotoechia tuta and Spirifer louisianensis are the only ones which range upward into the Burlington, while a number of the species, as Streptorhynchus tenuicostatus, Schizophoria chouteauensis, Camarotoechia chouteauensis, Shumardella obsolens Hall, Dielasma chouteauensis and Brachythyris peculiaris are limited to the Chouteau alone.

Fauna from exposure on Flat Creek

From the two lower beds of the Chouteau limestone, partly exposed on Flat Creek, the following fauna was collected:

Leptenae ? (young) sp.
Productus arcuatus
Productella sp.
Rhipidomella sp.
Shumardella obsolens Hall
Shumardella missouriensis
Camarotoechia chouteauensis
Spirifer sp.
Spirifer louisianensis

Fauna at Warsaw

The most complete fauna was obtained from the exposure of Chouteau limestone found at Laird's Bluff near Warsaw. The species found are:

Leptenae analoga (Phillips)
Schellwienella crenulicostata
Streptorhynchus tenuicostatum
Chonetes logani
Chonetes glenparkensis Weller
Chonetes burlingtonensis
Chonetes geniculatus
Productus sampsoni Weller
Productus sedaliensis
Productus arcuatus
Productus ovatus
Productus blairi Miller
Rhipidomella sp.

Schizophoria sedaliensis
Schizophoria chouteauensis
Camarotoechia chouteauensis
Paryphorpynchus sp.
Rhynchotetra caput-testudinatus
Rhynchotetra ovatum
Shumardella obsolens Hall
Dielasma chouteauensis
Dielasma fernglenensis Weller
Spiriferina subtexta White
Spirifer osagensis
Spirifer missouriensis
Spirifer latior
Spirifer platynotus
Spirifer gregeri
Spirifer louisianensis Rowley
Brachythyris chouteauensis
Brachythyris peculiaris (Shumard)
Syringothyris typus
Syringothyris sp.
Spiriferella ? schucherti
Reticularia cooperensis
Cliothyridina glenparkensis?
Composita? sp.

All of the species listed are Kinderhook species except Spirifer gregeri and Spiriferella schucherti which are lower Burlington species. Spirifer gregeri is often found in the Chouteau limestone, however, and Spiriferella schucherti was found in the top bed which contains a mingled Burlington and Chouteau fauna. The species most common or peculiar to the Chouteau limestone are nearly all present.

Fauna at Leesville

Only the upper beds of the lower member of the Chouteau limestone are exposed at Leesville, but a fairly representative fauna was obtained as follows:

Chonetes logani
Chonetes glenparkensis Weller
Productus sedaliensis
Rhipidomella? diminutiva
Hustedia circularis Miller
Shumardella obsolens Hall
Spirifer louisianensis
Brachythyris peculiaris

Syringothyris sp.
Reticularia cooperensis

This is again a typical Chouteau fauna, and compares favorably with the fauna of the beds at Warsaw.

Fauna at Avery

The beds at Avery belong to the base of the Chouteau limestone. The following species were collected there:

Leptenae sp. (analoga)
Chonetes logani?
Chonetes sp.
Chonetes burlingtonensis
Chonetes glenparkensis
Productus arcuatus
Productus sp.
Productus sampsoni
Rhipidomella sp.
Schizophoria ? chouteauensis
Camarotoechia chouteauensis
Shumardella obsolens Hall
Spirifer platynotus
Brachythyris peculiaris
Brachythyris sp.
Reticularia cooperensis

This is also a typical Chouteau fauna.

Fauna at Gerster

Fossils were much less abundant at Gerster, both in numbers and in species. The specimens found are mostly small and some of them are poorly preserved. The following fauna was collected:

Leptenae analoga
Chonetes burlingtonensis
Productus arcuatus
Productus sp. (n. sp.?)
Rhipidomella sp.
Productella concentrica
Cliorthydina ? sp.
Eumetria perstrialis ? Rowley
Camarotoechia chouteauensis
Shumardella sp.
Spirifer louisianensis

Fauna at Weableau

At Weableau fossils are not abundant and those present are poorly preserved, making identification difficult in several cases. The following species were collected:

Leptenae analoga
Chonetes sp.
Productus sampsoni
Rhipidomella missouriensis?
Rhipidomella thiema?
Shumardella missouriensis?
Spirifer louisianensis
Brachythyris sp.

It should be noted that Leptenae analoga and Productus sampsoni, two of the fossils found most commonly in the basal beds, are present in this fauna, and in both cases they were so well preserved that their identity is unmistakable.

A comparison of the faunas found at the different localities is shown in the following chart. Their range is indicated in the column to the right. See Plate V.

Comparative Study of the Faunas

A comparison of the faunas just described aids in a correlation of the sections and also indicates the probable existence of certain faunal zones.

A study of the distribution of the species at Warsaw where the most complete fauna was found, forms a basis for comparison with the less complete sections.

Comparison of Faunas Found
Throughout Central Missouri.

	Flat Creek	Dresden	Leesville	Warsaw	Avery	Gerster	Weaubleau	Range [1]
Leptenae analoga				x	x?	x	x	K&LB
Leptenae? sp	x							
Schellwienella crenulicostata				x				K
Streptorhynchus tenuicostatum		x		x				C
Chonetes logani			x	x	x			K
Chonetes glenparkensis				x	x			GP&C
Chonetes				x	x			
Chonetes geniculatus		x		x			x	L
Chonetes burlingtonensis				x	x	x		K
Chonetes sp.							x	
Productella concentrica						x		K
Productella sp.	x							
Productus sampsoni				x	x			C&FG
Productus sedaliensis			x	x				
Productus arcuatus	x	x		x	x	x		K
Productus ovatus				x				Miss
Productus sp. (n. sp.)						x		
Productus blairi				x				C
Rhipidomella ? diminutiva			x					K&LB
Rhipidomella missouriensis		x		x			x	L
Rhipidomella sp.	x			x		x2		
Rhipidomella thiema ?							x	UK
Schizophoria sedaliensis				x				UC
Schizophoria chouteauensis		x		x	x?	x		C
Camarotoechia tuta		x						C&LB
Camarotoechia chouteauensis	x	x		x	x			C
Paryporhynchus sp.				x				K
Shumardella obsolens Hall	x	x	x	x	x	x?		C
Shumardella missouriensis	x			x			x?	C
Dielasma chouteauensis		x		x				C
Dielasma fernglenensis?				x				FG
Spiriferina subtexta				x				
Spirifer osagensis				x				K
Spirifer missouriensis				x				C
Spirifer latior				x				C
Spirifer platynotus				x	x			K
Spirifer louisianensis Rowley	x	x	x	x	x	x		UK&LB
Spirifer sp.	x							
Spirifer gregeri				x				LB
Brachythyris chouteauensis				x				K
Brachythyris peculiaris		x		x	x			C
Brachythyris sp.			x				x	
Syringothyris typus				x				UK
Syringothyris sp.			x	x				
Spiriferella ? schucherti				x				LB
Reticularia cooperensis		x	x	x	x			K
Eumetria perstrialis Rowley						x		LB
Hustedia ? circularis			x					C
Cliothyridina glenparkensis?				x				FG
Cliothyridina sp.						x		
Composita ? sp.				x				

1. Range from Weller, Stuart, Mississippian brachiopoda, Ill. Geol. Survey Monograph I, 1913.

The following chart shows the range of species found at Warsaw.

	1	2	3	5	11	12	13
Leptenae analoga					x	x	x
Schellwienella crenulicostata				x			
Streptorhynchus tenuicostatum				x			
Chonetes logani			x				x
Chonetes glenparkensis				x	x		
Chonetes burlingtonensis		x		x			
Chonetes geniculatus							
Productus sampsoni					x		x
Productus sedaliensis				x			
Productus arcuatus				x			
Productus ovatus				x			
Productus blairi				x			
Rhipidomella sp.					x		x
Schizophoria sedaliensis			x				
Schizophoria chouteauensis	x		x	x			
Camarotoechia chouteauensis				x			
Camarotoechia chouteauensis							
Paryphorhynchus sp.				x			
Rhynchotetra caput-testudinatus	x	x					
Rhynchotetra ovatum	x	x					
Shumardella missouriensis				x			
Dielasma chouteauensis				x			
Dielasma fernglenensis						x	
Spiriferina subtexta				x			
Spirifer osagensis				x			
Spirifer missouriensis				x		x	
Spirifer latior							
Spirifer platynotus			x	x			x
Spirifer louisianensis Rowley	x	x	x	x	x		x
Brachythyris peculiaris				x			
Syringothyris sp.				x			
Syringothyris typus				x			
Spiriferella ? schucherti	x						
Reticularia cooperensis				x			
Cliothyridina glenparkensis?	x						
Brachythyris chouteauensis	x			x			x
Shumardella obsolens Hall		x	x	x	x		

As indicated in the preceding chart, the fauna of the upper beds at Warsaw is distinguished by such species as Schizophoria sedaliensis, Rhynchotetra caput-testudinatus, Rhynchotetra ovatum, and Spiriferella? schucherti, which are not present in the rest of the section at the other localities. Spiriferella? schucherti is a Burlington species and is found in the uppermost bed only, which is apparently a Burlington-Chouteau transition bed. Schizophoria sedaliensis, which is an upper Chouteau species, was found rather abundantly in Bed 3, and is particularly interesting because it suggests the possibility that these upper beds may be part of the upper member of the Chouteau limestone although in general character the beds resemble most those of the lower member. This would explain the apparent extra thickness of the lower member at this locality. These upper beds may represent a limestone phase of the entire upper member, or what is more probable, only the lower part of it, the rest having been eroded away before the deposition of the Burlington limestone.

The most characteristic Chouteau fauna is found in Bed 5 and the fauna obtained from it is also the most complete found throughout the area.

The fauna of the lower beds is characterized by the presence of Leptenae analoga which is quite common, and by Productus sampsoni. Wherever the lowermost beds were exposed, these species were found. Although Leptenae analoga is given as ranging throughout the Kinderhook and into the Burlington by Weller,[1] it was found by the writer only in these lower beds,

1. Weller, Stuart, Mississippian Brachiopoda, Illinois Geological Survey Monograph I, p. 52, 1913.

and apparently does not range throughout the Lower Chouteau, although it may appear again in other Kinderhook formations.

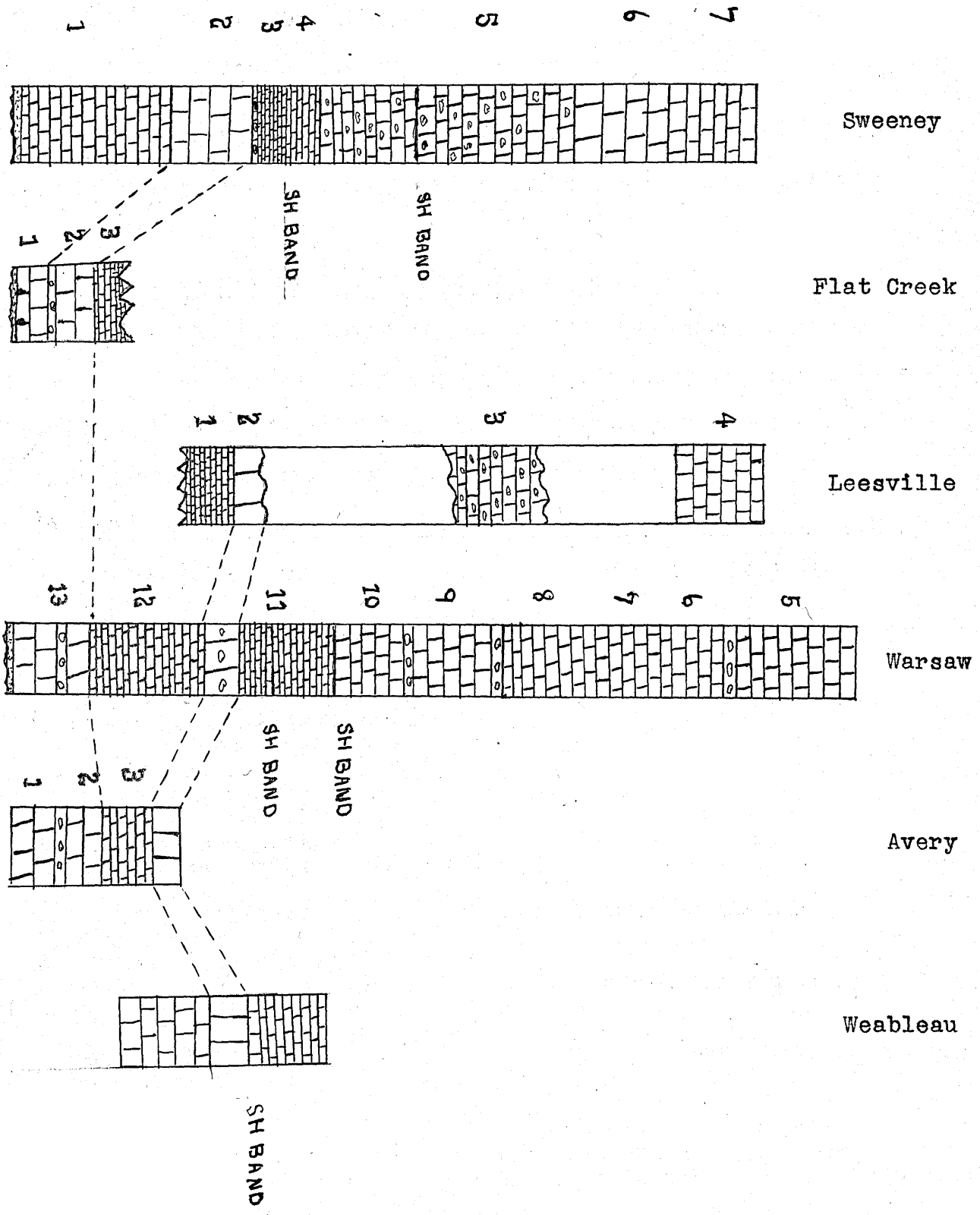
Spirifer louisianensis ranges throughout the section at Warsaw and was also found at every other locality. It is one of the most common species in the Chouteau as well as having the longest range. Shumardella obsolens Hall is perhaps the most common species and also occurs throughout the section.

A comparison of the fauna of the lower beds at all of the localities at which they were exposed is shown in the following chart.

	Warsaw 11, 12 & 13	Avery 3, 4, 5	Flat Creek	Gerster	Weablean
Leptenae analoga	x	x	x	x	x
Chonetes logani	x	x			
Chonetes sp.					x
Chonetes burlingtonensis		x		x	
Chonetes glenparkensis		x			
Productus sampsoni	x	x			x
Productus arcuatus		x	x	x	
Productus sp.		x			
Productus sp. (n. sp.)				x	
Rhipidomella missouriensis					x
Rhipidomella thiema					x
Rhipidomella sp.	x	x	x		
Productella concentrica				x	
Schizophoria chouteauensis		x			
Dielasma fernglenensis	x				
Eumetria perstrialis ? Rowley				x	
Camarotoechia chouteauensis		x	x	x	
Shumardella missouriensis					x?
Shumardella sp.				x	
Spirifer obsolens Hall	x	x	x		
Spirifer platynotus	x	x			
Spirifer louisianensis	x	x	x	x	x

PLATE VI.

CORRELATION OF SECTIONS



Spirifer sp.			x		
Brachythyris peculiaris		x			
Brachythyris chouteauensis					
Brachythyris sp.					x
Reticularis cooperensis		x			
Cliothyridina sp.				x	

On the basis of fauna as well as lithology, correlations shown in Plate VI were made between the sections described in Chapter III.

Comparison of Fauna with other Kinderhook Faunas

The fauna of the Lower Member of the Chouteau limestone of central Missouri as described in this report compares most favorably with the fauna of the Sac or "Louisiana" limestone of southwestern Missouri as described by Weller.[2]

Fauna of Chouteau limestone	Fauna of Sac limestone
Leptenae analoga	Leptenae rhomboidalis
Leptenae sp.	
Schellwienella crenulicostata	
Streptorhynchus tenuicostatum	
Chonetes logani	Chonetes logani
Chonetes glenparkensis	
Chonetes burlingtonensis	
Chonetes geniculatus	
Chonetes sp.	
Productus sampsoni	
Productus sedaliensis	
Productus arcuatus	
Productus ovatus	
Productus sp.	
Productus blairi	Productus blairi
Productella sp.	
Productella blairi	
Productella concentrica	Productella concentrica
Rhipidomella diminutiva	
Rhipidomella missouriensis	
Rhipidomella sp.	Rhipidomella burlingtonensis
Rhipidomella thiema	

2. Weller, Stuart, Correlation of the Kinderhook formations of Southwestern Missouri, Journal of Geology:Vol. 9, p. 134-139, 1901.

Schizophoria sedaliensis	
Schizophoria chouteauensis	Schizophoria swallovi
Camarotoechia tuta	
Camarotoechia chouteauensis	
Hustedia circularis	
Paryporhynchus sp.	Pugnax missouriensis
Shumardella obsolens Hall	
Shumardella missouriensis	
Dielasma chouteauensis	Dielasma sp.
Dielasma fernglenensis	
Eumetria perstrialis Rowley	
Spiriferina subtexta	
Spirifer osagensis	
Spirifer missouriensis	
Spirifer latior	Spirifer latior
Spirifer platynotus	Spirifer striatiformis
Spirifer louisianensis Rowley	
Spirifer sp.	
Spirifer gregeri	
Brachythyris chouteauensis	
Brachythyris peculiaris	Spirifer peculiaris
Brachythyris sp.	
Syringothyris typus	
Syringothyris sp.	Syringothyris missouriensis
Reticularis cooperensis	
	Athyris prouti
	Athyris sp.
Cliothyridina glenparkensis	
Cliothyridina sp.	Cleiothyris sp.
Composita sp.	
	Cyrtina

Most of the species described from the Sac limestone are typical species of the lower member of the Chouteau. Those species found in the Chouteau limestone and not in the Sac are mainly those of the upper beds at Warsaw.

The fauna of the Pierson limestone[3] of southwestern Missouri differs from the fauna of the Chouteau limestone mainly by the presence of several Burlington species.

Fauna of Chouteau	Fauna of Pierson
Leptenae analoga	Leptenae rhomboidalis
Leptenae sp.	
Schellwienella crenulisostata	
	Orthotetes cf. inflatus

3. Weller, Stuart, Correlation of the Kinderhook formations of Southwestern Missouri, Journal of Geology: Vol. 9, p. 144-145, 1901.

Streptorhynchus tenuicostatum
Chonetes logani
Chonetes glenparkensis
Chonetes burlingtonensis
Chonetes geniculatus
Chonetes sp.
Productus sampsoni
Productus sedaliensis
Productus arcuatus
Productus ovatus

Productus sp.
Productus blairi
Productella sp.
Productella blairi
Productella concentrica
Rhipidomella diminutiva
Rhipidomella missouriensis
Rhipidomella sp.

Rhipidomella thiema
Schizophoria sedaliensis
Schizophoria chouteauensis
Camarotoechia tuta
Camarotoechia chouteauensis

Hustedia circularis
Paryporhynchus sp.
Shumardella obsolens Hall
Shumardella missouriensis
Rhynchonella cooperensis
Dielasma chouteauensis
Dielasma fernglenensis
Eumetria perstrialis Rowley
Spiriferina subtexta
Spirifer osagensis
Spirifer missouriensis
Spirifer latior
Spirifer platynotus
Spirifer louisianensis
Spirifer sp.

Brachythyris chouteauensis
Brachythyris peculiaris
Brachythyris sp.
Syringothyris typus
Syringothyris sp.
Spiriferella ? schucherti
Reticularia cooperensis
Cliothyridina glenparkensis
Cliothyridina sp.
Composita sp.

Chonetes logani

Chonetes sp.

Productus arcuatus
Productus laevicostus
Productus punctatus

Rhipidomella burlingtonensis

Schizophoria swallowi

Camarophoria sp.

Dielasma sp.

Spirifer latior

Spirifer sp.
Spirifer marionensis
Spirifer grimesi

Spirifer peculiaris

Reticularia cooperensis

Athyris lamellosa

The Northview[4] shale of southwestern Missouri contains a Kinderhook fauna which is particularly abundant in pelecypods. The brachiopod facies, however, is partly suggestive of the Chouteau limestone.

The fauna of the Louisiana[5] limestone of northeastern Missouri is entirely differnt from the Chouteau fauna, most of the species found it it being limited to the Louisiana.

4. Weller, Stuart, Kinderhook Faunal Studies I, The Fauna of the Vermicular sandstone at Northview, Webster County, Missouri. St. Louis Academy of Science; Tr. 9, p. 9-51, 1900.

5. Keyes, C. R. and Rowley, R. R., Vertical Range of Fossils at Louisiana, Missouri, Iowa Acadamy of Science; Pr. 4, p. 26-40, 1897.

CHAPTER V

CONCLUSIONS AND GEOLOGIC RESUME'

The Chouteau limestone of central Missouri extends southward from Sedalia as far as Weableau in Hickory County. It decreases in thickness from around 60 feet in northern Pettis County to 20 feet at Gerster five miles west of Weableau.

The beds change in lithology, becoming more muddy, and in some places softer. The stratigraphic relations remain constant, however, and the fauna of the lower member remains a typical Chouteau fauna. The upper member is practically unfossiliferous throughout the region.

Relation to the southwestern Kinderhook Section

At Gerster in St. Clair County, the thinnest section of the central Missouri Chouteau was observed, the lower beds are from 8-10 feet in thickness and the whole section about 20 feet. The entire series of beds are shaly in appearance, the upper portion grading gradually into the lower portion which is hard, gray and blue limestone in thin irregular beds, and which contains the species common to the lowest beds of the Chouteau limestone elsewhere.

Fifteen miles south of this section, at Humansville, the upper part of the typical southwestern section was observed. See Table II, p. 3. Here 15 feet of Pierson limestone was found immediately below the Burlington and resting upon 6-8 feet of vermicular sandstone with about 4 feet of light green to tan colored shales below. The shales were abundantly

marked with caudi galli, and were certainly the Northview shales of southwestern section.

In northern Green County a limestone called at various times the Sac,[1] the Louisiana[2] and the Chouteau[3] has been reported as occurring at the base of the Northview or "Hannibal" shales. The fauna of this limestone as described by Weller compares very favorably with the fauna of the lower member of the Chouteau limestone of central Missouri as was shown in Chapter IV. This limestone has been described as being about 10 feet in thickness in northern Green County[4] which is about the thickness of the lower member at Gerster. Considering these facts it appears not improbable that the two limestones are the same, the "Louisiana" or "Sac" being a southward extension of the lower member of the central Missouri region. The decrease in thickness from north to south observed in central Missouri is also found in the "Louisiana" or the southwestern Chouteau which pinches out entirely by the time Springfield is reached.[5]

1. Weller, Stuart, Correlation of the Kinderhook formations in southwestern Missouri, Journal of Geology: Vol. 9, p. 134, 1901.

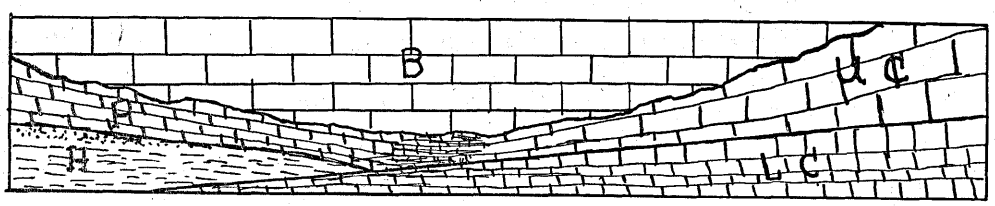
2. Shepard, E. M., A Report on Greene County, Missouri Geological Survey: Vol. XII, pt. 1, p. 84, 1898.

3. Branson, E. B., Geology of Missouri, University Bulletin 19 #15, p. 67, 1918.

4. Shepard, E. M., A Report on Greene County, Missouri, Geological Survey: Vol. XII, pt. 1, p. 85, 1898.

5. Ibid.

If the lower member is the equivalent of the Chouteau limestone of southwestern Missouri, this leaves the possibility of the upper member being equivalent to the Northview shales and the Pierson limestone. This might be possible by the gradual change of the shaly limestone of the upper member observed at Gerster to the shale of the Hannibal and the limestone of the Pierson, the thick shale and sand accumulating rapidly near the borders of the land mass. The probable relations of the central Missouri and southwestern sections indicated by the facts presented in this report are shown in the figure below.



B = Burlington limestone
P = Pierson limestone
H = Hannibal shale
Uc = Upper Chouteau
Lc = Lower Chouteau

The fact that the upper member of the Chouteau limestone in central Missouri is unfossiliferous may be accounted for by the high magnesian content of the limestone which condition is always unfavorable for the preservation of fossils.

Relations to section in Northeastern Missouri

In northeastern Missouri a shale and limestone succession is also found. At Louisiana, Missouri, the Louisiana limestone at the base of the section is overlain by 70 feet of shale and sandstone. The Hannibal shale and sandstone is very similar in appearance to the Northview of southwestern Missouri. The Louisiana is also similar in appearance to the lower member of the central Missouri Chouteau, but contains a fauna which is quite distinct from it.

The Louisiana limestone wedges out rapidly to the south and the Chouteau limestone of central Missouri decreases in thickness northward from Chouteau Springs, but that the same thing occurs in the north as in the south is improbable, due to the difference in forms present in the Louisiana limestone. It is not the faunal equivalent of the lower member of the Chouteau or of the Sac.

It is more likely that deposition took place in the north in a separate basin separated from the central basin by the St. Louis Barrier.[6]

General conditions during Chouteau Times

At the beginning of Kinderhook times the seas advanced into the Mississippi basin probably from the west and northwest.[7] Throughout central Missouri the Phelps sandstone was deposited and in Kentucky and Tennessee the Black shales were covered by the advancing sea.[8]

6. Branson, E. B., Geology of Missouri, Missouri University Bulletin 19 #15, p. 66, 1918.
7. Grabau,A.W. Text of Geology; Vol. II, page, 442, 1921
8. Ibid, p. 440.

In early Chouteau times limestones began to be deposited in the deeper places farthest from land and the clastics nearer shore. Central Missouri was surrounded by land on three sides as shown by the deposition of the clastics in the south and north and by the thinning of the Kinderhook deposits toward the east.[9] Deposition of the Kinderhook took place therefore, in a sort of embayment whose connection with outer sea was to the northwest or west as shown by the Chouteau fauna present in the Madison limestone of the west.[10]

At the close of Kinderhook time the seas became shallower with the deposition of magnesian limestone in central Missouri and arenaceous limestone in the south.

With the readvance of the seas in early Burlington time a small amount of magnesian and shaly limestone was deposited, then the seas cleared and the great thickness of pure Burlington limestone was laid down over the entire region.

9. Ibid, p. 441.

10. Ibid, p. 449.

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