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THE CHOUTEAU FORMATION OF
EAST CENTRAL MISSOURI

by

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CONTENTS.

	Page
Introduction, with acknowledgments-----	3
Previous work on the Chouteau-----	4
General characters of the Chouteau-----	7
Upper part-----	7
Lower part-----	8
Weathering-----	8
Description of outcrops-----	9
Tabular summary of the fauna according to locality-----	34
Relation to the overlying and underlying formations-----	35
Relation of the Chouteau to the Fern Glen-----	37
Economic considerations-----	40
Conclusions-----	44
Bibliography-----	46

INTRODUCTION.

The field work upon which this report is based was done chiefly during July and August, 1914. Only the work that was done at that time is shown on the accompanying geologic map. A short trip was made during the Thanksgiving recess to study the Chouteau in the eastern part of the state. This trip was necessarily in the nature of a rapid reconnaissance, and no map was made of the region. As the Chouteau outcrops are so limited there, such a map would be of slight importance.

I am glad to acknowledge my indebtedness to Mr. D. K. Greger for assistance in the identification of the fossils, and to Mr. C. R. Longwell for assistance in the field. I am most deeply indebted, however, to Dr. E. B. Branson, under whose instruction this work was done, and whose help and advice, both in the field and laboratory, have made this paper possible. The accompanying geologic map is taken from one made principally by Dr. Branson and Mr. Longwell.

PREVIOUS WORK ON THE CHOUTEAU.

The Chouteau limestone was first described and named by Professor G. C. Swallow in 1855, from the section at Chouteau Springs in Cooper County.¹ Professor Swallow placed the Chouteau at the top of the Chemung, and considered it as the upper member of the Devonian System in Missouri. From this early date down to comparatively recent times there has been considerable difference of opinion as to the age of the Chouteau, and the Devonian-Mississippian boundary has been shifted several times from above to below it and vice versa. Scott has given an excellent review of this controversy,² with the evidence and conclusions advanced by the different participants. At the present time, the Chouteau limestone is considered as undoubtedly Kinderhookian in age, and in the region studied in this paper, is the chief representative of the Kinderhook epoch. Scott has given detailed sections in Central Missouri, in the vicinities of Sweeney, Cooper County; Pin Hook bridge, near Sedalia, Pettis

¹Second Ann. Rept., Geol. Surv. Mo., 1855, p. 101.

²Master's Thesis, pp. 3-5.

County; and Providence and Rutland, Boone County.¹ His "farthest east" point is Sec. 36, T. 46 N., R. 13 W. It is the purpose of this paper to start from Scott's eastern limit, and trace the Chouteau eastward to the place where it dips under the surface, and is concealed by the younger rocks. The areal extent of the formation; the location of the principal outcrops; and the variations in the thickness, in the lithological characters, and in the faunas, where such exist, will be noted.

The areal extent of the Chouteau in this region is shown on the accompanying geological map. The localities where the formation was observed in some detail are given numbers to serve as references between the text and the map.

¹Ibid., pp. 7-17.

Legend.

— Chouteau

—Dark Hollow

—Devonian

—Ordovician

Scale 1:500,000

Fig. 1. The Chouteau at Providence, Mo.

Fig. 2. Showing the characteristic weathering of the Chouteau.

GENERAL CHARACTERS OF THE CHOUTEAU.

The general characteristics of the Chouteau are such that it can usually be readily recognized wherever it occurs. It varies considerably in thickness in different localities, being a little over sixty feet at Providence,¹ and pinching out to nothing in places. In general it consists of two parts which can be readily differentiated where a complete section is exposed. The upper part of the formation consists of a brownish grey or buff limestone, fine grained, and argillaceous or sandy. It occurs in thick, massive beds, is sparsely fossiliferous, and often contains masses of crystalline calcite, pyrite, or concretionary iron ore. It is usually rather highly magnesian, often giving little or no effervescence with cold dilute hydrochloric acid.

¹Scott, Master's Thesis, p. 11.

The lower part of the formation is characteristically an extremely compact, light bluish-grey or drab limestone, very brittle, homogeneous, breaking with a marked conchoidal fracture. This lower part, like the upper, often contains very few fossils, but in some localities the rock is crowded with fossils. Unless the fossils are weathered out, this rock is very hard to collect from, owing to its extreme brittleness. Often at a slight blow of the hammer the rock will shiver like glass.

The weathering of the Chouteau is peculiar and characteristic.¹ The upper part of the beds, when perfectly fresh (and it is usually necessary to get into the rock several inches to obtain a fresh piece), is a drab or slaty-blue color, and weathers to a tan or buff. The fresh surface of the lower beds is also of a drab or blue color, usually more of an ashy shade, but weathers to white on the surface. This color change is much more superficial than in the case of the upper beds. The lower beds have a marked tendency to "shell off" on the surface, giving a very rough and irregular character to the face of the cliffs. (See figure 2.) The Chouteau is

¹Cf. Van Horn and Buckley, Rept. Mo. Bur. Geol. & Mines, Sec. Series, Vol. 3., pp. 44-49.

probably not very resistant to weathering processes, as very often the formation will not be exposed in regions where we have every reason to suppose it to exist from the "float" or fragments scattered over the slopes and floors of the valleys. The ledges have been weathered back and covered by slope wash.

DESCRIPTION OF OUTCROPS.

From a thickness of $64\frac{1}{2}$ feet at Rutland, in Boone County, the Chouteau thins to a few inches of compact limestone near Fulton, Callaway County, and seems to be lacking from a mile east of Fulton to east of Mineola, in Montgomery County.¹ The formation appears again northwest of Danville, and is generally present as far east as the town of Hamburg, St. Charles County, where it is covered by younger formations. Following is a detailed description of the principal outcrops.

¹Dr. E. B. Branson, notes.

LOCALITY NO. I.

In the southwest quarter of section 2, T. 48 N., R. 6 W., on the west bank of Clear Fork, the Chouteau outcrops in a sixteen foot exposure. The whole formation is not visible here, as the outcrop occurs in a small syncline and the lower part dips under the stream bed. At the lower part of this outcrop are four feet of very compact, bluish-gray, brittle limestone. The beds are about an inch or an inch and a half thick, quite fossiliferous, and bear quantities of calcite. At times this crystalline calcite replaces the fossils, making it impossible to collect the latter as the fossils split along the cleavage planes of the calcite. Between the layers of limestone are interstratified thin beds of sandy shale. Among the fossils collected at this place are: *Spirifer latior*, *Reticularia cooperensis*, *Camartoechia gregaria*, *Chonetes ornata*, *Productus blairi*, *Shumardella obscuriplicata*, *Griffithides (?) sedaliensis*, *Barycrinus meekianus*.

Resting conformably upon this dense limestone is a twelve foot layer of yellowish, arenaceous, heavy bedded limestone, sparsely fossiliferous, also carrying quantities of calcite in cavities and veins. This grades imperceptibly into the Burlington above. (See fig. 3.)

LOCALITY NO. II.

Another outcrop of the compact, brittle Chouteau is found about a quarter mile down stream in the N. W. $\frac{1}{4}$ of section 11, in a small branch running into Clear Fork from the east. This forms the bed of the branch, is about four feet thick, and corresponds in every way to the lower part of the Chouteau described above. Near here in the S. W. $\frac{1}{4}$ of this same section were found the following fossils: *Spirifer latior*, *Camerotoechia gregaria*, *Spirifer peculiaris*, *Productus blairi*, and *Orthoceras* sp. und.

Fig. 3. The Chouteau at Locality No. I.

Fig. 4. The Chouteau at Smith's Branch. The thin layer between the ink lines is the Dark Hollow sandstone.

LOCALITY NO. III.

In an old quarry on Smith's Branch in the N. E. $\frac{1}{4}$ of section 13, T. 48 N., R. 6 W., the Chouteau is very well exposed. Here can be clearly seen the contacts between the Devonian, Dark Hollow and Chouteau. The Dark Hollow formation is represented by a thin layer, four to six inches, of green friable sandstone. The total thickness of the Chouteau is twenty-two feet, the lower part being compact, brittle, dark grey, while the upper part is brownish-yellow, sandy, crumbling. (See fig. 4.) Here the upper beds appear to be thinly bedded while the lower beds are more massive, an apparent reversal of the usual conditions. However, the lower beds have been recently exposed in the quarrying operations, and are fresh, while the upper beds, being very near the surface, are badly weathered, and this condition gives the appearance of closely spaced bedding planes. Mr. Greger collected and identified the following fauna from this locality: PELECYPODS - *Blairella sedaliensis*, *Macrodon facetus*, *Cypricardella eximia*, *Elymella missouriensis*, *Pernopecten circulus*;

GASTROPODS - *Platyceras* sp., *Euomphalus* sp., *Loxonema tenuilineatum*, *Bellerophon blairi*; CEPHALOPODS - *Poterioceras missouriense*, *Orthoceras* sp., *Solenochilus blairi*, *Triboloceras* Cf. *digonum*; BRACHIOPODS - *Leptaena rhomboidalis*, *Orthotetes rubra* (?), *Spirifer peculiaris*, *Spirifer latior*, *Productus blairi*, *Hustedia circularis*, *Chonetes glenparkensis*, *Paraphorhynchus elongatum*, *Cliothyridina tenuilineata*, *Shumardella missouriensis*, *Shumardella obscuriplicata*, *Productus ovatus*, *Rhynchopora cooperensis*, *Ambocoelia levicula*, *Rhipidomella tenuicostata*, *Productus arcuatus*, *Productus sampsoni*, *Athyris lamellosa*, *Cyrtina burlingtonensis*, *Dielasma chouteauensis*, *Reticularia cooperensis*; BLASTOIDS - *Schizoblastus roemeri*; CORALS - *Zaphrentis cliffordianus*, *Cyathaxonia arcuatus*; BRYOZOANS - one *Batostomelloid*, two *Fenestelloids*; VERMES - *Spirorbis blairi*, *Cornulites* sp.; CRINOIDS - *Blairocrinus bullatus*, *Platycrinus*; Trilobita - *Phillipsia*, two species.

LOCALITY IV.

In Smith's Branch, section 17, T. 48 N., R. 5 W., the Chouteau outcrops along the stream bed. A series of small folds keeps it at or near the stream level for a distance of half a mile. In the N. W. $\frac{1}{4}$ of the section is a small outcrop of the compact, brittle Chouteau, somewhat fossiliferous. Outcrops are so scant that the thickness cannot be determined. This compact rock dips down under the Burlington here, the yellow, sandy layer being missing. About seventy-five yards upstream the Chouteau comes up again in a small anticline, yellowish, sandy, very soft and friable. About thirteen feet are exposed here. The rock again dips underground and reappears a quarter mile upstream in a ten foot exposure. One hundred yards further upstream the Chouteau lies in the stream bed. It is very compact, brittle, bluish-grey in color, and very fossiliferous. About ten inches from the top of the exposure is a very cherty layer, the chert standing out on the weathered surface in large nodules. *Barycrinus meekianus*, *Platyceras paralius*, *Spirifer missouriensis* and *Spirifer latior* were found here.

LOCALITY V.

Compact Chouteau occurs in very thin exposure in the S. W. $\frac{1}{4}$ of section 31, T. 48 N., R. 5 W., in the south fork at the head of Sallee's Branch. The contact with the underlying rocks is not exposed here, but the Chouteau lies just a few feet above the Devonian outcrop. The Dark Hollow is either absent or very thin. There is room here for a maximum thickness of Chouteau of about twenty feet, but as neither limit is exposed it is impossible to determine the thickness exactly. Upstream, in a southeasterly direction, the Chouteau thins out very suddenly. Dark Hollow comes in, about fourteen inches thick, and between that and the Burlington there is room for only about three feet of Chouteau. The Chouteau is not exposed continuously, but numerous fragments of compact, brittle float on the slope below, show that it is present. *Shumardella obscuriplicata* and *Spirifer latior* were the only fossils found here.

LOCALITY VI.

In the S. W. $\frac{1}{4}$ of section 32, T. 48, R. 5 W., in a small stream running southwest to Clear Creek, many Chouteau fragments are found on the sides of the valley and in the stream bed. Outcrops are very scant, only an inch or two here and there, although there is room for a possible maximum thickness of ten feet. The rock is of the blue-grey, compact, brittle variety, not highly fossiliferous. *Productella concentrica*, *Productus blairi*, and *Camarotoechia gregaria* were found in the loose fragments on the sides of the valley.

LOCALITY VII.

In the S. E. $\frac{1}{4}$ of section 33, in the north fork of a small stream running into Clear Creek, there is an eighteen inch exposure of compact, brittle Chouteau, meagerly fossiliferous. On the south fork of this same creek, Chouteau, if present, is well covered, as no trace of its existence could be found. The following fossils were identified from this locality: *Productella concentrica*, *Spirifer latior*, *S. peculiaris*, *S. osagensis*, *Barycrinus meekianus*, *Camarotoechia gregaria*, *Girtyella cedargapensis* (?), and *Pernopecten cooperensis*.

LOCALITY NO. VIII.

In the valley of Whip-poor-will Creek, in the S. E. $\frac{1}{4}$ of section 3, T. 47 N., R. 5 W., there are no visible outcrops of either Chouteau or Dark Hollow. Devonian comes in very close under the Burlington, almost crowding the Dark Hollow and Chouteau out. Fragments of both kinds of rock found in the stream bed, indicate, however, that both formations are present, although they must be very thin. The Chouteau is of the compact, brittle variety, very sparsely fossiliferous.

LOCALITY NO. IX.

The Chouteau thickens to the southeast, for in the N. W. $\frac{1}{4}$ of section 12, in this same township, on the west bank of Pinnacle Creek, is found a four foot outcrop. It is very compact and brittle, non-fossiliferous, weathering on the surface to a yellowish, more friable rock. No more outcrops of Chouteau could be found in this branch, in the middle branch of Pinnacle Creek or in any of the side branches.

It occurs throughout this immediate region, however, as shown by the fairly large quantity of float in the stream beds. The position of the Devonian and Burlington precludes any greater thickness than four feet. Dark Hollow is very thin in this region, also, only a few fragments, six to nine inches thick, being found. A piece of Chouteau float from this locality yielded some small fragments of *Productella concentrica*.

LOCALITY NO. X.

In the southwest $\frac{1}{4}$ of section 4, T. 47, R. 4 W., in a branch running southward into Bear Creek, is found a small exposure of Chouteau two feet thick. It is of the compact, blue-grey, brittle variety, somewhat fossiliferous, and in thin beds, one and one half to two inches thick.

LOCALITY NO. XI.

The valley of Murder Hollow, in the N. E. $\frac{1}{4}$ of section 22, the N. W. $\frac{1}{4}$ of section 23, and the S. W. $\frac{1}{4}$ of section 14. By a series of small folds, occurring at stream level, the Chouteau occurs five

times in the stream bed in a distance of a half mile. As the tops of these anticlines have been eroded away, no measurements of the thickness of the rock could be obtained. Both the upper and lower Chouteau were found here, the former being a yellow, sandy, argillaceous limestone, non-fossiliferous, the latter a grey, compact, brittle, fossiliferous limestone.

LOCALITY NO. XII.

The southern half of section 13, T. 47 N., R. 4 W., gives some good exposures of Chouteau along the banks of Masses Creek. In the S. E. $\frac{1}{4}$ of the section, in a small branch running into Masses Creek from the northeast, the upper Chouteau is exposed on the side of the bank. It is typical upper Chouteau, yellow, sandy, somewhat friable, non-fossiliferous, except for a few crinoid stems. It merges into the Burlington above, no line of demarcation being apparent. In this same quarter section there is another outcrop of Chouteau on the west bank of Masses Creek, close to the road. This exposure is about six feet thick, is very compact, brittle, blue-grey in color, and quite fossiliferous.

There is still a third exposure, close to these two, in the S. W. $\frac{1}{4}$ of the section. It is in a small branch flowing into Masses Creek from the northwest, close to its junction with Masses Creek, and just around the point of the hill from the outcrop described above. These two outcrops are well exposed as the result of quarrying on a small scale, probably for road material. This rock is identical with that just described above, although not weathered quite so much, and therefore shows typical Chouteau features to better advantage. It bears a great deal of calcite and shows the interstratified layers of sandy shale mentioned before. It is quite fossiliferous. The following species were identified: *Ambocoelia laevicula*, *Spirifer osagensis*, *Leptaena rhomboidalis*, *Camarotoechia gregaria*, *Spirifer missouriensis*, *Girtyella cedargapensis* (?) and undetermined species of *Orthoceras* and *Platyceras*.

LOCALITY NO. XIII.

In the N. W. $\frac{1}{4}$ of section 36, T. 47 N., R. 4 W., Chouteau must be fairly thick, for although no outcrops could be found, owing to the abundance of hillside wash material, float was very abundant on the sides of the

valley and extended up and down for a considerable distance. Indications point to a maximum thickness of fifteen feet for the formation. The rock is of the dark grey, brittle, compact variety, bearing a good deal of calcite and numerous fossils. *Chonetes ornata*, *Shumardella obscuriplicata*, *Griffithides* (?) *sedaliensis* and *Productella concentrica* were found in the float.

LOCALITY NO. XIV.

In the N. W. $\frac{1}{4}$ of section 6, T. 46 N., R. 3 W., Chouteau outcrops directly above the Devonian, Dark Hollow being missing altogether. There are only three feet of Chouteau here but this probably does not represent the complete thickness of the formation. The outcrop occurs at the head of a small valley and the upper part has probably been eroded away. This rock is very fossiliferous. It is of the grey, brittle, compact variety, bearing large quantities of calcite. Chouteau also outcrops in the section just north of this, i. e., in section 31, T. 47 N., R. 3 W., although here again no estimate of its thickness could be determined. The following fossils were found in the N. W. quarter of section 6: *Leptaena rhomboidalis*,

Camarotoechia gregaria, *Triboloceras digonum*, *Spirifer peculiaris*, *Spirifer missouriensis*, *Bellerophon blairi* (?), *Productus blairi*, *Productella concentrica*, *Shumardella obscuriplicata*, *Shumardella missouriensis*, *Solenochilus blairi* (?), *Griffithides* (?) *sedaliensis*, *Dielasma chouteauensis*, *Reticularia cooperensis*, *Girtyella cedargapensis* (?).

LOCALITY NO. XV.

Just east of the locality last mentioned, in the valley of Henley Branch, N. E. $\frac{1}{4}$ of section 32, Chouteau outcrops in the stream bed, dense, compact, brittle and quite fossiliferous. Fauna: *Productella concentrica*, *Productus blairi*, *Spirifer peculiaris*, *Spirifer latior*, *Shumardella missouriensis*, *Camarotoechia gregaria*, *Chonetes ornata*, *Reticularia cooperensis*, *Dielasma chouteauensis*, *Platyceras paralius*.

LOCALITY NO. XVI.

In the northern part of section 4, T. 46 N., R. 3 W., was found the most complete and accessible section of Chouteau discovered during the summer. The rock here was not in a vertical section, but formed the

bed of a steeply falling stream and was measured down the ledges and steps of the stream bed. The following is the section, as well as it could be measured with the instruments at hand.

6. Yellow, argillaceous, finely granular limestone, streaked with very thin veins of iron oxide and calcite, non-fossiliiferous, thinly bedded. This grades imperceptibly into the yellow Burlington limestone above and it was impossible to draw a line between them. In fact part of this bed may be Burlington, but I drew an arbitrary line here.----- 10½ feet.
5. Yellowish-grey, fairly compact limestone, sparsely fossiliiferous. Can be easily split along definite bedding planes in contrast to No. 4 below.----- 2 feet.

4. Bluish-grey, extremely compact, brittle limestone, sparsely fossiliferous.

This rock is nearly as brittle as glass, and breaks with a conchoidal fracture, often giving sharp, jagged slivers. This property, as mentioned before, makes the rock very hard to collect from, although the horizons of very compact rock are often the most fossiliferous. This is perhaps the most characteristic horizon of the formation over the region studied, as it is found practically everywhere the Chouteau outcrops. In most places where it occurs, but is not exposed, the float that betrays its presence is from this layer. About eighteen inches from the top occurs a cherty bed in which are found large nodular masses of white to dark grey chert. This compact layer carries a great deal of calcite in veins and cavities.----- 3 feet.

3. Light yellowish-grey, sandy or argillaceous limestone, not so brittle as number four. Carries many large chert nodules light to dark grey in color. Not very fossiliferous.----- 5 feet.
 2. Two feet of dark grey, compact, brittle limestone, essentially like number four, but without chert.----- 2 feet.
 1. Light buff to grey limestone, like number three, but more fossiliferous, and without chert.----- 3 feet.
- Total thickness of formation.-----25½ feet.
- Devonian limestone.

LOCALITY NO. XVII.

Directly south of the exposure described above, and in the same section (section 4), Chouteau has thinned to about ten and a half feet. The exposures here are not good and a complete section could not be described. At the top, however, was found the yellowish, sandy layer as described at the top of the section given above (bed no. 6). Compact, brittle, bluish-grey limestone, quite fossil-

iferous, was found lower down; and at the bottom of the formation, lying on the Devonian, is a layer of light buff-grey, soft, argillaceous limestone, like number one in the above section.

Chouteau, mostly of the compact variety, was reported by Dr. Branson and Mr. Longwell as occurring in nearly all of section 2 and in the N. W. $\frac{1}{4}$ of section 11, T. 46 N., R. 3 W. It seemed to be about fifteen to twenty feet thick, although in most places it could not be measured as outcrops were scarce. *Shumardella obscuriplicata*, *Productus blairi*, *Griffithides* (?) *sedaliensis*, and casts of *Orthoceras* were found in the exposures in sections 2 and 11.

LOCALITY NO. XVIII.

In the S. E. $\frac{1}{4}$ of section 2, T. 46 N., R. 3 W., Chouteau is twenty feet thick in one place. It is of the yellowish, sandy variety above, and grey, compact, and brittle below. The lower, compact limestone is quite fossiliferous. All the way down the valley of Lost Creek, which runs southwestward through sections 2, 11, 15, 21, and beyond (see map), on both banks and in all the tributaries, Chouteau is present as far south

as the N. E. $\frac{1}{4}$ of section 21. Here it is about ten feet thick, compact and fossiliferous. In the S. W. $\frac{1}{4}$ of section 21, however, it seems to have disappeared entirely. From here on down the valley there was no further trace of it. In fact, only a short way down from the southern line of section 21 there is no room for Chouteau as the Devonian swings up to the tops of the hills. Chouteau is missing, however, even before it is crowded out by this rise of the Devonian.

LOCALITY NO. XIX.

In sections 13 and 24, T. 46 N., R. 3 W., Chouteau outcrops in both forks at the head of Henley's Hollow, which runs eastward into the Dry Fork of Charrette Creek. In the south fork of Henley's Branch the Chouteau outcrops in a three or four foot exposure, though there is space here for a maximum thickness of about ten and a half feet. This overlies a thin layer of Dark Hollow sandstone which in turn overlies the compact Ordovician limestone. The Devonian and Charrette formations are both missing here. In the north fork of Henley's Branch the outcrops of Chouteau are very meager. In the south fork of Henley's Hollow

the following Chouteau fossils were found in the N. W. $\frac{1}{4}$ of section 24: *Spirifer peculiaris*, *Spirifer missouriensis*, *Productus blairi*, *Shumardella obscuriplicata*, *Barycrinus meekianus*, and an *Orthoceras* of undetermined species.

LOCALITY NO. XX.

In the N. E. $\frac{1}{4}$ of section 13 and the S. E. $\frac{1}{4}$ of section 12, T. 46 N., R. 3 W., Chouteau outcrops in all of the small branches running into Dry Fork. No full sections are exposed, but the formation is probably twelve to fifteen feet thick at least. Here the Dark Hollow, Devonian and Charrette formations are all missing and the Chouteau rests directly upon the compact Ordovician.

LOCALITY NO. XXI.

In the S. W. $\frac{1}{4}$ of section 6, T. 46 N., R. 2 W. Chouteau outcrops in the small branches running south-eastward into Dry Fork. Thickness could not be determined. The Chouteau here rests upon the compact Ordovician limestone.

LOCALITY NO. XXII.

Chouteau is exposed down the valley of Dry Fork on both sides of the stream. It is first seen in the S. W. $\frac{1}{4}$ of section 5, T. 46 N., R. 2 W., near the road. Here it has been quarried recently and is fairly well exposed. The upper fifteen feet consist of thinly bedded, yellowish-grey, argillaceous limestone, somewhat fossiliferous. At the bottom is a two foot layer of very massive limestone in which no bedding planes appear. This rock is also argillaceous, yellow, and is not fossiliferous. It rests upon compact Ordovician limestone.

Chouteau gives intermittent exposures along the banks of Dry Fork as far downstream as the middle of section 18. Here it is found in a thin outcrop at the top of the bluff. South of this point the banks of the stream are not high enough to include the Chouteau.

The exposures last described are the last seen during the summer field season and the last that are shown on the geologic map accompanying this paper. A trip made at Thanksgiving time showed that the Chouteau limestone continues eastward for some distance, and

then dips underground and is covered by younger formations. East of the fifth principal meridian Chouteau outcrops are scant and hard to find. Owing to the non-resistant qualities of the rock and to the fact that the formation occurs high on the hills, there are no well-defined ledges. Waste covered slopes, with thin outcrops and float had to be depended on. This prevented getting the thickness of the formation any place.

In the N. E. $\frac{1}{4}$ of section 12, T. 45 N., R. 1 W., there appeared in the roadway fragments of rather fine grained, yellowish, argillaceous limestone, looking very much like upper Chouteau. It was conspicuously blotched with spots of purplish red, three to four inches in diameter. No outcrops of the rock could be found. Fragments of the same sort of rock were found in the S. W. $\frac{1}{4}$ of section 33, T. 46 N., R. 1 E., but no outcrops could be located.

The first outcrop of Chouteau in this region was found in the S. W. $\frac{1}{4}$ of section 35, T. 46, R. 1 E., in a small tributary of Callaway Fork, south of New Melle. The rock is greyish buff, quite compact, and shows nothing of the purplish spots mentioned above.

In the N. E. $\frac{1}{4}$ of section 23, T. 46 N., R. 1 E., in a small creek running into the Dardenne, the Chouteau outcrops in the side of the bank. It is a yellowish, argillaceous limestone, about five feet thick. Above it is a two to three foot bed of red clay, and below it a white medium grained sandstone (Dark Hollow).

On the main branch of Dardenne Creek, in the N. W. $\frac{1}{4}$ of section 24, this same township, is an outcrop of Chouteau of indeterminable thickness, white to grey, compact, brittle limestone. This was the last appearance of the Chouteau in this immediate region as a few hundred feet further downstream the dip of the rock carries it under the stream bed.

At the town of Hamburg, on the Missouri, Kansas and Texas tracks, in section 7, T. 45 N., R. 3 E., I obtained the following section.

6. Base of Burlington limestone to top
of bluff.----- 15 feet.
5. Yellowish-grey, fine-grained limestone,
abundant cherty layers (every 8 to 12
inches).----- 10 feet.

4. Sandy, yellow limestone, fine grained,
interstratified with thin layers of
sandy shale.----- 3 feet.
3. Green sandstone, fine-grained, friable.---- thin films
to one inch
2. Bluish-grey, fine-grained limestone,
crinoidal, with numerous calcite-
filled veins.----- 2 feet.
1. Yellow, rather coarsely crystalline
limestone, crinoidal, styolitic.----- to base of
cut

The Chouteau limestone is represented by
beds four and five. The formations here are dipping
rather rapidly eastward and just a few hundred yards
east of Hamburg the Chouteau dips underground and does
not reappear north of the Missouri River.

A TABULAR SUMMARY OF THE FAUNA ACCORDING TO LOCALITY.

Localities	I	II	III	IV	VI	VII	IX	XII	XIII	XIV	XV	XVII	XIX
Species.													
Spirifer													
latior	*	*	*	*		*					*		
S. peculiaris		*	*			*				*	*		*
S. missouriensis				*		*		*					*
S. osagensis						*		*					
Shumardella													
missouriensis			*							*	*		
Shumardella													
obscuriplicata*			*						*	*		*	*
Productella													
concentrica					*	*	*		*	*	*		
Productus													
blairi	*	*	*		*					*	*		*
Camarotoechia													
gegaria	*	*			*	*		*		*	*		
Reticularia													
cooperensis	*		*							*	*		
Leptaena													
rhomboidalis			*					*		*			
Dielasma													
chouteauensis			*							*	*		
Girtyella													
cedargapensis (?)						*		*		*			
Chonetes													
ornatus	*							*			*		
Ambocoelia													
levicula								*					
Griffithides(?)													
sedaliensis	*								*	*			
Triboloceras													
digonum			*							*			
Pernopecten													
cooperensis						*							
Platyceras													
paralius			?	*				*			*		
Barycrinus													
meekianus	*			*		*							*
Bellerophon													
blairi (?)										*			

Note. Mr. Greger has identified many more species from Locality III., but they are not included on this page as they were not found in the other localities. For a complete list of these fossils, see page 13.

RELATION TO THE OVERLYING AND UNDERLYING FORMATIONS.

In most places where the Chouteau limestone was observed it is underlain by the Dark Hollow sandstone, the lowest member of the Kinderhook in this region. The relations between the two formations is a disconformable one, as the Dark Hollow varies considerably in its thickness within small areas and in many places is absent altogether. As will be noted on the geologic map the Chouteau overlaps the Dark Hollow, and rests upon the Devonian in the northern part of Township 47 North, Range 4 West, in sections 4, 5, 6, 7, 8, and 9. This same relation is true in the valley and tributaries of Little Lost Creek, and in some of the western tributaries of Lost Creek in Range 3 West, Townships 46 and 47. In the main valley of Lost Creek, its eastern tributaries, and in the valley and tributaries of Dry Fork of Charrette Creek, the Chouteau rests upon the compact lower Ordovician limestone, the Dark Hollow, Devonian and the upper Ordovician (Charrette limestone) all being missing. The unconformity here is a great one as the hiatus represents upper Ordovician, all of Silurian and Devonian and lower Kinderhook times.

The relation to the overlying Burlington is generally a conformable one. In fact the gradation from the Chouteau to the Burlington in the region studied is so perfect that it was not possible to draw a definite line between the two formations any place. This relation is reported by observers in most places where the rock is exposed. Scott¹, in his sections, arbitrarily placed his contact "as the line above which crinoidal remains were abundant." There are some places, however, where a distinct contact between the two formations can be seen. Van Horn and Buckley,² in their description of the geology of Moniteau County, report such a contact and illustrate it with a photograph. The locality is in section 32, T. 47 N., R. 18 W., on the Missouri Pacific Railroad. Scott³ reports local occurrences of a sandy and argillaceous layer, weathering with the appearance of a shale, at the contact; and also an erosional unconformity between the two formations at Sweeney, in Cooper County.

¹Master's Thesis, p. 18.

²Rept., Mo. Bur. Geol. & Mines, 2nd series, Vol. 5, p. 44.

³Master's Thesis, pp. 18-19.

RELATION OF THE CHOUTEAU TO THE FERN GLEN.

The correlation between the Chouteau and the Fern Glen as worked out by Dr. Weller is stated in the fifth paper of his "Kinderhook Faunal Studies."¹ It is possible, however, that more evidence will necessitate a slightly different interpretation than that placed upon it by Dr. Weller. The Chouteau limestone occupies the same stratigraphical position in the region covered by this paper that the Fern Glen occupies in its typical development south of the Missouri River. Both formations lie beneath the Burlington and both show a rather gradual transition into the Burlington. The Fern Glen formation is described by Dr. Weller as being characteristically a red limestone, shaly in part.² It has its typical development at Fern Glen station, on the Missouri Pacific Railroad, twenty miles west of St. Louis.

¹Bull. Geol. Soc. Am., Vol. 20, 1909-10, pp. 321-323.

²Trans. St. Louis Acad. Sci., Vol. 16, 1906, pp. 435-437.

Dr. Weller states that the Chouteau in Central Missouri represents the entire Kinderhook interval, instead of the upper part of a three fold division, as it has been so often considered.¹ The Fern Glen may be a contemporaneous formation with the highest portion of the Chouteau, representing the closing stages of the Kinderhook. "In the sections where the Fern Glen has its typical development the limestone immediately beneath the red beds is the Chouteau."² "The most characteristic and typical Chouteau species..... do not occur in the Fern Glen, nor do they have any close relatives."²

The Fern Glen formation is not present north of the Missouri River. At the town of Hamburg, only fourteen miles, on an air line, from the station of Fern Glen, is found the Chouteau with its typical lithologic characters. However, in the eastern part of Warren County and in the western part of St. Charles County the Chouteau, in several places, takes on a deep purplish red color. This color change is not extensive, occurring sometimes as fairly large irregular masses in the normal grey limestone, or sometimes as mottlings

¹Bull. Geol. Soc. Amer., Vol. 20, 1909-10, p. 321.

²Ibid., p. 322.

on the grey. I have even found purplish-red mottling on the Chouteau as far west as Providence.

From the fact that the Chouteau in east-central Missouri, with its gradual transition into the Burlington, represents the closing stages of the Kinderhook, a relation that Dr. Weller assigns to the Fern Glen south of the river; from the fact that there is no Fern Glen north of the Missouri River, but that the Chouteau outcrops only fourteen miles from the type locality of the Fern Glen; and finally, from the fact that this red phase of the Chouteau becomes more important as it extends eastward toward the occurrence of the typical Fern Glen, it is possible that the Chouteau at some place merges into the Fern Glen and that the two formations are strictly contemporaneous. A careful exploration in this part of the state may permit the tracing of these two formations together, and the determination of the true relation between them. I rather think that such definite proof will not be found, however, as the critical part of the country between the Chouteau at Hamburg and the Fern Glen at Fern Glen station has been eroded away by the Missouri River. In the eastern part of St. Charles and St. Louis counties the Kinderhook is buried beneath

younger rocks. Well records show the presence of the Fern Glen formation near St. Louis,¹ however, and it may be that by the systematic collection of such data the relations of the two formations will be revealed sometime in the future.

ECONOMIC CONSIDERATIONS.

Some of the earlier reports of the Missouri Geological Survey speak rather optimistically of the probable economic value of the Chouteau limestone for building purposes of one kind or another, and as a natural hydraulic cement, or for the manufacture of portland cement. So far, however, the formation has proved to be of relatively small economic value. Neither the color of the massive beds, nor the structure of the thinner beds allow it to be used extensively for general building purposes. It has found a use in railroad ballast, however, and for rip-rapping along the river.² Locally it is quarried on a small scale and used on the roads. Some of the upper massive beds might be used for rough foundation work. Missouri,

¹Fenneman, N. M., Bull. 438, U. S. Geol. Surv.

²Scott, Thesis, p. 19.

however, has so much limestone that is more suitable for building purposes, that it has not been necessary to make use of this inferior material. Keyes says of the Chouteau at Burlington, Iowa, that it is too soft to be used as a building rock, but that this same softness in many places greatly facilitates the removal of the overlying rock when that is used as a quarry rock.¹

A number of earlier reports state that the Chouteau has the necessary requisites for a hydraulic cement.² Buehler states that the upper massive, impure beds are of no value in the manufacture of cement; that the lower, thinly bedded part contains ninety to ninety-five per cent calcium carbonate, and is pure enough to be used for this purpose, but seldom occurs in positions where it can be used economically.³ That last feature seems to be the chief reason why the Chouteau is used so little. Wherever it does possess characters that would make it of some economic value

¹Ann. Rept., Geol. Surv. Iowa, 1893, pp. 433-434.

²Meek, F. B., Report on Moniteau County, Mo. Geol. Surv., 1855, pp. 96-119; Callaher, J. A., Preliminary Report, Mo. Geol. Surv., 1900, p. 159.

³Lime and Cement Resources of Missouri, Rept. Mo. Bur. Geol. & Mines, sec. series, Vol. 6, 1907.

there is a better and more accessible limestone close by. Van Horn and Buckley₁ state that the formation is of small value and summarize their statements as follows.

Soils. The small surficial distribution of the Chouteau renders it of small importance as a soil maker.

Minerals. Occasional concretions of limonite and pyrite and crystals of zinc blende are the only metallic minerals observed in the formation. Barite is not common.

Building stone. The upper beds of the Chouteau, by reason of their resistance to weathering and the fact that they are easily quarried, are very suitable for building purposes. The lower beds are sometimes used for foundations.

Cement. The upper beds of the Chouteau might be used for making hydraulic cement, but analyses show too high a percentage of magnesium.

Gallaher₂ says regarding the economic value of the Chouteau, that its most important feature is that it forms the impervious floor to the open ground

¹Report on Moniteau County, Rept. Mo. Bur. Geol. & Mines, sec. series, Vol. 3, 1905, pp. 44-49.

²Preliminary Report, Mo. Geol. Surv., 1900, pp. 159-162.

or "reconstructed channels" in the overlying Burlington. It is a close structured mud rock, better adapted for the impervious floor than as a receptacle for water concentration of metallic ores. For this reason exploration in the Chouteau for metallic ore bodies is wasted energy.

It is a question, however, whether even this small honor should be given the Chouteau. Over practically all of the region where the Burlington overlies the Chouteau it is not ore-bearing. In southwest Missouri, where the Burlington carries quantities of metallic ore it cannot be definitely stated that the Chouteau lies below. There are no outcrops older than the Boone (Burlington-Keokuk).¹ A deep well (2005 feet) at Carthage goes through all of the stratified rocks and penetrates 255 feet into the crystalline rocks. Below the Boone, are fifteen feet of limestone that Ulrich, on only the basis of his stratigraphic studies farther east, correlates with the Chouteau.² The authors state that it is practically impossible to carry this correlation throughout the district, because of imperfection of well records and the variability of the formations themselves.³

¹Smith and Siebenthall, Folio 148, U. S. Geol. Surv.

²Ibid.

³Ibid.

Further than this, the great quantities and large masses of crystalline calcite, and of chert, and the occasional occurrence of small quantities of sphalerite, pyrite, and limonite, in the Chouteau, rather argue against the extremely impervious nature that Callaher assigns to the formation.

CONCLUSIONS.

Although my faunal lists are very incomplete, I believe that certain inferences can be drawn regarding the horizons of the Chouteau in this field. Reference to Scott's chapter on the vertical range of the Chouteau fossils¹ shows that certain species are found in the lower, or lower and middle horizons of the formation, e. g., *Productus blairi*, *Shumardella obscuriplicata*, *Shumardella missouriensis*, *Productella concentrica*, *Griffithides* (?) *sedaliensis*, *Barycrinus meekianus*, and others; other species seem to be confined to the middle and upper parts of the formation, the most prominent of which is *Spirifer peculiaris*; and finally there is quite a large number of species that range through the entire formation, such as

¹Master's Thesis, pp. 31-33.

Spirifer latior, *Spirifer osagensis*, *Leptaena rhomboidalis*, *Reticularia cooperensis*, etc. The rather constant occurrence of all of these typical Chouteau species would indicate that the entire formation is represented here, and that the thinning to the eastward is due to a thinning of the entire formation and not to the absence of any member of it. This inference is strengthened by the lithological character of the formation. Wherever both the lower and upper limits can be found, the typical compact, rather pure limestone is found at the bottom, and the yellowish, somewhat arenaceous limestone occurs at the top.

BIBLIOGRAPHY.

Following is a fairly complete bibliography of the literature on the Chouteau limestone, not including those papers that are purely paleontologic in nature. It comprises all the material that could be found while preparing this report, although no claim is made that it is an exhaustive list.

Bain, H. F.

Central Iowa Section of the Mississippian Series.

Am. Geol., Vol. XV., 1895, pp. 317-325.

Geology of Washington County.

Iowa Geol. Surv., Vol. V., 1895, pp. 131-140.

Ball, S. H., and Smith, A. F.

Geology of Miller County.

Rept., Mo. Bur. Geol. & Mines, Sec. Ser.,

Vol. I., 1903.

Beyer, S. W.

Geology of Harden County.

Iowa Geol. Surv., Vol. X., 1899, pp. 264-271.

Geology of Marshall County.

Iowa Geol. Surv., Vol. VII., 1896, pp. 221-226.

Beyer, S. W., and Williams, I. A.

Geology of Quarry Products.

Iowa Geol. Surv., Vol. XVI., 1906, pp. 371-400.

Broadhead, G. C., and Norwood, C. J.

Report on Howard County.

Rept., Mo. Geol. Surv., 1874, pp. 179-221.

Broadhead, G. C.

General Geology of Missouri.

Rept., Mo. Geol. Surv., 1874, pp. 18-34.

Report on Cedar County.

Rept., Geol. Surv. Mo., 1873-1874, p. 67.

General Geology of Missouri.

Rept., Geol. Surv. Mo., 1873-1874, p. 26.

Report on Warren County.

Rept., Geol. Surv. Mo., 1855-1871, pp. 38-64.

History of the Missouri Paleozoic.

Am. Geol., Vol. XIV., Dec., 1894, pp. 380-388.

Buckley, E. R., and Buehler, H. A.

The Quarrying Industry of Missouri.

Rept., Mo. Bur. Geol. & Mines, Sec. Ser.,

Vol. 2, 1904.

Buckley, E. R.

See also Van Horn and Buckley.

Buehler, H. A.

Lime and Cement.

Rept., Mo. Bur. Geol. & Mines, Sec. Ser.,

Vol. 6, 1907.

Gallaher, John A.

Preliminary Report on the Economic and Structural
Geology of Missouri.

Mo. Geol. Surv., 1900, pp. 159-162.

Hall, James.

Observations upon the Carboniferous Limestones of
the Mississippi Valley.

Am. Jour. Sci., Sec. Ser., Vol. 23, 1857,
pp. 187-203.

Hambach, G.

Preliminary Catalogue of Fossils Occurring in Missouri.

Mo. Geol. Surv., Bull. I., 1890, pp. 60-85.

Keyes, Charles R.

Kinderhook Stratigraphy.

Jour. of Geol., Vol. 8, 1900, pp. 315-321.

Coal Deposits of Iowa.

Iowa Geol. Surv., Vol. 2, 1894, p. 79.

Geology of Des Moines County.

Ann. Rept., Geol. Surv. of Iowa, 1893, p. 433.

Geological Formations of Iowa.

Ann. Rept. Geol. Surv. of Iowa, 1892, p. 56.

Devonian Interval in Missouri.

Bull. Geol. Soc. Am., Vol. 13, 1903, pp. 267 et seq.

Dual Character of the Kinderhook Fauna.

Am. Geol., Vol. 20, 1897, pp. 167-176.

Geology of Lee County.

Iowa Geol. Surv., Vol. III., 1893, pp. 338-340.

Marked Unconformity between Carboniferous and Devonian
Strata in Upper Mississippi Valley.

Am. Jour. Sci., 4th Ser., Vol. 36, 1913, pp. 160-164.

Faunal Aspects of the Original Kinderhook.

Am. Geol., Vol. 26, 1900, pp. 315-321.

Keyes, Charles R., and Rowley, R. R.

Vertical Range of the Fossils at Louisiana.

Proc. Iowa Acad. Sci., Vol. 4, pp. 26-40.

McGee, W. J.

Pleistocene History of Northeast Iowa.

Elev. Ann. Rept., U. S. G. S., 1889-1890, Pt. I.,
p. 313.

Macbride, T. H.

Geology of Humboldt County.

Iowa Geol. Surv., Vol. IX., 1898, pp. 123-127.

Marbut, C. F.

Geology of Morgan County.

Rept., Mo. Bur. Geol. & Mines, Sec. Ser., Vol. 7,
1907.

Meek, F. B.

Report on Morgan County.

Rept., Geol. Surv. Mo., 1871, p. 141.

Report on Saline County.

Rept., Geol. Surv. Mo., 1871, pp. 157-188.

Report on Moniteau County.

Sec. Ann. Rept., Mo. Geol. Surv., 1855, Pt. 2,
pp. 96-119.

Meek, F. B., and Worthen, A. H.

Remarks on the Age of the Goniatic Limestone at
Rockford, Indiana.

Am. Jour. Sci., Sec. Ser., Vol. 32, 1861,
pp. 167-174, 288.

Rowley, R. R.

The Chouteau Group of Eastern Missouri.

Am. Geol., Vol. 3, 1889.

Range of Chouteau Fossils.

Am. Geol., Vol. 12, July, 1893, pp. 49-50.

See also Keyes and Rowley.

Sampson, F. A.

Notes on the Sub-Carboniferous Series at Sedalia,
Missouri.

Trans. N. Y. Acad. Sci., Vol. 7, 1888, p. 246.

Sardeson, F. W.

Iowa Carboniferous Formations.

Am. Geol., Vol. XXX., 1902, pp. 300-312.

Savage, T. E.

Geology of Tama County.

Iowa Geol. Surv., Vol. XIII., 1902, pp. 213-228.

Schuchert, Charles.

Paleogeography of North America.

Bull. Geol. Soc. Am., Vol. 20, 1910, pp. 427-606.

Shumard, B. F.

Report on Ste. Genevieve County.

Rept., Geol. Surv. Mo., 1855-1871, p. 295.

Scott, H. M.

The Chouteau Formation of Central Missouri.

Master's Thesis, Univ. of Mo. Library.

Smith, A. F.

See Ball and Smith.

Smith, W. S. T., and Siebenthal, C. E.

Description of the Joplin District.

U. S. Geological Atlas, Folio. 148.

Stewart, Alban.

A Geological Section at Providence, Missouri.

Kans. Univ. Quarterly, Vol. 4, 1896, pp. 161-162.

Stookey, S. W.

Geology of Iowa County.

Iowa Geol. Surv., Vol. XX., 1909, pp. 167-168.

Swallow, G. C.

The Geology of Missouri.

Sec. Ann. Rept., Mo. Geol. Surv., 1855, Pt. I.,
pp. 59-136.

Report on Cooper County.

Sec. Ann. Rept., Mo. Geol. Surv., 1855, Pt. I.,
pp. 186-203.

Report on Marion County.

Sec. Ann. Rept., Mo. Geol. Surv., 1855, Pt. I.,
p. 176.

Udden, J. A.

Geology of Louisa County.

Iowa Geol. Surv., Vol. XI., 1900, pp. 71-92.

Van Horn, F. B., and Buckley, E. R.

Geology of Moniteau County.

Rept., Mo. Bur. Geol. & Mines, Vol. 3, Sec. Ser.,
pp. 44-49.

Weller, Stuart.

The Fauna of the Vermicular Sandstone at Northview,
Webster County, Missouri.

Trans. St. Louis Acad. Sci., Vol. 9, 1899, pp. 9-51.

The Fauna of the Chonopectus Sandstone at Burlington,
Iowa.

Trans. St. Louis Acad. Sci., Vol. 10, 1900,
pp. 57-129.

The Faunas of Beds No. 3 to No. 7 at Burlington, Iowa.
 Trans. St. Louis Acad. Sci., Vol. 11, 1901,
 pp. 147-219.

The Fauna of the Glen Park Limestone.
 Trans. St. Louis Acad. Sci., Vol. 16, 1906,
 pp. 435-471.

The Fauna of the Fern Glen Formation.
 Bull. Geol. Soc. Am., Vol. 20, 1909-1910, pp. 265-332.

The Northern and Southern Kinderhook Faunas.
 Jour. Geol., Vol. 13, 1905, pp. 617-634.

A Circum-insular Paleozoic Fauna.
 Jour. Geol., Vol. 3, 1895, pp. 903-917.

Classification of the Mississippian Series.
 Jour. Geol., Vol. 6, 1898, pp. 303-314.

Correlation of the Kinderhook Formations of South-
 western Missouri.

Jour. Geol., Vol. 9, 1901, pp. 130-148.

Correlation of the Middle and Upper Devonian and the
 Mississippian Faunas of North America.

Bull. Geol. Soc. Am., Vol. 17, pp. 257-285.

White, C. A.

Geology of Humboldt County.

Geol. of Iowa, Vol. II., pp. 244-245.

Geology of Franklin County.

Geol. of Iowa, Vol. II., 1870, p. 240.

Williams, H. S.

Correlation Paper - Devonian and Carboniferous.

Bull. 80, U. S. G. S., 1891.

The Origin of the Chouteau Fauna.

Jour. Geol., Vol. 4, 1896, pp. 283-290.

Williams, I. A.

Geology of Franklin County.

Iowa Geol. Surv., Vol. XVI., 1905, pp. 481-488.

See also Beyer and Williams.

Willis, Bailey.

Index to the Stratigraphy of North America.

U. S. G. S., Prof. Paper 71, pp. 408-409.

Winslow, Arthur.

Lead and Zinc Deposits of Missouri.

Mo. Geol. Surv., Vol. 7, 1894, pp. 394-420.

Worthen, A. H.

Geology of Washington County.

Geol. of Iowa, Vol. I., Pt. I., 1858, pp. 245-246.

Geology of Lee County.

Geol. of Iowa, Vol. I., Pt. I., 1858, p. 196.

Geology of Des Moines County.

Geol. of Iowa, Vol. I., Pt. I., 1858, pp. 205-206.

See also Meek and Worthen.

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E. B. Ransom

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