

STRATIGRAPHY OF THE CHESTER GROUP IN
SOUTHWESTERN ILLINOIS.

STUART WELLER*

Introduction.

The earlier work on the stratigraphy of the Chester group in southern Illinois was done by Swallow, (1) Hall, (2) Engelmann, (3) and Worthen. (4) No attempt will be made in this place to review in detail the work of these several observers. It is sufficient to state that after the publication of Worthen's reports of the Geological Survey of Illinois, a fairly well defined series of rock strata, at the summit of the so-called Sub-Carboniferous or Lower Carboniferous series, having their typical development in Randolph County, were commonly known as the Chester group. Hall had applied the name of Kaskaskia to the greater part of the same series and the names Kaskaskia and Chester were commonly considered as being synonymous. Rocks having similar lithologic characters and with the same fossils, were recognized in other states further south, notably in Kentucky and Alabama, and the same names, either Chester or Kaskaskia were applied to them. The total thickness of the rock strata to which these names were applied was 800 or more feet.

No serious attempt was made to subdivide this Chester group until the publication by Ulrich and Smith of a report on "The Lead, Zinc and Fluorspar Deposits of Western Kentucky" in 1905 (5). In this report Ulrich proposed to divide the entire group into three major formations, the Ste. Genevieve limestone below, the Cypress sandstone, second, and the Kaskaskia limestone above. The name Ste. Genevieve had been used by Shumard (6) for a limestone in Missouri, which comprised a part of the Ste. Genevieve of Ulrich. (6) The name Cypress had been proposed by Engelmann in the same sense as used by Ulrich, this sandstone being the basal member of the Chester group of Worthen. Kaskaskia was a revival of Hall's name which was originally applied to the beds lying above the Cypress sandstone of Engelmann. The

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Chester Group.	Kaskaskia limestone	Birdsville formation.
		Tribune limestone.
	Cypress sandstone.	
	Ste. Genevieve limestone	Ohara limestone.
		Rosiclare sandstone.
Fredonia oolitic limestone.		

subordinate members of the Ste. Genevieve limestone, Fredonia, Rosiclare, and Ohara, were used for the first time by Ulrich in this report, as were also the names Tribune and Birdsville, the two formations in which the Kaskaskia limestone was divided.

The most notable innovation in Ulrich's classification, is the inclusion of the Ste. Genevieve limestone in the Chester group. Engelmann had recognized two Chester beds in Johnson and other southern counties in Illinois, which he believed to be sub-Cypress in position, and to these two supposed sub-Cypress beds Ulrich gave the names Rosiclare sandstone and Ohara limestone and included them in his larger Ste. Genevieve limestone. The distinguishing features of Ulrich's Ste. Genevieve is a lithologic succession, limestone below and above with an intermediate sandstone member, rather than any faunal character.

The detailed field work of the writer during several seasons, upon the Chester formations in the Waterloo, Renault, Baldwin and Chester quadrangles, comprising parts of Monroe and Randolph counties, has led to some important conclusions in the interpretation of this upper portion of the Mississippian section, which are not wholly in accord with the classification of Ulrich. The detailed observations by Worthen and other earlier geologists, were confined mainly to the sections in the Mississippi River bluffs and although the Chester rocks were recognized at many points in the interior, no serious attempt was ever made to establish exact correlations between them and the beds in the bluff sections. A careful study of the Chester beds which are widely exposed in the stream valleys back from the Mississippi River bluffs, has greatly magnified the importance of the lower members of the section. Worthen's lower limestone, bed No.

2, in his Randolph County section, immediately superjacent to the Cypress sandstone, was described as a "compact gray limestone, with intercalations of blue, green and purple clay shales," 150 feet thick. The more detailed studies have shown this bed to be a composite member, made up of several distinct formational units, with an aggregate thickness considerably greater than estimated by Worthen. The Cypress sandstone also, as interpreted by Worthen, proves to be a composite member the higher beds comprising a distinct formation which rests unconformably upon the lower.

These detailed studies have necessitated the recognition of a series of nine distinct formations in the Chester group, which are designated as follows:

9. Clore formation.
8. Palestine formation.
7. Menard formation.
6. Okaw formation.
5. Ruma formation.
4. Paint Creek formation.
3. Yankeetown formation.
2. Renault formation.
1. Brewerville sandstone.

Each of these formations possesses distinct lithologic and faunal characters by which it may be easily recognized, and all of them may be readily traced and mapped throughout the region studied. Ulrich's division of the supra-Cypress portion of the Chester into the Tribune and Birdsville formations has not been carried out in detail by him in the Randolph and Monroe county area, but he has stated (7) that he considers the summit of the limestone ledge quarried in the Southern Illinois Penitentiary near Chester, to be the dividing line between the Tribune and Birdsville. Under this interpretation the Tribune of Ulrich would include the Okaw, the Ruma, the Paint Creek, the Yankeetown and part of the Renault formations, leaving the Menard, the Palestine and the Clore as the equivalent of the Birdsville. Furthermore, all the formations from the summit of the Okaw downward to some point within the Renault, have been differentiated from Worthen's 150 foot limestone member immediately superjacent to the basal sandstone or Cypress member in his Randolph county section. It will be understood from this statement, therefore, that the most important results of these recent studies have been in magnifying the importance of the lower portion of the Chester group, these members of the group having their more typical development, not in the Mississippi River bluffs, but in the region between the Mississippi and the Okaw or Kaskaskia valleys.

The general characters of each of the formational units designated above will be outlined here.

1. Brewerville Sandstone.

General characters. In its original application by Engelmann, the name Cypress was used to designate a series of "quartzose sandstones with some shaly portions, about 150 feet thick," which have a prominent development on Cypress creek in Johnson county. The same formation was recognized by Worthen in the Mississippi river bluffs below Prairie du Rocher, although he never used the name Cypress, referring to it always as "the lower sandstone of the Chester group." The thickness of the formation, as recognized by Worthen, was "from 50 to 100 feet or more." Excellent exposures of the formation in the Randolph-Monroe County area, are to be seen in the Mississippi river bluffs immediately above Modoc, and in the ravines between Modoc and Prairie du Rocher, also in the valleys of the north and south forks of Horse Creek and their tributaries west of Red Bud, in the valley of Rock House Creek southeast of Waterloo, and in the valleys of Prairie du Long Creek and its tributaries east and northeast of Waterloo.

It was apparently the purpose of Englemann, and also of Worthen, to include in the Cypress formation all the essentially arenaceous beds in the basal portion of the Chester group, and Ulrich's interpretation also conforms with that of these earlier writers, although he states that "in the most complete development of the formation it is divisible into three members or beds." (5) The upper member is said to include thin-bedded and slightly argillaceous strata, the lower member being apparently always massive. The middle bed of Ulrich, "a highly fossiliferous, cherty, blue, fine-grained limestone, rarely more than four or five feet thick," is said to lie 60 feet to 80 feet beneath the top of the formation.

The field studies of the writer have shown that these lower arenaceous strata of the Chester group are divisible into two distinct formations, separated by an unconformity and overlap. For the lower of these formations, which includes the more massive basal member of the Cypress as that term was used by Engelmann and by Ulrich, the name Brewerville is proposed.

The formation is a very massive, fine or medium grained sandstone in thick beds, often more or less conspicuously cross-bedded. Its color on freshly broken surfaces is a soft brown tint, which in some localities becomes nearly white. Not infrequently it is mottled with small, darker brown specks. On long exposed, weathered surfaces, the color in

most localities is a darker brown than that of freshly broken surfaces. Wherever the streams have eroded their channels in this massive sandstone formation, picturesque gorges have been formed with nearly vertical walls. The maximum thickness of the formation probably does not exceed 70 or 80 feet, and practically the entire maximum thickness is exposed in the Mississippi river bluffs, two miles above Modoc, and in the bluffs of Rock House Creek, three and one-half miles southeast of Waterloo. To the eastward, north of Prairie du Rocher, the formation thins out entirely, the superjacent Renault formation resting, by overlap, directly upon the St. Louis limestone.

Sub-Brewerville unconformity. Throughout the Randolph-Monroe county area, the Brewerville rests unconformably upon the underlying formations. The subjacent limestone floor in most of the area is the St. Louis limestone, but in the Mississippi River bluffs below Prairie du Rocher, and in some of the ravines southeast of the same town, a remnant of the Ste. Genevieve limestone is still present. The demonstration of the unconformity, however, is not alone dependent upon the absence of the Ste. Genevieve in part of the area. At the close of the erosion period during which the Ste. Genevieve limestone was wholly removed over a large area, the resultant surface was uneven, although with no abrupt relief features. Where the actual contact of the Brewerville upon the underlying strata can be seen, as in the bluffs between Prairie du Rocher and Modoc, the difference in elevation of the contact, as well as the different strata at the summit of the subjacent formation, are clearly discernible. A difference in elevation of the contact line, of at least 100 feet in a distance of one mile or less, is observable west of Red Bud. Furthermore, at many localities on the north fork of Horse Creek and its tributaries, and in Rock House Creek, the basal bed of the Cypress is a conspicuous layer of breccia, one foot or more in thickness, made up of angular masses of the very characteristic chert from the upper St. Louis limestone beds, these masses ranging in size from a fraction of an inch to a foot or more in their maximum dimension.

2. Renault Formation.

General characters. The Renault formation consists of an exceedingly complex series of strata whose lithologic characters change rapidly both in horizontal extent and vertically. The formation includes sandstones, arenaceous shales, variegated green, blue and purple shales, calcareous shales, thin platy layers of limestone in some of the calcareous shales, dense arenaceous limestones, nearly pure crystalline limestones, oolitic limestones, and in the northern part of

the Waterloo quadrangle, limestone conglomerate. The formation undoubtedly includes some portion of the "lower sandstone of the Chester group," of Worthen, and it is believed that Ulrich's middle and upper divisions of the Cypress in Kentucky should be referred to the Renault. The thicker bedded sandstone and the arenaceous limestone strata of the formation are conspicuously cross-bedded in almost every locality where they are exposed. In general the sandstones are thin-bedded with shaly partings, passing imperceptibly into arenaceous shales. In many localities thin flaggy beds of sandstone are pierced by closely crowded, vertical burrows a quarter of an inch or less in diameter which in a weathered condition, occur as more or less complete perforations of the beds. Some of the heavier sandstone layers closely simulate the massive Brewerville. Such beds usually occur, when present, in the higher portion of the formation and rarely or never attain a thickness of over 10 to 20 feet. They may be distinguished from the Brewerville, not only by their less thickness, but also by the presence of the underlying shales, often variegated, sometimes by underlying limestone strata, and they usually contain some more or less fragmentary fossils.

The Renault formation is typically developed in the eastern portion of Renault township in Monroe county, where excellent exposures may be seen in the valleys of the two forks of Horse Creek and their tributaries. Good exposures may also be seen in the stream valleys northeast, east and southeast of Waterloo. Towards the western border the formation is composed almost entirely of arenaceous strata. Eastwardly the thickness gradually increases until it attains its maximum of from 80 to 100 feet; the calcareous strata also become more conspicuous towards the east, where important crystalline limestone beds are developed. The variegated shales have a conspicuous development in the basal part of the formation in the region northeast of Waterloo, where an important bed of these sediments, 25 feet or more in thickness, is frequently exposed in the valleys of Prairie du Long Creek and its tributaries. Similar, but less extensive beds of the same general character, occur elsewhere in the formation, and they may be expected almost anywhere within the area of outcrop.

The Renault overlap. In its geographic distribution the Renault formation is much more widespread than the subjacent Brewerville, since through much of its area it overlaps the Brewerville along its western border, and rests directly upon the St. Louis or Ste. Genevieve limestone, the actual amount of overlap observed in the Renault quadrangle being at least two miles. The unconformable relations of the

Renault with these limestones, when they are the immediately subjacent rocks, is very clear, and in one point in Hickman Creek, about two miles west of Millstadt, in the northern part of the Waterloo quadrangle, an important bed of limestone conglomerate is present in the base of the formation. At this locality the conglomerate rests directly upon the Ste. Genevieve limestone, and the rounded pebbles in the conglomerate are mostly from the immediate underlying Ste. Genevieve beds. The unconformity of the Renault upon the Brewerville is not so obvious, but it seems to be clearly established. The arenaceous character of the higher formation, especially towards its western border, sometimes makes it difficult to determine exactly the line of contact between the two formations. In several localities, however, where the Renault is represented by calcareous beds and the Cypress is possessed of its typical, massive, unmistakable characters, there are notable discrepancies in the elevation of the contact between the two formations within rather short distances, which would indicate an erosion interval preceding the deposition of the younger formation. Furthermore, in a tributary of Hickman Creek, two and one-half miles northeast of Millstadt, the Renault rests upon the Brewerville with a limestone conglomerate in the base of the formation.

3. Yankeetown Formation.

General characters. The Yankeetown formation, although a thin stratum which probably never exceeds and rarely attains 20 feet in thickness, is one of the most persistent members in the Chester group of the Randolph-Monroe county area. In all its outcrops where it has been exposed to long weathering, the formation is almost completely siliceous, the color usually being light buff or nearly white. Where it has not been subjected to such long weathering, or where it has been encountered in digging wells, it is commonly, in part at least, composed of highly siliceous limestones; some of the beds are slightly sandy, and locally the formation is partly quartzitic; where this quartzitic facies is best developed, on Hickman Creek in the northern portion of the Waterloo quadrangle, the color is distinctly red or rose. The bedding of the formation is commonly very irregular and contorted.

In its geographic distribution the Yankeetown extends from the extreme northern portion of the Waterloo quadrangle to the Mississippi river bluffs, about two miles below Modoc, near the southeastern corner of the Renault quadrangle, where it passes beneath the younger formations. The bed is so resistant that in many localities it is well exposed in stream beds where other members of the Chester are en-

tirely covered, and in regions where the drift mantle is not excessively thick the position of the formation can be detected in the public highways, and frequently in the fields, by the presence of the characteristic chert-like fragments in the soil. In the valleys and the ravines the Yankeetown outcrop is reduced to a mere line on the map, but upon some of the divides it is the underlying rock over considerable areas because of its resistant character, such being the case southeast of New Design and east of Renault. Some excellent and typical exposures of the formation may be seen in the region about Yankeetown school from which exposures, the name of the formation has been derived. Northwest and southwest of Millstadt, in the northern portion of the Waterloo quadrangle, the Yankeetown constitutes the floor upon which the Pennsylvanian beds have been laid down and it is exposed in some of the stream beds which have been cut through the Pennsylvanian.

In its stratigraphic relations with the subjacent Renault formation, the Yankeetown is believed to be unconformable, although the unconformity can possibly not be established with entire satisfaction. At different localities the higher formation rests directly upon the very different beds of the Renault, sometimes upon sandstone, sometimes upon limestone and sometimes upon shale. Furthermore, the underlying Renault varies in thickness beneath the Yankeetown from 40 feet or less to more than twice that thickness. If the Yankeetown was not deposited unconformably upon the Renault, there must have been an abrupt transition from the remarkably heterogeneous conditions, as evidenced by the variable sediments of the Renault, to the wonderfully uniform sedimentation of the Yankeetown.

4. Paint Creek Formation.

General characters. The Paint Creek formation succeeds the Yankeetown with apparent conformity, and is very uniform in its characteristics throughout the entire Randolph-Monroe county area. Its thickness is from 60 to 80 feet, the average thickness probably not much exceeding 60 feet. The lower half of the formation, or perhaps somewhat more than half, is almost entirely shale, while the higher portion is largely limestone with shale partings.

In the lower portion of the formation occurs one of the most peculiar and most persistent beds in the whole Chester group. It is a deep red, compact clay, without lamination or bedding planes, commonly without inclusions of any sort, but in at least one locality a number of irregularly rounded pebbles of Chester limestone, from one or two to several inches in diameter have been observed. The summit of this

bed is uniformly, in all localities where measurements have been possible, from 20 to 25 feet above the Yankeetown chert. The exact thickness of the red bed itself, however, cannot often be observed because of the weathering and slumping of the material over the underlying strata, but where the interval immediately above the Yankeetown has best been seen, a series of bluish calcareous shales with plates of limestone extends for several feet above the chert. The actual thickness of the red bed is probably about 12 or 15 feet in the natural outcrops which have been observed, and this thickness is confirmed by the records of several dug wells which have penetrated the stratum. When encountered in well digging the bed is very hard and tough and can be excavated only by the aid of blasting, but when exposed to the weather it rapidly breaks down into a fine red mud. On freshly exposed surfaces in creek banks this red clay first crumbles into angular fragments, usually a fraction of an inch in maximum dimension, and finally breaks down into a fine red mud. The origin of such a bed as has been described, persistent as it is through a distance of at least 30 miles in the Waterloo and Renault quadrangles, is not clear. In its physical characters it closely simulates certain beds of red residual clays, but such an origin for this stratum, occurring as it does conformably in the midst of typical marine sediments, seems to be out of the question. One of the best points to observe this member of the Paint Creek formation, as well as the higher members of the same formation, is the valley of the tributary of Paint Creek, entering from the south, situated about one and one-fourth miles southwest of the village of Ames.

The higher, more calcareous members of the Paint Creek formation, shaly below and passing into firmer limestone beds above, are well exposed in many localities in the Waterloo and Renault quadrangles. In some localities underlain by the limestones of the formation, numerous sink holes are developed in the topography, such a condition being present on the divide immediately west of Ames.

5. Ruma Formation.

General characters. Succeeding the upper limestone member of the Paint Creek formation, is a series of shales the sandstones, rarely if ever more than 40 or 50 feet in thickness. The shales usually predominate, but in all localities where the formation is well exposed, there are important, thin-bedded sandstone layers and some arenaceous shales near the middle of the formation. The more shaly beds are in almost all localities conspicuously variegated, being blue, reddish and purple in color, not unlike some of the shale

beds of the Renault formation. The Ruma formation is the highest formation in the Chester group in Randolph and Monroe counties in which conspicuous variegated shale beds have been observed. In at least one locality a thin limestone ledge, one or two feet in thickness, has been observed in the midst of the Ruma, but the occurrence of limestone in the formation is rare. Excellent and typical exposures of the Ruma formation may be seen in the stream valleys tributary to Horse Creek, west and northwest of the village of Ruma.

6. Okaw Formation.

General characters. The Okaw formation comprises a series of alternating limestones and shales which have an aggregate thickness of from 150 to 200 feet. The valley of the Kaskaskia or Okaw River is excavated through these beds at its junction with the valley of the Mississippi, and excellent exposures of the various members of the formation are present both above and below this point in the Mississippi River bluffs.

At least four, and perhaps five important limestone members are present in the formation, the uppermost of which is the quarry ledge at the Penitentiary. These limestones vary greatly in color from dark blue to gray and nearly white, the weathered surfaces of some strata being buff or brownish. The texture also varies from a very compact limestone to more or less coarsely crystalline beds, with some distinctly oolitic zones. One very persistent oolitic bed nearly white in color, occurs about 50 or 60 feet from the base of the formation. Most of the limestone beds are free from chert, although some cherty horizons are present in the formation. These calcareous members of the formation sometimes consist of rather massive beds of limestone, but more frequently the individual beds are a foot or less in thickness, separated by thin shaly partings.

The shale members of the Okaw formation, occupying the intervals between the limestones, are soft and easily acted upon by the weather, and consequently are rarely well exposed. Where they have come under observation in certain ravines, these shales are commonly blue or gray in color, rarely with a slight admixture of red or purple, which is such a conspicuous feature of some of the lower shale horizons.

The highest member of the Okaw, immediately above the quarry ledge at the Penitentiary, consists of calcareous shales with interbedded thin limestones, and locally a sandstone ledge 10 to 12 feet in thickness is present.

7. Menard Formation.

General characters. The Menard limestone is a conspicuous formation, well exposed in the middle portion of the bluffs at Chester. One of the best exhibitions of the formation is to be seen immediately southeast of the hospital for criminal insane at Menard. In its typical expression this limestone is thin and moderately thick bedded, the bedding planes being undulating and hummocky in character, with thin shaly partings. In places these shaly partings become thicker and shale beds of as much as five feet or more in thickness are present. The basal portion of the formation, where it is exposed, is seen to be shale, as much as 35 feet of fine, blue clay shale being present in some localities between the top of the Okaw and the typical limestone beds of the formation. The lithologic character of the limestone of the formation differentiates the Menard rather sharply from most of the limestone strata of the Okaw. The limestones of the lower formation are commonly more or less crystalline or granular, often crinoidal, sometimes oolitic and usually free from chert. In the Menard the limestones are nearly always close textured, fine grained rocks, and not infrequently carry a small amount of chert; they are brittle and often exhibit a conchoidal fracture. Because of the difference in texture the weathered surfaces of the Menard are commonly smooth, those of the Okaw usually being more uneven. The color of freshly broken surfaces of the Menard is usually a bluish gray while that of the Okaw limestone is commonly lighter, some beds being nearly white. Locally there are more crystalline strata in the Menard which closely resemble certain of the Okaw beds, but such strata are always of limited thickness and usually occur in the higher portion of the formation. The thickness of the formation is about 80 feet. It is well exposed in the Mississippi River bluffs from Chester to Rockwood, and the valley of Mary's River, at its mouth, is excavated entirely through this formation into the higher beds of the Okaw.

8. Palestine Formation.

General characters. The formation succeeding the Menard is arenaceous throughout in most sections, consisting in part of heavy beds of sandstone suitable for building purposes, and in part of thinly bedded, ripple marked sandstones or arenaceous shales. Locally, however, more argillaceous shales are well developed in the formation. The formation is present in the higher portion of the bluffs at Chester, and has been quarried at several points for building stone. The buildings of the penitentiary at Menard are constructed of

this rock. The thickness of the formation is about 75 feet, and it seems to lie with some degree of unconformity upon the subjacent Menard limestone. The name of the formation is derived from Palestine township, in Randolph County, where excellent exposures may be seen.

9. Clore Formation.

General characters. The highest formation in the Chester group in Randolph County, is a limestone immediately overlying the Palestine sandstone. The greatest thickness actually measured in Randolph County is 30 feet, but it certainly exceeds this thickness in many localities. The passage beds from the underlying sandstone to the Clore limestone, consist of arenaceous and calcareous shales, with some beds of limestone occupying, in places, an interval of as much as 25 feet below the more continuous limestone strata. The lithologic characters of the limestone beds are variable, some being thin bedded and almost shaly, others being similar to the Menard in texture and hardness, but usually darker in color, while others are more granular or crystalline. Some shale beds are included in the formation.

The Clore limestone caps the summits of the hills upon which the city of Chester is built, and it outcrops in the heads of several of the ravines adjacent to the town. The formation also caps other of the higher hills east and northeast of Chester exposures being present in the heads of the ravines on the southwest side of the high ridge extending from Clore school to the Randolph County Farm. The most extensive exposures which have come under observation are in Bremen township of Randolph County, about two miles northeast of the village of Bremen, where a small anticlinal flexure brings this limestone to a lower elevation and its surface outcrops spread out on either side of Little Mary's River.

(1) Proc. Amer. Ass. Adv. Sci., vol. 11, pt. 2, p. 5. (1858).

(2) Trans. Albany Inst., vol. 4, p. 2 (1858); Geol. Surv. Iowa, vol. 1, pt. 1, p. 107 (1858).

(3) Trans. St. Louis Acad. Sci., vol. 2, pt. 1, p. 189 (1863); Geol. Surv. Ill., vol. 1, pp. 350-455 (1866).

(4) Geol. Surv. Ill., vol. 1, pp. 77-83, 284-292, 305-308 (1866).

(5) U. S. G. S., Prof. Paper, No. 36, pp. 24, 36-66. (1905).

(6) Trans. St. Louis Acad. Sci., vol. 1, p. 406 (1859).

(7) This is not a published statement, but a verbal statement made in the course of a discussion of the problem with the writer.