University of Kentucky

College of Arts and Sciences

KENTUCKY GEOLOGICAL SURVEY

ARTHUR C. McFARLAN, Director

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Some Old Chester Problems – Correlations of Lower and Middle Chester Formations of Western Kentucky

By

A. C. McFarlan, D. H. Swann, F. H. Walker, and Edmund Nosow

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LETTER OF TRANSMITTAL

March 17, 1955

Dean M. M. White
College of Arts and Sciences
University of Kentucky

Dear Dean White:

The Kentucky Geological Survey is publishing Bulletin No. 16, *Some Old Chester Problems—Correlations of Lower and Middle Chester Formations of Western Kentucky,* by McFarlan, Swann, Walker, and Nosow. The study was undertaken in an attempt to settle problems of stratigraphic correlations. There were certain differences in the conclusions arrived at by workers on the outcrop and those engaged in subsurface work in petroleum geology. It is an attempt to eliminate these differences.

The study was also necessary to put in order the stratigraphic framework for studies being carried on dealing with the industrial limestones of the State.

Respectfully submitted,
ARTHUR C. MCFARLAN, *Director*
Kentucky Geological Survey

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ILLUSTRATIONS

Some Old Chester Problems – Correlations of Lower and Middle Chester Formations of Western Kentucky

A. C. McFarlan, D. H. Swann, F. H. Walker, and Edmund Nosow[1]

The problems of Ste. Genevieve and Chester correlations in western Kentucky and adjoining states were pretty well settled in the works of S. Weller, M. Weller, Sutton, Butts, Ulrich, Stouder, and Malott in the past several decades. An approach to agreement was attained by the late 30's. This status had no more than been attained when the picture was again questioned by Dana and Scobey (1941) as a result of their subsurface studies, followed by the work of Swann and Atherton (1948) and others. Correlations established by work around the rim of the Western Coal Basin (Eastern Interior Basin) did not agree with those established by subsurface methods across the Basin from the western edge in Kentucky, Illinois, and Missouri to the eastern rim in Indiana and Kentucky.

Prominent among conflicting views were those concerning the Big Clifty-Cypress and the Sample-Bethel relationships. These are shown below (fig. 2).

Obviously someone was in error, and there were too many experienced stratigraphers on both sides of the fence to take either view lightly. In 1949 the Kentucky Geological Survey undertook a study of the State's limestone resources and also quadrangle work in the region around Hopkinsville. In this work an effort was made to restudy the stratigraphy of parts of the Chester in an effort to find in outcrop a justification (or lack thereof) for the correlations established in the subsurface. D. H. Swann and W. D. Chawner were invited to join the writers in three very satisfactory field conferences in 1952 and 1953, in which sections from Breckinridge County to Caldwell County were studied. Swann's (1948) detailed subsurface studies are well known. Chawner has an intimate knowledge of these beds from extensive surface and subsurface work between Edmonson and Christian Counties. His studies included cores as well as samples.

There is a considerable gap between sections in Grayson and

[1] Acknowledgment is made to W. D. Chawner of the Carter Oil Company who was an active participant in the work. H. W. Settle, formerly with the Kentucky Geological Survey, assisted in the early part of the work.

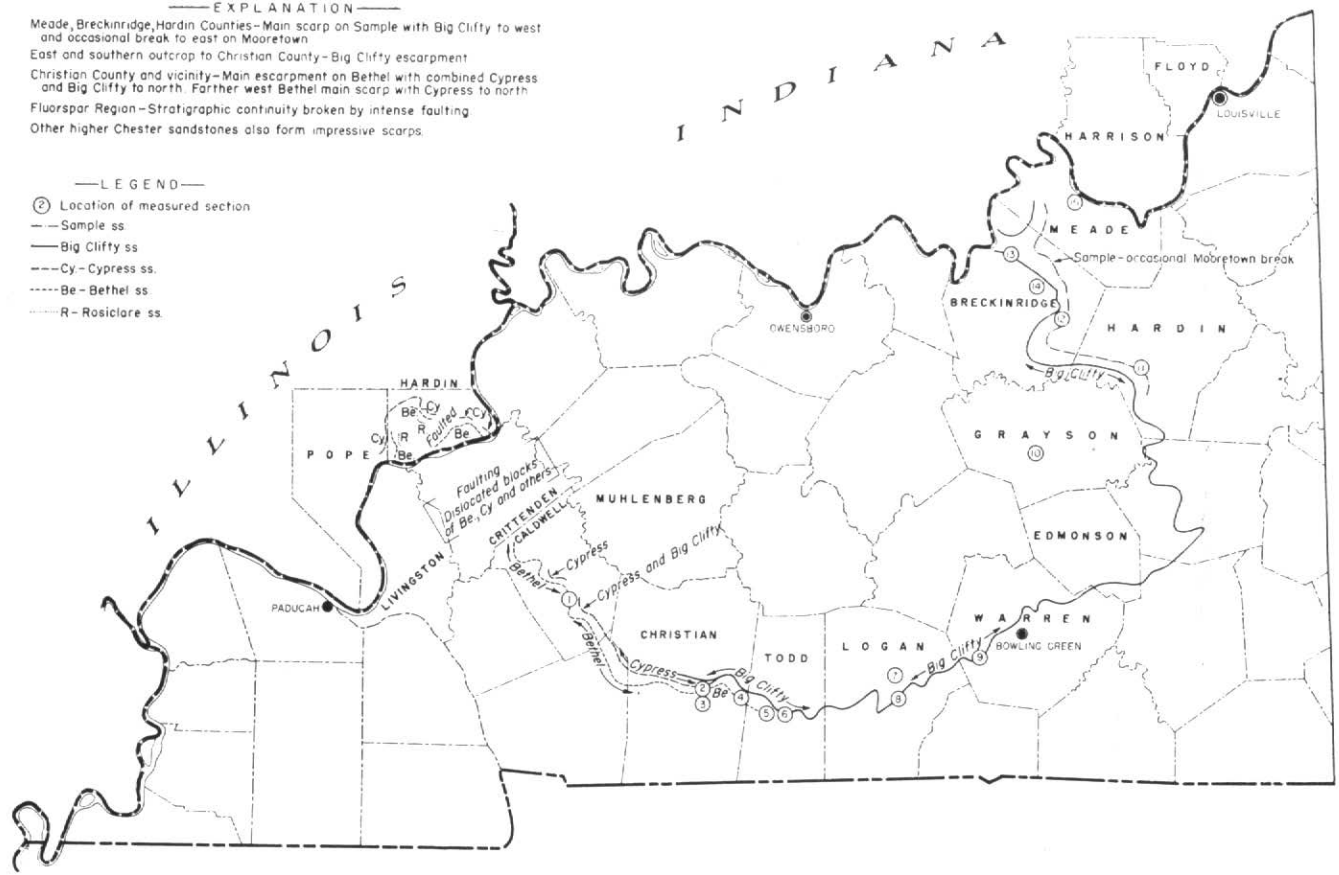

Fig. 1. General geographic relationships and composition of Dripping Springs ("Lower Chester") Escarpment.

Warren Counties, but correlations between these counties seem satisfactory, the sections to the north tying in quite adequately with those to the south.

The problems of correlation have resulted mainly from the wedging of lower Chester sandstones from both north and west toward the Bowling Green region (Logan, Warren, and Edmonson Counties), leaving an unbroken sequence of Ste. Genevieve and lower Chester limestones there. The sandstone capping the Dripping Springs Escarpment around the Western Coal Field, from Meade County to Crittenden and Livingston Counties in the fluorspar region, has commonly been recognized as Cypress. It is this apparent continuity and the related correlations that were made questionable by subsurface work.

Primarily two problems were involved:

I. *Sample sandstone–Bethel sandstone relationship.* The problem is an old one. Butts and Ulrich did not regard these sandstones as equivalent, and they correlated the Bethel with the Aux Vases sandstone of western Illinois. On this basis the limestone between the Bethel and Cypress is Renault-Paint Creek instead of Paint Creek. In support of the contention that the Bethel and Sample were not equivalent, Butts (1929) called attention to:

(a) the occurrence of "*Campophyllum gasperense*"[1] associated with large *Pentremites* of the *Pentremites pyriformis* and *P. godoni* types, and also distinctive large crinoid stem plates in the limestone below the Sample sandstone in Meade and Breckinridge Counties and vicinity.

(b) a faunal zone of the same character above the Bethel sandstone in the western area of outcrop.

This "*Campophyllum*" zone was regarded as one of the best horizon markers in the Mississippian and was recognized as consistently present not only throughout much of Kentucky but as far south as Alabama. It was pre-Sample but post-Bethel.

In 1932 Sutton and Weller announced the discovery of this coral below the Bethel sandstone at a locality in Christian County, and they also found it below the horizon of the Bethel sandstone (instead of above only, as heretofore recognized) in northwestern Warren County.

[1] *Campophyllum gasperense* Butts is now referred to *Caninia veryi* (Greene). *Productus inflatus* McChesney belongs to that group of productids now classified as *Dictyoclostus*. These are valid nomenclatural changes, but because of the frequent use of the old names in the numerous papers on the Chester, they are used in this paper and placed in quotation marks.

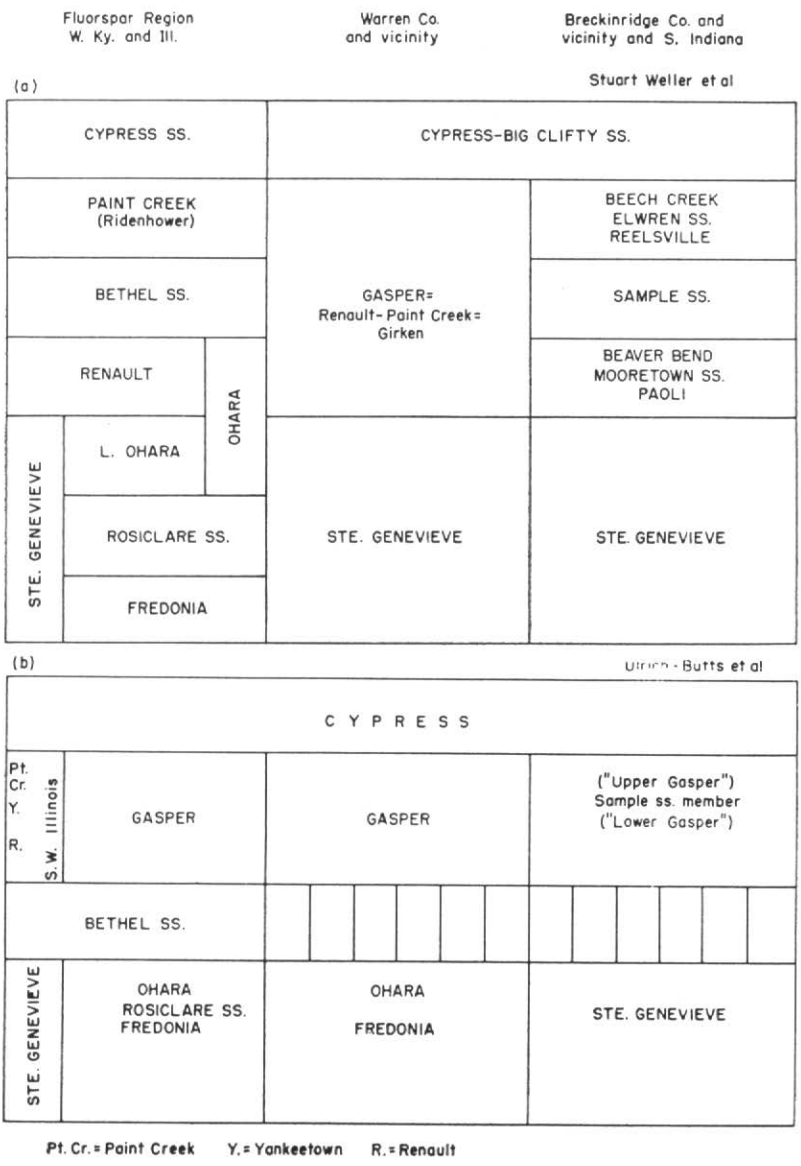

Plate 1. LOWER CHESTER CORRELATIONS

(a) After Stuart Weller and others.

(b) After Ulrich, Butts, and others.

The main differences are:

1. Weller correlated the Bethel with the Sample sandstone, whereas Ulrich and Butts regarded it as pre-Sample and occupying the position of the Aux Vases.
2. Ulrich placed the Ohara in the Ste. Genevieve. Weller divided it into an upper Ohara=Renault and a lower Ohara=Ste. Genevieve.

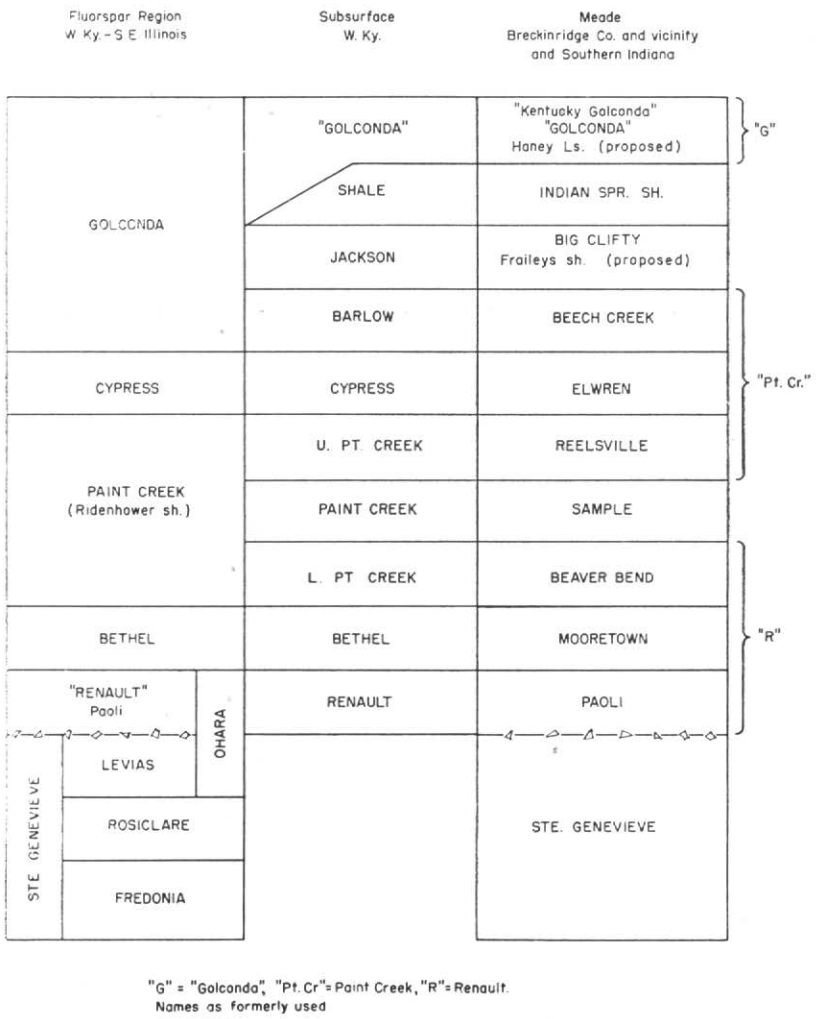

Fig. 2. Lower and Middle Chester correlations after Swann and Atherton.

The essential differences from the standard correlation set up by Stuart Weller are:

1. Bethel sandstone = Mooretown instead of Sample.
2. Cypress sandstone = Elwren instead of Big Clifty ("Kentucky Cypress").
3. Sample sandstone finds its equivalent in the middle Paint Creek instead of above it.
4. Beech Creek = Barlow limestone is lower Golconda instead of upper Paint Creek.
5. Big Clifty = Jackson sand = middle Golconda instead of Cypress.
6. "Indiana Golconda" (or "Kentucky Golconda") is the upper Golconda of Illinois and westernmost Kentucky.

The occurrence of "*Campophyllum gasperense*" thus lost much of its significance, though in the light of the present findings it is again significant.

Stouder (1941) found "*Campophyllum gasperense*" consistently present in the Beaver Bend and Paoli limestones in Grayson County and vicinity, but in no case did he find it above the level of the Sample sandstone. At Girken, in Warren County, he found "*Campophyllum gasperense*" 56½ feet below the top of the Beech Creek, which would be the horizon of the Beaver Bend.

Stouder (1938 and 1941) regarded the Sample as the Bethel. In Meade and Breckinridge Counties and vicinity he recognized a faunal zone of the upper Beaver Bend (below the Sample) characterized by the appearance of many typical *Pentremites pyriformis* and a limited number of *P. godoni*. It was a zone that could be traced southward into the Bowling Green region. The Elwren sandstone continues southward to Bowling Green as a thin shale.

In works by Dana and Scobey (1941), Swann and Atherton (1948), and others, the subject of Chester correlations again came to the fore. Swann and Atherton correlated the Bethel sandstone with the Mooretown ("Middle Renault") of Indiana and adjoining parts of Kentucky, instead of with the Sample.

On this basis the massive fine-grained sandstone forming the central part of the "Paint Creek" (Ridenhower) near Rosiclare, Hardin County, Illinois (Weller, Grogan, and Tippie, 1950, p. 63), and in Livingston and Crittenden Counties, Kentucky, represents the Sample. In Caldwell County it is represented by the shaly beds between the massive upper and lower limestones of the "Paint Creek" (S. Weller, 1923, and J. M. Weller and Sutton, 1940, p. 828). In the subsurface of Muhlenberg, Hopkins, northern Christian, and extreme northwestern Todd Counties it is represented by shaly beds and occasional sandstone. No clastic beds occur at this level over most of northern Todd County or in Logan and Warren Counties. The Renault of Crittenden, Caldwell, and Christian Counties becomes the Paoli (or "Lower Renault") of the Indiana-Kentucky section. This correlation is similar to that advocated by Ulrich and Butts in that they regarded the Bethel as pre-Sample but placed it below the Paoli, at the horizon of the Aux Vases, instead of at the horizon of the Mooretown.

The correlation of Bethel with Mooretown is substantiated by the present surface investigation.

II. *Cypress-Big Clifty relationship and age of the Beech Creek.* Swann and Atherton (1948) questioned the validity of the Kentucky "Cypress" (east and south side of the Basin), earlier known as the Big Clifty sandstone (Norwood, 1876). (The latter name comes from a

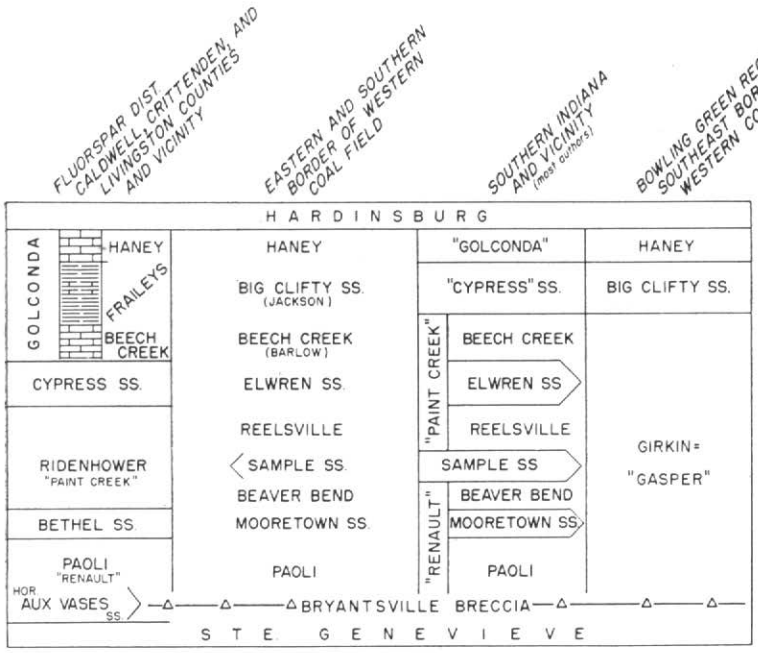

Fig. 3. Stratigraphic sections and correlations as used in this report. As indicated in the following pages, the correlation of (a) the Bethel and Mooretown sandstones and (b) the Cypress and Elwren sandstones, changes the concept of the Renault, Paint Creek, and Golconda as formerly used in Meade and Breckinridge Counties, Kentucky, and in Indiana (indicated in quotes).

community and creek of that name in Grayson County.) They correlated the Big Clifty with the drillers' Jackson sand and placed it in the Golconda. The Beech Creek limestone, commonly recognized as "Upper Paint Creek" in outcrop, was identified as the Barlow limestone of the subsurface and placed in the lower Golconda of the type region of southeastern Illinois. The "Golconda," as recognized in Indiana and much of Kentucky, thus involved only the upper Golconda of Illinois.

Butts (1917, p. 92), though correlating the Big Clifty and Cypress sandstones, had nevertheless realized that only the upper part of the Golconda was represented in the "Golconda" of west-central Kentucky. Ulrich (1917, p. 58, especially footnote) had qualms about the Cypress-Golconda relations. But he did not recognize the Beech Creek at the base of the Golconda in its type area; in fact, it is likely that none of the early workers even saw it there. He did recognize that the shales in the lower to middle part of the Illinois Golconda graded eastward into sandstone (Ulrich, 1917, pp. 74, 94), but he still

believed in the continuity of the Cypress-Big Clifty of the Dripping Springs Escarpment.

The current study has justified the belief that the Beech Creek of Indiana-Kentucky continues into the basal Golconda of westernmost Kentucky and Illinois and underlies the westward-shaling Big Clifty sandstone.

In following the Chester in outcrop one may note certain horizons that are consistent in lithology or fossil content, or both. The essential features of the more marked of these, particularly those of the lower Chester, are outlined below. There has been general agreement on the Hardinsburg, Glen Dean, and higher formations.

A. Haney chert zone:

The Indiana-Kentucky "Golconda," for which the name Haney limestone is proposed below (p. 18), carries a light-gray blocky chert that is distinctive. This cherty zone may be traced southward from the Ohio River counties around the east and south side of the Basin to Todd County.

B. Vienna chert zone:

The chert zone of the Vienna limestone higher in the section may be recognized along the entire border of the Western Coal Field in Kentucky and into Illinois. Along the east side of the Basin it is in the lower part of the Leitchfield and Buffalo Wallow formations. This chert should not be confused with that of the Haney.

C. Beech Creek–large crinoid and "*Productus*" *inflatus* associations:

The Beech Creek limestone of Indiana is characterized by a large crinoid stem, as much as an inch in diameter and of uncertain identity, which is helpful in tracing the formation as far south into Kentucky as the Sinking Creek section of Breckinridge County. Farther south the big crinoid is not known at this level. However, "*Productus*" *inflatus* is moderately abundant in the Indiana Beech Creek and becomes very abundant from Sinking Creek southward, where this horizon is Butts' (1917) "*Productus*" *inflatus* zone at the top of the "Gasper." This "*Productus*" *inflatus* zone may be carried south and west, just below the Big Clifty sandstone, to Butler and north-central Logan Counties (Russellville vicinity). Throughout this extent the Big Clifty sandstone forms and caps the Dripping Springs Escarpment. With topographic expression and with the underlying "*Productus*" *inflatus* zone the continuity

of this sandstone body is reasonably certain. The escarpment continues to the west but is differently constituted in the fluorspar region.

D. Reelsville-*Agassizocrinus cf. laevis* zone:

Throughout the entire belt from Meade and Breckinridge Counties to the Kentucky fluorspar region the introduction of *Agassizocrinus cf. laevis*[1] in large numbers apparently marks a definite stratigraphic plane. It first appears in the Reelsville limestone just above the Sample sandstone and occurs a short distance above the Bethel in the western area. There is a small species with shallower base below the Mooretown at Russellville, Logan County, and the same has been observed in the Beaver Bend limestone of the Sinking Creek section in Breckinridge County. Malott (1952) lists *Agassizocrinus ovalis* at the top of the Beaver Bend in Indiana, and this is probably the small one referred to above. This zone of the abundant *Agassizocrinus cf. laevis* above the Sample is a useful one, and with it as a basis an underlying zone of shale and thin-bedded limestone in the southern Pennyroyal of Warren, Logan, and Todd Counties is regarded as the Sample equivalent.

E. Beaver Bend-large *Pentremites* association:

Stouder (1938, 1941) recognized a well marked faunal zone in the Beaver Bend limestone of Meade, Breckinridge, and Hardin Counties, characterized by the development of large typical *Pentremites pyriformis* associated with a more limited number of *Pentremites godoni*. He regarded *P. godoni* to be more typical of the Reelsville, but it is the experience of the authors that *P. godoni* in places is equally as common as *P. pyriformis* in the Beaver Bend, beneath the Sample. As indicated below the large crinoid stem (see also C and F) has been recognized at this level along the southern border of the basin.

F. Western pre-Bethel–large crinoid and *Pentremites* association:

In Caldwell and Crittenden Counties a large crinoid stem, apparently the same as that in the Beech Creek of Indiana, marks a zone beneath the Bethel sandstone, where it occurs in a *Pentremites* association similar to that just noted in the Beaver Bend. The correlation of this pre-Bethel fossil association with the Beaver Bend association has in recent years been the most cogent argu-

[1] Only the fused infrabasals and separate other plates have been found, so that precise identity is not known. The base, though, has the general proportion of *A. laevis,* and this identification is tentatively accepted. Springer (Springer, Frank, 1926, Unusual Forms of Fossil Crinoids, U. S. Nat'l. Mus. Proc., vol. 67, art. 9, pl. 15, fig. 22) figures an *Agassizocrinus* base referred to as an unidentified species from the Gasper of Alabama which is essentially identical with our species.

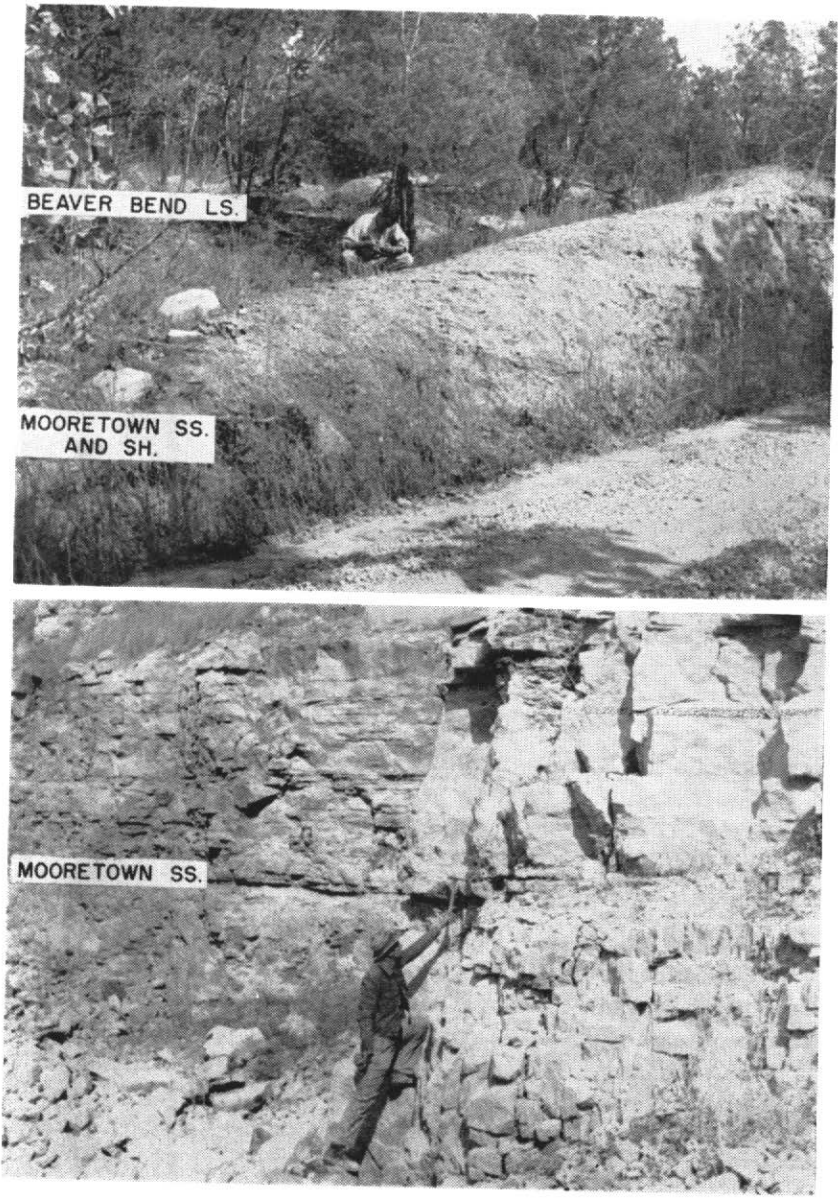

Plate 2. MOORETOWN SANDSTONE HORIZON

(See opposite page)

ment for the surface Sample-Bethel correlation. It was apparently strengthened in the authors' early field conferences by three developments: (1) the addition of the large crinoid to the Beaver Bend association in the Spurrier Mill (Grayson County) and the Big Sinking Creek (Breckinridge County) sections; (2) the occurrence of the large crinoid and associated forms above the Mooretown sandstone lenses north of Russellville (Logan County), where bed-by-bed tracing into the Russellville quarry placed the large-crinoid zone known in that quarry clearly in the Beaver Bend; and (3) extension of the pre-Bethel large-crinoid association eastward beneath the easternmost Bethel outcrop, then recognized at Shop, Todd County, only 18 miles west of Russellville.

However, this apparent correlation of the pre-Bethel and the Beaver Bend (pre-Sample) large crinoid-*Pentremites* associations was destroyed during the last field conference in the fall of 1953 by the discovery of this association at levels both above and below the horizon of the Mooretown sandstone in the vicinity of Russellville (fig. 7, p. 30) and Bowling Green (fig. 5, p. 28). To the west it had been known and was found both above and below the Bethel sandstone.

It is thus clear that the large crinoid occurs at three levels in the lower Chester:

(1) In the upper Paoli from Bowling Green westward to the fluorspar country. This is the "large crinoid" zone underlying the Bethel sandstone.

(2) Upper Beaver Bend in Breckinridge and Grayson Counties

Plate 2.

Fig. 1. A lense of Mooretown sandstone in the roadside exposure. This exposure is 2/5 mile from Ky. Hwy. 105, on a side road which intersects the State route 3½ miles northeast of Russellville.

(d) Limestone.
(c) 15 feet—shale and sandstone (photo).
(b) 6 feet—limestone conglomerate weathering into loose rubble.
(a) Limestone with *"Campophyllum gasperense."*

Another excellent section is exposed on a low hill to the west of the road 2 miles north of the Russellville Quarry. It is at the southwest corner of the Homer quadrangle.

(d) Limestone with the large crinoid stem (CR.), *Pentremites pyriformis* and *P. godoni.*
(c) 12 feet—shale and coarse-grained slabby sandstone.
(b) 1 foot (±)—limestone conglomerate.
(a) Limestone.

These two local lenses along with those at Elkton and Shop are significant in tracing the Mooretown into the Bethel. The presence of the conglomerate in the Russellville Quarry, as well as in the above two locations, is quite helpful.

Fig. 2. Elkton Quarry, Todd County, Kentucky. One foot of sandstone marks the Mooretown-Bethel horizon.

and again above the horizon of the Bethel sandstone in the southern Pennyroyal westward to the fluorspar region. This occurrence has been observed by Butts (1929).

(3) Beech Creek limestone in Indiana and at least as far south as the Big Sinking Creek section of Breckinridge County, Kentucky.

In all cases there is a similar *Pentremites* association. It may be added also that similar associations of large crinoid stems are known from the Golconda and Glen Dean, so that the use of this fossil must involve considerable discretion. Its occurrence may be a matter of recurring environment, or it may well be a matter of mechanical sorting on the sea floor, so that it occurs only in the coarser fragmental crinoidal rock.

G. Paoli and Beaver Bend "*Campophyllum gasperense*" zone:

The first compound coral known in the Chester was described by Greene in 1904 as *Lithodrumus veryi* and redescribed as *Campophyllum gasperense* by Butts in 1922. In both his 1917 and 1922 reports, Butts used it as an important stratigraphic marker, and much of his reluctance to regard Bethel as Sample was based on its occurrence. In the area of Breckinridge County and adjoining counties, where the Sample sandstone is typically developed, this coral occurs throughout those beds of the lower Chester beneath the Sample. It is most abundant in the Beaver Bend (Stouder, 1938). On the other hand, in the counties of Bethel sandstone outcrop in the fluorspar region, its occurrence was known only above the Bethel (Butts, 1929). Hence the difficulty in correlating Sample with Bethel. Sutton and Weller (1932), however, later found "*Campophyllum gasperense*" below the Bethel in Christian County and again at the equivalent level in the lower Gasper of Warren County.

The authors find this coral, as stated by Stouder, Butts, and others, in both the Paoli and Beaver Bend limestones of Meade, Breckinridge, and Grayson Counties and vicinity. It is restricted to these beds below the Sample sandstone, but, as noted, its occurrence brackets the Mooretown sandstone, occurring both above and below it. Also, the authors find it abundantly developed both above and below what they have regarded as the Mooretown equivalent in Warren and Logan Counties.

As indicated by Butts it is one of the best marked faunal zones of the Mississippian, but with a modified concept of its occurrence.

(a) In the region of Meade, Breckinridge, and Grayson Counties it occurs in both the Paoli and Beaver Bend, bracketing the Mooretown sandstone.

(b) In the region of the Bethel sandstone (fluorspar region) it occurs both above and below that sandstone, thus in the upper Paoli and in the lower Paint Creek (Beaver Bend). It brackets the Bethel.

On this basis this coral is one of the fine and consistent Mississippian markers.

The correlation of the Cypress (Engelmann, 1868) and the Big Clifty (Norwood, 1876) sandstones was accepted for years. Much of the strength of this correlation in Kentucky lay in the apparent continuity of this sandstone capping the Dripping Springs Escarpment from Meade and Breckinridge Counties to the western counties of the fluorspar region. The makeup of this escarpment varies regionally. In the region of Meade and Breckinridge Counties it is a "double step," with the Sample sandstone forming the lower bench. The locally massive Mooretown sandstone also leaves its imprint on the landscape.

To the south and on westward to Christian County there is a simple escarpment with a Big Clifty ("Cypress") cap. From Christian County westward the Bethel sandstone makes the major escarpment overlooking the Pennyroyal, and the Cypress forms a minor one behind. In the fluorspar region the continuity of the escarpment is broken by the complex faulting of that area.

The Big Clifty is the name under which the sandstone capping the Dripping Springs Escarpment was originally designated in Grayson County and vicinity. The Cypress sandstone was traced across from Illinois into Crittenden, Livingston, and Caldwell Counties. As interpreted in the subsurface, instead of being continuous and correlative, the Big Clifty as a sandstone wedges out to the west and overlies an eastward-feathering wedge of the Cypress sandstone. Between the two feathered edges is the Beech Creek limestone-Barlow lime. This has been the upper Paint Creek of Malott and others in Indiana and the lower Golconda of subsurface workers.

As indicated earlier there is a continuity of the Big Clifty sandstone underlain by the "*Productus*" *inflatus* zone as far south and west as Logan and Butler Counties, and there can be little doubt as to the identity of the Big Clifty sandstone throughout this eastern and south-central margin of the coal field. Similarly, the Cypress can be followed almost continuously from Illinois eastward into Caldwell County. It is in the region of Christian and Todd Counties that any discrepancy in earlier correlation would be found.

Possible complications of the nature outlined above were suggested by Ulrich (1917, p. 94) in a described section 3 miles east of Scottsburg, in Caldwell County, in which a poorly exposed 7- to 8-foot

limestone split his 178-foot Cypress sandstone section 50 feet below the top. The upper 50 feet of sandstone was referred to as ". . . perhaps belonging to the Golconda." It is the overlapping and westward-feathering Big Clifty. The limestone is the Barlow-Beech Creek.

As indicated on the stratigraphic chart, in an area a few miles north of Fairview on the western edge of Todd County, the 110-foot section of "Cypress" is broken by a 2- to 4-foot fine-grained, hard limestone with a 30-foot succession of sandstone and shale below. This lower 30 feet is regarded as Elwren, and the shales in the upper part of it have the usual red and green colors of the Elwren. It is the eastward feathering edge of the Cypress.

Obviously, a new name is needed for the "Golconda" as recognized east of Todd County and north into Indiana, and the name Haney limestone is proposed to fill this need.[1] The abandoned name Big Clifty (Norwood, 1876) returns to use for the sandstone that underlies the Haney and caps the Dripping Springs Escarpment from Todd County eastward and northward to the Ohio River. Because the Big Clifty is represented by little or no sandstone in the westernmost part of the Kentucky outcrop and subsurface, in the Illinois outcrop, and in most of the Illinois subsurface, the name seems unsuited in these areas, and the name Fraileys shale is proposed for the interval between the Haney and Beech Creek limestones wherever sandstone is insignificant or lacking. The Golconda section thus, from bottom up, is Beech Creek, Fraileys or Big Clifty, and Haney.

The type section for both the Haney limestone and the Fraileys shale is the easternmost exposure of the Golconda in Illinois, on the south slope of a hill along the west edge of the NE¼ SE¼ sec. 9, T. 12 S., R. 10 E., Cave in Rock (15-minute) quadrangle, Hardin County, Illinois. The outcrop faces the Ohio River 4 miles upstream from Cave in Rock, through a gap in the bluff made by a branch of Honey Creek not named on the topographic map but known locally as Haney Creek. The limestone is named for this creek. The shale is named for an abandoned village a mile to the northeast, known variously as Fraileys, Fraileys Landing, or Fraileys Store.

The outcrop is natural except for a few pits dug in limestone beds of the Fraileys to prospect calcite veinlets and traces of fluorspar. Though a number of quarries and a few natural outcrops in Illinois, Kentucky, and Indiana show the "Kentucky (and Indiana) Golconda," "Upper Golconda," or Haney limestone to better advantage, this outcrop is unique in eastern Illinois in showing the stratigraphic relations of all three Golconda units.

[1] This and the description of the Haney limestone and Fraileys shale in their type area is from a manuscript by D. H. Swann. Swann wishes to thank Elwood Atherton and Donald Saxby, his colleagues on the Illinois State Geological Survey staff, for aid in describing the Haney limestone and Fraileys shale.

HANEY—FRAILEYS TYPE SECTION

NE¼ NE¼ SE¼ sec. 9, T. 12 S., R. 10 E., Hardin Co., Ill.

Hardinsburg sandstone

W. Sandstone, very light gray, fine to medium, angular due to secondary enlargement of grains, in 1- to 5-foot beds, weathering to gray or yellowish-gray subrectangular blocks ..... 18′

(The total thickness of the Hardinsburg here is about 90 feet.)

Haney (upper Golconda) limestone (35′ 6″)

Covered ..... 5′

(As noted by Workman, 1940, p. 816, and Swann and Atherton, 1948, pp. 275-277, soft, gray, partly fossiliferous shale with occasional streaks of green shale, red shale, and brown dolomite is present discontinuously at this position above the main body of upper Golconda limestone, but rarely crops out.)

V. Limestone, light-gray to light olive-gray, coarsely crystalline, fossiliferous with a few silicified fossils, crinoidal, slightly cross-bedded, with the 8-inch to 2-foot beds fusing at some spots to form a massive bed as thick as 5 feet ..... 7′

U. Shale and limestone; the shale gray, calcareous, very fossiliferous, and the limestone moderate light-gray to yellowish-gray, shaly, fossiliferous, with coarse fossil debris in a fine granular matrix. In beds 1 to 4 inches thick which weather into slabs masking the shale. There is about as much shale as limestone in this interval, but exposure is largely limited to loose limestone slabs ..... 11′

T. Limestone, moderate light-gray, yellowish-gray, and light brownish-gray. Upper half argillaceous, with 2- to 8-inch beds; lower half in 6-inch to 2-foot beds and purer, except for increase in argillaceous content in bottom foot. Mainly coarsely crystalline and fossiliferous, with some oolite streaks 4 to 6 feet above base ..... 12′ 6″

Fraileys (middle Golconda) shale (94′)

S. Shale, dark-gray, fossiliferous, with very thin (up to ½-inch) discontinuous limestone streaks ..... 3′

R. Limestone, yellowish-gray, extremely argillaceous, somewhat silty, with scattered light-gray fossil fragments in a moderate yellow, fine-grained matrix ..... 1′

Q. Shale, medium-gray to faintly yellowish- or greenish-gray, sparingly fossiliferous ..... 1′

P. Mudstone, non-fissile, yellowish-gray to moderate yellow, very calcareous, but with flecks of non-calcareous, greenish-gray clay, unfossiliferous, firm ..... 1′ 8″

O. Shale, slightly calcareous, medium-light gray to greenish-gray, fossils uncommon ..... 7′

(A small amount of red shale is recorded at this position nearby.)

N. Siltstone, shaly, in part calcareous, medium-gray, no fossils noted ..... 10′

M. Shale, slightly calcareous, light-medium gray to greenish-gray, fossils uncommon except for several bryozoa including **Archimedes** in basal few inches ..... 11′ 6″

L. Limestone, argillaceous, light-gray to yellowish-gray, weathering to grayish-orange with concentric bands of dark yellowish-orange on the surface of many slabs, in 2- to 6-inch beds, very fossiliferous, bryozoa common, numerous **Archimedes** with attached fronds ..... 3′

K. Shale, slightly calcareous, medium-gray, fossils uncommon except at very base ..... 10′ 6″

J. Limestone, light olive-gray, composed largely of light-gray fossils (mostly brachiopods) in dark yellowish-orange to dusky-yellow argillaceous limestone or shale matrix; essentially a coquina of brachiopod shells varying in a few hundred feet laterally from a single limestone bed 5 feet thick, to 2 or 3 thin limestone beds with intervening shale, to shale marked from adjacent beds only by greater fossil density ..... 5′

I. Shale, calcareous, medium-gray, weathering greenish-gray; contains several fossil streaks that grade laterally into limestone stringers reaching an inch or so in thickness but forming no more than 1 or 2 percent of the unit ..... 21′

H. Limestone, medium-dark gray to olive-gray, pure, hard, sparingly oolitic, fossiliferous, forms topographic bench ..... 1′

G. Shale, gray, calcareous ..... 4″

F. Limestone, grayish-orange to pale yellowish-brown, very fossiliferous, bryozoa common ..... 8″

E. Shale, dark-gray, weathering to light greenish-gray, very fossiliferous, with thin limestone streaks forming 5 to 10 percent of the unit ..... 4′

D. Limestone, medium-gray to light brownish-gray, fossiliferous, largely crinoidal hash, cross-bedded, very irregular in thickness, in 1 to 3 lenses which separately range to 5 feet in thickness, with about 50 percent gray, fossiliferous shale in unit ..... 8′

C. Shale, gray, weathering to light greenish-gray, poorly exposed, with a few ½- to 2-inch very fossiliferous dark limestone lenses forming less than 10 percent of the unit ..... 5′

Beech Creek (lower Golconda) limestone (1′ 6″)

B. Limestone, slightly argillaceous, dark-gray approaching grayish-black, very hard, forming a single 16- to 19-inch bed, weathering to rounded dark-brown cobbles ..... 1′ 6″

Cypress sandstone

Covered. Some very fine to fine, light-brown sandstone float toward the base ..... 18′
(The covered rocks are known to consist largely of gray sandy shale with some beds of greenish siltstone.)

A. Sandstone, light-gray to yellowish-gray, weathering to light-brown, fine to medium, porous, partly ripple-marked and partly cross-bedded ..... 20′

The Cypress is 100 to 120 feet thick in this region.

The Haney is somewhat thin at this outcrop, the Fraileys somewhat thicker than average. The upper shale unit of the Haney reaches a maximum of 30 to 40 feet in thickness but occurs only as sporadic remnants beneath the pre-Hardinsburg unconformity. The main Haney limestone unit with minor shale interruptions is typically 40 to 50 feet thick, with extremes of 20 to 70 feet along the south-central border of the Illinois Basin. It thins slightly but retains its essential limestone character to the eastern and western outcrops. It both thins and becomes more shaly northward and can hardly be separated from the Fraileys shale in its northern subsurface occurrences. Both oolite and silicified fossils occur in the Haney type section. The oolite increases westward, and a particularly striking oolitic zone has been named the Marigold member in western Illinois (Sutton, 1934). Silicification is more prominent to the east, and an abundance of silicified fossils is perhaps as striking a character of the Haney in Indiana as is the gray blocky chert.

The Haney has been entirely removed by pre-Hardinsburg erosion in two places in the subsurface 40 miles northwest and 85 miles north of the type section. Its absence from another locality in the fluorspar region about 25 miles southwest has been reported (Sutton and Oesterling, 1952, p. 1791, Klondike and Royal areas). However, the Klondike section, Livingston County, Kentucky, which is restored from short segments of faulted diagonal cores, is perhaps open to other interpretations. It differs from all other records in the region in two additional respects. The total Bethel-Cypress section is the shortest recorded in the region, and the thick limestone reported in the middle of the Fraileys shale is unknown elsewhere in Kentucky, Indiana, or eastern Illinois. Several records in the unfaulted Joy area (Livingston County) a short distance north of Klondike are normal in all three respects. The Golconda section at Rosiclare, Hardin County, Illinois, which is represented by a number of good core records, is generalized rather differently by Sutton and Oesterling (1952, fig. 10, "Rosiclare") and by Swann and Atherton (1948, fig. 4, well 7).

The Fraileys is typically 70 to 90 feet thick in southeastern Illinois, with extremes of about 45 to 140 feet. In nearly all of the Illinois Chester area the Fraileys consists largely of shale. Only at the southwestern edge of the Basin do limestones become important, and differentiation of the Fraileys from the Haney limestone here is not easy. The presence of much oolite in the Haney of the southwestern area then becomes of diagnostic importance.

Paleontologically, the thin limestones and the fossiliferous shales of the Fraileys are noteworthy for providing most of the Golconda fossils collected from the type region in Pope and Hardin Counties,

Illinois, and Crittenden County, Kentucky. The massive wing plates of *Pterotocrinus capitalis*, considered the most characteristic Golconda guide fossil, are confined in this region to the Fraileys and are abundant only in the lower half. They have been found in beds D, E, and the lower part of I (refer to type sections).

The very dark Beech Creek limestone of this outcrop is similar to the lower part of the type Beech Creek of Indiana and to the lowest limestone in the Okaw of western Illinois. Fossils, though abundant, do not weather free and are usually seen only in cross section. The Beech Creek is unique among Chester limestones in thickening northward. It is thin and discontinuous in Hardin County, Illinois, but is recognized by geologists familiar with it in about half of the diamond drill holes logged through this position in the county (Swann and Atherton, 1948, p. 278). The only other outcrop known in southeastern Illinois is about a mile east of Homberg, Pope County. Both outcrops were found in 1949 in a search made specifically for this purpose. There are a few blocks of Beech Creek float but no outcrops at the base of the Ohio River bluff at the western edge of sec. 4, T. 13 S., R. 7 E., about 4 miles upstream from Golconda. This is a quarter of a mile upstream from the commonly visited Rock Quarry School section which, as Atherton (1947, pp. 128, 129) indicated, exposes only about the upper three quarters of the Golconda.

The Big Clifty sandstone and the Fraileys shale now appear to be stratigraphic equivalents. As indicated earlier, there is undoubted continuity of the Big Clifty sandstone beneath the "Kentucky Golconda" or Haney limestone and above the "*Productus*" *inflatus* zone (Beech Creek limestone) from the eastern margin of the coal field as far south and west as Logan and Butler Counties. Likewise, there is no doubt of the continuity of the typical Cypress from Illinois eastward into Caldwell County.

Following are a number of sections along the southern belt in Edmonson, Warren, Logan, and Todd Counties, taken from core drill holes. (Courtesy of the Carter Oil Company.) These are also shown on plate 4.

#1 CORE HOLE

Near Rhoda, South-Central Edmonson County, Kentucky

"Golconda limestone" (Haney of this report)		42± feet
0-12	Soil (some weathered limestone).	
12-33	Lost circulation—limestone solution channel.	
33-42	Limestone, tan, light-brown, to gray, coarsely crystalline and somewhat fossiliferous; silty and shaly in part.	

Big Clifty sandstone 48 feet

42-67 Sandstone, white, medium-grained, massive.

67-90 Sandstone, as above, with some gray shale beds.

Beech Creek (Barlow) 8 feet

90-98 Limestone, buff, tan, gray, coarsely crystalline, fossiliferous.

Elwren formation 7 feet

98-105 Limestone, buff to gray, fine-grained, and shale, gray, silty, calcareous.

Reelsville limestone 4+ feet

105-09 Limestone, buff to tan, oolitic, with some coarse-crystalline.

#2 CORE HOLE

Near Anna, North-central Warren County, Kentucky

0-25 Surface clay.

Big Clifty formation 66 feet

25-44 Shale, gray, somewhat silty and arenaceous.

44-45 Limestone, light-brown, fine-grained.

45-48 Shale.

48-88 Sandstone, white, fine- to medium-grained, fresh water, some thin shale beds.

88-91 Shale.

Beech Creek (Barlow) 7 feet

91-98 Limestone, buff or tan to gray and brown, fossiliferous and coarsely crystalline, silty and shaly in part.

Elwren formation 11 feet

98-109 Shale, green and light-gray, with interbedded limestone.

Reelsville limestone 7+ feet

109-16 Limestone, buff to tan, fine-grained to dense.

(T.D.)

On the outcrop, 1 mile south of this core hole, the Beech Creek limestone is exposed in one place with an abundance of "*Productus*" *inflatus*. The limestone is badly decayed and crumbly, and the "*Productus*" specimens weather out beautifully.

#3 CORE HOLE

Near Gasper, Northeastern Logan County, Kentucky

0-5 Surface clay ("**Golconda" limestone** outcrops nearby).

Big Clifty formation 69 feet

5-27 Shale, light- to medium-gray, silty or sandy in part.

27-29 Limestone, light-gray, coarsely crystalline.

29-50 Sandstone, light- to dark-brown, fine- to medium-grained.

50-52 Limestone, cream to dark-brown, coarsely crystalline, fossiliferous.

52-74 Shale, light- to medium-gray, silty and sandy in part, and sandstone, light- to dark-brown, fine- to medium-grained.

Beech Creek (Barlow) 7 feet

74-81 Limestone, tan to light-gray, coarsely crystalline, highly fossiliferous.

Elwren formation 9 feet

81-90 Shale, light-gray to greenish, silty in part.

Reelsville limestone 2+ feet

90-92 (T.D.) Limestone, buff to light-tan, medium- to fine-grained, slightly fossiliferous, slightly chalky.

On the outcrop on Gasper River and tributaries the 2-foot limestone in the Big Clifty section is not evident, but the Beech Creek limestone is present in several places and contains abundant specimens of "*Productus*" *inflatus*. *Pterotocrinus capitalis* fragments are also present in the upper part of the Beech Creek limestone, which is usually sandy as well as coarsely crystalline.

#4 CORE HOLE

Near Russellville, Logan County, Kentucky

Big Clifty sandstone 37 feet

0-10 Soil.

10-15 Sandstone, gray, medium- to fine-grained.

15-37 Sandstone, gray, shaly.

Beech Creek limestone 6 feet

37-43 Limestone, light-gray to brown, mottled, fossiliferous.

Elwren formation 14 feet

43-57 Shale, dark-gray to green.

Reelsville limestone and Beaver Bend limestone 88 feet

57-80 Limestone, tan, dense to oolitic.

80-90 Limestone, same, with traces of chert.

90-105 Limestone, tan, oolitic, slightly sandy in part.

105-10 Limestone, tan, dense, some oolitic, slightly shaly with traces of milky chert.

110-22 Limestone, tan to gray, dense, shaly.

122-26 Limestone, gray and tan, sandy, possibly dolomitic. (May be **Sample** horizon—?)

126-45 Limestone, gray to white, dense to oolitic.

Bethel (Mooretown) shale 9 feet

145-54 Shale, green to gray, slightly sandy.

Renault (Paoli) limestone 54+ feet

154-208 (T.D.) Limestone, white, tan to brown, oolitic to dense, with white, fine-grained dolomite.

#5 CORE HOLE

Near Wilhelmina, Central Todd County, Kentucky

0-15 Soil.

Hardinsburg sandstone 34 feet

15-49 Sandstone, fine, shaly, light-gray, and shale, light-gray.

"Golconda" formation (Haney limestone of this report) 48 feet

49-57 Limestone, fragmental, oolitic, buff, fossiliferous.

57-74 Limestone, sandy limestone, and gray shale.

74-84 Shale, gray, silty.
84-97 Limestone, gray to buff, some mottled, some crystalline.

Big Clifty formation 97 feet
97-108 Shale, gray.
108-11 Sandstone, white to gray, micaceous.
111-19 Shale, gray.
119-24 Sandstone, fine, greenish-gray, calcareous.
124-93 Sandstone, medium- to fine-grained, gray.
193-94 Shale.

Beech Creek limestone 5 feet
194-99 Limestone, gray, mottled.

Elwren formation 25 feet
199-224 Shale, light-green and gray.

Reelsville limestone 11 feet
224-35 Limestone, white, oolitic.

#6 CORE HOLE

Near Fairview, West-central Todd County, Kentucky

Big Clifty formation 31 feet
0-15 Sandy clay soil.
15-25 Sandstone, white, porous, medium-grained.
25-31 Shale, gray, silty.

Beech Creek (Barlow) 5 feet
31-36 Limestone, gray to brown, dense to silty and shaly.

Elwren formation 20 feet
36-45 Limestone, dense, gray, silty, and shale, dark-gray, calcareous.
45-56 Shale, reddish-brown to gray, and limestone, dense, gray, and silty as above.

Reelsville—Beaver Bend 98 feet
56-80 Limestone, brown to gray, dense to coarsely crystalline.
80-90 Limestone, brown-mottled, argillaceous.
90-95 Limestone, white, silty in part, chalky, with white calcite veins.
95-105 Limestone, gray, mottled, argillaceous.
105-12 Limestone, argillaceous, some brown, oolitic.
112-20 Oolite, brown to white, much crystalline calcite.
120-25 Oolite, with some dolomite and some gypsum.
125-35 Oolite, white.
135-40 Limestone, dense, some oolitic and dolomitic.
140-50 Limestone, light-gray to tan, dense to crystalline, dolomitic in part.
150-54 Limestone, gray-mottled, some oolitic, some dolomitic.

Bethel (Mooretown) 8 feet
154-62 Sandstone, light-gray, and some greenish shale.

Renault (Paoli) limestone 115 feet
162-80 Limestone, white, oolitic, some dense, some crystalline, some calcite.
180-85 Limestone, light-gray, dense, some dolomite.
185-95 Limestone, dense to crystalline, with some greenish-gray shale.

195-205	Limestone, buff to white, dense to oolitic.
205-35	Oolite, white, some fine dolomitic.
235-43	Limestone, buff, dense to much fine dolomite.
243-55	Limestone, buff, oolitic.
255-65	Limestone, lithographic, dense.
265-70	Limestone, same, with some blue-white chert fragments.
270-77	Limestone, brown, oolitic.

Aux Vases[1] 20 feet

277-97	Shale, green, silty, and green argillaceous limestone.

Ste. Genevieve[1] 48 feet

297-307	Oolite, white, nonporous.
307-22	Shale, green, with interbedded dense limestone. (Rosiclare[1])
322-45	Limestone, white, oolite, interbedded with dense limestone. (T.D.)

On the outcrop, so far as is known, "*Productus*" *inflatus* does not occur in the Beech Creek in Todd County. More often than not, the limestone does not show at the surface, and where it does occur it is usually a mottled, gray to brown, dense or crystalline limestone without fossils.

There are numerous facies changes in the Elwren of Todd County. On the most northwesterly outcrop there is usually a good section of greenish and reddish shales and greenish sandstone and not as much limestone as in the above core hole. Also, the thickness is quite variable, from 15 to 35 feet.

[1] As interpreted by Swann the zone 277-97 is Rosiclare, and the horizon of the Bryantsville breccia (contact between the *Platycrinus* zone below and *Talarocrinus* above) is somewhat higher in the section.

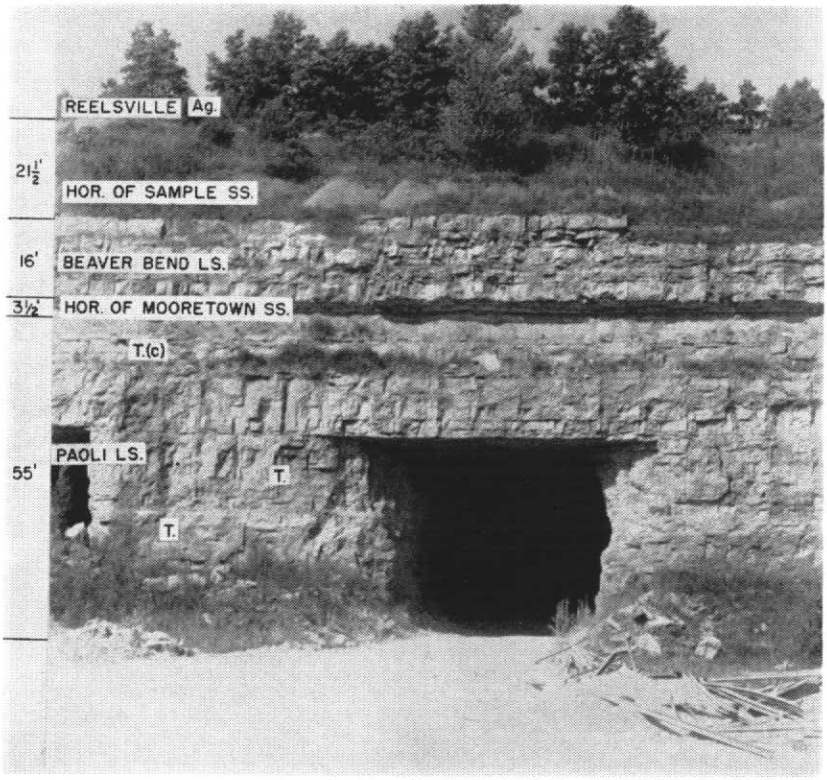

Fig. 4. Stephensburg Quarry, north of U. S. 62, 11 miles southeast of Elizabethtown, Hardin County, Kentucky.

Contrary to earlier measured sections, the Chester (Paoli) extends at least close to the bottom of the quarry. *Talarocrinus* (T.) plates occur within 6 feet of the bottom, and the Ste. Genevieve itself has not been identified.

The Mooretown is represented by a 3½-foot shale break, and the Sample by 21½ feet of shale.

Agassizocrinus cf. laevis (Ag.) is abundant in the overlying Reelsville, which is the usual level where it is introduced in abundance. *Talarocrinus* is particularly common in the upper Paoli.

(e) Reelsville ls. *Agassizocrinus* common. Rest of formation under cover	96-99 feet
(d) Sample horizon. Gray shale	74½-96
(c) Beaver Bend ls. Large *Pentremites* of the *P. pyriformis* type common	58½-74½
(b) Mooretown horizon. Gray shale	55-58½
(a) Paoli ls. (except possibly the lower few feet). *Talarocrinus* particularly common between 45 and 52 feet.—T. (c)	0-55

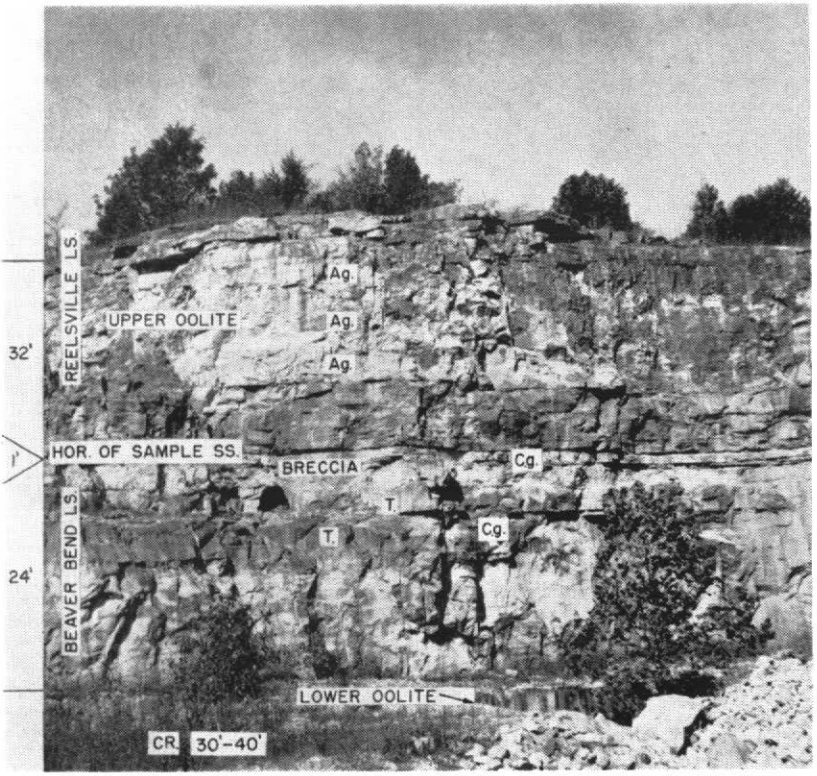

Fig. 5. Whitestone Quarry, west of Bowling Green, Warren County, Kentucky.

Agassizocrinus cf. laevis (Ag.) marks the level of the Reelsville, which is the upper white oolite formerly quarried.

The Sample sandstone is represented by a thin limestone and shale break with limestone breccia below.

The white oolite of the lower pit is Beaver Bend.

The horizon of the Mooretown is not exposed, but the large crinoid stem (CR.) was found in hillside exposures in a zone 30-40 feet below the quarry floor, which would be about the level of the lower occurrence (below the Mooretown) at Russellville.

"Campophyllum gasperense" (C.g.) occurs below the level of the Mooretown and also prominently within the thin limestones of the Sample horizon associated with the breccia.

T.—*Talarocrinus.*

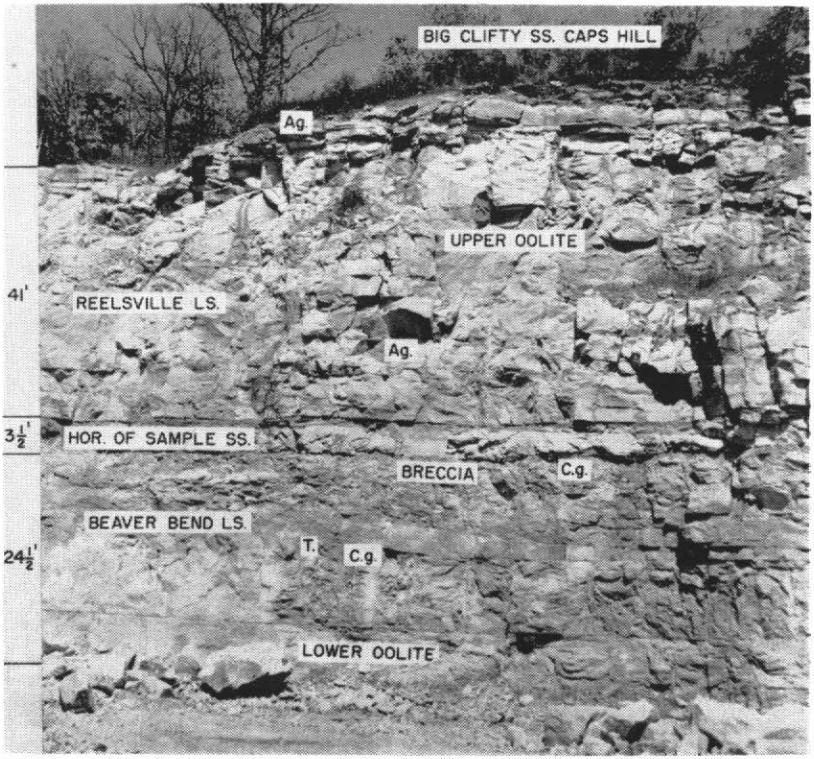

Fig. 6. Auburn Quarry, Auburn, Logan County.

This section with its upper oolite (Reelsville) and lower oolite (Beaver Bend) is similar to that of the Whitestone Quarry west of Bowling Green (fig. 5). Here the Big Clifty sandstone caps the hill.

The horizon of the Sample sandstone is represented by a shale and a thin limestone break. "*Campophyllum gasperense*" (C.g.) is present in this zone, and it also occurs on down in the Beaver Bend. Above the shale break is a silty limestone about 10 feet thick overlain by the oolite of the Reelsville.

As in other sections *Agassizocrinus* (Ag.) is common in the limestone above the horizon of the Sample.

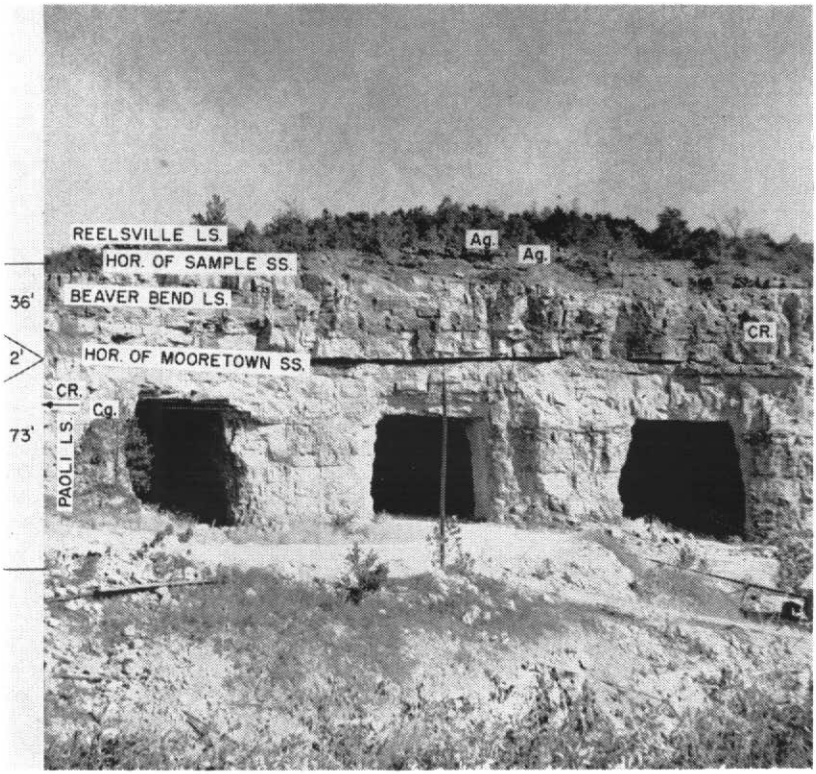

Fig. 7. Russellville Quarry, Logan County, Kentucky.

Agassizocrinus cf. laevis (Ag.) in abundance marks the Reelsville, with the Sample shale break just below.

The sharp shale break above the mine openings is regarded as Mooretown. The large crinoid stem (CR.) occurs in the limestone above, and also below, in a hillside exposure just beyond the west edge of the quarry face. Here it is associated with "*Campophyllum gasperense*" (C.g.) and the usual *Pentremites*. It was this outcrop that first established the occurrence of the large crinoid below, as well as above, the level of the Mooretown. Below the shale parting of the Mooretown horizon there is about 6 feet of limestone conglomerate.

Fig. 8. Elkton Quarry, Todd County, Kentucky.

Mooretown sandstone—see plate 2, figure 2.
Ag.—*Agassizocrinus cf. laevis.*
CR.—Large unidentified crinoid stem.

Fig. 9. Bethel shale and sandstone at Shop, 4 miles west of Elkton, U. S. Highway 68, Todd County, Kentucky.

The underlying limestone exposed in gullies to the west shows abundant large crinoid stems about 10 feet below the level of the Bethel. These are prevalent at this level farther west. This is the eastern feathered edge of the Bethel.

(f) Limestone in which *Agassizocrinus* is common.
(e) 15 feet—limestone.
(d) 25 feet—covered.
(c) 15 feet—shale and sandstone (photo).
(b) 1 foot (±)—limestone conglomerate.
(a) Limestone with the large crinoid stem about 10 feet below top and *"Camposphyllum gasperense"* 15-20 feet below.

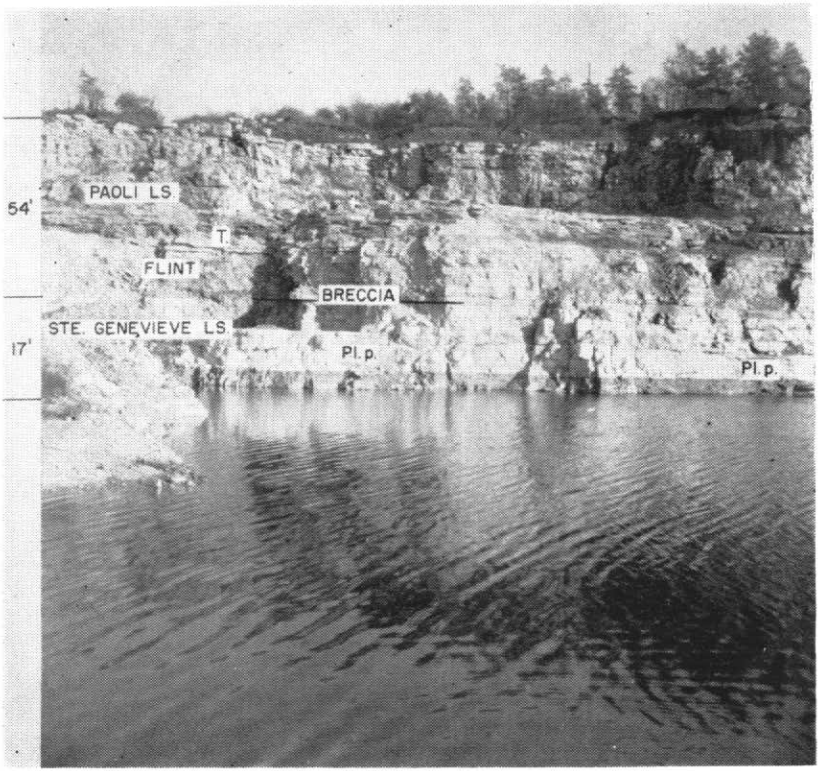

Fig. 10. Cook Stone Company Quarry, Hopkinsville, Kentucky.

Talarocrinus (T.) is reasonably common down to the top of the flint bearing beds, and *Platycrinus penicillus* (Pl. p.) up to the base of these beds. Within the flint beds themselves nothing significant could be found, and the basis for placing the Ste. Genevieve-Chester contact at the base is a poorly developed breccia.

A breccia in itself is not too significant, as in places more than one is found in the general vicinity of the contact (see Dyer vicinity in sections). The breccias vary from well developed limestone breccias to only a somewhat fractured stratum of limestone, and the two types grade into each other.

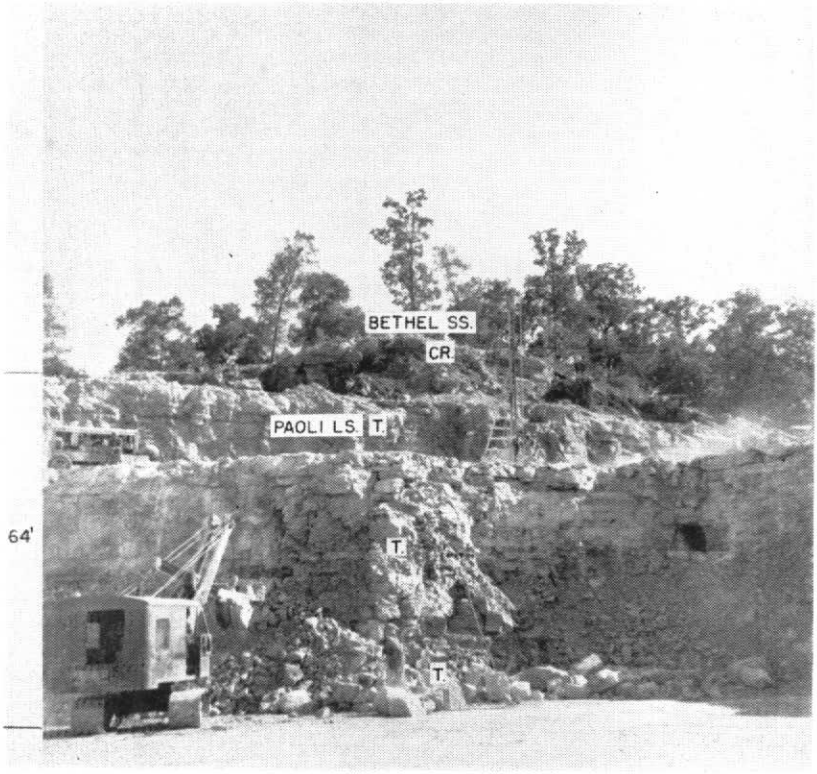

Fig. 11. Christian Quarry, Hopkinsville, Kentucky. Paoli limestone with the large crinoid stem (CR.) in the upper beds.

T.—*Talarocrinus.*

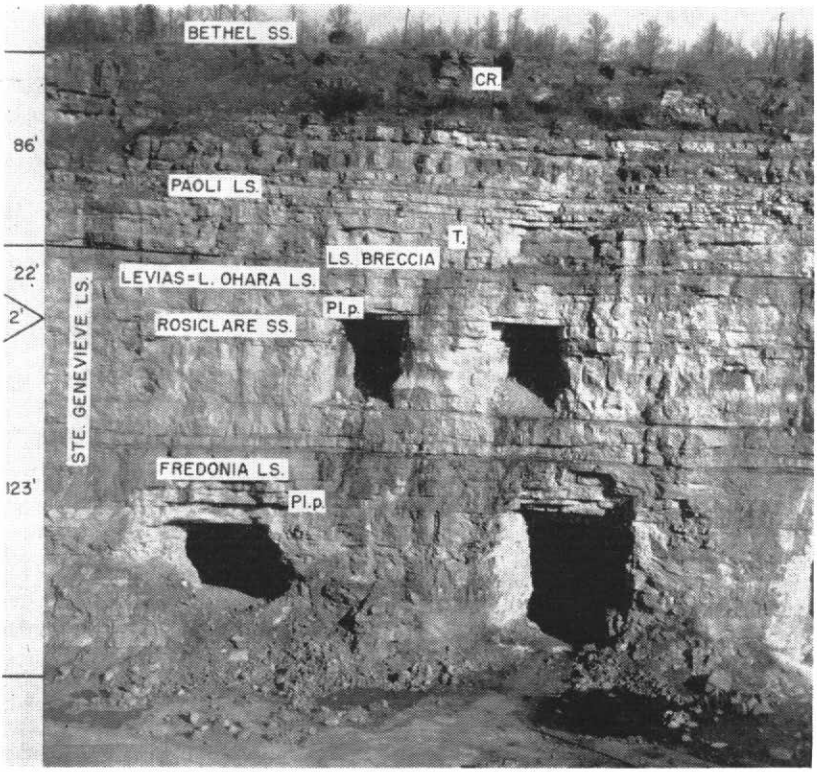

Fig. 12. Cedar Bluff Stone Company Quarry, 3 miles southeast of Princeton, Caldwell County, Kentucky.

The large crinoid stem (CR.) was found in beds exposed between this main quarry and the smaller one just to the north.

This is one of the easternmost known occurrences of the Rosiclare sandstone in outcrop. It is 2 feet thick. A green shaly and silty thin-bedded limestone occurs at this level in the Hopkinsville quarry 25-31 feet below the base of the Paoli (see pl. 3).

T.—*Talarocrinus.*

Pl. p.—*Platycrinus penicillus.*

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LOWER CHESTER SECTIONS IN WESTERN KENTUCKY

PLATE 3

CEDAR BLUFF QUARRY, 3 MILES S.E. OF PRINCETON, CALDWELL CO. 1
COOK QUARRY, HOPKINSVILLE, CHRISTIAN CO. 2
CHRISTIAN QUARRY, HOPKINSVILLE, CHRISTIAN CO. 3
N. OF FAIRVIEW, WESTERN TODD CO. 4
SHOP, 4 MILES W. OF ELKTON, TODD CO. 5
KENTUCKY STONE COMPANY, ELKTON, TODD CO. 6
N. OF RUSSELLVILLE, LOGAN CO. 7
KENTUCKY STONE COMPANY, RUSSELLVILLE, LOGAN CO. 8
WHITESTONE QUARRY, W. OF BOWLING GREEN, WARREN CO. 9
SPURRIER MILL VIC., GRAYSON CO. 10
STEPHENSBURG QUARRY, HARDIN CO. 11
VIC DYER, S.E. BRECKINRIDGE CO. 12
MYSTIC, N. BRECKINRIDGE CO 13
SINKING CREEK, N.W. OF GARFIELD, E BRECKINRIDGE CO 14
KOSMOSDALE QUARRY AND VIC., N MEADE CO. 15

GOLCONDA
Haney
Fraileys
Beech Creek CR3
"PAINT CREEK" (IND.)
Cypress–Elwren
Reelsville
Agassizocrinus
Sample
PAINT CREEK (Ridenhower)
Beaver Bend CR2
Bethel ss.
CR1
RENAULT
"RENAULT" (IND.)
Paoli
Ste. Genevieve

"CYPRESS"
BIG CLIFTY (Jackson)
Barlow = Beech Cr
Cypress

Compophyllum gasperense
Bethel
Ls. Breccia
Rosiclare
GREEN, SHALY AND THIN-BEDDED LIMESTONE
Hopkinsville

Hor. Sample ss.
Upper Oolite
White Oolite
Lower Oolite Pit
Sample ss.
Mooretown
Water level
floor
Elwren
Sample
Agassizocrinus cf. laevis

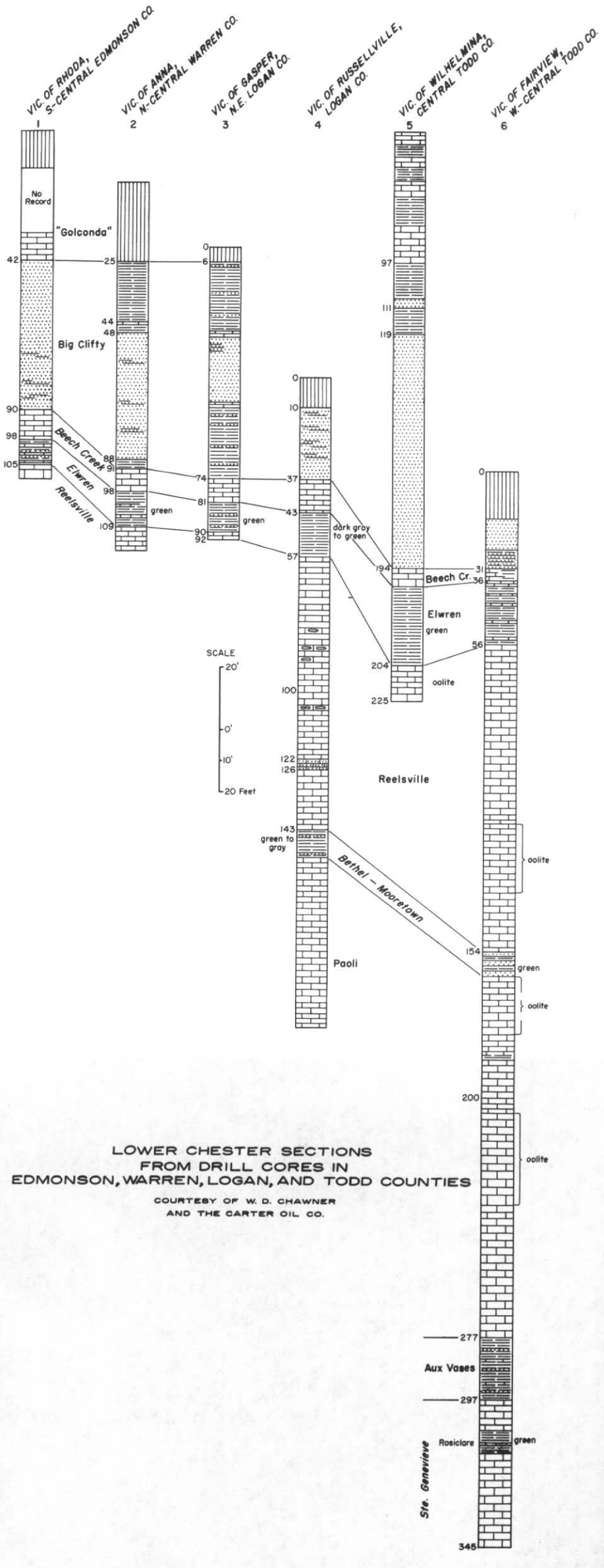
20'
0'
10'
20'

Covered
Limestone conglomerate
Chert
Limestone breccia

* QUARTZ ROSETTES
** A GREATER THICKNESS IS ASSIGNED TO PAOLI HERE THAN HERETOFORE. PLATYCRINUS PENICILLUS WAS NOT FOUND, BUT TALAROCRINUS WAS FOUND NEAR THE BASE OF BOTH EXPOSURES.
*** IN THE MCCLELLAN STONE COMPANY QUARRY, ONE MILE EAST OF HORSE CAVE, THE SAMPLE SANDSTONE IS REPRESENTED BY A THREE-FOOT BREAK INCLUDING UP TO SIX INCHES OF SANDSTONE SEVENTY FEET ABOVE THE STE. GENEVIEVE

WESTERN COAL FIELD
EASTERN COAL FIELD
TENNESSEE

CR LARGE CRINOID STEM–THREE ZONES — CR3 BEECH CREEK, CR2 BEAVER BEND, CR1 PAOLI
Pp. PENTREMITES PYRIFORMIS
Pg. PENTREMITES GODONI
Ag. AGASSIZOCRINUS CF. LAEVIS (REELSVILLE AND ABOVE)
(Ag.) AGASSIZOCRINUS OVALIS (SMALL SPECIES IN BEAVER BEND)
T. TALAROCRINUS (LOWER CHESTER)
C.g. CAMPOPHYLLUM GASPERENSE (PAOLI–BEAVER BEND)
Pl.p. PLATYCRINUS PENICILLUS (STE. GENEVIEVE)
Pr.i. PRODUCTUS INFLATUS (BEECH CREEK)



LOWER CHESTER SECTIONS FROM DRILL CORES IN EDMONSON, WARREN, LOGAN, AND TODD COUNTIES

COURTESY OF W. D. CHAWNER AND THE CARTER OIL CO.