CORRELATION OF THE EGGLESTON FORMATION AND RELATED BEDS IN SOUTHWESTERN VIRGINIA

by

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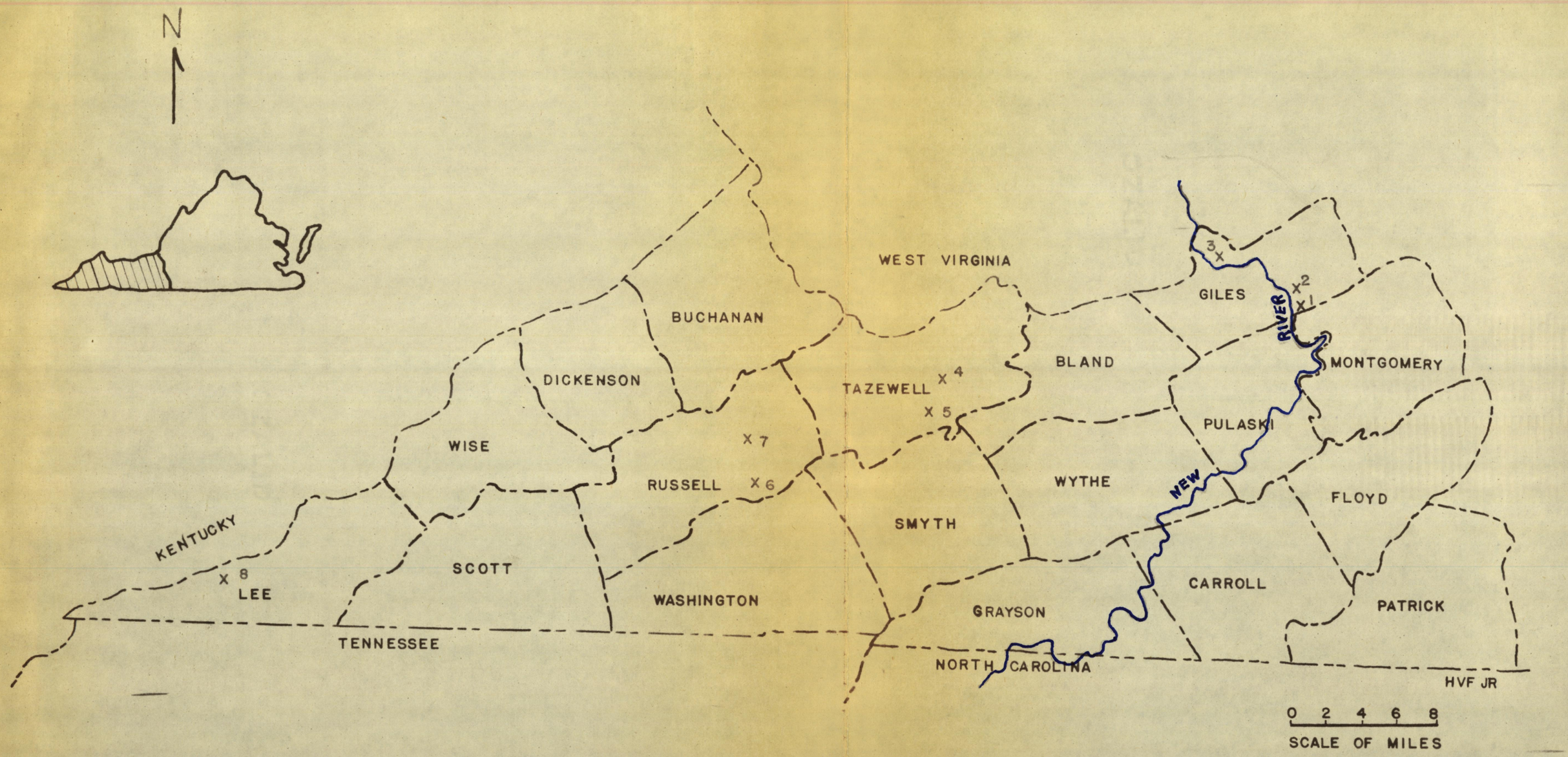

FIGURE I - INDEX MAP SHOWING LOCATIONS OF SECTIONS.

INTRODUCTION

General

In the Middle Ordovician strata of southwestern Virginia, a distinctive succession of yellow-drab and gray mudstones, shales, and limestones occurs between the overlying Martinsburg formation and the underlying red Moccasin formation. For many years, part of this succession was classified with the Martinsburg formation and part with the Moccasin formation. This practice could not be condemned on faunal grounds because the fauna of the sequence between the Moccasin and Martinsburg is so sparse and equivocal in general character. Altered volcanic ash beds which are especially characteristic of the succession range as low as the middle part of the Moccasin formation and are also present in the lower Martinsburg formation.

Mathews (1934, p. 48) proposed the name, Eggleston, and defined it to include the relatively unfossiliferous transitional beds and intercalated bentonites younger than the upper maroon Moccasin formation and older than the Trenton beds of the lower Martinsburg formation in Giles County, Virginia.

Until the present study was undertaken, few detailed studies of the Eggleston, as a separate unit, had been made. The almost barren beds had drawn little or no interest from the paleontologist. The intercalated bentonites were studied, only as a part of the Moccasin-Martinsburg succession, and an attempt was made to correlate these related beds with similar beds in other localities.

The name, Eggleston, has been accepted and is used in much of the

literature published since 1935 but no attempt has been made to correlate the entire succession of beds lying between the Moccasin and Martinsburg formations with similar succession throughout southwestern Virginia.

The writer has made a detailed study of this succession between New River and the Tennessee line to determine the relationship of faunas to the intercalated bentonites, and to correlate the beds of the succession with those at other localities in southwestern Virginia.

Acknowledgments

The writer is indebted to Dr. Byron N. Cooper, Professor of Geology, Virginia Polytechnic Institute, for his supervision of the problem, and for his many helpful suggestions and criticisms during the field work and in the preparation of the report. Dr. Wallace D. Lowry, Department of Geology, Virginia Polytechnic Institute, read the manuscript and made many helpful suggestions and criticisms.

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Previous Work

Although the Moccasin and Martinsburg formations in southwestern Virginia have received rather extensive study and description by numerous geologists, relatively little or no attention has been given

to the upper and lower limits, respectively, of these two units. The Eggleston was considered to be part of a transitional zone beginning in the lower part of the Moccasin and extending into the lower Trenton of the Martinsburg.

Hubbard and Croneis (1924, p. 47) studied the succession in the Narrows of New River (Geologic Section 3) in an attempt to locate the Trenton-Moccasin boundary. Calling the succession a transitional zone, they placed this boundary at the base of a bed of non-fossiliferous, bluish-gray limestone 40 feet below the first abundantly fossiliferous limestones of known Trenton age, and 100 feet above the top of the red calcareous mudstones of the Moccasin formation.

Mathews (1934, p. 48) defined the Eggleston to include "beds of upper Black River age which were younger than the upper red Moccasin member (Lowville) and older than the Trenton limestone." He, like Hubbard and Croneis, regarded the Eggleston as a transitional zone, but suggested that it be mapped separately.

Kay (1935, p. 48) drew the Moccasin-Martinsburg boundary at the top of the Moccasin red beds, and placed the transitional beds of Hubbard and Croneis and the Eggleston formation of Mathews in the Martinsburg formation.

Rosenkrans (1936, p. 48) identified the Eggleston as a lithofacies whose upper and lower limits differed from place to place, but gave no evidence for his conclusions. He regarded the Moccasin-Martinsburg contact established by Hubbard and Croneis to be a readily recognizable

horizon throughout southwestern Virginia and one of disconformity, the magnitude of the supposed hiatus varying from one locality to another.

Cooper (1944, p. 47), in his study of the Burkes Garden quadrangle, Tazewell County, Virginia, defined the Eggleston as lying directly above the Moccasin formation and below the lowest beds containing Sowerbyella curdsvillensis and Resserella rogata, which are considered to be guides of the lower Martinsburg. Cooper regards the Eggleston to be a valid formation, only if it is defined to include beds overlying the Moccasin and underlying the lowest beds carrying Martinsburg fossils.

STRATIGRAPHY

General Statement

The Eggleston formation and related beds overlie the maroon-drab Moccasin formation and underlie the impure, thin-bedded limestones of medial Trenton Curdsville-Cannon-Catheys age, which are generally referred to as the "Trenton limestone member of the Martinsburg formation". The Eggleston occurs, in Virginia, along the northwestern side of the Appalachian Valley from New River to Tennessee. The coarse-textured, richly fossiliferous limestones of the lower Martinsburg are very easily separable from the subjacent Eggleston which is only sparsely fossiliferous. The Eggleston-Moccasin boundary is marked by an abrupt color change, from the maroon-drab Moccasin to the buff to

yellow-drab Eggleston. (See Figure 2).

Ordovician System

Moccasin Formation

Name.- The formation was named by Campbell (1894, p. 47) from exposures along Moccasin Creek, Scott County, Virginia.

Description.- Most of the Moccasin formation is red, thin- to thick-bedded, calcareous mudrock. Some of it is composed entirely of terrigenous fine clastics without any calcium carbonate. Mudcracks and polygonal joints are preserved in many layers.

The Moccasin is distinctive and well-known throughout southwestern Virginia. In Clinch Valley, notably south and east of Tazewell, the Moccasin is from 300 to 450 feet thick and is composed of mudstone of greenish-gray layers and maroon-drab layers, the maroon being predominant.

Bentonites.- Nelson (1926, p. 48) and Woodward (1932, p. 49) described a thin bed of bentonite in the Moccasin formation on the north slope of Catawba Mountain along State Route 311. Several interbedded, maroon bentonitic shales occur in the section along Plum Creek in Tazewell County. Along these partings, superjacent beds have been sheared and crumpled without affecting the underlying beds. One of these intercalated bentonitic shales caps a small anticlinal fold well exposed in the Plum Creek section.

Stratigraphic Position.- The maroon Moccasin beds directly overlie the dove to bluish-gray Witten limestone, one of the most widespread

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FM.</td><td>EGGLESTON
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<tr><td>ELWAY LS.</td><td>ELWAY LS.</td><td>ELWAY LS.</td><td>ELWAY LS.</td></tr>
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COOPER

FIGURE 2 — COMPOSITE STRATIGRAPHIC SECTIONS, MIDDLE ORDOVICIAN, SOUTHWESTERN VIRGINIA

and persistent limestones in the Appalachian region. Butts (1943, p.47) regarded the beds now called Witten as Lowville in age because of locally included beds of limestone containing Cryptophragmus antiquatus and Tetradium cellulosum which were considered to be infallible guides to the Lowville. In Campbell's (1894, p.47) original definition, the limestones that Butts later called Lowville were excluded from the Moccasin. Cooper (1943, p.47) accords a Trenton age to the Moccasin, primarily because the fossiliferous beds of the Witten are either latest Black River or early Trentonian.

The Eggleston formation directly overlies the Moccasin. Where the Eggleston is absent (Geologic Section 6), the maroon beds are overlain by the basal, thin-bedded limestones of the Martinsburg formation of known middle Trenton age. This can be seen in an exposure along State Route 80, one mile south of Rockdell, Russell County, Virginia where the highly fossiliferous beds of the basal Trenton directly overlie the Moccasin.

Eggleston Formation

Name.- Eggleston was proposed by A. A. L. Mathews (1934, p. 48) for the 139-foot succession of beds lying between the Moccasin and Martinsburg formations along the road on the east bluff of New River about 1 3/4 miles southeast of Eggleston, and 1/2 mile north of Goodwins Ferry, Giles County, Virginia.

Description.- The Eggleston formation consists of a succession of drab-gray limestones, mudrocks, and intercalated bentonites directly

above the Moccasin formation and below the "Trenton member of the Martinsburg formation". At no locality have any red beds been observed within the limits of the Eggleston.

Distribution.- The Eggleston formation is best developed in Giles and Tazewell counties, but it can be traced southwestward, unmistakably, at least as far as Old Rosedale, Russell County. It is probably present at the top of the Moccasin in all outlying belts between Russell and Giles counties. It is exposed around the base of Elk Garden Ridge, Russell County, around the base of Beartown Mountain northeast of Elk Garden, and along Plum Creek, southwest of Tazewell.

Siliceous Zones and Bentonites.- The outstanding characteristic of the Eggleston is the presence of silicified beds with peculiar cuneiform jointing, which directly underlie the bentonite zones. In most places, the bentonite beds are not exposed, but the sharp angular, cuneiform-fractured rock furnishes unmistakable evidence of the presence of bentonitic material. This peculiar jointing is a unique result of deformation of the silicified beds and the alteration of volcanic ash beds into bentonitic clays after deposition. This process was accompanied by a release of silica which was carried downward into the limestone layers immediately subjacent to the bentonites. In some places, entire beds of limestone have been silicified. The upper surfaces of some of these silicified zones are locally vitreous enough to be called chert.

There are three to five zones of bentonite and bentonitic clay intercalated within the Eggleston in the sections studied between New

River and Lee County, Virginia. The presence of the cuneiform-jointed, siliceous beds was used to establish the location of the bentonites that were not evident in the natural exposures. (See Appendix I).

Fossils.- The Eggleston, in striking contrast to the abundantly fossiliferous overlying Martinsburg formation, is sparingly fossiliferous. Extensive search of several of the sections studied resulted in only a few identifiable fossils. At other localities, to be discussed later in detail, thin beds of chert and dense, gray limestone were found to contain a few genera of bryozoans, ostracodes, trilobites, and brachiopods.

Butts (1940, p. 47) listed 23 genera and 18 named species as being recovered from the Eggleston. He regarded all but two genera as indicative of Black River age. Most of them were found in the underlying Witten beds of Lebanon age.

Stratigraphic Position.- The Eggleston directly overlies the maroon-drab Moccasin limestones and mudrocks and is lithologically distinct and easily recognizable. It is succeeded by the thin-bedded, coarsely-crystalline, fossiliferous beds of the basal Martinsburg formation of middle Trenton age.

Where the Eggleston is absent, as at one locality in Russell County (Geologic Section 6), the Moccasin is succeeded directly by the Martinsburg. Near Hagan, Lee County (Geologic Section 8), the buff calcareous Witten limestone is succeeded by a 150-foot succession of impure limestones, green mudstones, and intercalated fossiliferous slabby limestones containing three prominent bentonites. Ruffman (1945, p. 48) identified this suc-

cession as Eggleston, basing his identification entirely upon the presence of the intercalated bentonites. Cooper (1950, p.47) applied the name, Tyrone, from central Kentucky to this succession, and regards it as lower Trenton in age. The name, Carters, applied by Wilson (1949, p. 49) to the succession in central Tennessee and correlated with the Tyrone of central Kentucky is used in this report. Carters, proposed by Safford in 1869 takes presidence over the name, Tyrone, and should be used when referring to the fossiliferous succession that replaces the Eggleston in Lee County, Virginia.

Martinsburg Formation

Name.- The Martinsburg formation was named by Darton (1892, p. 47) from the wide belt of argillaceous limestones, sandstones, and shales that occurs just east of Martinsburg, West Virginia.

Description.- The Martinsburg formation is predominantly limestone. The lower division is mainly thin- to medium-bedded argillaceous limestone grading upward through a thin-bedded shaly member to a thick- to massive-bedded sandstone member.

The formation varies locally. Thick zones of clay shale occur on the northwest slope of Clinch Mountain. Northwest of Clinch and East River mountains from Narrows, Giles County to Lebanon, Russell County, it is predominantly limestone in the lower part. In Lee County, the lower limestone member is distinctly different and is treated as a separate formation, the Trenton limestone. The shaly and sandy members are recognized as one unit, the Reedsville shale.

"Trenton Limestone Member"

The lower division of the Martinsburg formation is middle Trenton in age and directly overlies the Eggleston formation. It is the only division of the Martinsburg considered by the writer in the present study.

The"Trenton limestone member" consists, primarily, of a gray, argillaceous, calcareous, fossiliferous shale that alternates with a thin-bedded, crystalline, gray limestone. Many beds within the so-called Trenton division are abundantly fossiliferous. In several localities, as many as eight beds were found in the lower and middle Trenton that were coquina-like in composition. The following genera are abundant in the Trenton in southwestern Virginia:

Hallopora sp.

Rafinesquina alternata (Emmons)

Resserella fertilis Bassler

Sowerbyella sp.

Zygospira sp.

The "Trenton member" ranges in thickness from about 100 to 750 feet.

GEOLOGIC SECTIONS

Geologic Section 1. - Eggleston formation along Virginian Railway, 2 miles northwest of McCoy in Giles County, Virginia

	Thickness	
	Ft.	In.

Martinsburg formation

Eggleston formation (84 feet)

15.	Limestone, buff to gray, argillaceous, fractured.....	0	8
14.	Shale, black, thin bedded, calcareous.....	4	3
13.	BENTONITE C, straw-yellow.....	0	2
12.	Limestone, silicified, cuneiform-jointed.....	0	5
11.	Limestone, gray, argillaceous; contains few Resserella fertilis and Rafinesquina sp.....	11	10
10.	BENTONITE B, straw-yellow; contains fragments of buff and maroon shale.....	0	9
9.	Limestone, steel-gray, cherty near top with cuneiform-jointed zone.....	0	7
8.	Limestone, buff, thin to medium bedded; contains Eurychilina reticulata, Isochilina sp. and Hallopora ample.....	26	1
7.	Shale, buff, thin bedded; slightly sandy.....	1	10
6.	BENTONITE A, light-yellow.....	1	0
5.	Limestone, gray, silicified; 4-inch cuneiform-jointed zone at top.....	1	0
4.	Limestone, gray, argillaceous, sandy.....	8	7
3.	Siltstone, calcareous, dark-maroon, thin bedded.....	9	5
2.	Limestone, buff to gray, thin bedded, sandy.....	10	5
1.	Concealed.....	7	7

Moccasin formation

Structure.- The section is on the southeastern limb of the Sinking Creek anticline. The strike of the beds is N. 60° E.; the dip is about 67° SE. There is no evidence of shearing or faulting, but many of the beds are highly fractured.

Bentonites.- There are three well-defined, yellow to straw-yellow bentonites.

Bentonite A is light-yellow and contains abundant calcareous shale and silicified limestone fragments. It is 1 foot thick and lies 37 feet above the Moccasin formation.

Bentonite B is straw-yellow and has a waxy feel and luster. It contains abundant buff shaly fragments mixed with fragments of light-maroon shale. The entire zone is 9 inches thick and lies 65 feet 8 inches above the Moccasin formation.

Bentonite C is straw-yellow and waxy with thin partings of buff and dark shale. It is 2 1/4 inches thick and lies 78 feet above the Moccasin formation.

Fossils.- The section is sparingly fossiliferous. A few isolated specimens of Eurychilina reticulata, Isochilina sp., and Hallopora ampla were recovered from a dense gray limestone bed within a 26-foot succession of buff limestones directly above Bentonite A. Several specimens of Resserella fertilis and Rafinesquina sp. were recovered from a highly fractured limestone overlying Bentonite C.

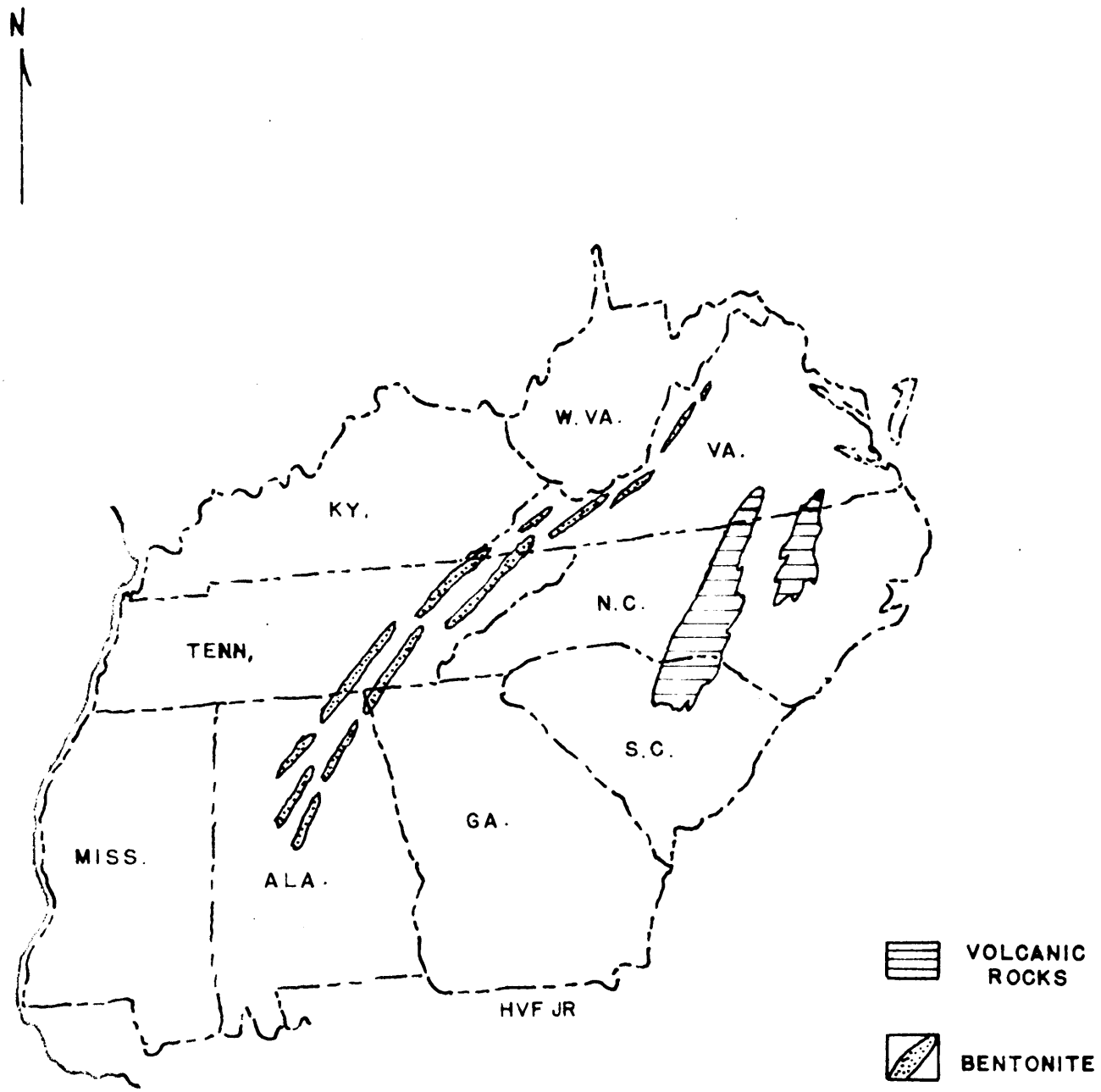

FIGURE 3 MAP SHOWING DISTRIBUTION OF ORDOVICIAN BENTONITES IN SOUTHEASTERN UNITED STATES.

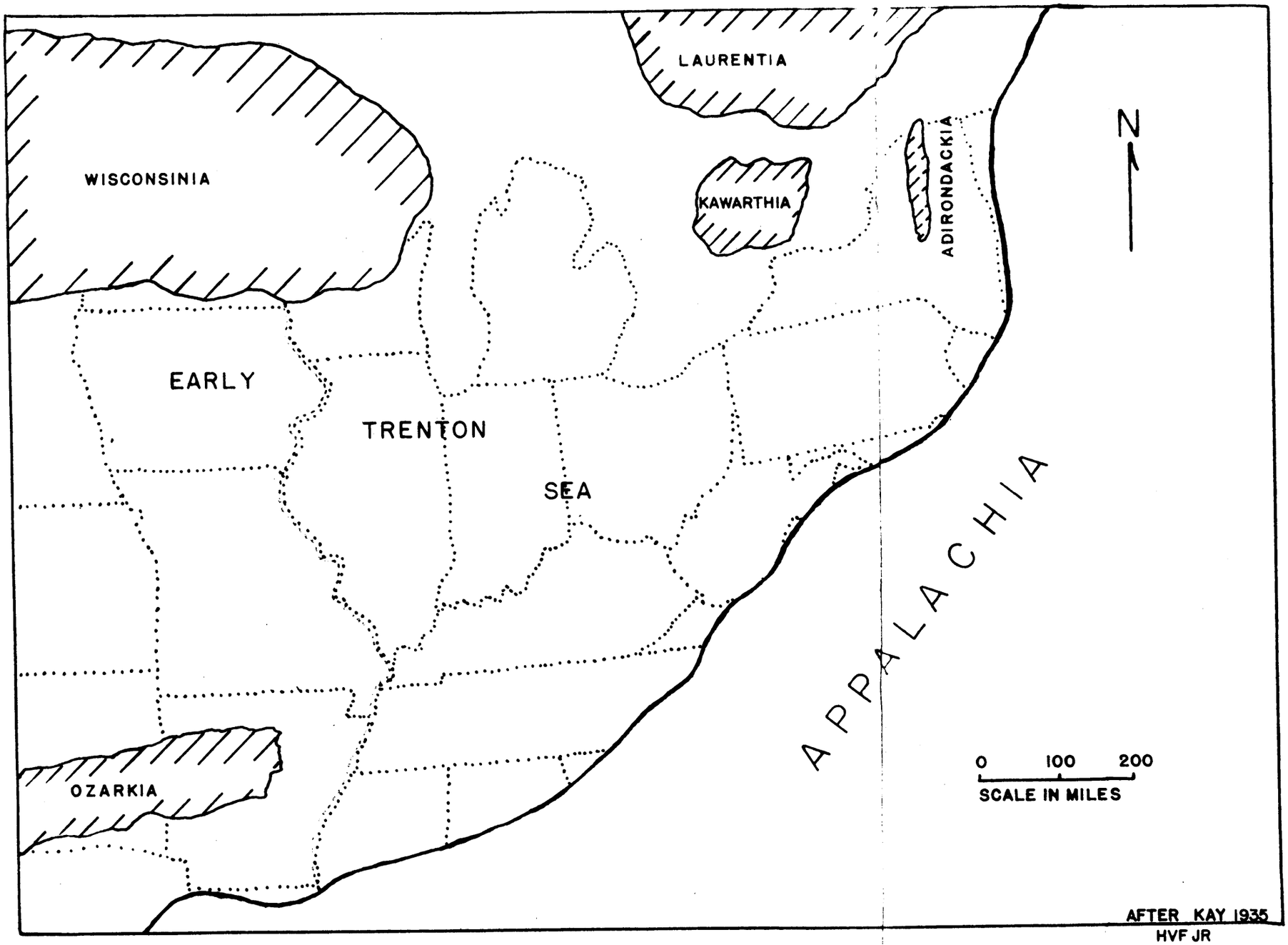

FIGURE 4 — PALEOGEOGRAPHIC MAP OF THE EASTERN UNITED STATES, EARLY TRENTON TIME.

Geologic Section 2.- Eggleston formation along State Route 625, 2 miles south of Eggleston, Giles County, Virginia

		Thickness Ft.	In.
Martinsburg formation			
Eggleston formation (139 feet)			
20.	Concealed	37	0
19.	Mudrock, calcareous, buff to yellow-drab, thin to medium bedded	8	4
18.	Limestone, gray, highly fractured; cuneiform-jointed near bottom	0	6
17.	Mudrock, buff, calcareous, shaly with thinner shaly partings; highly fractured and sheared; possible BENTONITE E zone	8	7
16.	Limestone and calcareous mudrock, gray, medium to thick bedded, highly fractured and crumpled; cuneiform-like fractures near top	10	4
15.	Shale, yellow, bentonitic (D), thin bedded; sheared and crumpled along thin shaly parting	1	10
14.	Mudrock, gray-drab, calcareous, thick bedded to massive; contains few shaly partings; weathers buff to yellow and ribbony	22	2
13.	Concealed	8	2
12.	Mudrock, calcareous, buff, thin to medium bedded with thin shaly partings; weathers ribbony	19	0

11.	Fault zone; shales and bentonitic shales faulted and crumpled	3	0
10.	BENTONITE C zone, yellow, predominantly thin-bedded yellow shale; faulted and crumpled	8	0
9.	Limestone, gray, argillaceous, ribbony; weathers to buff; sheared; contains few Eurychilina sp., Isochilina sp., and Hallopora sp	19	6
8.	Limestone, gray, silicified, cuneiform-jointed; fractured and contorted	1	4
7.	Mudrock, buff, calcareous, sandy; highly fractured; in series of asymmetrical folds	11	10
6.	Mudrock, greenish-gray, calcareous, medium bedded, cobbly	2	10
5.	Limestone, silicified, highly fractured; cuneiform-jointed	2	7
4.	BENTONITE B, yellow, shaly with thin maroon shaly intercalations	2	0
3.	Limestone, gray, with shaly interbeds; 2-inch cuneiform-jointed chert zone at top; interbeds show drag folding	1	5
2.	Mudrock, buff, calcareous, medium to thick bedded with yellow sandy layers and mealy yellow shaly interbeds; in series of asymmetrical folds; possible BENTONITIC A zone	7	4
1.	Autoclastic zone, gray; composed of green and drab mudrock fragments, black chert, and quartz	0	14

Moccasin formation

Structure.- The section is on the southeastern flank of the Bane dome, an elongated domal anticline with the axis trending to the northeast, and lies within the center of the Giles County marble belt as described by Mathews (1934, p. 48). The beds are severely folded and crumpled, and evidence of shearing and faulting is present throughout the succession. Drag folding may be seen in many of the incompetent shaly interbeds throughout the section. Fracture cleavage in the underlying Moccasin formation is developed to a high degree. The strike of the beds is N. 55° E. and the dip is about 50° SE.

The autoclastic bed (Plate 4b) at the base of the section is probably a result of the regional structure. Most of the rocks in the area have undergone great structural changes due to the application of enormous stresses. The region is one of intense deformation. Radiating from the Bane dome are three major structural features, the Mountain Lake anticline, the Pearisburg anticline, and the Thessalia anticline. The dome is bounded on the south by the Sinking Creek anticline and the Saltville fault, and on the north by the Angels Rest syncline and the Narrows fault.

The basal autoclastic zone is composed of fragments of mudrock, quartz, and chert, all in a calcareous matrix. This zone is seen to pass upward into the unbrecciated rock. Many of the breccia fragments appear to be worn, some of them notably rounded.

Bentonites.- The bentonite sequence at this locality contains five bentonites, or bentonitic zones whose presence was determined primarily by the presence of underlying, cumeiform-jointed limestones.

Bentonite A is represented by a zone of calcareous mudrock, yellow sandy beds, and mealy yellow interbeds of shale. It is 7 feet 4 inches thick, and grades downward directly into an autoclastic zone containing an abundance of quartz and chert. The zone is about one foot above the top of the Moccasin.

Bentonite B is yellow containing buff and maroon shaly interbeds. It is 2 feet thick and lies 9 feet 5 inches above the Moccasin.

Bentonite C is represented by a zone of predominantly yellow, thin-bedded shales. It is sheared and crumpled and overlies a thick succession of siliceous limestones. The entire zone is 8 feet thick, and lies about 50 feet above the Moccasin.

Bentonite D is a series of yellow, thin-bedded, bentonitic shales. It is 1 foot 10 inches thick, and lies about 110 feet above the Moccasin.

Bentonite E is represented by a zone of calcareous shaly mudrock that contains interbeds of thin yellow shale. It is sheared and crumpled and directly overlies a highly fractured limestone that contains cuneiform-like fractures near the top. The zone is 8 feet 7 inches thick, and lies about 122 feet above the Moccasin.

Fossils.- Several isolated specimens of Eurychilina sp., Isochilina sp., and Hallopora sp. were recovered from a succession of buff to yellow-drab argillaceous limestones directly below Bentonite C.

Geologic Section 3.- Eggleston formation along the Virginian Railway in the Narrows of New River, Giles County, Virginia

		Thickness Ft.	In.
Martinsburg formation			
Eggleston formation (104 feet)			
14.	Limestone, gray, blocky; contains very thin partings of brown and greenish shale.....	2	5
13.	BENTONITE D, yellow; contains fragments of drab to green shale.....	1	0
12.	Limestone, gray, argillaceous; cuneiform-jointed near top.....	1	2
11.	Limestone, drab, argillaceous; contains blocky shale in lower part.....	3	8
10.	BENTONITE C, yellow; contains fragments of green and buff shale and partings of dark-green shale....	2	5
9.	Limestone, gray, silicified; cuneiform-jointed zone of charty limestone near top.....	1	6
8.	Limestone, gray, thin bedded, cobbly with partings of shale.....	4	0
7.	Limestone, gray, argillaceous; contains few *Resserella* sp. and *Calliops* sp.....	23	9
6.	BENTONITE B, straw-yellow intermixed with buff to yellow shale and clay.....	1	5
5.	Limestone, gray, cuneiform-jointed.....	2	1

4.	Mudrock, buff to yellow, calcareous with greenish-yellow shaly partings; sandy near top; weathers to mealy yellow rock.....	32	8
3.	BENTONITE A, yellow, waxy; contains fragments of buff to yellow shale and clay.....	1	6
2.	Limestone, dark, medium to thick bedded; cherty near top showing cuneiform-jointing; surface appears to be ripple-marked.....	1	8
1.	Mudrock, calcareous, and intercalated argillaceous limestones, light-green to greenish-yellow; weathers to buff mealy rock.....	25	0

Moccasin formation

Structure.- The section is in the Narrows of New River on the northwestern limb of a narrow syncline. The northwestern limb is cut by the St. Clair fault that has brought the lower Ordovician Beekmantown dolomite into contact with the Devonian Chemung formation. The southeastern limb is truncated by the Narrows fault only 2 miles southeast of the St. Clair fault.

The strike of the beds is N. 85° E. and the dip is about 28° SE. Some of the bentonite zones are sheared. The argillaceous limestones of the basal Martinsburg formation are fractured and folded, and fracture cleavage is evident in the maroon-drab Moccasin formation. None of the beds show evidence of overturning.

Bentonites.- The bentonite sequence in this section is neither readily discernible nor completely established because of the dense

underbrush covering most of the section and the inaccessability of the beds. The Eggleston and its related bentonites are exposed along a steep embankment directly above the Virginian Railway right of way and directly below U. S. Route 460. Measurement of the section was made by the writer with the help of the previous work in the area by Butts (1940, p. 47) and Rosenkrans (1936, p. 48).

Four bentonites, or bentonitic clay zones were found.

Bentonite A is yellow and waxy containing fragments of buff to yellow shale and clay. It is approximately 1 foot 6 inches thick and lies about 27 feet above the Moccasin formation.

Bentonite B is a straw-yellow intermixture of shales, clays, and possibly bentonitic material. It directly overlies a 2-foot thickness of cuneiform-jointed, silicified limestone. It is about 1 foot 6 inches thick and lies about 64 feet above the Moccasin.

Bentonite C is yellow bentonitic material composed primarily of fragments of green and buff shale. It is approximately 2 feet 6 inches thick and lies about 95 feet above the top of the Moccasin.

Bentonite D is yellow-drab containing fragments of drab to greenish shale. It is 2 feet 5 inches thick and lies approximately 100 feet above the Moccasin.

Fossils.- From several feet of dark-gray, thin bedded limestones directly overlying Bentonite B, a few specimens of Resserella fertilis and one isolated specimen of Calliops sp. were recovered.

Geologic Section 4.- Eggleston formation along State Route 61, 1/4 mile East of U. S. Route 19, at Burkes Garden Siding, Tazewell County, Virginia

		Thickness Ft.	In.
	Martinsburg formation		
	Eggleston formation (78 feet)		
22.	Limestone and calcareous mudrock, yellow; weathers to soft, mealy rock.....	4	0
21.	Concealed.....	7	6
20.	Mudrock, straw-yellow, calcareous, medium to thick bedded.....	3	5
19.	Limestone, gray, silicified, cuneiform-jointed.....	0	5
18.	BENTONITE D, straw-yellow.....	0	6
17.	Limestone, drab-yellow, silicified, cuneiform-jointed.....	1	6
16.	Mudrock, yellow, calcareous, argillaceous, thick bedded with shaly partings.....	2	4
15.	BENTONITE C, straw-yellow.....	0	6
14.	Limestone, silicified, cuneiform-jointed.....	0	4
13.	Limestone, slate-gray, medium to thin bedded; weathers to mealy yellow rock; contains Eurychilina reticulata and Isochilina sp.....	4	0
12.	BENTONITE B, yellow; contains maroon shale fragments..	0	4
11.	Limestone, silicified, cuneiform-jointed.....	1	1

10.	Mudrock, slate-gray, calcareous, medium to thick bedded with shaly partings; weathers to black mottled, mealy rock.....	16	3
9.	Mudrock, slate-gray, calcareous, thin to medium bedded with shaly partings; contains abundance of calcite; weathers to greenish-black, channeled rock....	6	2
8.	Mudrock, straw-yellow, calcareous.....	1	8
7.	Concealed.....	3	2
6.	Mudrock, yellow, calcareous, argillaceous.....	0	5
5.	BENTONITE A, waxy, yellow with limy partings.....	0	7
4.	Limestone, black, silicified, cuneiform-jointed.....	0	3
3.	Limestone, dark, medium to thin bedded; cut by veins of calcite; thin shaly partings containing abundant calcite; weathers to yellow, mealy rock.....	9	5
2.	Concealed.....	4	3
1.	Mudrock, dark-gray, calcareous, argillaceous; contains abundant calcite.....	8	9

Moccasin formation

Structure.- The section is on the northwestern limb of the East River Mountain syncline. Much shearing is evident. The overlying "Trenton beds" of the Martinsburg formation are severely faulted and folded as indicated in the exposures at the junction of U. S. Route 19 and State Route 61 (Plate 6b). The underlying red Moccasin formation is fractured and the beds are vertical. The beds strike N. 85° W. and the dip is about 80° NE. Minor shear zones, associated with the bentonites

are evident. Although steeply dipping, the beds exhibit no evidence of overturning.

Bentonites .- The bentonite sequence at this locality consists of four readily discernible bentonites and their subjacent cuneiform beds.

Bentonite A is a waxy, straw-yellow material that contains thin, limy partings. The total thickness of the bentonite and the limy intercalations is 7 inches. It lies 23 feet above the top of the underlying Moccasin formation. The subjacent bed of dark limestone is silicified with a 3-inch band of cuneiform-jointed chert directly underlying the bentonitic material.

Bentonite B is straw-yellow and mealy with intercalations of maroon shale. It is approximately 4 inches thick and lies at a stratigraphic distance of 35 feet 4 inches above the top of the Moccasin. The underlying limestone is silicified, and is cuneiform-jointed for a little over 1 foot.

Bentonite C is a 6-inch bed of straw-yellow bentonite and associated fragments of drab-gray shale. It lies 44 feet 4 inches above the top of the Moccasin and directly overlies a 4-inch bed of silicified, cuneiform-jointed limestone.

Bentonite D is a buff, waxy bentonite containing fragments of dark shale. It is 6 inches thick and lies 52 feet 4 inches above the Moccasin. The underlying limestone bed is 1 foot 6 inches thick, drab-yellow, silicified, and cuneiform-jointed.

Fossils.- Careful search of the section produced only a few isolated

fossils. A few specimens of Eurychilina reticulata and Isochilina sp. were recovered from a 4-foot succession of slate-gray, medium- to thin-bedded limestones, approximately 1 foot above Bentonite B, and 36 feet 8 inches above the top of the Moccasin.

Geologic Section 5.- Eggleston formation along Plum Creek, State Route 16, 1 3/4 miles southwest of Tazewell, Virginia

		Thickness Ft.	In.
Martinsburg formation			
Eggleston formation (57 feet)			
13.	Mudrock, gray, siliceous, cuneiform-jointed.....	1	1
12.	Mudrock and limestone, greenish-gray, calcareous....	4	3
11.	BENTONITE C, straw-yellow.....	2	0
10.	Mudrock, dark-gray, cuneiform-jointed.....	3	3
9.	Limestone, blue, thin bedded, siliceous, ripple marked; weathers to gray, cobbly rock; contains Rafinesquina alternata.....	4	7
8.	Shale, gray to black, calcareous, with thinner shaly partings.....	7	4
7.	Limestone and mudrock, gray to green; limestone contains Isotelus sp. and Isochilina sp.....	14	5
6.	BENTONITE B, straw-yellow, contains 2-inch bed of red-drab shale in center.....	0	7
5.	Limestone, silicified, cuneiform-jointed.....	12	3

4.	BENTONITE A, yellow, waxy, with buff shaly intercalations.....	0	11
3.	Mudrock, gray, calcareous; weathers to mealy yellow rock.....	2	0
2.	Mudrock, gray; contains abundant calcite visible on surface.....	1	4
1.	Mudrock, dark-gray, with intercalated shales near top...	3	0

Moccasin formation

Structure.- The section is on the southeastern limb of a broad syncline. The strata are relatively free of crumpling. Several beds above the bentonites have been sheared and crumpled without affecting the beds underlying the bentonites. These bentonitic shear zones are well exposed here, as well as in the subjacent Moccasin formation.

The strike of the beds is S. 37° E., and the average dip is 24° NE. The northwestern limb of the syncline is less well exposed than the southeastern limb. Here, most of the Eggleston is concealed. Most of the underlying Moccasin is well exposed, and shows well-developed fracture cleavage.

Bentonites.- The sequence at this locality consists of three yellow bentonites with their associated cuneiform-jointed beds and intercalated shales.

Bentonite A is yellow, waxy, and contains thin, buff, shaly intercalations. It is 11 inches thick and lies about 6 feet above the top of the Moccasin. It is underlain by a 2-foot thickness of

silicified, calcareous mudstone that weathers into blocky fragments of a dark-yellow, mealy rock.

Bentonite B is straw-yellow with a 2-inch layer of drab-maroon shale. With the shaly intercalation, the total thickness is 7 inches. It lies 20 feet above the Moccasin. The bentonite is directly underlain by 12 feet of highly silicified, cuneiform-jointed limestones containing thin shaly partings.

Bentonite C is a straw-yellow bentonite containing numerous beds, or bands, of drab-yellow shale. It is approximately 2 feet thick, and lies about 30 feet above the top of the Moccasin formation. It is directly underlain by 3 feet of dark-gray, cuneiform-jointed, calcareous mudrock.

Fossils.- The pygidium of a large species of Isotelus and several small specimens of Isochilina sp. were collected from a 14-foot 4-inch succession of greenish-gray limestones and calcareous mudstones directly above Bentonite B, and 20 feet above the Moccasin. Three specimens of Rafinesquina alternata were recovered from a blue, thin-bedded, limestone 4 feet 7 inches thick, and 3 feet below Bentonite C.

Geologic Section 6.- Bentonite sequence, "Trenton member", Martinsburg formation along State Route 80, 1 mile south of Rockdell, Russell County, Virginia

	Thickness	
	Ft.	In.

Martinsburg formation, "Trenton member" (430 feet)

12.	Limestone, black, argillaceous with thin buff shaly partings; contains numerous beds composed wholly of fossil fragments, mainly Resserella sp. and Sowerbyella sp.....	75	0
11.	Limestone and shale, gray to black, thin to medium bedded, fractured; contains abundant calcite; contains Hallopora sp., Resserella sp., and Sowerbyella sp.....	160	0
10.	BENTONITE, yellow, powdery; contains much buff shale and clay.....	2	4
9.	Limestone, gray, silicified; cherty near top; irregular surface.....	2	0
8.	Limestone and shale, gray, thin to medium bedded, fractured; contains Hallopora sp. and Sowerbyella sp.....	35	0
7.	Shale, dark-gray, calcareous, thin bedded, with thinner shaly partings; contains abundant Resserella sp. in richly fossiliferous limy layers.....	85	0
6.	Concealed.....	40	0
5.	BENTONITE, yellow.....	0	11
4.	Limestone, dark-gray, silicified; cherty zone at top.....	4	6
3.	Limestone, black, thin to medium bedded, fractured; contains few Resserella sp.....	20	4
2.	BENTONITE, straw-yellow; contains fragments of shale.....	1	0
1.	Limestone, gray, thin bedded; cherty at top; cuneiform-		

jointed..... 6 0

Hiatus, Eggleston formation absent

Moccasin formation

Structure.- The section is on the northwestern limb of the Greendale syncline on the northwestern slope of Clinch Mountain just north of the Hayter wind gap. The upper limestones and shales are folded and fractured, and the associated bentonites are sheared. The section is nearly equidistant from the Copper Creek and Saltville faults. The beds strike N. 48° E. and dip about 40° SE. There is no evidence of overturning.

Bentonites.- At this locality, the "Trenton member" of the Martinsburg formation directly overlies the red Moccasin formation. The bentonite sequence here consists of three yellow bentonites, together with their associated shales, clays, and zones of silicified limestones.

The oldest bentonite is a straw-yellow bentonite that is well-dispersed among fragments of buff shale and clay. It is 1 foot thick, and lies 6 feet above the top of the red Moccasin formation.

The second bentonite is yellow, flaky, and intermixed with fragments of hard, buff shale. It is 11 inches thick, and lies about 32 feet above the top of the Moccasin. No evidence of any maroon intercalation was found.

The third, and youngest bentonite, is a zone of buff shales and clays. It is deeply weathered and barely discernible as a bentonitic zone. These shales and clays directly overlie a 2-foot thickness of limestone that shows

an irregular surface. This bentonitic zone lies about 195 feet above the top of the Moccasin.

The bentonites at this locality are believed to be younger than those found in the Eggleston formation at other localities throughout southwestern Virginia. No evidence of any pink or maroon intercalations was found within the three bentonites of the lower Martinsburg.

Fossils.- The fauna of the section was found to be typically that of the "lower Trenton member" of the Martinsburg formation. As in the typical basal Martinsburg, numerous beds, or layers, were found to be composed entirely of fossils and fossil fragments.

Directly above the first bentonite several specimens of Resserella fertilis were recovered. About 50 feet above the second bentonite, Resserella fertilis was found in thin shaly partings between beds of thicker dark-gray, limy shale.

Specimens of the following fossils were recovered from the limestone beds above and below the third bentonite:

Hallopora sp.

Resserella fertilis Bassler

Sowerbyella rugosa (Meek)

Geologic Section 7.- Eggleston formation along State Route 80, 1/2 mile northwest of Old Rosedale, Russell County, Virginia

	Thickness	
	Ft.	In.
Martinsburg formation		

Eggleston formation (76 feet)

17.	Limestone, gray, medium bedded, cobbly	4	9
16.	Limestone, gray, silicified, cuneiform-jointed	0	6
15.	Mudrock, drab-yellow, calcareous, medium bedded; weathers to straw color	2	9
14.	BENTONITE C, straw-yellow; contains thin shaly partings and clay	2	4
13.	Limestone, gray, silicified, cuneiform-jointed	1	0
12.	Limestone, light-gray, highly fractured; contains Rafinesquina alternata	1	9
11.	Mudrock, gray, calcareous, argillaceous, thin to medium bedded	17	6
10.	BENTONITE B, yellow, waxy,; contains partings of yellow and maroon shale and clay	6	1
9.	Limestone, gray, silicified, cuneiform-jointed	1	2
8.	Concealed	6	6
7.	Mudrock, gray, calcareous, argillaceous, fractured; weathers dark and ribbony	9	2
6.	Mudrock, gray to straw-yellow, calcareous, thin to medium bedded; weathers to dark, cobbly rock	4	8
5.	Mudrock, dark-gray, calcareous, medium to thick bedded; contains thin, limy interbeds	5	8
4.	Limestone, gray, thin bedded	5	7
3.	BENTONITE A, straw-yellow, thin shaly partings	0	4
2.	Limestone, gray, cuneiform-jointed chert zone at top	0	5

1. Mudrock, dark-gray, calcareous; thin, limy interbeds; shaly at top..... 6 7

Moccasin formation

Structure.- The section is on the southeastern limb of a broad syncline. The southeastern limb is cut by the Copper Creek fault which has caused the lower Ordovician Beekmantown dolomite to be thrust up into contact with the Moccasin formation.

The strike of the beds is N. 72° E. and the dip is about 82° SE. Bentonitic shear zones are well exposed. There is no evidence of faulting or overturning.

Bentonites.- There are three well-defined yellow bentonites in this section, each overlying a silicified, cuneiform-jointed limestone.

Bentonite A is a straw-yellow blocky bentonite that contains very thin shaly partings. The bed is 4 inches thick and lies 7 feet above the top of the red Moccasin formation.

Bentonite B is a thick, straw-yellow, waxy bentonite that contains partings of yellow and maroon shale and buff clay. The entire zone is 6 feet 1 inch thick and lies about 40 feet above the Moccasin formation.

Bentonite C is a drab-yellow flaky bentonite that contains several partings of buff shale and clay. It is 2 feet 4 inches thick and lies about 68 feet above the Moccasin.

Fossils.- Several fragmental specimens of Rafinesquina alternata were recovered from a bed of light-gray, fractured limestone containing abundant calcite, and about 2 feet below Bentonite B.

Geologic Section 8.- Bentonite sequence, Carters formation along the Louisville and Nashville Railway, 5 1/2 miles northeast of Rose Hill, near Hagan, Lee County, Virginia

		Thickness ft.	In.
"Trenton" limestones of Curdsville age			
Carters formation (150 feet)			
15.	Mudrock, yellow, calcareous, medium to thin bedded	0	9
14.	Limestone, gray, argillaceous, with thin, gray shaly partings	0	7
13.	BENTONITE D, gray to yellowish-green with drab shaly fragments	3	8
12.	Limestone, gray, medium bedded with 6-inch band of chert at top; rippled	6	5
11.	Mudrock, straw-yellow, calcareous, thin to medium bedded	18	0
10.	Limestone, dark-gray, thin to medium bedded	13	8
9.	BENTONITE C, green to yellow, shaly; sheared	3	0
8.	Limestone, dark-gray, thin to medium bedded, platy, dense; 4-inch band of black rippled chert at top; contains numerous Escharopora, Rhinidictya sp., Eurychilina sp., Strophomena sp., Opikina sp., Pionodema sp., and Zygospira sp.	38	7

7.	BENTONITE B, gray to yellow, shaly; contains fragments of yellow-drab and light maroon shale.....	0	5
6.	Limestone, dark-gray, argillaceous; silicified near top..	19	7
5.	Mudrock, gray to black, calcareous, massive.....	35	0
4.	Limestone, gray, thick bedded, faulted; contains Isochilina sp.....	7	9
3.	Shale, dark-gray, calcareous, laminated.....	0	5
2.	BENTONITE A, Blue-gray, flaky.....	0	4
1.	Limestone, gray, thin bedded; cherty near top.....	3	10

Witten limestone

Structure.- The section is located on the Cumberland overthrust block on the northwestern limb of the Powell Valley anticline. The beds strike N. 82° E. and dip about 33° SE.

At this locality, the Moccasin red beds and the Eggleston are absent. The dove Witten limestone is directly overlain by about 150 feet of impure limestones, buff to yellow mudstones, and intercalated, platy, fossiliferous limestones containing the bentonites generally seen in the Eggleston. The name, Carters, has been applied to this succession which is directly overlain by the "Trenton" limestones of Curdsville age. (See page 15).

Bentonites.- There are four bentonite zones in the section, two of which are prominent.

Bentonite A is blue-gray and flaky. It is 4 inches thick and lies

about 4 feet above the top of the dove Witten limestone.

Bentonite B is a gray to yellow, shaly bentonite that contains an abundance of fragments of yellow-drab and light maroon shale. It is 5 inches thick and lies about 67 feet above the Witten.

Bentonite C is a green to yellow, shaly bentonite that is highly sheared. It is 3 feet thick and overlies a bed of dense black chert that is ripple-marked. The bentonite lies about 106 feet above the Witten.

Bentonite D is gray to yellow-green with fragments of yellow-drab shale. It is 3 feet 8 inches thick and lies about 147 feet above the top of the Witten.

Fossils.- Limestone beds intercalated within the Carters are abundantly fossiliferous.

Several specimens of Isochilina sp. were recovered from a thick-bedded succession of limestones and dark shales directly above Bentonite A.

The following fossils were recovered throughout a 38-foot 7-inch succession of dark-gray platy limestones directly below Bentonite C:

Escharopora subrecta (Ulrich)
Rhinidictya nicholsoni
Eurychilina subradiata Ulrich
Isochilina sp.
Leperditia fabulites (Conrad)
Opikina minnesotensis (Winchell)
Pionodema sp.
Rafinesquina sp.
Strophomena sp.
Zygospira sp.

CONCLUSIONS AND CORRELATIONS

General Conclusions

Study of the succession of beds between the upper Moccasin red beds and the lower "Trenton" beds of the Martinsburg formation supports the following conclusions:

1. The Eggleston formation is a readily recognizable unit in the area between New River, Giles County and Russell County, Virginia.

The limits of the Eggleston formation are readily recognizable. It is delimited below by the Moccasin red beds and above by a coquina-like bed of gray limestone.

2. The Eggleston formation, as herein defined, is present only where underlain by the Moccasin red beds.

3. Where the Moccasin red beds are absent (Geologic Section 8), the overlying succession is more limy and contains beds of dense, platy limestone that are very fossiliferous.

4. At localities where the Eggleston formation is absent (Geologic Sections 6 and 8), the cuneiform beds directly underlying the bentonite zones are replaced by beds, or bands, of dense black to brown chert, the top surfaces of which are often ripple-marked.

5. The fauna of the succession, sparse though it is, suggests an early Trenton age. This fauna appears to be more or less restricted to the limy beds lying between Bentonites B and C.

6. Below Bentonites A and B, the beds are sparsely fossiliferous. Several isolated specimens of ostracodes were collected below Bentonite A.

7. The thickness of the Eggleston formation is more or less uniform, thinning slightly to the southwest.

8. Except for the color difference, the basal Eggleston is not megascopically unlike the upper Moccasin. The Eggleston is more competent.

9. The individual beds within the Eggleston formation become more limy southwestward from New River.

10. The thicker bentonites and bentonitic zones occur in Geologic Sections 2, 7, and 8. These sections occur along a line of strike extending from New River to the Tennessee line. A possible source might lie to the southeast, somewhere in the Piedmont of North Carolina, where there are abundant volcanic rocks believed to be post-Cambrian in age. (See Figure 3).

11. Early Trenton time was a period of much local volcanic activity. The ash falls occurred spasmodically and were interupted at varied intervals as is evidenced by the thin, calcareous, shaly intercalations within the bentonite zones.

12. The beds of the Eggleston formation were laid down near shore in the early Trenton sea. The muddy sediments provided an environment unfavorable to life, or possibly unfavorable to the preservation of

many forms of life.

13. A hiatus exists along the northwestern slope of Clinch Mountain in southern Russell County, Virginia where the Eggleston formation is absent. The vast amount of mud-cracked surfaces seen within the upper Moccasin red beds at this locality is indicative of very near shore deposition resulting in extensive mud flats with the possible removal of the Eggleston beds by local stream action. This action would produce clearer waters for the subsequent deposition of the dark, fossiliferous limestones of the lower Martinsburg formation which are found to lie directly on the Moccasin red beds.

14. The Eggleston formation and related beds lying between the Moccasin red beds and the lower Martinsburg formation represent a facies of the Moccasin formation. The succession of beds is distinct and widespread, and is worthy of being mapped separately and correlated with similar successions throughout southwestern Virginia. (See Plate 1).

Correlations

15. The Carters formation in Lee County, Virginia is equivalent in age to the Eggleston formation in southwestern Virginia and the Tyrone formation of central Kentucky. The absence of red beds in the Moccasin, the marked increase in the faunal content of the Carters, and the increase in the number of intercalated limestone beds are indicative of

off shore deposition in clearer waters.

16. Bentonite A is light-yellow to bluish-yellow in color. At all localities its presence marks the lowest bentonitic horizon within the Eggleston formation as herein defined. No evidence of any other bentonite or bentonitic zone was found below this horizon. Bentonite A ranges in thickness from slightly less than 6 inches to 12 inches, and contains very thin partings of calcareous shale.

17. Bentonite B, containing a thin intercalation of light- to dark-maroon shale, is a readily recognizable marker occurring in the succession from New River to the Tennessee line.

18. Bentonite C is yellow in color, and at all localities is found to contain fragments, or partings, of buff to gray-drab shale. No evidence of any other bentonite or bentonitic zone was found between the Bentonites B and C.

Within the Eggleston, at all of the localities, Bentonite C marks the uppermost limit of the fauna. The sparse fauna of the Eggleston was recovered from a succession of limestones directly below Bentonite C and above Bentonite B at all localities except two (Geologic Sections 1 and 8). Here, several isolated fossils were recovered below Bentonite B.

19. A fourth bentonite, Bentonite D, was found in Geologic Sections 2, 3, 4, and 8. It is not readily discernible due to weathering and to shearing, but where evident, Bentonite D was found to be slightly thicker.

It is best exposed near Hagan, Lee County (Geologic Section 8) and in Giles County (Geologic Section 2).

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a. Bentonite A and underlying bed of cuneiform-jointed limestone. b. Bentonite B and underlying bed of siliceous limestone. Along New River, 2 miles west of McCoy in Giles County, Virginia, Geologic Section 1.

Plate 2

a.

b.

a. Contact between the Moccasin formation and the Eggleston formation. b. Contact between the Eggleston formation and the Martinsburg formation; nine-inch coquina-like bed marks the lower limit of the Martinsburg. Along New River, 2 miles west of McCoy in Giles County, Virginia, Geologic Section 1.

Plate 3

a.

b.

a. Contact between the Moccasin formation and the Eggleston formation. b. Basal autoclastic zone within the Eggleston formation, knife marking upper limit of 14-inch zone. Along State Route 625, 2 miles south of Eggleston, Giles County, Virginia, Geologic Section 2.

Plate 4

a.

b.

a. Bentonite A. (Compass rests on bed of silicified limestone).

b. Bentonite B and underlying bed of cuneiform-jointed limestone. Along State Route 61 at Burkes Garden Siding, Tazewell County, Virginia, Geologic Section 4.

Plate 5

a.

b.

a. Bentonite C and underlying bed of silicified limestone.

b. Folds within the lower "Trenton" member of the Martinsburg formation. Along U. S. Routes 19 and 460 at Burkes Garden Siding, Virginia, Geologic Section 4.

Plate 6

a.

b.

a. Bentonite C and underlying chert bed. b. Bentonite D and underlying chert bed. Upper Carters formation along Louisville and Nashville Railway near Hagan, Lee County, Virginia, Geologic Section 8.

Plate 7

a.

b.

Appendix I

CHEMICAL ANALYSES OF ORDOVICIAN BENTONITES			
	1	2	3
SiO_2	54.21 %	55.11 %	47.89 %
Al_2O_3	17.63	18.46	20.63
Fe_2O_3	2.89	4.39	1.44
MgO	3.44	3.50	3.66
CaO	5.71	2.10	7.59
Na_2O	1.05	1.27	0.62
K_2O	4.93	5.78	5.20
TiO_2	0.22	0.25	0.26

C.E. Houston, Analyst

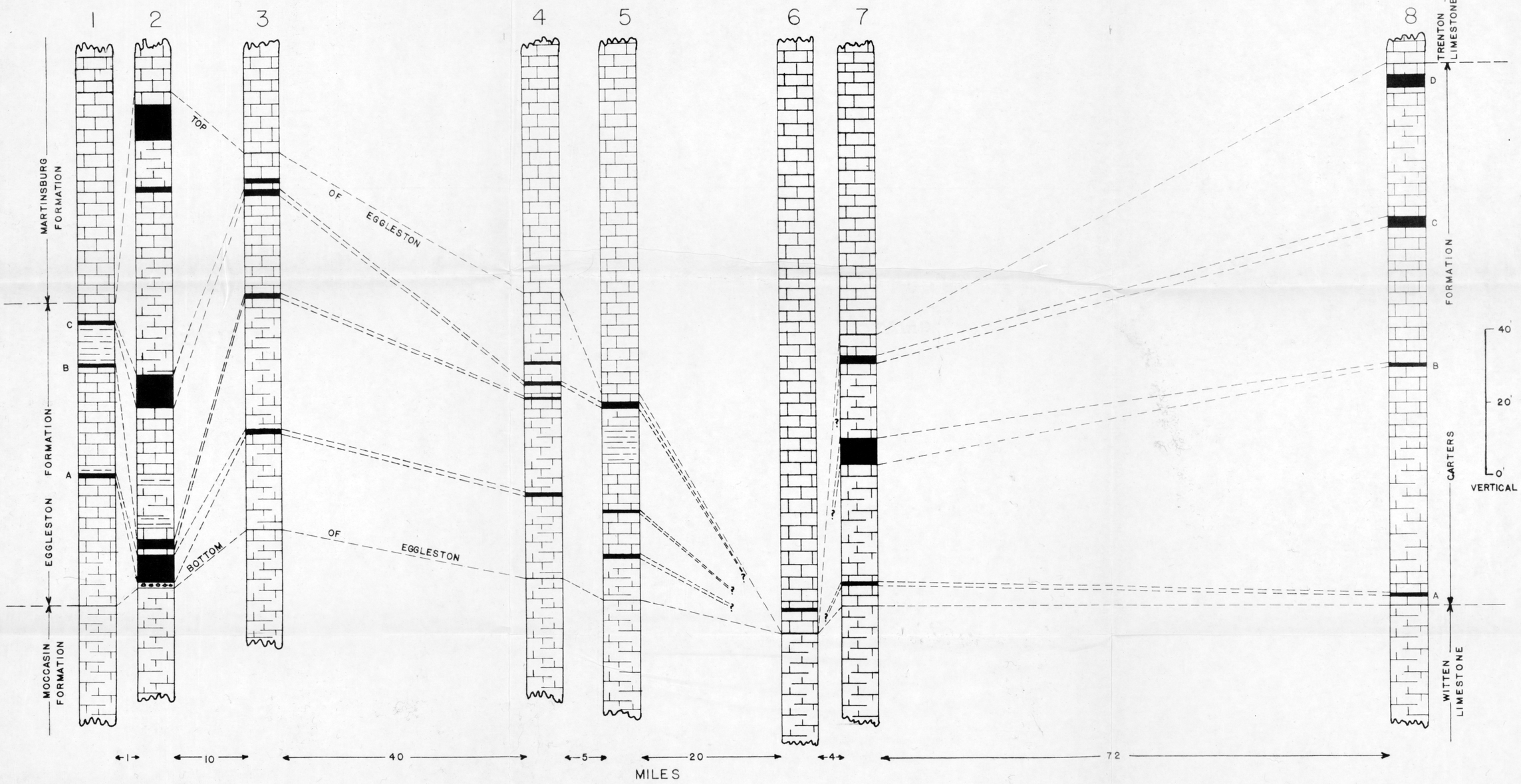
Appendix II

CORRELATION OF THE BENTONITES OF THE EGGLESTON FORMATION WITH THOSE OF THE EGGLESTON FACIES OF ROSENKRANS.*

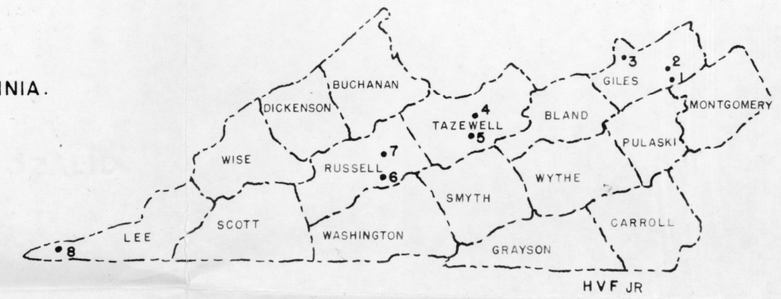
Rosenkrans 1936	Present Study
V-6	D
V-5	?
V-4	C
V-3	B
?	A
V-2	?

*(1926, p. 48)

PLATE 1



CORRELATION OF THE EGGLESTON FORMATION AND RELATED BEDS IN SOUTHWESTERN VIRGINIA.



HVF JR