

CORRELATION OF THE OUTCROP AT SPADES, INDIANA.

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INTRODUCTION.

The collections forming the basis for the present paper were carefully made by the Rev. T. A. Bendrat, M. S., during the autumn of 1913, from the exposure one mile west of Spades, Indiana. His careful description of the outcrop has been of considerable value in the correlation.

The identifications of the species were made in the laboratories of the Department of Geology of Indiana University under the supervision and direction of Professor E. R. Cumings and Dr. J. J. Galloway. Their assistance and suggestions have been of great value.

THE PRESENT DIVISIONS OF THE RICHMOND.

Richmond—

- Elkhorn (*Platystrophia moritura* zone).
- Whitewater (*Homotrypa wortheni* zone).
- Saluda (*Tetradium minus* zone).
- Liberty (*Strophomena planumbona* zone).
- Waynesville (*Dalmanella meeki* zone).

DESCRIPTION AND STRATIGRAPHY.

The reconstruction of the Cincinnati Division of the C., C., C. & St. L. Railroad through Ripley County, Indiana, in 1902-04 made available for study a section of strata high in the Cincinnati one mile west of Spades. The exposure at present is from five to six feet high and in places partially covered with debris, leaving, however, distinct ledges outcropping. The strata are approximately horizontal. The limestone at the base of the exposure weathers to a bluish-gray; it is very variable in texture, some portions being very finely crystalline, others containing quite large calcite crystals, as well as geode formations and iron concretions. Above this limestone the strata become more argillaceous, thinly bedded and present a distinct shaly structure.

This section possesses a distinct similarity to the upper part of the Whitewater section exposed at Richmond, Indiana, in being a very nodular, shaly limestone.

Though similarity in lithology is not a conclusive proof that two or more separated sections are parts of the same formation, yet the fact that there is a distinct resemblance does tend to lend favor to that decision.

A detailed description of this locality is given in the following section, taken from "The Stratigraphy and Paleontology of the Cincinnati Series of Indiana."*

SECTION ALONG THE WEST FORK OF WHITEWATER RIVER AT
RICHMOND, INDIANA.

(Number 1 is at the top of this section.)

1. Exposures in the bank above Thistlewaite Falls on the west fork of Whitewater River, about one and one-quarter miles north of the National road bridge across Whitewater River. Thin, lumpy limestone. *Rhynchotrema dentata* (aa). Several species of gastropode, including *Salpingostoma richmondense* (c). *Strophomena sulcata* (r)..... 8 feet.
2. Layer in the breast of the falls. Heavier layer at the top. Limestone. *Monticulipora epidermata* (c). *Platystrophia acutilirata senex* (c). *Homotrypa wortheni*..... 5 feet
3. West side of creek just below the falls. Bryozoa (aaa), *Monticulipora epidermata*, etc..... 5 feet.
4. Just north of the C. R. & M. R. R. bridge. Thin, shaly limestone, *Rhynchotrema capax*, the highest specimens. *Plectambonites sericeus* (rr)..... 5 feet.
5. Just south of the C. R. & M. R. R. bridge. *Rhynchotrema capax* (aa) 4 ft. 8 in.
6. About one-eighth of a mile north of the road bridge across the west fork. *Ptylodictya plumaria*, etc..... 5 feet.
7. A short distance north of the junction of the east and west forks of the river. Limestone and intercalated shale. *Hallopora*, very similar to *H. rugosa*. No specimens of *Rhynchotrema dentata* 4 feet.

*Prof. E. R. Cumings. Indiana Dept. Geology and Nat. Resources, 32d Ann. Rept. 1907.

RELATION OF THE SPADES SECTION TO CUT 18 NEAR WEISBURG.

In all parts of the Tanner's Creek section there is a general dip of five feet to the mile, and we may assume that this dip holds over the five miles from Weisburg to Spades. This places the base of the Whitewater, which is exposed in the cut 18 just north of the station at Weisburg, seventy-five feet below the railway grade at Spades. In the Richmond section of the Whitewater, where the whole of the formation is exposed, a similar thickness is found, leading us to conclude that the outcrop one mile west of Spades represents the upper strata of the Whitewater. The position of the latter outcrop in reference to the Whitewater in the Ripley County locality is shown on the accompanying chart. The lines of dip have been extended to Batesville, five and one-half miles northwest of Spades, where there is sixty feet of Whitewater, portions of which are exposed in the stream gullies a few miles south of Batesville.

RANGE OF THE SPECIES FOUND AT SPADES, INDIANA.*

Byssonychia grandis Ulrich, Upper Richmond.

Byssonychia obesa Ulrich, Whitewater.

Calymene callicephala Green. Common throughout the Cincinnati, especially at the top of the Waynesville.

Dalmanella meeki (Miller). Coryville-Arnheim and Waynesville.

Platystrophia laticosta (Meek). McMicken, Maysville and Richmond.

Lophospira trophidophora (Meek). Whitewater.

Platystrophia acutilirata (Conrad), Waynesville, Liberty and Whitewater.

Platystrophia acutillirata senex (Cumings). Upper Whitewater.

Platystrophia laticosta (Meek). McMicken, Maysville and Richmond.

Protarea richmondensis (Foerste). Waynesville, Liberty and Whitewater.

Rafinesquina alternata (Emmons). Throughout the Cincinnati.

Streptelasma rusticum (Billings). Waynesville, Liberty, Saluda and Whitewater.

Arthropora shafferi (Meek). Throughout the Cincinnati.

Bythopora delicatula (Nicholson). Coryville-Arnheim and Richmond.

Dicranopora emacerata (Nicholson). Maysville and Richmond.

Hallopora cf. ramosa. Richmond.

Helopora elegans Ulrich. Liberty and Whitewater.

*See "Stratigraphy and Paleontology of the Tanner's Creek Section of the Cincinnati Series of Indiana."

Heterotrypa sp. undescribed. Upper Whitewater.
 Homotrypa wortheni (James). Richmond and Whitewater.
 Homotrypella hospitalis (Nicholson). Waynesville to Whitewater.
 Nematopora cf. lineata (Billings). Middle and Upper Ordovician.
 Rhinidictya lata (Ulrich). Waynesville.
 Rhombotrypa sp. undescribed. Upper Whitewater.
 Stigmatella sp.

SPECIES FROM NUMBERS ONE AND TWO OF THE WHITEWATER SECTION AT
 RICHMOND, IND. (See section above.)*

Anomalodonta gigantis Miller.
 Byssonychia grandis Ulrich.
 *Byssonychia obesa Ulrich.
 Byssonychia suberecta Ulrich.
 Ischyrodonta modioliformis Ulrich.
 Pterinea demissa (Conrad).
 *Protarea richmondensis Foerste.
 *Streptelasma rusticum (Billings).
 Cyclonema bilix (Conrad).
 *Lophospira tropidophora (Meek).
 Salpingostoma richmondensis Ulrich.
 Cytoceras sp.
 Amplexopora sp.
 *Bythopora delicatula (Nicholson).
 Bythopora meeki (James).
 Ceramoporella ohioensis (Nicholson).
 Corynotrypa inflata (Hall).
 *Dicranopora emacerata (Nicholson).
 Hallopore subnodosa (Ulrich).
 Heterotrypa prolifica Ulrich.
 Heterotrypa subramosa (Ulrich).
 Homotrypa austini Bassler.
 Homotrypa flabellaris Ulrich.
 Homotrypa flabellaris spinifera Bassler.
 *Homotrypa wortheni (James).
 Monticulipora epidermata Ulrich and Bassler.
 Peronopora pavonia (d'Orbigny).

*The species marked with an asterisk are found in the section at Spades, Indiana.

Homotrypella rustica Ulrich.

Rhombotrypa crassimuralis (Ulrich).

Dinorthis subquadrata (Hall).

Hebertella occidentalis (Hall).

**Platystrophia acutilirata* (Conrad).

**Platystrophia acutilirata senex* Cumings.

**Rafinesquina alternata* (Emmons).

Rhynchotrema denatatum (Hall).

Strophomena vetusta James.

Strophomena planumbona (Hall).

Strophomena sulcata (Verneuil).

Zygospira modesta (Hall).

In comparing the fauna of this cut with the numbers, one and two, of the Richmond type section, we find that many species that appear in the type locality are not found at Spades, but those that do appear at Spades are undoubted Whitewater species. Those that are limited to and characteristic of, the Whitewater, are: *Homotrypa wortheni* (James?) *Platystrophia acutilirata senex*, Cumings. *Byssonychia obesa* Ulrich, and *Lophospira trophidopora* (Meek).

Twenty-four species were identified from Spades, three of which are new and undescribed. The description and discussion of their morphological structure will be given in a subsequent paper.

