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## MOHAWKIAN SERIES ON WEST CANADA CREEK, NEW YORK.

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**ABSTRACT.** The stratigraphy of the Mohawkian series along West Canada Creek from Trenton Falls to Herkimer is summarized. The Lowville, Rockland, Kirkfield and Shoreham limestones thin southeastward. The Denmark limestone grades southeastward into black shale. The Cobourg limestone disappears partly by gradation into shale, and partly by offlap. The Holland Patent black shale is relatively constant. The stratigraphic position of several metabentonites is established.

### INTRODUCTION.

THE preparation of the report on the geology of the Utica quadrangle, southwest of the Adirondack Mountains in central New York, has involved study of exposures of the Ordovician Mohawkian sediments along West Canada Creek from Trenton Falls to Herkimer. (Fig. 1.) The following is a summary of the stratigraphy which is more fully discussed in the report.

### STRATIGRAPHIC COLUMN.

The sequence of Mohawkian units in the northern part of the quadrangle is:

#### ORDOVICIAN system

##### CINCINNATIAN series

Eden group—Frankfort shale

##### MOHAWKIAN series

##### Trenton group

Holland Patent (Upper Utica) black shale . . . . . 400 feet  
(disconformity)

\* Temporary Geologist, New York State Museum; published with the permission of the Director.

Cobourg formation:	
Steuben limestone member .....	60
Rust limestone member .....	115
Denmark formation:	
Russia limestone member .....	70
Poland limestone member .....	60
Rathbun limestone member .....	10
(disconformity)	
Shoreham limestone .....	45
Kirkfield limestone .....	45
(disconformity)	
Rockland limestone .....	10
(disconformity)	
Black River group	
Lowville limestone .....	40
(disconformity)	

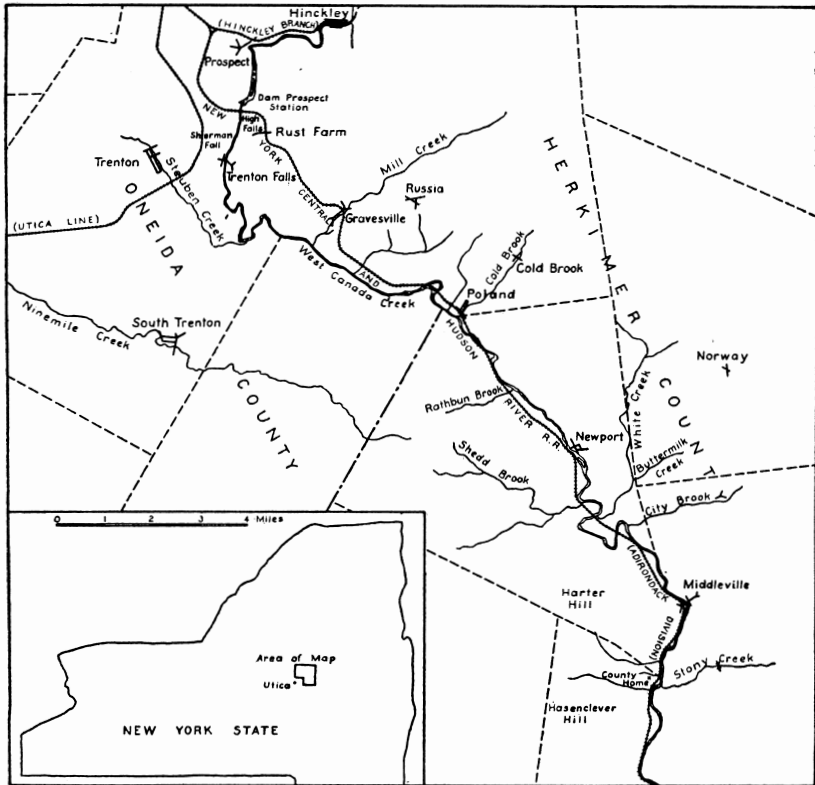


Fig. 1. Map showing localities along West Canada Creek.

## CAMBRIAN system

## ST. CROIXAN series—Little Falls dolomite

In the southeastern part of the quadrangle, the lower part of the Russia member is succeeded by black shale of the Canajoharie formation, and that by Utica shale, including beds equivalent to a part or the whole of the Cobourg and Holland Patent formations.

The Lowville limestone has 14 feet of argillaceous and arenaceous limestone overlain by 26 feet of relatively pure, sublithographic limestone in the quarry northwest of Newport. The dark, dense, black chert-bearing Rockland limestone ("Black River" of Raymond, 1903<sup>1</sup>) is exposed for 8 feet in the same quarry. The formation is overlapped by the Kirkfield<sup>2</sup> limestone southeastward, the latter thinning to about 10 feet at Little Falls, to extinction west of Canajoharie. The Shoreham limestone also thins to the southeast, being 41 feet on Rathbun Brook, two miles northwest of Newport, but only 16 feet on the stream north of County Home, near Middleville; it is the zone of *Cryptolithus tessellatus* Green. The relations are summarized in Figure 2. Regional stratigraphy has been discussed in a previous paper.<sup>3</sup>

The Denmark and Cobourg limestones are of exceptional interest because of their rapid change into black shale southeastward. The Denmark is divided into three newly defined members, the Rathbun, Poland and Russia. The Rathbun is

<sup>1</sup> Raymond, P. E.: 1903, 'The faunas of the Trenton at the type section and at Newport, New York.' Bull. American Paleont., No. 17.

<sup>2</sup> The name Kirkfield is preferred to "Hull" of the writer's earlier papers. Kirkfield (Johnston, W. A.: 'Simcoe District, Ontario.' Geol. Surv., Canada, Summ. Rept. for 1910 [1911], pp. 188-192) has precedence over Hull (Raymond, P. E.: 'Trenton group in Ontario and Quebec.' Geol. Surv., Canada, Summ. Rept. for 1912 [1914], pp. 342-350). The type Hull at Hull, Quebec, has the stratigraphic position of the Kirkfield of southern Ontario and northwestern New York, for it lies between the "*Triplesia* zone" (Rockland) and the "*Cryptolithus* zone" (Shoreham); the latter forms the basal part of the "*Prasopora* beds" (Sherman Fall) of Johnston and Raymond. There are faunal differences between the Hull and Kirkfield (Sinclair, G. W.: 1942, 'Age of the Trenton crinoid beds at Kirkfield, Ontario' (abstract), Bull. Geol. Soc. America, Vol. 55, p. 1833), but the writer believes them equivalent. There has been unfortunate assumption by some authors that all the echinoderms at Hull, Quebec, are from the Hull limestone, and synchronous with those described from the type Kirkfield, whereas many are younger.

<sup>3</sup> Kay, G. M.: 1937, 'Stratigraphy of the Trenton group.' Bull. Geol. Soc. America, Vol. 48, pp. 233-302.

6 feet of brachiopod coquina, calcilutite and calcareous shale in the type section on Rathbun Brook. The member contrasts with the underlying Shoreham in the relative abundance of calcilutite, and sharply with the overlying Poland, which lacks coquinal beds. The Rathbun persists along West Canada Creek, but is absent to the east at Little Falls. It is placed in the Denmark because a persistent, basal calcarenite suggests subjacent disconformity; but it is lithologically more like the

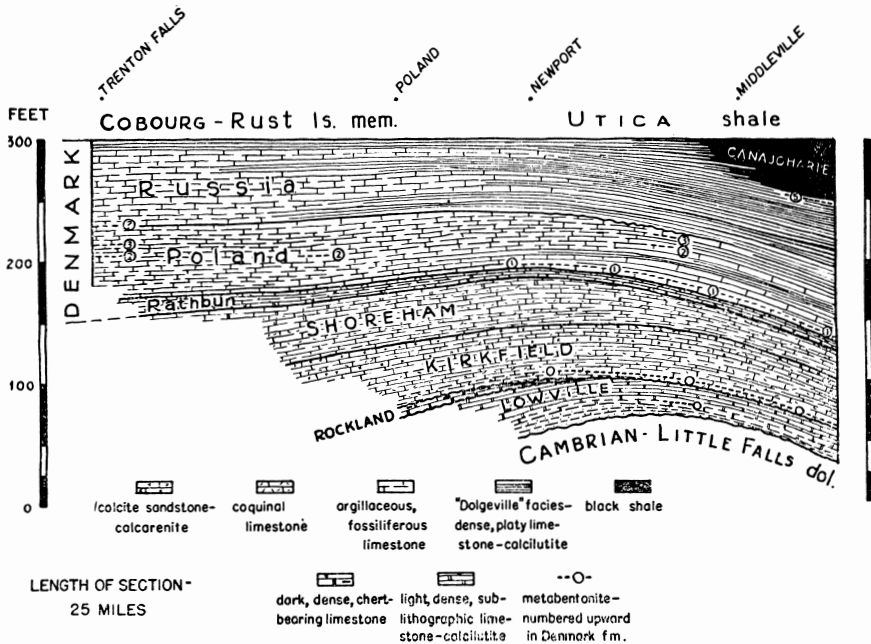


Fig. 2. Restored section of the Lowville, Rockland, Kirkfield, Shoreham and Denmark formations along West Canada Creek.

Shoreham than the Poland, and contains *Cryptolithus quadrilineus* Whittington; the disposition is somewhat arbitrary. The Poland member has 2 to 3 feet of black, dense, resistant limestone at its base, containing frequent cephalopods, including *Trocholites ammonius* Conrad; associated forms, such as *Geisonoceras tenuistriatum* (Hall), *Endoceras proteiforme* (Hall), *Calymene senaria* (Hall), and *Sinuities cancellatus* (Hall), and *Diplograptus amplexicaulis* (Hall), a guide to the member, are common in the succeeding beds. The Poland is defined at Trenton Falls as extending from the base of exposure

for 50 feet to the prominent re-entrant above Sherman Fall and at the base of High Falls, and includes underlying limestone to the base of the *Trocholites* subzone, unexposed at Trenton Falls but probably about ten feet below the lowest exposure; thus the thickness is about 60 feet. The Russia member is defined at Trenton Falls as extending from the top of the Poland through 70 feet of shaly limestone to a local discon-

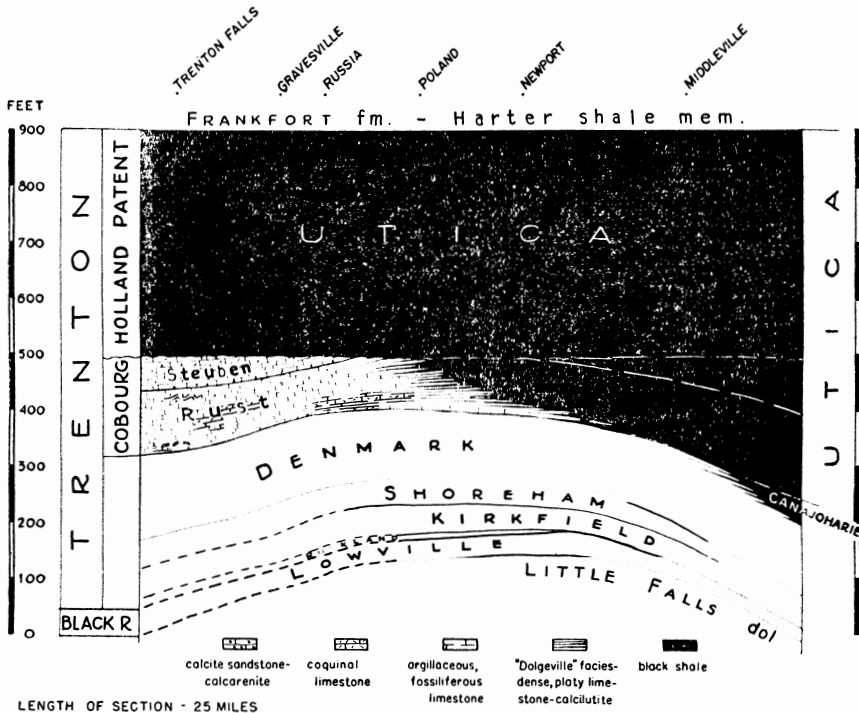


Fig. 3. Restored section representing the interpretation of the Cobourg and Utica formations.

formity 2 feet below a ferruginous bed in the base of Upper High Falls; the lower 50 feet are lithologically similar to the Poland, but relatively barren, platy calculutite and shale form the upper 20 feet.

The Cobourg limestone in the Utica quadrangle is equivalent to the Lower Cobourg (Hallowell) of northwestern New York. The formation is separable into two newly defined members, the Rust and Steuben (Text Fig. 3). The former, named from Rust Farm, east of the type section at Trenton Falls,

comprises 115 feet of argillaceous and *Rafinesquina deltoidea* (Conrad) bearing coquinal limestone to the base of the coarse-textured Steuben limestone above the level of the dam at Prospect bridge; the famous slump braccias at the bridge<sup>4</sup> are near the top of the member. The Steuben limestone, from Steuben Creek, principally calcite sandstone, is exposed for 26 feet above the dam; there is not a complete section in the immediate area, but the thickness is about 60 feet in the hills southwest of Barnveldt or Trenton.

The Upper Utica or Holland Patent black shale is exposed in several small areas in the northern part of the quadrangle, particularly along Ninemile Creek; the contact with the Cobourg cannot be seen, but is well shown on Big Brook near Frenchville, seven miles northwest in the Boonville quadrangle. The upper beds grade into the lowest part of the Frankfort formation, a 100-foot member of grayish to greenish shale underlying a prominent sandy member in the north and east faces of the Deerfield Hills. The Holland Patent shale is about 400 feet thick in the northwestern Utica quadrangle, containing a well-known fauna with a preponderance of graptolites,<sup>5</sup> gained from exposures along Ninemile Creek below South Trenton.

#### CHANGES IN FACIES.

In contrast to the section of 300 feet or more of limestone succeeding the Rathbun member near Trenton Falls, and succeeding 400 feet of Holland Patent shale to the south, the almost complete exposure along the stream flowing from the south of Harter Hill to north of County Home has about 100 feet of shaly limestone and 750 feet of black shale; in each the black shale is overlain by basal Frankfort gray shale. Twenty miles farther east at Canajoharie, black shale lies directly on the Shoreham limestone. The rocks are separable into five intergrading lithologic facies:

A—coarse-textured calcite sandstone or calcarenite;

B—interbedded shell limestone or coquina, fossiliferous shale, and dense, fine-textured limestone or calcilitite;

<sup>4</sup> Hahn, F. F.: 1913, *Untermeerische Gleitung bei Trenton Falls (Nordamerika) und ihr Verhältnis zu ähnlichen Störungsbildern*. Neues Jahrb., Beil. Bd. 36, pp. 1-41.

<sup>5</sup> Ruedmann, Rudolph: 1925, 'Utica and Lorraine formations in New York; Part I. Stratigraphy.' New York State Museum, Bull. 258.

- C—dark, dense, fossiliferous limestone and calcareous shale;  
D—sparsely fossiliferous, argillaceous calcilitite and laminated dark shale—the “Dolgeville facies”;  
E—black, fine-laminated, graptolitic shale.

These facies are believed to be arranged in the order of the depth of their deposition, from shallowest to deepest. The lateral and vertical relations are represented in Figs. 2 and 3.

The Shoreham and Rathbun limestones are of interbedded coquina, fossiliferous calcareous shale and calcilitite facies, the Rathbun containing a larger proportion of calcilitite. The Rathbun has a persistent bed of calcarenite about a foot thick at the base, and both have increasing proportions of calcarenite as they thin southeastward, the latter to extinction. The Poland is principally of dense fossiliferous limestone with intercalated calcareous shale (facies C) southeastward to Newport, passing wholly into sparsely fossiliferous argillaceous calcilitite and shale of the “Dolgeville facies” (D) at East Canada Creek, and ultimately into black shale (E) at Canajoharie. The Russia is similar to the Poland (C facies) at Trenton Falls, but the upper part is of the “Dolgeville facies” (D); the latter is prevalent at Middleville, where the upper Russia has the westernmost upper Canajoharie black shale (E), a relationship pertaining also at East Canada Creek. The whole is black shale (E) at Canajoharie. Thus, the lithologies indicate gradual deepening of water throughout Denmark time, with relatively greater sinking to the southeast.

The Cobourg limestones disappearance is more difficult to perceive because of limited exposure in critical areas. In the northwest, the deepening of water of the Denmark stage is reversed, for the Rust member is of interbedded coquinal and argillaceous limestones (facies B), the succeeding Steuben of calcarenite (A). The former is exposed southeastward to just within Herkimer County west of Poland, where it is 50 feet thick and more argillaceous; it may be represented in a 30-foot concealed interval on upper Rathbun Brook; *Ceraurus pleuraxanthemus* Green is common in the base of the Rust north of Gravesville and 1.5 miles north of Poland, as well as in the isolated exposure at Rust Quarry. The Steuben is exposed only to the mouth of Steuben Creek, and cannot extend far to the southeast of that locality. Southeast of County Home, southwest of Middleville, the beds between the upper Canajo-

harie and the basal Frankfort are entirely black shale; more thorough study and zoning of this Utica section will be needed before the problem of the disappearance of the Cobourg can be unequivocally solved. The interpretation that seems best to satisfy the known facts is that the Rust member changes to the black shale facies of the Utica between Newport and Middleville; the member is more argillaceous at Poland than at Trenton Falls, and interbedded calcilutite and black shale succeeds the covered interval of 30 feet above the Russia on Rathbun Brook, and underlies black shale having graptolites of doubtful Utica age (Ruedemann). The Steuben member is cut out by non-deposition on an arch in the vicinity of Poland, the equivalent part of the Utica black shale entering in lower West Canada Creek valley. The Holland Patent (Upper Utica) of the northwest, deposited in relatively deep water, lies with disconformity on the shallow-laid Steuben calcarenite, and is continuous southeastward to form the upper part of the much thicker Utica section in the vicinity of Middleville.

#### METABENTONITES.

Metabentonites are gray or buff clays, sectile and plastic when wet, that are the products of alteration of beds of volcanic ash. Those in the Utica quadrangle are thin representatives of layers that are much thicker in states to the south, toward the supposed volcanic source. They are readily distinguished from the black, hard shales and their x-ray diffraction patterns are like those of "potash bentonites" or metabentonites of known volcanic origin. The writer summarized the known clays nearly ten years ago<sup>7</sup>; new information permits addition and revision.

The Lowville limestone contains a prominent 3-inch clay near the base of the relatively pure limestone member and 20 feet from its top in the quarry just south of City Brook, two miles north of Middleville; there is but a prominent bedding plane at this horizon in the quarry northwest of Newport. A second *thin* clay is present in Central Ontario in beds correlated with the top of the formation,<sup>8</sup> and additional clays probably are

<sup>7</sup> Kay, G. M.: 1935, 'Distribution of Ordovician altered volcanic materials and related clays.' Bull. Geol. Soc. America, Vol. 46, pp. 225-244.

<sup>8</sup> Kay, G. M.: 1942, 'Ottawa-Bonnechere Graben and Lake Ontario Homocline.' Bull. Geol. Soc. America, Vol. 53, pp. 585-646.

present within the succeeding Chaumont in northwestern New York and southeastern Ontario.<sup>9</sup>

In the lower Trenton, a distinct thin clay, the Hounsfield metabentonite, lies near the base of the Rockland formation (Selby member) at Dexter, New York.<sup>10</sup> A prominent clay has been identified in several sections of the Kirkfield limestone near its base along West Canada Creek; inasmuch as the formation overlaps, this should lie at an horizon near the middle in the thicker sections in northwestern New York. A re-entrant in the "Sherman Fall" on Rathbun Brook,<sup>11</sup> now considered to be at 36 feet in the Shoreham, 5 feet from the top, may represent a thin metabentonite, though good clay has not been extracted.

The Denmark formation contains several metabentonites. None has been seen in the Rathbun member. The lowest, near the base of the Poland member, is 1 to 3 feet above the *Trocholites* subzone, has been seen in several sections, and is well displayed on an extensive pavement a foot above the subzone east of the highway bridge over Stony Creek, south of Middleville. The second and third clays show in the face of Sherman Fall<sup>12</sup> about 35 and 45 feet in the member; both are exposed on City Brook, north of Middleville, 31 and 40 feet in the member where it is principally of Dolgeville facies. A fourth clay is believed to be represented in the deep re-entrant at the contact of the Poland and Russia members at Trenton Falls. A fifth, a 5-inch clay, is present in the Russia member at the base of the Canajoharie black shale facies, 65 feet in the Russia on the stream one-quarter mile south of County Home.

Thus, within and near the Utica quadrangle, there are prominent clays in the Lowville and basal Kirkfield, a doubtful one in the upper Shoreham, three clays within the Poland member of the Denmark, a fourth doubtfully at the top, and a prominent clay in beds considered equivalent to the upper Russia. In northwestern New York and Ontario there are at least two additional clays in the upper Black River, and one in the basal Rockland. Metabentonites that have been found in the Sherman Fall (Shoreham plus the Denmark) limestone in

<sup>9</sup> Young, F. P., Jr.: 1943, 'Black River stratigraphy and faunas.' Amer. Jour. Sci., Vol. 241, pp. 211, 214-215.

<sup>10</sup> Kay, G. M.: 1935, op. cit., Fig. 2.

<sup>11</sup> —————: 1935, *ibid.*, p. 230.

<sup>12</sup> —————: 1935, *ibid.*, pl. 20.

northwestern New York probably correspond to some of those in the Utica quadrangle, but the stratigraphy of the formations is not sufficiently known to establish their equivalents.

Metabentonites prove most useful in establishing exact correlation where including beds are known by other means to be approximately equivalent, for they represent synchronous ash falls over great areas. Those in the basal Kirkfield come progressively nearer the base southeastward, permitting measurement of the overlap. Those in the Poland evidence the continuity of beds through changing facies, and demonstrate the essential constancy of thickness of deposits in the intervening beds. Inasmuch as the New York sections form the standard for classification, the clays found in New York will be useful in permitting precise correlation of horizons in the Appalachian region, where metabentonites are thicker and more conspicuous. Experience shows that even in the latter area, local conditions at the time of deposition result in varying thickness, or even absence of clays where they should be expected. But their limited number and relative constancy has proved most useful in precise stratigraphic studies.<sup>13, 14</sup>

<sup>13</sup> Whitcomb, Lawrence: 1932, Correlation by Ordovician bentonite. *Jour. Geol.*, Vol. 42, pp. 522-534.

<sup>14</sup> Rosenkrans, R. R.: 1934, Correlation studies of the Central and South Central Pennsylvania bentonite occurrences. *Amer. Jour. Sci.*, 5th ser., Vol. 27, pp. 113-134.

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