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ON THE "SNAKE HILL SHALE"

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ABSTRACT. Restudy of the terrain mapped as "Snake Hill Shale" in eastern New York reveals that at least three lithic units are present in it. One of these underlies the other two, which are lateral equivalents of each other. At Snake Hill, the type locality of the "Snake Hill Shale," the upper part of the Normanskill Formation is the only unit present and the Austin Glen Graywacke member forms the crest of the hill. A lithic unit composed of pebbles, cobbles, and boulders of graywacke, mudstone, and argillite as well as other lithologies in a matrix of highly contorted black shale overlies the Normanskill Formation east of Snake Hill and a unit composed mostly of siltstone overlies it west of Snake Hill. The siltstone unit apparently grades laterally into the Canajoharie Shale. The upper part of the Normanskill Formation and the two overlying units are Early Trenton in age. The name "Snake Hill Shale" should be abandoned.

INTRODUCTION

Most of the graptolite-bearing units in eastern New York have attained both formational and chronostratigraphic status. One of these units, the Snake Hill Shale, has been widely recognized (Ruedemann, 1912, 1930; Cushing and Ruedemann, 1914; Kay, 1937; Elam, ms). It has always been considered to overlie the Normanskill Formation and to be an equivalent of the lower part of the Canajoharie Shale. Its graptolite fauna was, in part, the basis for the tenth in a sequence of twenty Ordovician graptolite zones Ruedemann (1919, 1947) delimited in eastern New York.

In the course of a restudy of the New York Ordovician graptolite succession, the writer reinvestigated and recollected the terrain Cushing and Ruedemann (1914) and Ruedemann (1930) mapped as Snake Hill Shale. This investigation follows one (Berry, 1962) of the older part of the succession. Graptolite zones as discussed herein are those recognized by the writer (1960) in the Marathon region, Texas.

THE ROCK UNITS

Ruedemann (1901) described a distinctive, essentially molluscan fauna from several exposures of contorted shale near the mouth of the Mohawk River near Troy, New York (fig. 1). The fauna was identified as of Early and Middle Trenton age. Subsequently Ruedemann (1908), on evidence supplied by the few graptolites in the fauna, grouped the rocks bearing it in the Magog Shale, a unit recognized near Quebec, Canada. Later work revealed more "shelly" fossils from the New York "Magog Shale" but few graptolites were added to those already found. Ruedemann (1912, p. 59) concluded that although the New York and Quebec occurrences of the Magog Shale were equivalent, the New York unit bore too few graptolites to justify including both the New York and Quebec rocks in the same formation. He established (1912, p. 59) the name "Snake Hill Shale" for the New York unit because the largest and most diverse of the distinctive shelly faunas came from Snake Hill on the east shore of Lake Saratoga (fig. 2). Ruedemann thus used faunal not lithic criteria to typify his new formation.

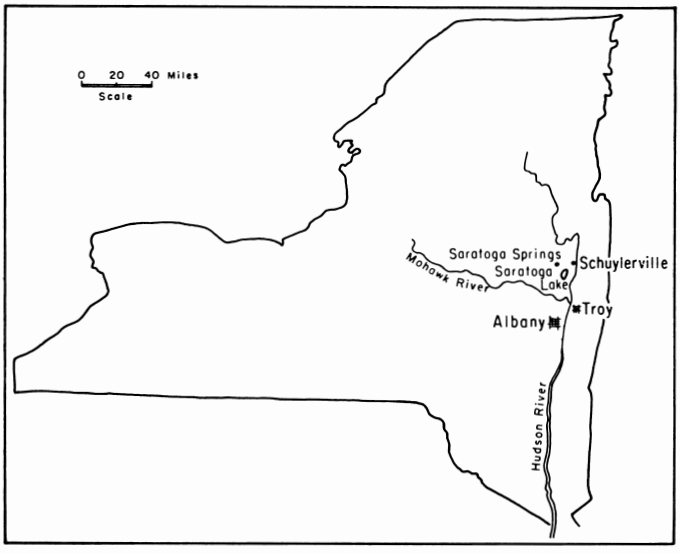

Fig. 1. Map of New York showing localities in eastern New York mentioned in text.

In 1914, he described the lithologic character of the Snake Hill Shale, indicating that the unit was lithologically similar to the Normanskill Formation and stating (Cushing and Ruedemann, 1914, p. 94): "The prepondering portions of the formation, however, are dark gray to black, bluish and greenish gray argillaceous shales which are difficult of separation from the Normanskill shales, save by the enclosed faunas". The rock type (Cushing and Ruedemann, 1914, and Ruedemann, 1930) discussed as most typical in the formation was argillaceous shale, but graywacke and conglomerate beds were noted as locally prominent.

Reinvestigation of the rocks mapped as Snake Hill Shale and their fauna has revealed that at least three different lithic units have been grouped in it. Each of these units has yielded elements of the distinctive fauna which Ruedemann used as the diagnostic feature of the formation.

At the type locality, Snake Hill (fig. 2), the fauna is present in brown, medium to thick bedded, coarse grained graywacke layers and in compact gray to black mudstone beds beneath them. Study of these rocks and the stratigraphy in the vicinity of Snake Hill revealed that the upper part of the Normanskill Formation crops out in the area. Snake Hill itself is composed, geologically, of a large syncline in the Austin Glen Graywacke member of the Normanskill Formation. The vertical northwest limb of the syncline forms the crest of the hill. The stratigraphically highest beds of the underlying member are exposed beneath the Austin Glen Graywacke on the north face of Snake Hill. Ruedemann (Cushing and Ruedemann, 1914) cited other fossil localities in his "Snake Hill Shale" on the east shore of Saratoga Lake. Study of the rocks exposed along the east shore of the lake and east from it for a distance of about a mile revealed that the rocks underlying this area are highly folded

Austin Glen Graywacke member of the Normanskill Formation and the upper part of the member stratigraphically beneath it. The Normanskill Formation is the only unit exposed within three miles north, east, or south of Snake Hill; Saratoga Lake obscures outcrops to the west.

The rocks from which Ruedemann obtained the original "characteristic fauna" are all highly contorted black shales and argillites exposed on the banks of the Hudson River and on islands in it, one or two miles north of Troy. These rocks commonly contain pebbles and cobbles of the Normanskill Formation and of other lithologies as well. This belt of cobbles and pebbles in contorted shale may be traced southward along the Hudson River into a unit composed of graywacke, chert, limestone, and black shale blocks in a gray shale matrix mapped by Elam (ms) in the vicinity of Troy and south from it along the Hudson. Fossils from the matrix of this unit were the original criteria for the formation for which Ruedemann subsequently chose Snake Hill

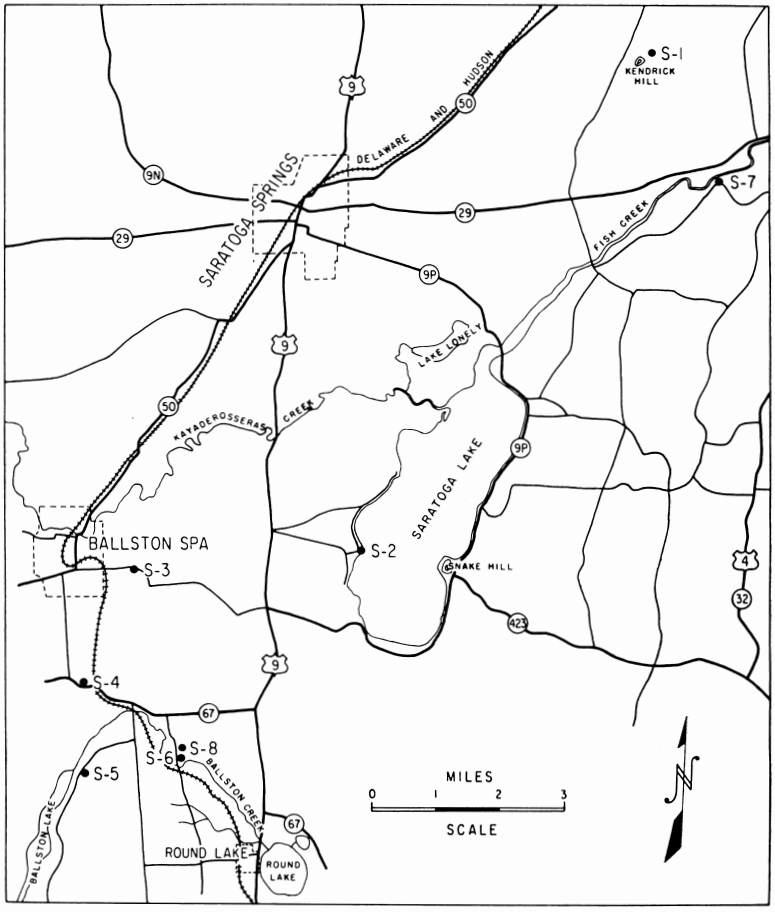

Fig. 2. Map of the Saratoga Lake area indicating fossil localities and places mentioned in text.

as the type locality. This cobbles and blocks-in-shale unit overlies the Normanskill Formation.

A third distinct lithic unit present in the terrain Ruedemann (Cushing and Ruedemann, 1914) mapped as Snake Hill Shale is that exposed on the western shore of Saratoga Lake. This unit is composed of gray, micaceous siltstone in layers one-fourth inch to two inches thick interbedded with rusty-weathering, brown, medium grained, cross laminated sandstone layers one-eighth to one-half inch thick, black, medium grained limestone in lenses up to two inches thick, and black micaceous shale. Several graptolite collections have been obtained from this unit (table 1). It overlies the Normanskill Formation and apparently grades into the cobbles and blocks-in-shale unit between Snake Hill and the Hudson River. Although no exposures were found in the present study to demonstrate its relationship with the Canajoharie Shale, the two formations, at least in part, apparently intergrade laterally.

No complete exposures of this siltstone unit were found, and it is folded in all outcrops studied. Only an estimate of the thickness can be made. The maximum may be approximately 1000 to 1200 feet.

This siltstone unit has been traced from Kendrick Hill south to Round Lake and Ballston Lake at about the latitude of East Line (fig. 2). Saratoga Lake forms the eastern border of part of the outcrop belt. The unit is folded around a plunging anticlinal nose developed in the upper part of the Normanskill Formation near fossil locality S-7 (fig. 2). One mile S80E from that locality, the unit grades into a highly contorted gray micaceous shale which

TABLE 1

Graptolites from the siltstone unit

Species	Locality (see map, fig. 2)							
	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8
Amplexograptus ? sp.	x							
Climacograptus brevis Elles and Wood			x					x
Climacograptus cf. C. pygmaeus Ruedemann	x							
Climacograptus spiniferus Ruedemann		x	x	x	x		x	
Climacograptus cf. C. spiniferus Ruedemann			x			x		x
Climacograptus typicalis Hall		x	x			x		x
Climacograptus aff. C. typicalis Hall		x						
Dicranograptus nicholsoni Hopkinson			x					
Dicranograptus nicholsoni var. longibasalis Ruedemann and Decker		x	x					
Diplograptus aff. D. multidens var. compactus Lapworth	x							
Diplograptus sp.		x						
Glyptograptus sp.	x	x						
Leptograptus sp.			x					
Orthograptus quadrimucronatus var. postremus Ruedemann								x
Orthograptus truncatus var. pertenuis (Ruedemann)	x	x	x	x	x	x		x
Orthograptus truncatus n. var.	x							
Orthograptus sp. (of the *truncatus* type)				x				

bears graywacke cobbles and small chert, mudstone, and graywacke pebbles. The writer considers this to be an exposure of the cobbles and blocks-in-shale unit in which only a few cobbles and pebbles are present in a contorted shale matrix.

Although the unit has not been traced south or east of Round Lake (fig. 2), inspection of exposures in the Albany Rural Cemetery which Ruedemann (1930) mapped as Canajoharie Shale revealed that these are lithologically identical to those on the west shore of Saratoga Lake. Perhaps the Canajoharie Shale can include this siltstone unit.

THE FAUNA

Ruedemann (1901, 1908, 1930; and Cushing and Ruedemann, 1914) listed an extensive fauna obtained from the terrain he mapped as Snake Hill Shale. The writer recollected from two of the three rock units described within this terrain. The Austin Glen Graywacke member of the Normanskill Formation at Snake Hill yielded a large brachiopod-trilobite fauna of which *Cryptolithus tesselatus* and *Sowerbyella sericeus* are the most common elements. Also, these graptolites were collected from the same beds: *Climacograptus* cf. *C. spiniferus* (Ruedemann), *Corynoides calicularis* Nicholson, and *Orthograptus truncatus* cf. var. *pertenuis*. The graptolites indicate the zone of *Orthograptus truncatus* var. *intermedius* (zone 13) of the Marathon, Texas, sequence. This zone is considered a correlative of the Trenton (Berry, 1960). The "shelly" fossils also indicate a Trenton age.

The cobbles and blocks-in-shale unit yielded few fossils to the writer, but study of Elam's (ms) collections from the matrix of this unit from exposures near Troy revealed the presence of a fauna typical of the *O. truncatus* var. *intermedius* zone. Elam's mapping indicates that the unit overlies the Normanskill Formation, although the upper part of that formation bears the same fauna.

The siltstone unit bears only graptolites. Eight collections were made from it. The species recognized in each are listed in table 1. *Climacograptus spiniferus* and *Orthograptus truncatus* var. *pertenuis* are the commonest elements of the fauna and *C. spiniferus* is by far the most abundant. The assemblage of *C. spiniferus* and *C. typicalis* with several orthograptids of the *O. truncatus* group and *O. quadrimucronatus* var. *postremus* is diagnostic of the *O. truncatus* var. *intermedius* zone. This siltstone unit, like the cobbles and blocks-in-shale unit, bears the same graptolite zonal assemblage as the beds below. Superposition in these instances reveals the precise local, temporal relations between lithic units.

CORRELATION

The lithic units that fall within the *Orthograptus truncatus* var. *intermedius* zone are Trenton in age. Preliminary restudy of the shelly faunas from the upper part of the Normanskill Formation indicates they are early Trenton (in the usage of Cooper, 1956), middle Trenton (in the usage of Kay, 1937) in age. The rocks bearing them appear to be correlatives of the Ion Formation and thus they would correlate with the lower part of the Sherman Fall Formation.

Kay (1937) recognized two members within the Canajoharie Shale. The upper, Fairfield Member, bears a fauna which includes *Climacograptus spiniferus, Corynoides calicularis,* and *Orthograptus quadrimucronatus* var. *postremus. C. spiniferus* is common in both the Fairfield Member and the siltstone unit and *O. quadrimucronatus* var. *postremus* is known principally from these beds. On the basis of these faunal similarities the author suggests that the Fairfield Member and the siltstone unit are at least in part correlative. Future mapping may demonstrate that the siltstone unit should be included in the Canajoharie Shale. The Fairfield Member is the correlative of the upper part of the Sherman Fall Formation (Cooper, 1956; Kay, 1937).

If the cobbles and blocks-in-shale unit is the equivalent of the siltstone unit and the Fairfield Member of the Canajoharie Shale, and if the blocks represent pieces from thrust sheets active during a Taconic orogenic movement, then that movement took place during the time of deposition of the upper part of the Sherman Fall Formation. The cobbles and blocks-in-shale unit is probably correlative with and may eventually be traced into the Forbes Hill Conglomerate and the Hortonville Slate mapped by Zen (1961) at the north end of the Taconic Range in west Central Vermont.

SUMMARY

The terrain mapped in eastern New York as "Snake Hill Shale" includes at least three distinct lithic units. One of the three underlies the other two.

The upper part of the Normanskill Formation is the only lithic unit present at Snake Hill, the type locality of the "Snake Hill Shale." Also, these beds are present along the east shore of Saratoga Lake at localities that Ruedemann (Cushing and Ruedemann, 1914, p. 97, and Ruedemann, 1930, p. 119) mentioned as exposures of the "Snake Hill Shale."

Overlying the Normanskill Formation is a cobbles and blocks-in-shale unit which is well exposed near the east bank of the Hudson River in the vicinity of Troy and also at Schylerville (fig. 1). This unit apparently grades laterally westward into a siltstone unit which also directly overlies the Normanskill Formation.

The upper part of the Normanskill Formation and both the blocks-in-shale and siltstone units bear a graptolite fauna which is diagnostic of the *Orthograptus truncatus* var. *intermedius* zone. Their age is early Trenton (in the usage of Cooper, 1956).

The name "Snake Hill Shale" should be dropped from use. More detailed mapping in the vicinity of Saratoga Lake and northeast from it should reveal the extent to which the Canajoharie Shale can be recognized. A new formation name may or may not be needed for the siltstone unit.

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