MIDDLE GRANVILLE SLATE

(new—Kidd, W.S.F., Delano, L.L., and Rowley, D.B., in Fisher, D.W., this publication)

Justification:

Previous mapping has confused dark slates and limestones above and below this unit. As a result, this unit has been included, in different places, in two different formations. Definition of this unit, and that of the Browns Pond Formation below it, overcomes this confusion.

Lithologic description:

Name proposed for green, purple, maroon and lesser pale to medium grey slates, extensively quarried, that lie *above* dark grey to black slates containing abundant limestones and lesser dark greywacke and orthoquartzite (Browns Pond Formation), and *below* sooty black slates containing common dolomitic arenites and quartzites, and local limestones (Hatch Hill Formation). The Middle Granville Slate weathers a distinctive and diagnostic tan color. It contains locally, in its lower to central portions, thin interbeds of grey micrite, in many places reduced to layers of disconnected nodules. Rare beds of pebbly limestone breccia and of calcarenite, up to 1 meter thick, are also found in the lower half. Phosphatic pebbles are present in these coarser limestones. Sections lacking purple and maroon slates and with scant limestones are common, particularly in the western portion of the northern Taconic Allochthon.

Contacts:

The upper contact of the unit is placed at the point where green or purple or pale-medium grey slates pass up into sooty, fissile black slates. This change is commonly sharp, or occurs over less than 1 meter thickness, but in some places is transitional over 1–3 meters.

The lower contact is placed where medium to dark grey slate changes upward to green slate. In most places this is a sharp contact or a transition over less than 1 meter thickness. At this position there is commonly a limestone breccia (which may be several meters thick); this breccia is included within the underlying Browns Pond Formation, the contact being placed at the top of the breccia, under the lowermost green slate.

Type section:

The type section is defined as the quarries and adjacent outcrops 300 to 1500 meters NNW of the bridge over the Mettawee River at Middle Granville [Granville 7½′ quadrangle]. Because further quarrying, degradation of abandoned quarries and future dumping of waste slate may obscure or remove features that can be seen at present, and because the upper contact is not well exposed in the type section, the following reference sections are provided to avoid future ambiguity arising from physical alterations in the type section.

1) A presently non-working quarry, 2.0 miles N24°E of the bridge over the Mettawee River at Truthville, at the west side of Holcombville Road. This section is described in Rowley, Kidd and Delano (1979). [Granville 7½′ quadrangle]

2) Outcrops in the field west of Holcombville Road up to the nearby southeastern shore of Browns Pond, on the northern side of the hill enclosed by 600 ft. contour. (3.15 miles N13°E of the bridge over the Mettawee River at Truthville). [Granville 7½′ quadrangle]

3) Outcrops adjacent to Hills Pond Road in the area where the 800 ft. contour crosses the road 0.3 mile north of the northern end of Hills Pond. [Thorn Hill 7½′ quadrangle]

4) Outcrops in the fields just west of Lee Road, in a belt extending up to 0.4 mile north of the southern of the two points where the 800 ft. contour crosses the road. (Lee Road is located 1.5 miles due west of the intersection of New York Routes 149 and 22 at the southern end of the town of Granville) [Granville 7½′ quadrangle]. All of these reference sections have sufficient outcrop to demonstrate the nature of the unit and the adjoining parts of the units above and below.

Thickness:

In the type section, an apparent thickness of up to about 95 meters is present but undetected repetition by minor folds may inflate the thickness here. A typical thickness of this unit in the Granville and Thorn Hill quadrangles is about 50 meters. Locally, as little as 10 meters may be present, and the unit is generally thin towards the western edge of the Allochthon in this area.

Age:

Fossils of the *Elliptocephala asaphoides* fauna have been recovered from limestones in the lower and middle parts of the unit (Dale, 1899; Theokritoff, 1964) indicating an Early Cambrian Age.

Synonomy and correlation:

This unit has previously been mapped both as part of the Mettawee Slate (upper part of the Bull Formation) and as part of the West Castleton Formation, by Theokritoff (1964) and Zen (1961). This is because these authors did not recognize the existence of the Browns Pond Formation and confused it, in places, with the basal part of the Hatch Hill Formation (the part designated by them West Castleton Formation). The unit was mapped as part of the Cambrian Roofing Slate by Dale (1899) who unfortunately misplaced this portion below rather than above the level of the Browns Pond Formation, one of whose distinctive lithologies (Black Patch Grit) he did recognize.

Farther south, it may be equivalent to an un-named greenish shale listed by Dale (1904) at the top of his Cambrian section, not discussed or named by Ruedemann (1914), in the Taconic sequence of Rensselaer and Columbia Counties. It is equivalent to an interval within the lower portion of the Germantown Formation of Fisher (1962).

GEOLOGIC AGE AND CORRELATION

Aside from determining the geologic history in a particular area, one of the primary goals of the geologist is to ascertain the age of the rocks and be able to correlate the local rock sequence with adjacent and far-away areas. Absolute age of rocks may be determined by radiometric dating, using isotopes of uranium, rubidium, potassium, or carbon. However, if the rock does not contain minerals that possess these isotopes then an absolute age is impossible to determine with the presently known methods. Relative ages of rocks are easier to ascertain and these are based on two fundamental laws. These are:

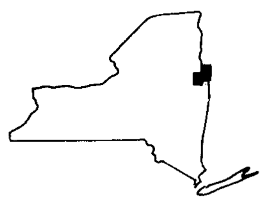
(1) **Law of Superposition,** which states, that in any undeformed pile of sediments or sedimentary rocks, a layer or bed of rock is younger than the bed below it and older than the bed above it, and

(2) **Law of Biotic Succession,** which states that animals and plants succeed themselves in an orderly and determinable sequence and that each interval of time (stage) can be reliably recognized by the diagnostic fossils within it.

Thus, a biostratigraphic zonation may be constructed using detailed knowledge of evolutionary changes within a specified fossil group over a period of time. Such zonations form the framework for correlation charts. The correlation chart shown (Figure 40) equates the Cambrian and Ordovician rocks of New York State to those regions where exceptional rock sequences and fossil zonations have been studied in other parts of North America and elsewhere in the World. In this way gaps in our geologic time scale are being filled by paleontologists and stratigraphers throughout the World. Additional paleontological research fortifies our framework and, thus, our correlations. Animals that were relatively short-lived, mobile, bottom dwellers, swimmers, or floaters constitute the best tools for correlation. Fixed bottom dwellers and those animals that changed little over millions of years provide useful data for reconstructing ancient environments but are of limited or risky use for correlations. In New York, the most utilitarian fossils for Cambrian and Ordovician correlations are trilobites, nautiloid cephalopods, conodonts, and graptolites. Brachiopods, bryozoans, corals, crinoids, cystoids, stromatoporoids, and snails locally may be useful for correlation but normally these types of fossils furnish more information on paleoenvironments.

Bedrock Geology of the Glens Falls — Whitehall Region, New York

by DONALD W. FISHER



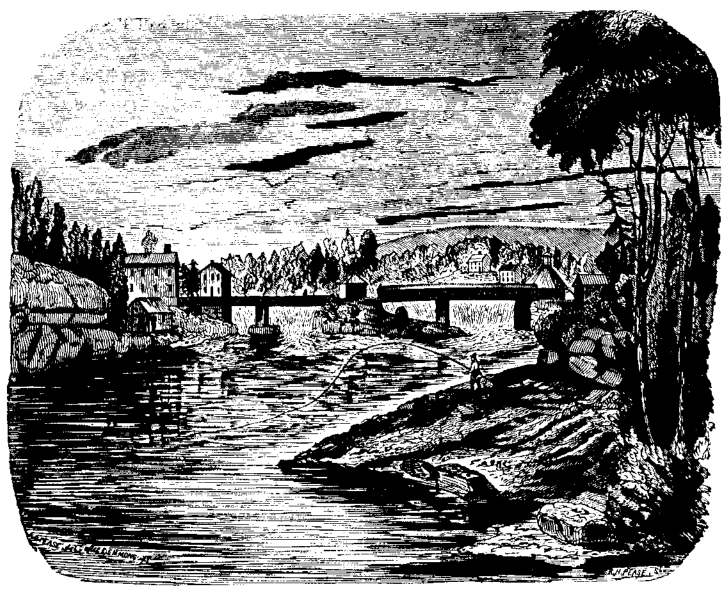


Figure 1. *Glens Falls, from a woodcut in "Geology of New York, Part 2, Comprising a Survey of the First Geological District" by Ebenezer Emmons, Sr. (1842)*

NEW YORK STATE MUSEUM

MAP AND CHART SERIES NUMBER 35

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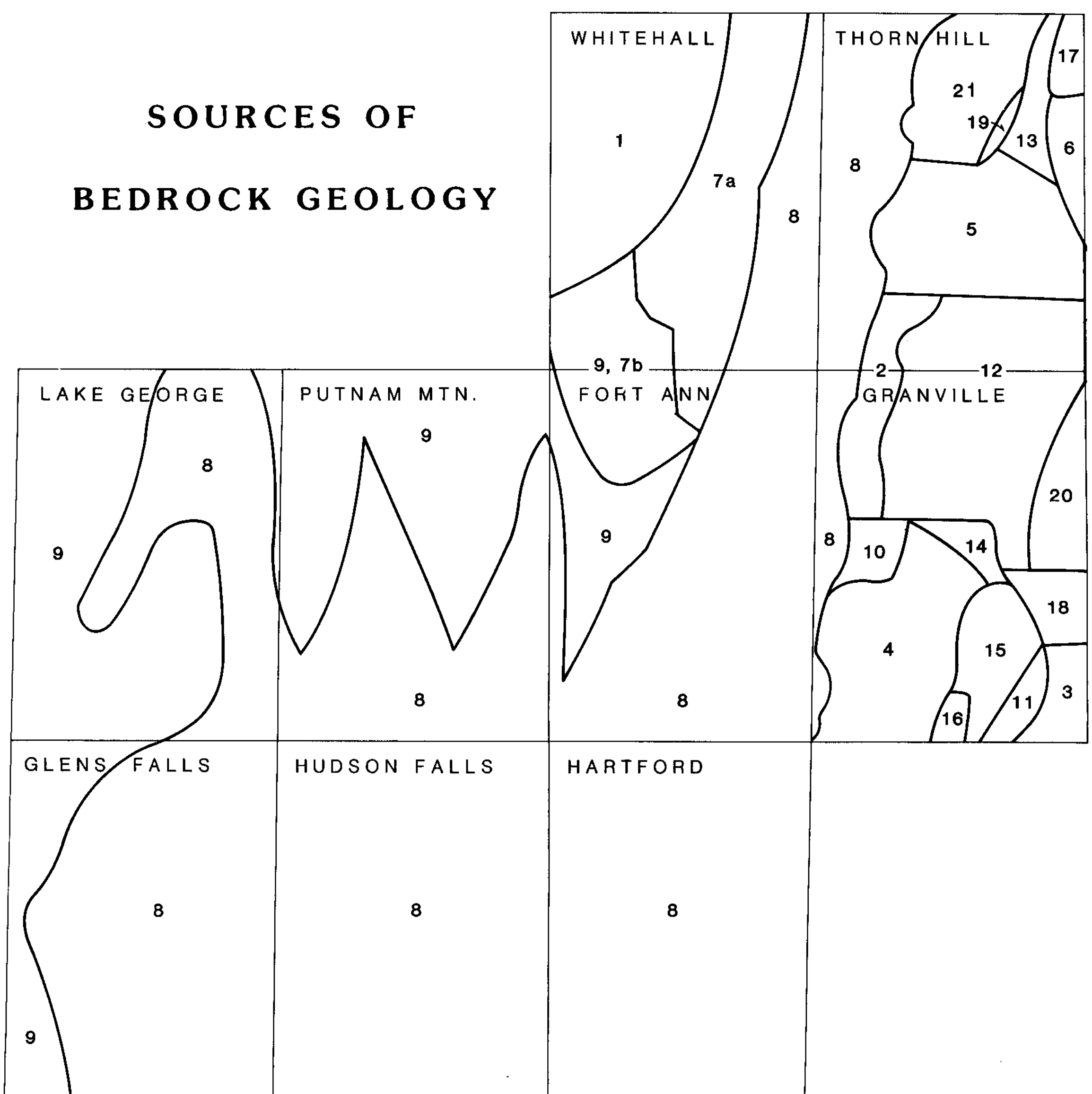
NOTE

The Proterozoic portion of the legend has been extracted from F. Alan Hill's (1965) doctoral thesis on portions of the Glens Falls and Fort Ann 15-minute quadrangles and Richard H. Berry's (1960) doctoral thesis on portions of the Putnam and Whitehall 7 1/2-minute quadrangles. Bedrock geology along the Adirondack Northway (I-87) and the Prospect Mountain Veteran's Memorial Highway was mapped by Yngvar W. Isachsen, Philip R. Whitney and Richard W. Wiener* of the N.Y. State Geological Survey; these exposures were unavailable to Alan Hills at the time of his mapping. Isachsen, Whitney, and Robert H. Fakunding also mapped the Proterozoic terrane east of South Bay.

The Proterozoic metamorphosed sequence has been constructed in collaboration with Richard W. Wiener. My education in southeastern Adirondack Precambrian geology and the differing philosophies of mapping metamorphic sequences have been immeasurably enhanced by his dedicated enthusiam to make this geologic map as useful and as up-to-day as possible. My colleague, Yngvar W. Isachsen, has exercised "Jobian" patience with my frequent interruptions and numerous (and sometimes pointed) questions. The benefit of his lengthy experience with Adirondack rocks has, with the willing aid of Wiener and Whitney, brought some sense of order out of a plethora of disconnected and often conflicting data. The sequence is generalized. Certain units may be locally absent and others present which may be out-of-sequence. It is assumed that the oldest rock unit is charnockitic gneiss in the core of the isoclinal anticline 0.6 km east of Putnam Mountain. Such a sequence also is suggested by correlation with Carl McConnell's, Brian Turner's and Matt S. Walton's unpublished mapping (N.Y. State Geological Survey open file maps) in adjacent quadrangles to the north, with James McLelland's published and unpublished mapping in the Adirondacks to the west, and with the stratigraphic sequence in the northwest Adirondacks (Wiener and others, 1983). Especial recognition should be given to Harold L. Alling's pioneer work (1918, 1927) for it was he who demonstrated that a stratigraphic sequence existed in the southeastern Adirondacks and that it maintained continuity. Because diagnostic top-and-bottom criteria are unrecognized in this area it is conceivable that the preferred sequential arrangement may be inverted. However, tentative correlation with stratigraphy of the northwest Adirondacks (Oswegatchie Group) suggests that the stratigraphic sequence (Lake George Group) used in this paper is right-side-up.

Bedrock geology of the Granville and Thorn Hill quadrangles occupied by rocks of the Taconic Allochthon was compiled by William S. F. Kidd of the State University of New York at Albany. His compilation is a revision and addition to the geologic maps of Zen (1961) and Theokritoff (1964), differing, in particular, with their stratigraphy and that of Platt (1960), Shumaker and Thompson (1967), and Potter (1972). Kidd's compilation is a composite of the M.S. theses of Jacobi (1977) and Rowley (1980), the Ph.D. thesis of Rowley (1983), mapping and observations from the 1974 to 1982 field mapping courses taught by Kidd at the State University of New York at Albany, similar data from the 1981-1982 field camp run by William Bosworth of Colgate University, and from miscellaneous unpublished mapping and observations by Kidd, Bosworth, and graduate and undergraduate students under Kidd's supervision. The sources used in compiling the Taconic part of the map are shown below.

SOURCES OF BEDROCK GEOLOGY



MAP NO.	SOURCE*
1	Berry, R.H. (1960).
2	Bosworth, W.
3	Bosworth, W.; Kidd, W.S.F., reconnaissance observations.
4	Bosworth, W., and members of the 1981 Colgate University Field Camp; Nachowitz, D.; Kidd, W.S.F.; reconnaissance observations.
5	Bosworth, W., and members of the 1982 Colgate University Field Camp; Shrady, C.
6	Cravens, S.; Kidd, W.S.F., reconnaissance observations.
7a	Fakundiny, R.; Isachsen, C.A.; and Whitney, P.R., reconnaissance mapping and photogeology.
7b	Fakundiny, R.; Isachsen, C.A.; and Whitney, P.R., photogeology.
8	Fisher, D.W., this publication (1985).
9	Hills, F.A. (1965).
10	Fillipone, J.; Kidd, W.S.F., reconnaissance observations.
11	Isachsen, C.A.; Kidd, W.S.F., reconnaissance observations.
12	Jacobi (Delano), L.L. (1977); Kidd, W.S.F., reconnaissance observations.
13	Rowley (1983); Kidd, W.S.F., reconnaissance observations.
14	Kidd, W.S.F., reconnaissance observations.
15	Kidd, W.S.F., and members of the 1974 SUNY Albany Field Camp.
16	Nachowitz, D.; Rowley, D.B.; Kidd, W.S.F., and members of the 1974 SUNY Albany Field Camp.
17	Kusky, T.; Rowley, D.B. (1983); Kidd, W.S.F.; Pindell, J. reconnaissance observations.
18	Lassonde, M.; Kidd, W.S.F., reconnaissance observations.
19	Rowley, D.B. (1983); Kidd, W.S.F., reconnaissance observations.
20	Rowley, D.B., (1980).
21	Xia, Z.; Rowley, D.B. (1983); Kidd, W.S.F., reconnaissance observations.

*Date indicates publication or thesis, listed in References. Otherwise, mapping is unpublished.

ALLOCHTHONOUS STRATA (TACONIC SEQUENCE)

(thicknesses not given owing to intense deformation and repetition)

ORDOVICIAN & CAMBRIAN

O€ts **Taconic Sequence.** Undifferentiated shales, argillites, slates with minor orthoquartzites, sandstones, graywackes, carbonate conglomerates, and bedded and nodular cherts.

Fair to good foundation for heavy structures; rock is usually rippable but locally may require explosives; slope stabililty fair to good depending upon cleavage direction in slates and presence of more resistant quartzites or limestones; drilling rate moderate; machine tunneling rate moderate to fast.

Generally yields low-water supplies although locally extensive jointing and cleavage may yield sufficient water supplies for local needs, water is soft but locally may contain high iron and hydrogen sulfide.

Used for fill and locally as source of slate for roofing and patio blocks. The Middle Granville Slate and the slates within the Nassau Formation (collectively termed Mettawee) provide green, purple, and mottled green-purple slates; the Hatch Hill (including West Castleton) and Brown's Pond (= Schodack of Ruedemann) Formations and the Mt. Merino provide black or brown varieties; the Poultney provides green-gray to black varieties; and the Indian River provides the highly prized red or maroon slate. The waste piles of slate have a potential for use as a lightweight aggregate.

MIDDLE ORDOVICIAN (CHAMPLAINIAN SERIES ?)

NORMANSKILL GROUP

Oag **Austin Glen Formation** [Ruedemann, 1942]

Opw **Pawlet Formation** [Shumaker, 1967; Zen, 1961]. Thin to thick-bedded bluish-grey, brown weathering greywacke interbedded with silty grey slate. Sole markings (turbidite) on undersides of greywacke beds. Rare graptolites in shales and in greywackes. Austin Glen Fm. is the preferred term for rocks in the belt of Snake Hill Shale/Forbes Hill Melange adjoining the west side of the Taconic Allochthon; Pawlet Fm. is preferred in this area for rocks in stratigraphic conformity with older units of the Taconic Allochthon.

Omm **Mount Merino Formation** [Ruedemann, 1942]. Dark grey to black slate and mudstone with interbedded dark green to black chert beds; in places nodular.

Oir **Indian River Formation** [Keith, 1932]. Maroon, red and light green slate with rare red and light green chert beds, nodular in places.

LOWER ORDOVICIAN (CANADIAN SERIES) ? AND MIDDLE ORDOVICIAN (WHITEROCKIAN SERIES)

Opo **Poultney Formation** [Keith, 1932]. Grey to light green slate with darker green argillite. Distinctive, thinly interbedded silty quartzites, rarely dolomitic, throughout. Thin ribbon limestones (micrites, arenites, less commonly pebble conglomerates) interbedded in places, particularly near the base. Rare graptolites in slates and trilobite fragments in limestones.

LOWER TO UPPER CAMBRIAN (TACONIAN AND CROIXIAN SERIES) AND LOWER ORDOVICIAN (CANADIAN SERIES)

€Ohh **Hatch Hill Formation** [Theokritoff, 1959, 1964]. Black to dark grey silty ferruginous slate with medium
€Ohhl to thick-bedded dolomitic sandstones and quartzites; local limestones, including micrites, arenites, and mostly pebbly limestone conglomerates, are found at the base (containing a *Paedumias* trilobite fauna), and at the top, where they locally form a mappable member(€ohhl). This member has been (in part) previously included in the Poultney Formation in this and other areas but lithically belongs with the Hatch Hill in this area. The rooted graptolite *Dictyonema* has been found near the top of the formation (Theokritoff, 1964) with conodonts indicating a middle *Saukia* Zone (Late Cambrian). Conodonts higher in the formation are lowermost Ordovician (*Symphysurina* Zone) (Landing, 1976). This unit includes in the lower part some of the rocks previously mapped as West Castleton Formation, now known to be equivalent to the Hatch Hill Formation in its type section.

LOWER CAMBRIAN (TACONIAN SERIES)

€ms **Middle Granville Slate Formation** (new-defined here) [Kidd, Delano and Rowley, *in* Fisher 1985]. Green and purple slates grading at the top to grey; tan-weathering. Interbedded nodular and ribbon micritic limestones (and rare limestone breccias) commonly occur in the lower part, and contain diagnostic trilobites (*Elliptocephala asaphoides* fauna).

€bp **Browns Pond Formation** [Rowley, Kidd and Delano, 1979]. Grey to black slates containing, in order from top to lower part, coarse limestone breccia, bedded calcarenites (rare), grey-black quartz sand-bearing wacke (*Black Patch Grit Member*), and coarse, thick-bedded orthoquartzite (*Mudd Pond Member*). *Elliptocephala asaphoides* fauna in limestones, which are ubiquitous in the upper part of the unit.

CAMBRIAN (?)

€n **Nassau Formation** [Ruedemann, in Cushing and Ruedemann, 1914]. Olive-green micaceous subgrey-
€nt wacke, quartzite and silty slate (*Bomoseen Member*); overlain by silty micaceous olive-green slate
€nb (*Truthville Member*). Both pass laterally into undifferentiated green and purple silty slates, with less abundant green quartzites. Bomoseen and Truthville members not everywhere distinguished. No diagnostic fossils known; very rare *Oldhamia* fossils have been found in strata thought to be equivalent in Rensselaer County to the south.