UPPER SILURIAN—LOWER DEVONIAN STRATIGRAPHIC SEQUENCE, WESTERN MID—HUDSON VALLEY REGION, KINGSTON VICINITY TO ACCORD, ULSTER COUNTY, NEW YORK

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Introduction

The remarks concerning the Upper Silurian and Lower Devonian stratigraphic units described in this paper largely pertain to strata within the Field Trip area (Fig. 1) extending in a belt from Accord (Stop 9) northeast to just beyond Kingston (Stops 1 and 2). The entire belt appears to be underlain with angular unconformity by a disrupted sequence of graywackes and shales to the northeast (Austin Glen affinity) and shales and siltstones to the southwest (Snake Hill affinity). The relations of these two lithologic groups in this area are not clear but it does seem that both were somewhat uplifted and folded (if not faulted) during the Taconian Orogeny; by latest Middle Silurian (?) the Ordovician sediments and structures were eroded to a surface of seemingly low relief or uniform slope. Subsequently a sequence of conglomerate (Shawangunk), shale (High Falls), sandstone (Binnewater) and carbonate (Rosendale-Wilbur) was deposited on the erosion surface in an apparent, general progression to the northeast.

From Rosendale-Wilbur times through the remaining Late Silurian and Early Devonian the region was generally covered by marine waters, although intertidal and supratidal conditions existed intermittently on a local to regional scale. The Late Silurian and Early Devonian strata are relatively uniform in lithology and thickness throughout the area but some local and regional differences in depositional environments are evidenced within the Rondout, Thacher, Connelly and perhaps other formations. Apparent throughout the Rondout-Lower Devonian sequence is a more or less rhythmic alternation of variously interrelated, high energy-low energy, clay-carbonate, "shallow water" - "deep water", marine environments of deposition.

UPPER MIDDLE-LOWER UPPER SILURIAN

SHAWANGUNK CONGLOMERATE: Shawangunk Grit, Mather, 1840, p. 246-250; Stops 5, 7, 8, 10.

Lithology: Generally light-colored, well-indurated conglomerate of well-rounded quartz pebbles with lesser amounts of quartz arenite and occasional thin red to green shales. Bedding generally thick to massive with cross-bedding common. Typically cliff-forming, capping the Shawangunk Mountain cuesta.

Distribution: Extensively exposed in Shawangunk Mountains in southwest part of area (Fig. 1). Absence north of Stops 5 (Maple Hill) and 7 (Williams Lake) apparently due to non-deposition.

Thickness: Increases southwestward from zero to about 300 feet (Berkey, 1911, p.136).

Lower Contact: In angular unconformity with underlying Ordovician shales and siltstones of Snake Hill (?) affinity (Stop 5).

Upper Contact: Distinct and apparently conformable with overlying High Falls Shale or gradational or interbedded through less than one foot (Stops 5, 8, 10). Uppermost foot or so of conglomerate atypically dark in color in High Falls - Rosendale area.

Fossils: None observed or reported in area.

Age: Middle Silurian (Fisher, 1960) but possibly late Middle Silurian if gradational to Late Silurian High Falls Shale (Fisher, 1960).

Members: Not subdivided in area but inspection of exposures along Shawangunk Mountain cuesta suggests two or three members may be recognizable.

Environment: Possibly marine, pebble and sand beach and/or near-shore conditions.

UPPER SILURIAN

HIGH FALLS SHALES: High Falls Shales, Hartnagel, 1905, p. 345; Stops 5-8, 10.

Lithology: Red to olive to green calcareous to non-calcareous shales, silty shales and mudstones, with occasional thin argillaceous limestones and dolostones. Occasionally ripple-marked or with desiccation cracks. Generally thin-bedded to finely laminated but bedding seemingly massive on occasion or obscured by foliation. Typical red coloration tends to be more pronounced toward the base to the southwest. Generally slope-forming.

Distribution: Exposures from Fourth Lake (Stop 6) and Maple Hill (Stop 5) south to Accord. Apparently absent to the north (Stop 3) due to non-deposition.

Thickness: Increases southwestward from zero to over 80 feet at High Falls.

Lower Contact: Other than with Shawangunk Conglomerate (which see); angular unconformity with Ordovician shales of Snake Hill aspect inferred but not observed. (Stop 6).

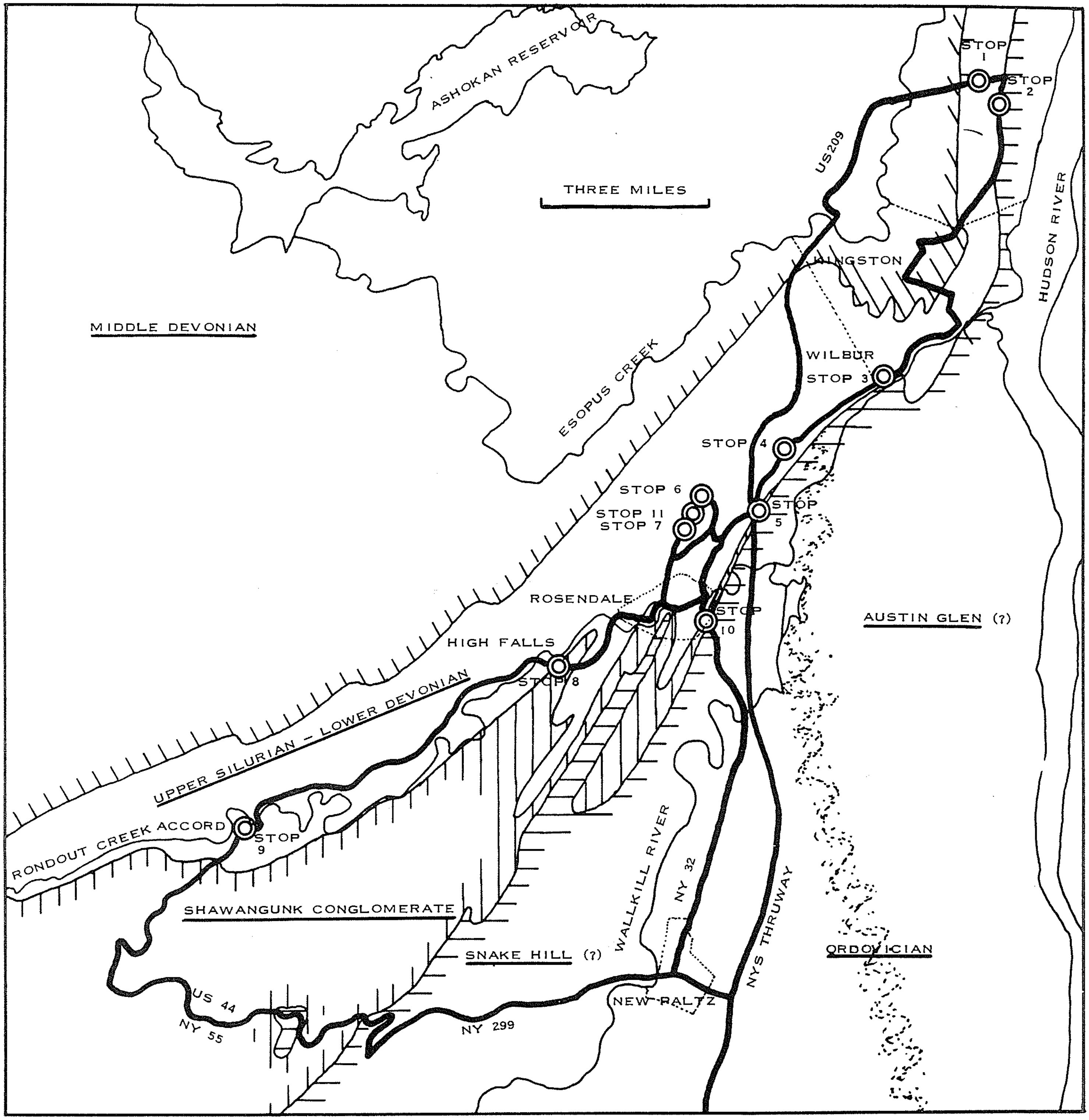
Upper Contact: Distinct to gradational to interbedded through several feet with overlying Binnewater Sandstone. (Stops 6, 10).

Fossils: None reported or observed in area except for occasional vermiform trails and burrows.

Age: Late Silurian, Canastotan, (Fisher, 1960).

Members: None recognised in the area but some thin carbonate units may prove useful as marker beds from High Falls to Accord.

Environment: Apparently marine, shallow water to intertidal to occasionally supratidal with oxidizing conditions or red-bed source.



SKETCH MAP
FIELD TRIPS D AND H

Fig. 1

BINNEWATER SANDSTONE: Binnewater quartzite, Hartnagel, 1905, p. 346; Stops 3,5,6,7,10,11.

Lithology: Light grey to brownish to greenish, occasionally well-indurated quartz arenite; somewhat dolomitic with occasional thin beds of shale, shale-carbonate and carbonate-shale rock increasing to the southwest. Generally thin-to medium-bedded; commonly cross-bedded to cross-laminated with ripple marks and with occasional desiccation cracks, slightly conglomeratic with shale pebbles in base when overlying Ordovician surface; cliff- to slope-forming.

Distribution: Exposures common from Wilbur (Stop 3) southwest to High Falls. Apparently absent north of Wilbur due to non-deposition (Stop 2).

Thickness: Increasing southwestward from zero north of Wilbur to 35 feet at High Falls.

Lower Contact: Other than with High Falls Shale (which see); in angular unconformity with Ordovician graywackes of Austin Glen aspect at Wilbur (Stop 3) and on Fly Mountain.

Upper Contact: In disconformable contact with overlying Rosendale Member of Rondout Formation from location 9 (Fig. 2b) between High Falls and Rosendale northwest to Wilbur (Stops 3,6,7,10), (Hoar and Bowen, 1967, p. 3). Contact at High Falls apparently conformable.

Fossils: Seemingly unfossiliferous except for uppermost three feet where fossils including stromatoporoids and occasional solitary rugose corals have been found (Hoar and Bowen, 1967, p.3) (Stops 10,11).

Age: Late Silurian, Murderian (part) (Fisher, 1960).

Members: None presently recognised in the area.

Correlatives: In the Accord area (Stop 9); Bossardville ? Formation (Hoar and Bowen, 1967, p. 3) equals Accord Shale of Fisher (1960); finely laminated, light grey-green, argillaceous dolomite and dolomitic shale, with possible desiccation cracks or fragments (similar to shale-carbonate beds in upper part of Binnewater Sandstone at High Falls and elsewhere). Physical correlation not yet established but relation inferred from equivalent stratigraphic position and lithology. Total thickness of Accord sequence unknown. Contact with overlying Rosendale Member conformable.

Environment: Best summarized by Hoar and Bowen (1967, p. 10). Near shore supratidal, less uniform conditions of sedimentation (northeast); grading to offshore generally more uniform, subtidal conditions (southwest).

RONDOUT FORMATION: Rondout waterlime, Clarke and Schuchert, 1899, p. 874-878; (here used in the sense of Rickard, 1962, p. 30); Stops 2, 3, 6, 7, 9, 11.

Lithology: Predominantly dolostones and limestones; further discussed under component members.

Distribution: Widely distributed from north of Kingston (Stop 2) to Accord (Stop 9).

Thickness: Generally increasing to the southwest; about 30 feet north of Kingston (Stop 2) to about 50 feet estimated in the vicinity of Accord (Stop 9).

Lower and Upper Contacts: See lower contact and upper contact of Rosendale-Wilbur Members and Whiteport member respectively.

Fossils: Refer to notes on component members.

Age: Late Silurian, Murderian (part) (Fisher, 1960).

Members: From bottom to top: Wilbur, Rosendale, Glasco and Whiteport Members (which see).

Environment: Marine, variously supra- to subtidal, biostromal, agitated to quiet water.

See remarks on component members.

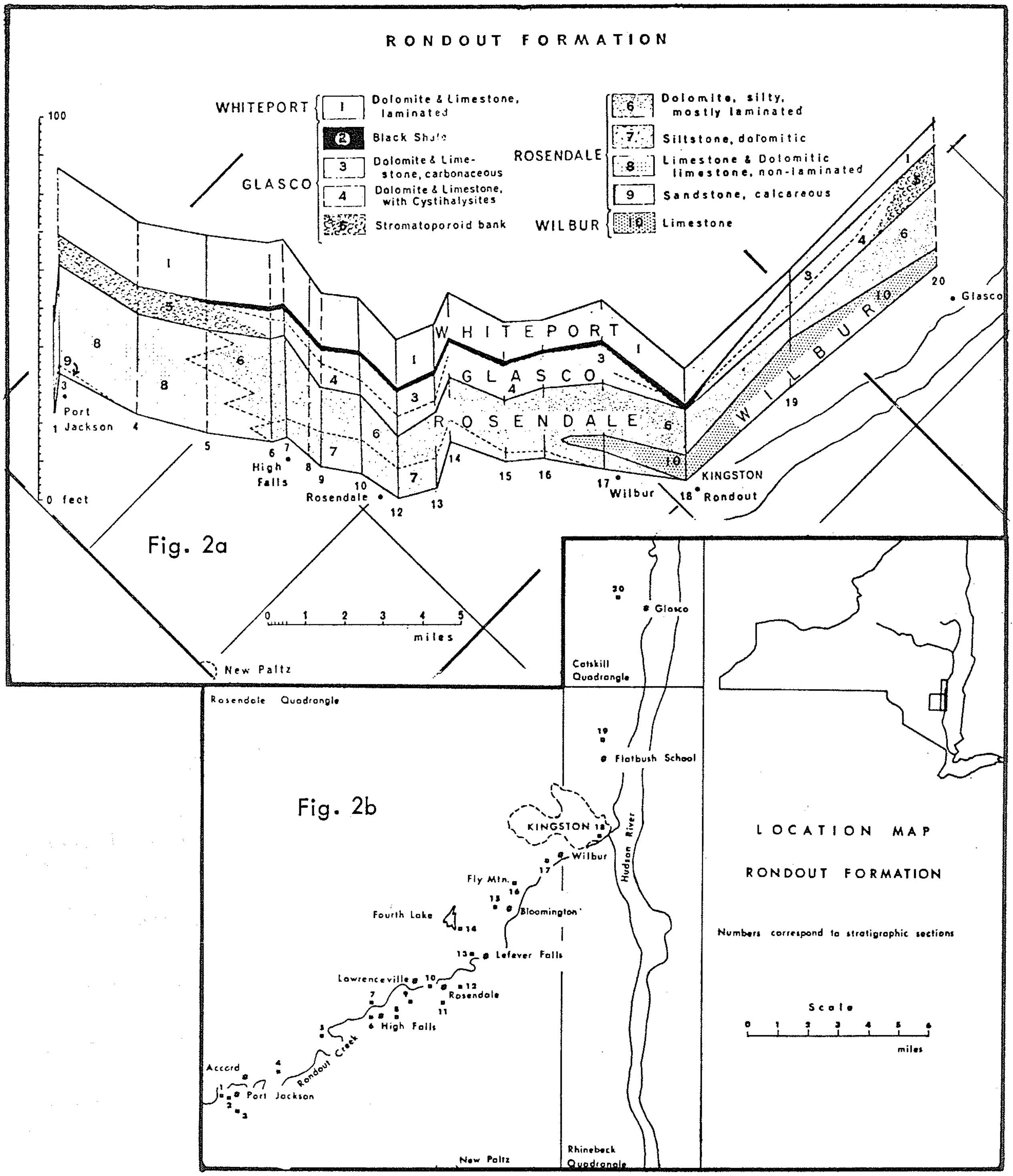


Fig. 2a Stratigraphic relations of the Rondout Formation members.

Fig. 2b Location map.

(Both figures adapted from Hoar and Bowen, 1967, text-figs. 1, 2; locations 3 (Fig. 2a), 11 (Fig. 2b), 14, 17 and 19 correspond to Stops 10, 9, 6, 3 and 2 respectively.)

WILBUR LIMESTONE: Wilbur limestone, Hartnagel, 1903, p. 1142-1152; Stops 2, 3;

Lithology: Dark colored, weathering light-gray, fine- to coarse-grained, occasionally silty limestone; slightly to very fossiliferous; thin- to medium-bedded; with occasional thin shaly partings and occasional cross-laminations; cliff-forming on occasion.

Distribution: Exposures from vicinity of NY 32 (Stop 2) south to Wilbur (Stop 3), (Fig. 2a).

Thickness: Four feet (Stop 3) to 12 feet (Stop 2). Apparently absent south of Stop 3 due to non-deposition.

Upper Contact: Conformable and gradational in places to overlying Rosendale Dolomite.

Lower Contact: Conformable and gradational where intertonguing with Rosendale Member at Wilbur (Stop 3); in angular unconformity with Ordovician graywackes to the north (Stop 2).

Fossils: Diverse fauna including brachiopods, gastropods, bryozoa, tabulate and reguse corals, stromatoporoids, occasional trilobites and pelmatozoan fragments.

Age: As for Rondout Formation.

Environment: Marine; biostromal; subtidal to occasionally intertidal; high energy regions with marginal low energy areas.

ROSENDALE DOLOMITE: Rosendale ls., Hall, 1893, p. 159; (Here used in the sense of Rickard, 1962, p. 35; and Hoar and Bowen, 1967 p. 4-8); Stops 2, 3, 6, 7, 9.

Lithology: Four distinctive lithologies (Fig. 2a); a) primarily silty, laminated, poorly fossiliferous dolomite; b) laminated to thin-bedded, occasionally fossiliferous, dolomitic siltstone; c) argillaceous to silty, partly dolomitic, thin- to medium-bedded fossiliferous limestone; d) cross-bedded, fossiliferous, calcareous quartz arenite. Dolomitic and silty facies to the northeast (Stops 2, 3, 6, 7) grading to calcareous and basal sand facies to the southwest (Stop 9).

Distribution: Frequently exposed throughout the field trip area from Stop 2 in the northeast to Stop 9 in the southwest.

Thickness: Generally increasing in thickness to the southwest from about six feet at Stop 2 to about 27 feet near Stop 9.

Upper Contact: Conformable and, on occasion, gradational to the overlying Glasco Limestone. Determined by the absence of Cystilhalycites according to Hoar and Bowen (1967, p. 9).

Lower Contact: Refer to upper contacts of Binnewater Sandstone and Wilbur Limestone.

Fossils: Generally without fossils in dolomitic and silty facies to northeast, but with increasing fossil content in calcareous facies to southwest. Fauna includes brachiopods, tabulate and rugose corals, stromatoporoids (Stop 9) and pelmatozoan fragments.

Age: As for Rondout Formation.

Environment: Marine, high to low energy, generally subtidal, with agitation increasing to the southwest.

GLASCO LIMESTONE: Glasco limestone, Chadwick, 1944, p. 44-55; Stops 2, 6, 7, 9

Lithology: Four distinctive lithologies (Fig. 2a): a) medium-grained, highly fossiliferous argillaceous, thin- to medium-bedded, limestone and dolomite; bearing *Cystihalycites*; b) biostromal limestone; c) laminated to medium-bedded, argillaceous and carbonaceous, limestone and dolomite; d) black, calcareous to dolomitic, fossiliferous shale, topmost member. The basal unit a) grades southwest into b). Cliff- to slope-forming.

Distribution: Widely exposed from Stop 2 in the northeast to Stop 9 in the southwest.

Thickness: Generally thickening from two feet at Kingston to 10 feet, more or less, to the north and southwest (Fig. 2a).

Upper Contact: Conformable and distinct to possibly gradational locally with overlying Whiteport Dolomite.

Fossils: Diverse fauna including stromatoporoids, tabulate and rugose corals, bryozoa, brachiopods, trilobites, ostracods, and pelmatozoan fragments. Stromatoporoids abundant in biostromal facies; *Cystihalycites* common in non-biostromal lower part of member.

Age: As for Rondout Formation.

Environment: Marine, biostromal to "off-reef", high to low energy. Biostromal portion to the southwest associated with underlying high-energy Rosendale calcareous facies; non-biostromal or "off-reef" portion to the northeast associated with underlying low energy dolomitic and silty facies of Rosendale member. (Hoar and Bowen, 1967, p. 11).

LOWER DEVONIAN?

WHITEPORT DOLOMITE: Whiteport member, Rickard, 1962, p. 36; Stops 2, 6 (type section), 7.

Lithology: Medium to dark gray, buff-weathering, fine-grained, laminated, generally unfossiliferous, argillaceous dolomites, calcareous dolomites, and dolomitic limestones with occasional desiccation cracks and ripple marks.

Distribution: Scattered exposures from north of Kingston (Stop 2) southwest to vicinity of Stop 9.

Thickness: Generally thickening southwest from about four feet at Stop 2 to an estimated 16 feet in the vicinity of Accord.

Upper Contact: Conformable with overlying Thacher Limestone and commonly marked by a thin dark calcareous shaly interval in the base of the Thacher (Stop. 2). On occasion contact apparently gradational (Stop 6?).

Fossils: Generally unfossiliferous but occasional brachiopods, ostracods and stromatoporoids are known.

Age: Considered Lowermost Helderbergian (Rickard, 1962, p. 106). A precise Silurian or Devonian assignment is tenuous at present.

Environment: Marine, largely intertidal to supratidal to shallow subtidal.

LOWER DEVONIAN

THACHER LIMESTONE: Thacher Limestone Member of Manlium Formation, Rickard, 1962, p. 43; Stops 1, 2, 6, 11.

Lithology: Mixed carbonate lithology: a) dark gray, medium-weathering, fine-grained, thin-bedded, occasionally fossiliferous limestones with thin shaly partings; the inch or ribbon beds of some authors; predominant near base of member. b) argillaceous, silty, siliceous, laminated, rarely fossiliferous, fine-grained dolomites of the Whiteport Member; predominant in lower part. c) dark, medium-weathering, thick- to thin- and regularly- to irregularly-bedded, slightly to very fossiliferous limestone with rubbly to massive weathering; predominant in upper part of the member. d) obscurely-bedded, stromatoporoidal, biostromal limestone; predominant near top of the member.

General Distribution: Commonly exposed in the Lower Devonian portion of the trip area from Stop 1 in the northeast to the vicinity of Stop 9 in the southwest.

Thickness: Relatively uniform throughout the region; from 52 feet (Stop 2) to 46 feet in the vicinity of Accord; most variation of thickness confined to upper part of member (Pedersen, 1966a, 1966b).

Upper Contact: Locally variable, from distinct to gradational to interbedded to disconformable with overlying Ravena limestone.

Fossils: Fauna varied, including brachiopods, stromatoporoids, gastropods, ostracods, algae, tentaculitids, etc.

Sub-units: In the map area traceable units have been demonstrated in lower part of member (Pedersen, 1966a, 1966b), but the upper part is more variable in lithology.

Age: Lower Helderbergian. (Rickard, 1964).

Environment: Marine, quite variable; biostromal and high energy to "off-reef" and low energy, supratidal to intertidal to subtidal.

RAVENA LIMESTONE: Ravena Limestone of Coeymans Formation, Rickard, 1962, p. 65); Stops 1, 2, 11.

Lithology: Light colored, light- to white-weathering, massive to thin-bedded, iregularly-bedded or wavey-bedded, biofragmental, fine-grained limestone with occasional cross-bedding. Cliff- to slope-forming.

General Distribution: Commonly associated with Thacher Limestone, from Stop 1 in the northeast to the vicinity of Accord (southwest).

Thickness: Relatively uniform from 17 feet at Stop 1 to 20 feet near Rosendale to 18 feet near Accord.

Upper Contact: Gradational through one foot or so with overlying Hannacroix Member of Kalkberg Limestone; usually picked at appearance of first chert nodules.

Fossils: Pelmatozoan debris and brachiopods common; lesser numbers of tabulate corals, massive bryozoa, trilobites, ostracods and cephalopods; presence of *Gypidula coeymanensis* useful in determining the Thacher-Ravena contact.

Age: Lower Helderbergian in the field trip area (Rickard, 1964).

Environment: Marine, uniform, high energy, subtidal within wave base, not biostromal.

KALKBERG LIMESTONE: Kalkberg Limestone, Chadwick, 1908, p. 346-348; (here used in the sense of Rickard, 1962, p. 79); Stops 1, 11.

Lithology: Four major lithologic subdivisions (Stop 1) (Dun *in* Dun and Rickard, 1961, p. C9, C11) in ascending order: (a) medium gray, cherty, fine-grained, fossiliferous thin- to medium-bedded, ledge-forming limestone; (b) light gray, fine-grained, thin- to thick-bedded, slope-forming, argillaceous and siliceous limestone with numberous irregular or wavy shaly partings; (c) light gray, thin-bedded, slope-forming, fine-grained, argillaceous and siliceous, fossiliferous limestone with numerous interbedded, calcareous shale layers and with a one to two foot bed of dark shale at base; (d) gray, thin- to medium-bedded, slope-forming, fine-grained, argillaceous and siliceous limestone with a characteristic pitted weathered surface.

General Distribution: Recognized the extent of the field trip area but rarely completely exposed; unit (a) above is best exposed and extends from north of Kingston (Stop 1) southwest to the vicinity of Accord.

Thickness: About 70 feet north of Kingston (Stop 1); southwestward thicknesses not as certain because upper part of formation may be included in New Scotland Formation by many workers.

Upper Contact: Based on change from argillaceous and siliceous limestone to overlying calcareous mudstone and siltstone of New Scotland Formation. (Dun *in* Dun and Rickard, 1961, p. C11).

Fossils: Variable fauna, partly reflected by changes in lithology; includes brachiopods, pelmatozoan fragments, bryozoa, trilobites, ostracods, and solitary tetracorals. Notable brachiopods are *Gypidula coeymanensis*, *Dicoelosia* (*Bilobites*) *varicus*, and *Koslowskielina* ("*Spirifer*") *perlaminellosa*.

Members: Two subdivided members recognized by Dun (*in* Dun and Rickard, 1961) based on lithologies listed above; from bottom to top: Hannacroix Member, lower(a), upper(b); Broncks Lake Member, lower(c), upper(d).

Age: Early Helderbergian (Rickard, 1964).

Environment: Marine, generally uniform, moderate to low energy, generally subtidal, generally above or near wave base.

NEW SCOTLAND FORMATION: New Scotland beds, New Scotland limestone, Clarke and Schuchert, 1899, p. 874-878; (here used in the sense of Rickard, 1962, p.85); Stop 1.

Lithology: Primarily an alternating sequence of very fine-grained calcareous siltstones and mudstones at the base grading upward into argillaceous and silty limestones; generally thin-bedded but massive weathering on occasion and leached out in more calcareous portions or pods.

General Distribution: Known to occur the length of the field trip area but better exposed northeast from High Falls.

Thickness: Estimated about 100 feet north of Kingston (Stop 1); to the southwest, thicknesses often questionable due to transitional nature of upper contact and by frequent inclusion of upper part of Kalkberg Formation by many workers.

Upper Contact: Gradational, interbedded; interbeds of New Scotland and overlying Becraft lithology; Becraft-like beds thickening upward; choice of contact arbitrary.

Fossils: Highly fossiliferous, with brachiopods, pelecypods, gastropods, trilobites, ostracods, bryozoa. Notable brachiopods are *Eospirifer macropleurus* and *Kozlowskielina perlamellosa*.

Age: Middle Helderbergian (Rickard, 1964).

Environment: Marine, uniform, subtidal, generally near or below wave base.

BECRAFT LIMESTONE: Becraft limestone, Darton, 1894b, p. 406-407, (suggested by Hall, 1893, p. 9-13); Stop 1.

Lithology: Light gray, coarse-grained, biofragmental, cliff-forming, massive-weathering pelmatozoan limestone with thin to thick irregular bedding increasing upward in thickness and irregularity.

General Distribution: Exposure known from vicinity of Accord northeast to Stop 1, but most outcrops of formation are northeast of High Falls.

Thickness: Estimated thickness of 55 feet on NY 32 south of Stop 2. Thicknesses either variable or uncertain because of gradational nature of lower contact and possible inclusion of Alsen Limestone. In a southwesterly progressing sequence the following thicknesses are known or reported: South of Stop 2 on Highway NY 32 - 55 feet estimated; Kingston area, (Darton, 1894b; Van Ingen and Clark, 1903) - 35 - 40 feet; near Whiteport, (Darton, 1894b) - 30 feet; between High Falls and Accord (Berkey, 1911) - 75 feet.

Upper Contact: Conformable and, in the field trip area, more or less distinct or gradational through a foot into overlying Alsen Limestone.

Fossils: Predominantly pelmatozoan fragments but with brachiopods, gastropods and trilobites. Notable are "Spirifer" concinnus and the thimble-like crinoid "holdfast" Aspidocrinus scutelliformis.

Age: Late Helderbergian (Rickard, 1964).

Environment: Marine, uniform, high energy, subtidal, well above wave base, "crinoid-bank".

ALSEN LIMESTONE: Alsen cherty limestone, Grabau, 1919, p. 468-470; Stop 1.

Lithology: Dark gray, fine-grained, thin- to medium-bedded, argillaceous, slope-forming limestone; only slightly cherty (from Kingston southwest).

General Distribution: Recognized in field trip area from north of Kingston (Stop 1) southwest to Rosendale; probably present in Accord area but not recorded.

Thickness: Twenty feet measured north of Kingston (Stop 1); similar thickness reported at East Kingston (Dun and Rickard, 1961, p. C14).

Upper Contact: Conformable distinct or gradational over a short interval with overlying Port Ewen Formation.

Fossils: Fauna includes brachiopods, bryozoa and corals. Notable are the bryozoan Monotrypa tabulata and "Spirifer" concinnus.

Age: Late Helderbergian (Rickard, 1964).

Environment: Marine, uniform, low energy, subtidal, at or near wave base.

PORT EWEN FORMATION: Port Ewen limestone, Clarke, 1903, (N.Y. State Mus. Handbook, 19, p. 21); (used in the sense of Rickard, 1962, p. 91-92); Stop 1, 4.

Lithology: Dark gray, fine-grained, thin- to medium-bedded, sparsely fossiliferous, highly argillaceous, limestones and calcareous mudstones with numerous ellipsoidal non-argillaceous limestone nodules (not concretions) throughout and with occasional heavy chert developments near top of section; weathered surface typically with large hollowed-out pits representing dissolved nodules; generally slope-forming.

General Distribution: Known in the field trip area from north of Kingston (Stop 1) southwest to the High Falls — Rosendale region; probably present in the Accord area as well.

Thickness: Estimated thickness north of Kingston (Stop 1) is between 70 and 80 feet. Apparently thickening southwest to possible 125 feet (Darton, 1894b) (exact location not known).

Upper Contact: Apparently disconformable locally and in angular unconformity regionally with overlying Connelly Formation or (where absent) with Glenerie Formation.

Fossils: Fossils rare although trilobites observed in section in limestone nodules; occasional brachiopods and the feeding-burrow *Zoophycus* cf. *Z. cauda-galli* noted in natural section in the upper half of the formation.

Age: Latest Helderbergian in field trip area (Rickard, 1964).

Environment: Marine, uniform, low energy, mostly below wave base; slightly reducing conditions.

CONNELLY FORMATION: Connelly conglomerate, Chadwick, 1908, p. 346-348; Stop 4.

Lithology: Mixed lithology; interbedded pebble conglomerates, quartz arenites, black shales, chert beds and all intergradations; thin- to thick-bedded; usually not well-exposed.

General Distribution: Not well-defined; apparently absent at Stop 1 but present (2-3 feet) a mile or so south on NY 32. More or less continuous south and southwestward through Connelly, Bloomington, and Maple Hill to Rosendale. Apparently absent north of High Falls but possibly reported by Darton (1894b, p. 460-461) northwest or west of Accord.

Thickness: Generally up to 18 or 20 feet; 19 feet estimated for Stop 4. Absence either due to non-deposition, pre-Glenerie erosion or lateral gradation to different lithology.

Upper Contact: Apparently locally conformable, disconformable or gradational with overlying Glenerie Formation.

Fossils: Generally unfossiliferous but some brachiopods of Glenerie aspect noted in upper sandstones (Stop 4).

Age: Middle Deerparkian (Rickard, 1964).

Environment: Marine (at least partly), variable, high to low energy, subtidal to supratidal?, above wave base.

GLENERIE FORMATION: Glenerie limestone, Chadwick, 1908, p. 346-348; Stop 1, 4.

Lithology: Mixed lithology: interbedded, siliceous and fossiliferous limestones, chert beds, and shales; thin- to medium-bedded.

General Distribution: Apparently present throughout the field trip area but only well-exposed to the northeast.

Thickness: About 50 feet reported from the East Kingston area by Van Ingen and Clark (1903, p. 1199); thickening southwestward to 80 feet near Whiteport (ibid.).

Upper Contact: Probably gradational with the overlying Esopus Formation through a small interval.

Fossils: Brachiopods and occasional trilobites. Costispirifer arenosus and Acrospirifer murchisoni are among the more common brachiopods.

Age: Late Deerparkian (Rickard, 1964).

Environment: Marine, variable, high to low energy, subtidal, above wave base.

ESOPUS FORMATION: Esopus shales, Darton, 1894b, p. 209-210; Stop 1.

Lithology: Dark to black, soft-weathering, non-calcareous argillaceous siltstones and silty shales.

General Distribution: Widely distributed along the western side of the Upper Silurian — Lower Devonian belt from north of Kingston (Stop 1) to the Accord area.

Thickness: About 200 feet in the Kingston area and probably thickening considerably to the southwest (inferred from Berkey, 1911, p. 126).

Upper Contact: Apparently conformable with the Carlisle Center Member of the Schoharie Formation and distinct; locally disconformable (Johnsen and Southard, 1962, p. A11).

Fossils: Relatively unfossiliferous except for occasional brachiopods and typically abundant feeding-burrows of Zoophycus cauda-galli.

Age: Early Onesquethawian (Rickard, 1964).

Environment: Marine, uniform, low energy, mostly below wave base; reducing conditions.

SCHOHARIE FORMATION: Schoharie layers, Vanuxem, 1840, p. 378; (used here in the sense of Johnsen and Southard, 1962); Stop 1.

Lithology: Three primary lithologic sequences from bottom to top: (a) interbedded and intergradational calcareous mudstone and muddy limestone; thin- to thick-bedded; with a distinctive banded appearance; bedding partially disrupted by burrowing activity; with a distinctive two to three foot siliceous black bed about one third above the base. (b) Interbedded and intergradational muddy limestone and calcareous mudstone with distinctive ellipsoidal lime nodules (not concretions); banding present as in (a) but less distinctive. (c) interbedded limestones and very calcareous mudstones; much more fossiliferous than (a) or (b) north of Kingston (Stop 1).

General Distribution: Occuring all along the western margin of the Upper Silurian - Lower Devonian belt from Kingston southwest to Accord but best exposed to the northeast.

Thickness: Thickening to the southwest from about 180 feet north of Kingston (Stop 1) to about 215 feet west of the Accord area (Johnsen and Southard, 1962).

Upper Contact: Conformable and gradational with the overlying Onondaga Limestone over an interval of one foot or so.

Fossils: Faunal diversity increasing upward through the section; includes brachiopods, trilobites, solitary tetracorals, bryozoa, diverse types of burrows including *Zoophycus cauda-galli*, gastropods, etc.

Members: Three members recognized in Kingston area (Johnsen and Southard, 1964) corresponding to lithologies above - from bottom to top; Carlisle Center Member (a), Aquetuck Member (b) and Saugerties Member (c); distinction between upper two members lost to the southwest.

Age: Early to Middle Onesquethawian (Rickard, 1964).

Environment: Marine, uniform, low energy, near or below wave base.

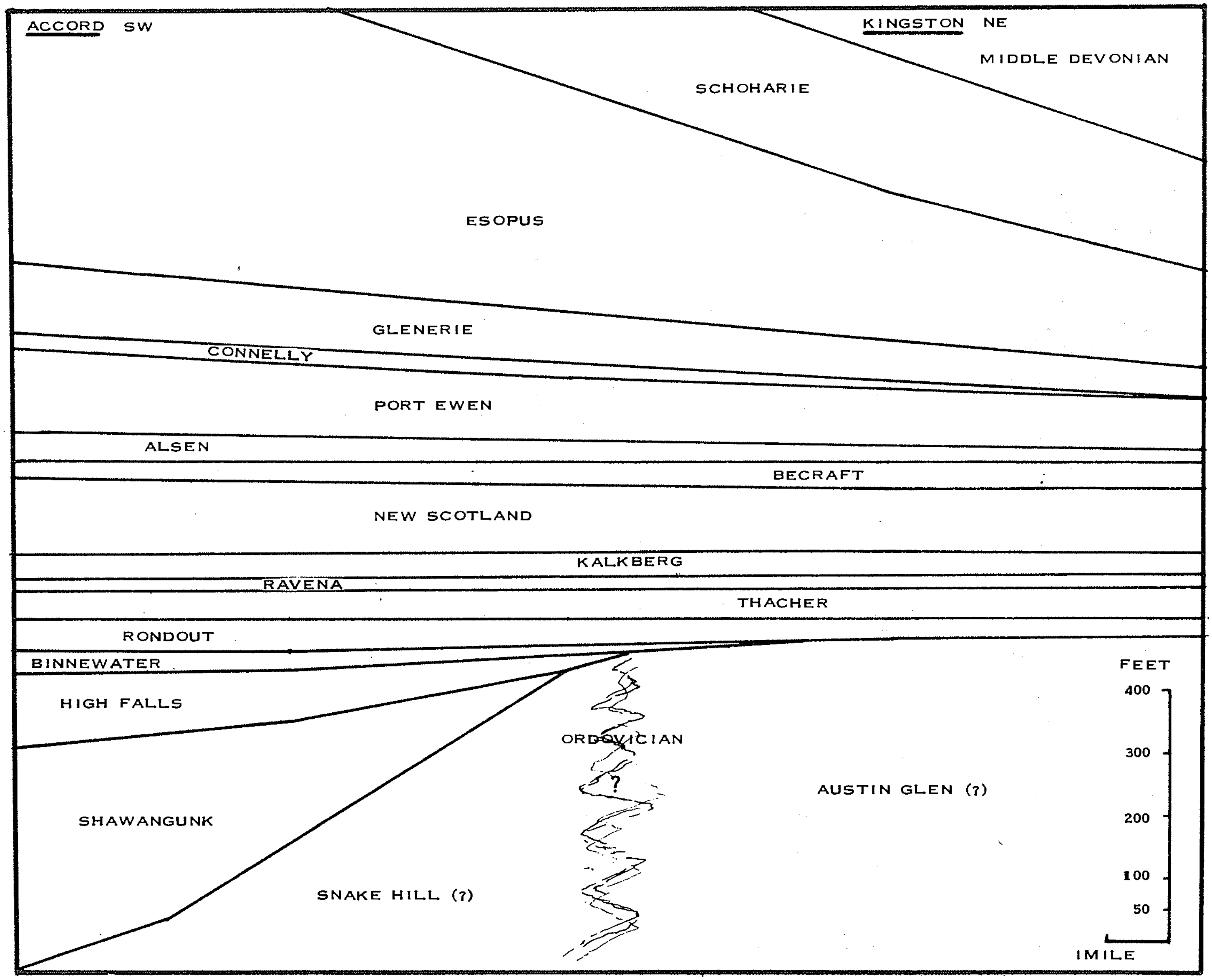


Fig. 3 Stratigraphic relations of Upper Silurian — Lower Devonian Formations, Accord to Kingston, New York (base line top of Rondout).

ROAD LOG FIELD TRIP D

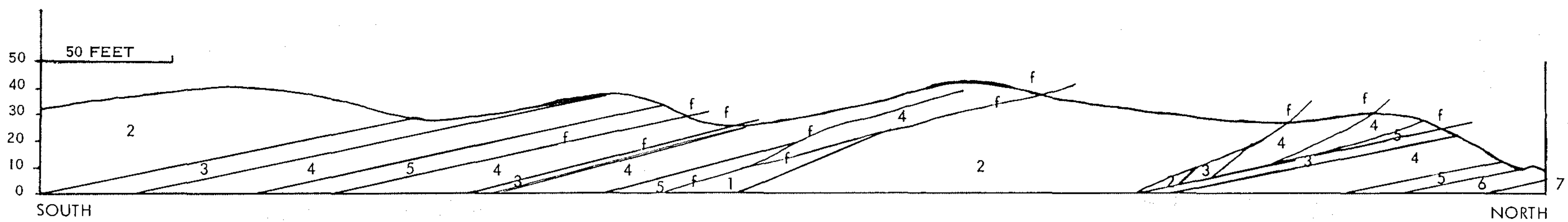
Co-leaders: Russell H. Waines and Florence Grosvenor Hoar

TOTAL MILES	Miles Between Points	Remarks
0.0	0.0	Holiday Inn parking lot. Exit, turning left (east) onto NY 17K. Continue 0.2 miles past traffic light (at intersection of NY 17K and Union Avenue). Turn left toward NYS (New York State) Thruway as indicated by sign.
1.4	1.4	Toll Booth, NYS Thruway Interchange 17 (Newburgh). Proceed north (right) onto Thruway toward Albany. Between Newburgh and New Paltz occur occasional road cuts in Ordovician (Martinsburg-Snake Hill (?)) slates and siltstones. Note the generally progressive decrease in degree of foliation of the beds northward.
17.5	16.1	NY 299 overpass near NYS Thruway Interchange 18 (New Paltz). North of New Paltz the degree of foliation in several extensive road cuts in the Ordovician shales is much less pronounced than further south. A fauna found in Ordovician beds north of New Paltz shows affinities with that of the Snake Hill Shale (Late middle Ordovician).
23.4	5.9	Wallkill River cutting Ordovician shales and siltstones on the right.
25.8	2.4	Rondout Creek cutting Ordovician shales and siltstones. Lefever Falls (rapids) on the left. This is about the northernmost extent of Ordovician outcrops along the Thruway in the field trip area (Fig. 1).
27.0	1.2	Underpass NY 32. For the next 5.3 miles there are intermittent outcrops and road cuts in a more or less regularly ascending order of formations from Kalkberg (Lower Devonian) through Onondaga (Middle Devonian). High speed traffic does not permit close observation.
32.4	5.4	N.Y. Central Railroad.
32.7	0.3	Esopus Creek.
32.9	0.2	NYS Thruway Exit 19 (Kingston). Bear right.
33.3	0.4	Toll Booth, NYS Thruway Interchange 19. Proceed southwest and enter traffic circle. Keeping right, bear onto NY 28 heading northwest.
33.7	0.4	Traffic light. Just past light bear right toward US 209 By-Pass and Kingston-Rhinecliff Bridge.
34.0	0.3	North on US 209 By-Pass. For the next 2.1 miles are extensive road cuts in gently dipping siltstones and shales of Mt. Marion Formation (Middle Devonian).
36.2	2.2	Pass over NYS Thruway.
36.6	0.4	Bridge over Esopus Creek. Mt. Marion (?) outcrop north of road and east of creek.

TOTAL MILES	Miles Between Points	
37.4	0.8	End US 209 By-Pass. Begin NY 199. Continue east.
37.5	0.1	Pass over US 9W.
37.6	0.1	<u>STOP 1a</u>: <u>Road Cut in Esopus and Schoharie Formations</u>: Pull off onto north side of highway with care. On this trip (Stops 1A-C) <u>do not cross over onto south side of highway</u> because of high speed traffic. Observe anticlinal exposure of upper (40-45') of Esopus Shale to the west and synclinal exposure of Schoharie Formation to the east. Contact between the two formations is covered but contacts, lithologies and thicknesses of the Carlisle Center, (including Black Bed), Aquetuck and Saugerties Members of the Schoharie can be observed. Fossils are best collected from the Saugerties Member. Sections of the feeding burrow <u>Zoophycos</u> <u>cauda-galli</u> are common in the Esopus Shale and Carlisle Center Member. Total extent of road cut is about 0.3 miles. Proceed east on foot along north side of highway right-of-way about 0.5 miles to the next stop.
38.1	0.5	<u>STOP 1b</u>: <u>Road Cut in Glenerie, Port Ewen, Alsen and Becraft Formations</u>: In this anticlinal exposure a partial section of Glenerie Formation and complete or almost complete sections of the Port Ewen and Alsen Formations can be closely examined on the western flank. A partial section of Becraft Limestone is exposed in the core of the structure. Although the contact between the Glenerie and Port Ewen Formations is covered, the Connelly Sandstone which intervenes to the south does not seem to be present here. The Port Ewen-Alsen-Becraft contacts are well-exposed. Some fossils can be collected in the Glenerie, Alsen and Becraft Formations. This road cut extends about 0.1 miles. Proceed east on foot along north side of highway right-of-way about 0.2 miles to the next stop.
38.3	0.2	<u>STOP 1c</u>: <u>Road Cut in New Scotland, Kalkberg, Ravena and Thacher Limestones</u>: In this road cut a sequence of west-dipping beds are exposed. From west to east these are: the New Scotland Formation (incomplete); the Kalkberg Limestone with its two members, the Broncks Lake and Hannacroix (complete); the Ravena Limestone, sole representative member of the Coeymans Formation (complete); and the Thacher Limestone, sole representative member of the Manlius Formation. The Thacher-Ravena-Kalkberg and possibly Kalkberg-New Scotland contacts are well-exposed. Fossils can be collected from all formations or members, but especially the New Scotland Formation. The brachiopod <u>Gypidula coeymanensis</u> is noteworthy in the Ravena and Hannicroix limestones but is difficult to obtain whole. Stromatoporoids are noteworthy in the Thacher Limestone. This road cut

FIG. 4

HORIZONTAL SCALE EQUALS VERTICAL



SKETCH OF STRATIGRAPHY AND STRUCTURE IN ROAD CUT NORTH END STOP 2A

1. RAVENA
2. THACHER
3. WHITEPORT
4. GLASCO
5. ROSENDALE
6. WILBUR
7. AUSTIN GLEN (?)
f. FAULT

TOTAL MILES	Miles Between Points	
		extends about 0.1 miles.
		Return to transportation at STOP 1a and continue east on NY 199.
38.6	0.3	Exit to NY 32. Bear Right (south then west). Last turn-off before Kingston-Rhinecliff Bridge!
38.8	0.2	Stop Sign. Turn left (south) onto NY 32. Proceed south 0.2 miles and pull off on west side of highway opposite road cut.
39.0	0.2	STOP 2a: Road Cut Exposing Wilbur Limestone — Austin Glen (?) Graywacke Angular Unconformity: Because of high speed traffic please do not cross highway on this trip. Here is exposed a slightly folded, but largely horizontal, bed of Wilbur Limestone (lowermost member of the Rondout Formation) indistinct angular unconformity with underlying graywackes of possible Austin Glen affinity. It is possible that the unconformity is actually a fault but the same relations obtain too often elsewhere to make this likely. Some fossils may be extracted from the Wilbur Limestone. *Coenites* is abundant locally.
		Proceed with care on foot south along NY 32 about 0.1 miles.
39.1	0.1	STOP 2b: Road cut, Austin Glen (?), Rondout, Thacher and Ravena Formations and Members with Structural Complications. Watch for falling rocks. This road cut extends for the next 0.3 miles. Starting from the north end there is a stratigraphic succession from Austin Glen (?) through Ravena Limestone which is somewhat complicated in the north half of the cut by faulting. Individual stratigraphic units are well exposed but Figure 4 should be consulted in order to verify their structural relations. The following Formations or Members are present and their lithologies and contacts (/) indicated:
		Ravena ls./Thacher ls./Whiteport dol./Glasco ls./ /Rosendale dol./Wilbur ls./Austin Glen (?) graywacke
		A few fossils may be collected from all units except perhaps the Whiteport and Rosendale dolomites and the Austin Glen (?). Especially noteworthy are Cystihalysites and stromatoporoids in the Glasco limestone.
		Return to transportation and proceed south on NY 32.
		From the south end of STOP 2b (39.4 miles) south to the intersection of NY 32 and US 9W (42.3 miles) there are intermittent outcrops and road cuts in a more or less regularly ascending stratigraphic order from Austin Glen (?)

TOTAL MILES	Miles Between Points	
		through Onondaga Formations. The overall picture is somewhat complicated structurally. Of especial note however, is a two to three foot bed of Connelly Sandstone exposed at the south end of a road cut on the east side of the highway about mile 40.6 of this trip. Traffic does not permit close observation from a bus.
42.3	3.2	Traffic light. Intersection NY 32 and US 9W. Continue straight south on NY 32 (Flatbush Avenue, City of Kingston).
43.1	0.8	Traffic light. Turn sharp left onto Foxhall Avenue and proceed south.
43.3	0.2	Turn right at Chevron service station onto O'Neil Street and proceed southwest.
43.4	0.1	Traffic light.
43.8	0.4	Traffic light. Turn left on Broadway (NY 28) and proceed southeast.
44.0	0.2	Underpass. New York Central Railroad.
44.1	0.1	Trailways bus depot. Rest Stop. Continue south on Broadway.
44.6	0.5	Traffic light. End NY 28. Continue straight on US 9W South.
45.0	0.4	Traffic light. Keep right for thru-traffic.
45.1	0.1	Bear left on US 9W South.
45.4	0.3	Traffic light. Do not enter bridge south over Rondout Creek, but turn right on Abeel Street and proceed southwest.
45.9	0.5	Block Park on left.
46.4	0.5	Underpass. New York Central Railroad.
46.7	0.3	Traffic signal. Wilbur. Bear left onto NY 213 (continuing Abeel Street) southwest parallel to Rondout Creek. Prepare to pull off road to right suddenly in 0.6 miles. Park in entrance to gravel pit road if road is chained off. If road is open, do not block entrance.
47.3	0.6	<u>STOP 3: City of Kingston Wilbur Gravel Pit;</u> Standard Reference Section of the Rondout Formation and Type Section of the Wilbur Member; Intercalation of the Wilbur Member with Rosendale Member; Binnewater Sandstone disconformably underlying the Rondout Formation and overlying the Ordovician Austin Glen graywackes and shales in angular unconformity. Walk up road to gravel pit (northeast)

TOTAL MILES	Miles Between Points	
		about 0.1 miles. The cliff to the northwest is formed of an extensive sequence of Upper Silurian and Lower Devonian strata (mostly carbonates) partly repeated by faulting. Rickard (1962, p. 30) suggested that the standard reference section for the Rondout Formation be located in this quarry and Hoar and Bowen (1967, p. 4) designated this locality as the type section for the Wilbur Limestone Member which here intertongues with the Rosendale Member (Fig. 2). Disconformably underlying the Rondout Formation is the Binnewater Sandstone which is absent further north (STOP 2a, 2b) and which, at the present stop, overlies graywackes and shales of Austin Glen (?) affinity with angular unconformity.
		Return to transportation and continue southwest on NY 213 along southeastern base of Fly Mountain Ridge.
47.6	0.3	Pass under Nytralite conveyor.
47.8	0.2	Keep straight southwest onto Mountain Road; NY213 bears left. Continue parallel to Fly Mountain ridge on the right.
48.5	0.7	Stop Sign. Turn right (southwest) onto De Witt Lake Road. Continue parallel to Fly Mountain ridge on the right.
49.3	0.8	Stop Sign. Turn left (south) onto NY 32.
49.4	0.1	Bear right onto Beversoorfer Street.
49.6	0.2	Junction with Whiteport Road on right. Continue straight (left) on Beyersoorfer Street.
49.7	0.1	Park near entrance to NY 32. Walk 0.1 miles north (down hill) on west side of highway to road cut. <u>Do not stand on highway or cross to other side</u> on this trip because of high speed traffic and blind hill.
		<u>STOP 4: Road Cut NY 32, Bloomington Vicinity; Glenerie, Connelly and Port Ewen Formations:</u> Here is exposed an almost continuous sequence of northwest-dipping beds of the upper part of the Port Ewen Formation (up hill) through the Connelly Sandstone into the lower part of the Glenerie Formation (downhill). The Connelly Sandstone has thickened considerably from the two or three foot exposure about one mile south of Stop 2a. Layers of abundant brachiopods exposed in section can be seen in the Glenerie limestones but collection in the round will prove difficult.
		Return to transportation and bear right continuing south on NY 32.

TOTAL MILES	Miles Between Points	
50.9	1.2	Northern approach to bridge over NYS Thruway. Turn left off NY 32 onto Alberts Avenue. Proceed 0.2 miles on dirt road and park beyond garages on the right. Walk north uphill on dirt road about 0.1 miles to quarry in shales and siltstones. STOP 5: South End Quarry Hill; Binnewater Sandstone — High Falls Shale — Shawangunk Conglomerate — Snake Hill (?) Sequence: Examine the disturbed siltstones and shales of Ordovician Snake Hill (?) aspect then examine the northwesterly dipping partly covered sequence of beds between the quarry and the edge of the mine pit to the west. Don't crowd edge of pit! From west to east the formations present are: Binnewater Sandstone (partly covered), Highfalls Shale (largely covered), Shawangunk Conglomerate, Snake Hill (?) shales and siltstones. The Binnewater —High Falls contact is covered but the High Falls—Shawangunk—Ordovician shale contacts are fully exposed. Noteworthy is the two to three foot thickness of Shawangunk Conglomerate and its relatively dark color (typical of the top of the formation locally). Also of note is the first two or three feet of shale beneath the conglomerate. This shale seems to differ from more typical Ordovician shales which underlie it. The mine pit to the west is excavated in a fault-complexed body of Rosendale Dolomite. The far wall (west) of the pit from bottom to top reveals a normal sequence of Glasco Limestone (ledge), Whiteport Dolomite (lower portion mined out) and lower part of the Thacher Limestone (upper part of the cliff). Walk back to transportation and return to NY 32.
51.2	0.3	Stop Sign. Turn left onto NY 32 and continue south.
51.3	0.1	Pass over NYS Thruway.
51.7	0.4	Turn right onto Old NY Route 32. Proceed south.
52.2	0.5	Kallops Corners. Bear right.
52.5	0.3	Junction of Breezy Hill Road (from left) and Hickory Bush Road. Continue straight (north) on Hickory Bush Road. Caution, narrow road, blind hill and children at play (usually).
53.1	0.6	Abandoned natural cement kilns on roadside to right. Turn sharp left into open field and head toward distant kilns to the west by following dirt road left then right.
53.3	0.2	Park in front of kilns. Walk uphill to the right (north) over a glaciated shale outcrop of Snake Hill (?) affinity, then bear northwest over rubble pile and continue west at top of hill to New York Central Railroad tracks. Total distance is about 0.1 miles.

TOTAL MILES	Miles Between Points	
		STOP 6: Fourth Lake; Rosendale Member Type Section; Ordovician, Snake Hill (?) Shale, High Falls Shale; Rondout Formation; Thacher Limestone (part) Sequence: Walk north (right) about 0.05 miles along track to rail road cut in Ordovician shales of Snake Hill (?) affinity. Retrace steps south about 0.07 miles along west side of track examining soil of covered interval for first signs of red shale particles (High Falls). Because traces of the Shawangunk Conglomerate are lacking and because the formation is not exposed locally, it is assumed that the High Falls Shale is in direct contact with the Ordovician shales even though the contact is covered at this Stop and not exposed locally. Continue walking south to the partly covered contact between the High Falls Shale and the Binnewater Sandstone. For the next 0.1 miles in the railroad cut along the west side of the track is exposed a continuous sequence of northwest-dipping strata including uppermost High Falls (north) through Binnewater, Rosendale, Glasco, Whiteport and lower Thacher (south) members and formations. Examine the various units in light of general descriptions in the text. Contacts between units should be observed — some with caution. Except for pillars the bulk of the Rosendale and lower Whiteport members has been mined out. Please do not fall into the pits. Hoar and Bowen (1967, p. 4) has designated this locality the type section of the Rosendale Dolomite Member of the Rondout Formation.
		Return to transportation and drive back to field entrance.
53.4	0.1	Leaving open field turn right and proceed south on Hickory Bush Road.
54.1	0.7	Junction of Hickory Bush and Breezy Hill Roads. Turn right and proceed west then southwest on Breezy Hill Road.
55.0	0.9	Stop Sign. Keators Corner (Binnewater). Cross New York Central Railroad track and turn right (north) onto Binnewater Road.
55.3	0.3	Proceeding straight ahead (north) leave Binnewater Road and enter Williams Lake Hotel property.
55.4	0.1	Keep straight ahead (northeast).
55.5	0.1	Turn right across railroad track into private turning area and park so as not to block access. Walk back to track then right (north) along railroad to railroad cut.

TOTAL MILES	Miles Between Points	
		STOP 7: Williams Lake; Rondout Formation; Binnewater Sandstone; High Falls Shale; Shawangunk Conglomerate Sequence: For the next 0.1 miles north in the railroad cut on both sides of the track is exposed a continuous sequence of westerly-dipping strata which include the Whiteport (south) through Glasco, Rosendale, Binnewater, High Falls and Shawangunk (north) members and formations. The various units and their contacts (where exposed) should be examined in light of general descriptions in the text. The Shawangunk Conglomerate, apparently absent at Stop 6, is well-developed here as well as locally, but the Shawangunk-Ordovician angular unconformity is not exposed.
		Return to transportation and drive south to exit from Williams Lake Hotel property.
55.8	0.3	Stop Sign. Proceed straight ahead (south) onto Binnewater Road.
56.0	0.2	Keators Corner (Binnewater). Continue south on Binnewater Road. Rosendale Hill lies directly ahead.
56.6	0.6	Century Cement Company natural cement kilns on right. These are still in occasional operation.
57.0	0.4	Stop Sign. Turn right (southwest) onto NY 213.
58.1	1.1	Bridge over Rondout Creek.
58.2	0.1	Extensive cliffs on right are formed by New Scotland Formation.
59.3	1.1	Bear right onto side road (High Falls).
59.5	0.2	Bear left.
59.6	0.1	Park opposite Mobile gasoline station. Walk ahead about 0.05 miles to NY 213. Walk uphill (east) along north side of highway. Do not cross highway; heavy traffic.
		STOP 8: High Falls, NY 213 Road Cut; High Falls Shale — Shawangunk Conglomerate Contact: Examine slightly anticlinal, light-colored exposure of Shawangunk conglomerate along extent of road cut (about 0.05 miles). Note the High Falls — Shawangunk contact at the east end of the cut (uphill) and determine whether it is distinct, conformable, gradational and/or interbedded. Note the dark color of the uppermost conglomerate layer.
		Return to transportation and proceed to main highway.

TOTAL MILES	Miles Between Points	
59.7	0.1	Stop Sign. Turn right (west) onto NY 213.
59.8	0.1	Sign on right noting the discovery of natural cement at nearby Bruceville in 1818. Just ahead is a section of the Delaware and Hudson Canal. The recently formed (1966) Delaware and Hudson Canal Historical Society plans to restore to operating condition some of the canal locks at High Falls. The canal played an important part in the transportation of natural cement and coal in the latter half of the nineteenth century.
60.1	0.3	High Falls and Central Hudson generating facilities on the right. The face of the falls is formed of the Glasco Limestone and Rosendale Dolomite members of the Rondout Formation. Extensive exposures of Binnewater Sandstone and High Falls Shale occur from the base of the falls downstream.
60.2	0.1	Bridge over Rondout Creek.
60.3	0.1	Turn left (south) off NY 213 and proceed south on newly paved (county) road.
62.1	1.8	Outcrops and road cuts for the next 0.4 miles reveal a succession of strata from the New Scotland Formation (north end) through the Whiteport Dolomite in the bed of Kripplebush Creek at mile 62.5 (south end).
63.4	1.3	Crossroad. Keep straight.
64.2	0.8	Outcrops and road cuts for the next 0.4 miles expose Glasco and Rosendale limestones.
65.6	1.4	Stop Sign. Turn left (west) onto US 299.
66.4	0.8	Turn left (south) with care off US 299 into Accord (formerly Port Jackson). Just ahead is bridge over Rondout Creek.
66.5	0.1	Turn right down side road just past bridge.
66.6	0.1	Road fork. Bear right.
66.7	0.1	Bear right onto main road then immediately right onto road with Dead End sign. Proceed past sign 0.1 miles bearing left then right into Town of Rochester Highway Department yard. Park (mile 66.9). Walk a short distance southeast over abandoned road and descend into abandoned railroad cut. Walk to east end of cut.

<u>STOP 9</u>: <u>Abandoned New York, Ontario and Western Railroad Cut at Accord; Glasco Limestone (part), Rosendale limestones and Bossardville ? Formation (Accord Shale) Sequence</u>:
Walk west in cut and observe the following sequence: stromatoporoidal limestone of the Glasco Member overlying highly calcareous Rosendale member (compare

TOTAL MILES	Miles Between Points	
		with Rosendale at Stops 2, 6 and 8) which contains a highly arenaceous unit at the base and which overlies a laminated soft-weathering argillaceous dolomite and dolomitic shale (compare with Binnewater Sandstone and thin interbedded shales at Stops 6 and 7). The argillaceous, dolomitic beds here are tentatively assigned to the Bossardville Formation. They have also been referred to as the Accord Shale (Fisher, 1960). Extent of cut is about 0.1 miles.
		Time permitting, visits may be made to nearby quarries in the Rosendale limestones and in the Thacher and Ravena Limestones.
		Walk back to transportation and return to main road.
67.1	0.4	Turn right (west) onto main road.
67.2	0.1	On left is entrance to quarry largely excavated in Rosendale limestones. Road skirts northwest side of quarry.
68.1	0.9	Outcrop of Shawangunk Conglomerate on left.
69.4	1.3	Entrance to the Granit on left.
69.8	0.4	Junction. Bear left.
70.1	0.3	Cross bridge, then bear right.
71.0	0.9	Stop. Turn sharp left onto US 44 - NY 55 and proceed south.
72.0	1.0	Begin ascent of the general dip slope of the Shawangunk Mountains. For the next 6.1 miles the Shawangunk conglomerates and orthoquartzites which, in effect, sheath the Shawangunk Mountains, crop out extensively giving rise to typical Shawangunk Mountain topography.
75.4	3.4	Entrance to Minnewaska Lodge on left. Keep straight.
76.3	0.9	Ordovician shales of Snake Hill (?) aspect on the right. This exposure is part of an Ordovician shale window in the Shawangunk Conglomerate. Several years ago a very deep, very dry, wildcat was drilled in this window.
78.1	1.8	Bridge underpass. Lowermost part of the Shawangunk Conglomerate is exposed in the road cut just east of the bridge.
78.2	0.1	Exposure of Ordovician shales of Snake Hill (?) aspect to the left. View of the Mid-Hudson Lowlands to the east and on a clear day, the Hudson Highlands to the southeast. Begin descent of Shawangunk Mountains.
78.4	0.2	Shear cliffs of the eastern face of Shawangunk Mountain cuesta tower on the left, capped by almost two hundred feet of conglomerate and ortho quartzite. These cliffs are much used for practice in mountain-climbing

TOTAL MILES	Miles Between Points	
		as they present most, if not all grades of climbs. On weekends and holidays the cliffs are well-populated with climbers from many states and Canada.
		The sport is not without risk; at least two climbers have "come off" here in the last three years.
78.7	0.3	Slow! Switch-back.
79.6	0.9	Junction. Turn left onto NY 299 and proceed northeast through countryside underlain by Ordovician shale and siltstones of Snake Hill (?) affinity.
85.4	5.8	Bridge over Wallkill River. Enter New Paltz and continue east on NY 299 (Main Street). The State University College at New Paltz is located here.
85.45	0.05	New York Central Railroad crossing.
85.6	0.15	Junction with NY 32 on left (north) and NY 208 on right (south). Keep straight on NY 299.
85.8	0.2	NY 32 north on left.
86.0	0.2	Traffic light. NY 32 south on right. Keep straight on NY 299.
87.1	1.1	Entrance to NYS Thruway. Bear right (south).
87.3	0.2	NYS Thruway toll booth, Interchange 18 (New Paltz). Proceed south on Thruway toward New York City.
103.6	16.3	Bear right for NYS Thruway Exit 17 (Newburgh) and proceed east past toll booth.
104.4	0.8	Keep left for NY 17K.
104.6	0.2	Bear right for NY 17K.
104.8	0.2	Bear right onto NY 17K and proceed west.
104.9	0.1	Traffic light. Continue straight (west).
105.1	0.2	Turn right for Holiday Inn, Newburgh, New York.

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