Trips B-3 and C-3

STRATIGRAPHY AND PALEONTOLOGY OF THE BINNEWATER SANDSTONE FROM ACCORD TO WILBUR, NEW YORK

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The Binnewater Sandstone was first recognized as a stratigraphic unit by Hartnagle (Binnewater quartzite, 1905, p. 346). It has long been recognized in outcrop within a narrow, structurally complex belt extending nine miles southwest from Wilbur (just south of Kingston) to High Falls. In addition, the Binnewater Sandstone has been recognized in bore holes just west of High Falls (Berkey, 1911, p. 132), near Accord (Port Jackson) (Johnsen and Waines, 1969, p. 30) and near Wawarsing (Bird, 1941, p. 276-278). These borings are located eight tenths, six and twelve miles southwest of High Falls respectively so that the total linear extent of the Binnewater as presently recognized is about twenty-one miles.

The Binnewater Sandstone thickens progressively from Wilbur where 4.3 feet have been measured on the east bank of Roundout Creek to about thirty feet in the Rosendale area to about forty feet at High Falls to about sixty at Accord. Bird's stratigraphic columns for Wawarsing (1941, p. 276-278) indicate 125 or 170 feet depending on the scale of the column used. According to his lithologic descriptions the thickness is more likely 85 or 105 feet. In addition, the scale in his column on page 278 seems to be in error. North and east of Wilbur the Binnewater has apparently been removed by pre-Rosendale erosion.

The lithology of the Binnewater is variable. From High Falls northeast to Wilbur it is predominantly a slightly dolomitic, fine to medium-grained quartz arenite with sparse interbeds of dolomitic shale and argillaceous dolostone. Southwest from High Falls interbeds of dolomitic shale and argillaceous dolostone tend to increase at the expense of the sand content. Non-sand content increases southwest from High Falls to Accord to Wawarsing from about five to fifty to apparently seventy per cent.

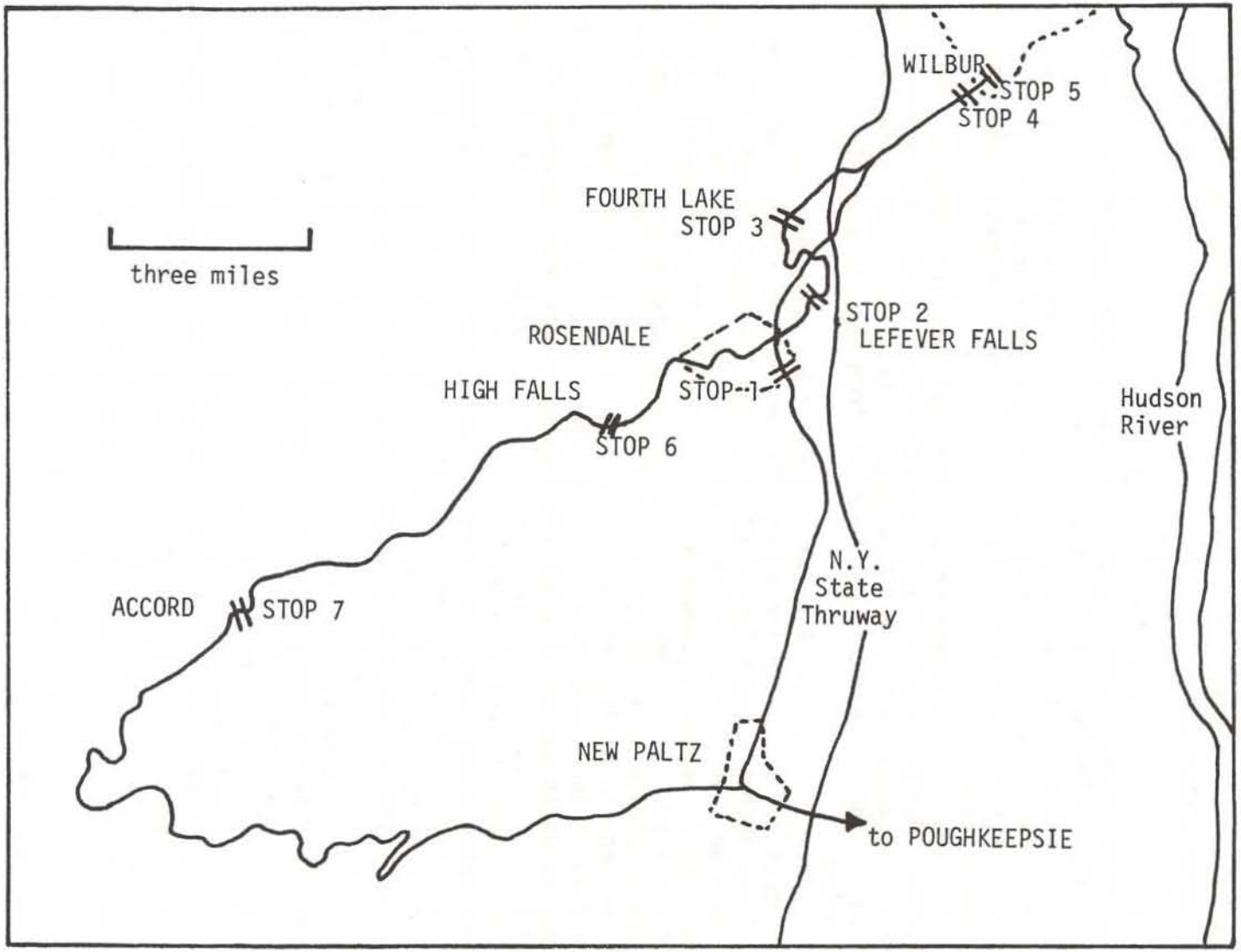
The sandstones of the Binnewater are generally dark grey to light grey to white, weathering orange to buff to grey to white. Increase in dolomite content is attended by an increasingly orange to rusty appearance when weathered. Shales and dolostones within the Binnewater may be dark grey to light grey-green. Again, increasing dolomite content is accompanied by an increasingly darker rusty color. Distinct red coloration more typical of the High Falls Shale may occur in sandstones, shales or dolostones and varies from traces at High Falls to about 15 per cent in drill core at Accord to perhaps as much as 30 per cent at Wawarsing.

From Wilbur to Accord and apparently to Wawarsing the Binnewater Sandstone is in contact with the overlying Rosendale Member of the Rondout Formation. From Wilbur to Accord the contact is disconformable although perhaps conformable at High Falls (STOP 6). Discontinuous concentrations of pyrite may mark the contact as at Wilbur (STOP 5). From Rosendale to Wilbur the contact may exhibit vermiform borings into the Binnewater which are filled with carbonate of Rosendale lithology. Relief along the contact rarely exceeds one inch.

For the most part the Binnewater Sandstone overlies the High Falls Shale but from a point about 0.6 miles south of STOP 5 northeast to the termination of Binnewater outcrops the lower contact is in angular unconformity with Ordovician shales, siltstones and greywackes. Where the Binnewater overlies the High Falls the contact seems to be conformable to gradational, or at times disconformable. In the Rosendale area, between longitudes 74°3'30"W and 74°5'00"W, a thin shale overlying an argillaceous dolostone occurs at the base of the major Binnewater sandstone unit. Occasional thin shale bebbles occur in the basal inch or so of the main sandstone. It would normally be argued that the shale (which does not have a typical High Falls aspect) represents the top of the High Falls Shale. However, thin sand lenses of Binnewater aspect may be seen occasionally in the dolostone underlying the shale. In addition, the dolostone occasionally contains shale clasts and in some localities appears to be a clastic dolostone breccia. For the purposes of this paper the base of the Binnewater is placed somewhere within the argillaceous dolostone layer or at its base.

The title of this paper is, no doubt, somewhat misleading because the fossil content of the Binnewater is very sparse and such fossils as have been found are generally very poorly preserved. Detail is largely destroyed by fragmentation and silicification and fossils are presently known from only five or six outcrops. Most fossils occur in an upper massive sand unit in the Rosendale area which lies between the latitudes of 74°4'10"W and 74°5'20"W. These include infrequent fragmentary silicified stromatoporoid coenostea and even more infrequent fragmentary solitary rugose corals. In addition, Ringler (1970, 1971) reported the presence of favositid corals and brachiopods as well as stromatoporoids at STOP 1 near Rosendale. These are also fragmentary and silicified. One or two fragments of stromatoporoid coenostea preserved in the usual manner have been observed on a bedding plane near the top of the Binnewater sequence at High Falls. An ostracod has been reported from the Binnewater at High Falls and another from the Accord Shale equivalent in core taken from a drill hole at Accord.

One of the more interesting occurrences of fossils is at Lefever Falls (STOP 2) where the upper massive sandstone unit is missing due to pre-Rosendale erosion and the Rosendale Dolostone lies directly on remnants of the thin shale which underlies the upper massive unit. In places the shale unit has been stripped away to expose the bedding surface of the underlying main sand unit. Here and there in apparent growth position on this bedding plane substrate are hemispherical, completely silicified stromatoporoid coenostea.



SKETCH MAP

figure 1

Field Trips B - 3 and C - 3

The presence of stromatoporoids in situ on a sandstone substrate suggests a somewhat more marine environment just before and during at least part of the time of shale deposition. The time interval was probably relatively short and preceeded the deposition of the upper massive sandstone unit. The presence of fragmentary fossils in the upper massive unit (including broken stromatoporoid coenostea) suggests that the material was derived from marine deposits to the north and east of the present upper massive sandstone occurrences. Consequently, the upper massive unit seems to represent a recessional deposit formed as the sea margin was withdrawing to the south and west of the Wilbur area.

The only other fossils encountered in the Binnewater are the worm-like borings at the upper contact which were mentioned earlier. It is most likely that these represent life forms of early Rosendale rather than late Binnewater time.

The age of the Binnewater Sandstone has been indicated as Late Silurian - Murderian (part) according to Fisher (1960). The paleontology of the Binnewater is not well enough understood to assist in determining the age so that inferences must be drawn from more datable strata above and below.

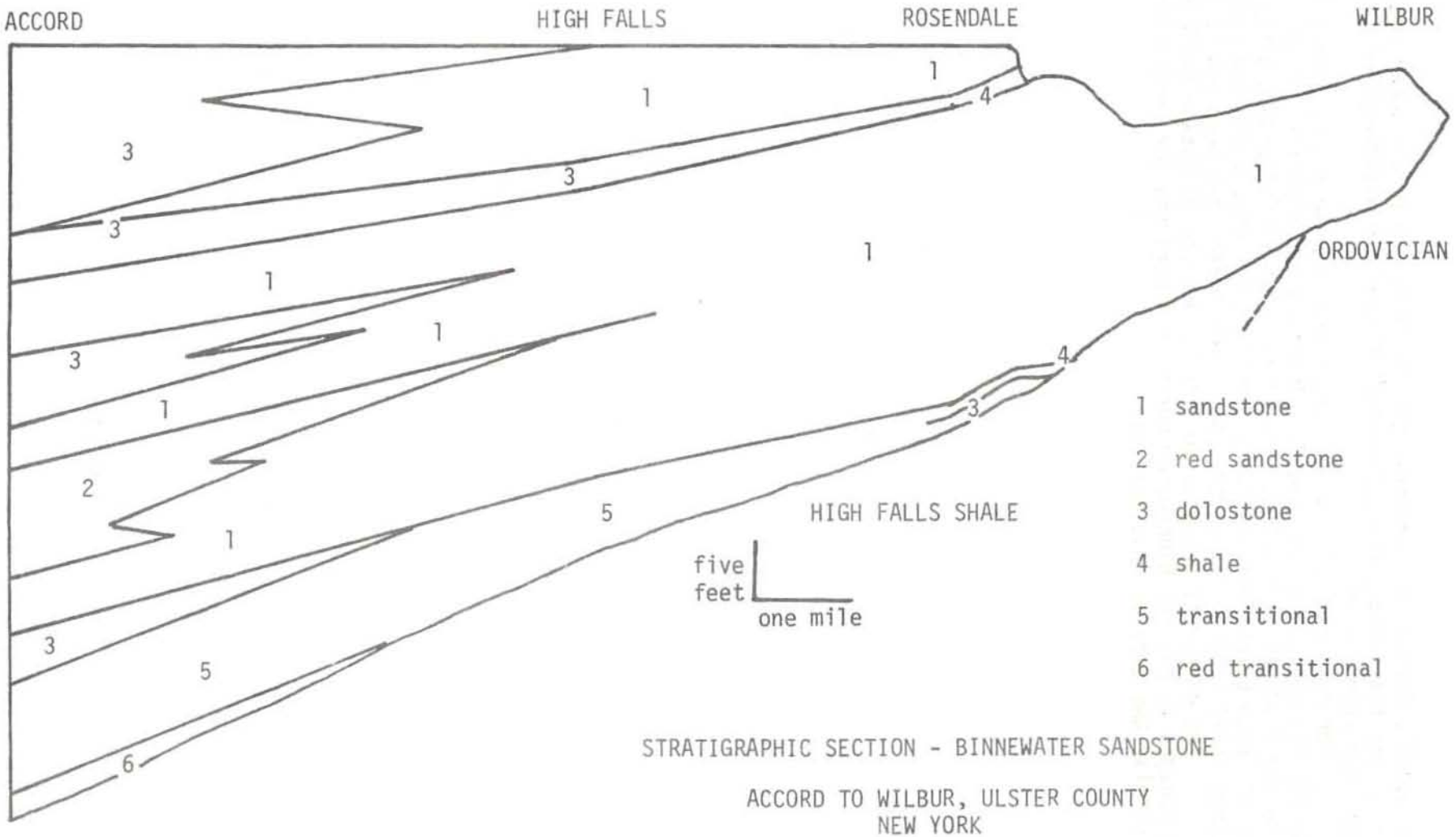
Bedding in the main Binnewater sand of the Rosendale area varies from about one to twelve inches in thickness and averages between two and three inches. Cross-laminated beds comprise about 25 per cent of the main unit at STOP 1. Average maximum angles of cross laminae range from 18 to 25 degrees although angles as high as 34 to 36 degrees have been observed. Ripple marks on bedding planes are generally asymmetrical in the Rosendale area indicating waves of translation. Mud cracks are not uncommon on bedding planes in the same area. Erosion channels of more than an inch in depth are rare in the outcrop area, but some up to a foot in depth and up to about ten feet wide have been observed at High Falls and about 0.6 miles south of STOP 5 at Wilbur. Cross laminae in the Binnewater Sandstone are generally tangential and tabular. Topset laminae are generally absent. Current directions as determined by cross laminations and asymmetric ripple marks are markedly bimodal in the sections studies with one mode especially dominant suggesting a back and forth direction of current with a net shift of material in one preferred direction. A tidal flat environment is proposed for the main sand in the High Falls to Wilbur area at least. The bimodal aspect of the cross laminations, the desiccation marks and rare casts of salt hoppers, the asymmetric ripple marks, the relative uniformity of bedding thickness, the tabular nature of the cross laminations, the general absence of erosion channels,deeper than average bedding thickness all point to an environment in which base level is close to that of the level of the sediments and in which there is a persistent net shift of sediments from land to sea. The studies of Ringler (1970, 1971) and Fields (1975a, 1975b) (STOP 1) and of Christianson (1964) (STOP 3) together with studies by the author at several other localities indicate that the providence of the Binnewater lay generally to the east and that the net shift of sediment was generally to the west and possibly southwest.

It would appear that the bulk of the Binnewater represents an onlap from southwest to northeast or west to east during the greater part of Binnewater time. Following a short existence of more open marine conditions offlap accompanied by cannibalization and re-deposition of

more upshore Binnewater sediments (as is evidenced by the upper massive unit in the Rosendale area) culminated in complete withdrawal of the Binnewater sea from the area.

The author would like to acknowledge the help, assistance and academic stimulation in the field, laboratory and classroom of the following students at S.U.N.Y., New Paltz: Don Christianson, Terry Ringler, Ruth Ellen Nielson, Harry Dembicki, Sue Mocco, and Ron Fields. Without their contributions, this paper would not have been possible.

The author is grateful to John H. Johnsen of Vassar College who managed to get the Binnewater cored at Accord and for permission to display the core at this meeting.



STRATIGRAPHIC SECTION - BINNEWATER SANDSTONE

ACCORD TO WILBUR, ULSTER COUNTY
NEW YORK

figure 2

ROAD LOG

(Field Trips B-3 and C-3)

Total Miles		Miles Between Points	
0.0	-	-	Vassar College north parking lot. Exit turning left (west) onto College View Avenue.
0.2	-	0.2	Continue straight across Raymond Avenue and proceed west on Fulton Avenue, then Forbus Street to Hooker Ave.
1.3	-	1.1	Turn right onto Hooker Avenue and proceed northwest.
1.5	-	0.2	Veer left at the traffic light onto Montgomery Street and proceed west.
2.0	-	0.5	Turn right onto Jefferson Street and proceed north.
2.2	-	0.2	Turn left on Church Street (US 44 - NY 55) and proceed west.
2.6	-	0.4	East bank of Hudson River. Pass onto Mid-Hudson Bridge.
3.1	-	0.5	West bank of Hudson River.
4.0	-	0.9	Take right lane to US 9W north toward Highland and proceed north.
6.3	-	2.3	Junction with NY 299. Turn left at the traffic light and proceed west towards New Paltz.
11.5	-	5.2	N.Y. State Thruway entrance and exit (18) on left. Continue west on NY 299 toward New Paltz.
12.8	-	1.3	Downtown New Paltz. Elting Memorial Library on the right. Turn right (northwest) and continue downhill to NY 32.
12.9	-	0.1	Turn right at stop sign and proceed north on NY 32.
17.6	-	4.7	Bridge over Wallkill River.
19.5	-	1.9	Park on right beside road cut towards bottom of long hill. Pull well off road because of fast traffic.

STOP 1: Complete exposure of Binnewater Sandstone can be seen at this stop; including upper contact with Rosendale Dolostone, upper massive sandstone unit, poorly developed underlying shale unit, main cross-laminated sandstone unit, lower shale unit, bottom dolostone breccia unit and possible lower contact with the High Falls Shale. Cross-laminations, ripple marks and desiccation cracks can be observed in the middle unit. Casts of salt hoppers have been found in the upper part of the middle unit and will be displayed in the Geology Department at Vassar College at the conclusion of this trip. Studies of cross-laminations by Ringler (1970, 1971) and of sand grain orientations by Fields (1975a, 1975b) indicate a preponderant net shift of sediment to the northwest ($N36^{o}W$) with a statistical allignment of long axes of sand grains ($N80^{o}E$-$S80^{o}W$). This may indicate that the bulk of the sand grains progressed northwestward as

"rollers" rather than as "sliders". A tidal flat environment is proposed for most of this section.

Caution - This road cut has become increasingly unstable over the years. Watch out for falling rocks and blocks!

Return to transportation and proceed north on NY 32.

21.1 - 0.6 Bridge over Rondout Creek.

21.2 - 0.1 Turn right onto Creeklocks Road and proceed northeast.

22.0 - 0.8 Lefever Falls below to the right has been somewhat modified by the U.S. Army Corps of Engineers.

22.1 - 0.1 At bottom of hill after passing through a decending left-hand curve park on loading platform on the right. This platform once served barges berthed in a turning basin of the Delaware and Hudson Canal. The canal was last used around the turn of the Century.
Walk back uphill on Creeklocks Road about 300 feet or where the road turns sharp left. Turn right and proceed into the woods over a low mound. Head north on the trail beyond the mound for about 300 feet. Follow the trail which now turns sharp left and proceed uphill on the trail to the Lefever Falls Mine entrance.

STOP 2: Caution - Please do not fall into the mine as accidents will impeed the progress of this field trip and we are on a tight schedule! Do not crowd one another near the edge of the mine!

A nearly complete section of Binnewater Sandstone can be seen at this stop in the southwest wall of the mine entrance. It is not as well exposed as that in STOP 1 due to cover by mosses and lichens. The upper massive sandstone has been removed by pre-Rosendale erosion. The shale beneath is not exposed but can be seen several hundred feet to the south on the dip slope of the top surface of the main sandstone unit. The contact between the shale and the overlying Rosendale Dolostone can be observed in the vicinity only with difficulty. The lower shale unit and the bottom argillaceous dolostone unit can be observed on both the north and south walls of the mine entrance. Pass through the archway

in the wall on the left (south) and proceed with care past the steeply dipping mine opening on the right. Your first slip may be your last. Continue south for several hundred feet with the dip slope of the main sandstone unit on your left. Where possible, examine the slope for signs of silicified, hemispherical stromatoporoid coenostea in growth position. Should you find one please do not collect it as our studies of this location are not completed. Continue south until the upper shale unit is reached and can be examined. The significance of this locality is discussed in the text.

Return with care to transportation on Creeklocks Road and continue northeast.

22.3 - 0.2 Turn left on Lefever Falls Road and proceed north parallel to N.Y. State Thruway.

22.9 - 0.6 Map Hill - Turn right onto Old Route 32 and proceed west.

23.1 - 0.2 NY 32 - Proceed across and continue on Old Route 32 which bears toward the south.

23.6 - 0.5 Bear to right at junction and continue on Hickory Bush Road which bears north.

24.6 - 1.0 Cross Penn Central RR tracks and park on left side of road. Return to tracks and bear right. Walk about 1200 feet to the southwest.

STOP 3: A complete section of Binnewater Sandstone can be seen with all units as at STOP 1 but the upper dolomitic shale unit is much more clearly defined. The relief on the top of the upper massive sandstone unit can be seen on the dip slope of the floor of the mine where the overlying Rosendale Dolostone has been removed. The Binnewater - High Falls contact probably lies within or at the base of the lower argillaceous dolostone unit. Studies of cross-laminations and ripple marks by Christianson (1969) indicate a marked net shift of sand toward the southwest (S75^{o}W). Some yewars ago Susan Mocco, a student in the Dept. of Geological Sciences at S.U.N.Y. New Paltz, studied this section extensively to determine if there was indication of periodicity in the lithological variation within the main sandstone unit. The variation appears to be more random than periodic. Note the silicified stromatoporoid coenosteum in the upper massive unit, and flat shale pebbles in the bottom of the main sandstone unit.

Caution - As at STOP 2, please avoid falling into the mines as it will unnecessarily delay the trip!

Return to transportation and proceed north on Hickory Bush Road - now Whiteport Road.

25.3	0.7	Pass under Penn Central RR tracks then N.Y. State Thruway.
25.5	0.2	Whiteport
26.1	0.6	Turn left and proceed north on Byersdorfer Street.
26.2	0.1	Highway 32 - Proceed left (north) with caution.
26.4	0.2	Turn right onto DeWitt Lake Road which bears east then north.
27.2	0.8	Veer left onto Mountain Road and continue north.
27.9	0.7	Park on right just before junction with NY 213. Walk back (south) facing traffic along Mountain Road about 300 feet then cross to uphill side opposite road cut.

STOP 4: Caution - The roadway is narrow and local drivers often speed along this stretch. At this location the main sandstone unit is all that remains of the Binnewater at this latitude and it is in distinct contact with the High Falls Shale. The lower shale unit and the bottom dolostone unit are missing, probably indicating an onlap relation with the High Falls in an apparent northeast direction. The High Falls at this location is an uncharacteristic, poorly sorted, argillaceous, quartzose, quartz pebble-bearing material which was mistaken for a basal unit of the Binnewater sandstone by Waines and Sander (1968, p. 18).

Return to transportation and proceed straight ahead (north) and onto Abeel Street with caution. NY 213 enters from the right.

28.0	0.1	Pass under Nytralite conveyor.
28.5	0.5	Entrance to City of Kingston gravel pit on the left (west). Pull off to the left with caution and park in the entrance. Walk uphill past the gate about 200 feet.

STOP 5: At this location the Binnewater Sandstone consists solely of the main sandstone unit which is completely exposed at the north end of the outcrop. The unit consists of an upper dark, somewhat silicified portion and a lower lighter colored portion. This subdivision occurs only locally. Cross-lamination is primarily confined

to a very narrow zone. Dolomitic content in this section is uncharacteristically high. The Binnewater-Rosendale Dolostone contact is delineated by a discontinuous line of bleeding pyrite and can be closely observed at the north end of the outcrop. The Binnewater-Ordovician contact can best be seen near the base of the outcrop several tends of feet south of the main exposure of Binnewater. The contact is in angular unconformity with Ordovician shales, siltstones and greywackes. Quartz pebbles occur within the base of the Binnewater up to several inches above the contact. In several large blocks of Binnewater Sandstone which have fallen forward from the outcrop a cross-laminated, ripple-marked, mud-cracked bedding plane can be observed along with the Binnewater-Rosendale contact. Preliminary estimates of net sand transport from cross laminations indicate a general net shift to the south.

Return to transportation and turn right with caution onto Abeel Street. Proceed south.

29.1	- 0.6	Stay right onto Mountain Road.
29.8	- 0.7	Veer right onto DeWitt Lake Road.
30.6	- 0.8	Turn left onto NY 32 and proceed south.
33.9	- 3.3	Veer right onto NY 213 just opposite Creek Locks Road on left and pass through Village of Rosendale.
34.7	- 0.8	Pass under Penn Central R.R. trestle.
35.8	- 1.1	Bridge over Rondout Creek.
37.7	- 1.9	High Falls and Central Hudson generating facilities (not operating) on right. Park in entrance on right or on opposite side of road where possible.

STOP 6: Walk north to edge of Rondout Creek and observe falls from platform. Do not crowd! Upper contact of Binnewater Sandstone with Rosendale Dolostone occurs near base of falls and can be observed only with difficulty if at all. A complete exposure on the far side of the river is not accessible on this trip. Continue downhill (east) on paved road and observe exposure of Binnewater on right (south). This sequence lies somewhere in the middle and lower part of the Binnewater. Generally the Binnewater is not quite the same as in the Rosendale area. The sands especially in the lower part become somewhat vugular and tend to be more dolomitic.

Occasional traces of red coloration begin to appear. The lowermost five feet or so are somewhat transitional to more typical High Falls lithology. The lower part of the section is in some ways more akin to that in the Accord drill core which will be displayed at Vassar at the conclusion of this trip.

Return to transportation and proceed west on NY 213.

37.8	- 0.1	Bridge over Rondout Creek.
37.9	- 0.1	Turn left onto Lucas Avenue and proceed south.
43.2	- 5.3	Junction with US 209. Turn left and proceed south.
44.0	- 0.8	Turn left (south) with care off US 209 and cross bridge over Rondout Creek into Accord (Port Jackson).
44.1	- 0.1	Turn right onto side road just past bridge.
44.2	- 0.1	Road fork. Bear right.
44.3	- 0.1	Bear right onto main road, then immediately right onto dead end road. Proceed 0.1 miles bearing left then right into Town of Rochester Highway Department yard. Park. Walk a short distance southeast over abandoned road and descent into abandoned railroad cut. Walk to west end of cut.

STOP 7: Here the Rosendale Limestone contains a highly arenaceous unit at the base which disconformably overlies a laminated, soft-weathering, argillaceous dolomit with the fissility of shale. This has been referred to as the Accord Shale by Fisher (1959). Drill cuttings of the top six feet of this unit obtained in a nearby quarry were examined for insoluble residues through six inch intervals by Ruth Ellen Nielson, a student at S.U.N.Y. New Paltz several years ago. All residues proved less than half the samples by weight; generally between thirty and forty-five per cent. Harry Dembicki, another student, determined a general fifty-fifty ratio in the Ca/Mg ratios in the dissolved portions of the samples suggesting dolostone. According to drill core taken in a nearby boring, this argillaceous dolostone unit is about 14 feet thick. The disconformable contact with the overlying Rosendale Limestone can also be seen in the same core. There is a possibility that ostracods may be found in this outcrop. One was encountered in the drill core in about this interval. Possible relation of this dolostone to the Binnewater

		Sandstone at High Falls is indicated in figure 2.
		Walk back to transportation and return to main road.
44.7	- 0.4	Turn right (southwest) onto Granit Road.
44.8	- 0.1	On left is quarry mainly excavated in Rosendale Limestone. Road skirts northwest side of quarry. Drill core mentioned at STOP 7 was taken on far side of quarry.
47.0	- 2.2	Entrance to the Granit.
47.4	- 0.4	Junction. Bear left.
47.7	- 0.3	Cross Bridge then bear right.
48.6	- 0.9	Turn sharp left onto US 44 - NY 55 and proceed southeast.
57.2	- 8.6	Junction NY 299. Turn left and proceed east towards New Paltz.
63.0	- 5.8	Bridge over Wallkill River.
63.4	- 0.4	Junction with NY 32 North on left. This brings us back to Mile 12.8 on the outward bound portion of this trip. Return to Vassar College in reverse order of the road leg.
76.2	- 12.8	Turn right into north parking lot of Vassar College. The drill core of the Binnewater Sandstone obtained at Accord will be displayed in the Geology Department.

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