

University of New Hampshire

University of New Hampshire Scholars' Repository

NEIGC Trips

New England Intercollegiate Geological
Excursion Collection

1-1-1965

Geology of the Buckfield and Dixfield Quadrangles in Northwestern Maine

Warner, Jeffrey

Pankiwskyj, Kost A.

Follow this and additional works at: https://scholars.unh.edu/neigc_trips

Recommended Citation

Warner, Jeffrey and Pankiwskyj, Kost A., "Geology of the Buckfield and Dixfield Quadrangles in Northwestern Maine" (1965). *NEIGC Trips*. 78.
https://scholars.unh.edu/neigc_trips/78

This Text is brought to you for free and open access by the New England Intercollegiate Geological Excursion Collection at University of New Hampshire Scholars' Repository. It has been accepted for inclusion in NEIGC Trips by an authorized administrator of University of New Hampshire Scholars' Repository. For more information, please contact nicole.hentz@unh.edu.

TRIP K

Geology of the Buckfield and Dixfield Quadrangles in Northwestern Maine

Leaders: Jeffrey Warner, Harvard University and Maine
Geological Survey

Kost A. Pankiwskyj, University of Hawaii and
Maine Geological Survey

INTRODUCTION

This trip will study the Silurian and Devonian rocks on the southeast limb of a major northeast plunging syncline. All the rocks seen are in the sillimanite and staurolite zones of metamorphism. The stratigraphic nomenclature developed by Billings and his co-workers in New Hampshire was originally used in this area. However after detailed mapping by Fisher (1962), Guidotti (1965), Pankiwskyj (1964), and Warner (in preparation) in respectively the Bethel, Bryant Pond, Dixfield, and Buckfield Quadrangles, a new set of stratigraphic names was developed. Although these names are not yet official, we use them here as a matter of convenience. A geologic map appears in Figure 1.

Stratigraphy

The stratigraphy to be seen is shown in Table 1.

BUCKFIELD GROUP. This package of conformable formations is composed of sillimanite-biotite rich schists and calc-silicate granulites. The Buckfield Group has been traced northeast into the large pluton in the Farmington and Norridgewock Quadrangles. To the northeast of the pluton is found a large section of the "sandstone fancies" which will be discussed in a later section. The Buckfield Group has been traced through the Bryant Pond, Poland and Lewiston Quadrangles, into the Sebago Pluton. On the south side of this pluton, similar lithologies are found in the Eliot Formation of Hussey (1962 and unpublished 1963 map).

The Buckfield Group is correlated with the Waterville Formation of Osberg (in press), which contains graptolites of Wenlock (Middle Silurian) age. This correlation is based on lithologic similarity and the presence of a major anticline through the Livermore Quadrangle, evidence for which is not as yet conclusive. However, it is possible that the lithologic types may be traceable continuously from Buckfield, through the Poland, Lewiston, Gardiner, and Augusta Quadrangles to the Waterville area. Caldwell, who is mapping the Livermore Quadrangle and one of the writers (JW) both agree on an anticline in Livermore, but they disagree on the location of the axis.

TABLE I

Age	Pelite Facies	Sandstone Facies
Devonian		Staples Pond Fm.* Temple Stream Fm.* Saddleback Mtn. Fm.*
Devonian or Silurian	Woodstock Group	Severy Hill Fm.* Peru Fm.* Newton Hill Fm.* Thompson Mtn. Fm. Anasagunticook Fm.* Ludden Brook Fm.*
Silurian	Buckfield Group*	Moody Brook Fm. Berry Ledge Fm. Noyes Mtn. Fm. Patch Mtn. Fm. Turner Fm.*

* - Unpublished and unofficial stratigraphic names.

Turner Formation. This unit is composed of sillimanite-biotite-muscovite-garnet schist with many zones and beds of biotite quartzite and biotite metagraywacke. A thin zone of graphite schist has been mapped by Caldwell.

Patch Mountain Formation. This is a thick unit (about 1000 feet) composed of marble and/or calc-silicate granulite interbedded with biotite-quartz granulite and/or biotite quartzite. The individual layers are between 2 and 10 cm. thick. The calc-silicate and marble make up between 50 and 80 percent of the unit. In the vicinity of North Turner, however, the amount of calc-silicate and marble is lower (about 30 percent). In the vicinity of Buckfield there are several lenses of two-mica schist.

Noyes Mountain Formation. Like the Turner Formation, this unit is composed of sillimanite-biotite-muscovite-garnet schists with zones and beds of biotite quartzite. Knots of sillimanite are very common in the schists. They are as large as 2.5 cm. across and weather out as white spots. The field name for this lithology, "maggot schist," is a result of these white sillimanite knots.

Berry Ledge Formation. The Berry Ledge, like the Patch Mountain, is composed of marble and calc-silicate granulite interbedded with biotite-quartz granulite. Guidotti (1965) states that the Berry Ledge contains more calcite than the Patch Mountain in the Bryant Pond Quadrangle. This generalization does not hold up in the Buckfield region. Unlike the Patch Mountain, the Berry Ledge is only about 200 feet thick. The difference in thickness is the key to distinguishing the two calc-silicate formations.

Moody Brook Formation. This unit is composed of sillimanite-biotite-muscovite schists. There are beds and zones of calc-silicate granulite and others of biotite quartzite in the unit. One thin lens of graphite schist has been mapped in the southwest part of the Buckfield Quadrangle. The discontinuous horizon of calc-silicate granulite in the Moody Brook appears to coincide with one of the discontinuous calc-silicate horizons in the Anasagunticook Formation. In several places, e. g., the Spruce Hills in the west part of the Buckfield region, the Moody Brook contains sulfide and is slightly rusty-weathering. The rusty zones do not seem to be stratigraphic.

WOODSTOCK GROUP. This package of conformable formations is composed of rusty- and gray-weathering, well- and poorly-bedded spangled-muscovite schists and gneisses. Cyclically bedded schist and quartzite is found at the top, and small lenses of calc-silicate granulite are found throughout the group. The schists of the Woodstock Group are rich in muscovite and feldspar, and commonly contain muscovite spangles, whereas those of the Buckfield group are rich in sillimanite and biotite.

To the west the Woodstock Group has been traced through the Bryant Pond, Rumford and Bethel Quadrangles into the gneisses of the Littleton Formation in New Hampshire. To the northeast, i. e., in the Buckfield, Dixfield, Livermore, and Farmington Quadrangles, the Woodstock Group thins considerably and, at least in part, is replaced by the "sandstone facies" which is found to the northeast. The Ludden Brook Formation is considered to be a southwestward extension of the sands. Figure 2 is a restored cross-section of Northwestern Maine, illustrating the relations within the Woodstock Group.

The Woodstock Group underlies the Devonian (?) Saddleback Mountain Formation, and overlies the Silurian Buckfield Group. It is thought to be of Devonian or Silurian age. Note that several mapped formations in the Woodstock Group will not be seen on the trip and are not discussed below.

Anasagunticook Formation. This unit is composed of coarse-grained spangled muscovite-sillimanite-feldspar-biotite-garnet schist and migmatized gneiss. To the northeast, where the metamorphism is less intense, this unit is well-bedded. Several lenses of calc-silicate granulite have been mapped. As has already been noted, the lowest horizon of these calc-silicate lenses seems to be continuous with a similar horizon in the Moody Brook Formation. This relationship is highly suggestive that the upper part of the Buckfield Group is in facies relation to the lower part of the Woodstock Group.

Thompson Hill Formation. In the Farmington Quadrangle this unit is composed of two parts. The upper contains sulfidic, rusty-weathering mica schist, muscovite schist, and quartzite, in beds ranging in thickness from 1/2 cm. to 1/2 meter. The lower part contains bedded argillaceous sandstone and pelite. To the southwest, in the Dixfield Quadrangle, the lower part of the formation is discontinuous, and farther on in the Buckfield Quadrangle it is altogether absent. The sandstone and pelite are found in beds from a few centimeters to 1 meter thick. The ratio of sandstone to pelite averages 1:1 in the Buckfield Quadrangle, 3:1 in the Dixfield Quadrangle, and as much as 8:1 in the Farmington and Norridgewock Quadrangles. This reflects the coming in of the "sandstone facies" to the northeast.

Newton Hill Formation. This unit is composed of cyclically bedded schist and quartzite. The individual layers are 2 to 15 cm. thick. The beds are graded in many places. Abundant pods of calc-silicate granulite are found near the top of the unit. The Newton Hill is found as discontinuous (?) lenses at the top of the Woodstock Group.

Ludden Brook Formation. This unit is composed of fine-grained to medium-grained biotitic-feldspathic sandstone and minor micaceous

sandstone, with pods, beds, and stringers of calc-silicate. Biotite laminae spaced from 1 to 10 mm. apart are common. The Ludden Brook is traced southwest as far as the northeast border of the Buckfield Quadrangle, where it interfingers with gneisses of the Woodstock Group. To the northeast it has been traced by one of the writers (KAP) as far as the village of Brownville in Piscataquis County. This unit is considered to be one of the tongues of the "sandstone facies".

Peru Formation. In the west part of the Dixfield Quadrangle this unit is composed of thinly-bedded calc-silicate (locally marble) and biotitic granulite in the west part of the Dixfield Quadrangle, but grades into biotitic granulite with pods of calc-silicate in the east part of the Dixfield Quadrangle. Farther to the northeast in the Farmington Quadrangle it is a calcareous sandstone interbedded with minor calcareous slate.

Although the map pattern of the base at the Peru Formation looks suggestive of an unconformity, we believe it is conformable. In several places the Woodstock Group has been observed grading into the Peru. We believe the map pattern is caused by the eastward thinning of the Woodstock Group.

Severy Hill Formation. This formation is composed of sulfidic, rusty-weathering quartzite, muscovite schist, and mica schist. These are interbedded in a manner reminiscent of the upper part of the Thompson Hill Formation. The Severy Hill Formation is continuous from the south part of the Dixfield Quadrangle, across the Farmington Quadrangle, and into the southeast part of the Kingfield Quadrangle. To the northeast from there, it is not persistantly sulfidic, but contains abundant zones of bedded gray sandstone and sulfidic slate. In the west part of the Dixfield Quadrangle, the Severy Hill Formation forms discontinuous patches stratigraphically above the Peru Formation. These are interpreted as due to lack of deposition, rather than to unconformity or erosion.

Saddleback Mountain Formation. This unit forms the bulk of the major syncline in the Dixfield Quadrangle. The most common rock type is cyclically bedded pelite and sandstone. Individual beds of the sequence range in thickness from 1 to 25 cm. The pelite is rich in muscovite, averaging 15 percent. Both graded-beds and cross-beds are abundant. Sections several meters thick, composed of homogenous pelite or sandstone are found throughout the unit. Commonly the sandstone is slightly calcareous and contains pods of calc-silicate. Many lenses of "ribbon limestone" and sulfidic rocks are present within this formation.

North from the Dixfield Quadrangle, the Saddleback Mountain Formation is traced across a fault and a granodiorite pluton into the

Bear Hill Formation of Moench. To the east and northeast from the Dixfield Quadrangle the Saddleback Mountain Formation is sandwiched by the sulfidic Severy Hill Formation on the southeast and by the sulfidic Temple Stream Formation on the northwest. This triple layer is traced as far as the Kennebec River in the Center of the Anson Formation. As in the case of the Thompson Hill Formation, the ratio of sandstone to pelite in the Saddleback Mountain Formation increases to the northeast. Excellent exposures of dominant sandstone with lenses of cyclically bedded sandstone and pelite can be seen in the Carrabassett River in North Anson.

The Saddleback Mountain Formation is assigned a Devonian age based on its lithologic similarity to the Seboomook Formation and the similarity of the Littleton trilogy (gneiss - calc-silicate (Boott) - well-bedded) with the Woodstock - Peru - Saddleback Mountain section.

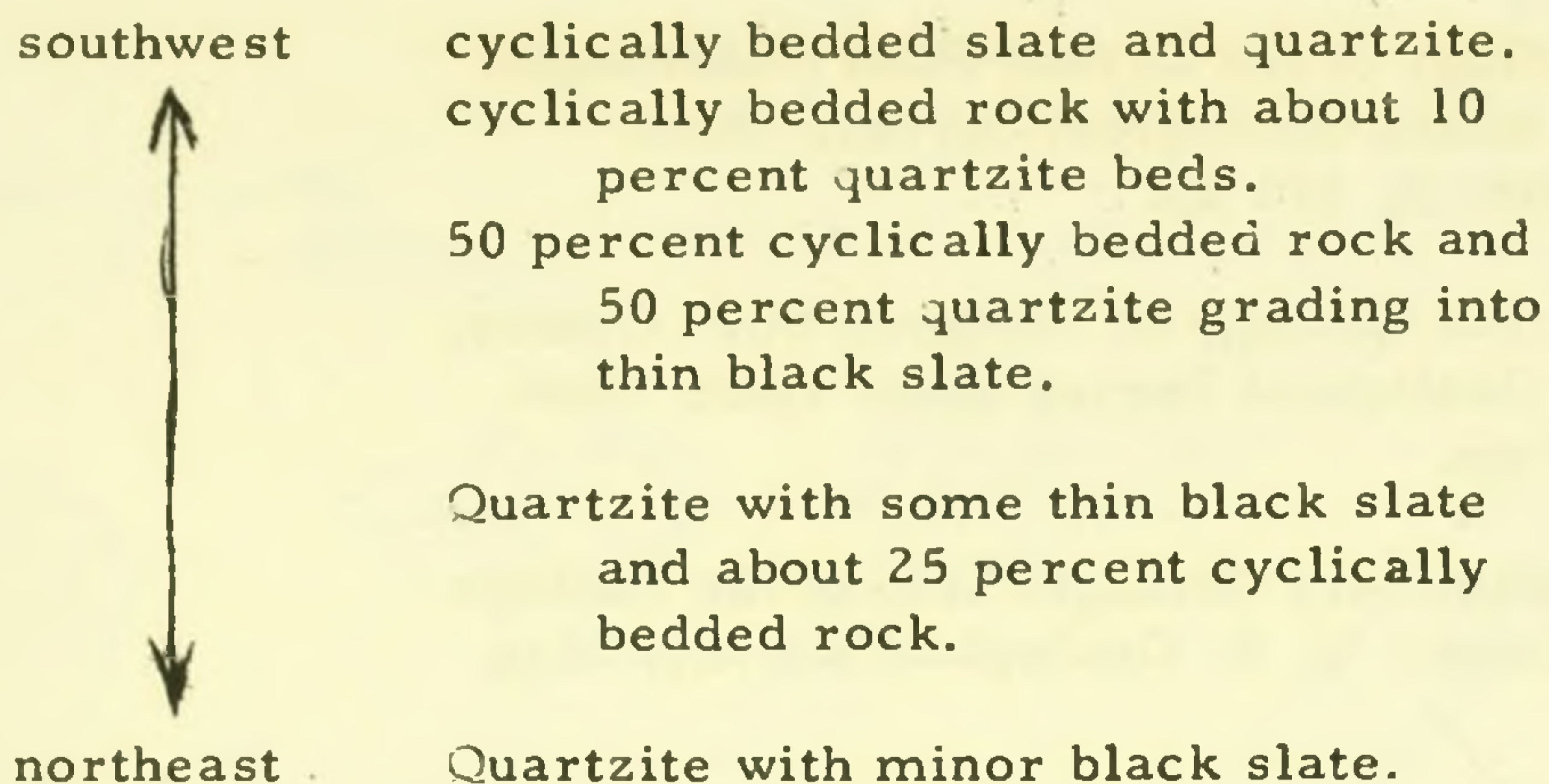
Temple Stream Formation. This unit is composed of sulfidic, rusty-weathering quartzite, mica schist, and muscovite schist. As is the case of the Severy Hill to the northeast of the Dixfield Quadrangle, the rusty types are interbedded with gray sandstone.

Staples Pond Formation. This is the youngest unit under consideration. It is composed of thinly bedded to massive calcareous sandstone and minor slate. Like the Ludden Brook, it appears to be a southwestward extension of the "sandstone facies" which dominates the northeast.

The Facies Problem

It is notable in the above discussion of the stratigraphic units that the only formation which could be traced for a considerable distance to the northeast is the Ludden Brook Formation - a sandstone. Further, it has been repeatedly noted that there is a pronounced increase in the sandstone to pelite ratio of each formation toward the northeast. This is especially clear cut in the case of the Saddleback Mountain Formation.

The Saddleback Mountain Formation, sandwiched between two rusty units, is a cyclically bedded pelite and quartzite in the Dixfield and Farmington Quadrangles, whereas it is a sandstone in the Kingfield and Anson Quadrangles. One of the writers (KAP, who is currently mapping in the Kingfield Quadrangle) reports the following section in the Saddleback Mountain Formation at the southern edge of the Kingfield Quadrangle:



This section is 1/2 mile long and almost parallel to strike.

Other evidence that has a bearing on this problem is:

1. All the rusty units become thin and patchy towards the northeast.
2. Thousands of feet of the Buckfield Group apparently disappear.
3. The lower part of the Thompson Mountain becomes predominately a sandstone in the middle of the Farmington Quadrangle.
4. The Peru Formation changes from bedded calc-silicate and biotitic granulite in the eastern part of the Dixfield Quadrangle, to a calcareous sandstone in the Farmington Quadrangle.

It is clear to the writers, from the evidence cited and from four years of intermittent reconnaissance, that there is a general facies change from dominantly pelite in the southwest to dominantly sandstone in the northeast. We interpret the Ludden Brook and Staples Pond Formations as southwestward extensions of the "sandstone facies."

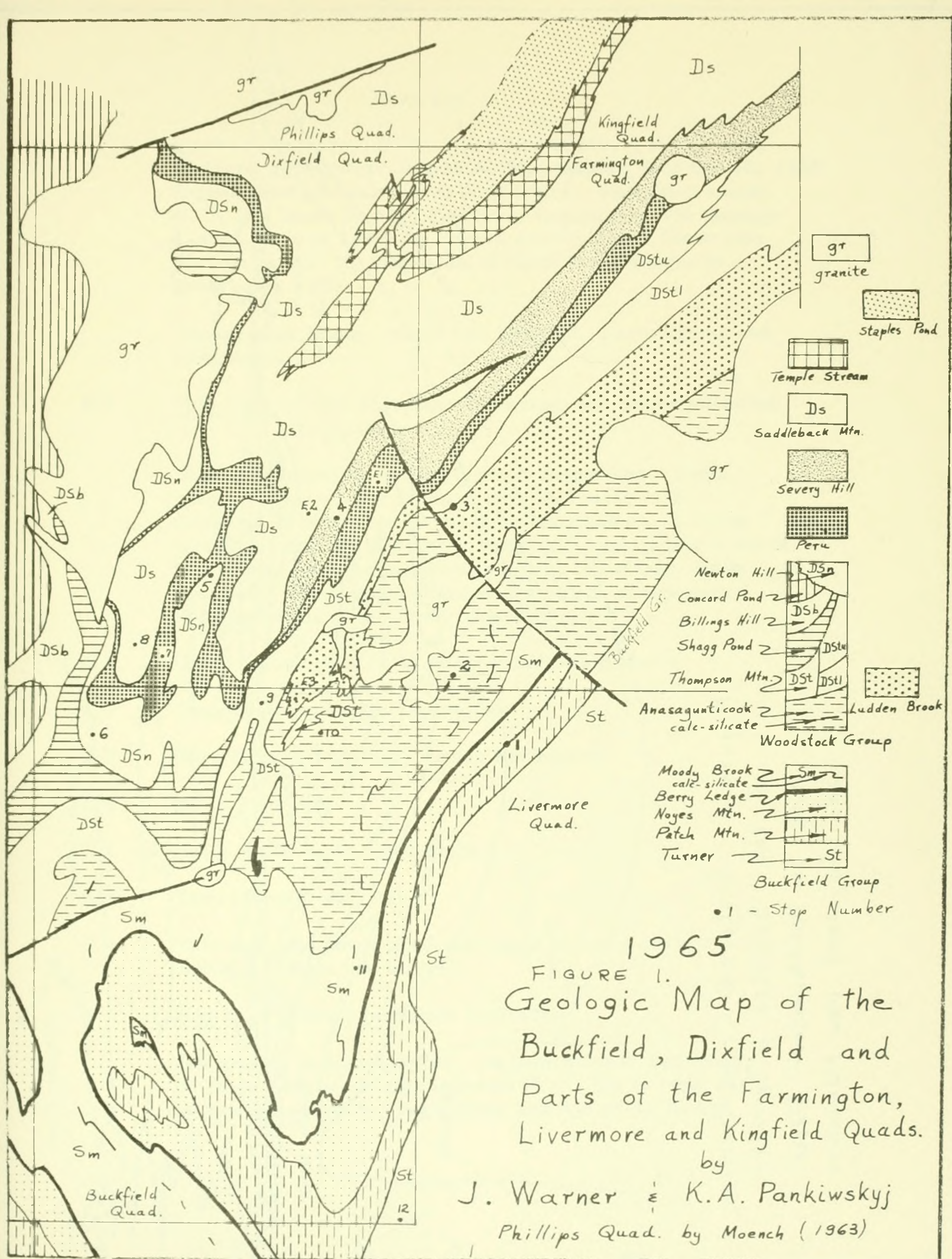
Based on reconnaissance, the writers feel that farther to the northeast the "sandstone facies" gives way to abundant pelite. This appears to take place in the Bingham, Kingsbury and Greenville Quadrangles.

The relationship of the "sandstone facies" to the rocks in the Buckfield and Dixfield Quadrangles is illustrated in Figure 2.

References Cited

- Fisher, I. S., 1962, Petrology and Structure of the Bethel area, Maine: Geol. Soc. Am. Bull., Vol. 73, pp. 1395-1420.

- Guidotti, C. V., 1965, Geology of the Bryant Pond Quadrangle, Maine: Quad. Maine Geological Survey, Quad. Mapping Ser. No. 3, 116 pp.
- Hussey, A. M., II, 1962, The Geology of Southern York County, Maine: Maine Geological Survey Spec. Geol. Stud. Ser. No. 4, 67 pp.
- Moench, R. A., 1963, Preliminary Geologic Map of the Phillips Quadrangle, Maine: U. S. Geological Survey, Map MF 259.
- Pankiwskyj, K. A., 1964, Geology of the Dixfield Quadrangle, Maine: Ph. D. Thesis, Harvard University, 224 pp.



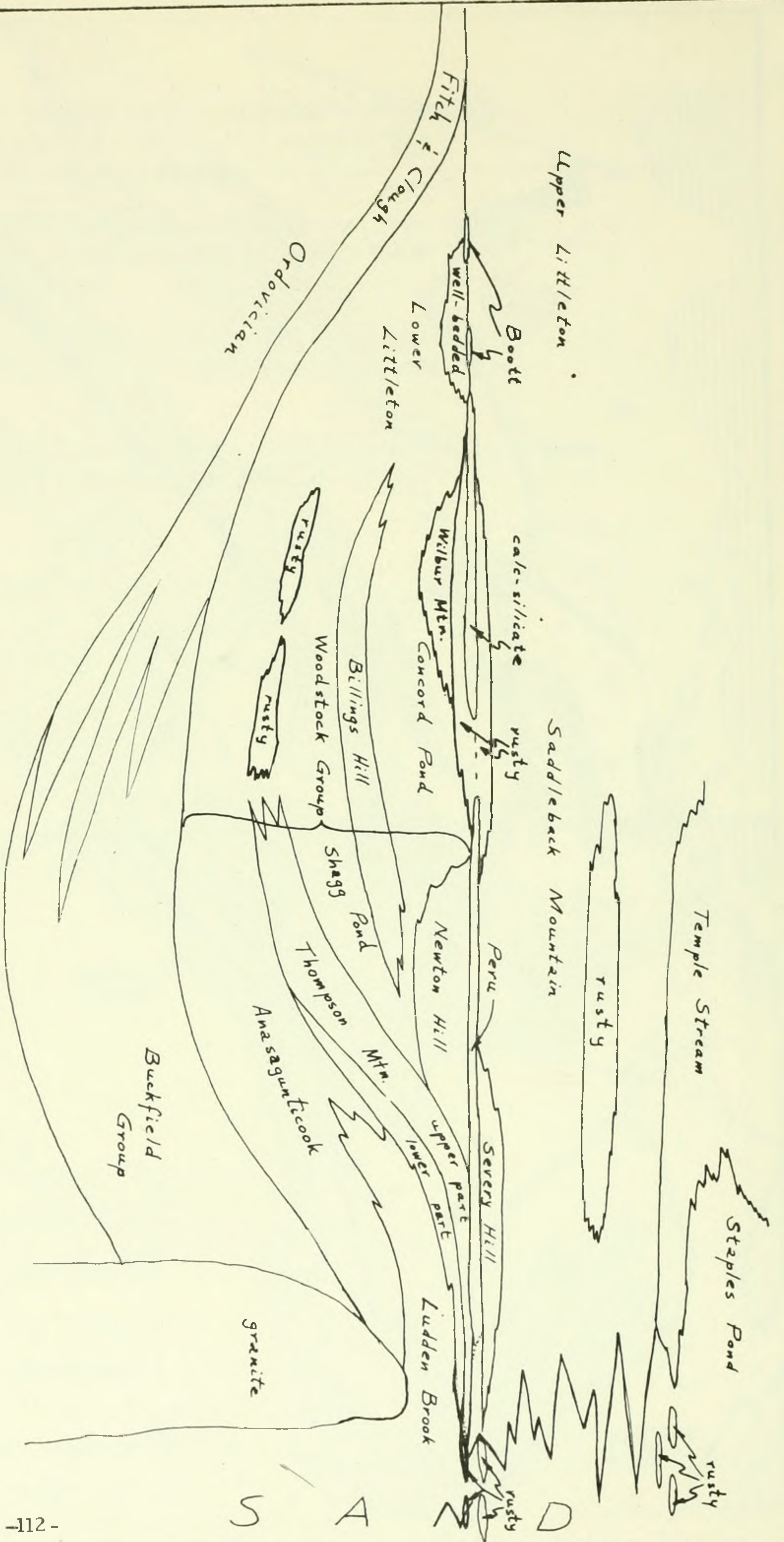


Figure 2 - Restored Cross-Section
of the Silurian & Devonian
Rocks in Northwestern Maine
and Adjacent New Hampshire

Road Log

Meet at Livermore Falls, west side of Me. 4 bridge over Androscoggin River, at 9:15 A. M., Sunday, October 10, 1965. Suggest leave Brunswick at 0800 hours. Suggested route: U. S. 201 north through Topsham, left on Me. 196 through Lisbon Falls to Lewiston, cross Androscoggin River into Auburn on Me. 11, follow Me. 4 north from Auburn to Livermore Falls.

Topographic maps: Buckfield, Dixfield, Farmington, and Livermore.

0.0 Stop 1 Patch Mountain Formation and Noyes Mountain Formation.

Patch Mountain Formation in river below dam. Some geologists have seen primary tops right side up here. Crops on road are Noyes Mountain Formation. Several isoclinal folds are present in crop. Around corner to north is a weathered crop showing excellent sillimanite knots (maggots). Behind gray house to south is an exposure of the top beds of the Patch Mountain.

0.2 Cross bridge on Me. 4, left turn following Me. 4.

1.1 Crop of Berry Ledge Formation.

1.2 Several crops of Moody Brook Formation.

2.3 R. R. crossing.

2.6 Enter Farmington Quadrangle.

2.8 Turn left onto Me. 140.

3.0 Turn left onto paved road just short of white house, continue across two bridges.

3.3 Stop 2 Anasagunticook Formation.

Jay granite to east in river. Anasagunticook Formation on knob. Across bridge in a new R. R. cut to right are exposed Jay granite, pegmatite, and one of the lenses

of calc-silicate within the Anasagunticook Formation.

Turn around, retrace route toward Me. 4.

- 3.8 Turn left onto Me. 4 and Me. 17.
- 4.1 Power line.
- 4.7 Jay Hill Picnic area, view of Mount Blue.
- 6.8 Straight through N. Jay on Me. 4. Granite quarry 1/2 mile west of town.
- 9.2 Turn left about rotary onto U. S. 2.
- 9.6 Stop 3 Thompson Mountain Formation and Ludden Brook Formation.
- East end of crop contains intricately, disharmonious folds and convolutions in the Ludden Brook Formation. Note the mineralogic zoning in the calc-silicate pods and beds. Center 15 feet of crop is a rusty-weathering "fault breccia" and intruded pegmatite. East end of crop contains mica-rich rocks of the lower part of the Thompson Mountain Formation. Several tight folds can be seen. Note the upgrade pseudomorphs of muscovite + biotite after staurolite.
- 9.7 Continue on U. S. 2 through yellow blinker. Crops of Thompson Mountain Formation.
- 10.0 Enter Dixfield Quadrangle.
- 10.5 View of Mount Blue.
- 11.6 Extra Stop 1 Peru Formation
- Biotite granulite with scattered pods of calc-silicate.
- 13.7 Crops of Peru Formation.
- 14.2 Straight through East Dixfield on U. S. 2.

14.4 Stop 4 Severy Hill Formation

Park by Hall Farm. Crop is in brook at south end of field on south side of road. Walk on path through gate.

Thinly bedded Severy Hill Formation.

15.2 Crop of Saddleback Mountain Formation.

15.4 Extra Stop 2 Saddleback Mountain Formation.

Well developed cross- and graded-bedding indicate isoclinal folds.

17.9 Height of land.

20.0 Stop 5 Newton Hill Formation

Turn right on paved road, turn around, and park. Crop instream to south. NO HAMMERS PLEASE. This crop of Newton Hill is in the nose of a major anticline. It lies within 200 feet of the Peru Formation. Pods and beds of calc-silicate granulite of the upper part of this unit.

20.1 Turn right back onto U. S. 2 and Me. 17.

22.0 Newton Brook Picnic Area. Alternate lunch stop.

23.1 Crop of Peru Formation.

23.4 Turn right following U. S. 2 at lumber mill.

24.1 Crop of Saddleback Mountain Formation.

25.3 Entering Village of Dixfield - smell Rumford yet?

25.4 Crops from here to New Hampshire on U. S. 2 are all in the Woodstock Group.

26.3 Turn left over bridge crossing Androscoggin River.

26.6 Straight onto paved road. Cross Me. 108.

- 27.6 Pegmatite and Billings Hill Formation.
- 28.6 Enter Buckfield Quadrangle. View of Black Mountain.
- 29.7 Turn left onto paved road.
- 30.7 Turn right at four-corners onto dirt road.

31.4 Stop 6 Newton Hill Formation

This crop displays excellent graded bedding, axial plane foliation, and disharmonic folding.

LUNCH

- 31.6 Continue on dirt road until cemetery, make a U-turn. Good view of the Sugarloves to the north. Retrace route to four-corners.
- 32.4 Straight through four-corners.
- 32.7 View of Mount Zircon to west.
- 33.7 Turn right. Good view of Webb Valley and mountains in Rangeley region.
- 34.4 Turn left and stay on paved road until Me. 108 in Peru. Good view of Colonel Holman Ridge.
- 35.2 Enter Buckfield Quadrangle.
- 36.8 Turn left onto Me. 108.
- 37.1 Several crops of Newton Hill Formation.
- 37.5 Stop 7 Peru Formation

This crop is typical of the Peru Formation in the sillimanite zone: folded and injected by pegmatites. Tar cover of crop is not typical of the Peru Formation, but it is common of crops on Me. 108. Note that calc-silicate outcrops have a higher frequency of pegmatite than crops of other lithologies.

- 38.1 View of Whittemore Bluff across river - Saddleback Mountain Formation.
- 38.3 Stop 8 Saddleback Mountain Formation
- Typical cyclically bedded pelite and quartzite, but with a greater than normal amount of calc-silicate pods and beds. There is a zone at the west end of the crop that has an unusually high concentration of calc-silicate.
- 39.8 Woodstock Group crops out from here to Rumford on Me. 108.
- 40.1 Turn right over bridge, retrace route through Dixfield to lumber mill at mile 23.4.
- 43.3 At lumber mill go straight (DO NOT FOLLOW U. S. 2) on paved road toward Canton Point.
- 44.8 Ledges in Newton Hill Formation.
- 45.2 Enter Buckfield Quadrangle. Crops of Newton Hill Formation.
- 46.8 Stop 9 Thompson Mountain Formation
- Typical crop of this unit in the Buckfield Quadrangle and of the upper part of the unit in the Dixfield Quadrangle.
- 47.9 Extra Stop 3 Ludden Brook Formation
- Type locality of this unit.
- 48.9 Stop 10 Anasagunticook Formation
- This crop is typical of all the coarse-grained, gray-weathering, migmatitic schists (gneisses) in the Woodstock Group.
- 49.4 Caution- bad left turn in road.
- 50.7 Turn right at stop sign onto Me. 140.

- 51.4 Cross Androscoggin River on Me. 140.
- 53.1 Turn left onto Me. 108 in Canton.
- 53.2 Dixie to left.
- 53.8 Crops of Anasagunticook Formation with a lens of calc-silicate and injected with granite.

56.2. Stop 11 Moody Brook Formation

This and following crops are typical of this unit. The next crop is rich in the biotite quartzite phase of the unit.

- 56.6 Small crop to west of farmhouse on right is the Berry Ledge Formation (?).
- 56.7 Following crops are in the Noyes Mountain Formation.
- 58.0 Continue straight.
- 58.9 Continue right by joining Me. 4. From here to stop 12 we are in poorly outcropping belt of Patch Mountain Formation.
- 60.5 Boulders and crop of Patch Mountain Formation.
- 61.3 Straight through cross-road (Me. 219).
- 62.8 Crops of Noyes Mountain on hill to right.
- 64.8 Crops of Turner Formation.
- 67.6 Cross bridge over Nezinscot River at Turner.
- 68.1 Stop 12 Turner Formation

This is the oldest rock seen on this trip. The geology of the anticline between the Buckfield - Dixfield regions and the Waterville region is now being studied.

Suggested route to Boston - follow Me. 4 to Maine Turnpike Exit 12, 5 miles south of Auburn. Jimmy's Diner and Texaco in Auburn for good food and low gas prices.