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### Paleozoic Section Across Central Maine

Doyle, Robert G.

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## TRIP B

### PALEOZOIC SECTION ACROSS CENTRAL MAINE

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#### INTRODUCTION

This trip will study the stratigraphy in a 45 mile wide belt through the major synclinorium in South-Central Maine. The rocks are all high grade metamorphics; starting with the Wenlockian (Middle Silurian) pelites and interbedded limestone 10 miles northeast of Lewiston, traversing eastward into the Devonian (?) interbedded pelites and quartzites at Coopers Mills, and continuing east back down section to the pelites and interbedded limestones at Appleton and Union.

The synclinorium is overturned with its axial plane dipping to the northwest. There are many structural complications in the Lewiston Quadrangle, related, at least in part to the 40 mile wide Sebago pluton. A geologic map is included in Figure 1.

#### Stratigraphy

A stratigraphic column is included as Table 1. Many stratigraphic names that are not as yet published are used in a casual manner as a matter of convenience.

Sabattus Formation. This unit is composed of sillimanite-muscovite-biotite-garnet schist with beds and lenses of two mica-feldspar-quartz schist and other lenses of quartzite. Beds, 1 to 5 cm. thick, of calc-silicate granulite are scattered throughout this unit. In the low and medium grades of metamorphism (in the Augusta Quadrangle) this unit has interbedded thin quartzite layers (1 to 15 mm.). The pelite layers are 2 to 10 times as thick. The quartzites display a complicated set of internal laminations; very few tops can be read from these laminations. In the sillimanite zone the unit typically has knots of sillimanite, in places attaining the size of 1 cm. The Sabattus Formation is 3000 - 7000 feet thick, based on the exposed section at Sabattus Mountain.



Limestones - The limestones are 40 - 300 feet thick zones of ribbon-rocks, i. e., they are composed of interbedded calcareous and slatey beds. The lime beds are 1 - 7 cm. thick, whereas the slate beds are only 1/2 to 1/10 as thick. The calcareous beds are diopside or actinolite marbles, or calc-silicate granulites. The slate beds are biotite-quartz granulites.

Table 1

Stratigraphic Column for South-Central Maine

Age	Northwest Flank	Southeast Flank
	Coopers Mills Formation*	
Devonian or Silurian	Volcanics*	
	Iron Hill Formation*	
	Vassalboro Formation	Quartzites
		Lincoln Sill
	Sabattus Formation	Penobscot Formation
Silurian	Limestones	Limestone

The Sabattus Formation, with its limestones is traced directly into the fossiliferous Waterville Formation of Osberg (in preparation). Based on lithologic similarity the Sabattus Formation is also correlated with the Eliot Formation and its limestone (Hussey, 1962) and the Buckfield Group (Warner and Pankiwskyj, this guidebook). The Sabattus Formation is considered Wenlockian (Middle Silurian), the age of the fossils in the Waterville Formation.

Penobscot Formation. This unit, named by Baston (1908) is an undifferentiated package of metamorphosed clastic sediments plus several limestone

\*Unpublished names used informally for convenience of discussion and reference.



zones. The unit contains rusty- and gray-weathering pelites and quartzites. The upper part of the unit is a chiastolite and/or staurolite schist. At lower grades it is a crinkled phyllite. The limestone zones are actinolite or diopside marbles. Based on lithologic similarity and the symmetry of the section, at least the upper part of the Penobscot Formation is correlated with the Sabattus Formation. The lower part of the Penobscot Formation may be Ordovician.

Vassalboro Formation. This unit is composed of thin to thick bedded (2 meter thick beds have been observed) biotitic, feldspathic and calcareous quartzites. The beds are graded in several places. The upper part of the unit is characterized by quartz-feldspar-biotite+actinolite granulite. This "salt and pepper" rock includes much of Fisher's Pejepscot Formation (1941). Many of the biotitic quartzites contain the biotite in thin (1 mm.) laminae. Scattered through the formation are beds (1 to 5 cm. thick) of pelite. Thin beds of limestone have also been observed. Many beds and stringers of calc-silicate are found. They are from 1 to 10 cm. thick, and may make up 30 percent of a given outcrop. The unit's thickness is difficult to establish since there is a great variation in areal outcrop distribution. A presumed thickness of at least 10,000 feet is suggested.

Tops evidence on the northwest contact of the Vassalboro Formation has been found by Osberg (in preparation) in the Waterville region. He finds graded-bedding topping into the Vassalboro. The Vassalboro is thus assigned a Post-Wenlock age.

The Vassalboro Formation is correlated with the Berwick Formation of Hussey (1962). The Vassalboro has been traced northeast into the Bucksport Formation of Trefethen (1950) where it turns around the nose of the syncline. It has been further traced into the quartzites on the southeast limb of syncline we are studying.

Quartzites. This unit is composed of calcareous and biotitic quartzites. It is correlated with the Vassalboro Formation as stated above. It may be traced south to the ocean at Pemaquid.

Lincoln Sill. This unit has been studied by Trefethen (1937). He calls it a porphyritic syenite.

Iron Hill Formation. This unit is highly sulfidic "with minor graphite" pelite and quartzite. It weathers a deep rusty color and is an excellent marker horizon. It is between 200 and 500 feet thick, and is found at the Vassalboro - volcanics boundary.



Volcanics. This unit is composed of a complex of zones of three rock types: 1. amphibolite 2. feldspar granulite and 3. quartzite. The amphibolites are hornblende+feldspar+garnet granulites. The feldspar granulites are feldspar-biotite-quartz granulites with beds and stringers of amphibolite. The quartzites are biotite quartzites with thin interbeds of muscovite. The quartzites contain zones of two-mica schist. The volcanic unit has a thickness of 200 to 800 feet.

The volcanics lie over the Vassalboro Formation or its equivalents and under the Coopers Mills Formation. They pinch or facies out to the northeast. On the northwest limb of the syncline, the volcanics are traced south into the "Sebascodegan" Formation of Hussey (Trip A, this guidebook), and the Cushing Volcanics of Bodine (Trip F, this guidebook). It is not clear whether the volcanics are a facies of the underlying quartzites or the overlying pelites. The non-volcanic portion is quartzitic in most places, but Coopers Mills type pelite is observed interbedded with the volcanics in several outcrops.

Coopers Mills Formation. This unit forms the core of the syncline. It is composed of interbedded two-mica schist and biotite quartzite. Bedding is on the scale of 1 to 4 cm. Several zones of the unit are mostly quartzite and many others are mostly pelite. The quartzites are distinct in texture from the Vassalboro quartzites in that they are not calcareous or laminated. Since the top of the Coopers Mills is never exposed, only a minimum thickness may be estimated - 3500 to 4500 feet.

The Coopers Mills Formation has been traced south into the Cape Elizabeth Formation of the Casco Bay Group (Hussey, Trip A, this guidebook). The Coopers Mills has also been traced northeast into the Knox Gneiss of Perkins and Smith (1925) and Trefethen (1950). The Knox Gneiss is a dark, fine-grained quartzite with 1 mm. thick muscovite partings that are 2 - 10 mm. apart.

#### References Cited

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### Road Log

Meet at 0800 hours, Saturday, October 9, 1965.

Topographic maps needed: Gardiner, Lewiston, Liberty, Vassalboro, Waldoboro, and Wiscasset.

- 0.0 Road log starts at the Main Gate of Bowdoin College at Sills Hall. Go 1/2 block east to traffic light, turn left onto Federal Street.
- 0.6 Stop sign, turn left for one block, then right onto Maine Street. Cross Interstate 95 and cross bridge over Androscoggin River on U. S. 201. You are now on Main Street in Topsham.
- 1.3 Left turn onto Me. 196.
- 2.5 Crops from here to Lisbon Falls are salt and pepper rocks of the Vassalboro Formation and pegmatite.



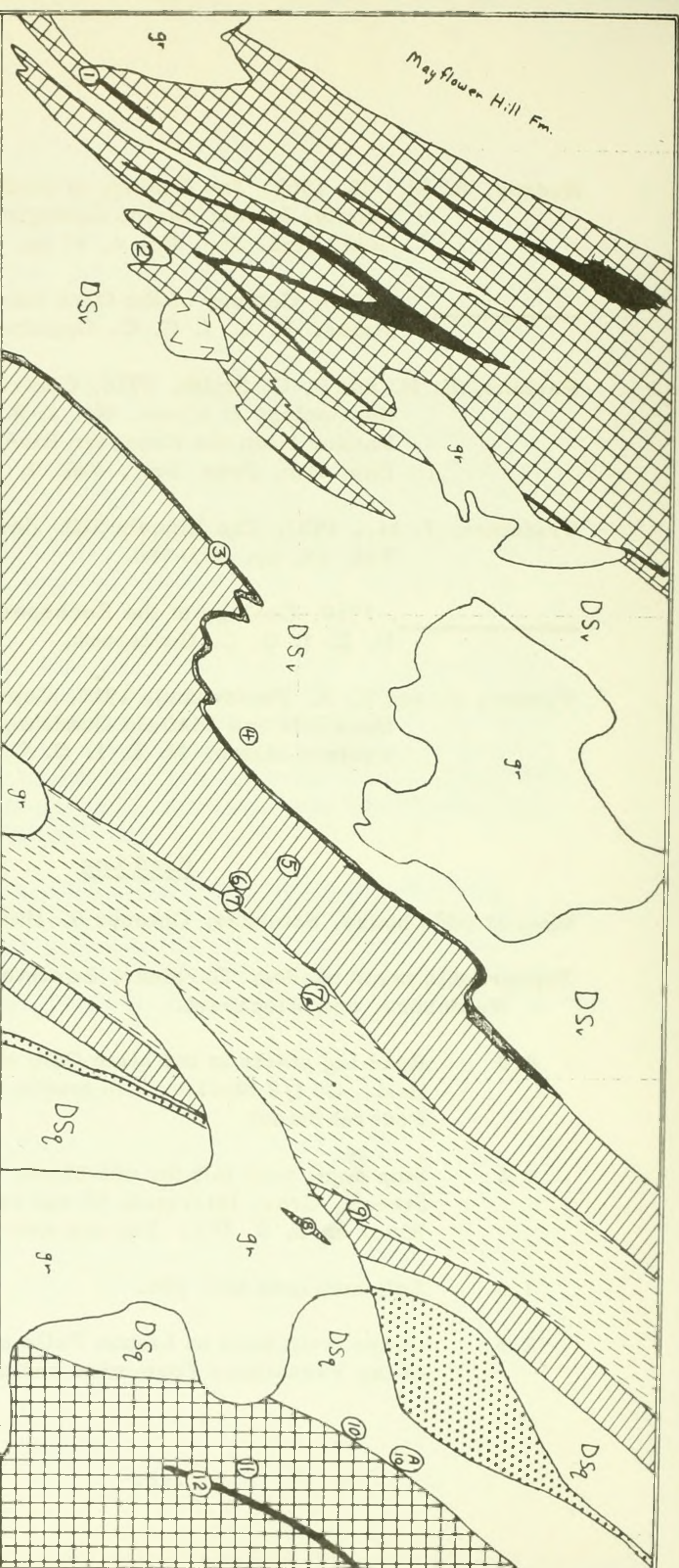


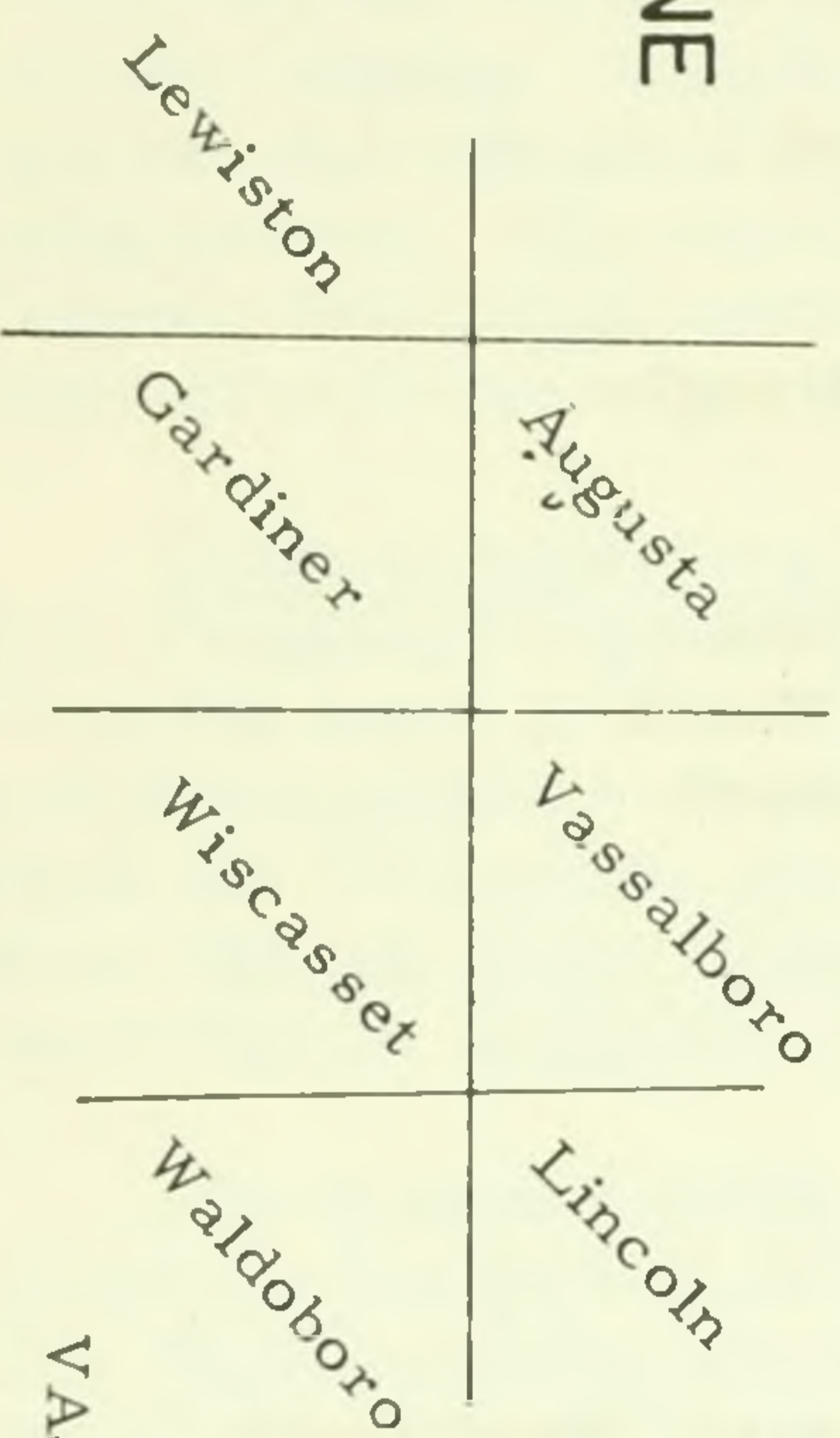
FIGURE 1

# GEOLOGIC MAP OF SOUTH-CENTRAL MAINE

by  
**R. G. DOYLE**  
**J. WARNER**  
**A. M. HUSSEY II**

1965

## INDEX



- COOPERS MILLS
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- SABATTUS limestone
- VASSALBORO
- QUARTZITES
- PENOBSCOT limestone
- granite
- litchfieldite
- Lincoln sill
- DS<sub>v</sub>
- DS<sub>q</sub>
- Stop Location



- 7.2 Enter Androscoggin County.
- 7.7 Through Lisbon Falls on Me. 196 and Me. 9. Enter Lewiston Quadrangle.
- 8.5 Right turn onto Me. 9. 0.1 miles farther bear right toward Sabattus.
- 14.1 Crops for the next mile are Sabattus Fm. and pegmatite.
- 15.6 Cross Maine Turnpike on Me. 9.
- 16.3 Turn right onto paved road at gray house.
- 17.1 Turn right back onto Me. 9 and Me. 126.
- 18.4 Sabattus Mountain, type locality for the Sabattus Formation to left. Stop 1 is 5 miles along strike northeast of the mountain.
- 19.1 Crops of Sabattus pelite with some quartzite beds.
- 20.5 Crop of biotite quartzite with beds of calc-silicate (Vassalboro type).
- 21.1 Straight through cross-road.
- 21.3 Turn left onto paved road. Bear right up hill.
- 22.2 Stop 1 Sabattus Formation

Please - Respect the farmer's pasture and fences. On the east side of road are the schists of the Sabattus Formation. This crop is particularly rich in non-maggot schist. On the west side of the road is an actinolitic marble with interbeds of actinolitic quartzite. The marble shows an elaborate fold pattern which appear to plunge under the schist. The crop to the southwest has marble at the bottom and a biotite granulite at the top. The last crop to the west is a gabbro dike.

- 22.5 Continue up hill and turn around at Elmvale Farm. Return to Me. 9 and Me. 126.



- 23.5 Turn left on to Me. 9 and Me. 126.
- 25.2 Enter Gardiner Quadrangle.
- 25.6 Enter Kennebec County.
- 26.3 Crop of marble and interbedded biotite quartzite on east and a rusty crop on west of road. In the woods to the east are pelites.
- 26.7 Crop of Vassalboro type under power line.
- 26.9 Crop of Sabattus type under power line.
- 27.1 Rusty quartzite (a common rock type at the base of the Vassalboro), then quartzite with calc-silicate beds and pods. We have just crossed a tight fold. In less than 1/2 mile across strike we saw a belt of pelite with a marble zone sandwiched between two belts of quartzite.
- 28.2 Stop 2 Vassalboro Formation
- A typical outcrop of this unit.
- 28.6 Continue on Me. 9 and Me. 126. Crops of Vassalboro types.
- 30.2 to 31.9 Crossing litchfieldite body. Outcrops are rare; the body is mapped by its boulders and the topography. Several boulders of litchfieldite have been placed at stop 3.
- 32.1 Crops from here to stop 3 are various quartzites and granulites in the Vassalboro Formation.
- 34.6 Cross Maine Turnpike on Me. 9 and Me. 126.
- 35.8 Crop of biotite-feldspar-quartz granulite (a possible volcanic) in the Vassalboro Formation.
- 37.1 Cross bridge over Cobbosseeconte Stream. Make a sharp right turn, then a left turn up West Street.
- 37.8 Straight at yield sign, then a left turn onto U. S. 201 at stop sign.



38.1 Stop 3 Iron Hill Formation

North end of crop is cut by a pegmatite. Note the boulders of litchfieldite.

39.2 Continue north on U. S. 201 into Gardiner. At end of park, take the right fork down hill to stop light, then straight across intersection, then...

39.5 Cross Kennebec River.

39.7 At stop light turn right onto Me. 27 and Me. 126.

40.4 Turn left onto Me. 126.

40.6 Crop of Iron Hill Formation.

40.8 Enter Wiscasset Quadrangle. Crops of salt and pepper Vassalboro types and pegmatite.

44.3 Stop 4 Vassalboro Formation

This is a typical salt and pepper type in the "upper" Vassalboro. Typical of this part of the structure, the dips are low to the northwest - evidence that the syncline is overturned and isoclinally folded.

44.6 Continue on Me. 126. Crop of salt and pepper type.

45.3 Enter Lincoln County.

48.1 Turn left onto paved road toward Togus at Saint Denis Church (second oldest Catholic Church in Maine).

48.6 Turn right onto dirt road just short of red barn with peeling paint.

49.1 Stop 5 Volcanics

Walk through woods to west to top of ridge and 100 feet down other side. Find three crops typical of the volcanic unit. Note garnet-rich rock in rusty crop and the pale fibrous amphibole.

50.3 Continue up dirt road. Crops of biotite-feldspar granulite with beds and stringers of amphibolite.



- 50.6 Turn right at cross-road.
- 50.9 LUNCH in field to south of fieldstone house.  
Ladies down hill to south, gents to the west.
- 52.4 Turn left onto Me. 126.
- 52.7 Stop 6 Volcanics
- Crop in front yard of school. Intermediate volcanic phase of unit intruded by pegmatite.
- 53.1 Stop 7 Coopers Mills Formation and Volcanics
- Park on East side of bridge over Sheepscot River. Crops on west side of bridge are volcanics with a pale amphibole. Crops under bridge and on the east bank are typical Coopers Mills Formation.
- 53.7 Turn left onto Me. 218.
- 53.9 Crops of Coopers Mills pelite.
- 56.1 Enter Vassalboro Quadrangle.
- 56.7 Stop 7a Coopers Mills Formation
- Turn right onto Me. 17 and Me. 32. This stop may be eliminated if time is short. Crop to west of intersection. Type locality of the Coopers Mills Formation.
- 56.9 Picnic area, alternate lunch.
- 57.0 Bear left on Me. 17.
- 57.7 Crops from here to mile 62.1 are of the Coopers Mills Formation. Several of the crops near mile 59.9 have the typical lithology of the Knox Gneiss.
- 59.3 Enter Liberty Quadrangle.
- 62.0 Enter Knox County. Crop of a diabase dike cutting a Coopers Mills type micaceous quartzite.



- 62.1 Straight on Me. 17 through junction with Me. 206.
- 62.2 Crop of granite and pegmatite.
- 63.1 Stop 8 Lincoln Sill
- Park on right in pullout near yellow "Dow" 50 gallon drums. Crop is 115 yards west on north side of road. WATCH TRAFFIC. Lincoln Sill with oriented phenocrysts intruded by granite and pegmatite. A small inclusion of the quartzite that the Lincoln Sill intruded is present. This crop is an inclusion in the granite.
- 63.1 Turn around and return to junction of Me. 17 and Me. 206.
- 64.2 Turn right onto Me. 206.
- 64.6 Another crop, in field to left, of the diabase dike from mile 62.0. Crops from here to mile 65.8 are in the Coopers Mills Formation.
- 65.8 Turn right onto Me. 105. Hills to east held up by staurolite schists in the top of the Penobscot Formation.
- 66.1 Stop 9 Volcanics and Coopers Mills Formation
- Park at fourth maple tree, walk 100 yards to south on tote-road. Crop is on the southeast limb of a small overturned anticline. Coopers Mills to northeast, volcanics to southwest.
- 67.7 Continue on Me. 105. Crop of quartzite within the volcanics.
- 67.8 Straight through Razorville on Me. 105.
- 68.4 Crop of granite.
- 68.9 Crop of quartzites.
- 69.2 Straight on Me. 105 and Me. 220 into Washington.
- 69.3 Bear right on paved road to right of monument.
- 69.5 Bear left at fork in road.



- 70.0 Crop of granite.
- 71.5 Straight through cross-road.
- 72.6 Turn left onto dirt road.
- 72.8 Stop 10 Quartzites  
 Typical crop of quartzites.
- 73.3 Junction of dirt road with Me. 105.
- 73.3 Alternate Stop 10 Quartzites  
 This is the best crop of the quartzites in the region.  
 Only go to this stop if time permits. Go straight across Me. 105 on dirt road for 1 mile, park at last house, walk up to top of hill to west behind house.
- 73.3 Road log continues without Alternate. Turn right (left if you went to Alternate) onto Me. 105 heading east.
- 75.7 Turn right onto Me. 131. Crops from here to mile 79.0 are in the belt of andalusite schist.
- 77.9 Stop 11 Penobscot Formation  
 Park at dirt road, walk up road 125 yards. The uppermost part of this unit is a staurolite schist which crops out on top of the ridge about one mile to the west. The next lower part of the Penobscot Formation is a chiastolite schist, this crop. The Penobscot has not as yet been studied farther down section. Note that the andalusite crystals are alligned with a low southernly plunge. Also, many of the andalusites are altered to sillimanite in radial growths. Several beds have as much as 35% andalusite.
- 77.9 Continue down Me. 131.
- 79.0 Bayonet turn to the left toward Union. Make a left for 200 feet on Me. 17 and Me. 131,...
- 79.1 Then a right at sign for Union (Just past Gulf station).



79.3      Stop 12      Union Quarry

Turn right into Lime Products Corporation Union Quarry. Follow quarry road. This is one of the zones of limestone in the Penobscot Formation. The rock is a pure, actinolite, or diopside-garnet marble. Most of the marble is ground and used for agriculture.

79.8      Leave quarry, turn right at quarry entrance.

80.1      Crops of rusty-weathering schist and quartzite in the Penobscot Formation.

80.2      Turn right onto Me. 235. Follow 235 for 9.3 miles to U. S. 1. Follow U. S. 1 for 40 miles to Brunswick and Bowdoin College.