

GEOLOGY OF EASTERN UNITED STATES

74. PRE-SILURIAN STRATIGRAPHY IN THE SHIN POND AND STACYVILLE QUADRANGLES, MAINE

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Ordovician graptolites were found in slates associated with chert near the mouth of Wassataquoik Stream (A of fig. 74.1) by W. W. Dodge in 1881, and the trace fossil *Oldhamia* was discovered by E. S. C. Smith along the East Branch of the Penobscot River in 1928, leading him to conclude that beds there are Cambrian in age. These early workers, however, did not establish the geologic relations between these occurrences. The present mapping indicates that both are contained in the same anticlinorium, and that they are separated by a great thickness of Ordovician volcanic rocks.

The formation (Cg of fig. 74.1) containing *Oldhamia* was named Grand Falls formation by Ruedemann and Smith (1935, p. 354), but this name was preoccupied by the Grand Falls chert of Winslow (1894, p. 417-419). The *Oldhamia* occurs in maroon siltstone and slate both at Bowlin Falls (B of fig. 74.1) and at the type locality of the formation, which is indicated on the topographic map of the Shin Pond quadrangle as the Grand Pitch of the East Branch of the Penobscot River (C of fig. 74.1). Maroon rocks are a minor but conspicuous component of the formation; its more common constituents are gray to greenish-gray quartzite, and gray, greenish-gray, and dark-gray slate. Steep dips and tight folds characterize exposures of these rocks, and steeply dipping faults of unknown displacement can be identified at several places. Although the boundaries of the formation are fairly well established in the Shin Pond and Stacyville quadrangles, the tectonic pattern and stratigraphic succession within the formation are not yet understood.

Through most of this area the "Grand Falls" formation is overlain by greenstone (Ov of fig. 74.1). Volcanic conglomerate, graywacke, and fossiliferous tuffaceous sandstone (Ovt of fig. 74.1) intervene between them in the southwestern part of the synclinal belt that terminates on Sugarloaf Mountain. These sedimentary rocks are a thousand feet thick along Shin Brook; they may continue for a considerable distance to the northeast, but poor exposures hamper tracing them in that direction. Studies of the fossils from these rocks are not yet complete, but the assemblage of orthoid brachiopods, gastropods, cystid plates, bryozoans, and trilobites suggests an early Middle Ordovician age.

The greenstone and associated rocks have been in-

tensely deformed. Although they have steep dips and strong cleavage, they are much less complex in structure than the sequence of interbedded quartzite and slate of the "Grand Falls" formation which underlies them. Some of this contrast may be due to differences in their tectonic competency in response to the Taconic and Acadian orogenies. Nevertheless, the abrupt lithic change, the structural contrast, and the presence in the volcanic conglomerate of pebbles of quartzite like that of the rocks below, all make it probable that the contact between these units is an angular unconformity, and that the quartzites and slates were folded before the deposition of the volcanic debris.

Greenstones immediately overlie the quartzite and slate units along a contact that follows the East Branch for almost ten miles and then swings northward around the southern flank of the anticlinorium. The chert and slate (Ovc of fig. 74.1), in which the graptolites were found, lie at the southeastern margin of these greenstones, apparently at their top. The present work has failed to uncover additional graptolite localities, although similar cherty rocks lie along the eastern border of the smaller body of volcanic rock that is probably a fault slice.

Ruedemann (Ruedemann and Smith, 1935, p. 353-354) identified the graptolites both in Dodge's collection and in one made by Smith at the same locality, and concluded that they were of Normanskill age. My own more recent collections, which contain conodonts as well as graptolites, do not alter this conclusion. If the volcanic rocks of the Sugarloaf-Roberts Mountain belt are of the same age as those to the southwest, the fossils at the base of the former and the top of the latter limit the time of their formation to the Middle Ordovician.

Intruding both the greenstones and the quartzite and slate is a porphyritic quartz diorite (Oqd of fig. 74.1) which contains fragments of greenstone and in one place forms the matrix of a greenstone breccia. There are two reasons for believing that this diorite is of Ordovician age: (a) the abundance of calcite in minute fractures pervading the diorite indicates that it is more altered than the Acadian intrusives in the region; and (b) cobbles of the diorite occur in conglomerate that overlies the greenstone on the east, and at one place graywacke associated with this conglomerate

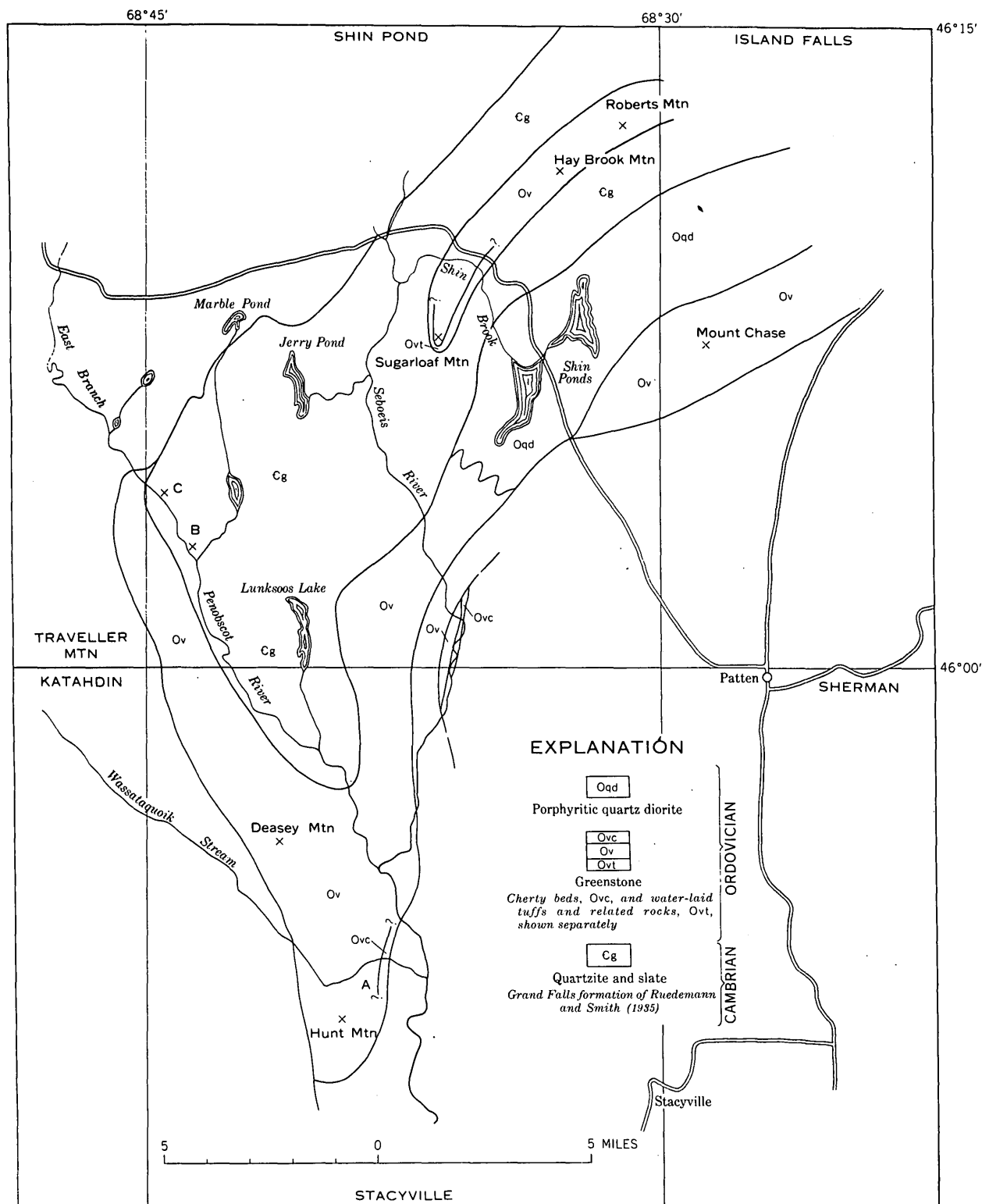


FIGURE 74.1.—Geologic map of the pre-Silurian rocks in the Shin Pond and Stacyville quadrangles, Maine. Localities referred to in text: A, Dodge's graptolite locality; B, Bowlin Falls, Smith's *Oldhamia* locality; C, Grand Pitch of the East Branch of the Penobscot River. Geologic mapping by R. B. Neuman, assisted by John Duane (1957), R. H. Raymond (1958), and H. H. Roepke (1959), supplemented by unpublished mapping in the Traveller Mountain quadrangle by D. W. Rankin (Vanderbilt University) and in the Island Falls quadrangle by E. B. Ekren (U.S. Geological Survey). Planimetry from U.S. Army Map Service Millinocket and Presque Isle 1:250,000 sheets, and place names from the U.S. Geological Survey topographic quadrangles indicated.

contains fragmentary fossils that are probably of Silurian age.

REFERENCES

- Dodge, W. W., 1881, Lower Silurian fossils in northern Maine: *Am. Jour. Sci.*, ser. 3, v. 22, p. 434-436.
- Ruedemann, Rudolph, and Smith, E. S. C., 1935, The Ordovician in Maine: *Am. Jour. Sci.*, ser. 5, v. 30, p. 353-355.
- Smith, E. S. C., 1928, The Cambrian in northern Maine: *Am. Jour. Sci.*, ser. 5, v. 15, p. 484-486.
- Winslow, Arthur, 1894, Lead and zinc in Missouri: *Missouri Geol. Survey*, v. 7, sec. 2, p. 389-542.



75. A COMPARISON OF TWO ESTIMATES OF THE THORIUM CONTENT OF THE CONWAY GRANITE, NEW HAMPSHIRE

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Determining the distribution of uranium and thorium in the Conway granite of New Hampshire is part of a broader study of these elements in igneous rocks. The radioactivity of the red and green phases of the Conway granite from the quarry at Redstone, Carroll County, N.H., has been discussed by Smith and Flanagan (1956), who observed the differences in radioactivity of samples taken at closely spaced intervals. The differing amounts of the major contributors to the radioactivity in these samples might also prove valuable for future comparison with results obtained from samples taken over wide areas. Analyses of the two phases of the granite by W. H. Herdsman (Billings, 1928) indicate that potassium should also be classified as a major contributor to the radioactivity of the samples.

Uranium is present in igneous rocks approximately in the range 0.1 to 20 ppm and thorium from 1 to 100 ppm. The determination of these elements in igneous rocks, especially that of thorium, is time-consuming in spite of continuing improvements in analytical methods; potassium, on the other hand, can be determined rapidly by the methods of Shapiro and Brannock (1956), and the determination of radioactivity by beta-counting is a simple physical measurement.

Other investigators, for example Hurley (1956) and Adams and others (1958), have described methods for determining thorium in the parts-per-million range by gamma-scintillation spectroscopy and by alpha-counting methods. While thorium can be determined directly by gamma-scintillation spectroscopy, the method may require long counting periods, and the uranium content has to be known before the thorium content can be calculated from the alpha-counts. Although the technique described below probably cannot be used in the low (1 to 10 ppm) thorium range and is none too accurate for individual determinations, its less stringent

requirements, such as short counting times (each sample in table 75.1 was counted for five minutes), and the use of an average potassium content of the rock under study, recommend its use in reconnaissance work where replicate samples are available. The useful range of the method covers only granites and some granodiorites and rocks abnormally enriched in thorium, but the method may be useful as an assay tool for low grade thorium ores.

Indirect estimates of the thorium content of uranium ores have been made for years by subtracting the uranium content of the ore from the radioactivity expressed as equivalent uranium, and then multiplying the remaining radioactivity by the specific counting rate ratio for U/Th. As the potassium contribution to the radioactivity of uranium ores is negligible, the correctness of these estimates depends on whether the uranium and thorium series are in equilibrium. When they are not in equilibrium the estimates are of little value.

If we are justified in assuming that radioactive equilibrium exists in the Conway granite, the indirect thorium values obtained by subtraction can be used in estimating the thorium content, despite the fact that both the radioactivity and the uranium and thorium content of the granite are two or three orders of magnitude lower than those of uranium ores. The correctness of these estimates, and hence the validity of the underlying assumption, can be tested by comparing them to values determined chemically.

INDIRECT THORIUM ESTIMATES

To determine if such indirect thorium estimates are valid, four samples were picked at random from each of the four groups (weathered and fresh, red and green) of samples of the Conway granite from the Red-