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GLACIAL GEOLOGY OF THE CASTLETON QUADRANGLE

INTRODUCTION

Topography The topography of the quadrangle is that of low gently rolling mountains. They are technically known as the Taconic Mountains. They are bounded by two north-south valley lowlands; the western one is now occupied by Bomoseen Lake in a capacious ice-scoured river valley, the eastern one is now the valley of Otter Creek. The mountains themselves, which rise to about 2500 to 2700 ft. altitude, were left after deep and thorough dissection of the bedrock by dendritic streams. The hills in the western part of the quadrangle are much lower and there the streams have etched out the softer layers of the NNE to SSW structure of the metamorphic rocks to produce a distinct NNE to SSW "grain" to the topography. Probably the most striking piece of topography is the valley of Castleton River which cuts east-west squarely across the north-south Taconic Mountain mass in the middle of the quadrangle. This phenomenon of a river valley cutting right across a present mountain range is not uncommon to the river valleys in

Vermont and is evidently part of the geomorphic history of the state. This part of the Castleton valley is some 12 miles long, 800 to 900 ft. deep and from 1/2 to 1 mile wide. This size and capacity shows it to be of pre-glacial origin.

Bedrock The bedrock of the region consists of early paleozoic metasediments that have been tightly folded, intensely metamorphosed and intricately faulted into a complex of N-S structures.

Glaciation The entire quadrangle has been overrun by the Shelburne glaciation leaving till with northeast maxima to the fabric, (Fig. 00) and then later the northern half was overrun by Burlington glaciation leaving till with northwest maxima to its till fabrics.

West Rutland Exposure Just east of the village of West Rutland, a big fresh highway cut has exposed about 150 ft. of till. Unfortunately for us, as part of the highway construction, the bank has been "shaped" by grading the fresh surface by bulldozers and planting grass to prevent erosion. This process has made detailed study hard and necessitates lots of shallow digging.

Two Tills   Fortunately there are enough 2-3 foot little gullies, which are eroded down to fresh till, to allow numerous till fabrics to be made. The exposure about 20 ft. above the base of the cut yielded a good fabric with weighted mean of pebble orientation of N.24°E., which shows it to be Shelburne till. About 100 ft. higher up the bank digging in a small gully uncovered good glue-gray calcareous fresh till. Fabrics of this upper till had a weighted mean of pebble orientation of N.12°W., showing it to be Burlington till. Unfortunately, so much slump and excavation refuse had accumulated that time did not permit finding and studying of the contact between the Shelburne and the Burlington drift. The surface of this deposit of Burlington till has constructional terminal moraine topography.

As previously said, north of this exposure and the Castleton Valley all the fabrics have NW maxima and show drift to be Burlington, whereas south of this valley six well-spread till fabrics are all from the northeast; i.e., Shelburne. Within the valley itself lie patches of a Burlington terminal moraine.

BURLINGTON TERMINAL MORAINE

The moraine is composed of both till and gravel.

A) Till There are five patches of till which have terminal moraine topography and northwest fabric. (1) At the east edge of the quadrangle, just south of the river and in SW. outskirts of the city of Rutland, excavation for the foundation of a new house exposed till with fabric of weighted mean at N.20°W. (2) a 1 x 1/2 mile patch on south side of the river at Centre Rutland, shows morainal topography and contains a barrow pit exposure of till with NW fabric; weighted mean at N.23°W. (3) The surface of the deposit at the big cut; 1/4 mile east of West Rutland shows constructional morainal topography and fabric, as said before, of weighted mean at N.12°W. This patch is down in the valley but is actually on the north side here of the insignificant river. (4) The next patch, going westward, lies 2 and 1/2 miles west of West Rutland and in the deep narrow part of the valley at the foot of Bird Mountain on the axis of the Taconic Mountains. This is a patch of till 2 miles long by 1/2 mile wide and 150 ft. thick, banked against the south valley slope. It shows constructional topography on its top and NW. fabric of its material with weighted mean N.22°W. (5) The fifth patch of morainal till is a mile long by half mile wide and 200 ft. thick, banked against the south valley wall at Castleton. A deep enough exposure for till fabric was not found, but shallower pits exposed fresh calcareous till to within a couple of feet of the land surface, showing it to be a very young till.

B) <u>Gravel</u>. Along this same terminal ice stand seven patches of ice-contact gravel are found. (1) At Centre Rutland on north side of river and banked against the foot of the 900 ft. mountain is a patch of kame moraine 1 by 1/2 mile in extent. Pits show it to be coarse ice-contact gravel. (2) 1 and 1/2 miles west of West Rutland a mile-long patch of kame moraine lies on north side of the river against the base of the 1000 ft. north valley wall. Gravel pits again show it to be composed of ice-contact gravel. A steep, sharp little half-mile-long esker descends from the valley slope on to its surface. It can be traced across the top of the kame terrace to its valleyward edge where it flattens out in the general valley declivity. This little esker shows stagnant ice conditions along this ice margin. (3) A mile and a half farther west, i.e., 2 miles east of Casteleton, about at the axis of the Taconic Mountain range, lies another mile-long by half-mile wide patch of kame moraine, dominated by a 100 foot high sharp conical moulin kame at its eastern end. It lies out in the axis of the valley with a fosse, followed by the railroad, on the north side and the Castleton River with its flood plain on the south side. Gravel pits display coarse ice-contact gravel. (4) Another area of gravel lies 1/2 mile to the southwest and against the south valley wall. Its eastern end again is a large conspicuous conical moulin kame, which joins ~~continuing~~ a half mile westward ~~into~~ an ice-contact kame terrace. (5) The village of Castleton is built on the flat top of a kame terrace, and remnants of a higher kame terrace can be seen a mile to the south on the north side of the tributary valley. (6) Two miles west of Castleton, at the south end of Bomoseen Lake, lies a patch of kame moraine a half mile across, composed of ice-contact bouldery gravel.

This, then, is the terminal moraine of the Burlington lobe of Wisconsin ice in Vermont. To the north of this morainal stand the till fabrics are from the northwest, whereas to the south they are from the northeast. (Fig. 00)

GLACIAL DRIFT SHEET

A) Till For the most part, the uplands of the quadrangle are littered with a thin discontinuous deposit of till lying on the bedrock, and, as previously said, north of Castleton River the striae and fabrics are from the northwest, whereas south of the river they are from the northeast, showing two different derivations for the drifts. Most of the till seen is basal till, though ablation till occurs in a good exposure in Fennell Hollow, 3 miles NE. of East Poultney. It has a good NE. fabric. Till has been moulded into drumlins at Ransomvale in central part of the quadrangle.

B) Gravel Along both sides of Otter Valley there are kame terraces and areas of kame moraine. One of the largest is at Proctor where the eastern part of the village is built on top of a big kame terrace. Other areas are seen north and northeast of Pittsford where they form a part of the ice-marginal deposits at the edge of the Burlington ice lobe. A mile west of Florence is a mile-long patch of kame moraine at 700 ft. altitude on the east slope of the Taconic Mountain range. Smaller kame terraces are strewn along the upper reaches of Castleton River. And along North Brittain Brook kame terraces flank the stream on one or both sides. The northern end of Bomoseen Lake is studded with kame terraces.

In the southern part of the quadrangle extensive kame terraces are found at Hampton, Poultney and East Poultney and in the upper reaches of Poultney River. But the largest deposit of kame moraine and kame terrace is at Chippenhook in the southeastern corner of the quadrangle. Large gravel pits are extracting ice-contact gravel from this 1/2 by 2 mile area of gravel.

POST-GLACIAL LAKE DEPOSITS

The bottoms of the valleys are deeply filled with lake clays, silt and sand. A test boring on northern outskirts of West Rutland passed through 125 feet of clay before reaching bedrock. Silt, silty clay and lake sand comprise the surface material of the valley fills where they are not made of modern river alluvium. Extensive low terraces of lake sand occupy the Otter Creek Valley between Proctor, Pittsford Mills and Pittsford as well as Bomoseen Lake lowland and Castleton River valley from Castleton to the west edge of the quadrangle and on to include the large area on which Fair Haven is built. The surface of this lake sand terrace in the Otter valley around Pittsford was around 500 ft.* in present altitude before it has been extensively dissected down to the present flood plain at 370 ft. altitude. During the degradation the sand has been carried off in considerable areas to expose silt and clay. In the Bomoseen Lake-Castleton area lake sands were deposited up to about present 460 ft. level, later to be dissected and cut down to the present floor plain level at 360 ft. altitude at west edge of the quadrangle. During this latter dissection of the lacustrine valley fill at Castleton Corners a terrace was developed at 440 ft. altitude. Extensive sand and gravel pits excavated by the highway department show that the material of this terrace is coarse sand and ~~run from~~ uniform very fine gravel, with foreset bedding dipping gently westward. It

* At Hortonville clay is found at 495 ft.

appears to be a pebbly sand deltaic deposit covered with shoal-water lacustrine sand at the surface.

The shore line of this short-leved post-glacial lake has been confidently identified in only a few and widely scattered places. To confidently distinguish beach gravel from other types of gravel is not always easy and to encounter a fresh excavation when the structure of the gravel is still to be seen is entirely fortuitous. Such a beach was encountered in a fresh excavation for a new house on the west valley slope of Otter Creek valley 1 mile NW. of Centre Rutland and 3 miles south of Proctor: (see photograph, Fig. 00). The exposure shows beach gravel resting on lake sediments which showed subaqueous slumping. Hand levelling from road corner gives the top of the bedded beach gravel to be 151 ft. in altitude, a patch of what may be beach gravel two miles north of Pittsford has altitude of 600 ft. at present. For aught that is now known these occurrences may be manifestations of a single ice-dammed post-glacial lake.

<u>Potholes</u> Two miles south of Proctor on the east valley slope of Otter Creek valley and about 150 ft. above the valley floor occur 6 or 7 large potholes eroded into the marble bedrock (Fig. 00) The smaller ones are 8 -10 ft. across and 6- 8 ft. deep with vertical to even overhanging sides. The larger ones may be 50 ft. across by 30 ft. deep. One of them has 3 1/2 ft. granite boulder resting in its bottom, another had a rounded spine of bedrock standing in its center. These potholes are a manifestation of former glacial activity of superglacial streams plunging down into crevasses of the glacier and swirling and grinding their way into the underlying bedrock. They are familiar today in the Swiss Alps as "Moulin" or glacial mills. The ice must have stood still for a long time to allow such large and deep potholes to have been formed here high on the valley wall of Otter Creek and shows that the ice was stagnant here when they were made.

6/11/98
The figure captions correspond to the photographs but are not appropriately referenced in the text.

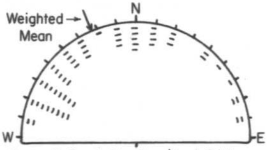
Figure A: Small esker on the Burlington moraine
kame terrace, Castleton River Valley 1.5 miles west of West Rutland Castleton quadrangle

Figure B: Beach gravel on lake sediments 1 mile nw Center Rutland and 3 miles south of Proctor. Top of beach gravel is 151 ft. altitude. Castleton quadrangle

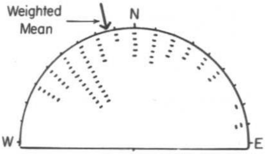
Figure C: Lacustrine silt and very fine sand
0.5 mile north of Proctor in 20 ft. terrace. Castleton quadrangle

Figure D: Pothole and boulder 2 miles south of Proctor over 180 ft above the valley bottom

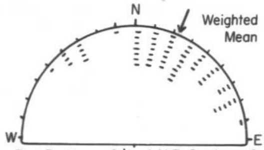
Figure E: Two-till exposure 0.5 mile east of West Rutland, Castleton quadrangle



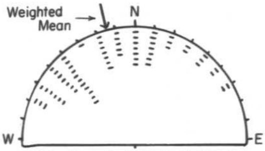
Centre Rutland, Moraine ½ mi. S.W., Castleton Q.



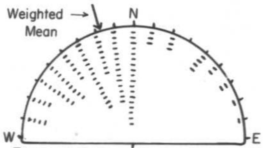
Proctor, 3 mi. S., Castleton Q.



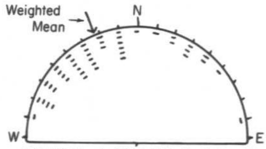
East Poultney, 2 ½ mi. N.E., Castleton Q.



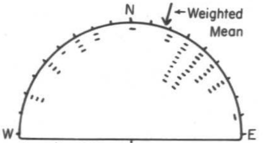
Hubbardton, 2 mi. W., Castleton Q.



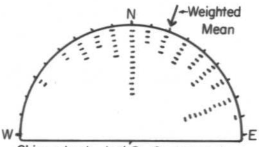
East Hubbardton, 1 mi. N.W., Castleton Q.



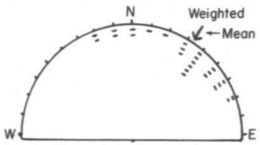
West Rutland, 3 ½ mi. W., Castleton Q.



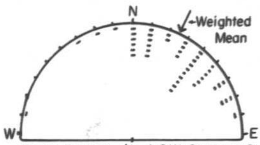
Ira, ½ mi. N., Castleton Q.



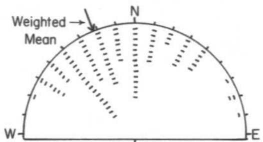
Chippenhook, 1 mi. S., Castleton Q.



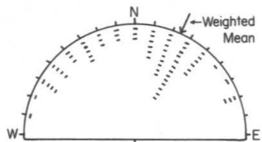
Centre Rutland, 2 mi. S.S.E., Castleton Q.



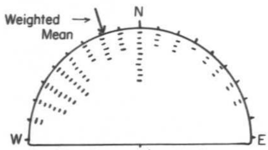
Centre Rutland, ½ mi. S.W., Castleton Q.



West Rutland, ½ mi. E., Upper Till Castleton Q.



West Rutland, ½ mi. E., Lower Till Castleton Q.



Castleton Corners, ½ mi. N.W., Castleton Q.

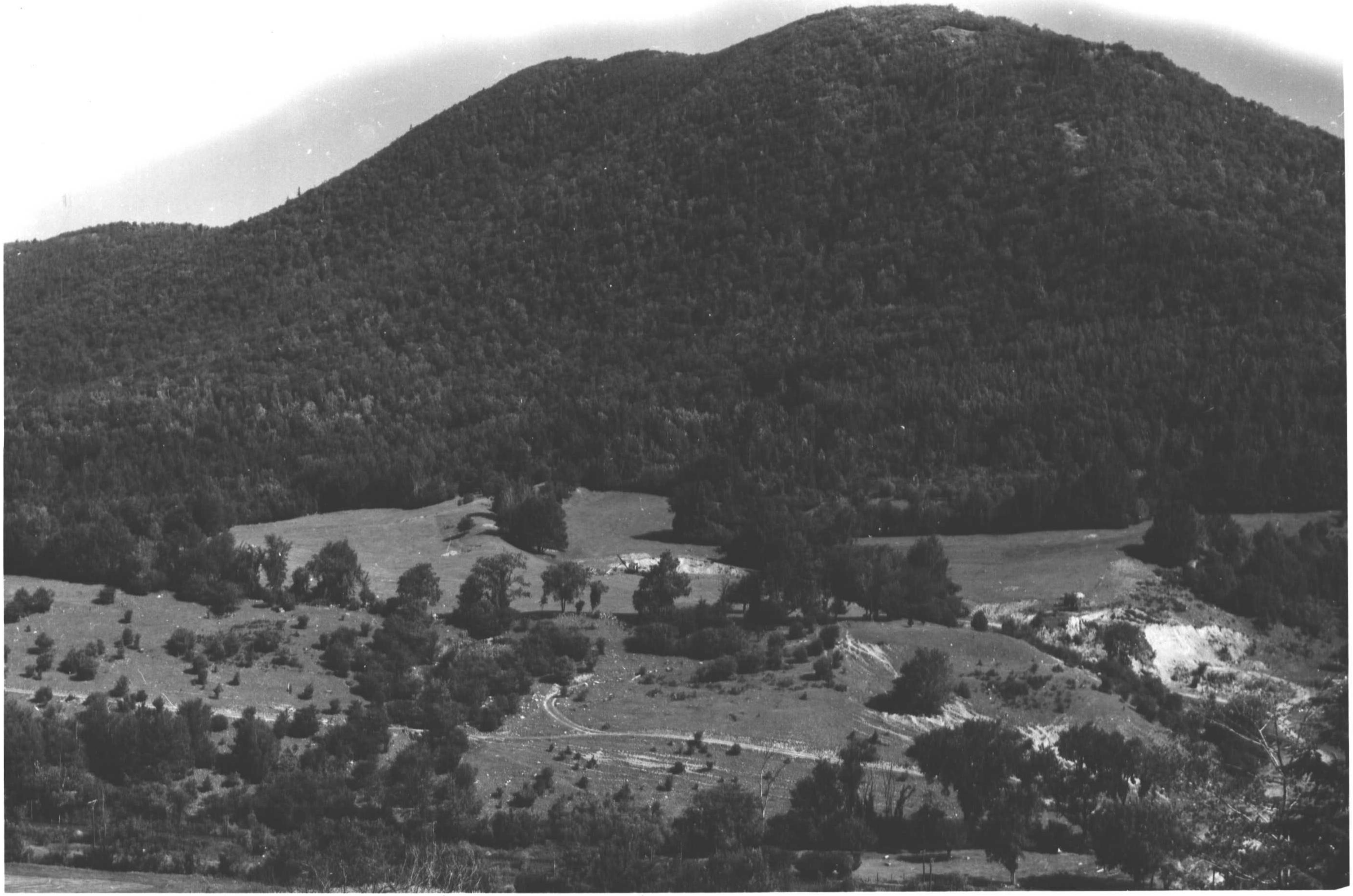


FIG A

(Fig 00) Small esker on the Burlington marine kame terrace, Castleton River valley 1½ miles west of ~~West Rutland~~. Castleton Quadrangle

FIG. A

FIG. B

(Fig 00) Beach gravel on lake sediments.

1 mile n.w. Centre Rutland and 3 miles south of Proctor. Top of beach gravel is 151 ft. altitude

Castleton Quadrangle

FIG B

FIG. C.

(Fig 00)

Lacustrine silt and very fine sand
1/2 mile north of Proctor in 20 ft. terrace
Castleton Quadrangle

FIG C

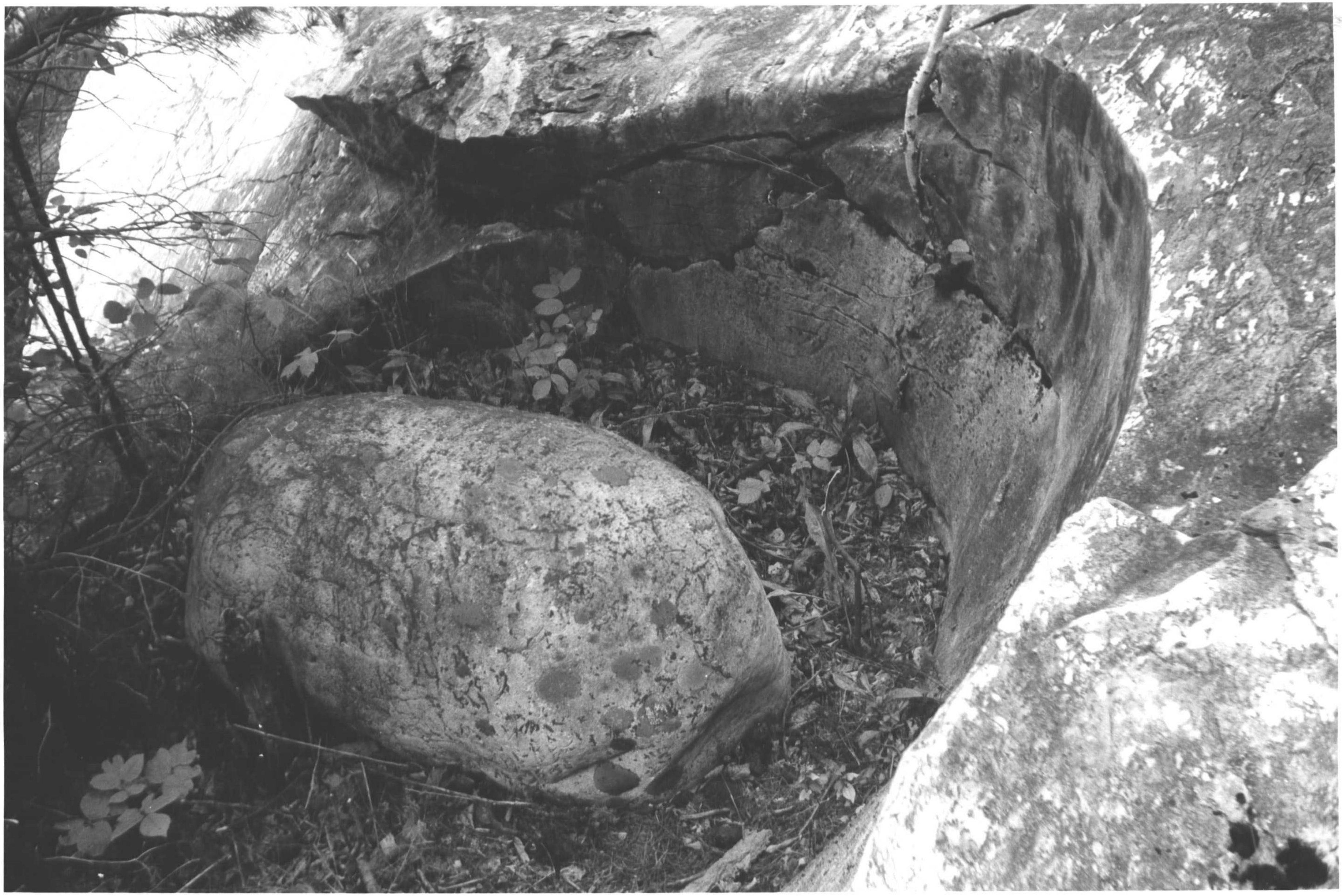


FIG D

(Fig. 00) Pothole and boulder 2 miles south of Prosby are 180' ft above the valley bottom

FIG D

FIG E

(Fig 00)

Two-till exposure 1/2 mile East of West Rutland, Castleton Quadrangle

FIG E