DISCUSSION

GLACIAL GEOLOGY AND THE VERMONT FLOOD

AMONG the many interesting things connected with the Vermont flood of November, 1927, there is one of considerable interest to glacial geologists which I think has not yet been reported.

A quarter of a mile southeast of the East Clarendon station, on the Bellows Falls and Boston line of the Rutland Railroad, seven miles south of Rutland, Vermont, Mill River, one of the chief eastern tributaries of Otter Creek which drains the Rutland valley north into Lake Champlain, turns sharply southwest, almost at right angles from its comparatively open, terraced, northwesterly trending, glacial valley, and cuts a flume-like, box-canyon gorge fifty or more feet deep and an eighth of a mile long through gneisses, schists and quartzite of Whittle's Mendon-Algonkian series. A mile or two farther downstream, it cuts another similar and lower gorge and, having thus accomplished the steep side descent, flows out onto the broad floor of the glaciated valley of Otter Creek.

Passers-by on the railroad and state highway, as well as hikers on the Long Trail of the Green Mountain Club along the western range of the Green Mountains, frequently note the upper gorge, which is in plain view from railway, highway and Long Trail footpath and is a striking scenic detail.

As seen from the railway and highway, it opens with startling abruptness, like a narrow side passageway straight to the southwest, out of the moraine-blocked, northwesterly trending valley of Mill River. Across the upper end of the gorge, like the lintel of a doorway, hangs an old-fashioned, board-sided bridge formerly crossed by the Green Mountain Club Long Trail, but now threatening to fall, and focusing attention on the mouth of the gorge.

Of the many who notice the gorge, some few of a more inquiring turn of mind wonder why Mill River makes such an abrupt turn here from a shorter, more direct course to a narrow and difficult one. The answer to these inquirers is that, at the time Mill River assumed its gorge course, it had no other choice. Its direct course to the northwest was blocked by the Lake Champlain-Otter Creek valley glacier and its deposits, of which the lateral kame-and-delta terraced moraine is still very conspicuous and fifty or more feet high at East Clarendon. Somewhat less conspicuous terrace deposits, some at much greater elevations, appear here and there along Mill River valley also.

The valley glaciers and their flanking morainal deposits, especially thick near the junction of Mill River valley with Otter Creek valley, spread across Mill River valley at East Clarendon, forcing Mill River to turn from its well-established, northwesterly course, southwest along the Otter Creek moraine and glacier onto the gneisses and schists.

Once on them, Mill River began cutting into them, and it cut so long and so deep that, when the glacier blocking its former course melted out and the morainal deposits slumped or were partly washed away, it could not return to its preglacial course. Possibly in late glacial time Otter Creek drained southward to or toward the Hudson River. The sharp southwest turn of its branch, Mill River, on nearing Otter Creek valley, would seem a natural consequence. When northward drainage was finally established in Otter Creek valley, Mill River was too deeply entrenched in its gorges to avail itself of a more direct course. So it happens that the easier, earlier, northwesterly course of Mill River at East Clarendon is marked by a shallow pass, between the lateral delta moraine terrace and the gneiss ridges, and followed by the railway and state highway but not by Mill River itself.

The East Clarendon gorge is only one of many reported instances of postglacial gorges cut by glacier-displaced streams not only in Vermont but generally where much glacial deposition has succeeded stream dissection. Ausable Chasm, across Lake Champlain, in northeastern New York, and the famous gorge of the Niagara River are classic examples.

Mill River, like all streams flowing from the Green Mountains, became a rushing torrent during the November, 1927, flood. It swept away both heavy iron state highway bridges at Cuttingsville, three miles upstream from East Clarendon, bending iron rods like pins. It frequently changed its course, converting long stretches of highway into river bottom, cutting through meadow and woodland, excavating moraine and terrace and leaving former bends and pools deserted. The erosive work of a single night and day was astounding. Five miles of state highway were so demolished that it will require most of the coming summer, in addition to last year's work, to complete repairs. It furnishes a most impressive example of the rapidity and intensity with which a stream occasionally works, and helps the mind to visualize more dramatically the earlier cutting of the glacial terraces.

At East Clarendon, where Mill River turns at right angles from its open preglacial course to enter its narrow gorge, the constricted torrent rose twenty feet and flowed over the north end of the old wooden bridge spanning the mouth of the gorge. The rough stone foundation of the other end was partly swept away, leaving the bridge hanging precariously on a slant. Débris, on the sides of the gorge and in trees and thickets, still marked a year afterward the height reached by the rising water.

Erosion was enormously intensified, according to well-known laws, and concentrated upon the outer side of the abrupt turn from the comparatively open course into the gorge; that is, it was concentrated upon the railroad embankment and morainal deposits blocking the preglacial former course of the river. In other words, Mill River set to work to regain its former course now occupied by moraine, state highway and Rutland Railroad. Only the abatement of the storm prevented the river, after washing away the railroad embankment, from cutting through the moraine and down into the village of East Clarendon.

Conditions developed somewhat suggestive of those at the famous Whirlpool in the gorge of the Niagara River, but of course on a very much smaller scale. Niagara River, at the Whirlpool, runs athwart the moraine-filled course of an older, preglacial stream, and has scoured out of the moraine-filling a vast pit about which it whirls in an effort to find the narrow gorge gateway out, at a considerable angle to that by which it entered. So Mill River, flooded to torrent strength, rushed straight for the pass in its moraine-filled former course at East Clarendon, whirled against railway, highway and moraine embankment, and roared out under the old bridge and through the narrow gorge in the gneiss series.

The through train for Boston reached East Clarendon late that afternoon and started through the pass in the moraine and onto the railway embankment against which the whirl of Mill River was directed. Passengers reported that they felt the embankment yield under the weight of the train and the attack of the river, but the train pushed on in safety to Cuttingsville, where it was stalled for several days. The embankment over which it had passed at East Clarendon soon slumped into the river, and a half dozen freight cars and carload upon carload of marble refuse from the yards of the Vermont Marble Company at West Rutland and Proctor were required to fill the gap.

What might have happened to the village of East Clarendon had the storm continued and Mill River cut through the pass in the moraine is suggested by what actually did happen at Proctor about the same distance beyond Rutland. There, Otter Creek, or another branch stream, too swollen to pass through its gorge, overflowed, cut across the Vermont Marble Company yard, submerged a milk train stalled in a railroad cut and washed away a large part of the farmland slope leading to its lower valley.

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THE SPECIES OF PARAMECIUM AND THE THYROID QUESTION

A RECENT article by D. H. Wenrich (*Trans. Am. Mic. Soc.*, 47: 275: 1928) discussing eight well-defined species of Paramecium calls attention to the fact that these species differ not only morphologically but also physiologically, and points out the importance of proper species determination in experimental research. These conclusions are of particular interest to me in view of my contributions (*J. Exp. Zool.*, 17: 297: 1914, and 22: 529: 1917) regarding the effects of a thyroid diet on Paramecium, in which I concluded that this protozoon could ingest thyroid substance with a pronounced acceleration of the division rate. The species studied were then described as *P. aurelia* (1914) and *P. caudatum* (1917). With regard to the second species I reported the effect of thyroid on the structure and activities of the contractile vacuole, and described the appearance of individuals with three contractile vacuoles in the thyroid-treated lines. At about the same time Hance (*J. Exp. Zool.*, 23: 287: 1917) reported the appearance of these multi-vacuoled individuals in a race described as *P. caudatum* after subjection to high temperatures. Subsequently Landis (*J. Morph. and Physiol.*, 40: 111: 1925) demonstrated that the species with which Hance worked was *P. multimicronucleata,* and that this race has a tendency to form three or more contractile vacuoles. I have recently restudied the preserved specimens of the races with which my own experimental work was performed and find that the 1914 race was indeed *P. aurelia* as described at the time, but that the 1917 race was *P. multimicronucleata* and not *P. caudatum.*

In view of these facts I have taken occasion to review the literature on thyroid feeding as applied to Paramecium with particular reference to the species involved and find that the results may be summarized as follows:

Nowikoff (*Arch. Protistenk.*, 11: 309: 1908) reports an increase in the division rate. *P. caudatum.*

Shumway (*l. c.*, 1914), an increase in the division rate. *P. aurelia.*

Budington and Harvey (*Biol. Bull.*, 28: 304: 1915), an increase in the division rate. *P. caudatum.*

Shumway (*l. c.*, 1917), an increase in the division rate. *P. multimicronucleata.*

Abderhalden and Schiffman (*Pfluger's Arch.*, 194: 211: 1922), an increase in the division rate. *P. sp.* (?)

Cori (*Am. J. Physiol.*, 65: 295: 1923), an increase in the division rate. *P. putrinum.*

Woodruff and Swingle (*idem*, 69: 21: 1924), no increase in division rate. *P. aurelia.*

Torrey, Riddle and Brodie (*J. Gen. Physiol.*, 7: 449: 1925), an increase in the division rate. *P. sp.* (?)

The three last contributions also report that thyroxin does not increase the division rate as I can confirm from unpublished researches. It is, however, significant that thyroxin is active only in an alkaline medium, while the normal environment of Paramecium