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Boulder trains in western Massachusetts

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BOULDER TRAINS IN WESTERN MASSACHUSETTS - REVISITED

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The New England landscape is strewn with numerous concentrations of rock fragments ranging from fine materials to blocks of house size. Close examination of these loose rocks in the past has sparked the imagination of investigators and elicited what today may be considered bizarre hypotheses concerning their origin. Specific interest in the nineteenth century was focused on the significance of erratic rock fragments in the interpretation of drift sheets. Writers have attributed the emplacement of erratics observed in New England to a variety of mechanisms, including pack ice, icebergs, waves of translation, streams, and even glaciers.

Rock fragments which differ in lithology from the underlying bedrock are, by definition, erratics, regardless of the mode of transportation or deposition. Erratics correlated with specific rock outcrops are indicators which typically occur as particle concentrations extending in linear or fan-shaped dispersions from a source area. During the nineteenth century, these features were collectively called "Boulder Trains," regardless of their geometry or particle size. Today they are more specifically called "indicator fans" or "indicator trains" (Flint, 1971).

Numerous boulder trains have been observed in New England (Flint, 1971), but few have the historical interest achieved by the Richmond Boulder Train in western Massachusetts. It was first described by Stephen Reed in an 1842 article in the local Lenox Farmer, and then in 1845 in a paper he read to the Association of American Geologists. He identified this train as "a chain of erratic, serpentine rocks." He noted the distinctively large size of the boulders, their tough, resistant lithology, a train length of approximately 20 miles trending to the southwest, an average breadth of 20 rods, and that the largest boulders were on the southeast-facing slopes and had crossed hills higher than their source area on Canaan Ridge.

The Richmond Boulder Train is important because its initial investigation and description coincided with the emergence of the glacial theory in North America, and the concomitant controversy regarding the deposition of drift sheets. The accessibility of this train, the exposure afforded by open farm fields, and the distinctive placement of boulders on the terrain surface, encouraged investigation by several eminent geologists, including Sir Charles Lyell, Edward Hitchcock, James Hall, and Louis Agassiz.

Hitchcock (1844; 1845) extended Reed's (1845) observations by noting that the train was longer than 29 meters, and that there were actually two trains. He was the first to publish speculations on the mode of deposition, although he did not propose any explanation. He rejected water currents because of the large boulders, the straight course of the train, and the lack of boulder rounding. He rejected icebergs because boulder emplacement would have required the successive movement of many large boulders along a narrow line. He rejected both glaciers and packed river ice because he doubted that either existed here. His rejection of glaciers seems inconsistent with several of his own concepts regarding drift deposition. In 1841 Hitchcock obviously envisioned continental glaciation. He postulated that ice perhaps 1200 meters thick covered the entire area. This ice was responsible for drift, for the transport and emplcement of large blocks and gravels over wide areas, and for the emplacement of boulders upon the crests of narrow mountains (1841, p. 251-256). By 1845, however, he seems to emphasize only alpine glaciation, comparing the blocks in the Richmond Boulder Train to Agassiz' alpine moraines, and stating:

"But when we come to examine the country with reference to a glacier, we shall find it about as difficult to imagine the existence of one there as of a river. ...if we can imagine a glacier to start from the ridge in Canaan, it must ascend 100 or 200 feet...in order to go over the next ridge into Richmond;..." (Hitchcock, 1845, p. 264-265)

An additional explanation for these unusual boulder deposits was summarized by G. William Holmes (1966) in his salutation to Stephen Reed. This explanation involved a "wave of translation" transporting and depositing the boulders, and was first advocated by Rogers and Rogers in 1845. Holmes' summary states (1966, p. 434-435):

"Rejecting glacial transport and iceberg drifting, they held that the train was the result of a sudden discharge of the Arctic Ocean southward, as a wave of translation (not unlike a tsunami). The Arctic waters picked up speed sweeping down the south-west slopes of the Adirondack Mountains and drove enormous ice islands against the summit of The Knob. This produced a vortex 'endowed with an excess gyratory or spiral velocity' which had a pendant column (similar to a tornado funnel or dust devil in the atmosphere). The whirlpool then gathered into its rotating column blocks from the summit and strewed them in a line along which its pendant apex dragged along the ground."

Desor (1848) was the first to formally propose a glacial origin, noting that, in Switzerland, similar trains existed which extended in the direction of glacial movement. This idea, however, was not accepted by the scientific community in America for more than two decades.

During those decades, Sir Charles Lyell entered the debate (1855; 1871). He traversed the Richmond Boulder Trains, and defined five additional linear trains on the landscape parallel to Reed's (1845) main boulder train. These additional trains consisted chiefly of carbonate rocks. Lyell attributed their source to the Richmond Range lying southeast of, and parallel to, the Canaan Ridge, which was the metavolcanic source for Reed's main boulder train. Since carbonate rocks are extensively exposed in this region, the carbonate trains (Lyell, 1855; 1871) are not "indicator trains."

Although Lyell (1871) was specifically investigating "glacial drift and erratics" in Berkshire County, Massachusetts and adjacent parts of New York, he rejected glacial emplacement for these blocks. He believed that glacially deposited blocks "would have radiated in all directions from a centre, whereas not one even of the smaller ones is found to the westward..." (p. 358). He conjectured "that the erratics were conveyed to the places they now occupy by coast-ice, when the country was submerged beneath the waters of a sea cooled by icebergs coming annually from arctic regions." (p. 361).

A glacial origin was again advocated in 1871, this time by John Perry. He visualized thinning ice, perhaps 200 meters thick, moving around nunataks such as Douglas Knob. This ice received loose blocks on the surface which were subsequently deposited downstream as the ice melted. A year later Louis Agassiz (1872) presented his views and effectively ended the debate. He also postulated glacial origin for the trains, but he believed a large ice sheet 3000-3700 meters thick was responsible. Reed (1873) presented further observations supporting glacial transport for the second boulder train.

The most detailed study of the trains was made by Benton in 1878. He confirmed the observations of Reed (1845; 1871), but found fragments of only two of Lyell's (1855; 1871) five carbonate trains.

About 30 years later, Frank Taylor (1910) reconnoitered this region. He found intermittent "amphibolite" boulders extending southward to State Line, Alford, and Great Barrington, which he named the Great Barrington Boulder Train. He believed these scattered fragments represented an early ice invasion which incorporated talus material into the basal part of southward-flowing ice. This mode of origin and transport would account for the greater degree of weathering and rounding of the boulders than observed in the Richmond trains, and also would account for their partial burial in till. Recent mapping (Ratcliffe, 1974 personal communication) revealed other meta-volcanic rock exposures in ridges south and east of Canaan Mountain. Other lithologies occurring to the west of this area may be mistaken for the meta-volcanic rocks exposed on Canaan Mountain. The reconnaissance level at which Taylor (1910) made his observations, the possible lithologic confusion, the additional metavolcanic source areas, and the notable gaps along the route of the train, raise doubts about the existence and significance of Taylor's (1910) "Great Barrington Boulder Train," and its relationship to the Richmond Boulder Trains.

REFERENCES

Agassiz, Louis, 1872, Observations on boulders in Berkshire County: Boston Soc. Natural Hist. Proceedings, v. 14, p. 385-386.

Benton, E. R., 1878, The Richmond boulder trains: Mus. Comparative Zoology, Harvard College, Bull., v. 5, p. 17-42.

Desor, E., 1848, On parallel trains of boulders in Berkshire County, Mass.: Boston Soc. Natural Hist. Proceedings, v. 2, p. 260-261.

Flint,R. F., 1971, Glacial and quaternary geology: New York, John Wiley and Sons, 892 p.

Hitchcock, Edward, 1841, First anniversary address before the Assoc. of Amer. Geologists: Amer. Jour. Sci., 1st ser., v. 41, no. 2, p. 232-275.

__________1844, Dispersion of blocks of stone at the drift period in Berkshire County, Mass. (abs.): Amer. Jour. Sci,1st ser., v. 47, no. 1, p. 132-133.

__________1845, Description of a singular case of the dispersion of blocks of stone connected with drift in Berkshire County, Mass.: Amer. Jour. Sci., 1st ser., v. 49, no. 2, p. 258-265.

Holmes, G. William, 1966, Stephen Reed, M.D., and the "celebrated" Richmond Boulder Train of Berkshire County, Massachusetts, U.S.A.: Jour. Glaciology, v. 6, no. 45, p. 431-437.

Lyell, Charles, 1855, On certain trains of erratic blocks on the western borders of Massachusetts, United States: Notice of the Proceedings at the Meetings of the Members of the Royal Institution, v. 2, p. 86-97.

__________1871, The geological evidences of the antiquity of man: 2d ed., Philadelphia, J. B. Lippincott and Co.

Perry, John B., 1871, Boulder trains in Berkshire County, Mass: Am. Assoc. for the Advancement of Sci. Proceedings, v. 19, p. 167-169.

Reed, Stephen, 1845, A chain of erratic serpentine rocks passing through the center of Berkshire County: Assoc. of Am. Geologists, Proceedings, 6th annual meeting, p. 12.

__________1871, On trains of boulders and on the transport of boulders to a level above that of their source: Amer. Jour. Sci., 3rd ser., v. 5, p. 218-219.

Rogers, H. D., and Rogers W. B., 1845, On the boulder trains of Berkshire County, Mass.: Boston Soc. Natural Hist. Proceedings, v. 2, p. 79-80.

__________1846, An account of two remarkable trains of angular erratic blocks in Berkshire, Mass., with an attempt at an explanation of the phenomena: Boston Jour. Natural Hist., v. 5, p. 310-330.

Taylor, Frank B., 1910, Richmond and Great Barrington boulder trains. Geol. Soc. America Bull., v. 21, p. 747-752.

ROAD LOG

TOPOGRAPHIC QUADRANGLES (1:24,000, 7-1/2 minute) - Great Barrington, Egremont, State Line, Canaan, Pittsfield West, and Stockbridge

0.0 Start at Monument Mountain School, proceed south on Route 7 to Great Barrington, and through the main business district.

4.0 Turn right on Alford Road (Castle Street). Proceed northwest, driving through a wooded, suburban area which has thin till with numerous bedrock exposures.

5.2 The field to the left of the road contains many unweathered boulders of Cheshire quartzite. Boulders of this same lithology and a similar population density occur in and beyond the orchards on the right (north).

5.7 An outwash apron originating from a head-of-outwash ice-contact position a short distance to the north has apparently covered the quartzite boulders in the vicinity of the Simon's Rock School.

6.3 Intersection, Seekonik Road. Quartzite boulders are again evident to the right, while those presumably present to the left of the road are covered by Holocene alluvium.

6.8 Deusenville Road. High density of quartzite boulders to the right.

7.2 STOP 1 - CHESHIRE QUARTZITE EXPOSURE

(Park along the right shoulder. Please EXERCISE CAUTION when exiting and entering your vehicle here and at all stops)

The Cheshire quartzite crops out for about a mile along a north-striking ridge and east-facing escarpment. The quartzite is well exposed, starting about 100 feet above the level of the road. Microstriations strike within 15 degrees of N. 60° W. (use lead pencils to reveal those scratches!). These exposures appear to be the source of the quartzite erratics found to the east and southeast of this stop. However, since the Cheshire quartzite also crops out 1.4 miles to the northeast, and 1.6 miles to the southeast, this area is by no means a unique source of quartzite erratics. Nevertheless, it is presumed that the boulders we drove by between Great Barrington and here had their source in these exposures, since the lithology of the boulders is identical to that of the supposed source. Cheshire quartzite boulders are not evident west of this area. The strong easterly component of glacial flow demonstrated here (and as will be demonstrated again later today), across the topographic grain of the landscape, suggests glacial outflow controlled by the axis of the Hudson-Champlain Lowland (Kelley, 1975, p. 234-242 of this volume) or a more remote center of outflow far to the northwest.

Continue northwest on Alford Road.

8.6 At intersection, bear left into Alford.

8.8 Bear right onto West Street. Area is bedrock covered by thin till.

9.8 Enter State Line quadrangle.

12.6 Intersection, turn left on West Center Road.

14.6 Extensive dead-ice and ice-contact topography.

15.5 Intersection, turn left on Route 102. A well-defined kame terrace abuts the north slope of this pass through the Taconic Range.

16.5 Turn right onto Route 22. The gradient of the kame terrace is still apparent on the right and suggests water flow was to the east.
18.5 Enter Canaan quadrangle.
19.6 Large erratic may be seen to the left of the highway.
21.9 Queechy Lake to the left. Observe ice-contact topography evident along this valley in the next three miles.
22.6 Berkshire School. Reed's second (southwestern) boulder train extends across this valley, through the school campus, from northwest to southeast. Scattered boulders are evident on both sides of the road.
23.2 Reed's main boulder train crosses Route 22 from the northwest to southeast. (The trip will return to this area later)
23:3 An ice-channel filling is exposed in the gravel pit to the right.
24.6 STOP 2 - SMALL MORAINE

(Route 22 is often busy, and cars move rapidly. The caravan needs to turn around in driveways north of this moraine, at points where visibility allows safe turning. Return southward after turning, park on the west shoulder. USE CAUTION EXITING/ENTERING CARS)

The formation of the landscape features and deposition of materials associated with this moraine will be considered. Problems include the origin of abandoned drainage channels, and the gradient on outwash materials south of this moraine.

Continuing south along Route 22, Douglas Knob becomes visible to the southwest through the trees. It is the highest peak on the Canaan Mountain ridge and is considered the point source for the metavolcanic erratics comprising Reed's main and second boulder trains.

26.0 STOP 3 - REED'S MAIN BOULDER TRAIN

(Park on west side, and cross the small South Wyomanock stream)

Significant aspects of the boulders and their placement on the terrain can be examined. Points to ponder - What is the degree of boulder surface weathering? Are the boulders rounded or angular? How "tough" is the boulder material? What is the average size of the fragments? Is there any apparent orientation among these fragments? Is it significant? How well defined are the lateral limits for this train? Why? Was Douglas Knob the point source for both of Reed's trains (there is a gap in the boulders of the second train in the vicinity of the swamp north of Queechy Lake)?

26.6 STOP 4 - REED'S SECOND BOULDER TRAIN

Boulders in this train can be compared with boulders in Reed's main train. Factors of weathering, rounding, burial, orientation, size and continuity should be considered. Were these trains emplaced simultaneously? When in the glacial cycle did emplacement occur?

Proceed south on Route 22.

28.0 Turn left (southeast) onto Route 295. Note the paucity of boulders on the observable terrain.
30.1 Enter Pittsfield West quadrangle.
30.2 Reed's second train crosses Route 295 between this point and the next intersection at Richmond Road. Where are the boulders? The second train is often poorly defined, and distinct gaps exist between concentrations of erratics.
30.5 Turn left (north) onto Richmond Road.
31.1 STOP 5 - LYELL'S ROCK

Reed's main boulder train crosses Richmond Road and, unlike the paucity of boulders in the secondary train, numerous boulders are evident on each side of the highway. This location is on a lee slope, where boulders tend to have a larger mean size than do boulders on the stoss slopes. Cross the highway to the northwest, enter the woods, contemplate the orientation of the particles, seek the boundaries of the train, and then proceed on foot "up-ice" to a large "particle" (16 x 6 x 6 meters) which is commonly called Lyell's Rock. Lyell's sketch of this rock indicates a broken fragment derived from the nearby, larger block. Other boulders were once joined to adjacent or nearby fragments. Perhaps initial size, transport, emplacement, and post-depositional shattering account for the downstream decrease in mean particle size. Lyell's Rock is the second largest erratic in these trains. The largest, called "The Alderman," is 29 meters long. It is on Dupey's Mount in the Richmond Range of the Taconic Mountains (Canaan quadrangle).

Proceed northeast on Richmond Road.

31.7 Turn right (south) onto Dublin Road. Observe the frequent carbonate erratics in the adjacent field. These are believed to be part of Benton's minor carbonate train, lying northeast of the main train.

32.5 Turn right (west) onto Summit Road.

32.6 Reed's main boulder train crosses Summit Road.

32.9 Carbonate erratics evident to the right of the road

33.2 Turn left (south) on Route 41.

33.5 Reed's second boulder train crosses Route 41.

33.7 Turn left (west) onto Sleepy Hollow Road. Reed's second train extends towards the southeast across this road.

34.0 Carbonate rocks are again evident.

34.3 Re-cross the path of Reed's main boulder train.

34.4 Cross railroad tracks. Observe metavolcanics in the field walls.

34.6 Turn right (south) onto Medlyn Road.

35.4 Oblique intersection of Swamp Road. Continue south on Swamp Road.

35.8 STOP 6 - RECAPITULATION
Reed's main train extends across this terrain toward the southwest, where it crosses Lenox Mountain. Mean size of boulders is distinctly smaller in this region than upstream. Farmers have removed the boulders from fields to adjacent walls, a procedure which becomes more significant to the appearance of the train farther downstream. Reed's second boulder train is 0.2 miles south of this location.

This is the last trip stop. Those returning to the Monument Mountain School should continue southward on Swamp Road into the village of West Stockbridge.

39.0 Intersection with Route 102. Continue straight southward on Route 102 to Stockbridge

44.0 Turn right (south) on Route 7.

46.6 Enter Great Barrington quadrangle.

47.6 Monument Mountain School

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