

sion of a glacial river from one avenue into another near its point of discharge from the ice-sheet. Each series seems to be attributable to deposition in the ice-walled channel of a stream of water flowing down from the surface of the melting ice-sheet, where the gravel and sand had been gathered from the previously englacial drift that had been exposed by ablation as a superglacial stratum. Near their mouths, or places of discharge to the land surface, these rivers appear to have flowed in valleys or gorges inclosed by unmelted plateaus of the ice-margin, upon which much drift rested. In some sections of our drift formations, as of Third and Fourth Cliffs in Scituate, Mass., which are partially eroded drumlins on the shore of the ocean, thick beds of stratified gravel and sand are found which were undoubtedly laid down by subglacial streams (<sup>1</sup>). But such beds formed under the ice-sheet are rare in most parts of the country, and the eskers here described and all others which have come under my examination of extensive areas in New England, and in Minnesota, northern Iowa, the Dakotas, and Manitoba, I believe to have been deposited in ice-walled channels open above to the sky.

Before proceeding to consider more in detail the structure and materials of these eskers in their bearing on this view of their mode of accumulation, it will be desirable to notice former expressions of opinion as to the origin of the Pinnacle hills. The earliest reference to this esker is by James Hall, in his report on the Fourth Geological District of New York, published in 1843. In pages 323 and 324 he gives a figure and description of the section where the ridge is intersected by Monroe avenue. "The gravel," Professor Hall remarks, "consists principally of waterworn fragments of the Niagara limestone, on which the whole deposit rests, and of the sandstones and limestones on the north. There are some boulders of the limestone, from two to four feet in diameter, worn perfectly smooth, or often striated with shallow grooves; and from the fact that this is the subjacent rock, they have received their rounded forms and smooth surfaces from attrition near the spot where we now find them." When this was written, the glacial theory of Agassiz had been published only a few years, and was not apprehended by Hall with such clearness as to seem adequate to account for this and our other drift deposits. It was observed that in this section "nearly all the strata dip towards the west," whence it was concluded that "the accumulation doubtless took place from

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(1.) Proceedings of the Boston Society of Natural History, Vol. XXIV, 1889, pp. 228-242; Vol. XXV, 1891, pp. 228-242.