ART. XLI.—*On Glaciers of the Glacial Era in Virginia*; by
R. P. STEVENS. (From a letter to one of the Editors.)

IN a late visit to the Richmond, Va., coal field, my attention was drawn to palpable signs of glacial action, in long and narrow trains of pebbles and small boulders: one train I traced for more than five miles. These trains in the vicinity are called "*ancient river beds*." Their general direction was north and south.

Other than these signs were seen at the new opening upon the middle vein, on lands of the James River Coal Co., lying north of the James River. I found the northeastern outcrop of the Coal-measures, including the lower vein of coal, had in many places been removed, and, with the debris of associated strata, had been carried over and deposited upon the northerly slope of the hill holding the upper vein of coal, making a true drift deposit, composed of Coal-measure materials mingled with material from gneissoid rocks. I was able to follow the line of removed outcrop up to the northern limit of the coal field. I had previously noticed similar phenomena south of James River. That the Richmond coal field had been struck by a moving glacier was quite as palpable as the northern fields of Pennsylvania. Richmond is in latitude $37^{\circ} 30' S$.

From Richmond, as far as Covington, I passed over the Chesapeake and Ohio R. R.: consequently no observations for glacial action could be made. At Covington, which is situated on the Jackson branch of the James River, having a short time for examination, I soon found in the railroad cuts the up-turned edges of bluish slates shaved off, with drift clays and

gravel reposing upon them. Similar observations were made all the way up to Lewis Tunnel, or the passage of the railroad into the valley of the Green River.

The Jackson branch has its source on the east flank of the east front of the Alleghany Mts., in Highland Co., Va. The Green River rises on the west side of the same mountains, in Pocohontas County.

You may remember, that some time since I wrote you, that I had found Canadian boulders on the summit of the West Front Mts., or Back Bone Mts., in Tucker Co., at the sources of the N. W. branch of the Potomac River. Bearing this in mind, I was on the alert to find signs of glaciers, also, in the Green Briar Valley.

No sooner had the tunnel been passed, and the valley entered, when great masses of true boulder drift were found massed on slates and limestones of the Subcarboniferous group. Beds were seen thirty feet in thickness. These evidences continued as low down as the junction of the Green Briar with New River, at Hinton. At this point there was a good field for observation. Excavations had recently been made for foundations of railroad buildings. Here was seen the crushing, polishing, and grooving action of glaciers upon the hard gray sandstone of the valley, with boulder clays and gravel reposing upon it. There was no doubt left on my mind that glaciers had moved down both of these valleys; one to the South and West, the other to the South and East.

It is an interesting inquiry, where did the Green Briar glacier pass from Hinton? Up the New River into the great valley of Virginia? or down New River and Kanawha River to join the Ohio glacier? Or did it follow the channels of both rivers?

Was the entire crest of the Alleghany Mts., East Front and West Front, with their parallel and associated ranges, the sources of these glaciers? or were they a portion of the great Canadian glacier?

Ascending to the table land in Fayette Co., S.W. from Hinton, up to the height of 1370 feet above the ocean level, I failed to find signs of glacial action along the line of the highway to Fayette Co. court-house. Nor, when following the range of highlands forming the sources of Piney, Paint, Coal, and Guayandotte Rivers, did I find any signs of glaciers.

May not a glacier have once covered all the highlands in these southern latitudes and remained *stationary* on the heights, then, perhaps, and most probably more extensive table lands than at present, and only moved along the water courses where *slopes* obtained to give descent to the sea?

New York, Sept. 25, 1873.

[A subsequent letter dated October 6th, contains the following additional observation.—Eds.]

I have revisited the summit of the Alleghanies at the crossing of the Baltimore & Ohio railroad, and, in the vicinity of Oakland station found evidence of a southward movement in the torn up fragments of the Coal measures, and their transportation southward where they repose upon the upturned edges of Rogers No. XI. The opening of many coal banks in the vicinity of Oakland, Deer Park and Strawberry Summit have given greater facilities for observation of superficial deposits than I enjoyed in 1867. Oakland station is about 30 miles north of the locality where I found, in the year above mentioned, a true Canadian boulder of real feldspathic gneissoid granite.