have been able during the present session to lay before the Society a tolerably complete list of the fossils hitherto found in the western parts of the counties of Edinburgh and Linlithgow, but find I must have some more time yet. Perhaps by next session I shall have got my plant-remains and corals named and arranged, for these are the chief hindrance.

II. *On the Evidence of the Existence of an Old River Course previous to the deposition of the Boulder Clay, at the Water of Leith, above Colinton.* By JOHN HENDERSON, Curator of the Museum.

The condition of the surface of Scotland immediately preceding the deposition of the boulder clay is very little known, nor can much be expected, when we consider the circumstances under which the boulder clay was deposited. That the boulder clay is mostly made up from the rock upon which it rests is evident from an examination of our own neighbourhood. To the north and west of Edinburgh the underlying rocks consist of soft black shales and grey sandstones. Overlying these, in many places we find a great thickness of hard bluish sandy clay, full of boulders of grey sandstone and greenstone; while in the southern district, where reddish sandstones and shales prevail, the boulder clay so closely resembles in colour the rocks upon which it rests, that it is often difficult to distinguish the clay from the shales upon which it lies. But a large number of the boulders in the clay offer an exception to this rule, many of them being derived from rocks lying at a considerable distance to the west of where they are found. The boulder clay in this respect presents a curious anomaly to ordinary sedimentary deposits, more especially to those of river or oceanic currents, which generally deposit the larger stones first, and carry the finer sediment farthest; whereas in the case of the boulder clay, the finer sediment has scarcely been removed from the parent rock, while the larger blocks have been transported in many instances to a great distance. The action which produced the boulder clay might be compared to that of some great plough that went tearing into the solid rocks, carrying along the larger blocks, and parting with them as it moved onwards under some enormous pressure, making the mass so compact that it is sometimes more difficult to cut into than the solid rocks beneath. Even small stones are with difficulty got out of it, and when taken out the finest markings on the stone are found impressed upon the clay. It will be readily seen, from the amount of erosion the rocks lying immediately beneath the boulder clay have been subjected to, that we can expect to gather very little information about the condition of the surface of the country before the deposition of the boulder clay, and it

is only in the deep gorges and river courses which have been partially denuded and filled up by the boulder clay that we can expect to find any evidence of these pre-glacial land surfaces. It is the evidence of one of these old river courses in our own neighbourhood that I would lay before you to-night.

It has been observed by our President, Professor Geikie, as a curious circumstance that the Water of Leith, when it leaves the steep slopes of the Pentland Hills, instead of making for the low-lying valley to the north, bends round to the east and runs along the flank of the hills separated from the low-lying district to the north by a long straight ridge several miles in length, along the top of which runs the road through Juniper Green and Currie to Lanark. On the north side of the ridge the ground slopes down to the broad open valley, but on the south a deep narrow glen runs parallel with the road. Along the bottom of this glen the Water of Leith wends over rocks and through pools, cutting sometimes into one side of the glen and sometimes into the other. The appearance of some parts of this glen would lead us to believe that the Water of Leith had cut its way down through the solid rock from the top to the bottom, as the bare rock is exposed in some places up to the top of the ridge, and river gravel is seen at all heights from the bed of the river to the top of the ridge. But from a more careful inspection of the sections exposed along the glen from Colinton to Currie, I expect to be able to show that the Water of Leith at this place is only clearing out a much older river course, which had been cut out of the carboniferous rocks and afterwards filled up with boulder clay during the glacial period. A lithograph of one of these sections is annexed. The first evidence I found of this was during the time that the short tunnel was making at Colinton for the Balerno branch of the Caledonian Railway. The tunnel is cut through a portion of the long ridge already alluded to, and passes through the carboniferous shales; but just where the tunnel comes out into the upper glen above the village, the following section occurs:—The carboniferous rocks dip into the side of the ridge at an angle of about 20° , showing their edges truncated in a sloping direction towards the bed of the river, and on these truncated edges a mass of stiff boulder clay is deposited, full of large and small dressed and scratched boulders. The clay at this place is 10 feet thick, and on its upper surface, which slopes down to the bed of the river, lie several feet of river gravel. This can be traced from the top of the bank down to the gravel in the bed of the river, showing that the river has cut its way from the top down to its present bed, not through the solid rock but through the boulder clay. The large stones in the gravel at this place also indicate that they have been washed out of the boulder clay. But another fact is also evident, viz., that an older river

*SECTION OF OLD RIVER COURSE.
ON THE
WATER OF LEITH ABOVE COLINTON*

J. HENDERSON, DELT.

- D. Present River Gravel.*
- C. Boulder Clay*
- B. Old River Gravel*
- A. Carboniferous Rocks*

channel had existed here, cut out of the solid rock, and filled up with the boulder clay.

I set to work to examine some more of the railway cuttings further up the stream, to see if I could discover any additional evidence of this. About half a mile further up a deep cutting is again made into the boulder clay, and the following section is exposed:—First, a bed of gravel and sand about 4 feet thick, with angular stones and several large boulders. Above this gravel lies a mass of boulder clay about 20 feet thick; and above the clay is a thin bed of river gravel. This section is exposed for about one hundred yards along the north bank of the river, which is a part of the long ridge previously referred to. The boulder clay lies on the top of the gravel bed with a nearly horizontal line of junction. It is the usual hard, stiff, unmistakable boulder clay, full of rounded and scratched boulders, while the gravel below is loose and sandy, and full of angular and sub-angular stones, many of them evidently derived from the rocks forming the bed of the river. I searched this gravel to try if I could get any scratched stones, but after turning over a large number of them without finding any of them scratched or rubbed, I came to the conclusion that they had not been subjected to the same process as those in the boulder clay, and that this was a portion of the undisturbed gravel of the old river-bed buried under the boulder clay. The upper gravel, lying on the top of the boulder clay, shows that the present river is again clearing out the boulder clay, and cutting a channel for itself down through the old course. A short distance above this the river takes a sharp bend to the north, right against the ridge, clearing out all the boulder clay, and exposing the rock from top to bottom, showing that the backbone of the ridge is carboniferous rocks. Half a mile farther up the rock is again exposed, showing the boulder clay lying on its truncated edge. Sloping down to the river bed, the boulder clay is here again covered with river gravel from top to bottom. The whole of these sections conclusively show that the Water of Leith has only been clearing the boulder clay out of a much older river channel.

So far, the old river course has been satisfactorily traced, but in what direction it extended below Colinton has yet to be determined. The Water of Leith, which above Colinton has a north-easterly course, takes a quick bend at the village, and turns direct north, and then turning at a right angle runs a short distance nearly due west, then with another turn to the north it makes its way through a rocky glen to the low country. It will be seen, by a reference to a map of the district, that the river in taking these sudden turns has succeeded for the first time in cutting through the long ridge which had hemmed it in for so many miles. It became a matter of interest to find out if it was still

following the old river channel. The railway cuttings through this glen below Colinton have exposed some beautiful sections of the carboniferous rocks, and ought to have exposed some patches of boulder clay, if any existed. But although the rocks have been cut into in many places, I have failed to observe one single patch of boulder clay, but I have found the river gravel lying at all heights on the bare rock. On the side of the glen opposite the railway cuttings few sections are exposed; but wherever the ground is free from vegetation, it is either the older rocks or river gravel which are seen. It appears to me from this evidence that the present river has left the old channel and cut a new course for itself. What, then, has become of the old river course? A section at the top of the glen gives me what I consider an answer to this question. At the top of the glen, near the village of Colinton, there is a high cliff of sandstone, whose perpendicular face rises from the edge of the water, and although not apparent at first sight, yet this cliff is a very fine example of an anticlinal curve in the carboniferous rocks, which the stream has cut down to its present bed, passing right through the anticline. A short distance above this sandstone cliff the boulder clay is again met with for the first time coming up the lower glen. It lies high upon the bank; and further up there is a small burn running into the Water of Leith, which shows the boulder clay from the top of the bank almost down to the water's edge. The position of this clay is facing the old river course. It appears to me that this is the turning-point where the present stream has left the old water course, and cut out a new channel for itself through the ridge that confined it; that is to say, that it found it easier to cut through the ridge than to cut through the boulder clay, which may have been piled up higher here than anywhere else in its course.

To follow the line of the old river course further on is much more difficult, seeing that in all likelihood it is filled up with boulder clay. But if we prolong the line in which we have traced it further to the north-east, we shall find that it leaves the Water of Leith just at the bank of boulder clay, between the sandstone cliff and the village of Colinton, and passes on through a broad valley between the foot of the Pentlands and Craiglockhart Hill, and along the north side of Blackford Hill, in the direction of Portobello or Joppa. And although the hills stand up irregularly over all this district, they offer no obstruction in this line, which is nearly straight, low-lying, and mostly covered with boulder clay. It is impossible to determine the extent and depth of this old river channel. The boulder clay which has filled it up is mostly derived from the erosion of the rocks forming its north-western side. This is evident when we consider that the erosive agent came from the west, and many of the

blocks imbedded in the clay are derived from the sandstones of the subjacent rocks. That the old river course was in all probability much larger than the present, may be inferred from the amount of denudation the ridge on the west side has undergone during the glacial period.

Before closing these remarks, I should like to say a few words regarding the boulders exposed in the cuttings along the banks of the stream. It was here that Professor Geikie found the subject for his interesting and instructive "Story of a Boulder," and some of the boulders recently exposed might well afford the gifted author materials for other stories. Of scratched blocks there are innumerable examples. One large block of sandstone was exposed near Woodhall, the surface of which, about six feet square, was finely striated, the striæ running west and east, but sloping down to the bed of the river. Another one, of greenstone, was scratched in the same direction, the striated face also sloping down to the river. On another block in this locality, I found one side of it covered with root-like impressions, penetrating the mass of sandstone about an inch, and the whole of that surface of the stone covered with fragments of encrinites, showing that it had once formed a part of the surface of the sea-bottom during the carboniferous era. The mass itself, on being broken up, showed no traces of organisms except on the one surface. A very fine assemblage of grooved and striated blocks occurs in a cutting about half a mile above Currie.

One of these, a cube-shaped block of limestone, with hollow cavities all over its surface, is scratched in every conceivable direction. It looks as if some person had taken a glazier's diamond and covered it with short scratches, both in the plane surface and in the cavities. I cleared three of the large boulders embedded in the stiff clay along their upper surface, and found them to be beautifully grooved. I took the direction of the groovings, and found the whole of them nearly due west. But possibly the finest examples of large grooved boulders in this locality are to be seen three or four miles farther up the Water of Leith, near the mouth of the Cockburn, on the farm of Whelpside; Mr D. J. Brown and I came upon them when going over that district examining the older rocks. There are two of them, one measuring 12 feet each way. Its thickness we could not determine, but, assuming it to be one-half its breadth, that is 6 feet, it cannot be less than 50 tons in weight. The upper surface is flat, and the whole face is grooved in long straight lines running north-east by east. This is certainly the most striking boulder I have ever seen, showing upwards of 100 feet of dressed and grooved surface. The other boulder is about half this size; it lies a few feet to the west of the large one, and is grooved in the same direction. They are both greenstone, and

are in all likelihood derived from some of the large masses of greenstone lying a mile or two to the westward. I shall conclude by advising the members of the Society to visit the very interesting sections at present opened up along the banks of the Water of Leith from Slateford to Balerno, in connection with the construction of the new branch railway there.

The following Gentleman was elected a Fellow of the Society :—

HENRY DRUMMOND (of Stirling), Student in Science, Edinburgh University, and of the Free Church College, Edinburgh.

Thursday, 13th February 1873.

HENRY CADELL, Esq. of Grange, Vice-President, in the Chair.

The following Communications were read :—

- I. *On the new Slate Quarries of Cuilchenna, Onich, Fort-William.*
By RALPH RICHARDSON, W.S., Honorary Secretary. *With Letters and Sketch Map by the Manager, Mr RICHARD DAVIES.*

- II. *The Geology of Edinburgh and its Suburbs. Part I. Igneous Rocks.* By GEORGE LYON, Treasurer.

Scottish geology was cradled in the German school of Werner ; and Jamieson, his ardent and devoted pupil, was the first who described, in a systematic manner, the rocks around Edinburgh. His knowledge, however, did not go beyond their structure, mineral composition, and external characters, and conveyed no idea of their mode of formation. Jamieson's prelections on mineralogy had rendered the study of that science extremely fashionable, aided no doubt by the attractive nature of the study, as dealing with the most beautiful productions of nature's laboratory. Museums and cabinets were crowded with minerals of great value, and fabulous prices were given for rare and uncommon specimens. A change, however, "came o'er the spirit of their dream." Werner and Jamieson, although intimately acquainted with mineralogy, and the nature and origin of veins, knew little or nothing of rocks in the mass, or of the structure, arrangement, and origin of mountain chains. The Wernerian theory was concocted in the mines of Saxony, and had too narrow a basis to withstand the progress of discovery. The true theory of the earth had yet to be thought out.