NO. IX.—THE SURFACE GEOLOGY OF PAISLEY. BY THE LATE
MATTHEW BLAIR.

[Read 10th January, 1889.]

THE few remarks which I intend making to-night have reference to the Surface Geology of Paisley—a subject which, in my humble estimation, ought to commend itself to every advanced schoolboy, as well as to every grown man in the community. I shall commence with the locality where we are met,* or rather on the hill behind, which, I daresay, you will agree with me is a good centre to start from.

Oakshaw Hill, as most of you know, is composed principally of Boulder-clay, which contains about the same percentage of boulders as is found in this deposit in other parts of our district. The late Mr. Smith of Jordanhill tabulated them as follows:—

Sandstones, Shales, &c.,	-	-	-	60 per cent.
Traps,	-	-	-	30 „
Clay, Slate, and Greywacke,	-	-	-	10 „
Granite,	-	-	-	1 „

In Paisley and neighbourhood, however, as far as my observation has gone, they are made up in something like the following proportions:—

Sandstones and Shales, including Coals,	-	50 per cent.
Traps,	-	33 „
Limestones,	-	10 „
Clay, Slate, and Greywacke,	-	7 „
Granite,	-	10·1000 „

I know of only three points where granite boulders have been found—1st, in the Boulder-clay at Mill Street Quarry; 2nd, at a spot where the Canal Railway crosses the road between Paisley and Johnstone; and 3rd, at the excavations for the new dock on the River Cart, on the top of the rock below the brick- or shell-bearing clay. At the latter place there were marine shells adhering to the boulders, three in number, although, in my opinion, they were deposited in the spot where they were found by the action of the drift, or dropped by an iceberg during the later formation. They appear to have come from Ben Awe, the rock of which they most resemble in structure; and the only agency that we know which could have effected this transportation is the agency of ice.

* The substance of this paper was originally read to the Geological Section of the Paisley Philosophical Society.

But to return to Oakshaw Hill; the upper surface is made up of mould or soil about one foot in thickness. Beneath this thin covering, Boulder-clay of a dark bluish or reddish colour is found over the entire surface. Many of the boulders are of a compact nature, being composed of limestone, basalt, and the harder varieties of trap, and exhibiting the beautifully-seen scratches or striations which they must have received during the "Glacial Epoch." Oakshaw Hill appears to be a fair type of the similarly rounded hills in the district. Woodside Hill, Saucel Hill, Hunter Hill, Dykebar Hill, Stanley Hill, Barshaw Hill, &c., are all composed of pretty much the same materials, and no doubt owe their origin to the same order of causes. The Boulder-clay of these hills belongs to two distinct members, and, in my humble opinion, owes its origin to two separate conditions in the region which now forms this tract of country.

The junction between the upper and lower series has been exposed in several cuttings which have been made within the last few years, such as the excavations for the Coats' Memorial Church in High Street. The upper clay is easily distinguished by the tenacity of its matrix, as also by the large percentage of boulders which it holds, of all sizes from small pebbles to blocks of many tons weight. The lower clay attains a much greater depth, although less uniform in its deposition. It is largely mixed with sand and gravel, and contains a much lower percentage of boulders, although those found are as large in proportion as the largest individuals in the upper clay. In some places one of the clays is wanting, the higher resting on the rock, or the higher being absent and the lower underlying the surface soil.

On the south-eastern slope of Oakshaw Hill the Boulder-clay is covered by a layer of sand mixed with a large percentage of mud; it is water-bearing, and is known as running sand. It thins out on the hill, but increases in thickness as it recedes outwards. This running sand passes up into a compact clay known as the *brick-clay*, or shell-bearing clay. It is first seen at the Messrs. Parlane's property, 97 High Street, and is continued eastwards to the river, forming the subsoil of the east portion of High Street, the Cross, and Moss Street, extending southwards to the Infirmary and beyond. It certainly runs out on the face of Saucel Hill at the railway. Proceeding westwards, the shell-bearing clay runs out, as I have said, at the Messrs. Parlane's property,

and re-appears at the Museum; indeed, one of the front pillars has its foundation on a mussel bed. It again disappears at the Coats' Memorial Church, and the Boulder-clay comes to the surface.

In George Street, a little to the south, at a lower level, the rock rises to the surface west of Barr Street, continuing westwards, at a depth of 2 to 10 feet from the surface, until we pass Maxwellton Street, where it dips to the west and disappears. When near the surface in George Street, the underlying Carboniferous rocks disclose, amongst other minerals, a coal seam from 4 to 9 inches in thickness. Maxwellton Street, Queen Street, Cross Street, and Castle Street are almost built on the rock, which comes so near the surface that the foundations of several of the houses must actually be placed on it. As far as my recollection serves me, the rock which lies below Queen Street, &c., is an impure limestone.

Towards the north end of Castle Street, the rock is either covered by, or impinges against, a bed of brown sand, which increases in thickness towards Broomlands and Sandholes, where it becomes the subsoil. I have not ascertained its thickness, but it must be a good many feet.

The strata continue near the surface south of Castle Street until, topped by a massive sandstone, they disappear under Castlehead at the railway. They are again exposed along the Canal Railway eastwards to Camphill, beyond which they dip under the Boulder-clay and shell-bearing clay. Rising again to the surface at Causeyside, they have been cut through by Espedair Burn, forming a valley or ravine, but with this interruption they continue at the depth of a few feet from the surface past Blackhall Buildings to Blackhall House, where they dip eastwards, again rising to the surface in the form of intrusive dolerite and a burnt coal bed at Jenny's Well. During their course there are exposed several seams of shale, coal, limestone, and other strata, which, from the waterfall at the Hammils to the section exposed at Hawkhead Bridge, have a continuous dip to the east or south-east.

When we turn our attention to the north side of Oakshaw Hill, towards the low-lying district of St. James' Park, or the Racecourse, we would expect, from the flat appearance of the surface, that the subsoil would be somewhat uniform. But that is not the case: for although the brick-clay rises on the slopes of the hill at

Underwood and attains great thickness in Caledonia and Love Streets, yet at the eastern extremity of Mossvale Street the Boulder-clay rises to the surface, while at Greenhill Road, also at Ferguslie School and north of Craigielea, the sandstone rises to the surface. At the latter place it was long quarried for building purposes. On the north side of the Hill a new member of the surface series appears as the subsoil, on the top of the brick-clay, namely, Peat Moss. As far as my observation has gone, this material is not met with in the southern district of the town. It, however, was got in the foundation of St. James' Church, and in several other places in the neighbourhood. Peat, or a substance akin to it, was also met with in the foundation of the New County Buildings at the corner of St. James and Love Streets. It occurs at a depth of 2 feet, resting on the shell-bearing clays. The Boulder-clay retains its normal relative position northwards towards the Clyde, rising to the surface at Laighpark, and dipping as far as the rock will allow it at Nethercommon, where it is covered by the entire series of muddy sand, gravel, shell-bearing clay, upper gravel, and surface soil. The sandstone strata rise towards the east at this point until they reach the surface at Netherhill, where they were recently quarried for building purposes.

The excavations for the new harbour on the River Cart near this spot have exposed a new member of the surface deposits which I have not observed at any other place, neither do I know of it being referred to by any writers on the subject. It consists of a dark brown laminated clay, about 2 feet in thickness, which is deposited on the surface of the Boulder-clay, and is as different from it as a log of wood in a condition of pulp is from a bed of coarse gravel. The laminations are so fine and the contact with the Boulder-clay (which at this place is dark in colour) so sharp, that you can touch the junction with the point of a needle.

This laminated clay follows the sinuosities of the uneven surface of the Boulder-clay, on which it rests, and although in one place the Boulder-clay has its level raised 20 feet higher than at another, this brown laminated clay follows its course, and retains its uniform thickness. It contains very few stones, if any, and, so far as my observation has gone, is as destitute of organic remains as the Boulder-clay it covers. But as I have neither washed it nor examined it with the microscope, I advance no opinion.

The sinuosities formed by the Boulder-clay, and followed by the

brown laminated clay, are filled up with the muddy or running sand, by which it is covered, and the junction between these two is very marked. I have not seen any organic remains in this stratum. It has a thickness of from 4 to 9 feet, with an abundance of concretionary or "fairy" stones. It becomes much more impregnated with mud or clay as it rises to the surface; and although it has a rather uneven bottom, it presents a comparatively level surface for the brick-clay and shell-bearing clay to rest on. This bed of shell-bearing clay, which attains a thickness of from 7 to 12 feet, is covered by a bed of gravel and sand about 4 feet thick, topped by 14 inches of surface soil, much filled with roots. It appears to be made up of sand, clay, and vegetable loam. The Boulder-clay appears to rise and fall, following northward in a general way the surface presented by the strata until a point about a mile above Inchinnan Bridge, where it dips beneath a great deposit of sand, mud, and gravel. It is not touched at a point 500 yards above the bridge at a depth of 60 feet. This immense deposit of mud, sand, and gravel is continued northwards to a point 50 yards from the junction of the Cart with Clyde, where the Boulder-clay again comes up to within 12 feet of the surface, below a bed of sand and gravel. It again dips towards the river; for at the junction of Cart and Clyde, 50 yards further north, nothing but sand is found at a depth of 45 feet.

[At the excavations of the new harbour on the Cart the horns of *Bos primigenius* were found at a depth of 14 feet from the surface; and a few years ago the *scapular bone* of the Irish Elk, *Megaceros Hibernicus*, was found at about the same depth in a clay-field on the west side of the river; and one of the horns of this animal was found at the excavations for the last gasometer which was erected at the Paisley Gasworks. The last two specimens are in the public museum. These remains point to the existence of those animals on the higher portions of our district, when the lower parts (including all the low-lying districts around Paisley) were many feet below the sea, which covered and deposited the materials which make up Greenlaw.]

There can be little doubt that the Boulder-clay underlies this depression, for it is found resting on the strata right under the west end of Inchinnan Bridge, at a depth of 93 feet. The strata dip towards Renfrew for a few hundred yards north-east, close to

the spot where the Earl of Argyll was taken prisoner in the year 1685. The depth of the alluvial soil is 95 feet.*

You will thus note that, from a point about a mile-and-a-half from the junction of Cart and Clyde, the Boulder-clay has a dip of not less than 80 feet from south to north, when it again appears at a single point 12 feet from the surface, and afterwards disappears beneath the sands of the Clyde. This points to a different condition from that in the neighbourhood of Paisley, and leads to the conclusion that long after the last elevation of the land, which raised all the low-lying parts of the town above high-water mark, that portion of the River Cart to which I have alluded formed either part of a deep lake or an arm of the Firth of Clyde which extended well up to Paisley, and which certainly did extend eastwards above the spot where Glasgow Bridge now stands, and before it got filled up by the detritus from the higher parts of the valley.

But what of the brick-clay with its arctic shells, which forms such a large part of the subsoil of nearly all the low-lying streets in Paisley? It would appear to have been deposited long before the last elevation of the land, when the lower parts of the town were not less than 60 to 80 feet below a sea in which were deposited stones and mud by means of floating land ice or icebergs, the chief part of the materials being derived from the washing down of the Boulder-clay from the higher lands, some districts of which have been almost denuded of all the Boulder-clay that they ever possessed.

But it would appear that many ages before the period of which we speak, from the evidence to be found on our highest mountains, the entire area of Scotland was probably submerged to a depth of

* I may relate an incident connected with this spot which occurred in 1832. In the summer of that year a number of unemployed weavers were engaged removing sand from the bed of the river at the lower portion of Colin's Isle. At about 3 feet from the surface one of the weavers dug up a silver shoe-buckle about the size of the palm of one's hand. It had a crest on it. The find was taken to Paisley and offered for sale to a silversmith, who refused it. It was afterwards offered to another, who weighed it, and gave the weavers 7s. 6d. for it. He broke it with a hammer before their eyes, put the pieces into a pot, and the weavers adjourned to a public-house and drank the money. Had this ornament any connection with the Earl of Argyll, who, being pursued during the Monmouth rising, crossed the river about this spot on foot, was taken prisoner at the spot indicated, and was afterwards executed at Edinburgh?

not less than 2000 feet, during which period the upper division of the Boulder-clay was deposited.

Before this great depression took place, or during its earlier period, and during much more intense conditions of cold than afterwards prevailed, the great ice-sheet covered the land to a depth as great or greater than that of the waters by which it was succeeded. The ice may have been so thick as to have displaced the water outwards in all directions from what is now our borders, denuding every material over which it pushed. It is to this ice-movement that we ascribe the striated surface of the older rocks when their surface deposits were first removed; and, in my humble opinion, it was during this period that the nucleus at least was formed of those mounds of sand and till which form the interior of the green rounded hills which go so far to diversify our district and impart to our landscape its principal item of beauty.

Before proceeding to look at the eastern district of Paisley, I would point out the ridge of rocks at the Hammils. The platform which forms the south bank of the Laigh Linn consists of a fine-grained sandstone, the thickness of which I cannot give. This sandstone is topped at the Craigs, which form the north margin of the High Linn, by a seam of soft shale about 1 foot thick, which is covered by about 1 foot 6 inches of a harder material. It appears to contain a large quantity of iron, being what I would call a ferruginous shale, and the series is covered by a bed of coarse-grained sandstone, about 6 feet in thickness, which forms the bed of the upper portion of the river at this point. The continuous removal of the soft shale by the overflow of water has caused the ridge to retreat southwards through the undermining of the upper strata, and there can be no reasonable doubt that at one time the entire series extended northwards in line with the fine-grained sandstone, which then had an elevation of not less than 20 to 26 feet above the level of the lower part of the river. The dip, as I have already said, is towards the south, and the retreat of this escarpment is as sure an indication of the age of the river as days measure out the length of a year, or years the length of a century. Geologically considered, the age of the lower part of our river is of recent date. Compared with such rivers as the Elbe and the Rhine, it is an infant of days.

In crossing the river, we shall first look at the foundations of

the Town Hall. The southern half of its west front is on the Boulder-clay at a depth of 37 feet from the surface. When the excavations had been made 22 feet below the bed of the river the clay was as dry as the floor of a room. The northern half, which contains the clock tower, is founded on a crystalline dolerite at a depth of 28 feet from the surface. This rock forms an intrusive bed which lies parallel with the other strata, and is covered by a seam of shale of from 1 to 2 inches thick, with a coal-bed above it, which was so pure that it was used, so far as obtainable, for fuel to fire the engine of one of the cranes which was working at the excavations. The coal is covered by a bed of calcareous shale, which increases in thickness northwards as it disappears under the street at "Old Smithhills." The usual series of mud, sand, clay, and gravel bring the alluvial soil to the surface, near which were found a considerable quantity of hazel-nuts.

Crossing over to the Abbey Church, we find that the west gable has taken a swing from the perpendicular. This was accounted for by Mr. Salmon, the architect who had charge of the restorations, by the presence of a bed of peat which passes under the foundation. This peat, however, rests on a bed of sand and clay which appears to have been deposited in its present position by the rush of water which was forced over the Craigs on the opposite side of the river at periods when it was in flood. The great rush of water at this spot over an escarpment of not less than 20 feet must have diminished in later times as the rocky face retreated backwards, allowing the peat, which at that time covered the district to the north, to creep over the sand; and the presence of the latter, in my opinion, will better account for the unstable foundation on which the Abbey is built. Even in later times, when St. Mirren preached to the inhabitants of Strathgryffe, and built them a place of worship, he was doubtless attracted to the place by its surprising beauty; and in still more recent times, Walter, the first Steward, when selecting the spot to found the present church, must have been attracted as much by the beauty of the place as by the legendary traditions of St. Mirren. The water which at present constitutes the impure stream is perhaps not one-fifth of what made up its volume in its palmy days, before so much of it was diverted to supply the south side of Glasgow, and retained in great ponds, was dammed up against times of scarcity, to be afterwards sent down the Clyde in a polluted condition.

When the water flowed in its pristine beauty over the rugged escarpment which extended right across the present site of the Infirmary, with the Saucel Hill, wooded to the top, for a background, and trees fringing the stream on both sides, the green sward sloping from the church to the river's brink, and the pure water, alive with perch, flounder, trout, salmon, and the pearl-bearing mussel, which was exported to different countries—the scene on a summer Sabbath-day must have been as refreshing to the bodies of the parishioners and pilgrims from distant parts of the country as the truths taught within the walls of the church were grateful to the minds of the worshippers.

Passing further east, we are met by the intrusive dolerite, which appears near the surface in Abbey Street. This rock cannot extend further west on its present level than Bridge Street, as is proved by the underground passage extending between that street and the river. This passage appears to have been constructed entirely in alluvial soil, for the dolerite appears near the surface at the east end of Abbey Street, underlying Thread Street, Bank Street, and Gauze Street, and rising to the surface at Mill Street.*

It appears somewhat peculiar that this rock should form such an abrupt side to the west boundary of Mill Street, and at first I came to the conclusion that it had been faulted; but Mr. Clark informs me that it was quarried about 90 or 100 years ago for building purposes, a fact that accounts for its absence. Several of the houses on the west side of Mill Street have their front walls built on the dolerite, while the back walls are resting on forced earth; and one or two which have been recently built in this position are showing signs of subsidence, which is not to be wondered at. This bed of dolerite extends eastwards until we come to the magnificent opening at the workings in Mill Street

* There was a legend current 50 years ago—long before the passage was discovered—that in the days of Mary Queen of Scots there existed an underground passage which extended from the Abbey to Crookston Castle. But the presence of this bed of intrusive dolerite interposes an insurmountable barrier to the existence or extension of the underground passage much farther eastward than Bridge Street. The late Mr. Semple proved the reputed residence of Mary Stuart at Crookston Castle to be a myth, for he tabulated every day she spent in Scotland, from the day on which she landed at Leith until the day she fled to England, and he could not find one single day on which it was possible for the Queen to have been at Crookston Castle!

Quarry. It does appear strange that, while strangers coming from distant parts of our own country and from other countries exhibit the greatest interest in the examination of those marvellous surface striations on the rock and the boulders which acted as tools in the production of them, comparatively few of even our intelligent townsmen have ever seen them, although their presence suggests as much to the reflective mind in this country as the Alps suggest to European travellers or the Andes to South American ones.

The section at the quarry consists of—

Surface Soil,	-	-	-	-	1 foot 5 inches.
Upper Boulder-clay,	-	-	-	-	3 to 4 feet.
Lower Boulder-clay,	-	-	-	-	6 feet 8 inches.
Intrusive bed of Dolerite,	-	-	-	25	„
Burned Coal, rendered columnar,	-	-	-	-	4 inches.
Argillaceous Shale,	-	-	-	-	upwards of 10 feet.

At the foundation of the stalk of the Seedhills Finishing Works the Boulder-clay was found rising to the surface at an angle of about 20 degrees. The sand, shell-bearing clay, and gravel, all lie in their proper order at the same angle. It looks as if the series had formed part of the slope of a hill of which the top had been cut off, the ground being comparatively level for a considerable distance round the spot.

The construction of the common sewer which was recently formed in front of Greenlaw Church, at a depth of 16 feet, started from Glasgow Road in the Boulder-clay which forms the subsoil for the entire distance until the slopes of Greenlaw are reached, when its surface is covered by the entire series of upper deposits. Indeed, this hill appears to consist entirely of, and owes its elevation above the surrounding subsoil of Boulder-clay to, these deposits, which rest in a perfectly horizontal and isolated position.

Proceeding a little further to the east, we come to that interesting section which has been so perfectly exposed by the opening up of Arkleston Tunnel. Before making any statement about this section, I would draw attention to the north bank of the railway, from the bridge over the line west to the signal-box. The weathered limestone stratum in this bank exhibits a richer variety and more abundant quantity of delicate organisms than I have yet seen in any section of these deposits. This section was closed about ten years ago, and has since got a large covering of

the débris placed over it. But from the exceptional interest of the deposit I think it well worthy of being noted in a paper such as this.

When passing through the railway cutting at Arkleston, we can all see that the section has been faulted upwards at its western extremity to an elevation of not less than 70 feet. The section is a perfect counterpart of the Mill Street Quarry, with this difference—that it has a different elevation and dip. I might also add that the dolerite is not nearly so pure as it is at Mill Street. At the lower part of its western exposure, it has caught up large quantities of the “blaes” in its mass. Large sections of the altered dolerite (or “white horse” of the miner) pervades it in places from top to bottom, while it has caught the upper portion of the coal-bed in pockets at its upper surface. I had considerable difficulty for several years in assigning the various exposures of this dolerite to the same horizon, there being nothing on the upper surface of the Mill Street rock except a few patches of the burned coal where that had been spared by the grinding of the ice-sheet. But within the last year a new stratum was discovered at the east end of the quarry which had just been uncovered, and on examination I found it to consist of an impure limestone, about the same thickness as that which covers the iron pyrites at Arkleston; also, a thin bed of the pyrites, which, although only a very thin seam, goes, I think, to prove that the strata are identical, and that between these two places, about a mile apart, the dolerite has been intruded through the same coal strata. I would also state that the greater purity of the dolerite in the exposure at Mill Street, as also its greater density and compact form, may be due more to differences in the rate of cooling than to variations in the mineral composition of the rock itself.

I have now taken you to the eastern boundary of the Burgh of Paisley. Before closing, however, allow me to make a few observations on its western extremity.

In the neighbourhood of the new spinning mill erected at Ferguslie by Messrs. J. & P. Coats there have been several openings made and bores put down, so that the Surface Geology of this district is better known than it had been previously. The section to which I shall confine my remarks is on the slope of one of those rounded hills to which I have alluded, and immediately to the south of what is known as the Green Road. The rock is

usually struck at an elevation of from 27 to 30 feet above sea-level, and is generally covered by the Boulder-clay. But in a section a little south of the old Glasgow and Ardrossan Canal, now converted at this place into a reservoir for the mills, there are only 8 inches of broken rock on the top of the bed-rock, the Boulder-clay being quite absent. Above the broken rock there is a deposit of sand and gravel 3 feet 7 inches, and over this we have a bed of fine clay 6 feet 6 inches, which is topped by 1 foot of muddy clay, increasing into a bed of muddy sand 2 feet 6 inches thick. This is covered by a bed of pure sand, 7 feet 6 inches; sandy gravel, 1 foot; gravel, 1 foot 3 inches; sandy clay, 1 foot 6 inches; surface soil, 1 foot 2 inches; the entire section representing 26 feet 11 inches of surface deposits, and being something like what we should expect, with the exception of the missing Boulder-clay.

But 100 feet further south, at an elevation of 6 feet 6 inches above the former section, we have the following, commencing at the surface—

Sandy Surface Soil,	-	-	-	2 feet.
Sand,	-	-	-	5 ,, 2 inches.
Sandy Gravel,	-	-	-	1 foot 6 ,,
Boulder-clay,	-	-	-	24 feet 8 ,,

You will remark that the five lower members are absent, their place being taken by the Boulder-clay. I have not taken the broken rock into account, as I consider it the remains of the Boulder-clay. Now, you have here eight distinct deposits sharply marked, and occurring at heights now ranging from 30 to 59½ feet above high water. This last section does not show the highest point indicated by these deposits, as behind the chimney-stalk of the spinning mill there is a bed of sand mixed with clay which at an elevation of 73½ feet above sea-level tapers to a point on the face of the Boulder-clay, which rises from below the newer beds and forms the subsoil of the top of the hill several feet higher. This 73½-feet level is, therefore, the highest point at which I have been able to trace the sea in recent geological times in our neighbourhood.

[The author died on 19th February, 1889, in the 57th year of his age, a few weeks after reading this paper at the January Meeting of the Society. See notice in the *Proceedings*, March, 1889.]