direction. This we can read in the trend of *roches montonnées* and striae, in the dispersal of the stones in the till, and the distribution of loose erratics and perched blocks. Nay, we have even clear evidence to show that sometimes the under strata of the ice flowed in one direction, while the ice sweeping along at the surface followed a different route. Hence we can have no difficulty in admitting that such heaping up and bulging of the ice as is required to account for the transport of boulders from lower to higher levels must frequently have taken place in Scotland during the Glacial Epoch.

The generally non-glaciated aspect of the boulders in question is also perfectly accounted for on the theory I have ventured to advance. Once embedded in the ice, stones and boulders might travel for hundreds of miles without suffering abrasion. The well-known incident of the knapsack* which was lost in a crevasse of the Glacier du Talefre on 29th July, 1836, and disgorged by the coalescent Glacier du Lechaud on 24th July, 1846, after having travelled, embedded in the ice, over a distance of 4300 feet, shows how little change a hard lump of rock would sustain in travelling through a mass of glacier ice. Occasionally, however, such an included block might be rubbed against the rocks of a hill-side, and so receive a dressing on one or more faces.

I have thought it worth while to send this note to the Society, as it seems to me to give a feasible explanation of what has always hitherto appeared an insoluble difficulty. As I have remarked above, the acceptance of this explanation does not commit one to any particular theory of glacier motion. So far as it is concerned, all the theories may be wrong, or, what is perhaps more likely, there may be something of truth in each.

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## XX.—*On the* Post-Tertiary Fossiliferous Beds of Scotland. By David Robertson, F.G.S., and the Rev. H. W. Crosskey, F.G.S.

(Continued from page 137).

### XV.—JORDANHILL BRICKWORKS.

These works are situated fully a mile to the north-west of Partick, Glasgow, and extend on both sides of the Crow Road, 63 feet above the level of the sea. The works on the west side of the

* *Edinburgh Philosophical Journal*, January, 1847.

road are named Woodend, and those on the east side Claythorn Brickworks. The clay is well seen in recent cuttings, extending on the west, also eastwardly, along the depressions on both sides of the Royal Lunatic Asylum, towards the Great Western Road. There can be little doubt that it is a continuation of the same clay which was lately exposed in sinking the foundations of Maryhill Gas Works, and in which fragments of mussel shells and Foraminifera *(Polystomella striato-punctata* and *Nonioninæ)* were found.

On the eastern side of Claythorn Works, the Whiteinch Railway cuts through an extension of the same clay, laying open a section about 800 yards in length. Under the bridge of the Crow Road, which crosses the railway, the clay is exposed to a depth of 14 feet. At the bottom it is dark-gray, with the common mussel embedded in considerable numbers. Immediately overlying the mussels, *Tellina calcarea* is met with, and some specimens present the two valves together.

About midway between the bridge and the east end of the section, the stiff stony boulder-clay comes on, and gradually rises to the height of a few feet; and from this point the laminated clay dips westerly and easterly along the cutting. For the greater length of the dip on the western side, the clay reaches the mould of the surface, but along the eastern side it is overlaid by gravelly sand to the depth of about 10 feet.

The same clays are seen in a cutting for the railway embankment along the hill-side towards Partick, and there can be little doubt that it is an extension of the same clay which is met with in the Stobcross Railway cutting; and we may also include the clays on the south side of the river as part of the same deposits, *e.g.*:—Windmill Croft, 10 feet above the level of the sea; Rowan Bridge, on the side of Paisley and Glasgow Canal, 46 feet; Muirhouse Brick Work, 57 feet; and Pollokshields, a little further to the west, at a still higher level.

There is one shell, the common mussel, *Mytilus edulis*, found in all these beds, and in all of them it is abundant. We may remark of this mollusc that it has been considered to have its zone or position near the surface, and to lie *above* the true types of the post-pliocene arctic shells in the clays of the Clyde district. This, no doubt, is frequently the case, but it is also found at greater depths and overlaid by arctic shells. At Paisley Brick Works the mussel is found 12 feet below the surface; at Jordanhill, 14 feet; at

Muirhouse, 19 feet; and at Stobcross, 24 feet from the surface, leaving no doubt that it lived in common with the arctic shells throughout the whole period of these deposits in the valley of the Clyde.

The clay at Jordanhill is worked to the depth of twenty-two feet. Under one or two feet of surface-mould are seven or eight feet of reddish-brown clay, full of vertical fractures, whose sides have a bluish colour, and generally so smooth that they have much the appearance of "slickensides." Below this, the clay becomes dark gray, or what is generally called "blue clay," and is more compact than the overlying clays, till it reaches a bed which the workmen call mud, and which when dry is of a whitish colour and thinly laminated, and so friable that it is unfit for brick-making, unless mixed with other clays of a tougher character.

In passing, it may be noticed that on the east side, near the upper end of the Claythorn workings, beneath a bed containing arctic shells, the clay is greatly crowded with concretionary nodules, mostly of small size. These are of various shapes, but the greater number are flattened spheres, entirely smooth, with the exception of occasional small pebbles enclosed during formation. These nodules seem to be restricted to a space of a few yards in circumference. There is another small patch on the the same floor, of a reddish brown colour, and rough on the surface. These concretions are common in many of our clays, but it is unusual to find them in such profusion, and within so narrow limits as here, when they are almost entirely absent from the adjacent clays.

Another feature of the clays in this neighbourhood is the presence of portions of oak trees. One of these pieces, thirteen feet long and twenty inches in diameter, was met with in the clay at Woodend Works, at a depth of twelve feet. It lay horizontally, and had lost much of its roundness from decay, but was quite hard within. Another stump of oak, with about three feet exposed, and widening towards the bottom, was seen in an upright position, and reaching to within four feet of the surface in the railway cutting on the east side of the Royal Lunatic Asylum.

The deposit being marine, the upright position must be accidental. Other pieces of oak have been found in the brick works on the south side of the Great Western Road; and Mr. James Bennie informs us of the occurrence of such remains of vegetation in the laminated clays at Muirhouse, and at Gladstone Brick Works, near Bishopton.

Still, oak trees, or portions of them, are of rather rare occurrence in the fossiliferous laminated clays of Scotland.

The clays of Jordanhill are not rich in shells or other animal remains, and such shells as do occur are generally not well preserved. This is more owing to erosion than to fracture or abrasion. On the west side of the road the shells are few, and chiefly mussels; but on the east side a number of different species, mostly arctic, are moderately common—particularly at the south-east corner of the works, where they are chiefly confined to a narrow band of two or three feet in thickness, which at some places is only about seven feet below the surface. Overlying this is a thin layer containing littoral shells, such as *Littorina littorea*, *Littorina obtusata*, *Littorina rudis*, and the young of *Mytilus edulis*.*

AVIS.

| | |
|---|---|
| Bones of a Bird. | Species undetermined. |

CONCHIFERA.

| | |
|---|---|
| *Anomia ephippium*, Linn. | Rare. |
| *Mytilus edulis*, Linn. | Moderately common. |
| *Nucula tenuis*, Mont. | Moderately common. |
| *Leda pygmæa*, Münst. | Moderately common. |
| *Leda pernula*, Müll. | Rather rare. |
| *Cyprina Islandica*, Linn. | Rather rare. |
| *Tellina calcarea*, Chemn. | Rather rare. |
| *Mya truncata*, Linn. | Rather rare and small. |
| *Saxicava arctica*, Linn. | Rare. |

GASTEROPODA.

| | |
|---|---|
| *Trochus helicinus*, Fabr. | Moderately rare. |
| ,, *Grœnlandicus*, Chemn. | Rare. |
| *Lacuna divaricata*, Fabr. | Rare. |
| *Littorina littorea*, Linn. | Moderately common. |
| ,, *rudis*, Maton. | Moderately common. |
| ,, ,, var. Saxatilis. | Moderately rare. |
| ,, *limata*, Loven. | Moderately common. |
| *Rissoa striata*, Adams. | Moderately rare. |
| ,, *parva* var. *interrupta*. | Rather rare. |
| ,, *inconspicua*, Ald. | Rather rare. |

* A similar littoral bed is met with on the lower grounds on the north side of Paisley, about forty feet lower than at Jordanhill, thus showing two tidal belts that could not be coexistent. A sample of the clay at this place, containing the littoral shells, s found, when dry, to consist of—

66 per cent fine mud.
11 ,, ,, sand.
6 ,, coarse sand.
16 ,, gravel.

| | |
|---|---|
| *Skenea planorbis*, Fabr. | Rather rare. |
| *Homalogyra atomus*, Philip. | Rather rare. |
| *Natica Grœnlandica*, Beck. | Rather rare. |
| *Purpura lapillus*, Linn. | Rare. |
| *Buccinum undatum*, Linn. | Moderately rare. |

POLYZOA.

CRUSTACEA.

| | |
|---|---|
| *Balanus crenatus*, Brug. | Very common on the north side of the road at the north-east corner of the works. |

ANNELIDA.

| | |
|---|---|
| *Spirorbis spirillum*, Linn. | Moderately common. |
| *Serpula vermicularis*, Ellis. | Moderately rare. |

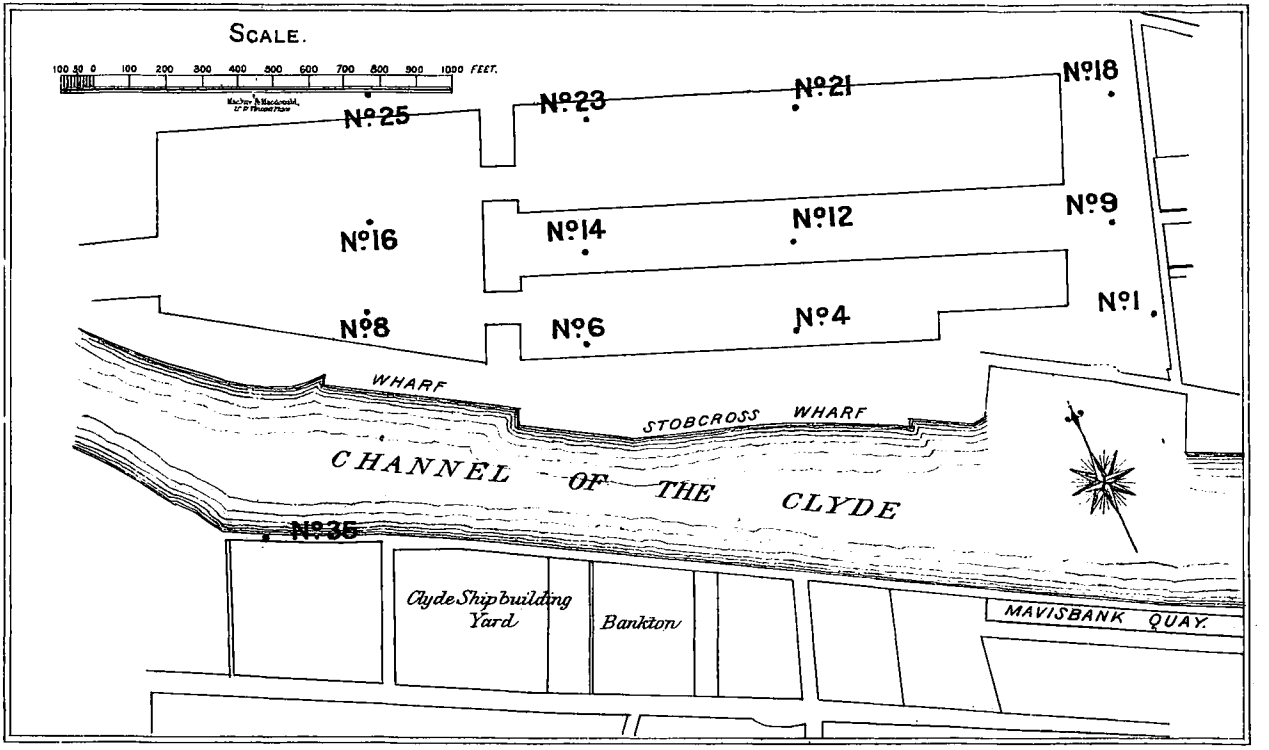
FORAMINIFERA.

| | |
|---|---|
| *Biloculina depressa*, D'Orb. | Rare. |
| ,, *elongata*, D'Orb. | Rare. |
| *Quinqueloculina seminulum*, Linn. | Common. |
| ,, ? | Moderately rare. |
| ,, *subrotunda*, Mont. | Moderately rare. |
| *Orbulina universa*, D'Orb. | Rare. |
| *Polystomella striato-punctata*, Linn. | Common. |
| *Nonionina asterizans*, F. & M. | Common. |

## XVI.—STOBCROSS.

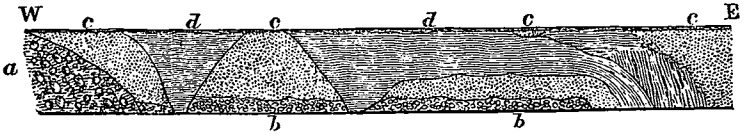
The cutting for the extension of the railway to the new docks at Stobcross exposed a section nearly half a mile in length, extending from Galbraith Street on the east to Sandyford Street on the west, and running nearly parallel to the Clyde, at a distance of about two hundred yards to the north of the river. This cutting was from thirty to forty feet in depth, and passed through boulder clay, sand, gravel, and laminated clay. It seemed also to coincide to some extent with a line of junction between two different deposits, as it exposed for a considerable distance a ridge of gravel on the south side, and beds of laminated sand and clay on the north. It thus presented to geologists an exceedingly favourable opportunity for studying the different beds brought to view in such close juxtaposition, and under circumstances so favourable for comparison.

At the west end of the cutting it passed through a knoll of boulder clay fully three hundred yards in length, and at a depth of




PROPOSED STOBCROSS DOCKS.— PLAN SHEWING POSITION OF BORES.

thirty-seven feet from its highest summit. By a bore put down by the Clyde Trustees, this hard stony unstratified clay was found to rest on 'blaize' at a depth of 104 feet from the surface of the ground. On the east, where the knoll dipped more rapidly than on the west, it was overlapped by a fine yellowish sand, which, after continuing a little further eastward, was replaced by gravel which was seen to extend to near the old house of Stobcross.




*Section of Stobcross Railway Cutting—North side,*
(Shewing the chief features, but not drawn to scale.)

*a* Boulder-clay.
*b* Gravel and sand.
*c* Sand.
*d* Laminated clay, with arctic shells.

This gravel does not appear to be a rewash from the boulder clay of the neighbourhood, as it contains a much greater proportion of schistoze white quartz, and a much smaller proportion of trap than we find in the boulder clay of the locality. When we consider the rolled, rounded, and smoothed state of the gravel, denuded of all striation, we are led to the conclusion that if it were a rewash of boulder clay, it must have come from some considerable distance. If the gravel were a rewash of underlying boulder clay, we would necessarily find the large boulders in the gravel that are so abundant in the boulder clay. But this is not the case. They are singularly absent from the gravel, and one larger than a man's head is rarely to be found in it. The agency that carried, and rolled, and smoothed the gravel, seems to have been incapable of transporting the larger blocks. If, then, the gravel is a rewash of boulder clay, we may presume that it is from a locality that will account for the greater preponderance of the schistoze rocks, and this cannot well be from the present tract of any part of the Clyde.

This gravel formed a connecting ridge with the boulder clay to the west, on which the sands and clays on the north side abutted and overlay. These beds of sand and clay were well exposed all along the north side of the cutting, the sand overlying the gravel, which again was overlaid by clay, and in some curves again by

sand. But this must not be taken as a rule for the order of deposition of the sands and gravels of the locality, as it appears from the Journal of Bores, that in many places the sand and gravel alternate, to the depth of between eighty and ninety feet below the datum line (or ten feet above high water).

These layers of sand, clay, and gravel did not maintain a horizontal line, or follow any regular dip, but presented at several points violent contortions and false bedding, and the overlying shell-bearing clays conformed to the undulations of the sand banks on which they were deposited.

The laminated clay for the most part was of a sandy character, and it was only near the eastern end that it became very pure and dark in the colour. At this point the clay was of great depth, and was overlapped from the east by muddy sand, which became less and less mixed with the clay as it receded from it.

Along the north face of the cutting, where the clay was seen overlying the lower sand, many of the layers of the sand were mixed with mud in a greater or less degree. The deposition of the mud seems to have gone on mixing with the sand till circumstances set in which allowed the former to accumulate.

On examining pieces of the clay made up of very thin layers, it was found that in most cases the divisions between the layers were formed by a very thin sprinkling of fine sand; and these layers were again divided into groups by thicker and coarser bands of sand. The groups of thin layers were sometimes of nearly uniform depth, but at other times were more irregular. The bands of sand also varied in their thickness. These very thin layers appear to have been formed by frequent gentle motions of the water, caused by winds or tides, carrying out over the mud only the finest particles of sand; and the thicker bands carried out by stronger winds and currents.

The relative time between the recurrence of these disturbing causes might be reckoned by the distance of the bands from one another, and the strength of such disturbances by the depth of the bands. We might further infer from the sharp lines between them that the causes were transient; but with such deposits as were seen at Stobcross, where the sand and clays had so much the appearance of having been washed and surged into each other, we should suppose that the conditions in such cases must have been more continuous, and probably in water comparatively shallow.

The animal remains obtained from this section are chiefly from the deep bank of clay near the east end; and although not numerous, they furnish sufficient proof of their purely marine and arctic character. This is all the more important, as we found brackish water Ostracoda in the excavation for the new docks immediately adjoining. But as these occurred in beds of muddy sand close by the river, there is no doubt they are of much more recent date than the organisms now referred to.

### CONCHIFERA.

| | |
|---|---|
| *Mytilus edulis*, Linn. | This is the prevailing shell, but mostly crushed, and the broken valves bound together by indurated clay. |
| *Cyprina Islandica*, Linn. | Rare, half grown. |
| *Tellina calcarea*, Chemnitz. | Rare, rather small. |
| *Mya truncata*, Linn. | Rare. |
| *Saxicava rugosa*, Linn. | Rare, large. |

### GASTEROPODA.

| | |
|---|---|
| *Lacuna devaricata*, Fabr. | Rare, small. |
| *Littorina rudis*, Maton. | Rare, small. |
| *Rissoa Sp.* ? | Rare, greatly eroded. |
| *Homalogyra atomus*, Phil. | Rare. |

### POLYZOA.

| | |
|---|---|
| *Crisia eburnea*, Linn. | Rather rare. |
| *Membranipora Flemingii*, Busk. | Rare. |

### CIRRIPEDIA.

| | |
|---|---|
| *Balanus crenatus*, Brug. | Common. |

### OSTRACODA.

Ten Species.

### FORAMINIFERA.

| | |
|---|---|
| *Quinqueloculina seminulum*, Linn. | Rare. |
| ,, *subrotunda*, Mont. | Rare. |
| *Trochammina inflata*, Mont. | Rare. |
| *Lituola Canariensis*, D'Orb. | Rare. |
| *Discorbina globularis*, D'Orb. | Rare. |
| *Polystomella striato-punctata*, F. & M. | Moderately common. |
| *Nonionina asterizans*, F. & M. | Moderately rare. |
| ,, *umbilicatula*, Mont. | Rare. |
| ,, *depressula*, W. & J. | Rare. |

For the Journal and Sketch Map of the Bores we are indebted to the kindness of Mr. James Deas, C.E., Clyde Trust.

The bores within the sketch plan show that the deposit is exceedingly variable both in composition and order of strata.

Although within an area of about 800 by 300 yards, there are not two bores in the twelve with the order of contents alike.

The rock is overlaid in six of the bores by gravel, and sand, and gravel; in two by coarse and fine sand; in two by clay; in other two by clay and stones (boulder clay). Three of the bores show gravel and sand alternating, of various depths, between the rock and surface soil, and one with clay and stones (boulder clay). Eight of the 12 bores have interstratified clay, or muddy clay, or muddy sand, of various thicknesses and at various depths.

Much of the clay in the railway section was seen bent into deep hollows or troughs. This was particularly the case at the eastern end of the cutting, where the clay bent steeply to the east. It is suggested by Mr. John Young, V.P. of this Society, that this might arise from the encroachment of the river on the sand banks, scooping out the sand from beneath the clays, and causing a falling in or bending down of the clays, as may still be seen in some parts of the river banks. This suggestion appears to be so far borne out by the crushed state of the mussel shells in the deposit, which we can easily conceive would be injured by any shifting of the material in which they were embedded. It may be remarked, however, that the same species is also found much crushed in the clays of Jordanhill Brickworks, where the shell deposit rests on stiff boulder clay, with little appearance of disturbance of any kind since the clays were first laid down.

Fig. 3 shows the irregularity of the rock surfaces, and that they are deepest on the line of bores 8, 6, 4, 1, nearest to the river, and stand higher 83 yards further back on the line 16, 14, 12, 9, and higher 133 yards still further back on the line 25, 23, 21, 18, except at 25, where the rock is only reached at a greater depth.

Bore No. 1.

| | Ft. | In. | Ft. | In. |
|---|---|---|---|---|
| Ashes, | 2 | 0 | | |
| Gravel, | 0 | 9 | | |
| Brown sand, | 14 | 0 | | |
| Gravel, | 1 | 0 | | |
| Light sand, | 5 | 0 | | |
| Brown sand, | 35 | 3 | | |
| Gravel, | 1 | 6 | | |
| Sand, | 24 | 6 | | |
| Gravel, | 1 | 0 | | |
| Sandstone, | 2 | 0 | | |
| | | | 87 | 0 |

Rock, 84·72 feet below surface.
,, 77·08 feet below high-water level.

Bore No. 4.

| | Ft. | In. | Ft. | In. |
|---|---|---|---|---|
| Sand and ashes, | 1 | 0 | | |
| Yellow clay, | 5 | 0 | | |
| Light and dark sand, | 4 | 0 | | |
| Gray Sand, | 3 | 0 | | |
| Fine light sand, | 12 | 0 | | |
| Yellow sand, | 18 | 0 | | |
| Brown sand, | 17 | 0 | | |
| Coarse sand, | 7 | 6 | | |
| Gravel, | 2 | 0 | | |
| Coarse sand, | 3 | 0 | | |
| Sandstone, | 2 | 6 | | |
| | | | 75 | 0 |

Rock, 72·65 feet below surface.
,, 65·00 feet below high-water.

Bore No. 6.

| | Ft. | In. | Ft. | In. |
|---|---|---|---|---|
| Ashes, | 1 | 0 | | |
| Soil, | 1 | 0 | | |
| Muddy sand, | 5 | 0 | | |
| Sand and gravel, | 6 | 0 | | |
| Sand, | 19 | 0 | | |
| Sand and gravel, | 15 | 0 | | |
| Sand, | 9 | 0 | | |
| Sand and gravel, | 2 | 0 | | |
| Sand, | 5 | 0 | | |
| Sand, clay, and stones, | 5 | 0 | | |
| Sand and gravel, | 2 | 0 | | |
| Sandy clay, | 9 | 0 | | |
| Sandstone, | 30 | 0 | | |
| | | | 109 | 0 |

Rock, 78·73 feet below surface.
,, 70·22 feet below high-water.

Bore No. 8.

| | Ft. | In. | Ft. | In. |
|---|---|---|---|---|
| Soil, | 1 | 6 | | |
| Muddy sand, | 6 | 6 | | |
| Sand and gravel, | 68 | 0 | | |
| Coarse sandstone, | 2 | 0 | | |
| | | | 78 | 0 |

Rock, 75·71 feet below surface.
,, 67·81 feet below high-water.

Bore No. 9.

| | Ft. | In. | Ft. | In. |
|---|---|---|---|---|
| Soil, | 1 | 6 | | |
| Sand and clay, | 7 | 6 | | |
| Gravel, | 6 | 0 | | |
| Sand, | 28 | 0 | | |
| Gravel and sand, | 4 | 0 | | |
| Brown sand, | 7 | 0 | | |
| Gravel, | 1 | 6 | | |
| Sand, | 1 | 6 | | |
| Gravel, | 7 | 0 | | |
| Sand, | 2 | 0 | | |
| Clay and stones, | 17 | 0 | | |
| Sandstone, | 2 | 0 | | |
| | | | 85 | 0 |

Rock, 82·57 feet below surface.
,, 70·75 feet below high-water.

Bore No. 12.

| | Ft. | In. | Ft. | In. |
|---|---|---|---|---|
| Soil, | 2 | 0 | | |
| Gravel, | 0 | 9 | | |
| Coarse sand, | 8 | 0 | | |
| Sand and gravel, | 9 | 6 | | |
| Coarse sandstone, | 3 | 6 | | |
| Coarse brown sand, | 11 | 0 | | |
| Fine brown sand, | 29 | 9 | | |
| Sandstone, | 2 | 0 | | |
| | | | 66 | 6 |

Rock, 64·14 feet below surface.
,, 53·95 feet below high-water.

Bore No. 14.

| | Ft. | In. | Ft. | In. |
|---|---|---|---|---|
| Soil and clay, | 1 | 6 | | |
| Clay, | 20 | 0 | | |
| Muddy clay, | 19 | 0 | | |
| Sand, | 20 | 0 | | |
| Gravel, | 7 | 0 | | |
| Sand, | 5 | 0 | | |
| Gravel, | 2 | 0 | | |
| Sandstone, | 2 | 0 | | |
| | | | 76 | 6 |

Rock, 74·12 feet below surface.
,, 65·95 feet below high-water.

Bore No. 16.

| | Ft. | In. | Ft. | In. |
|---|---|---|---|---|
| Soil, | 2 | 0 | | |
| Sand, | 2 | 0 | | |
| Sand and gravel, | 8 | 0 | | |
| Brown sand, | 24 | 0 | | |
| Light sand, | 18 | 0 | | |
| Sand and gravel, | 11 | 0 | | |
| Sand and gravel, | 4 | | | |
| Coarse sandstone, | 8 | 6 | | |
| Soft gray sandstone, | 4 | 0 | | |
| White sandstone, | 11 | 6 | | |
| Sandstone with faikes, | 6 | 6 | | |
| | | | 100 | 0 |

Rock, 68·90 feet below surface.
,, 60·02 feet below high-water.

Bore No. 18.

| | Ft. | In. | Ft. | In. |
|---|---|---|---|---|
| Soil, | 0 | 6 | | |
| Gavel, | 7 | 0 | | |
| Yellow sand, | 20 | 0 | | |
| Muddy sand, | 32 | 0 | | |
| Brown sand, | 12 | 6 | | |
| Coarse brown sand, | 8 | 0 | | |
| Sand and till, | 10 | 0 | | |
| Sandstone, | 17 | 0 | | |
| | | | 107 | 0 |

Rock, 89·46 feet below surface.
,, 60·02 feet below high-water.

Bore No. 21.

| | Ft. | In. | Ft. | In. |
|---|---|---|---|---|
| Soil, | 1 | 0 | | |
| Sand and soil, | 3 | 0 | | |
| Brown sand, | 18 | 0 | | |
| Gravel, | 7 | 0 | | |
| Brown sand, | 24 | 0 | | |
| Sand and gravel, | 2 | 6 | | |
| Gray sandstone, | 35 | 0 | | |
| | | | 90 | 6 |

Rock, 55·06 feet below surface.
,, 35·60 feet below high-water.

Bore No. 25.

| | Ft. | In. | Ft. | In. |
|---|---|---|---|---|
| Soil and clay, | 1 | 6 | | |
| Clay and stones, | 102 | 6 | | |
| Dark blaize, | 12 | 6 | | |
| | | | 116 | 6 |

Rock not reached.

Bore No. 23.

| | Ft. | In. | Ft. | In. |
|---|---|---|---|---|
| Soil, sand, and gravel, - | 2 | 6 | | |
| Coarse sand, - - - | 3 | 0 | | |
| Sand and gravel, - - | 7 | 6 | | |
| Sand, clay, and gravel, - | 14 | 0 | | |
| Coarse gravel, - - | 12 | 0 | | |
| Sand and gravel, - - | 5 | 0 | | |
| Coarse gravel, - - | 14 | 0 | | |
| Gray sandstone, - - | 2 | 0 | | |
| | | | 60 | 0 |

Rock, 57·47 feet below surface.
,, 35·72 feet below high-water.

Bore No. 35.

| | Ft. | In. | Ft. | In. |
|---|---|---|---|---|
| Sand and stones, - - | 4 | 0 | | |
| Sand and mud, - - | 8 | 0 | | |
| Yellow sand, - - - | 2 | 0 | | |
| Brown sand, - - - | 29 | 0 | | |
| Gray Sand, - - - | 36 | 6 | | |
| Soft brown sand, - - | 13 | 0 | | |
| Sandstone, - - - | 4 | 0 | | |
| | | | 96 | 0 |

Rock, 92·00 feet below surface.
,, 88·23 feet below high-water.

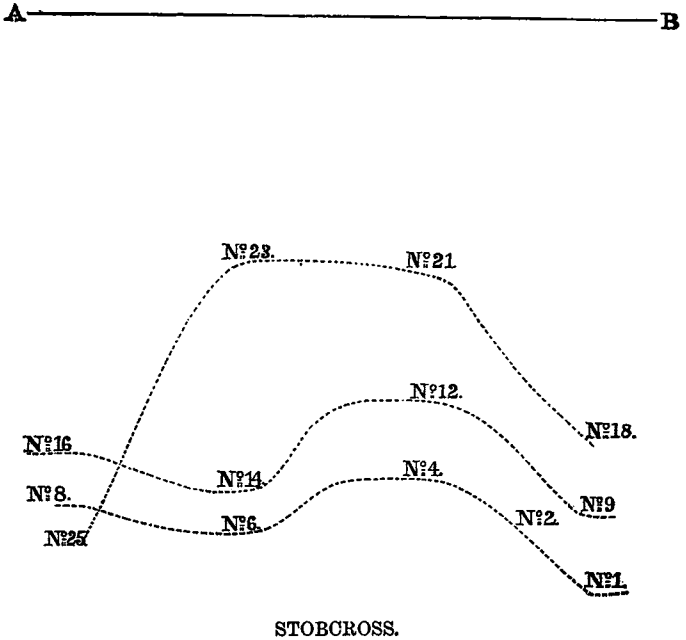



Figure 3.—Shewing the depths of the Bores from the level of ordinary high-water Spring-tides (A—B) to the surface of the rock.

## XVII.—FAIRFIELD, NEAR GOVAN.

(Randolph, Elder, & Co.'s New Dock.)

In the cutting of this dock two different deposits were exposed. I. The first one was close to the river, consisting (*a*) of about four feet of sandy mould overlying one foot of black mud full of leaves, fragments of twigs, &c.; underneath this (*b*) were three to four feet of gravelly sand, which rested on muddy sand, of which only a

foot or so was exposed. The layers of this part of the section were very irregular, and at some points much contorted.

In this muddy sand a few small valves of *Pecten opercularis* (Linn.), and *Trochus cinerarius* (Linn.), were obtained. Both of these shells are found living around our coasts, and subfossil in our old raised beaches; but not in any well authenticated cases are they associated with shells of arctic type. Along with these shells we found an Ostracod, *Loxoconcha elliptica* (Brady), which, remarkably enough, is a decidedly brackish-water form.

II. In the same section, about a dozen yards from the river, a different deposit of dark gray clay appeared. Unfortunately the progress of the dock was unexpectedly brought to a close ere the clay was much opened up, and the excavation soon filling with water, excluded all opportunity of seeing the mode of junction of the two deposits, and other particulars which we could have wished to obtain.

This dark gray clay dipped from the river for a distance of about eighty yards, when it began to incline upwards. At this point, at a depth of eighteen feet, marine shells were met with sparingly, *e.g.*, *Cyprina Islandica* (Linn.), *Mytilus edulis* (Linn.), and *Buccinum undatum* (Linn.) This last shell was partly covered by *Balanus crenatus* (Brug.) Although none of these shells proves decidedly the arctic character of the deposit, yet they are all common in the clay beds of the Clyde valley, which contains undoubted arctic species. Further, among the Ostracoda, *Cythere Montrosiense* (B. C. & R.) is moderately common, a species generally met with in the clays on the east of Scotland, which have been considered more intensely arctic than those on the west. We have no doubt that this deposit is of different age from that of the muddy sand close to the river, and that it belongs to the same series as the clays of Stobcross and Windmillcroft.

## XVIII.—PAISLEY CANAL.

The discovery of marine shells in excavating the Glasgow and Paisley Canal was recorded in a paper read to the Wernerian Society, by Captain Laskey, so long ago as 1814.* This paper supplied the following list of species, all of which, according to the

* Memoirs of the Wernerian Society, Vol. IV., page 568.

author, still inhabit the Frith of Clyde, but only below Dumbarton, where the water is constantly salt:—

*Turbo littoreus* = *Littorina littorea*, (Linn.)
,, *rudis* = ,, *rudis*, (Maton.)
,, *teretra* = *Turritella terebra* (Linn.)
*Arca minuta* = *Leda minuta* (Mül.)
,, *nuculus* = *Nucula nucleus* (Linn.)
*Patella pellucida* = *Helcion pellucidum* (Linn.)
,, *vulgaris* = *P. vulgata* (Linn.)
*Buccinum lapillus* = *Purpura lapillus* (Linn.)
*Mytilus edulis.*
*Pecten opercularis.*
*Venus Islandica* = *Cyprina Islandica* (Linn.)
*Venus striata* = *Venus gallina* (Linn.)?
*Venus literata* = *Tapes pallustra* (Montagua.)
*Balanus communis* = *B. balanoides.*
*Buccinum undatum.*
*Anomia ephippium.*
*Tellina plana* = ? *calcarea*, or *Scrobicularia peperato.*?
*Cardium echinatum.*
*Natica litteralis.*
,, *glaucina* = *Natica Alderi.*?
*Mya truncata.*
*Trochus crassus* = *T. lineatus* (Da Costa.)

We are indebted for correction of the synonymy to Mr. Jeffreys, who says "that it is impossible to do more than guess at what is meant by *Venus striata*, *Tellina plana*, *Venus literata*, *Balanus communis*, and *Natica glaucina*."

The whole list is a puzzle, and it needs unusual faith in the author to believe that there is not some mistake. The group of shells is different from any thing we have in the clay beds in the west of Scotland; *Turritella terebra*, *Patella vulgata*, *Natica Alderi*, and *Trochus lineatus* are shells that we never find associated in any of our glacial deposits.

They would agree with those of our raised beaches, and were we quite satisfied that his *Tellina plana* was the *Tellina calcarea* of Chemnitz, we could not help suspecting that it was an interloper.

Some shells were recently found in cutting a drain on the north bank of the Canal, near Rowan Bridge, about two miles west of Glasgow, but we regret that we had no opportunity of procuring specimens to enable us to speak with any certainty of the character of the group.

An unexpected piece of evidence, however, has lately been

afforded us on the subject. In the fine collection of minerals, &c., of the late Mr. Brown, of Langfine, presented to the Hunterian Museum, there are a few post-tertiary shells labelled "Glasgow and Paisley Canal, about one-half mile from Glasgow." This group is quite different from Laskey's list, and similar to the other glacial deposits of the Clyde district.

The species which we have identified are as follows:—

| | |
|---|---|
| **CONCHIFERA.** | |
| *Anomia ephippium*, Linn. | Rare; fry. |
| *Mytilus edulis*, Linn. | Crushed, with indurated clay holding the valves together. |
| —— *modiolus*, Linn. | |
| *Nucula.* | |
| *Leda pernula*, Müll. | Moderately, in good condition. |
| *Leda pygmæa*, Münster. | |
| *Cyprina Islandica*, Linn. | In good condition. |
| *Tellina calcarea*, Chemn. | |
| *Mya truncata*, Linn. | Fry and large. |
| *Saxicava rugosa*, Linn. | |
| **GASTEROPODA.** | |
| *Littorina littorea*, Linn. | Large. |
| —— *obtusata*, Linn. | |
| —— *rudis*, Maton. | Rare. |
| *Lacuna divaricata.* | |
| *Trophon truncatus*, Ström. | |
| *Buccinum undatum*, Linn. | |
| *Fusus antiquus.* | |
| *Natica affinis*, Gmelin. | Common and large. |
| —— *Grœnlandica.* | |
| **CIRRIPEDIA.** | |
| *Balanus crenatus.* | |
| **FORAMINIFERA.** | |
| *Biloculina ringens*, Lamk. | Rare. |
| *Quinqueloculina Gaultieriana*, D'Orb. | Rare. |
| —— —— *seminulum*, Linn. | Moderately common. |
| —— —— *subrotunda*, Mont. | Moderately common. |
| *Lagena squamosa* var. *hexagona.* | Rare. |
| *Orbulina universa*, ? D'Orb. | Rare. |
| *Discorbina globularis*, D'Orb. | Rare. |
| *Polystomella striato-punctata*, F. & M. | Moderately common. |
| *Nonionina depressula*, W. & J. | Moderately common. |

The clay is of a gray colour, and when dry consists of 89 per cent. fine mud; 11 per cent. debris of shells, and small gravel, and sand. The shell fragments are mostly the common mussel (*Mytilus edulis*) and *Balani*.

## XIX.—DIPPLE TILE-WORKS.

These works are situated about three miles to the east of the town of Girvan, in Ayrshire.* The deposit is remarkable for the character of its fauna, containing fresh-water, brackish, and marine forms in descending order. These are not mixed promiscuously together from top to bottom, but are mostly pure marine forms at the bottom, brackish in the middle, and fresh-water towards the top. We examined three samples of the clay from these different parts of the section.

(A.) The uppermost bed, between six and nine feet below the surface, is distinctly laminated, of a brownish colour, and mixed with black specks and streaks, giving the layers a dark, mottled appearance. When they are separated or laid open when dry, masses of fibrous substance are seen embedded in the clay in all directions, which, together with a few seed-like bodies, are doubtless of vegetable origin.

The animal remains at this depth are mostly of fresh-water character, such as a great abundance of the chitonous parts of the families *Daphniadæ* and *Lyncidæ*, together with various forms of *Cypridæ* and others, with more or less tendency to spread out into brackish water, such as *Limnocythere inopinata*, *Laxoconcha tamarindus*, and *Cythere tenera*. Along with these there are a few small fragments of shells, which appear to be of the common mussel; but at this depth of the section no purely marine forms are seen.

(B.) Under this, at a depth of nine to thirteen feet, the clay is of a uniform gray colour. At this part of the section there are a few fresh-water remains, as *Sphærium corneum* and *Cypris gibba;* but the brackish water forms greatly predominate, as *Cytheridea lacustris*, and *Cythere castanea*, the latter being very abundant; while the more decided marine character begins to appear in *Utriculus obtusus* and *Homalogyra atomus*.

(C.) At from thirteen to sixteen feet the fresh-water and brackish organisms have mostly disappeared. The shells here, although few belong to the larger species, are more numerous both in species and individuals than in any of the overlying beds. If we take them in their prevailing order, they are as on next page.

* We are indebted to Mr. Robert Gray, late Secretary to the Natural History Society of Glasgow, for introducing us to this deposit.

| | |
|---|---|
| *Homalogyra atomus.* | *Mya truncata*, fry. |
| *Rissoa striata.* | *Mytilus edulis*, fragments. |
| *Utriculus obtusus.* | *Balanus crenatus.* |
| *Leda pygmæa.* | Crab claw. |
| *Axinus flexuosus.* | A few fry of Gasteropods, very |
| *Skenea planorbis.* | small, undetermined. |

There are about twenty-two species of Ostracoda from the three samples, most numerous in the lowest, with some few fresh and brackish water forms.

There are only seven species of Foraminifera found in the section from top to bottom, and what may seem strange is, that all these seven species are represented in the upper part of the section, that is, between six and nine feet from the surface—two of the seven species in the middle part of the section between nine and thirteen feet, and four in the lower part of the section between thirteen and sixteen feet from the surface.

In no part of the section were any of the species abundant; in the upper part six of the species were represented by one specimen each.

CONCHIFERA.

| | |
|---|---|
| *Mytilus edulis*, Linn. | Rather rare. |
| *Leda pygmæa*, Münst. | Moderately common. |
| *Axinus flexuosus*, Mont. | Rare. |
| *Mya truncata*, Linn. | Rare, fry. |
| *Sphærium corneum*, Linn. | Common. |

GASTEROPODA.

| | |
|---|---|
| *Rissoa striata*, Adanis. | Moderately common. |
| *Skenea planorbis*, Fabr. | Rare. |
| *Homalogyra atomus*, Phil. | Common. |
| *Utriculus obtusus*, Mont. | Common. |

OSTRACODA.

Twenty-two Species.

CIRRIPEDIA.

| | |
|---|---|
| *Balanus crenatus*, Brug. | Rare. |

ECHINODERMATA.

| | |
|---|---|
| *Spines, Sp.* ? | A few small pieces. |

FORAMINIFERA.

| | |
|---|---|
| *Quinqueloculina seminulum*, Linn. | Rather rare. |
| ——— *subrotunda*, Mont. | Rare. |
| *Trochammina inflata*, Mont. | Rare. |
| *Lituola Canariensis*, D'Orb. | Rare. |
| *Polystomella striato-punctata*, F. & M. | Moderately common. |
| *Nonionina asterizans*, F. & M. | Rare. |
| ——— *depressula*, W. & J. | Moderately common. |