No. VII.—THE GEOLOGY OF THE LUGTON VALLEY. By JAMES
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THE valley through which the Lugton water flows is situated in the northern part of Ayrshire, with a small portion of its upper end in Renfrewshire, and comprises parts of the parishes of Neilston, Beith, Dunlop, Stewarton, and Kilwinning. It runs S.W., and is 13 miles in length, with an average width of nearly 2 miles. To the E. lie the parallel valleys of the Glazart and the Annick, and on its W. those of the Dusk and the Garnock.

With the exception of a few patches of peat moss, the district is a rich agricultural one, long famous for the excellence of its dairy produce. It contains no towns, and except in the hamlets of Ouplawmoor, Lugton, Burnhouse, Auchentiber, and Toranyard, and the mining villages of Doura, Bensley, and Fergushill, the population is mostly confined to its numerous well-appointed farm steadings. The mansions of Caldwell, Montgreenan, and Eglinton Castle with their surrounding woods and policies give a pleasing variety to the landscape, which is otherwise generally plain and unadorned.

The lowest rock in the valley consists of beds belonging to the upper member of the trappean series which forms the highlands of Renfrewshire, and stretches across its confines into Ayr and Lanark. These are made up of a variety of bedded basalts, melaphyres, and porphyrites, with occasional bands and beds of fine tuff and coarse volcanic agglomerate. Sometimes sandstones, shales, and thin impure limestones are seen. When continuous they are fringed with a border of ash-like strata, upon which rest the lower members of the Carboniferous Limestone series, and which vary much in different localities. At Beith and Caldwell they consist of ashy grits, sandstones and shales, with conglomerates, and seem to have been derived from the tear and wear of the underlying traps and tuffs. Sometimes they contain interbedded tuffs and agglomerates, showing that the volcanic forces were repeatedly active during the formation of the overlying mass.

While these trappean rocks are supposed to underlie the entire basin, they come to the surface only in its N. portion, and for a distance of 4 miles occupy the surface of the valley, except that part covered by Lochlibo, and a patch occupied by the Lower

Limestone series. Farther down, in the parish of Dunlop, they form the surface of the E. slope for a farther distance of $3\frac{1}{2}$ miles, occurring twice on the W. side near the farms of Brownhills and Sidehead, both in the parish of Beith. In this first-mentioned locality these porphyrites contain augite and closely resemble dolerite.

On Lochridgehills farm, about a mile S.E. of Lugton station, a fine example of columnar basalt is seen cutting through the bedded felstone rocks—the columns being 5-sided, 6 to 10 feet in height, and 18 to 24 inches in diameter. “Many of them,” says Mr. Dugald Bell, “are curiously curved, and the contraction joints between the columns, like those of Cathkin, are filled with vertical veins of calcite mixed with a green serpentinous earth. The basalt is a fine-grained rock, of a blackish-grey colour, and a friend informs us that on pounding it into fine grains he found some of it attracted to the magnet, showing the presence of magnetic iron ore in its composition.”

Immediately over these trappean deposits lies the Carboniferous Limestone series, consisting of beds of limestone, shale, and sandstone, with seams of coal and clayband ironstone. A narrow tongue-shaped portion of this formation is situated in the bottom of the valley at its extreme N. end, some 16 acres of its extent being covered by Lochlibo. Near the E. side of this lakelet, beds of white sandstone have been quarried for building purposes, and old shafts are still to be seen where coal was wrought some forty years ago. Tradition says that the loch broke in and flooded one of these pits near its margin, several lives being lost. Half a mile W. of Caldwell house coal was wrought for several years in a pit near the march of the two counties, but being of inferior quality the work ceased about twelve years ago. A short distance below Caldwell station, and close to the railway, clayband ironstone is at present wrought, and at Lugton similar operations were carried on in a pit now filled up. On Waterland farm it is worked at no great depth in the method of early mining days by “inganeers.”

In connection with this seam of ironstone is found a thin layer containing fine specimens of “Cone-in-cone” or “Maggie band,” first figured and described by David Ure in his “History of Rutherglen and East Kilbride,” 1793. In volume viii. of our *Transactions* a paper on “Cone-in-cone,” by Mr. John Young, F.G.S.,

with illustrations of specimens from this very layer, gives the most satisfactory explanation of this peculiar structure yet put forward.

The limestone is found along the E. side of the valley for a mile below Lugton station, and, with the exception of the two faults caused by the trap already referred to, it covers the entire W. side for five miles. In two narrow strips at Bentfauld and Clonbeith it crosses the valley still farther down.

At Burock, about a mile N. from Dunlop, a "little outlying basin of the limestone entirely surrounded by the underlying igneous masses" is well seen in a railway cutting. Another detached patch occurs farther E. in the valley of the Annick at Gabrochill. The existence of such remnants shows that the limestone series once covered all this region, and that it was afterwards removed by denudation.

The limestone at Waterland is the main or lower limestone of Beith and Howrat. It is not so well developed in this basin as farther to the W., where it reaches a thickness of 100 feet—its highest development in Ayrshire, or indeed in Scotland. It is of considerable thickness, some 10 or 12 feet, and is intersected by joints or fissures perpendicular to the lines of bedding, which cause the rock to break up into large tabular masses. Its upper surface here presents a brownish appearance caused by a thin layer of volcanic ash, mixed with limy matter, said to overlie a large extent of the limestones in North Ayrshire. It contains numerous species of shells and corals, and remains of fishes, such as teeth, spines, &c., of *Psammodus*, *Helodus*, and *Petalodus*; and *Sigillaria* roots are frequently met with in its upper portion.

About three miles S.W. of Waterland, on Lugtonridge farm, the rock consists of a bed of whitish clay topped by a seam of coal 1 foot, $1\frac{1}{2}$ foot of clayey shales, a post of limestone 3 feet, 1 foot of shale, 5 feet of dark-coloured limestone, nearly 3 feet of drab-coloured shales, surmounted by $1\frac{1}{2}$ feet of vegetable soil.

Of the five limestones which the Survey gives as found in the Dalry basin, the lowest or Howrat limestone has the most extensive area. The Highfield limestone, the next in ascending order, can be seen, says Mr. Robert Craig, "in the Caldwell coal-field, and it crops out on the N.E. of Lochlibo, near Shilford, in the parish of Neilston, being found to the S. of the large fault which runs from Ardrossan up the Dusk and Lugton valleys into Renfrewshire.

Crossing into Kilwinning it stretches S.E. by Golderaig, Lyleston, and Clonbeith into the S. of Stewarton parish. It has been extensively wrought in all these places, and is still being mined at Moscow and Cessnock. Some doubts have been expressed as to the limestone of these last-mentioned places being the Highfield bed; but as it is on the same horizon and bears the same physical and fossiliferous characters as the Dalry deposits, it may be regarded as the same until it is proved to be different."

The two highest beds of limestone of the Dalry basin—the lower and upper Linn limestones—extend into the north of Kilwinning parish, and are seen on the Lugton water near the volcanic rocks found there, but much reduced in thickness.

The lower limestone is very rich in fossils, but while the Highfield beds contain few, the shales associated with them are very fossiliferous, and the Linn limestones contain many organic remains. The Survey gives a list of 96 fossils found in the Howrat limestone, and Mr. Craig, in the list attached to his paper "On the Upper Limestones of North Ayrshire,"* gives 96 as found in the Highfield, and 208 in the Linn limestones.

These consist of corals, crinoids, crustaceans, polyzoa, brachiopods, &c., up to fishes, and in the Memoir belonging to the 22nd sheet of the Survey, 77 genera or 182 species are named as being found in the coal basins of North Ayrshire. A good list of the fossils found in the Dalry basin is given by Mr. Robert Craig in vol. iii., part 2, of our *Transactions*.

Of the sandstones and shales included in the upper limestone series several fine sections are exposed on the banks of the Lugton near Montgreenan, where some of the higher members of the sandstone of a soft texture have been used for the manufacture of whetstones.

Above the Carboniferous limestone series, and separating it from the Coal Measures, there is found, in the S.W. of the Dalry basin, a large extent of later erupted volcanic rocks, well developed at Blair and Bankhead, where they form a ridge for some four miles with an average breadth of nearly half a mile. This great sheet of basaltic rock is also met with in the Lugton valley, beginning near Sevenacres Mill, and extending in a narrow strip past Montgreenan House, Old Mains, and Auchenhavrie. In the last-named locality it forms the foundation on which the old castle of

* *Transactions*, vol. viii., part 1.

Auchenharvie stands, besides supplying the materials of which its outer walls are mostly composed.

The rest of the area of this basin is overspread by the Upper Coal Measures, with a breadth of two miles on the W. side, widening out to double that distance, and four on its E. border, being a small portion of the coal-field of North Ayrshire which stretches E. from Saltcoats by Kilwinning, Dregghorn, Kilmarnock, and Hurlford to Galston and Newmilns.

A little below Sevenacres Mill the main coal is seen cropping out on the banks of the Lugton, beautifully columnar by intrusive dolerite. It has the largest area in the district, and is the lowest at present wrought. It is of good quality and $4\frac{1}{2}$ feet in thickness. A tradition runs that it has been worked for two hundred years. Mr. Rodger, the manager at Fergushill, informs me that there is an old pit on the side of the Lugton where the Kilwinning road crosses, and, when some of its old workings were gone through, the workmen found tools and wooden picks shod with iron lying as if left in a hurry, leading to the conclusion that the pit had been drowned out. This is said to have been one of the first pits in Scotland which had a pumping machine driven by water power, the pumps being made of wood hooped with iron. Traces of the dam with the "lade" can still be seen.

About $2\frac{1}{2}$ fathoms above this main seam occurs a coal of very limited extent, from 1 to 3 feet thick. Some $2\frac{1}{2}$ fathoms above this lies the Stone coal, which consists of 6 inches of coal, 10 inches of stone, and 22 inches of bottom coal. This is succeeded about 9 fathoms higher by the Ell coal 2 feet 8 inches thick, with a fire-clay pavement. Then 3 fathoms up is found a coal of 1 foot thick, supposed to be the equivalent of the Blackband ironstone of Plan, near Kilmaurs.

The Ladyha' coal, with a thickness of $1\frac{1}{2}$ feet, is met with 5 fathoms higher; and this is the seam chiefly wrought at Doura, supplying the fireclay manufactured there. A seam of oil shale 12 inches thick occurs 4 fathoms above this, and has 12 inches of coal underlying it. A ton of this shale, which contains the remains of fish bones, teeth, and scales, yields from 32 to 36 gallons of crude oil. It has been mined at Doura and is now worked at Annick Lodge.

Some 18 fathoms higher the Wee coal is found 2 feet thick, and $2\frac{1}{2}$ fathoms above this another coal seam, known as the Turf coal,

3 feet thick, is met with. Above the Turf coal $2\frac{1}{2}$ fathoms lies the Splint or Parrot coal, 3 feet 7 inches thick. The last or highest seam presently wrought at Fergushill is the Five Quarter coal, which is $4\frac{1}{2}$ feet thick and of very limited extent.

Thus there are found in this basin of the Lugton valley no less than 9 seams of coal, with an aggregate thickness of 25 feet 7 inches.

In various parts of this river basin intrusive rocks of post-Carboniferous age are met with. These are supposed to be connected with the doleritic plateaux of Antrim and the Western Isles, of which the Giant's Causeway and Fingal's Cave are well-known portions, and are probably of Miocene age. These intrusives occur in the form of irregular bosses or sheets, and as dykes or veins. A little below Lugton station one of these dykes about 20 feet in breadth crosses the bed of the stream in a W. direction, forming a waterfall of about 5 feet high. Two miles farther south another dyke 60 feet broad strikes N.W. from near the village of Burnhouse through the Barr coal-field to the farm of Craighouse, some half mile S.E. of Beith. Its entire length is 3 miles. Along its N. side it is clearly defined, being in some places high and steep.

Near its end it rises 100 feet above the ground to the N., and at this point stands the castle of Giffen—a tower once 40 feet square, and five storeys high. The greater portion of it fell in 1838, and now only a small fragment of one of its corners remains. It belonged, with the surrounding barony, to a younger branch of the Eglinton family. When visiting this crumbling castle many years ago I noticed that it is in a straight line with Auchenhavrie Castle, already referred to, and with Dundonald Castle in Kyle. This last, once a royal residence, and the scene of the death of Robert II., is built on a boss of the very same rock on which Giffen stands.

It is an interesting fact that from very early times such elevated masses of intrusive rock have been selected as sites for strongholds, and that, in Scotland at least, most of our great historic castles have been so placed. Those of Edinburgh, Stirling, Dumbarton, and Dunbar all occupy the summits of commanding heights of this rock, around which the din and strife of human passion have often raged.

I am reminded in this connection of a striking passage in Hugh

Miller's "Geology of the Bass," wherein he says, "I remember at one time deeming it not a little curious that the early geological history of a country should often seem typical of its subsequent civil history. If a country's geological history had been much disturbed; if the trap rock had broken out from below, and tilted up its strata in a thousand abrupt angles, steep precipices, and yawning chasms, I found the chances as ten to one that there succeeded, when man came upon the scene, a history, scarcely less disturbed, of fierce wars, protracted sieges, and desperate battles. The stormy morning during which merely the angry elements had contended I found succeeded, in almost every instance, by a stormy day mad-denied by the turmoil of human passion."

Some 3 miles further S., near Auchentiber, there occurs on both sides of the Lugton a ridge of volcanic rock nearly 2 miles in length, which differs from the two last-mentioned in running slightly N.E. For some distance it is parallel to the Lugton, and at its N. end it rises on its W. side some 30 feet above the stream. Hard and compact in some places, in others it is soft, weathering into a dark brown earth which forms an excellent soil. Several of these intrusive dykes are met with in the Fergushill coal-field—the largest stretching in a direction similar to the last.

The Drift series found in this district comprises the Boulder-clays, sands, and gravels forming the Kame series of the Survey. The Boulder-clay covers a large extent, and the lower division is of varying thickness, tough and compact, and, where it overlies the Coal Measures, is of a dark gray or bluish colour. It is full of stones small in size, more or less rounded and well striated, which are mostly of local origin. The underlying rocks are smoothed and striated, as is specially evident over the limestone surfaces, and the striæ show a direction nearly N. and S. I am not aware of any arctic shells or mammalian remains being found in this area, as was the case in the Carmel valley near Kilmaurs, and in Cowden glen a little beyond the N. water-shed of the Lugton. The upper portion of the Boulder-clay is coarser in quality, and not so dense in texture as the lower, and often contains large angular stones. As the district is an agricultural one most of the erratic blocks which once studded its surface have been removed. About half a mile beyond the E. water-shed of the basin, on the farm of Brannelside, in the parish of Dunlop, one of these blocks is still to be found. It is known as "The Thougrit Stane," and is a mass of

blue augitic porphyry of hard and compact texture. It is oval in form, rises to a ridge-like shape on the top, and measures 12 feet 6 inches long, 4 feet 6 inches above the ground, and 8 feet at its greatest breadth; it probably contains upwards of 800 cubic feet. Some have thought that it was once a Loganstone or rocking stone.

A short distance N.E., at the base of a steep cliff of trap, stood a small chapel, now entirely removed, which was dedicated to the Virgin Mary, and there is a popular tradition that for sins of a certain carnal nature the transgressors had to do penance at "The Thongrit Stane" by going round it on their bare knees so many times each day according to the nature of the offence.

The Boulder-clay lying immediately below the vegetable soil contains, in many places, the remains of the roots of trees, mostly oaks, showing that a thick forest once covered most of this region; and the small number of places in its area bearing Celtic names shows that its population must have been sparse when Gaelic was spoken in S.W. Scotland.

The only deposit of Sand and Gravel I know of in this locality is a little to the N. of Lochlibo; it is circular in form and of small extent.

At either end of this loch small patches of Alluvium have been formed by gradual silting up from materials washed down from the higher grounds, and from the decay of water plants. The Caldwell meadows have had a similar origin, and before the Lugton deepened its channel near Bentfauld a lakelet of more than a mile in length stretched N. from that place. Its site is now fine alluvial land, and the bed of the stream running through it is overgrown with *Equisetæ*—the last remains of the aquatic vegetation. The level lands near the confluence of the Lugton and Garnock Waters, now forming part of the pleasure grounds of Eglinton Castle, are composed of materials washed down by these streams, and to this circumstance their level beauty and high fertility are largely due.

The last formation to be noted in this district is the accumulation of vegetable matter known as Peat Moss, which is found in detached patches, generally in basin-shaped hollows of varying extent. There are six such areas—Bloak, Dykhead, Auchentiber, Cockcuhead, Sidehead, and White Mosses—the first named and largest containing 640 acres. A considerable area around the margins of these patches, where the moss is of little depth, has

been brought under cultivation. Some forty years ago large quantities of peat for fuel used to be dug from all these mosses, but at present, owing to the cheapness and easy carriage of coal, the "casting" of peats has nearly been discontinued.

Trunks and roots of oak, willow, birch, and hazel trees are found in the mosses. The oaks seem to have mostly grown on the outskirts of the basins, and, judging from the remains of roots and trunks, must sometimes have been of a great size. But the stems of trees found are very few in proportion to the roots, and it has been thought that the former may have been largely removed by human agency.

Hazel nuts are often found imbedded among the twigs and branches on which they grew.

The Minutes of the Society of Antiquaries, for 17th Nov., 1791, refer to an interesting discovery made in Cockenhead Moss—"Dr. Ferris presented to the Society a shield dug out of a large moss about 1779, 6 or 7 feet below the surface, when the people who found it were casting peats on a farm called Lugtonridge, near Giffen Castle, in the parish of Beith. There were four or five more dug out at the same time, and they were observed to have been regularly placed in a ring. The possessor of the estate, Bailie John Storie of Paisley, could only procure this one, as the labourers had destroyed the rest before he had received any information of the discovery of them. It is of brass, $26\frac{1}{4}$ inches in diameter, embossed in the middle, and hollow on the other side to admit the grasp of the hand." Similar bronze bucklers have, I understand, been found at Yetholm on the Border. Probably a shallow lake once occupied the centre of this area, with a broad strip round it clad with a thick growth of birch, hazel, and willow, and that bordered by a dense forest of goodly oaks. Possibly under this forest shade those bronze bucklers were laid down around the grave of one of the tribal chiefs. Club mosses and water mosses grew, and died, their decay forming soil for their successors, the deposit spreading in extent and increasing in thickness until the lake was overspread, the brushwood overhid, the shields overgrown, and the fallen oaks buried out of sight, the peat moss we now see covering all in its dark embrace.