

THE PHYSICAL HISTORY OF ARTHUR'S SEAT.

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ARTHUR'S SEAT is, for its size, one of the most interesting volcanic hills in Scotland. Its dimensions are certainly not very great, being about a mile and a half from east to west, a mile from north to south, 822 feet in height above sea level, and a little more than 700 feet above Holyrood. Hill Burton calls it a mountain in miniature, and observes the resemblance, on a smaller scale, of the Salisbury Craigs to the great precipice of Braeriach. The remarkable shape of the hill is caused by its unusually complicated geological structure, which we will now consider. We must bear in mind that it has suffered extensive erosion, and was once, probably as large as Vesuvius, if not larger.

The highest part of Arthur's Seat is composed of two volcanic vents, the Lion's Head, and the Lion's Haunch, each of which consists of a central plug of basalt, surrounded by large masses of agglomerate traversed by lava flows and intrusions, between which are intercalated sedimentary rocks, such as limestones and sandstones, mingled with volcanic dust. To the north of the vents we have, counting from west to east, first the dolerite sill of the Salisbury Craigs, intruded between two beds of sedimentary rocks (Upper Old Red Sandstone and Lower Carboniferous) which, in places, it has baked and corrugated, the sandstones having been changed into quartzite, and the shales into porcellanite; next comes the hollow of the Hunter's Bog, overlooked by the intrusive rocks called the Dasses; almost immediately behind them is the lava flow named the Long Row;

succeeded by the valley of the Dry Dam, paved with agglomerate ; beyond which again we have no fewer than nineteen lava flows, intercalated with ash beds, and limy or sandy sedimentary rocks, which together make up the Whinny Hill, the most easterly member of the mass. The basalt plug of Dunsapie Rock marks the southern limit of the Whinny Hill lava series. On the south of the vents again, we have the remarkable columnar basalt intrusion of Samson's Ribs, (which really belongs to the Lion's Haunch vent), and further east, at Windy Goul, the escarpments of the Girnall Craig and the Loch Craig, the southern extensions respectively of the Dasses and the Long Row. Finally, there are a large mass of agglomerate, a basalt intrusion on which Duddingston Church is built, and a series of lava flows, representing, more or less, the southern extension of the Whinny Hill lavas.

There are several large dislocations in or near the hill, which have greatly modified the outcrops. The most important is the Calton Fault, which is responsible for the present position of the Calton Hill, originally a part of the Whinny Hill ; the others being St. Margaret's, St. Anthony's, and St. Leonard's Faults. Parenthetically we may remark that these saintly personages would seem to have a grievance against geologists for usurping the functions of the *Advocatus Diaboli* in discovering their faults. When we mention the bed of a glacial lake, near which Holyrood is built, an interesting *roche moutonnée* on the side of the Queen's Drive just above Samson's Ribs, some transported boulders scattered about in various places on the hill, the margin of the 100 feet Raised Beach traversing the parade ground near the foot of the Whinny Hill, and many springs on or near the lines of fault, some of which feed Duddingston Loch, we have completed our hasty survey of the principal geological features of Arthur's Seat.

The foregoing is only the rough sketch of an amateur, but anyone who desires thoroughly to understand the geological structure of the hill is strongly advised to

procure a copy of "The Arthur's Seat Volcano" (with map), by Dr. B. N. Peach, F.R.S., F.R.S.E., (Edin. W. & A. K. Johnston, Ltd., 2/6). That masterly monograph forms a capital pocket companion for a visit to the locality.

We may now consider the most difficult part of our subject—how the volcano came into existence, and how it acquired the form and dimensions which it has assumed at the present day. In the early times of the Carboniferous Epoch, there would appear to have been a great uprising of the subterranean reservoir of molten matter lying below the stratified rocks, which burst through the Cement Stones, the lowest bed of the Carboniferous System, and formed the volcanic neck now known as the Lion's Head. Somewhat later the centre of disturbance shifted a little to the south, and gave rise to another neck which we call the Lion's Haunch. From these vents issued the lava flows and masses of agglomerate and volcanic ash which are described above; there were also various intrusions of molten rock among the strata, the largest of which is the sill known as the Salisbury Craigs. The volcano was evidently, like most volcanoes, quite near to the sea, and the mighty subsidence of the Carboniferous Era having begun, the waters frequently broke in upon the site, as is shown by the sedimentary beds intercalated in many places between the lavas and other igneous rocks. The whole scene, with its clouds of smoke and steam, its flames and volcanic dust and bombs, must have been exceedingly impressive; but, unfortunately, there were no beings of higher intelligence to witness it than the fishes of the Lower Carboniferous, who must have been considerably startled at times, and, evidently, usually gave it a wide berth, as few of their remains are found associated with the rocks of the hill. This vast disturbance went on for many ages, but eventually died down, and the great secular subsidence still continuing for millions of years, the site of the volcano, and the whole country for many miles around, were covered by the lagoons, estuaries, and water-jungles of Carboniferous

times, until the poor old extinct volcano was buried beneath a thickness of something like 8000 feet of sedimentary rocks, including the oil shales and the coal measures. Some time after the close of the Carboniferous Period, the process was reversed, and a great but slow upheaval took place, until the igneous rocks of Arthur's Seat began to reappear through the softer sedimentaries, which were worn away by sub-aerial denudation. The rise, however, was not equal over the whole region, for the rocks of what is now the valley of the Esk remained more or less at their former level, and formed the great syncline or trough of the Midlothian coal field. This was fortunate for us, as this field produces, on an average, about two million tons of coal per annum, and the reserves are sufficient to maintain a similar output for many generations. A further result was that the beds immediately to the west of the valley were folded at a very steep angle, becoming in some places vertical or even reversed, and the strain was so intense as to cause the powerful dislocation known as the Great Pentland Fault. The rocks of Arthur's Seat also, somewhat further west, contracted a dip of from 20 to 30 degrees to the east or north of east. The consequence was, that these rocks at their western extremity were exposed to intense denudation, their truncated edges forming escarpments, and towards the east they formed gentle dip-slopes, which finally plunged below the sedimentary beds, here known as the Abbeyhill Shales. On the advent of the Glacial Period the great ice-sheet, coming from the west, scooped out the débris from the front of the escarpments, and deposited it on and at the foot of the dip-slopes, thus completing the Crag and Tail formation characteristic of Arthur's Seat, and other isolated volcanic hills of the Lothians. Owing to the processes enumerated above, the aspect of the hill varies very much when seen from different points. The view from the north (Regent Road), is very striking, as the escarpments and dip-slopes are seen in profile. From the north-east or east (Portobello or Inveresk) it

is rather tame, as we see little but the dip-slopes. From the south (Craigmillar), it is bold and rugged, but not at all lion-like. From the south-west (Braid Hills) it is the finest of all, as we face most of the steep escarpments, and the outline is that of a veritable Lion Couchant, which surpasses in grandeur and dignity the productions, in that way, of Landseer or any other artist.

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