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ORIGINAL ARTICLES.

I.—ON THE OCCURRENCE OF A QUARTZITE BOULDER IN A COAL-SEAM IN SOUTH STAFFORDSHIRE.¹

By REV. T. G. BONNEY, M.A., F.G.S.,
Fellow and Tutor of St. John's College, Cambridge.

INTERRUPTIONS in the continuity of a Coal-seam, whether in the form of intercalated layers of sand or shoals of clay, are not rare; but I have been able to find little on record concerning the occurrence of pebbles of any considerable size, except where there was reason to suppose that the miners had struck upon an old river channel. The Boulder, which forms the subject of this paper, was found in the 13th Coal of the sinkings belonging to the Cannock and Rugeley Colliery Company; and I am indebted to the kindness of its manager, E. C. Peake, Esq., for the opportunity of exhibiting the specimen and for much of the following information. The seam occurs at a depth of about 540 feet from the surface of the ground; the Boulder was completely enveloped in the coal, but its precise distance from the top of the seam was not ascertained. This 13th coal is considered to be identical with the 12th coal in the Brereton Colliery. In the latter colliery this seam is about 135 feet above the lowest or 15th coal; and by boring to a depth of 68 feet, red rocks were reached, which very probably, like those detected in the sinkings at Halesowen, belong to the passage-beds between the Silurian and Old Red Sandstone.

The Boulder is in shape subspheroidal; having been probably once a rhombic parallelopiped, defined by joint planes whose angles have since been worn away. Its girth in two directions at right angles is about 19 inches, and its greatest thickness about 4 inches; it weighs 13 lbs. 13½ oz. The rock is a very compact and highly altered pale grey quartzite, with a sharp almost conchoidal fracture; lines on the exterior roughly parallel to its flatter ends probably indicate divisional planes due to original stratification. Lithologically it resembles very closely one of the varieties of quartzite which is very common in the Bunter pebble-beds of the neighbourhood.

Two questions at once present themselves with regard to this Boulder—(1) How did it come, (2) whence did it come, into the position in which it was found?

(1). The absence of other pebbles shows that a stream alone, even in flood-time, is not likely to have brought it. For a torrent

¹ Read before the Cambridge Philosophical Society, March 3, 1873.

strong enough to have transported such a Boulder could have hardly failed to throw down grit enough to spoil the neighbouring coal. At the same time it must have been brought by a swollen stream, for otherwise whatever acted as a float could hardly have penetrated the dense mass of vegetation constituting the coal-seam. The only agents that appear likely to have transported it are ice or a tree. The former does not appear a probable one at this period of the world's history; the Boulder, however, could readily have been brought entangled in the roots of a tree, which might have been torn up during some unusually high flood, have been swept by an eddy out of the course of the main current, and have been left in the jungle on the retreat of the water. In process of time the tree would be imbedded in a coal-seam, and any trace of it would easily be overlooked by the workmen. The finer sediment would be washed out on the journey.

(2). The locality whence this Boulder came is a harder question to determine. There are quartzites at the Wrekin and the Stiper stones, but not, I believe, exactly of this kind. The two localities known to me where a similar rock occurs within a moderate distance are Hartshill, near Nuneaton (to the S.E.), and the eastern side of Bromsgrove Lickey (to the S.). The former of these is supposed to be an altered Millstone-grit; the latter is of Upper Llandoverly age. Both resemble the rock of the Boulder and of the Bunter conglomerate; the former most closely. But not only is it in the highest degree probable that both these quartzites were buried beneath many fathoms of strata in the Triassic age,¹ but also, if we regard the distribution of the Bunter pebbles, it is almost impossible that they can have furnished the materials. Again, the South Staffordshire Coalfield is on the northern slopes of the great barrier which in the earlier Carboniferous periods separated the northern and southern sea-basins, and this, if ever quite overspread by Coal-measures, would not be till rather late in the period. Thus we are driven to seek a northern rather than a southern origin for the Boulder. The sedimentary materials, as Mr. Hull has shown in a very able paper,² during the Triassic as well as the Carboniferous period came from the N.W., passing through the open space between Cumberland and Wales, then probably the embouchure of a great river. The Bunter pebbles, however, seem rather to have come from the N.E., brought by the current of another stream (which may have drained a considerable area to the eastward of the Firth of Forth), or possibly rolled along the coast-line of the Pennine chain, as in later days the pebbles washed out of the Boulder-clay have travelled down the eastern shores of England. He suggests that they have been originally derived from the quartzites of the Northern Highlands, and have halted on the way in conglomerates of intermediate age. With this opinion, after examining several

¹ If the Hartshill rock be Millstone-grit, it would probably be unaltered at this rather early epoch of the Coal-measures.

² *Quart. Journ. Geol. Soc.* xviii. p. 127; and *Triassic and Permian Rocks of the Midland Counties* (Memoir of the Geol. Survey), p. 60.

conglomerates of Old Red Sandstone and Carboniferous age in Scotland, I fully concur. The Bunter conglomerates of the Midland Counties, with which I am very familiar, only differ from some of those in Scotland in the greater prevalence of quartzite pebbles; this, however, is merely a case of the ‘survival of the fittest,’ for a quartzite is one of the most durable of rocks.

We are, I think, justified in looking to a distant locality for this Boulder; because, had it come from near, pebbles of considerable size would be common in the Coal-measure sandstones, which is not the case in Central England; indeed, I am not aware of any instance either in the Carboniferous or Permian periods (for the breccia of the latter is no parallel) where quartzite Boulders of this size have been observed. I should therefore suppose that it had been brought during a flood from some deposits to the N.W., similar to those which still remain in more than one place about the Firth of Clyde. It might, indeed, have come, like the Bunter pebbles, from some Old Red Sandstone district to the east of the present Lammermuirs; but, as the Pennine chain did not then exist, and as the streams, judging from Mr. Hull’s curves of thickness,¹ ran in a south-easterly direction, it is difficult to understand how anything could have drifted across the line of their current to the position of this Boulder. Both explanations have their difficulties; indeed, with our present knowledge, we can do little more than state the problem, and leave its solution, like that of many other kindred investigations, to the future.

II.—ON “BLOCKY” ROCK SURFACES, AND THE THEORY OF THE SHRINKING NUCLEUS OF THE GLOBE.

By G. POULETT SCROPE, F.R.S., F.G.S., etc.

THE article by Mr. Clifton Ward upon “Rock Fissures” in the GEOLOGICAL MAGAZINE for June, has reminded me of a special characteristic of some igneous rocks, which has been perhaps as yet imperfectly appreciated. I mean by igneous rocks, such masses of subterranean mineral matter as have apparently thrust themselves upwards to the surface of the globe by a process of internal expansion or intumescence, caused by heat—not always attaining absolute fusion, but in some degree owing to the general permeation of the matter by super-heated water, or steam, or other gases.

The characteristic I refer to is the superficial fissuring of these rocks in the manner aptly called by Mr. C. Ward “blocky”; the surface of the rock or mountain, as in one of the examples described by him, viz., the summit of Scafell Pikes, “being thickly strewn over with large rough blocks of stone, so that one’s progression is often limited to jumping from rock to rock.” No words could more exactly describe the conformation of the surface of many erupted volcanic masses, such as the basaltic hills of the Siebengebirge; the extremities of the basaltic plateaux that reach the valleys of the Borne

¹ Quart. Journ. Geol. Soc. xviii. plate vii.