Siccar Point: Hutton's Classic Unconformity

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Route: (Map 18)

Historically the Siccar Point unconformity is world-famous because its discoverer, James Hutton, was the first geologist to grasp the true significance of such a structure. Although this was not the first unconformity that Hutton had observed—the others were in Arran in 1786 and Jedburgh in 1787—it is certainly the most spectacular. His view of the rocks of the Earth as being the products of an essentially cyclical, oft-repeated process was triumphantly demonstrated at Siccar Point in 1788.

Siccar Point [NT 813 710] lies on the coast 4 km east of Cockburnspath. Turn east off the A1, a little over 2 km south of Cockburnspath on to the A1107. This road crosses the post-glacial gorge of the Pease Burn almost at once and the quarry road to Siccar Point turns off 450 m on the left after the narrow bridge over the gorge. Keep to the right fork of the quarry road, cross the grid bridge and continue along an extremely fine glacial drainage channel into Old Cambus Quarry. Continue through the north-east gate in the quarry and strike obliquely left up the hillside towards the far corner of the field, 60 m below which lies Siccar Point and Hutton's uncon-formity. From the cliffs a fine panorama can be seen to the north-west of the Upper Old Red Sandstone grading up into the grey sandstones of the Lower Carboniferous (Cove Excursion). The lighthouse in the middle distance at Barns Ness lies on the Lower Limestone Group (Catcraig Excursion) and in the far distance the Bass Rock juts out from the sea with North Berwick Law lying inland slightly to the west. Both are plugs of phonolitic trachyte (North Berwick Excursion).

Siccar Point speaks eloquently for itself and needs little description. It is spectacular at any stage of the tide. An inclined uneven basement of vertical greywackes and shales of Llandovery, Silurian, age youngs to the WNW and is covered unconformably by gently dipping dull-red breccia and sandstone of Upper Devonian or Lower Dinantian age. The breccia is composed of greywacke fragments. The breccia and sandstones were formed under flood conditions. The strong imbricate structure of the clasts in the breccia shows that the direction of derivation of the material was from the NNE and not from the cliffs above.

Both Hutton and Playfair deserve to be quoted. Hutton described it (1795, I, 458) as follows:

"Having taken boat at Dunglass burn, we set out to explore the coast; and, we observed the horizontal sandstone turn up near the Pease burn, rising towards the schistus. We found the junction of that schistus with the red sandstone and marly strata on the shore and sea bank, at St. Helens, corresponding in general with what we had observed in the burns to the westward. But, at Siccar Point, we found a beautiful picture of this junction washed bare by the sea. The sandstone strata are partly washed away, and partly remaining upon the ends of the vertical schistus; and, in many places, points of the schistus strata are seen standing up through among the sandstone, the greatest part of which is worn away. Behind this again we have a natural section of those sandstone strata, containing fragments of the schistus.

After this nothing appears but the schistus rocks, until sandstone and marl again are found at Redheugh above the vertical strata. From that bay to Fast Castle we had nothing to observe but the schistus, which is continued without interruption to St. Abb's Head. Beyond this, indeed, there appears to be something above the schistus; and great blocks of a red whin-stone or basaltes come down from the height and lie upon the shore; but we could not perceive distinctly how the upper mass is connected with the vertical schistus which is continued below.

Our attention was now directed to what we could observe with respect to the schisti, of which we had most beautiful views and most perfect sections. Here are two objects to be held in view, in making those observations; the original

formation or stratification of the schisti, and the posterior operations by which the present state of things has been procured. We had remarkable examples for the illustration of both those subjects (Figure 19).

With regard to the first, we have every where among the rocks many surfaces of the erected strata laid bare, in being separated. Here we found the most distinct marks of strata of sand modified by moving water. It is no other than that which we every day observe upon the sands of our own shore, when the sea has ebbed and left them in a waved figure, which cannot be mistaken. Such figures as these are extremely common in our sandstone strata; but this is an object which I never had distinctly observed in the alpine schisti; although, considering that the original of those schisti was strata of sand, and formed in water, there was no reason to doubt of such a thing being found. But here the examples are so many and so distinct, that it could not fail to give us great satisfaction.

We were no less gratified in our view with respect to the other object, the mineral operations by which soft strata, regularly formed in horizontal planes at the bottom of the sea had been hardened and displaced. (Figure 4) represents one of those examples; it was drawn by Sir James Hall from a perfect section in the perpendicular cliff at Lumesden burn. Here is not only a fine example of the bendings of the strata, but also of a horizontal shift or hitch of those erected strata."

Hutton's clinical description is in marked contrast to that of the eloquent prose of Playfair (1805, 71–72).

"The ridge of the Lammermuir Hills in the south of Scotland, consists of primary micaceous schistus, and extends from St Abb's-head westward, till it joins the metalliferous mountains above the source of the Clyde. The sea-coast affords a transverse section of this alpine tract at its eastern extremity, and exhibits the change from the primary to the secondary strata, both on the south and on the north. Dr Hutton wished particularly to examine the latter of these, and on this occasion Sir James Hall and I had the pleasure to accompany him. We sailed in a boat from Dunglass, on a day when the fineness of the weather permitted us to keep close to the foot of the rocks which line the shore in that quarter, directing our course southwards, in search of the termination of the secondary strata. We made a high rocky point or headland, the Siccar, near which, from our observations on the shore, we knew that the object we were in search of was likely to be discovered. On landing at this point, we found that we actually trode on the primeval rock, which forms alternately the base and the summit of the present land. It is here a micaceous schistus, in beds nearly vertical, highly indurated, and stretching from south-east to north-west. The surface of this rock runs with a moderate ascent from the level of low-water, at which we landed, nearly to that of high-water, where the schistus has a thin covering of *red* horizontal sandstone laid over it; and this sandstone, at the distance of a few yards farther back, rises into a very high perpendicular cliff. Here, therefore, the immediate contact of the two rocks is not only visible, but is curiously dissected and laid open by the action of waves. The rugged tops of the schistus are seen penetrating into the horizontal beds of sandstone, and the lowest of these last form a breccia containing fragments of schistus, some round and others angular, united by an arenaceous cement.

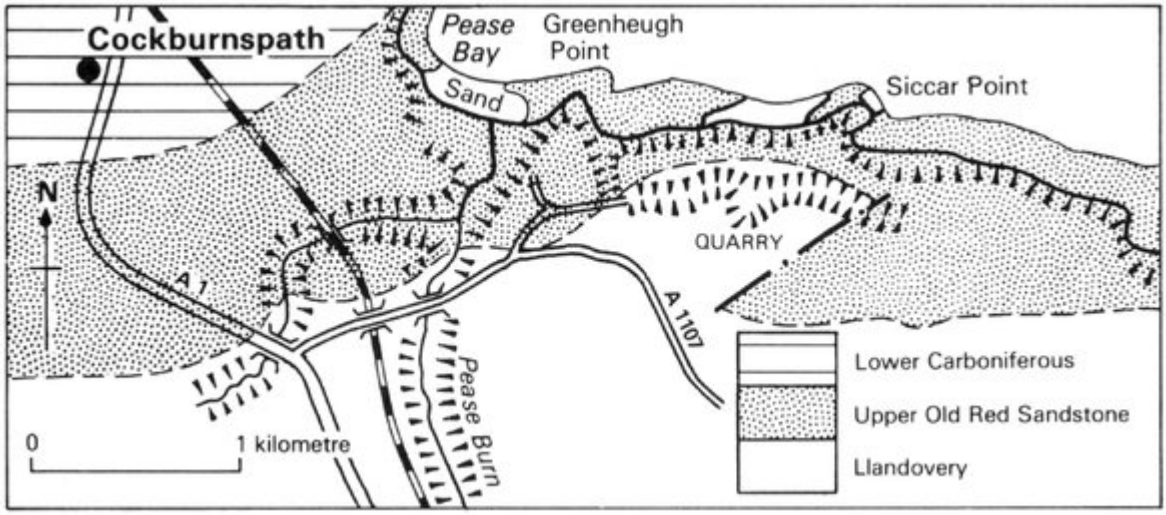
Dr Hutton was highly pleased with appearances that set in so clear a light the different formations of the parts which compose the exterior crust of the earth, and where all the circumstances were combined that could render the observation satisfactory and precise. On us who saw these phenomena for the first time, the impression made will not easily be forgotten. The palpable evidence presented to us, of one of the most extraordinary and important facts in the natural history of the earth, gave a reality and substance to those theoretical speculations, which, however probable, had never till now been directly authenticated by the testimony of the senses. We often said to ourselves, What clearer evidence could we have had of the different formation of these rocks, and of the long interval which separated their formation, had we actually seen them emerging from the bosom the deep? We felt ourselves necessarily carried back to the time when the schistus on which we stood was yet at the bottom of the sea, and when the sandstone before us was only beginning to be deposited in the shape of sand or mud, from the waters of a superincumbent ocean. An epocha still more remote presented itself, when even the most ancient of these rocks instead of standing upright in vertical beds, lay in horizontal planes at the bottom of the sea, and was not yet disturbed by that immeasurable force which has burst asunder the solid pavement of the globe. Revolutions still more remote appeared in the distance of this extraordinary perspective. The mind seemed to grow giddy by looking so far into the abyss of time; and while we listened with earnestness and admiration to the philosopher who was now unfolding to us the order and series of these wonderful events, we became sensible how much farther reason may sometimes go than imagination can venture to follow. As for the rest, we were truly fortunate in the course we had pursued in this excursion; a great number of other curious and

important facts presented themselves, and we returned, having collected, in one day, more ample materials for future speculation, than have sometimes resulted from years of diligent and laborious research."

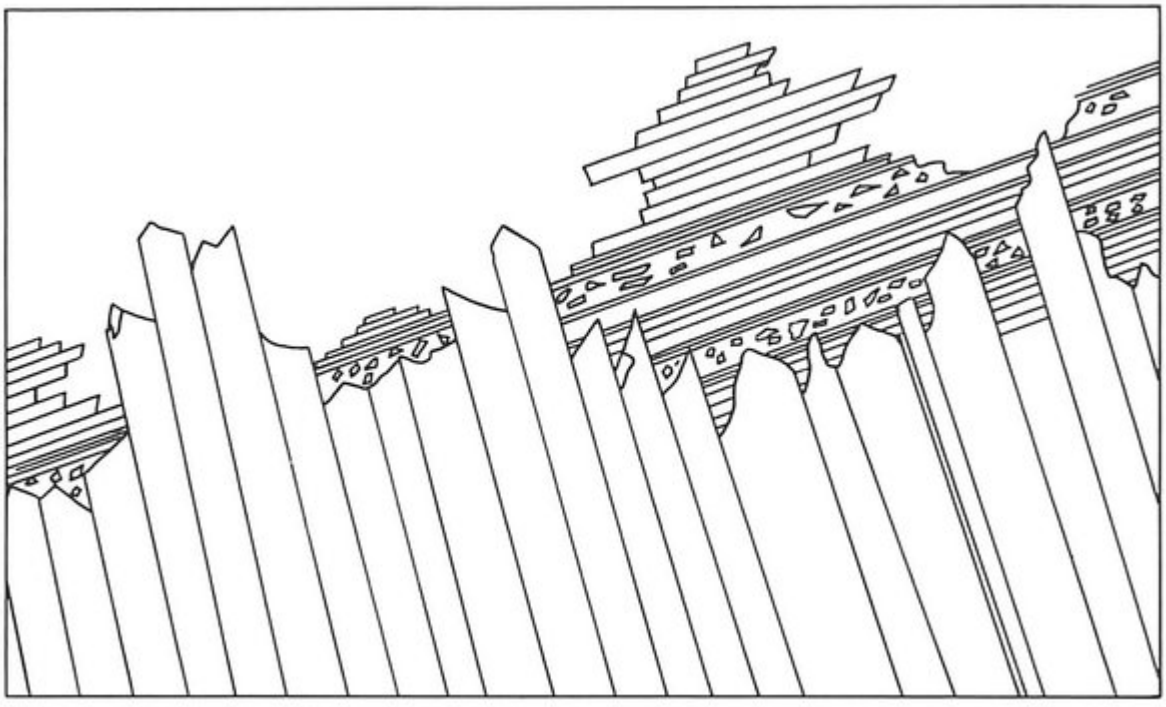
Other localities might seem to be an anticlimax after Siccar Point, but three in the general area are worth mentioning. The first is an anticline of Silurian greywackes and shales exposed in the old quarry (801 653) at Grantshouse, some 5 km south of the junction of the A1107 with the A1. The core of the fold is cut by a minor reversed fault trending parallel to the fold axis and downthrowing to the south-east. Cleavage is developed in the shales and slickensiding seen in bedding planes. Graded bedding, flute marks and groove moulds are among the more common sedimentary structures.

Hutton owned two farms, not one as is commonly recorded, and lived in one of them, Slighhouses [NT 823 593] between 1754 and 1767. This farm can be reached by turning off the Al some 6 km south-east of Grantshouse on to the B6437 then west on the B6438 for 3 km [NT 822 603] to turn south on an unclassified road. The second is an upland farm, Nether Monynut [NT 728 645], and lies some 4 km north-west of Abbey St Bathans. On a fine day this part of the Border country can be delightful, but if it is wet . . . !

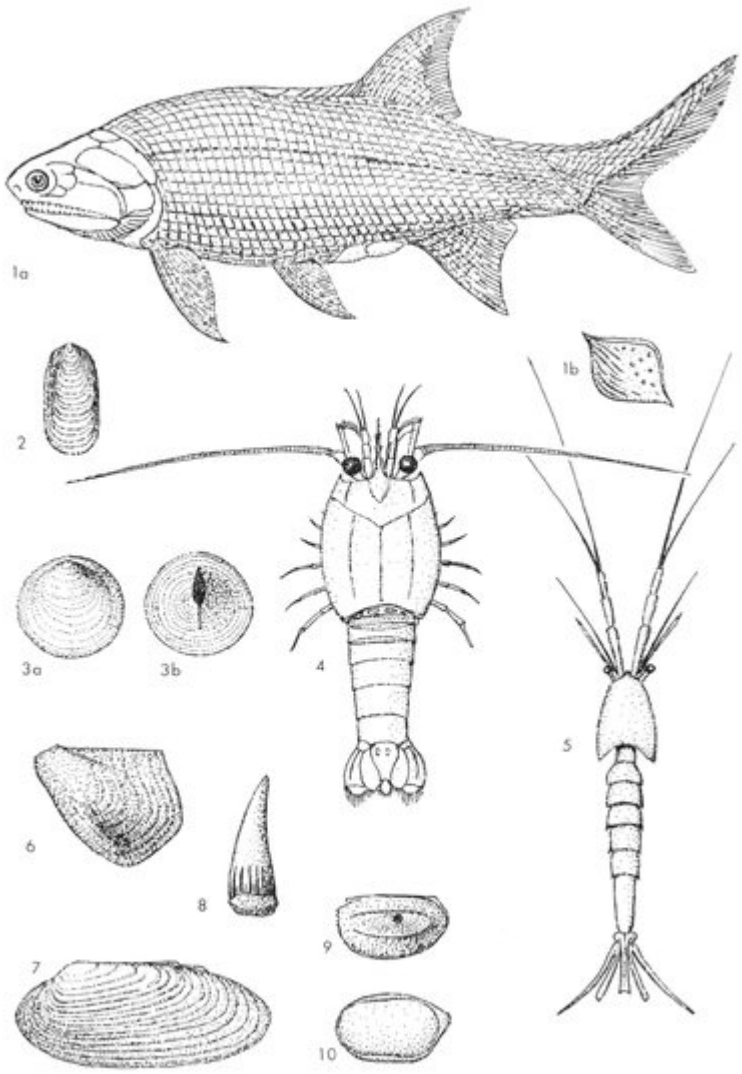
References



(Map 18) Siccar Point Map.



(Figure 19) Siccar Point. after Sir J. Hall from 'Hutton: The Lost Drawings', Craig et al. 1978.



(Figure 4) Carboniferous lagoonal and non-marine fossils. 1. Elonichthys robisoni Traquair, (a) restoration after Traquair × I; (b) caudal scale × 8; Viséan. 2. Lingula squamiformis Phillips × 1; Viséan-Namurian. 3. Orbiculoidea nitida Phillips. (a) brachial valve, (h) pedicle valve × 2; Viséan-Namurian. 4. Tealliocaris woodwardi Peach × 4; Viséan. 5. Waterstonella grantonensis Schram × 10; Viséan. 6. Naiadites modiolaris J de C Sowerby × 1; Westphalian. 7. Anthracosia planitumida Trueman × 1.5; Westphalian. 8. Rhizodus hibberti Traquair, tooth × 0.33; Viséan. 9. Beyrichiopsis plicata Jones and Kirkby × 16; Viséan-Namurian. 10. Cavellina spola Robinson × IS; Viséan. Lingula and Orbiculoidea are marine fossils tolerant of low salinity.