VIII.—NOTES *from the* ISLAND OF BUTE.

By DAVID CORSE GLEN, C.E.

I.—ON A TRACT OF COLUMNAR SANDSTONE, AND A PERCHED BOULDER, NEAR KILCHATTAN.

[Read 11th Dec., 1873.]

THE tract of columnar sandstone which forms the subject of the following remarks, I have thought of sufficient interest to bring before this Society. Although known to the Rev. Mr. Macbride, and a few other residents in Bute, yet no account, that I am aware of, has hitherto been given of the section, nor has it been noticed by Dr. Bryce when describing the other geological features of the island.*

The first time I observed this section was in 1869, when landing in a small boat from a steam yacht with a pic-nic party. It was so striking in appearance, that even the non-geologists of the company compared it to a miniature Giant's Causeway; and the remarkable feature is that the rock is columnar sandstone, and not trap, and that no trap appears in the neighbourhood, nor for some distance along the shore. I had previously passed along the shore from Glencallum Bay to near this point, and made a small collection of the rocks, many of which are peculiar and very interesting. They are mostly igneous, and appear to have been ejected from some volcanic vent in the neighbourhood.

The section lies about half a mile south of Kilchattan pier, and immediately beyond the first fence dyke, across the road leading along the shore southwards. It is about four or five yards wide, and extends from below high-water mark up to the cliffs, which lie about forty yards inland. The strata here dip from the sea towards the cliff, at an angle of about 25° to 30°.

The best developed tract of this columnar sandstone is near

* Dr. Bryce remarks with regard to Bute—"It has many points of great interest; strata occur here to be met with nowhere else in Scotland, and the effects of its trap dykes upon the adjoining strata are extremely curious—indeed of a unique character. . . . The portion extending from Rothesay Valley to Kilchattan is occupied by red sandstone; and finally, the southern portion, with a substratum of red sandstone, consists mainly of various rocks of the trap family, erupted through and overlying the sandstone."—*Geol. of Arran, &c.*, p 316-17, 4th Ed.

high-water mark, and is about four or five yards square. In the centre of this space there is a fissure, which at first appears to be a dyke; but on removing the loose materials washed up by the tide, no trap is to be found, and the columnar structure is only observable for a few feet on each side of this centre.

The columns are all nearly vertical, none being more than twenty degrees from the perpendicular. Their size varies from six or seven inches in diameter down to half-an-inch. Some of the large columns break into smaller ones from exposure to the weather, and others branch into two, forming twin columns. The number of sides varies from four to eight or ten, six being the most common.

Heat was no doubt the agency by which the sandstone was made to assume the columnar form along this narrow tract; but the source and nature of the heat, and the conditions under which it acted, are the points to be ascertained and answered.

Had a sheet of lava overflowed the sandstone at this point, we might expect to see its effects over a wider area of rock than the narrow strip of columnar sandstone which has been described. We might also look for some trace of this bed of igneous rock overlying the sandstone in the cliff, but such does not occur. I am inclined, therefore, to think that the sandstone has been rendered columnar by steam, or some other highly heated vapour, passing upwards through a vertical fissure in the rock, and which has altered the sandstone to a certain distance on each side. Beyond that point, a distance of some six or seven feet, the rock retains its normal character of a bedded red sandstone.

It is well known that in the neighbourhood of recent volcanoes there are sundry fissures through which steam and other heated gases escape to the surface; and as we have abundant evidence of igneous action in Bute, I think it highly probable that the phenomenon in question has been produced in this manner.

A few notes of a more general kind on columnar structure may here be added. This structure is developed in both igneous and sedimentary rocks: in the former it is the result of cooling under certain conditions from a fluid to a solid mass; in the latter, it is the result of long-continued heat acting upon a mass of solid strata. In the cooling of a mass of basalt, or any other igneous product, which has a tendency to assume the columnar form in passing into the solid or stony condition, it is found

in most instances, that the columns arrange themselves at right angles to the cooling surfaces. Thus, in bedded basalt, the columns are vertical, or nearly so, as in the Giant's Causeway, Ireland; Staffa, and other localities in the Western Isles; or like those on the Cathkin Hills, and at Craigallion, near Strathblane, in our own neighbourhood. In these cases it is evident that the cooling has acted from above downwards, the columns being most perfect in form nearest the surface of the bed. In masses of basalt that have come up through the strata, either in the form of dykes or isolated bosses, the columns are generally arranged in horizontal series in the dykes, and in the bosses in a prismatic or radiating order, varying from the perpendicular to the horizontal. Good examples of this latter arrangement are to be seen in the north-eastern face of Dunglass Hill, near the spout of Ballagan, and at the "Spindle Rock," near St. Andrews.

Columnar structure in certain igneous rocks has generally been ascribed to a contraction of the mass in cooling, so that it may be looked upon as a sort of crystallisation on a large and rude scale; the cooling surfaces being determined by the character of the rock mass, and the conditions under which it has been ejected.

Columnar structure in sedimentary rocks is a very much rarer phenomenon than in those of igneous origin; and I have not observed in any of the geological text-books, or other papers that have come under my notice, any special reference to it in this class of rocks. I think, however, there can be little doubt that it has been superinduced by heat acting on the strata in which it is observed.

In most cases we can trace the agent that has produced it. Where intrusive and overlying trap is found in connection with sedimentary strata, it is no uncommon circumstance to find that the strata have been strongly acted upon by the heat; and in several instances columnar structure has been superinduced to a certain extent. In the pits at Shettleston, where an intrusive bed of greenstone lies over one of the coal seams of that locality, the coal is found in parts to be rendered beautifully columnar on a small scale. Columnar coal, or rather coke, has also been found in connection with trap in many other localities in both the Lanarkshire and Ayrshire coal-fields.

We have noticed that the columnar structure in the sedi-

mentary rocks is always arranged at nearly right angles to the face of the trap. Thus, when the trap is horizontal, the columns are vertical, and when the trap is vertical, the columns are horizontal. A very fine example of this latter feature is to be observed at Bishopbriggs, north of Glasgow, where in a section well-known to many of the members of this Society, a mass of Carboniferous sandstone, several feet in width, is to be seen, locked between the walls of a double dyke of trap that runs from north-east to south-west through the strata, and a horizontal columnar structure has been superinduced in the sandstone at right angles to the vertical walls of the two dykes.

It has also been observed that the sandstone pavement forming the bottom of iron furnaces which have been long in blast, is often rendered columnar, the columns, like those in the red sandstone at Kilchattan, being vertical to the bedding of the stone.

At a short distance along the shore southwards from the section just described, there occurs the finest specimen of a perched boulder I have seen, shewing the effect of the weather and tide on the soft red sandstone. As from its exposed situation on that stormy shore, this boulder cannot remain in its perched position much longer, I have thought it worthy of recording, and also of having it figured in our *Transactions*, from a sketch, with dimensions, taken on the spot by Mr. Dairon.

The upper part or table is a micaceous schist, and the pedestal or pillar is a bedded red sandstone, which is so very soft that it

can be rubbed away with the fingers. The table has at one time been larger, a considerable corner having split off, and is now lying at its base.

The present dimensions of the table are twelve feet long, seven feet broad, and five feet thick. The pillar is two feet in diameter, and the top of the table is eight feet above the level of the shore at this place.

Perched blocks of stone, supported on a pivot or pillar of ice, are a common phenomenon on many of the glaciers in Switzerland. These blocks are often of large dimensions, and their elevated position is caused by the sun melting away the surrounding ice, while the stone forms a shade like an umbrella to protect its own pillar.

It is evident that in this instance at Kilchattan, the soft column of sandstone owes its preservation in a similar manner to the protecting influence of the mass of rock that now lies above it.*

II.—ON A MAGNETIC SAND FROM EAST BAY, ROTHESAY.

[Read 30th Oct., 1873.]

THE magnetic sand now submitted to consideration is from the shore at East Bay, Rothesay. Although previously observed on this part of the coast, no evidence had been obtained with regard to the rocks from whence it had been derived. On examination of the rocks along the beach, I was led to investigate some of the neighbouring trap dykes which cut through the red sandstone, and found that by pounding to a powder portions of the rock of which they are composed—a dark coarse-grained dolerite—I could readily obtain by the magnet small quantities of the magnetic sand. I also found that all the dust

* Sir Charles Lyell mentions some very remarkable perched boulders, which he names "earth pyramids," or "stone-capped pillars," at Botzen, in the Tyrol. He says—

"The columns are of indurated mud, varying in height from twenty to one hundred feet, and are usually capped by a single stone, some of which are ten feet in diameter. They have been separated by rain from the terrace of which they once formed a part, and now stand at various levels on the steep slopes bounding narrow valleys."—*Principles of Geology*, vol. i., pages 335 and 340.