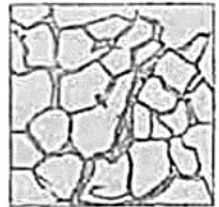


wacké, and tuff. They appear to have been erupted while the sedimentary strata were in a horizontal position, and to have suffered the same dislocations which those strata have subsequently undergone. In the volcanic tuffs of this age are found not only fragments of limestone, shale, flinty slate, and sandstone, but also pieces of coal.

The other or older class of carboniferous traps are traced along the south margin of Stratheden, and constitute a ridge parallel with the Ochils, and extending from Stirling to near St. Andrews. They consist almost exclusively of greenstone, becoming, in a few instances, earthy and amygdaloidal. They are regularly interstratified with the sandstone, shale, and ironstone of the lower Coal-measures, and, on the East Lo-mond, with Mountain Limestone.

I examined these trap rocks in 1838, in the cliffs south of St. Andrews, where they consist in great part, of stratified tuffs, which are curved, vertical, and contorted, like the associated coal-measures. In the tuff I found fragments of carboniferous shale and limestone, and intersecting veins of greenstone. At one spot, about two miles from St. Andrews, the encroachment of the sea on the cliffs has isolated several masses of traps, one of which (fig. 679) is aptly called the "rock and spindle,"* for it consists of a pinnacle of tuff, which may be compared to a distaff, and near the base is a mass of columnar greenstone, in which the pillars radiate from a centre, and appear at a distance like the spokes of a wheel. The largest diameter of this wheel is about twelve feet, and the polygonal terminations of the columns are seen round the circumference (or tire, as it were, of the wheel), as in the accompanying figure. I conceive this mass to be the extremity of a string or vein of greenstone, which penetrated the tuff. The prisms point in every direction, because they were surrounded on all sides by cooling surfaces, to which they always arrange themselves at right angles, as before explained (p. 484).

Fig. 680.

Columns of green stone, seen endwise at *b*, fig. 679.

A trap dike was pointed out to me by Dr. Fleming, in the parish of Flisk, in the northern part of Fifeshire, which cuts through the grey sandstone and shale, forming the lowest part of the Old Red Sandstone. It may be traced for many miles, passing through the amygdaloidal and other traps of the hill called Normans Law. In its course it affords a good exemplification of the passage from the trappean into the plutonic, or highly crystalline texture. Professor Gustavus Rose, to whom I submitted specimens of this dike, finds the rock, which he calls dolerite, to consist of greenish black augite and Labrador felspar, the latter being the most abundant ingredient. A small quantity of magnetic iron, perhaps titaniferous, is also present. The result of this analysis is interesting, because both the ancient and modern lavas of *Ètna* consist in like manner of augite, Labradorite, and titaniferous iron.

* "The rock," as English readers of Burns' poems may remember, is a Scotch term for distaff.