

Probably an acquaintance with modern active volcanoes would lead one to attribute the phenomenon solely to a breaching of the cone on its northern side by later explosions. Such speculation, however, does not appear quite without interest, especially where other evidences are so little available.

For the photographs which illustrate this paper it is a pleasure to express indebtedness to Mr. John C. Caldwell, M.A., of the Madras College, St. Andrews.

#### EXPLANATION OF PLATE XIII.

FIG. 1.—Rock and Spindle shore stack, 2 miles east from St. Andrews. The fossil fish-teeth reported on by Dr. Smith Woodward were collected from the centre of the Spindle.

„ 2.—Concentric arrangement of ash layers, Rock and Spindle. In the distance may be seen the stratified rocks beyond the eastern margin of the vent.

### III.—CHROMITE IN BEER STONE.

By G. M. DAVIES, M.Sc., F.G.S.

THE Beer Stone is a gritty limestone, made up largely of shell fragments with some foraminifera, quartz grains, and soft chalky material, occurring in the *Rhynchonella Cuvieri* zone of the Middle Chalk near Beer Head in the south-east of Devon. It has long been worked for building purposes in underground galleries about one mile west of the village of Beer, and has been described by W. Hill and W. F. Hume in the Geological Survey memoir on the Lower and Middle Chalk.<sup>1</sup> Dr. Hume records the following minerals as present in the insoluble residue of the stone: quartz, muscovite, glauconite, chalcedony, pyrites, tourmaline, rutile, andalusite, and possibly anatase.<sup>2</sup> A. J. Jukes-Browne<sup>3</sup> says the residue “contains a variety of minerals which have clearly been derived from land consisting of granite and Palæozoic rocks such as occur in South Devon and Cornwall”.

Samples collected by me last year in the underground workings have yielded additional evidence which is of some interest.

A sample weighing 157 grammes was treated with dilute hydrochloric acid and yielded 3.1 per cent muddy residue and 0.32 per cent sand. The latter consists chiefly of quartz, up to 2.1 mm. diameter, the larger grains being well rounded. There is also a fair amount of felspar, mainly orthoclase, and of muscovite and glauconite, as well as a little flint.

The sandy material was treated with bromoform, and the heavy residue was found to amount to 0.012 per cent of the stone. Coarse red and black grains are conspicuous in it. The former consist of limonitic matter, and the latter were tested in borax beads on the supposition that they might contain manganese. The beads, however, showed the fine green colour, somewhat yellowish in the oxidizing flame, characteristic of chromium. On crushing the

<sup>1</sup> *Cretaceous Rocks of Britain*, vol. ii, 1903.

<sup>2</sup> *Ibid.*, pp. 509, 513.

<sup>3</sup> *Ibid.*, p. 545.

black grains and examining them under the microscope the fragments exhibit the deep brown colour in transmitted light and the isotropic character of chromite. In several instances a green serpentine is associated with the chromite. The other heavy minerals present are tourmaline, staurolite, biotite, zircon, rutile, and andalusite, none of which call for special comment.

A second sample gave 0.28 per cent sandy residue, but no chromite was seen in it. A thin section of the stone showed as many as seven fairly large quartz grains in an area of about half a square inch.

Detrital chromite does not seem to have been recorded in any Cretaceous or older deposits in England. From this fact, as well as from the coarseness of the grains and the patchy nature of the occurrence, we may conclude that the chromite was derived directly from some area of ultra-basic rocks, possibly the Lizard, possibly an area now submerged beneath the English Channel; and the occurrence is of interest as showing that serpentines as well as granites were being eroded in Turonian times.

#### IV.—ON THE OCCURRENCE OF *PRODUCTUS HUMEROSUS* (= *SUBLEVIS*) IN DOVE DALE; AND ITS VALUE AS A ZONE-FOSSIL.

By J. WILFRID JACKSON, F.G.S., Manchester Museum.

DURING a recent examination of the Carboniferous Limestone in the Dove Dale district I have met with an abundance of *Productus humerosus*.<sup>1</sup> This species is a common fossil in the cliffs extending for a distance of quite 2 miles from the top end of Nabs Dale to beyond Tissington Spires. It is most prolific at and near Reynard's Cave, where the shells occur in clusters, often cupped into each other.

The beds containing this fossil are apparently not far below the top of the limestone, probably not more than some 500 feet.

The limestone is dark-grey in colour, with very obscure bedding. It breaks up irregularly into angular fragments, and contains some crinoid debris in places. Here and there occurs an organism of the nature of a Stromatoporoid, which invests the various fossils. There is an absence of chert, the limestone being very pure.

In addition to *P. humerosus* the beds contain *Amplexus coralloides* (very common), and several interesting Brachiopods, Gastropods, and Lamellibranchs; also Trilobites and Fenestellids, the fossils occurring in nests in certain places.

The specimens of *P. humerosus* include several varietal forms, which may or may not deserve distinctive names. Pending an exhaustive study of the material from Dove Dale and Caldon Low I here use the specific name *humerosus* to cover all such variations. Four such forms may be distinguished, but these are linked together by intermediates:—

1. *P. aff. sublevis*, de Kon., almost smooth, narrow and highly convex, with no trace of median sinus; flattened down median area from the beak to the anterior margin.

<sup>1</sup> First recorded in GEOL. MAG., July, 1919, p. 335.