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ORIGINAL ARTICLES.

I.—ON THE ROCKS OF BRAZIL WOOD, CHARNWOOD FOREST.

By S. ALLPORT, F.G.S.

AN interesting discovery having just been made in consequence of the examination of a single thin slice of rock, the following communication is recommended to the attention of those geologists who, to say the least, still fail to recognize the value of the microscope in geological investigations.

A short time since, a friend in Leicester kindly sent me a specimen of the so-called gneiss from Brazil Wood; having prepared a thin section and placed it under the microscope, I immediately recognized an old acquaintance. It so closely resembled some of the altered clay-slates which surround the Land's End mass of granite,¹ that I could not but regard it as another illustration of contact metamorphism, and the following day was devoted to an examination of the locality in which it occurs.

Under the guidance of Mr. W. J. Harrison, of Leicester, who kindly accompanied me, a small quarry in the wood was soon found, and in a few minutes we were gratified by the discovery of a mass of granite in contact with the "gneiss." It is at present the only known junction of the granite with the old sedimentary rocks, and proves conclusively that, like the syenites of the district, the granite is also an intrusive rock. Subsequently to our visit, Mr. Harrison has discovered a bed of indurated banded slate overlying the gneiss; it has a distinct cleavage, and contains numerous small garnets. This slaty rock is interbedded with another which is rather more compact, and has a less perfect cleavage; it also contains garnets. The discovery of these slaty rocks is another point of interest, as none have been previously observed to the east of the Swithland slates. There can be no doubt that they belong to the Charnwood series, and it will be seen that their altered condition may be fully explained by their close proximity to the intrusive granite. As the locality in which these discoveries have been made has been frequently visited and described, it may afford satisfaction to previous observers to learn that the granite just found has been exposed to view by very recent quarrying of the rock.

The microscopic structure of the Mount Sorrel granite, and of

¹ Described by me in Quart. Journ. Geol. Soc. 1876, vol. xxxii. p. 407.

many other Charnwood rocks, has quite recently been admirably described by Messrs. Hill and Bonney in a most valuable paper read before the Geological Society;¹ it will therefore suffice to give a short account of two masses of granite and the altered sedimentary rock.

In Brazil Wood a small conical hill of granite rises about 70 or 80 feet above the surface, and is separated from the knoll of "gneiss" by an interval of 35 yards; this depression is occupied by soil and vegetation, so that the junction of the two rocks cannot be observed. On the occasion of our visit we found that recent excavations had been made in the north-west corner of the quarry, and had exposed to view a mass of granite which clearly forms part of an intrusive vein. In one place there is a piece of the gneiss completely inclosed in it, and it has thrown off smaller veins which penetrate the gneiss in various directions. It will be seen, then, that the beds of "gneiss" and slate are within 35 yards (measured along the surface) of a considerable mass of granite, and that they are also penetrated by granite veins; they have been subjected, therefore, to influences of the same kind which, in Cornwall and elsewhere, have converted ordinary clay-slates into crystalline micaceous schists.

Hornblende Granite, Brazil Wood.—The rock forming the conical hill is a rather fine-grained granite of dark colour; its constituents are orthoclase, plagioclase, quartz, hornblende, biotite, magnetite, and a few long slender prisms of a light brown colour not determined. Although orthoclase predominates, the triclinic feldspar is very abundant, and occurs here and there in rather large crystals beautifully striated. Both felspars are in a remarkably fresh state of preservation. Hornblende of a brownish-green colour is abundant, and is frequently quite unaltered; other crystals are however either partially or completely altered to a green fibrous variety which closely resembles uralitic pseudomorphs after augite. The *Biotite* is occasionally quite unchanged, and exhibits its usual optical characters; much of it has, however, been altered to a pale green substance, which is less strongly dichroic. The rock is a good one for the study of this mineral, as it may be seen in every stage of alteration.

Quartz is plentiful and contains many minute fluid cavities.

Granite intrusive in schist.—This rock is also rather fine-grained, but contains many crystals of white feldspar, which give it a somewhat porphyritic character. The constituents are orthoclase, plagioclase, quartz, biotite. Both felspars are well preserved; the orthoclase exhibits many Carlsbad twins; the plagioclase is comparatively clear, and shows a very characteristic twin striation. The mica agrees in every way with that described in the last-named rock.

The *Quartz* is clear, but contains numerous very minute cavities disposed in parallel lines; it is worthy of remark that the direction of these lines is the same in several adjacent grains of quartz. There are a few small garnets near the junction with the schist, but none have been observed at a greater distance than an inch. It is

¹ Quart. Journ. Geol. Soc. 1877-78, vols. xxxiii. and xxxiv.

remarkable that hornblende should be absent, as it occurs in all the other granites of the district.

The junction with the schist is interesting, as it presents two varieties. In one specimen the junction is as sharp and distinct a line, as in any of the Cornish examples described in the paper already quoted; in others, it is not so well defined; the two rocks have, in fact, been so completely blended together, that there is a narrow band of such indefinite character, that one can hardly say to a quarter of an inch where one begins and the other ends. A thin slice shows under the microscope a narrow belt between normal granite and normal schist, which consists almost exclusively of imperfectly developed felspar crystals and mica. This felspathic band is also marked by the presence of numerous minute black grains of magnetite, which are here and there loosely aggregated in clusters. The slice contains small garnets in both the granite and schist.

Micaceous Schist.—The rock into which the granite has been intruded has been called a peculiar or unique gneiss; it is, in fact, so peculiar that the term is inappropriate, as the rock has neither the mineral composition nor the structure of gneiss; it contains no recognizable felspar, and there is no true foliation. It is tough and difficult to break, though rather more fissile in one direction than in others; it is purplish grey in colour, and glitters with numerous bright flakes of mica. The description of its microscopic structure given by Professor Bonney in the paper already cited agrees in the main with my own observations; in my slices there is, however, so little of the "fine granular base," that I should prefer to describe it as a rock consisting almost entirely of two micas, with a few grains of quartz, and numerous minute black grains (doubtless magnetite) irregularly scattered through the mass; and, in addition, there are occasional small patches of the fine granular substance showing aggregate polarization; it occupies spaces between the flakes of mica, but exhibits no crystalline forms. There are also small flakes and streaks of clear red ferric oxide. The brown and greenish-brown mica has all the characters of altered biotite. The white mica is more abundant, and occurs here and there in rather large flakes; in its brilliant chromatic polarization, and other optical characters, it agrees perfectly with a white mica in the altered clay-slate in contact with the granite of St. Michael's Mount, Cornwall. As it is not quite like muscovite, it may probably be paragonite as suggested to me by Prof. Bonney; and this would agree well with the analysis given by him at p. 224, as that mineral contains from 36 to 40 per cent. of alumina. As regards structure, there is no approach to foliation in any of my slices; the constituents lie in all possible directions without any definite arrangement. There is, however, a banded appearance in some specimens caused by the crystallization of the two micas in rather larger plates along roughly parallel lines. Near the junction with the granite the schist contains many small garnets, which are interesting microscopic objects.

It will be seen, then, that this schist is neither a gneiss nor a true mica-schist; it belongs, in fact, to a group of rocks which have not yet received distinctive names, although they are far from uncommon. They occur round the skirts of granitic masses, especially when the latter have broken through clay-slates. When the prevailing constituent is mica, and they are more or less fissile in one direction, they may for the present be called micaceous schists, in order to distinguish them from normal mica-schists. This Charnwood rock is singularly like some of the Devonian slates near their junction with the Land's End granite, it is not more highly altered, and the present crystalline condition of both may clearly be explained by the same cause, namely, their contact with large masses of intrusive granite.

It may possibly be objected to this explanation that no such amount of alteration has been produced in the sedimentary rocks of the district by the intrusion of the syenite. It must not be understood, however, that the syenite has produced no effect whatever. But the two cases are not strictly analogous, and the following considerations may probably suffice to remove the apparent difficulty. If we regard the large masses of granite which occur among our Palæozoic strata as crystalline products formed at the roots of old volcanos, and subsequently exposed by denudation, it is evident that the surrounding rocks must have been exposed to great heat and intense metamorphic action during the entire period of volcanic activity; whereas rocks lying at a distance would receive no more heat than that given out by any gradually cooling masses which might be intruded among them. In the first case, the heat would be far more intense and continuous; in fact, its duration might probably be measured by an entire geological period; while in the second, the heat would be far less at the commencement, would be a gradually diminishing quantity, and the duration of its efficient action might be reckoned by years. Sheets of molten matter intruded among rocks at a distance of a very few miles would everywhere meet with cold surfaces, and would necessarily be cooled down at a comparatively rapid rate. It has frequently been observed that granite has produced greater alteration in contiguous strata than other intrusive rocks; but it is also true that the amount of change is very unequal, sometimes being comparatively slight. Such facts are quite in accordance with the theory here advocated. Leaving out of consideration any inequality due to differences of composition in the rocks attacked, it is probable that prolonged volcanic action would vary greatly in intensity at different times and in various directions. It might then easily occur that the molten material of granite forcing its way through strata towards the close of a volcanic period would produce far less effect than in the earlier stages of activity; or the occasional transfer of the volcanic source from point to point during periods of varying length would also account for very considerable variations in the amount of alteration produced.

The slaty rock overlying the micaceous schist is very fine grained,

and may fairly be described as an indurated banded slate. Although highly altered, the mass is less perfectly crystallized than in the schist, and has more the character of a spotted slate; minute red granules and flakes of brown mica being grouped in clusters and straggling lines. A very thin slice examined with a quarter-inch objective shows that the mass is in a crystalline state, and crowded with minute flakes of white mica. This difference in the condition of the two adjacent beds is common in the Cornish rocks, and is doubtless due to original differences of composition or texture in the sedimentary deposits.

II.—NOTES ON THE FOSSIL FLORA OF EASTERN AUSTRALIA AND TASMANIA.

By Dr. OTTOKAR FEISTMANTEL,
of the Geological Survey of India, Calcutta.

THROUGH the kindness of the late Rev. W. B. Clarke, of Sydney, I had the opportunity of examining two collections of fossil plants from Australia, which that gentleman had kindly placed at my disposal, together with explanatory notes, which he communicated to me in private letters.

My own remarks upon the plants contained in the first collection (which I obtained three years ago) were published in the 4th edition of Mr. Clarke's "Remarks on the Sedimentary Rocks of New South Wales," 1878, but they require a few corrections now. The descriptions of the plants and figures were published by me in the "Palæontographica," 1878-79.

The second collection sent by Mr. Clarke contained also numerous new forms; besides this, Mr. C. S. Wilkinson, another Australian geologist, has recently contributed some specimens from the Hawkesbury beds (see further on), and as in the mean time Mr. Clarke's above-mentioned work was published, and also Mr. R. Etheridge's "Catalogue of Australian Fossils," I was enabled to write a supplemental memoir (with several plates), on the fossil Flora in Australia.

Before it can, however, be published, I may be permitted to give a short account of the present state of our knowledge of this Flora; but the Palæozoic and Mesozoic forms only are here taken into consideration.

I shall first indicate the stratigraphical classification of the beds containing the plants, based upon the observations of the most trustworthy authors, and shall then proceed to a short systematic discussion of the Flora (with addition of the few fish remains).

I. QUEENSLAND.

The best account of the Geology is found in Daintree: Geology of Queensland, Quart. Journ. Geol. Soc. 1872, vol. xxviii. The plants are described by Mr. W. Carruthers, F.R.S.

The following classification is given:

1. *Carbonaceous* (Mesozoic strata) (see *l.c.* pp. 273, 283). *Tæniopteris Coal-measures* (*l.c.* p. 288 and p. 325). Localities: Brisbane, Tivoli Mines, near Ipswich, etc.