1.

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3.

To Illustrate Mr. Teall's paper on the Amygdaloids of the Tynemouth Dyke.

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ORIGINAL ARTICLES.

I.—ON THE AMYGDALOIDS OF THE TYNEMOUTH DYKE.¹

By J. J. H. TEALL, M.A., F.G.S.

(PLATE XIV.)

IN a paper published in the Quarterly Journal of the Geological Society for 1884,² I gave some account of the Tynemouth Dyke. In that paper, however, I omitted to describe one feature, connected with the microscopic structure of the dyke, because at the time of writing I did not understand it. A short time ago I had occasion to re-examine my preparations, when my attention was again directed to the feature in question; and this time an explanation suggested itself which appears to be in every respect satisfactory. The main object of this communication is to supplement my already published description by giving an account of the feature to which I have referred, and which may be briefly described as the occurrence of spherical patches of interstitial matter. (See Pl. XIV. Fig. 1.)

At the time of my residence at Tynemouth (1882) the dyke was exposed in the angle formed by the breakwater and the cliff on which the Priory stands, and also in the cutting close to the railway station. The rock of which the dyke is composed varies somewhat in character owing to the presence or absence of porphyritic feldspars and small spherical amygdaloids. A typical specimen may be said to consist essentially of porphyritic crystals, or rather crystalline aggregates of a feldspar closely allied to anorthite, embedded in a dark, finely-crystalline ground-mass, composed of augite, lath-shaped feldspars, and interstitial matter. Olivine has been detected in one or two slides; but it is not usually present.

The porphyritic constituents undoubtedly belong to the earliest phase in the consolidation of the original mass of molten matter. They consist, as a rule, not of single crystals, but of two or more individuals. Where the individuals of one and the same group are in contact with each other, they exhibit no trace of crystalline form;³ but where they are in contact with the ground-mass, they are bounded by definite faces. In other words, the internal relations of the individuals forming a group are those of plutonic rocks (*e.g.* gabbro), whereas the external relations of the same individuals are those of volcanic rocks. This, of course, is in strict accord with the general view that the porphyritic constituents have been developed under plutonic conditions. An examination of the porphyritic aggregates

¹ Read at the Brit. Assoc., Newcastle-on-Tyne, in Section C. (Geology), Sept. 1889.

² Petrological Notes on some North of England Dykes, vol. xl. p. 233.

³ See fig. 1, plate xiii. accompanying the paper already referred to.

under crossed Nicols reveals the fact that the felspar-substance to which the external idiomorphism is due differs from that forming the central portions. This, taken in connection with the fact that the augite-grains of the ground-mass are occasionally included in the peripheral zone of the porphyritic groups, justifies the conclusion that such external form as the individuals possess was given to them at a later stage in the history of the consolidation of the rock than that at which the groups themselves were formed, and also under different physical conditions.

The augite is pale in colour, and occurs in grains or granular aggregates. It is occasionally penetrated by the lath-shaped felspars, and must, on the whole, have been formed after them.

The lath-shaped felspars call for no special description. They frequently show multiple twinning of the usual type.

The interstitial matter contains extremely minute microlites and skeleton crystals of felspar, grains and skeletons of magnetite, and an indistinct brownish granular substance. It is not possible to recognize any true glass, even with the highest powers. This interstitial matter occurs in more or less angular patches wedged in between the other constituents, and gives to the rock the structure for which Professor Rosenbusch has proposed the term *intersertal*. The rock itself would be termed by this author a tholeite.

Now the peculiar feature to which I wish to call special attention is the occasional occurrence of spherical patches of interstitial matter. These appear in the thin sections—and they have only been recognized in the sections—as circles. How are these spherical patches to be accounted for? An answer to this question is found by studying the amygdaloids, which have been already referred to as occurring in certain portions of the dyke. (See Pl. XIV. Fig. 2.)

Microscopic examination enables us to determine the precise stage in the history of consolidation at which the vesicular cavities, now for the most part filled with carbonates with or without a narrow border of chalcedony, were formed. Their development evidently displaced the lath-shaped felspars, for these are often arranged tangentially with reference to the bubbles; but it produced no effect on the disposition of the constituents of the interstitial matter. It appears, then, that the gas bubbles were produced after the formation of the porphyritic constituents, the augite and the lath-shaped felspars, but before the consolidation of the interstitial matter. It is possible that their development was due to the relief of pressure consequent on the rise of the semi-liquid mass in the crack. If so, then they are analogous, so far as their mode of formation is concerned, to the bubbles which arise in the contents of a soda-water bottle as the cork is partially removed.

Now, the spherical patches of interstitial matter agree in form and size with the amygdaloids, and to account for them we have only to suppose that the portion of the mass which was liquid at the time of their formation, oozed into some of the vesicles owing to the absorption, escape, or condensation of the gas. That this is the true explanation is proved by the occurrence of cavities which have been only

partially filled up. (See Pl. XIV. Fig. 3.) The last act to which we have to call attention was the filling up of the cavities remaining empty after final consolidation with chalcedony and carbonates.

We may summarize the history of the rock so far as it is recorded in microscopic structure as follows:—

1. Development of granular aggregates of a felspar allied to anorthite under plutonic conditions.
2. Addition of felspar substance to the external portions of the granular aggregates, and the consequent production of crystalline form.
3. Development of lath-shaped felspars.
4. Separation of augite.
5. Formation of vesicles owing to the separation of gas from the magma.
6. Partial or complete filling up of some of these vesicles with interstitial matter.
7. Consolidation of the interstitial matter. [carbonates.]
8. Filling up of the vesicles remaining empty after final consolidation with

EXPLANATION OF PLATE XIV.

Augite is indicated by dots, interstitial matter by lines. The felspar is left clear. Magnetite is black.

FIG. 1. Vesicle filled with interstitial matter.

„ 2. „ filled with carbonates.

„ 3. „ partly filled with interstitial matter and partly with carbonates.

II.—THE EFFECTS OF PRESSURE ON CRYSTALLINE LIMESTONES.¹

By Prof. T. G. BONNEY, D.Sc., LL.D., F.R.S., F.G.S.

THOSE who have carefully studied the crystalline schists cannot fail to have noticed that a community of structure—a sort of family likeness—prevails throughout any one group of rocks, while those which occur apparently at different horizons exhibit dissimilar structures. Thus the marbles associated with any group of crystalline schists are coarse or fine in grain, according to the structure of the latter. But to this rule exceptions appear, at first sight, not infrequent. For instance, in the Alps, we find not uncommonly, in that group of schists which seems to occupy the highest position, marbles which present an abnormally compact aspect. On closer examination they prove indeed to be crystalline in structure, but the crystals seem so small, the general structure so compact, that until we find them graduating into typical mica or other schists, we can hardly feel satisfied we are not being duped by infolded limestones of Mesozoic or Palæozoic age. When, however, we study the microscopic structure of such crystalline limestones, the abnormality proves to be more apparent than real. This compact structure is due, not to the absence of crystallization, but to the destruction by pressure of an original crystalline structure: for we find on examination that the rock, once perhaps coarsely crystalline, has been crushed and again consolidated, so that it has now assumed a comparatively compact appearance.

A proof of the above statement may be afforded by a brief description of the structures which are exhibited by a series of limestones² which I have from time to time collected and examined.

¹ Read before Section C, Brit. Assoc. Newcastle-upon-Tyne Meeting, Sept. 1889.

² Many of the Alpine limestones, both in the Mesozoic and in the Crystalline series, are more or less dolomitic, but I have not thought it necessary to distinguish these. The statements apply to both, except that, among the ordinary sedimentaries, the