Devitrification of cracked and brecciated Obsidian.

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[Read April 14th, 1891.]

In examining a specimen of the rhyolitic lava-flow of the Rocche Rosse, Lipari,[1] in the collection of the Royal College of Science, London, I was struck by the fact that the areas of pure black glass visible upon the fractured surface were each bordered by a band of spherulitic matter, the convex surfaces of the spherulites being directed inwards towards the glassy area. The specimen, collected by Prof. J. W. Judd, F.R.S., evidently comes from a portion of the flow which has become brecciated during movement of the viscid mass; intermingling of glassy and hemicrystalline matter has occurred, and an approach to the structure of the well-known "Piperno" of Naples has resulted. But the irregular little lumps of obsidian have not received their spherulitic crust from any chilling effect that they may have had upon the surrounding groundmass; the spherulites belong to the glass-fragments themselves, and are not deposited upon their surfaces.

So much can be seen in the hand-specimen. Prof. Judd has kindly had a thin section prepared, which shows that this structure of glassy fragments with hemicrystalline envelopes is also a microscopic feature.

Thus the large lumps of obsidian exhibit a thin zone of spherulitic matter following every curve of their outline; the particular section examined has not traversed any examples of the thicker crusts so easily visible to the unaided eye. But the hemicrystalline interstitial matter, playing the part of groundmass in the specimen, unexpectedly exhibits the same characters on a minutely detailed scale. One or two lumps of dull normal rhyolite occur; but the main mass appears at the first sight to consist of well-developed axiolites, fitting closely against one another, irregular and curving, as in the fine examples from the Western States of America.

[1] See Prof. Judd, *Volcanoes*, p. 124.

In axiolites, however, spherulitic aggregation has taken place along an axis; the body grows from this line outwards, and convexities of the surface occur where the normal spherulitic rather than the axiolitic tendency asserts itself. In the rock of the Rocche Rosse we soon see that the boundaries of the separate bodies are cracks, or even accidental lines of junction of adjacent fragments, and that the fibrous crystallisation has originated at the surface and spread gradually inwards, often leaving a glassy area at the centre. The minuter structure of the rock is thus merely a reproduction of that of its coarser portions.

The spherulitic envelopes, thus found to be so prevalent, are subsequent in origin to the fracturing and partial brecciation of the mass. A "eutaxitic" structure, like that of the Piperno or of the pitchstone of Spechtshausen in Saxony, having been set up in this layer of the lava-flow, sufficient heat remained in the mass to promote slow devitrification. The surfaces of the displaced fragments of obsidian, and the cracks which arose in the deformed and ruptured bands of glass, have served as starting-places for the crystalline tufts and spherules, which have only very rarely spread into the centre of the glassy particle. In this matter we have the strong support of the experiments of Messrs. Herman and Rutley[1] on the devitrification of artificial glass. The glass operated on, of whatever form, becomes opaque and crystalline from its surface inwards when exposed to prolonged heat short of the temperature of fusion. The fibrous groups of crystallites also develop along cracks;[2] and a purely microscopic fracture suffices for their production, as was shown by the experiment of flawing a piece of plate-glass beneath the scratch of a diamond, and subjecting the specimen to a bright red heat for nine days.[3] Hence, in the case of the lava of the Rocche Rosse, subsequent heating may have even fused the surfaces of adjacent fragments together; but the fact that a thin crack separated them before devitrification set in would account for the present disposition of the products of that process.

Mr. Rutley's experiments upon natural glassy rocks[4] confirm us in our opinion that spherulitic crusts will arise where fragments of obsidian, sufficiently consolidated for fracture, are subjected to renewed heating, or

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[1] "On the microscopic characters of some specimens of Devitrified Glass." *Proc. Roy. Soc.* Vol. XXXIX. pp. 87-107.

[2] *Ibid.* p. 99.

[3] *Ibid.* p. 107.

[4] "Notes on alteration induced by Heat in certain Vitreous Rocks." *Proc. Roy. Soc.* Vol. XL. p. 434.

even to the slow passage of the residual heat from the lava-flow of which they form a part.

The structure above described merits consideration when cases of axiolites are under examination. On a microscopic scale it is possible to mistake the crack or line of junction between two obsidian fragments for the axis of an axiolite, and the two completely independent bands of spherulitic matter on opposite sides of it for a united axiolitic body.

Lastly, perlitic structure seems to arise in glassy lavas after the spherulitic stage has been passed through, or where it has been rendered impossible by the rapidity of cooling; but a perlitic glass subjected to renewed and sufficient heating ought to present very interesting and striking features of the Rocche Rosse type.

SECTION OF OBSIDIAN OF ROCCHE ROSSE, LIPARI.
× 18.

In the upper part of the field is a large glassy fragment, on the margin of which a thin spherulitic envelope has developed. The main part of the field is occupied by smaller fragments of glass, which have also become devitrified from their outer surfaces inwards.