

28. *On a SPHERULITIC and PERLITIC OBSIDIAN from PILAS, JALISCO, MEXICO.* By FRANK RUTLEY, Esq., F.G.S., Lecturer on Mineralogy in the Royal College of Science, London. (Read April 22, 1891.)

[PLATE XVIII.]

THE specimen upon which the following observations were made is a greyish-green or leek-green obsidian with a waxy lustre, containing numerous deep brownish-red spherulites, ranging from the size of peas to smaller dimensions. It was collected by Dr. A. E. Foote, to whose kindness I am indebted for it.

Under the microscope the thin section shows banded and perlitic structures, the former being delicate and even, while the latter is developed with a perfection which I have never seen equalled. Each perlitic area, as a rule, includes several centres, sometimes five or six, or more, around which perlitic structure has been developed (Pl. XVIII. fig. 1). A similar complex perlitic structure has already been noted in certain dacites by Prof. Judd *. The glass of the obsidian contains numerous globulites and longulites, which are densely crowded together along the fluxion-banding.

The perlitic fissures appear in all cases to have been filled up with siliceous matter, showing, in some instances, minute crystalline rods or fibres, passing from the walls towards the middle of the fissure, where a distinct line of arrest parallel to the walls may be seen. This secondary crystalline matter exhibits double refraction, so that the perlitic structure appears brightly illuminated and in strong relief against the glass of the obsidian, when viewed between crossed nicols (Pl. XVIII. fig. 2).

It is only here and there, however, that these somewhat regular growths from opposite walls of the cracks are to be seen. At times the minute crystalline rods or fibres occur in little divergent groups, and occasionally the growth has also passed from the walls of the crack into the glassy substance of the obsidian, thus giving rise to very minute pellets or spherulites of chalcedony which, when the section is viewed between crossed nicols, cause the perlitic fissures to appear broader than they do in ordinary light. These divergent groupings or spherulitic bodies are very minute as a rule, but in one or two instances, where they are sufficiently large to admit of the determination of their optical sign, they are found to be positive. The longulites which follow the direction of the fluxion-banding seem to pass through the material which has sealed up the perlitic fissures; but this appearance is, of course, deceptive, and is due to the inclination of the cracks to the plane of section, a longulite when partially overlying or underlying an obliquely-inclined crack appearing to penetrate the transparent matter with which the latter is sealed.

* See 'The Volcanic Rocks of the North-east of Fife,' by J. Durham, with an appendix by Prof. J. W. Judd, Quart. Journ. Geol. Soc. vol. xlii. (1886) p. 429.

In addition to the ordinary circumferential perlitic fissures, radial fissures may sometimes be observed, but they do not pass uninterruptedly through a series of circumferential cracks, being merely continuous from one crack to the next.

The dark brownish-red spherulites appear reddish or yellowish brown in thin section, when viewed in transmitted light. Their outlines are sharply defined, and the perlitic structure accommodates itself to their boundaries. From this, and from the fact that no trace of perlitic structure is to be discovered within them, it is evident that the spherulites were formed before the perlitic structure was developed. It might be urged that molecular rearrangement (induced during the formation of the spherulites) might have obliterated any perlitic structure, had such existed, in the areas now occupied by those bodies; but such an hypothesis cannot be entertained, since the delicate fluxion-banding of the obsidian is clearly visible—passing uninterruptedly through the spherulites; and it is evident that, since this structure is preserved, so also would the perlitic structure have been, had it been developed prior to the formation of the spherulites.

The sequence of the structures in this rock admits of no question. The fluxion-banding was developed first, the spherulites were subsequently formed, then perlitic structure was set up, and these fissures were finally sealed by the introduction of chalcedonic matter.

At the point or points (for there are sometimes more than one) from which the spherulites originated, a confused microcrystalline structure may usually be seen, and from this point, or from these points, divergent bundles of delicate fibres or crystalline rods have been developed. Within these fasciculi, finely puckered or wavy transverse banding may be noticed, indicating slight pauses in the crystalline growth, and occasionally the fluxion-bands appear to have offered a temporary check to the development of crystalline bundles which were growing approximately at right angles to the direction of the fluxion-bands. In such cases the band which caused the check has served as the base from which a fresh crop of crystalline bundles has grown (as shown in Pl. XVIII. fig. 3), and in one instance the development of a spherulite has been completely arrested along a fluxion-band, as represented in Pl. XVIII. fig. 4.

In another case a spherulite has been developed prior to the formation of a similar but larger spherulite which encloses it. Some of the spherulites envelop small crystals of triclinic feldspar, as shown in the upper half of fig. 4, Pl. XVIII. They present the appearance either of imperfectly-developed or of corroded crystals, probably the former, and delicate fringe-like processes from the enclosing spherulite may be seen penetrating them for a short distance beyond their margins.

Fig. 5, Pl. XVIII., represents globulites, longulites, and minute pellets of chalcedony occurring in the glassy portions of the rock.

It seems very probable that this obsidian has been subjected to hydrothermal agency since its solidification and the development of its perlitic structure. The siliceous matter with which the perlitic

fissures are filled, and which also occurs in the obsidian itself, either fringing the perlitic cracks or disseminated in small spherulitic bodies, indicates this, while the numerous globulites which are present are probably due to a like cause. Whether solfataric action gives rise to the formation of globulites in vitreous rocks is a question which has not, I think, as yet, been demonstrated; but I may mention that a specimen of spherulitic obsidian, collected by Mr. G. F. Rodwell some years ago in the crater of Vulcano at a point where a powerful jet of steam issued and where sulphur was deposited, no longer presents the bright glassy lustre so characteristic of fresh obsidians, but appears perfectly dull and has a stony instead of a glassy aspect.

In thin section under the microscope the rock is seen to be traversed by a network of fine, irregular cracks, and its loss of lustre is found to be due to the development of innumerable globulites, as shown in fig. 6, Pl. XVIII. The distinctness of the spherulitic structure has also suffered considerably, owing to the devitrification which, in this case, appears very probably to have been engendered by the action of steam.

EXPLANATION OF PLATE XVIII.

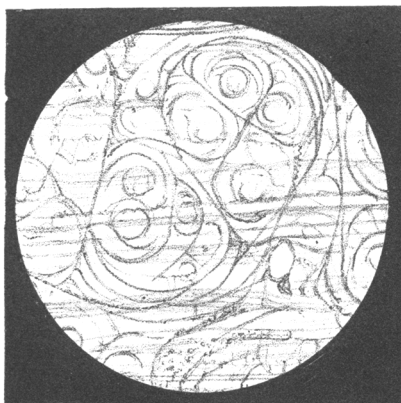
- Fig. 1. Spherulitic and perlitic obsidian from Pilas, Jalisco, Mexico, showing complex perlitic structure and delicate fluxion-banding. $\times 18$ linear. Ordinary transmitted light.
2. Ditto, showing perlitic fissures filled with doubly-refracting siliceous matter (chalcedony). $\times 140$ linear. Crossed nicols.
3. Ditto, showing portion of a spherulite, in which the growth has been temporarily arrested along a fluxion-band, the latter having served as a basis for subsequent growth of the spherulite. $\times 18$ linear. Crossed nicols.
4. Ditto, showing portion of a spherulite, the development of which has been permanently arrested along a fluxion-band. This figure also shows that the perlitic structure does not traverse the spherulite, but that it accommodates itself to the contours of the latter. The fluxion-banding passes through the spherulite. $\times 18$ linear. Ordinary transmitted light.
5. Ditto, showing globulites, longulites, and pellets of chalcedony, occurring in the glass of the obsidian. The fluxion-banding passes diagonally upwards from left to right in this figure. $\times 250$ linear. Ordinary transmitted light.
6. Devitrified spherulitic obsidian from the crater of Vulcano, Lipari Is. Collected at a point from which a powerful jet of steam was issuing. This obsidian is completely, or almost completely, devitrified by the development of globulites. In many parts of the section the globulites are much more densely crowded than in the portion here figured. $\times 250$ linear. Ordinary transmitted light.

DISCUSSION.

Prof. Judd asked whether the Author had any information as to the locality of this interesting specimen, and especially as to its relation with any of the well-known varieties of Mexican obsidians.

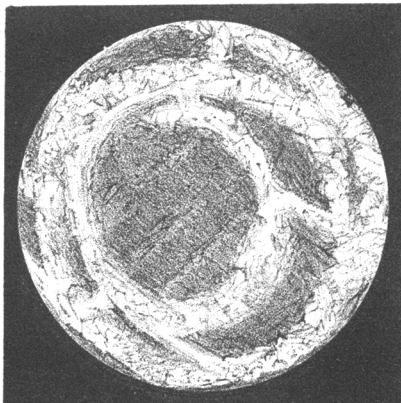
Mr. G. F. Kunz stated that the locality in Jalisco was about one hundred miles west of Mexico city, and one hundred and fifty miles north-west of Pachuca ("Navajas"), the Hill of Knives.

1.



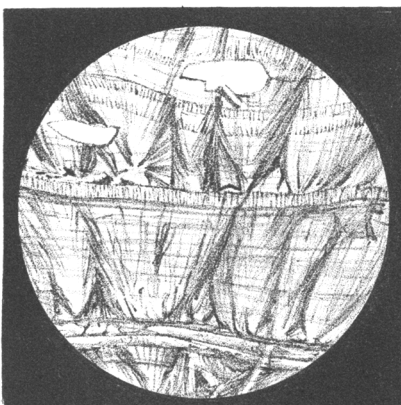
X 18.

2.



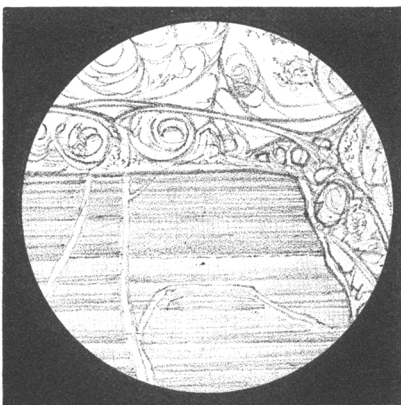
X 140.

3.



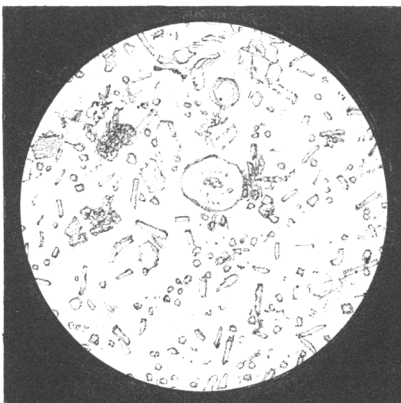
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4.



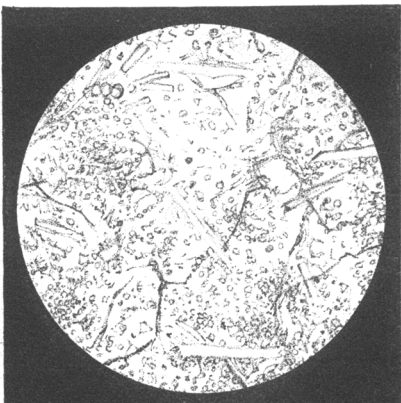
X 18.

5.



X 250.

6.



X 250.

Frank Rutley del. F.H. Michael lith.

Mintern Bros. imp.

1-5. OBSIDIAN FROM PILAS, JALISCO, MEXICO.

6. OBSIDIAN FROM VULCANO, LIPARI IS.

Mr. RUTLEY, in reply to Prof. Judd's remarks, stated that, although the specimen resembled a pitchstone in lustre, he was inclined to believe this due to partial devitrification, as indicated in the paper. It was, however, difficult at times to say positively whether minute bodies, such as globulites, longulites, &c., present in a vitreous rock were developed at the time of solidification or at a subsequent period; but he was disposed to regard them in this case as secondary products. It was fortunate that Mr. Kunz was present and able to describe the locality from which the specimen was derived.