

Banded Precipitates of Vivianite in a Saskatchewan Fireclay.

By J. STANSFIELD, M.A., F.G.S.

(By permission of the Director of the Geological Survey of Canada.)

(PLATE XVI.)

WHEN visiting the fireclay quarry of the Dominion Fire Brick and Clay Products Company at Claybank, Sask., during the summer of 1918, the writer noticed an occurrence of banded precipitates in the fireclay of one part of the quarry. Through the kindness and courtesy of Mr. H. G. Love, Managing Director of the Company, a collection of some examples of the occurrence was made and forwarded to the writer for further examination.

The fireclay worked by the Dominion Fire Brick and Clay Products Company is exposed on the slope of the escarpment of the Missouri coteau, which, at Claybank, is facing north, though generally the coteau faces north-east. Usually, the coteau is covered with drift deposits, and Claybank is one of the few points along it at which the Tertiary strata to which the fireclay belongs are exposed. The fireclay has been described in the reports of the Geological Survey of Canada, and also of the Mines Branch, Department of Mines.¹

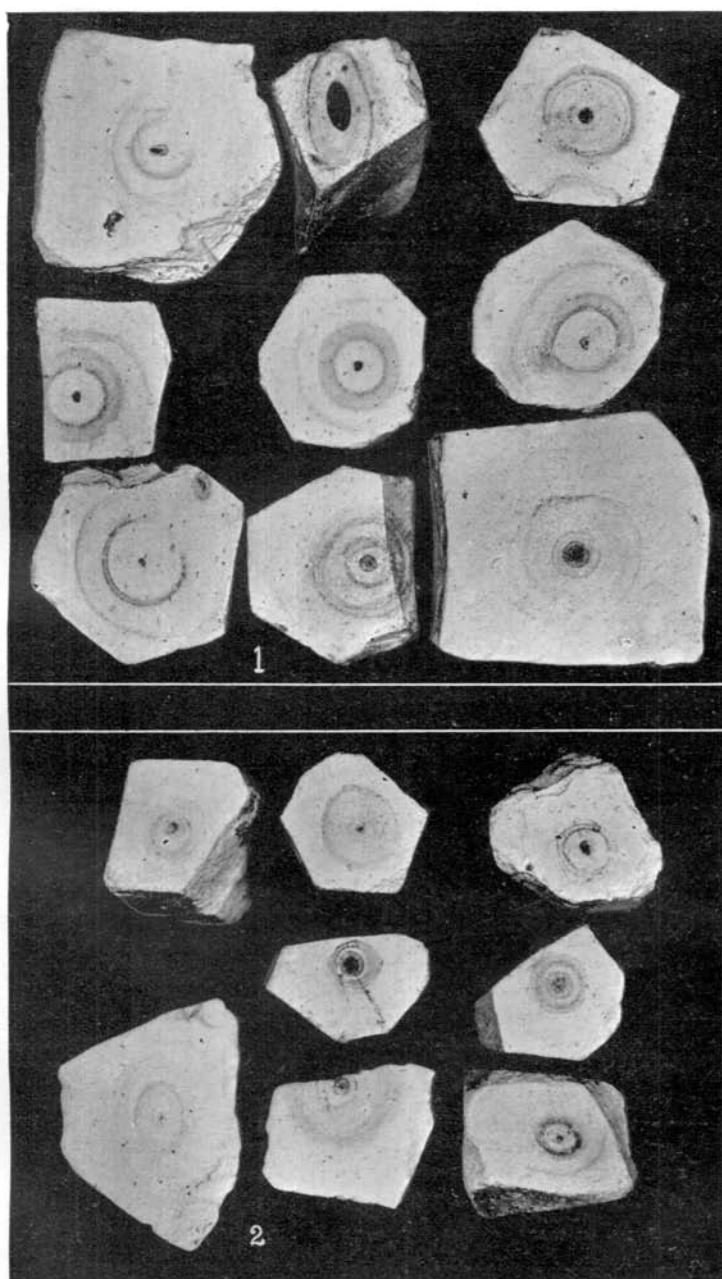
In the quarry the fireclay has a light grey colour. At the northern part of the floor of the quarry, as exposed during the summer of 1918, some bluish-black spots of circular or elliptical outline were noticed, which are the subject of this paper.

The stained parts of the clay are sometimes spherical in outline, sometimes ellipsoidal, and often elongated so as to approach the cylindrical, with rounded ends. The stains vary in diameter from $\frac{1}{8}$ in. to $1\frac{1}{2}$ in., less than $\frac{1}{2}$ in. in diameter being usual. The greatest length of axis noticed in a cylindrical case is one inch, but only part of the whole specimen was available.

The bluish-black stain is deepest in colour at the centre of the sphere, or along the axis of the cylinder. Around the central stain there may be a non-banded stain of less intense colour, or there may be one, two, or three separate concentric stains of similar kind, but not quite so dark in colour as the central stain. In true cross-sections these stains have an approximately circular outline (see Fig. 1 centre), though in some cases the circle may not be complete (see Fig. 1 upper left). Inclined sections of the cylindrical examples show elliptical shapes (Fig. 1, top, middle; Fig. 2, bottom, left and right), and longitudinal sections of the latter show parallel lines on each side of the axis.

The clay between the bands may have the same colour as the normal clay, or it may have a slightly darker colour, owing to the presence of a small amount of the pigmenting material (Fig. 1,

¹ Ries & Keele, *Mem. 24E Geol. Surv. Can.*, 1912, pp. 84-92. Davis, N. B., *Report on the Clay Resources of Southern Saskatchewan*, 1918, pp. 66-71.



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top, middle and right; Fig. 2, top, middle). In some cases one of the bands, or one part of it, may be seen to consist of two or more very closely contiguous bands (see Fig. 1, lower left; Fig. 2, centre, and lower left).

Some examples show bands which are excentric (especially Fig. 2, upper left and bottom, middle).

The bluish-black pigmenting material of these stains loses colour on heating, gives an iron borax bead, dissolves readily in hydrochloric or nitric acid, and gives a definite phosphate reaction. It is presumed that it is the earthy amorphous variety of vivianite. Under the microscope it is opaque, though a few flakes can be found which show a pleochroism and birefringence which agree with those of vivianite.

An examination into the possible mode of formation of these stains brings out several points of great interest. It is supposed that the vivianite has been formed by precipitation as a result of reaction of solutions carrying iron and phosphate, the iron solution being dilute and deriving its iron from the general mass of the fireclay, which contains only a trace of iron, and the phosphate solution being more concentrated and derived from some phosphatic body in the clay. The phosphatic body may have been bone, fish scale or coprolite, if of animal origin, or plant root or stem, if of vegetable origin (phosphates being essential constituents of plants). From the information available at present no definite conclusion can be reached with regard to the original character of the central phosphatic bodies.

From their general characters, as described above, there can be little doubt that the stains under discussion have been formed as a result of diffusion of solutions in opposing directions, as the somewhat similar "rhythmic precipitates" are formed in gelatine, agar, etc.¹ In the opinion of the writer the colloidal material of the fireclay itself formed the medium through which the diffusion took place. The vivianite bands are unlike Liesegang rings, which become wider apart away from the centre of diffusion, and they are also unlike the modifications produced by the writer, which are evenly spaced under certain conditions, or becoming closer together away from the centre of diffusion under certain other conditions (op. cit., pp. 19-21 and 24).

Examination of the accompanying photographs will show how the spacing of the bands of vivianite varies and appears to follow no law which has yet been worked out in connexion with banded precipitates. In discussions of banded precipitates which have appeared up to the present time the effect of the medium through which diffusion takes place, upon the reaction, has either been supposed to be very slight, or has been neglected. When dealing with certain reactions in gelatine the effect of the medium appears

¹ *Amer. Jour. Sci.*, Ser. IV, vol. xliii, 1917, pp. 1-26

to be very slight. In the case of the reaction of potassium iodide and lead nitrate in gelatine, the medium appears to have some distinctly disturbing effect upon the reaction (op. cit., p. 25). The precipitates formed in the experiments cited appeared to be continuous, even to microscopical examination. When the plate on which the reaction had been carried out was placed in a bath of sodium hydroxide solution, a set of bands appeared suddenly in the lead iodide precipitate, and they resembled the vivianite bands under discussion in their apparently irregular spacing and also in the presence of precipitate throughout the spaces between the bands, which also occurs in some cases of the vivianite precipitate in fireclay.

It is to be expected that investigation of the effects of the media upon the reactions of solutions diffusing through them will add very considerably to our knowledge of banded precipitates.

Note on the Llwydmor Bach Granophyre.

By ALBERT HEARD, M.Sc., F.G.S., University College of South Wales and Monmouthshire.

[This paper was submitted to the Editor of the Magazine three weeks before the publication of Mr. N. L. Silvester's paper.¹ I commenced work on the area early in the summer of last year, and apparently Mr. Silvester began at about the same time, but as he has secured priority of publication I have decided to postpone further work and publication on the district.—A. H.]

[Mr. Silvester's paper was in the Editor's hands for some months before publication. It was sent to the printers before the existence of Mr. Heard's MS. was known to the Editor.]

I. INTRODUCTION.

THE rock which is described in this communication, occurs along the western flank of Llwydmor Bach, about 6 miles east-south-east of Bangor, and about 8 miles south-west of Conway. On the 1 in. map of the Geological Survey,² this rock, together with entirely different types on its eastern margin, are all marked as intrusive felspathic rocks. On the $\frac{1}{4}$ in. map,³ it is described as granite, and its eastern boundary is mapped.

The outcrop of the rock is in the form of an elongated lenticular mass, about 3 miles long by $\frac{1}{2}$ mile wide, with the long axis having a direction north-north-east—south-south-west (approximately).

In the field the typical rock weathers generally into relatively thin flaggy slabs, which occupy the lower crests of Llwydmor Bach, and form small screes on the slopes.

Two distinct rock types are present; the interior of the laccolith consists of a granophyre, whilst near the margin practically all

¹ GEOL. MAG., Vol. LIX, 1922, p. 134.

² Sheet 78 S.E. Geol. Surv. of England and Wales, Old Series, 1852.

³ Sheets 9 and 10, $\frac{1}{4}$ in. Geol. Surv. of England and Wales.