Notice of an occurrence of niccolite and ullmannite at the Settlingstones mine, Fourstones, Northumberland; and of serpierite at Ross Island mine, Killarney, Co. Kerry, Ireland.

By Arthur Russell.

[Read January 18, 1927.]

THE old mine Settlingstones, situated three miles north of Haydon Bridge in the county of Northumberland, was originally worked as a lead mine, but, during the last fifty years, as the vein has been explored farther west, it has attained far greater importance as the largest and most consistent producer of witherite in the British Isles. The Settlingstones main vein has a direction approximately north-east and south-west, and has been proved for a distance of nearly $1\frac{1}{2}$ miles. The vein has varied in width from 3 feet up to 40 feet, the most productive witherite-bearing portion averaging 10 to 12 feet. The enclosing rocks are sandstones ('whetstones') and shales ('plate') of Carboniferous age, and dolerite (Whin-sill) which here attains a thickness of a little over 21 fathoms.

In January 1925 I received from my friend the late Mr. Sydney F. Watson, manager of the mine, specimens of niccolite which had been found there in July 1924. I at once visited Settlingstones, but unfortunately, owing to a heavy fall of ground and influx of water, the spot has not since been accessible. Mr. Watson, however, furnished me with exact particulars as to the mode of occurrence. His description is as follows: 'In the 90 fathom level we discovered a "pipe" of galena yielding 15 tons to the fathom which we worked up to the 70 fathoms level in corkscrew fashion. Near the 70 fathom level we discovered the niccolite lying by the side of the galena and next to the Whin-sill side or north side of the vein, the south side of the vein at this point being shale ('plate').[1] The niccolite was in a distinct string about 4 inches thick by 3 feet wide, and we worked this with the galena for about 2 fathoms,

[1] Many of the specimens I have examined have adhering grey micaceous sandstone, showing that the vein was in part enclosed by that rock.

when the collapse took place. I might mention that just before the collapse took place we found some antimonial lead, but not in very large quantities.' Mr. Watson most kindly afforded me every opportunity of looking over the niccolite, of which there was perhaps a little over half a ton raised. In view of the fact that ullmannite had been found some years ago in the 'barytes-witherite vein at New Brancepeth Colliery, Co. Durham,[1] I was particularly on the look out for this mineral, and was

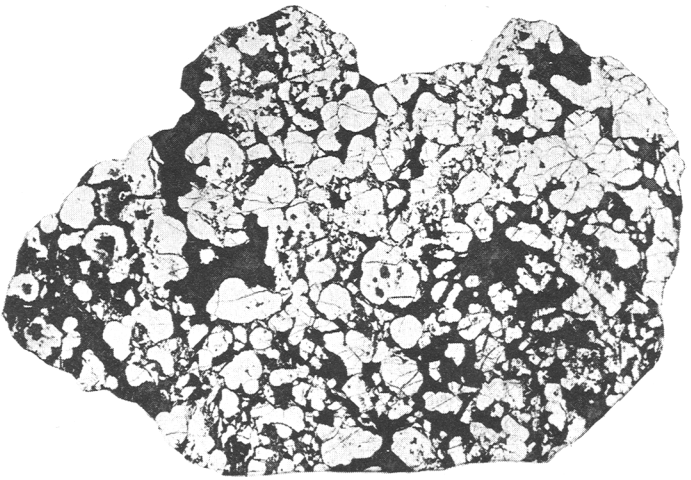

FIG. 1. Polished surface, showing roughly spherical niccolite, with blende, ullmannite, and witherite. ($\times \frac{6}{7}$.)

rewarded by finding it to be present, though in small quantity, intimately associated with the niccolite.

Typical specimens of the ore show a preponderance of niccolite intimately associated with blende, usually some galena, and very much smaller quantities of ullmannite, the interstices between the metallic minerals being filled by white witherite and sometimes a soft grey micaceous sandstone. The niccolite has the characteristic pale copper-red colour, has a finely crystalline structure, and shows a very marked tendency to assume roughly spherical forms; the exterior of some of the masses being very definitely botryoidal, with a drusy dark grey surface. The structure of the ore is beautifully shown in polished sections, which also enhance several interesting features. Fig. 1 is a photograph of a polished section showing the spherical niccolite, sometimes with a dark

[1] L. J. Spencer, Min. Mag., 1910, vol. 15, p. 302.

nucleus of blende. The dark areas are white witherite, the rather lighter, brown blende. The ullmannite is indistinguishable in this photograph from the niccolite except where it has a minutely cubical outline. The blende, which often forms a large proportion of the mass, is more or less fine-grained, has a resinous brownish-yellow colour, and does not occur crystallized. Galena is present in most specimens, but in much smaller quantity. It is for the most part segregated away from the richer

FIG. 2.

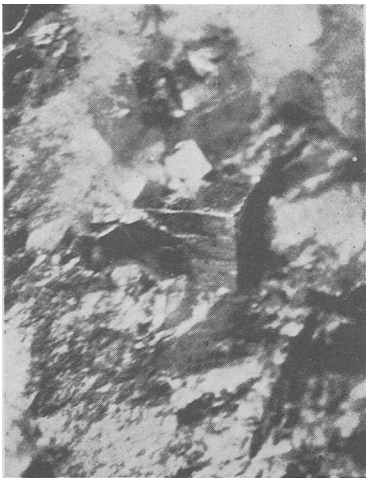

FIG. 3.

Fig. 2. Polished surface, showing cubes of ullmannite in witherite (dark), with niccolite. (×18.)

Fig. 3. Cubes of ullmannite, with witherite, and niccolite. (×18.)

masses of niccolite which only show occasional small strings of galena in the polished specimens. Some of the rich masses of niccolite from the side of the vein show slickensided surfaces with a thin coating of galena. Ullmannite appears in relatively small quantity, but is present on practically all the specimens examined. In the polished sections the mineral is seen to form irregular fringes around the niccolite and strings running through it, and also more rarely as minute cubes in the groundmass of witherite. Fig. 2 is a photograph of a part of the polished section shown in fig. 1, under a higher magnification. The small isolated masses are ullmannite, one of which is a distinct cube, the dark groundmass is witherite, and the large light-coloured masses are niccolite. On a few specimens are very small, bright silver-white, and well-defined inter-

penetrating cubes of ullmannite, projecting from the white witherite, and it was upon these that a qualitative chemical test was made to determine the nature of the mineral. The largest crystal observed has a diameter of about 1 mm. No forms other than the cube are present. Fig. 3 shows one of these isolated cubes with the characteristic pyrite-like striations. Minute crystals of pyrite were observed on the surface of one of the masses of niccolite-blende ore. I have not been able to obtain a specimen of the 'antimonial lead' mentioned by Mr. Watson, and it is therefore impossible to say whether the antimony was present in the galena or as an admixture of ullmannite. The occurrence of niccolite in a witherite vein in rocks of Carboniferous age is interesting, and the specimens are by far the best examples of the species so far met with in the British Isles. My especial thanks are due to Mr. E. P. Deas, of the Settlingstones Company, for permission to publish this record, and to Mr. A. F. Hallimond for photographing the polished sections.

Serpierite.[1]

The rare mineral serpierite has hitherto been recorded from one locality only, the Kamareza section of the Laurion mines in Greece. In the present notes I am able to record its occurrence at the old copper mine of Ross Island, Killarney, Co. Kerry, Ireland, where, in 1914, I found several well-defined specimens on the old dumps.

The Ross Island mine[2] is situated on the southern shore of Ross Island on Lough Leane or Lower Lake, Killarney (Six-Inch Ordnance Map, Kerry 66). It had been worked at intervals from very early times, the periods of its greatest activity being 1804 to 1810 and from 1825 to 1829, since when no regular mining has been done. The copper ores were apparently exceptionally rich, and ore to the value of over £100,000 was obtained. The ores are chalcopyrite, tetrahedrite, and bornite, and they form pockets, irregular patches, and strings, along with calcite in

[1] Serpierite was described by A. Des Cloizeaux in 1881 as a hydrated basic sulphate of copper and zinc. The only quantitative analysis that has been made of the mineral is one by A. Frenzel (Tschermaks Min. Petr. Mitt., 1894, vol. 14, p. 121), who found also CaO 8·00 %. The formula was written as $3(Cu,Zn,Ca)SO_4 + 3H_2O$, and it has been so copied. This was, however, evidently intended to be $3(Cu,Zn,Ca)O.SO_3.3H_2O$. But this also is an error, for a slip was made in calculating the molecular ratios. From Frenzel's analysis the ratios are $(Cu,Zn,Ca)O : SO_3 : H_2O = 2{\cdot}21 : 1 : 3{\cdot}07$.

[2] A detailed and interesting description of this mine is given, along with a plan and section, by Thomas Weaver, F.R.S., in his Geological Relations of the South of Ireland, 1830–1835.

a thin bed of bluish-grey Carboniferous Limestone, underneath which is a bed of highly siliceous limestone completely barren of metallic minerals. There also occurred rarely native copper, cuprite (both crystallized and as tile-ore), malachite, and chessylite. Of the two former I found one specimen showing small spike-like sprigs of native copper upon which are implanted minute octahedra of cuprite, occupying a cavity in yellowish crystalline limestone. The deposit as a whole is perfectly illustrated on a small scale by hand-specimens of the ores which may be obtained from the dumps. At the eastern end of the workings is a large water-logged open-work known, from the colour of its waters, as the Blue Hole, and it was from the dump debris from this that the specimens of serpierite were obtained. The ores worked in the Blue Hole were in the northern part chalcopyrite, and in the southern a fine-grained intimate mixture of blende, galena, pyrite, and a little chalcopyrite, exactly similar to the so-called 'blue stone' of the Parys and Mona mines, Anglesey, and to ores occurring at the Ovoca mines, Co. Wicklow. Smithsonite ($ZnCO_3$) is also tolerably abundant as brownish cellular and minutely stalactitic masses, containing spots of galena and chalcopyrite, and it is in cavities of this smithsonite that the serpierite occurs; this association and the appearance of the specimens being precisely similar to that prevailing at Laurion. The serpierite forms very small greenish-blue spherical aggregates or tufts (0·5 mm. in diam.) composed of minute crystals flattened parallel to $c(001)$ and elongated in the direction of the a-axis. The crystals are too small to permit of measurement, but under the microscope they show an outline which, besides being elongated in the direction of a, suggests that they are bounded at the ends by $m(110)$. The cleavage is parallel to c, which has a distinctly pearly lustre. The mineral is optically biaxial and negative, with the acute bisectrix perpendicular to c (001). Refractive index slightly above 1·59. Pleochroism weak. A qualitative test proved the presence of Cu,Zn,Ca,SO_3 and H_2O. Other small cavities on the specimens described are lined with a pale-blue wool-like mass of very minute crystals, which also appear to be serpierite. To Mr. Campbell Smith I am indebted for the determination of the optical characters.