Chemical analysis of ullmannite from New Brancepeth, Co. Durham

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THE first occurrence of this mineral in Britain was announced by L. J. Spencer[1] who found it in the great baryte-witherite vein at New Brancepeth, near Durham. It was found later by Sir Arthur Russell[2] in the witherite vein at Settlingstones, Northumberland.

Spencer proved the presence of antimony in considerable quantity and of sulphur, and returned the nickel as 27·87 %, a quantity which agrees well with the accepted formula, NiSbS; the specific gravity was given as 6·70. In view of the rarity of the mineral and its scientific interest, a complete analysis was deemed advisable, and I have carried this out on a specimen from New Brancepeth, which came into my hands not long after its discovery.

This specimen contained some calcite, which was removed as far as possible by hand-picking the coarsely crushed material; though this was not entirely successful as the analysis showed the presence of 1·57 % of calcium carbonate. There was also 3·93 % of lead present as galena and, rather surprisingly, cold water extracted from the finely powdered mineral no less than 0·9 % of ferrous sulphate. Solution of the mineral in aqua regia left a small residue of quartz. The complete analysis given below shows 8·71 % of these four adventitious constituents; the mode of combination of the remaining 90·93 % will be discussed shortly.

Ni	23·44	$FeSO_4.7H_2O$	0·90
Fe	2·94	$CaCO_3$	1·57
Sb	49·74	PbS	4·54
As	0·95	SiO_2	1·70
S	13·86		99·64
		Sp. gr.	6·73

A section of the polished mineral, examined microscopically in reflected light, did not show the parallel intergrowth of galena and ull-

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

[2] A. Russell, Min. Mag., 1927, vol. 21, p. 383.

mannite observed by Spencer. The galena and calcite occurred together as an infilling of cracks in the ullmannite, and in places the galena could be seen as idiomorphic crystals in the matrix of calcite. There was no evidence of pyritic minerals, so that it may be inferred that the iron and arsenic with their equivalent of sulphur were not present as pyrite, pyrrotine, or mispickel. The origin of the ferrous sulphate is thus, probably, from an external source; in other words, it is an infiltrated addition. Arsenic is clearly in isomorphous association with antimony, and a similar relationship may be accepted for iron and nickel. These inferences are confirmed by the simple relationship between the following molecular ratios:

$$(\mathrm{Ni,Fe}):(\mathrm{Sb,As}):\mathrm{S} = 1{\cdot}05:1:1{\cdot}01$$

and the formula of the mineral may thus be expressed as $(\mathrm{Ni,Fe})(\mathrm{Sb,As})\mathrm{S}$. Deducting impurities and calculating to 100 %, the composition of the mineral is given under I, and the calculated composition for the simple formula NiSbS under II.

	I.	II.
Ni	25·8	27·6
Fe	3·2	—
Sb	54·7	57·3
As	1·0	—
S	15·3	15·1
	100·0	100·0