Excursion to Durham and the northern Pennines.

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THE decision of the Council to organize an excursion, the first since the Jubilee of the Society in 1926, arose from an invitation presented by Dr. A. E. J. Vickers, on behalf of Imperial Chemical Industries Ltd., to visit the anhydrite mine at Billingham. During the excursion the opportunity was also taken of visiting mineral localities in the northern Pennines (west Durham and Cumberland) under the leadership of Professor Wager and the writer. Accommodation was arranged in Durham at University College (by kind permission of the Master), and here, housed in the ancient castle, members enjoyed a comfortable stay. Transport each day was by private coach. The excursion was organized by Dr. G. F. Claringbull; the thanks of members are also due to Mr. E. Myers, secretary of the north-east section of the Society of Chemical Industry for his help in making local arrangements.

The following attended: The President, Dr. W. Campbell Smith (London), W. Anderson (Newcastle), P. D. Blake (Manchester), G. F. Claringbull (London), K. C. Dunham (London), J. Drugman (Liége), T. J. Duffy (Dublin), R. C. Evans (Cambridge), G. S. Gowing (Billingham), Mrs. K. Lonsdale (London), D. M. C. MacEwan (Harpenden), G. H. Osborn (Aylesbury), J. V. Ramsden (Honiton), J. E. Richey (Edinburgh), L. J. Spencer (London), R. C. Spiller (Oxford), F. H. Stewart (Durham), J. H. Taylor (London), S. I. Tomkeieff (Newcastle), A. E. J. Vickers (Billingham), L. R. Wager (Durham), R. C. Walsh (Blackpool), D. G. A. Whitten (Billingham), Miss D. E. Wisden (Newcastle), J. D. H. Wiseman (London).

The party assembled in Durham on the evening of 1st July.

Tuesday, 2nd July.—The main objective on the first day was the Rotherhope Fell lead mine, near Alston, Cumberland. The route followed took the party across the western part of the Durham coalfield to Tow Law, formerly the site of an important iron industry smelting ores from the Pennine metalliferous veins, but now derelict. Thence the 'Millstone Grit' was crossed and between Wolsingham and the head of Weardale rocks of the Upper and Middle Limestone groups of the Carboniferous Limestone Series could be seen making terrace-like features

on the hillsides. The Cumberland border was crossed at the pass of Killhope (2056 feet), where the Wear River rises, and passing through Nenthead and Alston, Rotherhope Fell mine, situated on the Black Burn, a tributary of the South Tyne, was reached.

At the mine, which is owned by the Vieille Montagne Zinc Co. Ltd. (Manager, Mr. Amos Treloar, J.P., M.I.M.M.), the party was conducted

FIG. 1. Rotherhope Fell lead mine.
(Photo. by Dr. G. F. Claringbull.)

round the workings by Mr. G. Robinson. The deposits consist of metasomatic flats replacing the Tynebottom Limestone (Middle Limestone Group: 22 feet thick), on both sides of the ENE. Rotherhope Vein. The quartz-dolerite Whin Sill, here 180 feet thick, directly underlies the limestone, and vein-oreshoots were formerly worked in the sill at this mine. The minerals in the flats include chalcedony, opal, quartz, fluorite, galena, blende, marcasite, chalybite, ankerite, and calcite. The flats occur beneath a flat-topped anticline which follows the vein, and are clearly related to minor fissures which diverge from it.

We rode (fig. 1) into the mine by way of the Blackburn Level, engineered by Smeaton in 1837. The level runs southward as a crosscut through a shallow syncline in the 'Alternating Beds' (above the Tyne-

bottom Limestone); we noted a minor waterfall where Victoria Vein was cut by the level. On reaching Rotherhope Vein, the level runs WSW. From this the north side flats were reached by way of an incline, and pillars typical of the deposit were examined. In one of them Mr. Walsh pointed out a pink incrustation of erythrite which he had discovered on a previous visit. From these pillars we proceeded along the north side of the vein to the south-west end of the workings, where crystals of calcite, fluorite, and marcasite were obtained. The incline was then followed down to the south-side flats which lie approximately 35 feet below those on the north side owing to the throw of the vein. Here specimens of 'White Whin', a calcitized, sericitized, and silicified modification of the quartz-dolerite resulting from the action of the mineralizing fluids, were collected.

Lunch was eaten in the sunshine outside the mine, and after a brief visit to the gravity mill where the lead ore is dressed, the journey was resumed. Near Alston a stop was made at the old Blagill mine, the well-known locality for barytocalcite, good examples of which were collected from the dumps. Tea, probably the most memorable meal of the excursion, was taken at the Nenthead Hotel. Nearby is the flotation plant which was erected during the war to recover zinc from the 600,000 tons of dumps at Nenthead; this operation has now been completed.

A final stop was made at the outcrop of Old Moss Vein, in Killhope Burn, which is exposed in the Great Limestone. A channel-sample across this outcrop, taken in 1940, assayed as follows: SiO_2 14·6, total Fe 29·3, Mn 2·3, MgO 1·5, CaO 10·6, CO_2 15·7, Zn 3·2, Pb 1·2, S 1·4, F 3·3 (Geological Survey Lab., No. 1170).

Wednesday, 3rd July.—A short journey from Durham brought the party to New Brancepeth colliery, where, by courtesy of the New Brancepeth Coal Co. Ltd. (Manager, Mr. G. S. Watson), we visited the workings on one of the baryte oreshoots associated with the Deerness fault. Before arriving Dr. Spencer[1] recalled the circumstances of his discovery of ullmannite and alstonite at this mine in 1910.

Under the leadership of Mr. A. Harrison and six of his staff, the deposit was reached by way of the colliery shaft, and a somewhat arduous walk along a drift in the Harvey Seam, the highest seam worked at this colliery. It lies in a fault striking ENE. and downthrowing 120 feet N.,

[1] L. J. Spencer, On the occurrence of alstonite and ullmannite in a barytes-witherite vein at New Brancepeth Colliery, near Durham. Min. Mag., 1910, vol. 15, pp. 302–311.

considered to be the continuation of the Coldberry–Sharnberry vein-system of the northern Pennines.[1] The ore-shoot varies up to about 25 feet wide, the filling being baryte, with a little witherite in places, particularly near the walls; an average analysis of monthly shipments during the year ending March 1945 gave $BaSO_4$ 90·28, $BaCO_3$ 2·36, SiO_2 3·64, $Fe_2O_3 + Al_2O_3$ 1·50, Mn_3O_4 0·18, $CaSO_4$ 0·20, Cu 0·013, ZnS 0·31, PbS 0·71, ignition loss 0·86 (from analyses by Athole G. Allen (Stockton) Ltd.). It is worked by a series of levels reached from an underground shaft and winzes below the Harvey coal, and the visit involved climbing numerous ladders. Crystals of baryte and witherite were obtained, and an efflorescence containing nickel-bearing goslarite, first analysed by Dr. J. A. Smythe,[2] was collected; a new examination of one of the samples obtained, made by Mr. G. H. Osborn, showed the presence of 1·9 % $NiSO_4.7H_2O$. Another sample taken by Mr. G. S. Gowing was analysed by Mr. H. N. Redman of Imperial Chemical Industries and showed: $ZnSO_4.7H_2O$ 88·5, $MnSO_4.7H_2O$ 2·6, $FeSO_4.7H_2O$ 4·6, $MgSO_4.7H_2O$ 4·3. Nickel was not present in this sample.

Lunch was taken at the colliery canteen, through the kind permission of the miners' committee, and afterwards the party proceeded by bus to Annfield Plain, where the witherite dressing plant and barium chloride plant of the Holmside and South Moor Colliery Co. were examined. Here our guide was Mr. E. W. Muddiman, B.Sc., F.R.I.C., who has published a description of the mining and treatment of witherite.[3] The ore is mined from a fault in the Middle and Lower Coal Measures; it consists largely of witherite with minor amounts of baryte, pyrite, and calcite. A visit was also paid to Mr. Muddiman's laboratory, where systematic assays of vein- and product-samples are made.

After dinner at the Castle, Professor L. R. Wager took the party round the Geology Department of the Durham Division of the University; a feature of special interest was his material from Greenland. The evening ended with an entertainment at Professor Wager's house.

Thursday, 4th July.—Weardale was again visited, the objective being the Stanhopeburn fluorspar mine, north of Stanhope, belonging to Fluorspar Ltd. Here, under the guidance of Mr. W. Herdman, the manager, we were conveyed underground in mine cars, along Shield

[1] K. C. Dunham and H. G. Dines, Barium minerals in England and Wales, Geological Survey Wartime Pamphlet, 1945, no. 46, pp. 64–66.

[2] J. A. Smythe, Nickel-bearing goslarite, epsomite and melanterite from County Durham. Vasculum, 1933, vol. 19, pp. 12–17. [M.A. 5-283.]

[3] E. W. Muddiman, Witherite. Journ. Oil and Colour Chemists' Assoc., 1942, vol. 25, pp. 127–142. [M.A. 8-336.]

Hurst Level. The deposit is a complex of ore shoots on the ramifying branches of the Red Vein, one of the most persistent WNW. veins of the Pennines. Widths of fluorite of about 20 feet occur here, where the veins cut the Great Limestone and the thick underlying sandstone. Minerals present other than fluorite include subordinate amounts of quartz, galena, calcite, ankerite, and marcasite. From Shield Hurst

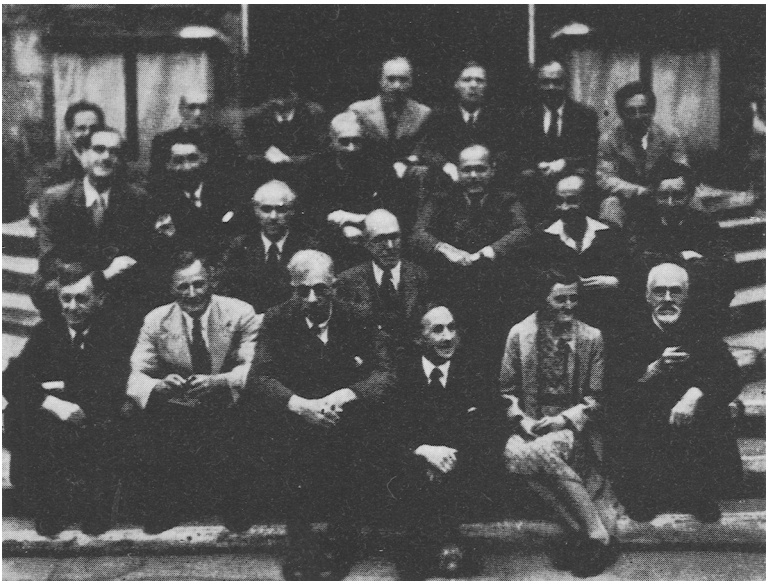

FIG. 2. At the Castle, Durham.

Drugman, Stewart, Duffy, Blake, Tomkeieff, Osborn, Evans, Dunham, Wager, Taylor, Richey, Wiseman, Walsh, MacEwan, Spiller, Anderson, Ramsden, Campbell Smith, Miss Wisden, Spencer. (Photo. by Dr. G. F. Claringbull.)

level, we descended the Beaumont underground shaft and proceeded through a series of impressive shrinkage stopes, returning to the shaft by way of the 17-fathoms level.

From Stanhope we continued up the valley to St. John's Chapel, then crossed the Harthope pass to Teesdale. Here Mr. Anderson pointed out ganister workings on a siliceous sandstone near the horizon of the Fell Top Limestone. Professor Wager now took over the party and under his guidance High Force quarry in the Whin Sill was visited, specimens of pectolite and zeolites being secured as well as material representative of the gabbroid facies of the sill. The High Force was briefly visited;

then followed tea at the Hotel. Afterwards a call was made at Wynch Bridge to see the alteration of the Whin Sill by lead-vein solutions,[1] associated with fissures feeding small metasomatic deposits in the Single Post Limestone. The dump from war-time exploration of one of these was visited, where blende-chalybite ore, assaying SiO_2 2·9, Al_2O_3 1·3, CaO 5·5, MgO 1·7, Fe 24·6, Zn 19·4, Mn 3·2, S 9·6, BaO trace, CO_2 21·1, F trace (Geological Survey Lab. No. 1091) was examined.

This concluded the tour of the metalliferous mines; typical localities in the fluorspar, fluorspar-galena, galena-blende, and barium zones[2] having been visited.

Friday, 5th July.—The last day of the excursion was devoted to a visit to the anhydrite mine and plant of Imperial Chemical Industries at Billingham, south of Durham. Here we were met by Dr. A. E. J. Vickers, Mr. G. S. Gowing, Miss E. Napier, Mr. D. G. A. Whitten, and Mr. E. R. Johnson, and conducted to the mine where the party was taken underground by Mr. G. E. Stewart and Mr. J. T. Owen. The anhydrite deposit worked is a bed 20 feet thick near the middle of the south Durham Permo-Triassic succession having an average dip of 1 in 19 in a direction S. 47° E. The bulk analysis[3] of the mine output over a year is: $CaSO_4$ 90·5, SiO_2 2·1, NaCl 0·006. Detrital minerals present in minor amounts include muscovite, biotite, paragonite, quartz, hornblende, fluorite. The mine is worked from two shafts which reach the anhydrite at a depth of 778 feet below surface. We were conveyed along the impressive main haulage road, 18 feet wide, in a train hauled by an electric locomotive. Workings to the rise and dip were then examined, where features of interest seen included large gypsum crystals in the anhydrite, and an 'intrusion' of red marl and dolomite in the roof of the seam showing evidence of plastic deformation.

The party was entertained to lunch at the works after the visit to the mine; in addition to members of the directorate and staff mentioned above, Mr. A. T. S. Zealley, Dr. M. P. Applebey, and Dr. I. J. Faulkner were also present. There was time for a stroll in the sunshine in the pleasant sports grounds near the works before the next event, which was a talk on sulphate crystallization, illustrated by slides and films, by Mr. J. W. R. Rayner. In this Mr. Rayner gave an account of the

[1] L. R. Wager, Metasomatism in the Whin Sill of the North of England. Part I: Metasomatism by lead vein solutions. Geol. Mag., 1929, vol. 66, pp. 97–110.

[2] K. C. Dunham, The genesis of the north Pennine ore deposits. Quart. Journ. Geol. Soc., London, 1934, vol. 90, pp. 689–720. [M.A. 6–367.]

[3] G. E. Stewart, Billingham mine. Bull. Inst. Mining Metall., 1946, no. 480, pp. 2–4.

work done on the control of the crystal-form of the ammonium sulphate. It had been found that the normal untwinned orthorhombic form was subject to excessive wear, and that it also caused compacting when the sulphate was stored. The product was much more satisfactory when a stout pseudo-hexagonal twinned form predominated.

After a visit to the sulphate-crystallization plant and the cathedral-like storage silo, the party had tea and the excursion came to an end.