THE MINERALOGICAL MAGAZINE

AND

JOURNAL OF

THE MINERALOGICAL SOCIETY

No. 205 June, 1949 Vol. XXVIII

The Wherry mine, Penzance, its history and its mineral productions.

(With Plates XXVI–XXVIII.)

By Sir ARTHUR RUSSELL, Bart.

[Read March 9, 1939.]

IF the visitor standing at Wherry Town on the south-western end of the esplanade at Penzance looks seaward he will observe at low tide at some distance from the shore a low seaweed-clothed rocky shoal (fig. 1), and from his now very conventional surroundings it is difficult to realize that upon this shoal, always surrounded by water, there existed many years ago a rich tin mine, unique in the boldness of its conception, romantic in the extreme in its situation and execution, and withal the effort of a poor working miner.

Very fortunately in the year 1790, during the hey-day of its career, this remarkable mine was examined by a very competent observer in the person of John Hawkins (1761?–1841), F.R.S., of Trewithen, Cornwall, and Bignor Park, Sussex, and it is to him that we owe most of the details concerning its mode of working, &c.[1] The Wherry mine and its history have always fascinated me, as they must have many others, and in re-telling the old story I have endeavoured to collect all the known facts, both as to the mine itself, its mode of working, and its mineral productions, and in so doing pay tribute to its gallant and resourceful originator Thomas Curtis.

The low coast forming what was originally a part of the Western Green

[1] John Hawkins's account of the Wherry mine was published in four periodicals, two English, one French, and one German (see references at end). They are all substantially the same, that in the Annual Register being a little fuller; here he gives the date of his visit as 1790, whereas in Trans. Roy. Geol. Soc. Cornwall he gives it as 1791, the former being probably correct.

and now covered by Penzance esplanade and Wherry Town is composed of metamorphosed slaty rocks in part alternating with greenstone, these being well exposed at Lariggan Rocks a little to the west of the Wherry mine, where they contain much axinite in strings and lenticles. The foreshore has a sloping shingle beach through which rock projects at and below low-water mark. At a distance of about 240 yards from the coast and nearly parallel with it, the slate is traversed by an elvan or quartz-felspar-porphyry dike which has a south-westerly direction

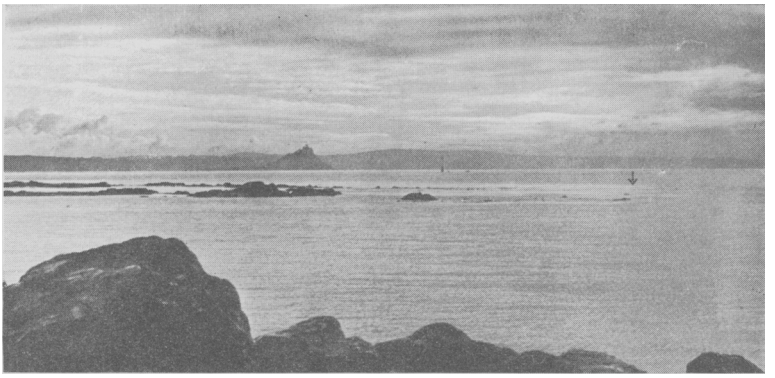

FIG. 1. View of the Wherry Rocks, with Lariggan Rocks in the foreground and St. Michael's Mount in the background. The site of the Wherry mine shaft is marked with an arrow at the farthest shoal. Photo by A. W. G. Kingsbury, 1948.

and dips north-west at an angle of 60° to 70°, and it was upon a stanniferous portion of this dike that the Wherry mine was sunk. The elvan, which is very variable in width, can be traced at low water from the Battery Wharf to Wherry Rocks, a distance of some 830 yards, but farther west towards Newlyn is not again visible (Boase, 1834). The map (fig. 2) is a reduced portion of the six-inch Ordnance map upon which has been marked the exact position of the elvan dike and the Wherry mine shaft. There is also some evidence that a definite lode intersecting the elvan was met with in the workings. The two mining prospectuses of 1834 and 1836 (further referred to below) mention a lode containing copper and a cobalt lode, the latter having a north and south direction; while William Jory Henwood writing of the mine in 1843 says that 'the masses and veins of the oxide of tin, which are distributed through it [the elvan] without regularity, rather appear to follow the intersection of the elvan by the Black lode'. This latter statement is tantalizing, for the nature of the Black lode is nowhere

mentioned. The mine, as will be shown, was worked at three periods.

First working.—Of this our knowledge amounts to little more than tradition. Early in the seventeen-hundreds it was known that one particular section of this elvan dike exposed at low tide was traversed by veinlets of very rich cassiterite, the adjacent rock also being more or

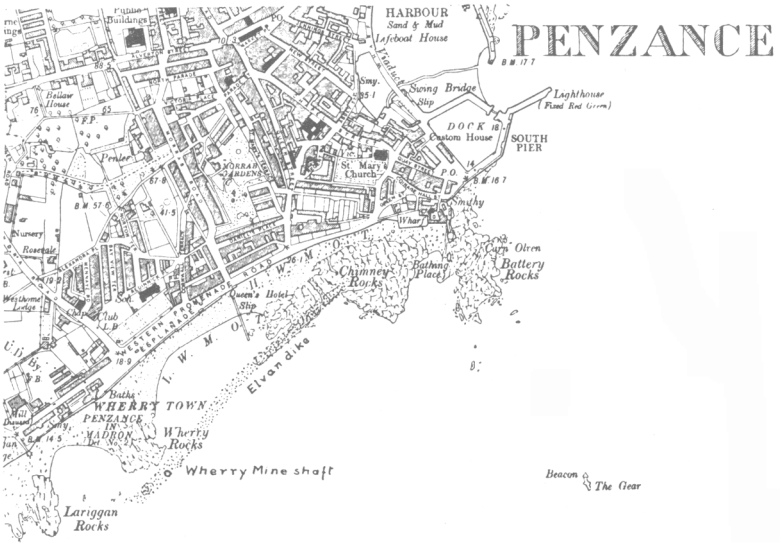

FIG. 2. Six-inch Ordnance Survey map, Cornwall 74 NW., second edition (1909), on which the positions of the elvan dike and the Wherry mine shaft have been marked. Reproduced ($\times \frac{2}{3}$) with the sanction of the Controller of H.M. Stationery Office.

less thickly charged with spots of the same mineral, and in consequence miners were tempted, when weather conditions and tide permitted, to remove the more easily accessible ore, until eventually the excavation so made, which according to Hawkins was few fathoms in depth, became untenable and the working was reluctantly abandoned to the waters. Ore-books of the old Angarrach smelting works contain entries of tin-ore bought in 1713 and 1714 from Penzance Work and Wheal Kathen, Penzance, either of which may well have been in the Wherry elvan.

Second working.—About the year 1778 Thomas Curtis (fig. 3), a working miner from Breage, then aged 57 and whose total property, Hawkins says, was not worth fifty crowns, became interested in the spot and conceived the bold idea of working it as a mine proper. With this end in view he commenced, apparently single-handed, to sink a very small

shaft practically on the site of the former workings on the shoal. In the winter months work was impossible and even in summer it was only practicable for two hours a day between tides, part of this precious time having to be devoted to bailing out the water. His difficulties may be gauged by the fact that the shoal is covered by the sea about ten months out of the twelve and at high tide the shaft collar was covered by 18 to 19 feet of water, and owing to the rapidly shelving beach, even at low tide the rock upon which the shaft was sunk was surrounded by a considerable depth of water, the spot moreover being prone to the breaking of much surf. One can imagine, too, his difficulty with blasting in so wet a situation when only black powder was in use and reeds or quills charged with powder were used in place of fuse. In this way three summers were patiently occupied, during which time the tin raised in the course of sinking can in no way have requited the labour. Whether from the commencement Curtis intended to work the mine by the plan he now proceeded to carry out, we know not, but it seems probable that he did. This consisted of preparing a flat hewn surface round the collar of his shaft, upon which was erected a turret of stout boards rising to a height of 20 feet above the rock and 2 feet 1 inch square, this apparently being the size inside timbers, so that the shaft was extremely small. The rock removed in preparing the foundation for this erection was dressed to shape and built round the outside of the base of the turret to form a collar, the whole being caulked with oakum and rendered with fat cement. The wood turret and the lagging of the shaft were also caulked and splayed with pitch. The turret was held in position by eight stout iron stays, four inclined from the four sides at the top to their hold formed by holes drilled in the rock, and four inclined from lower down and anchored in a similar manner. A platform of boards was then constructed round the mouth of the turret and this was lashed to four stout poles which were held in position by being

FIG. 3. Portrait of Thomas Curtis. (Artist unknown, but possibly John Opie.)

clamped to the turret stays. The platform itself afforded support for a windlass worked by four men.

The execution of this work, as might be expected, met with many mishaps and setbacks, but was after three summers successfully completed, and Curtis was then able to start regular production. He had apparently hoped that it would be possible to work throughout the winter except during very unfavourable weather conditions, but in this he was disappointed, for it was found that the swell and surf caused the water to find its way into the shaft, and when the workings were extended in a lateral direction a considerable quantity of water also found its way through the joints in the elvan, added to which when the sea was rough he could not transport his ore to the shore by boat.[1] The whole winter was therefore a period of inaction and it was not before April that the work could be restarted; when once resumed, however, the mine proved extremely rich and though worked on a very small scale only, became a most profitable adventure. Curtis had, however, apparently in common with many of the early coast miners, made the grave mistake of greedily attacking all available ore regardless of leaving an adequate rock and water barrier; and in the year 1789 he opened a pit on the shoal near his shaft and from it obtained tin worth £30.[2]

About twelve years after its commencement the mine was examined, in the autumn of 1790, by John Hawkins, who gives the following particulars. A short level from the shaft, which was then 26 feet deep, communicated with a large irregular chamber where the ground had been stoped away both above and below, leaving in places only 3 feet of rock between it and the sea, and heavy timbers were necessary to support the roof. The greatest depth of the stope was 36 feet, its maximum width 18 feet and minimum 3 feet, while owing to the dip of the elvan being as much as 60° to 70° the miners were actually able to walk up the foot-wall (Carne, 1822). At the commencement of each shift between tides, four men were employed for two hours at the windlass raising the water, apparently at the rate of four gallons a minute,[3] while towards the end of the time six men were 'teaming' or bailing the water from the bottom of the stope to the level from whence it ran to the sump. In

[1] The employment of a flat-bottomed boat or wherry for transporting the ore from, and materials to, the shaft before the erection of the trestle bridge was evidently the origin of the name Wherry mine.

[2] Letter from Samuel Milford to John Hawkins, dated Truro, March 11, 1834. (See below, p. 524.)

[3] In Hawkins's account in the Annual Register the amount of water raised is given as four tons a minute, tons being evidently a misprint for gallons.

Hawkins's second account of the mine, the number of men employed on the windlass is given as twelve, and this is probably to be accounted for by the fact that the work was so arduous as to necessitate frequent relays of four. The water having been got out the men then mined for a further six hours, making up a shift of eight hours. Between each tide they raised on an average, and landed by means of a boat, about thirty sacks of ore, each sack containing fourteen gallons.[1] Of this ore $\frac{15}{16}$ was so rich as to produce $\frac{1}{6}$ of a hundredweight of tin, the remaining $\frac{1}{16}$ producing $\frac{1}{16}$ of a hundredweight. The elvan where worked was 18 feet wide, 15 feet of it 'producing 1600 of "white tin" in 1000 sacks, and another foot as much as one cwt. of "white tin" in every sack'. In the six summer months of 1790 tin to the value of £600 was raised by the ten men employed. During Curtis's working, at any rate, the mine had no dressing appliances, the tin-bearing elvan being merely burnt in an ordinary lime kiln in order to render it more friable before being sent to a stamping mill.[2] A circular building which appears to be the lime kiln is shown on the engraving of the mine (pl. XXVI).

In the winter of 1791 Thomas Curtis died at the age of seventy, while the mine was steadily increasing in prosperity. His portrait reproduced here (fig. 3) is from a painting by an unknown artist, quite possibly John Opie (1761–1807), and has recently been presented to the Museum of the Royal Geological Society of Cornwall at Penzance by the late Dr. John Symons of that town.[3] John Hawkins records that in 1790 proposals were being considered for the erection of a lighthouse on the Wolf Rock off the Land's End and that he asked Curtis his opinion of the project, to which Curtis replied that he considered it practicable, but suggested as far preferable the blowing up of the entire rock, which he readily engaged to do for a proper remuneration. After Curtis's death the mine was apparently carried on by local adventurers, and Mr. Davies

[1] The very crude method of buying and selling tin ore by the sack was then still in vogue, the sacks being a convenient form of transport by mule or horse. The capacity of the sacks varied between 9 and 18 gallons beer measure, the buyer always reserving for himself a large margin for loss in dressing apart from the amount set aside for profit.

[2] J. H. Collins's statement (Observations on the west of England mining region, 1912, p. 68) that the ore was burnt because foul or contaminated with stannite, chalcopyrite, &c., is incorrect, for Hawkins specifically states the burning was to render it friable before stamping.

[3] I am informed by Dr. Symons's two daughters that they can offer no information as to how their father became possessed of the portrait; they have, however, two family portraits undoubtedly by Opie and the similarity of style suggests that that of Curtis may well be by that artist.

Gilbert, President of the Royal Society of London, in a letter[1] to John Hawkins dated September 1792 says: 'The course of stanniferous porphyry near Penzance (the Wherry) promises to make a very great mine. There are indications of the tin being continued to a great extent in both directions, and the bottoms are growing larger and remain rich. A house near the Green, built with fragments of this stone, which was probably picked up on the shore, or broken from the top of the rock, is, I hear, to be pulled down and rebuilt with other stone, for the sake of its tin. An adventurer told one that £3000 worth of tin had been raised from this extraordinary mine in the course of the present summer.' In a subsequent letter,[1] apparently also written in 1792, Mr. Gilbert says: 'A steam engine is erecting on the Green opposite, and they are constructing a wooden bridge from thence to the rock, to serve as a communication, till the engine shaft has been sunk sufficiently deep, and a drift carried out to the mine; as a stage for supporting the sliding or rather hanging rods.'

The engraving accompanying Hawkins's paper published in 1818 in volume 1 of The Royal Geological Society of Cornwall Transactions and reproduced here (pl. XXVI) shows this further important introduction of the engine, trestle bridge, and pump whereby the mine could be more effectively worked. The engine, a rotary, stood on the shore and, by means of flat rods carried along a wooden trestle-bridge, worked a Cornish pump in the shaft, the beam and balance bob of which can be seen in the engraving. On the authority of Mr. Joseph Carne (Carne, 1827) we learn that the engine was one of Mr. Jonathan Hornblower's two-cylinder compounds built in competition with the engines of Boulton and Watt, and was evidently one of the earliest if not the second of this type to be erected in Cornwall, the first being set to work at Tincroft mine, Illogan, in 1790 or 1791. A headgear was also erected over the shaft on the seaward side and this was apparently worked by a horse walking to and fro along the bridge, the animal being shown in the engraving, as also a man wheeling a barrow of ore or deads to the land. Whether the application of this machinery enabled the mine to be worked for a more prolonged part of the year is not known, but the probability is that it did. It is evident from Mr. Gilbert's second letter that it was ultimately intended to sink a shaft on the mainland and drive a level out to the elvan dike. This was, however, never done, probably owing to lack of capital and the usual failing of the old cost-

[1] Quoted by Hawkins in Trans. Roy. Geol. Soc. Cornwall, 1818, vol. 1, p. 141.

book companies, the desire to get what ore lay in sight with the minimum expenditure and time on dead work.

In 1794 the mine was visited by William George Maton, M.A., F.L.S., and Charles Hatchett, F.R.S., during their tour through Cornwall. In Maton's description of the mine, which he went down, he says it was then 17 fathoms deep, that the sea continually drained into the workings, and that the roar of it could be distinctly heard. 'The descent is by means of a rope tied round the thighs, and you are let down in a manner exactly the same as a bucket is into a well;—a well indeed it is, for the water is more than knee-deep in many parts of the mine. The upper part of the shaft resembles an immense iron chimney, elevated about twelve feet above the level of the sea, and a narrow platform leads to it from the beach: close to this is the engine-shaft, through which the water is brought up from below' (Maton, 1797). There are unfortunately no records of the mine during the next four years. In 1798, however, after a life of nearly twenty years, it came to an untimely end through an American vessel breaking its anchorage in Gwavas Lake (Newlyn harbour) and, striking against the turret, demolished the whole, thus ending this in every way remarkable venture. The staunch belief which Thomas Curtis always held for the mine, though he did not live to see it at its zenith, was expressed by him when he said 'There is more tin in the Wherry than would purchase all the land round Penzance', and in this he was to some extent justified, for during the twenty years of its working tin ore to the value of £70,000 was raised.

Third working.—In the year 1834 a prospectus headed 'Capital Speculation—The Wherry Mine, Mount's Bay' was printed by E. Heard of Truro. In this the former riches of the mine, which had lain abandoned some 36 years, are adverted to and extracts are given from the papers of John Hawkins and Sir Humphry Davy (Davy, 1818) relative to it. The presence of copper in the mine is also alluded to and the suggestion made that it could be profitably worked in conjunction with the tin. In corroboration of this it is stated that specimens of very rich copper ore had recently been picked up on the old dumps and that a lode of it had been left unwrought in the mine. It mentions that there were still some old men living in Newlyn who had made a 'comfortable independence' by taking tribute pitches in the mine during the former working. The prospectus also included a scheme for converting Gwavas Lake into a shipping basin. On the back of a copy of the prospectus in my possession, which is addressed to John Hawkins, is a letter to him from Samuel Milford, dated Truro, March 11, 1834, in which the latter says

he had lately inherited, through the will of his cousin Daniel Ley, a moiety of the Wherry mine and the estate adjoining, and asking Hawkins for his patronage and recommendations with a view to aiding the formation of a cost-book company for reworking the mine. According to this letter the mine at the time of its destruction in 1798 was 150 feet deep, and it mentions that Curtis always maintained that there was 'a good course of tin going west but only the rich branches followed down'. This company does not appear to have materialized until two years later when the two Cornish newspapers 'The West Briton and Cornwall Advertiser' and 'The Cornwall Royal Gazette', in their issue of April 29, 1836, contain a further prospectus and the notice of a meeting of the Wherry Mining Company held at the Union Hotel, Penzance, on April 25, 1836, with Mr. Richard Pearce[1] in the chair supported by Samuel Higgs[2] and Richard Millett.[3] The company consisted of 800 shares of £5 each.[4] In this prospectus, in addition to the tin and copper, mention is made of a 'large cobalt lode' running north and south. Unfortunately little or nothing is known of the work carried out by this company and I have failed to discover any record of the amount of tin, if any, which was produced. It is known, however, that success did not attend the venture and that the mine was finally abandoned in 1840 after a considerable loss. Whether, on reopening, the mine was found to be poor, or whether water and other difficulties precluded deeper and more extensive mining, or whether the very small capital was insufficient to place the mine on a sound footing, is not known. It is curious that again no attempt was made to sink a shaft on the shore and drive a level out to the elvan dike; however, the jointed nature of the slate rock and consequent likelihood of serious water difficulties, and Curtis's assertion that the deposit was more likely to yield riches in lateral extent rather than in depth, may have decided them against this course.

A now rare print entitled 'View of Penzance, and the Wherry mine, with the surrounding scenery', was drawn and published by James

[1] Richard Pearce (1792–1862) of Chapel Street, Penzance. Five times Mayor of Penzance.

[2] Samuel Higgs (1794–1874) of Alverton, Penzance. Grocer and merchant; he held an interest in a large number of mines and was purser of several in St. Just and Lelant, and Mayor of Penzance.

[3] Richard Millett (1807–85), solicitor, of Lariggan, Penzance.

[4] Mr. Ferris of 49 Belgravia Street, Penzance, has recently shown me a certificate for two shares of five pounds each in the Wherry Mining Company, Penzance, dated May 2, 1836. This certificate bears a receipt for two pounds as the sole and final dividend on the winding-up of the company by Mr. J. G. Beckerleg (Secretary), May 11, 1842.

Tonkin of Penzance about the year 1837 or 1838 (pl. XXVII); it clearly shows the layout, which differed little except in detail from that employed in the second working. A Cornish rotary engine, apparently not the original Hornblower, was erected on the shore, and by means of a trestle bridge carrying flat rods, worked a pump on Curtis's shaft which was again surmounted by a turret. There is also in my possession a small etching ($5\frac{3}{4} \times 8\frac{7}{8}$ inches) of Penzance and the Wherry mine signed as drawn and etched by A. M. S. Poltair. A. M. S. stands for Anna Margaretta Scobell, an artist of considerable merit, who was the only daughter of Captain Edward Scobell of Poltair, Penzance. In 1839 she married Daniel Higford Davall Burr, M.P., of Aldermaston Court, Berkshire. As can be seen from the accompanying reproduction (pl. XXVIII), the drawing was made from the foreshore directly west of the mine with Lariggan Rocks in the foreground, and differs considerably from and lacks many of the details shown in Tonkin's print. Though undated, the etching was apparently executed at the time of, or at any rate soon after, the last working from 1836 to 1840.

On September 25, 1930, the late Mr. E. Richards and his son, enterprising photographers of Penzance, succeeded on an exceptionally low tide in taking two photographs, one showing the iron pump column which still stands in the shaft, on this occasion 3 feet 6 inches above the surface of the sea, and another, the remains of two of the trestle bridge timber supports and iron tie-rods, both these photographs being reproduced in a paper on 'Abandoned Cornish mines' by the late Mr. E. W. Newton (Newton, 1930). In March 1948, on the occasion of an exceptionally low spring tide, I myself was able to wade out to the large pump column (18 inches diameter) which stands in a cup-shaped depression on the site of the old shaft, and my companion, Mr. Arthur Kingsbury, was able to take the photograph with part of Newlyn in the background which is reproduced in fig. 4. These scanty remains are now the only visible evidence of the mine, all traces of the dump having been buried long since under the concrete esplanade which was constructed by the Penzance Corporation in 1843. The account house of the mine is said to have stood at a spot now occupied by a café on the north side of the street.

The elvan dike and the minerals contained therein.

Although stanniferous elvans have been worked in a number of mines in Cornwall none is more interesting and remarkable than that of the Wherry mine. The rock forming that portion of the elvan dike on

which the mine was worked and which constitutes the outer portion of the shoal visible only at low tide consists of a groundmass of pinkish fine-grained orthoclase with sparsely distributed phenocrysts of quartz and innumerable small cavities plugged with scaly crystals of secondary chlorite and occasionally minute prisms and radial aggregates of dark brown to black tourmaline. Stanniferous phenocrysts and strings of translucent reddish-brown resinous cassiterite are sometimes sparsely and in other cases very thickly distributed.

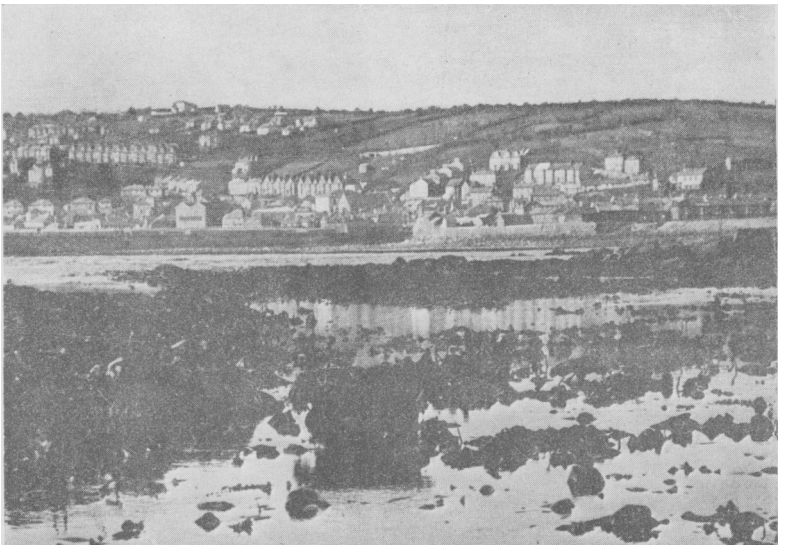

FIG. 4. View of the iron pump column standing on the site of the Wherry mine shaft, with part of Newlyn in the background. Photo. by A. W. G. Kingsbury, 1948.

In another variety of the elvan the pinkish-buff groundmass of orthoclase contains innumerable small cavities, many of which are rudely square in outline, lined with minute pink adularia-habit crystals of orthoclase upon which are rosettes of dark green scaly six-sided crystals of chlorite beautifully iridescent on their edges, these also being accompanied by occasional slender prisms of black tourmaline. Distributed through portions of the elvan are large and small patches of dark green fine-grained chlorite which is in some cases highly stanniferous. More rarely the groundmass of the elvan consists of white felspar thickly spotted with round and square chlorite-packed cavities, while some are occupied by a single

square prism of cassiterite. Good specimens particularly of the pinkish-buff coloured elvan showing visible cassiterite may still be obtained from the dike outcrop close to the shaft site.

Cassiterite.—The Wherry mine cassiterite both massive and crystallized, of which unfortunately not many specimens have been preserved, is very characteristic of the locality, and R. P. Greg and W. G. Lettsom (1858) especially refer to the crystals as being both beautiful and remarkable, although by a curious error their description of the mode of occurrence is that of the cassiterite in the well-known slate and chlorite pebble conglomerate from Relistian mine, Gwinear. Most of the specimens herein described are from the Philip Rashleigh collection, the MS. catalogue of which contains ten entries of cassiterite from the Wherry mine, and of these the greater part are now in my possession, the remainder being in Truro Museum. The most characteristic type of ore, exemplified by two specimens raised in 1789, consists of pink elvan which is actually almost pure fine-grained mottled dark and light pink orthoclase with little or no quartz, and through which is disseminated much reddish-brown to black resinous cassiterite both in spots up to 6 mm. in diameter, often showing square and six-sided sections, and in strings. In other specimens the orthoclase groundmass is white, the thickly speckled cassiterite affording a striking contrast (fig. 5); in others again the felspathic rock is so densely charged with cassiterite as to impart a resinous brown colour to the whole mass. In a quite different type of ore, black cassiterite forms definite veins up to 2½ cm. in thickness, composed of large intergrown pyramidal crystals, the walls consisting of white orthoclase heavily charged with disseminated cassiterite and chlorite, and it is in cavities in these veins that the crystals about to be described occur. Another type of ore consists entirely of fine-grained dark green chlorite through which are disseminated minute slender pyramidal crystals of cassiterite, the specimens often containing smaltite and showing crusts of erythrite. Two distinct types of crystals occur:

Type 1 (fig. 6 A and B).—Those of pyramidal habit, the so-called 'sparable tin', of which the Wherry mine crystals are the largest examples of this type of crystal known from Cornwall. They are exemplified by two very fine specimens, one from the Philip Rashleigh collection entered in the MS. catalogue as 'Tin Ore No 410. An Exceeding Rich piece of Tin Ore with Crystals 1½ inch in length with long four sided & some six sided Pyramid Ends the points bursting into several Angles. Huel Wherry W R [William Rashleigh] r r r [very very rare] 1798.' The

other from the George Croker Fox collection consisting of similar but sharper and more brilliant crystals up to 1 inch in length. These crystals, which are black, are characterized by the prominence of the pyramid (321) in combination with (110), (320), (111) and sometimes (101). The prism faces are always deeply furrowed from the repetition of (110) with (320); and as a rule the crystals are considerably flattened parallel to the

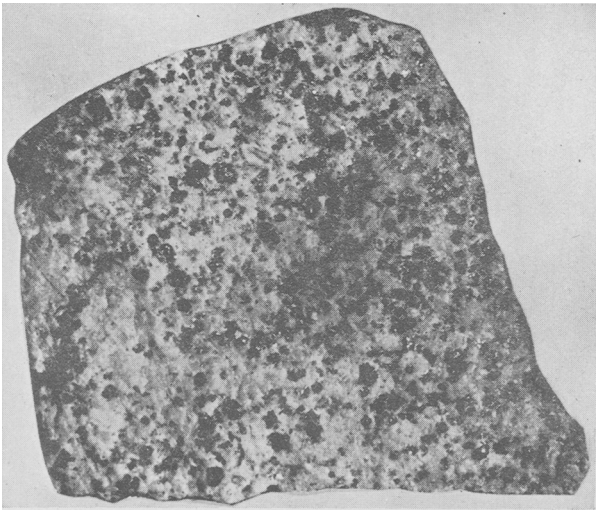

FIG. 5. Cassiterite disseminated in elvan. Philip Rashleigh collection, MS. catalogue: 'Tin Ore No. 345. Small spots of Black Tin Ore in White Quartz and Felspar, Huel Wherry near Penzance.' Natural size.

vertical axis and polysynthetically developed, a number and often a very large number of distinctly terminated crystals being united in parallel position to a common prism. A beautiful example of this is shown in a stout detached crystal $2 \times 1\frac{1}{4}$ cm., now in my collection, and which is probably the original of that figured and described in Philip Rashleigh's 'Specimens of British minerals', Part 1, 1797, pl. XXXII, fig. 14.

Type 2 (fig. 6 C and D).—Crystals of this type are characterized by the more usual prominence of (111) and (101) terminating a square prism (110). Fig. 6 C represents a crystal from a specimen from the Philip Rashleigh collection, the MS. catalogue entry being 'Tin Ore No 447. Tin Ore of a brown colour spoted with green Peach and Quartz, crystallized on the surface in the hollow part of which the crystals are

very perfect and curiously form'd. Wherry. W R.' These crystals are translucent, of a red-brown colour, and exceedingly bright and measure up to 7 mm. along the vertical axis. Upon them are several small white crystals of orthoclase of adularia habit and also minute rosettes of chlorite. They are further characterized by quite largely developed (430) in the prism zone, and the presence of (552) which appears as a

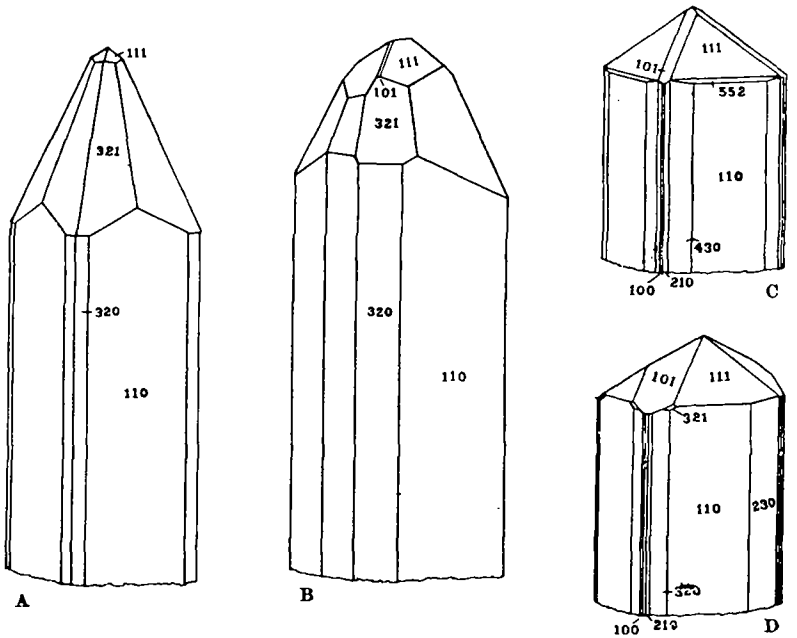

FIG. 6. Crystals of cassiterite from Wherry mine, Penzance, Cornwall.

bright and very distinct form but with broken continuity owing to the furrowing of the prism faces by alternations of (110) with (430) and (210). The other forms present are (100), (111), and (101). The largest of the crystals on this specimen are polysynthetic, a single prism having several distinct terminations. Two of the smaller crystals are beautifully twinned on (101), the only examples of twinned crystals I have seen from this mine. Fig. 6 D represents a measured crystal detached from a specimen from the Philip Rashleigh collection in Truro Museum. These crystals are black and attain a length of about $4\frac{1}{2}$ mm. and are considerably flattened, the forms present being (100), (110), (210), (320), (101), (114), (111), (552), (321), and somewhat doubtful (12.12.1). The

form (114) is nearly always present as minute faces terminating the crystals, but is not shown on the drawings. As in type 1 the (110) faces are deeply furrowed from repetition with (320). Face indices given above are for the axial ratio $a:c = 1:0{\cdot}6723$.

Chalcopyrite.—A good deal of chalcopyrite appears to have occurred, especially as the mine deepened, and W. G. Maton noticed it as being mixed with cassiterite in a quartzose matrix when he visited the mine in 1794. Sir Humphry Davy also mentions its occurrence, as does William Phillips; and in the prospectus issued in connexion with the third and last working the Wherry is spoken of as a tin and copper mine, and mention is made of there being 'a course or lode of copper ore left standing in the bottom 25 fathoms'. The only specimens I have seen are two from the last working, which were presented to the Museum of the Royal Geological Society of Cornwall, Penzance, by Mr. Richard Pearce, the chairman of the company. These consist of ordinary massive chalcopyrite with galena, chlorite, and quartz. In my own collection is one which shows a thin layer and an indistinct crystal of chalcopyrite on the surface of a very rich mass of resinous cassiterite distributed through white orthoclase with a little chlorite.

Galena.—This occurred in small quantity. There are two specimens in the Royal Geological Society of Cornwall Museum, Penzance, presented by Mr. Richard Pearce. One consists of a coarse cleavage mass, the other of galena associated with chalcopyrite in chlorite. In 1948 I found on the beach directly opposite the mine a large rolled pebble consisting of light brown chalybite traversed by a vein of quartz and containing several patches of galena. Whether this actually came out of the mine is uncertain, but if it did, it is evidence that there is a true lode in addition to the stanniferous elvan.

Blende.—This is one of the minerals which Sir Humphry Davy states he found on the mine dump. I have not seen a specimen.

Arsenopyrite.—This is another of the minerals recorded as occurring here by Sir Humphry Davy, and I have a specimen from the Lady Elizabeth Anne Coxe Hippisley collection, which was presented by him to that lady prior to 1818. It shows a number of tolerably well-defined tin-white crystals up to 6 mm. in length, combinations of (110) and (014), vertically flattened, and embedded with some quartz in compact greyish-green chlorite.

Smaltite.—Mention has already been made of a 'cobalt lode' having a north and south direction being met with in the workings. A specimen from the Philip Rashleigh collection in my possession labelled 'Rich

Cobalt ore, Wherry mine', and also one from the Lady Hippisley collection presented by Sir Humphry Davy, show crusts of erythrite on fine-grained chlorite thickly charged with cassiterite, and on freshly fractured surfaces small granular patches and disseminated grains of tin-white smaltite. The Davy specimen, according to the label, contains nickel in addition to cobalt, as nearly all smaltites do, and in the list of minerals which he recorded having found on the Wherry dump, nickel is included. Robert Hunt writing in 1887 says that there was a tradition of an attempt to utilize the ore for the manufacture of smalts and goes on to say that within the last few years good specimens of tin-white cobalt [smaltite] have been collected from crevices of the rocks a short distance above low-water mark, between Penzance and Newlyn.

Erythrite.—Three specimens which I have from the Philip Rashleigh collection and one from the John Hawkins collection presented by Philip Rashleigh, and also one from Lady Hippisley's collection presented by Sir Humphry Davy, show crusts of erythrite in the form of minute globules of a peach-blossom colour on fine-grained chlorite heavily charged with cassiterite and some smaltite. Accompanying the erythrite are very small quantities of a white to yellowish efflorescent substance—a sulphate, apparently alunogen.

Pitchblende.—Sir Humphry Davy mentions having found 'pechblende' and 'oxide of uranium' on the Wherry dump. The 'oxide of uranium' may have been either torbernite or autunite as at that date both these minerals were assumed to be oxides, the latter a pure oxide of uranium. As far as I am aware no specimen of any uranium mineral from the Wherry mine has been preserved.

Sir Humphry Davy also mentions having seen on the dump 'oxide of titanium and iron' [ilmenite]; and T. M. Hall (1868) gives cobaltite and wad as having occurred; the cobaltite is probably a mistake for smaltite and the wad needs confirmation.

Axinite.—As already mentioned, axinite occurs abundantly in lenticles and strings in the greenstone adjoining the elvan dike and may be found both in the water-worn boulders on the beach and in the Wherry and Lariggan Rocks. It is coarsely crystalline and has the usual violet-grey colour, but seldom shows definite crystals: it is accompanied by small quantities of yellowish epidote, actinolite, and sometimes a little pyrite.

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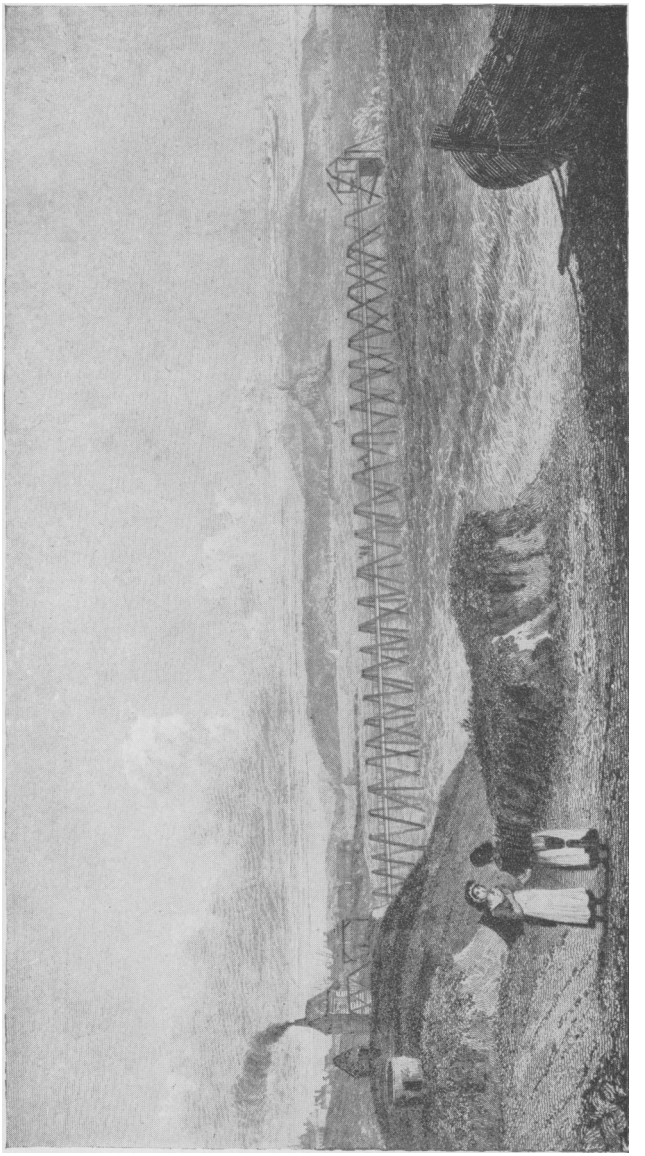
EXPLANATION OF PLATES XXVI–XXVIII.

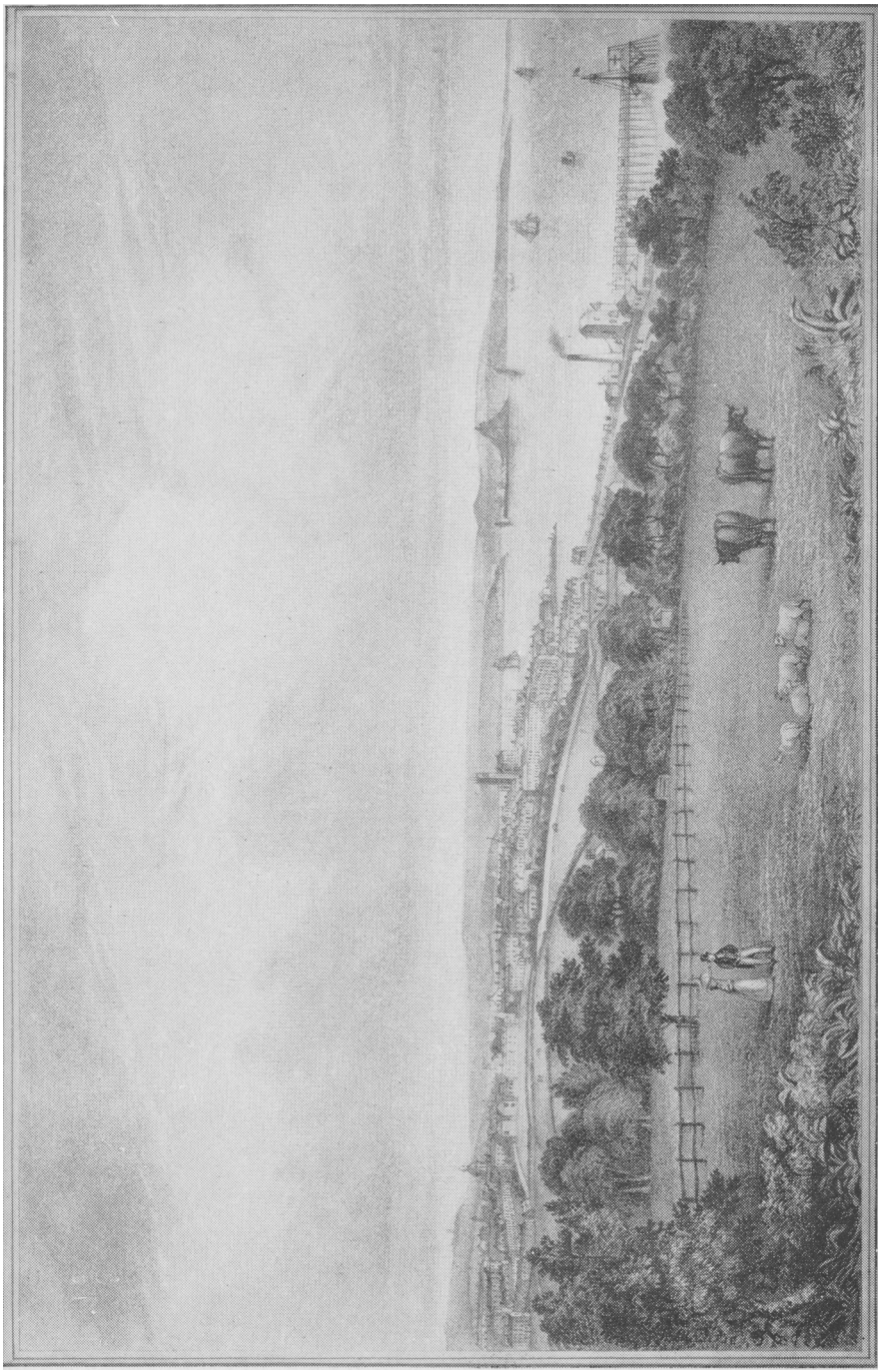
Pl. XXVI. Wherry mine, Mount's Bay, Cornwall. St. Michael's Mount in the background. Reproduced from the frontispiece of vol. 1 of Trans. Roy. Geol. Soc. Cornwall, 1818.

Pl. XXVII. Reproduced from a rare print entitled 'View of Penzance, and the Wherry mine, with the surrounding scenery', drawn and published by James Tonkin of Penzance, about 1837–38.

Pl. XXVIII. View of the Wherry mine and Penzance. Reproduced from an etching by Anne Margaretta Scobell, about 1836–40.



SIR ARTHUR RUSSELL: THE WHERRY MINE, PENZANCE.



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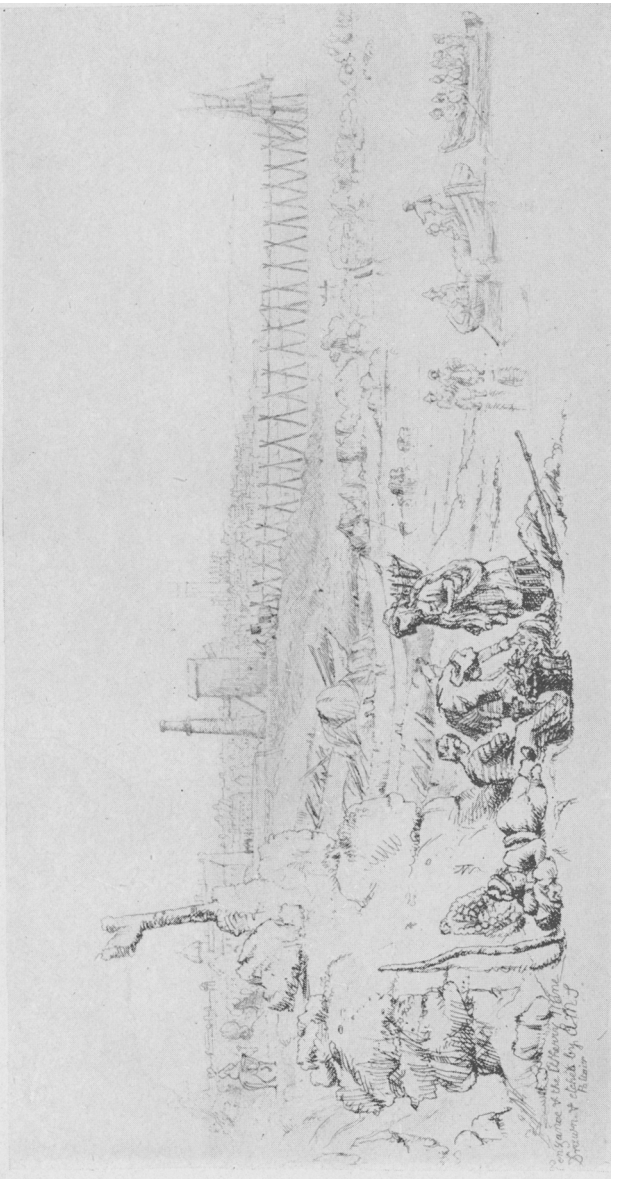

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