

## THE GEOLOGY OF CASTLE-AN-DINAS WOLFRAM MINE, CORNWALL.

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IN the Geological Magazine for August, 1920, the writer gave a brief description of the geology of Castle-an-Dinas mine. Since then the mine has been much more developed and a clearer idea of its geology has been obtained. He therefore makes no apology for a second paper on the same area.

Castle-an-Dinas mine is situated on the northern slope of the hill of the same name which lies about two miles to the east of the town of St. Columb Major in Cornwall. It is about four miles

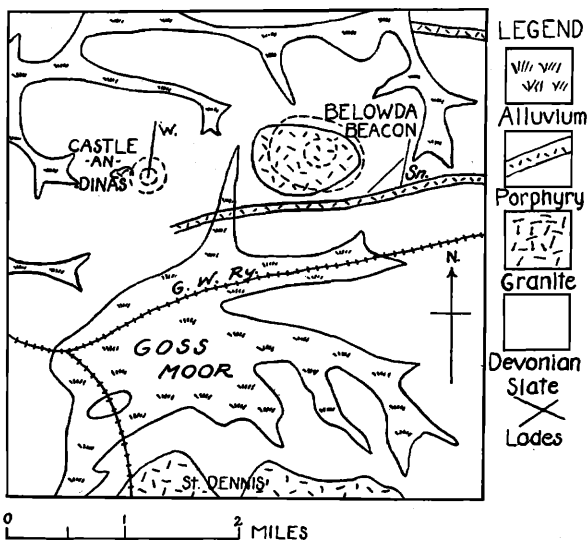


FIG. 1. Sketch map showing Castle-an-Dinas area.

to the north of the St. Austell or Hensbarrow granite mass (Fig. 1), and between it and the Hensbarrow hills lie the Goss Moors, where rich alluvial tin gravels were worked in the first half of

the last century. The hill is just over 700 feet high; the surrounding country lies between 350 and 400 feet above sea level. It is surmounted by a triple circular earth-work of early British age, which gives the hill its name, and is one of the reputed birth places of King Arthur. About one mile to the east of Castle-an-Dinas hill lies Belowda Beacon, a hill 740 feet high formed by a granite cupola; it contains veins of tin and wolfram, associated with greisen bands, and also an area of china clay.

In 1915 the outcrop of a lode was traced on the northern slope of Castle-an-Dinas hill, and this has been developed by means of adits.

#### THE ROCKS OF CASTLE-AN-DINAS HILL.

The bulk of the hill is composed of Devonian slates which belong to the Meadfoot series. They strike approximately east-west and are folded on axes parallel to their strike. The slates are red in color, with well developed cleavage; in some areas they show definite foliation. As the hill lies within the metamorphic aureole of the St. Austell granite mass, the slates show the effects of both dynamic and contact metamorphism. For the most part they are cleaved and foliated rocks, and the foliation consists of either alternating bands of quartz and tourmaline, or of quartz, and quartz with secondary mica. The slates are invaded by narrow veins of greisen and by veinlets of quartz with lithia mica and cassiterite (Fig. 3). These veinlets commonly show a "lit-par-lit" structure. Other minerals in the slates are wollastonite, andalusite, biotite and variscite, which in places lines the cleavage planes.

On the north side of the hill, near the summit, there is an outcrop of granite (Fig. 2). The rock has a fine-grained texture, with phenocrysts of orthoclase and quartz, both minerals being idiomorphic. It has, therefore, the texture of a granite porphyry, but underground exposures show it to be a normal coarsely crystalline granite. The character of the outcrop seems to be the result of the chilling of a small tongue of granite by the surrounding slate. This type of porphyritic granite has been

recorded at other localities, notably at St. Michaels Mount<sup>1</sup> and at St. Agnes Beacon.<sup>2</sup>

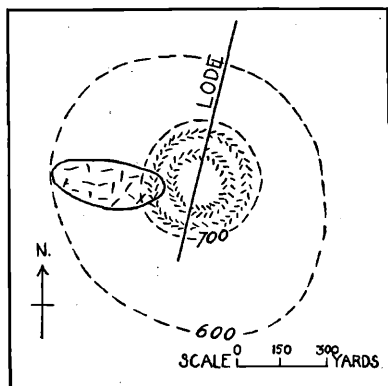


FIG. 2. Detail of Fig. 1, showing Castle-an-Dinas. (See legend, Fig. 1.)

The lode outcrops on the north side of the hill; it strikes N. 15° E., and has an average width of three feet. It occupies a vertical fissure in the slates; the filling consists essentially of white vein-quartz containing irregular patches of coarsely crystallized wolfram which vary in size from a few inches in diameter to several feet. The almost complete absence of other metallic minerals is remarkable; there are some stains of oxidized copper compounds, small plates of native copper, and small quantities of bismuth tungstate have also been found in a clay-filled veinlet that cuts the lode. The absence of cassiterite in the lode is shown by the fact that the wolfram concentrate obtained contains less than 0.25 per cent. tin oxide, in spite of the fact that no steps are taken to separate cassiterite from the wolfram. Cassiterite does occur, however, in the country rock; samples of slate from the walls of the lode have yielded 1.0 per cent.  $\text{SnO}_2$ .

The Castle-an-Dinas lode is almost unique in character when compared with the other wolfram lodes of Cornwall, which include the following types: (a) Pegmatite with wolfram and

<sup>1</sup> Davison, E. H.: Geology of St. Michaels Mount. Trans. Roy. Geol. Soc. Can., vol. 15, p. 34.

<sup>2</sup> Davison, E. H.: Handbook of Cornish Geology, p. 95.

cassiterite; (b) greisen veins with wolfram and cassiterite; (c) fissure lodes with wolfram, arsenopyrite, cassiterite and sometimes chalcopyrite.

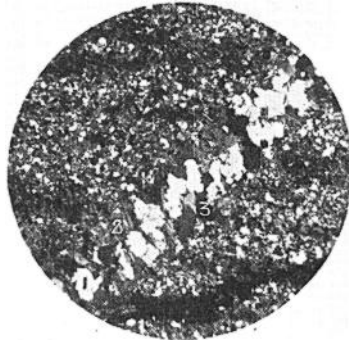


FIG. 3. Photomicrograph of altered slate from Castle-an-Dinas mine, St. Columb, showing granitic vein. (1) quartz; (2) gilbertite mica; (3) cassiterite (black).

The unusual features of the lode described above are:

- I. The absence of minerals representing the volatile constituents of the granite magma, such as tourmaline, topaz, or fluorite. Tourmaline, although absent in the lode, is found in the country rock.
- II. Almost complete absence of other metallic minerals.
- III. The coarsely crystalline character of the vein filling.

#### MINING DEVELOPMENT AND UNDERGROUND GEOLOGY.

The mine consists of two levels, 60 feet apart, driven into the hill along the strike of the lode. Air shafts connect the upper level with the surface, and the two levels are connected by winzes and stopes (Fig. 4). The upper level has been driven nearly through the hill and the country rock is slate all the way, but there are bands of greisen and aplite in the slate near the center of the hill. The lower level starts in slate, but towards the center

of the hill the lode passes through granite for about 80 feet. This granite is completely kaolinized near the margin but is less altered in the center, where it is a medium-grained rock composed of quartz, orthoclase, albite, lithia mica and tourmaline. It was generally thought that this granite formed the crest of a granite cupola, but when a winze was sunk from the lower level it passed into slate again 10 feet below the level and continued in slate to a depth of 65 feet below the level. A rich lode was found the full depth of the winze and some feldspar occurs in the lode. The granite exposed in the level is therefore a tongue.

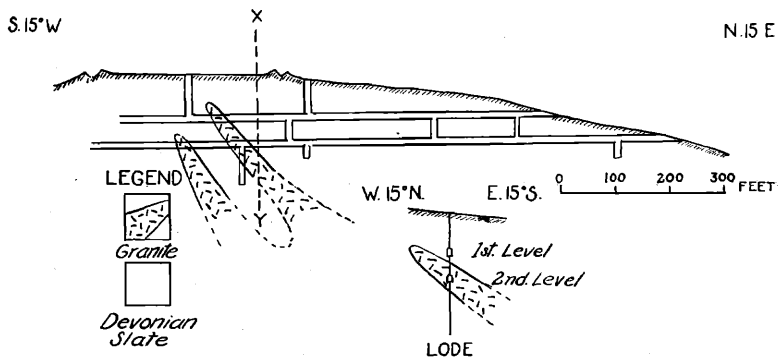


FIG. 4. Section, Castle-an-Dinas mine.

The latest development is the commencement of an adit, from the bottom of the valley to the north of the hill, at a depth of about 140 feet below the present lower level.

The ore is dressed chiefly by coarse crushing and then by jigs, the bulk of the wolfram concentrate having the size of fine gravel and a tungstic oxide content of 65 per cent.  $WO_3$ .

#### GENESIS OF THE LODE.

The sequence of events which culminated in the formation of the lode seems to have been:

- I. Folding and cleaving of the slates.
- II. Intrusion of the granite followed by the action of the volatile constituents of the granite, resulting in the deposi-

- tion of cassiterite in the slate and the formation of greisen, kaolin and tourmalinized slate.
- III. Opening of the lode fissure.
  - IV. Filling on the lode fissure by magmatic solutions, giving rise to a pegmatite which, near the surface of the granite, became a quartz wolfram lode.

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