Note on the colour and alteration of Pyrrhotite.

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THE colour of the well-known iron sulphide, pyrrhotite or pyrrhotine, is given in most treatises on mineralogy as 'bronze-yellow'. Dana calls it 'between bronze-yellow and copper-red', and also notes that it is 'subject to speedy tarnish'. The accuracy of the last statement will not be doubted by any one who has had much acquaintance with mining operations in districts where pyrrhotite is a common lode mineral, but it does not appear to have been put on record in any scientific publication that the characteristic colour, not very accurately designated 'bronze-yellow', does not seem to be the original one of the unaltered mineral.

The writer's attention was first drawn to this fact about twelve years ago, when curator of the museum at Bulawayo, by the receipt, from the Nelly mine in the Insiza district of Rhodesia, of a mineral for identification which was as nearly as possible tin-white in colour. As tests showed that it contained nothing but iron and sulphur, it was, after some hesitation, put down as pyrrhotite, and the correctness of this determination was borne out by the fact that some months later the specimen was found to have assumed the usual 'bronze-yellow' colour. A similar observation was made on numerous other occasions, and the writer drew the attention of Professor, now Sir Henry, Miers to the fact in 1904. Later on, when directly associated with mining operations, he made several attempts to ascertain how long the change of colour took to accomplish, using specimens which he had himself extracted from working faces in various mines. Precise results were not obtained, owing to long and frequent absences from head-quarters on every occasion when fresh specimens had been secured, but it is safe to say that a month is sufficient for a marked change of colour to take place, not only on the surface but throughout the whole mass of a small specimen.

The cause and nature of the change it is not proposed to discuss here, but it seems possible that the genesis of the mineral may have some

bearing on the subject. Experience seems to show that in all cases where it occurs, in Rhodesia at any rate, it is a mineral which was either originally formed under conditions of great heat and pressure, or afterwards subjected to such influences. The same appears to be the case with the only English occurrences of which the writer has personal knowledge, namely, those round the north of Dartmoor. The mineral lodes (usually worked for gold) in which it often occurs in Rhodesia are known to be older than the great granite masses which have invaded the country rocks. The pyrrhotite is only characteristic of lodes in the contact zone, and is evidently an original constituent of them, as indicated by the fact that it occurs in intimate association with other minerals which would show obvious signs of alteration if it had been deposited subsequently to them. For instance, at the Antelope mine, where both the lode and the neighbouring rocks are chiefly contact altered sediments very close to a great granite mass and actually penetrated by offshoots from the granite, pyrrhotite is found enclosed in perfectly fresh augite, biotite, &c. It appears very probable in this and other cases that the original sulphide was pyrites, and that during the progress of the metamorphism half the sulphur was driven off. All the secondary sulphides subsequently deposited along cracks and joint-planes are in the form of pyrites. The difference between the circumstances of heat and pressure attendant on the formation of pyrrhotite and those prevalent at the surface of the ground may have much to do with the curious colour-change which takes place after its extraction from deep down in a mine.

When damp, as is always the case in a mine, pyrrhotite decomposes with extraordinary rapidity on exposure to the atmosphere, and in gold ores which contain it, the rapid production of ferrous sulphate from this cause often prevents the use of the cyanide process on the raw ore, owing to absorption of oxygen and reprecipitation of the dissolved gold. The Antelope and Giant mines in Rhodesia may be instanced in this connexion. The 'drives' in the former are even coated with masses of glittering crystals and stalactites of iron sulphate, owing to the abundance of pyrrhotite in the lode.