its characters. The only specific gravity value available is the one calculated from the analysis of the opalized garnet-felspar-rock given on page 257. The value so calculated is 3·76, and is intermediate between the value given by Dana for grossularite, namely 3·55 to 3·66, and that given for andradite, namely 3·8 to 3·9.

At Nautan-Barampur, also in the Ganjám district, there is an occurrence of a rock composed of rhodonite, a manganese-garnet, and blue apatite. The garnet is sherry-coloured and very similar in appearance to that of Boiráni. It has not been analysed, so that it cannot yet be stated if this is another occurrence of grandite.

Aplome.

This is a name given by Haüy to a variety of andradite that had its dodecahedral faces striated parallel to the shorter diagonal of the rhombs instead of, as is customary when striations are present, the longer diagonal. The one analysis given by Dana of a specimen from Altenau happens to be manganiferous, containing 3·02% of MnO; but it is apparently not known if these striations necessarily indicate the presence of manganese; for the aplome of the other localities does not seem to have been analysed. The only record of aplome in India is contained in E. Balfour's catalogue of the Rev. Mr. Muzzy's Madura collection of minerals[1], and in J. H. Nelson's more detailed account of the same[2]. The latter mentions the occurrence of aplome near Solavandán, about 12 miles west of Madura, and near Melavalavu, about 20 miles N.-E. of Madura. This record is to be considered doubtful in the absence of any account of how the mineral was identified.

Calderite.

Occurrence.

In 1850 H. Piddington published a paper in the *Journal of the Asiatic Society of Bengal*, Vol. XIX, pp. 145 to 148, entitled 'On Calderite, an undescribed Silicco-Iron-and-Manganese-Rock, from the district of Burdwan'. From this paper it appears that he obtained specimens of the rock to which he has given this name from 'Kut-Kumsandy 12 miles N.-W. of Házáribágh,' as well as from the Burdwan district; But the particular part of the latter district from which the specimens

[1] Catal., Govt. Central Mus., Madras, p. 3, (1855).
[2] 'The Madura Country', pp. 14, 27, (1868).

were obtained is not specified. He distinctly states that calderite is a rock composed of two minerals. One of these is quartz, the other being a mineral which, to judge from his descriptions and the analysis he gives, must be a garnet. The hardness of the rock that he analysed is given as 7 to 8 and the specific gravity as 3·65, the garnet being evidently the principal mineral and the quartz only present in comparatively small amount. As the fresh fracture of the rock is described as being exactly like black rosin, whilst splinters are described as being 'sometimes highly translucent like dark brown rosin', it is evident that the garnet must have been one of the very dark brown varieties approaching melanite in appearance. In fact, in a subsequent paper [3], in which he describes a series of specimens of calderite, ranging from quartz containing only a small amount of the garnet up to rocks probably entirely composed of garnet, he particularly says, regarding the rock composed mostly of quartz, that the iron and manganese mineral in the rock is 'seen only in small and minute rounded specks like Melanite garnets'.

In the former paper he gives the following analysis of the rock composed mostly of the garnet:—

Silex	46·35
Alumina	0·35
Lime	1·00
Arsenic	0·20
Perox. Iron	30·18
Protox. Manganese	21·00
	99·08
Loss, partly fluorine, of which there are traces	0·92
	100·00

Composition.

Mallet, in discussing this analysis in his Mineralogy of India, p. 90, notes that the excess of silica above that which would be present in a garnet may be due to the quartz that Piddington says was disseminated through the specimen. He also remarks on the fact that the ratio of peroxides to protoxides is quite wrong for a garnet, and on this account 'and the inaccuracy of one or two other analyses by the same author' regards the above analysis as very doubtful. This is an unnecessary

[1] *Jour. As. Soc. Beng.*, XX, pp. 207 to 210, (1852).

assumption. It is probable that in carrying out the analysis Piddington weighed the iron as Fe_2O_3, and the manganese as Mn_3O_4, and that he assumed the iron to be present in the rock as Fe_2O_3 and the manganese as MnO. In fact he probably omitted to determine the amount of available oxygen in the rock. Had he done this he might have found that a portion of the iron was present in the protoxide form, giving the correct ratio of peroxide to protoxide for a garnet. On the supposition that the analysis is substantially correct, only lacking the determination of the available oxygen, it can be re-arranged mineralogically as follows:—

Garnet:—		
MnO	21·00	
CaO	1·00	
FeO	7·56	
Al_2O_3	0·35	
Fe_2O_3	21·78	
SiO_2	25·28	
	76·97	76·97
Quartz		21·07
Oxygen		0·84
Arsenic		0·20
Loss		0·92
		100·00

The 0·84% of oxygen left over according to the foregoing interpretation was not, of course, determined to be present, and is to be regarded as another part of the undetermined constituents. If this interpretation be the correct one, then it is evident that we have here a garnet corresponding to the formula $3MnO.Fe_2O_3.3SiO_2$. None of the six type garnets possesses this formula, so that it seems possible that a seventh is to be added to the six garnets at present recognized. It will be desirable to use the term *calderite* to describe this garnet rather than the whole rock. Mallet has in fact already used this term as the name of a mineral rather than of the rock in which it occurs. But he has unfortunately used it, in his Mineralogy, page 89, for a garnet that contains only traces of manganese, as well as for the highly manganiferous garnet to which it properly belongs. He says: 'In the metamorphic rocks of the Hazáribágh district irregular beds of massive garnet, some-

times of considerable thickness, are met with'. He refers to this massive garnet as that which Piddington called calderite, and gives an analysis by Tween showing only traces of manganous oxide, but showing on the other hand a large percentage of lime. The analysis shows that the garnet analysed approaches sufficiently near to the theoretical composition of andradite to be called by that name. The name calderite is therefore wrongly applied to this garnet; unfortunately this mistake has been repeated in Dana's System of Mineralogy. I have been able to find in the collection of the Geological Survey of India one specimen of calderite labelled 'A. S. B.'. This means that it formed part of the collection of the Asiatic Society of Bengal; and it is presumably one of the specimens that were examined and described by Piddington. The rock is composed almost entirely of garnet and in fact could be described as massive garnet. In the hand-specimen it is a dark resin-brown as looked at from a little distance. When examined closely, however, it is seen to be of a rich orange-brown wherever a crack renders a portion of it transparent. There is some red in the colour of this mineral, so that it looks very like some specimens of spandite in appearance. I tested it for manganese, and found that it reacts distinctly but not strongly for this element, so that the Piddington's analysis was either made on a piece of different composition, or Mallet's supposition as to its inaccuracy is correct. In places the specimen contains a dark green pyroxene. It is obvious that it will need a careful analytical examination of this garnet before it can be considered proved that it is a manganese-iron-garnet conforming to the formula $3MnO.Fe_2O_3.3SiO_2$.

During 1906 a specimen was received in the Geological Survey Office of a rock from Sirsia, $5\frac{1}{2}$ miles N.-E. of Kharagdiha, in the northern part of the Házáribágh district, the sender being Mr. J. W. Boilard. The rock seems to be similar to that mentioned by Mallet [1] as being found in the bed of the Patru nadi, N.-E. of Gulgo, in the north part of the same district. He describes it as a mixture of garnet and coccolite containing traces of galena and copper. He refers to the garnet when it occurs in the massive form as calderite. Mr. Boilard's specimen consists essentially of a mixture of a rich brown garnet and a bright green pyroxene, with galena present in parts of the rock, sometimes in abundance and sometimes only sparingly. Under the microscope the garnet is seen to be brownish pink in colour and the pyroxene very

[1] *Rec. Geol. Surv. Ind.*, VII, p. 34, (1874).

pale bluish. On testing it is found that both minerals react for manganese, the garnet very strongly, and the pyroxene distinctly, but not strongly. It seems probable that both this and the case mentioned by Mallet are occurrences of calderite. From its colour the pyroxene may be suspected to be related to the manganese-pyroxenes of the blanfordite type. The galena has been introduced subsequent to the formation of the rock by the process of metasomatic replacement. Along cracks the garnet is usually finely crystalline, showing faces of the rhomb-dodecahedron.