Detrital Andalusite in Cretaceous and Eocene sands.

By G. M. Davies, B.Sc., F.G.S.

Scientific and Technical Department, Imperial Institute.

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SIX years ago, in a paper read before this Society,[1] Dr. Herbert H. Thomas drew attention to the relative abundance of andalusite in the Pliocene deposits of Cornwall, East Anglia, and Kent, and also in various glacial and recent sands. When that paper was written, the only recorded occurrence of unaltered detrital andalusite in sedimentary rocks of greater age than the Pliocene was that in the Middle Chalk of Beer in Devonshire.[2]

Dr. Thomas concluded: 'It therefore appears that andalusite has not survived as such in the Cretaceous and Lower Tertiary rocks of the London and Paris basins. In all the older British sediments that I have examined . . . no unaltered grain of this mineral has been detected.

'It is, therefore, highly probable that andalusite cannot remain in a sand without decomposition for more than a limited period, after which its place is taken by certain micaceous aggregates, such as are of frequent occurrence in the Triassic sandstones of the west of England.

'It may, I think, be taken for granted that the presence of unaltered andalusite in a glacial or recent sand means that much of the detritus has been furnished either directly by some metamorphic area, or indirectly by Tertiary sediments derived in part from similar or identical metamorphic masses.'

In 1912 I referred to the occurrence of unaltered detrital andalusite in several Eocene and Cretaceous sands,[3] and more recently Prof. J. W. Gregory announced that Mr. G. W. Tyrrell has found it in the Triassic St. Bees sandstone of Seascale in Cumberland.[4] As these records are in

[1] H. H. Thomas, Mineralogical Magazine, 1909, vol. xv, p. 241.

[2] W. F. Hume in 'Cretaceous Rocks of Britain.' Mem. Geol. Survey, 1903, vol. ii, p. 507.

[3] G. M. Davies, Quart. Journ. Geol. Soc., 1912, vol. lxviii, p. 249.

[4] J. W. Gregory, Geol. Mag., 1915, dec. 6, vol. ii, p. 148.

papers on other subjects than andalusite, and are therefore liable to be overlooked, it seemed advisable to bring before this Society evidence of the frequent occurrence of andalusite in sediments of greater antiquity than the Pliocene.

A series of microscopic slides, exhibited at the meeting, represents the heavy minerals from various Eocene and Cretaceous sands, in all of which andalusite occurs in pleochroic and unaltered grains. Cases in which the presence of colourless andalusite is suspected are not recorded here. The reddish tint is given by the fast ray, the slow ray giving a colourless effect or sometimes a transient suggestion of green due to eye-fatigue after observing the red. Inclusions are usually few, or absent altogether. Some of the grains are elongated parallel to the vibration-direction of the fast ray, and appear to be either prisms or prismatic cleavage fragments. More often, however, there is no trace of this cleavage. The grains are then irregular in outline, with an uneven surface, as though minute flakes had been battered off them. None of the grains are well rounded. In greatest length they range from 0·12 to 0·62 mm.

The localities from which the samples were obtained, and the associated heavy minerals, are as follows :—

In the Bagshot pebble beds, at Holden's Wood, Brentwood (Essex), andalusite occurs in comparative abundance in association with ilmenite, staurolite, tourmaline, zircon, rutile, kyanite, and sillimanite.

In the Blackheath Beds of Hayes Common (Kent) and Kennel Wood, Shirley (Surrey), a few grains of andalusite were obtained. The associated heavy minerals are ilmenite, tourmaline, staurolite, zircon, kyanite, rutile, garnet, and magnetite ; also epidote, hornblende, and apatite in the former sample, which is loamy, and green spinel in the latter.

A sample of the glauconitic loamy bottom bed of the Woolwich Beds from Plumstead (Kent) yielded andalusite, together with ilmenite, zircon, rutile, kyanite, tourmaline, staurolite, hornblende, magnetite, garnet, and spinel.

In the sandy Reading Beds of Northwood (Middlesex), and the Cowcroft outlier (Bucks), andalusite is associated with ilmenite, zircon, kyanite, tourmaline, staurolite, rutile, magnetite, sillimanite, and garnet.

In the Thanet Sand I have only observed one grain of pleochroic andalusite, though colourless grains in other samples may be this mineral. The grain in question was in a sample from Wansunt pit, Crayford (Kent).

In the Folkestone Beds andalusite was seen in four out of nine samples

examined. The samples containing it came from Reigate and Limpsfield (Surrey), and Dunton Green and Folkestone (Kent), and the associated heavy minerals are kyanite, tourmaline, staurolite, ilmenite, zircon, rutile, garnet, and magnetite, with spinel at Dunton Green, pyrite and barytes at Folkestone.

A sample of Lower Greensand sponge gravel from Faringdon (Berks) yielded andalusite, together with kyanite, zircon, ilmenite, rutile, staurolite, tourmaline, and garnet.

A sample of ferruginous sand of Wealden age from Shotover Hill (near Oxford) yielded andalusite associated with tourmaline, kyanite, zircon, rutile, staurolite, ilmenite, garnet, magnetite, and spinel.

It is evident from the above facts that andalusite is a frequent constituent throughout the Eocene and Cretaceous beds of the south-east of England. There is at least a possibility that it was derived from earlier sediments and not directly from metamorphic rocks. In some of the Pliocene and Pleistocene deposits it is more abundant than in any older beds that I have examined, but this is readily explained by the advent of detritus from fresh sources, Rhine-borne in the Pliocene beds of eastern England, and derived from the Cornish metamorphic areas in the case of the St. Erth Beds. It is unnecessary to assume excessive instability of the mineral, and also contrary to evidence in view of the freshness of the grains from Lower Cretaceous sands.

It thus appears that the presence of a small amount of andalusite cannot be regarded as evidence of the Pliocene or post-Pliocene age of the deposit in which it occurs or from which it was derived. Nor is abundant andalusite satisfactory proof of such comparatively recent age. Every petrologist who has examined many sediments has probably met with cases where a mineral, usually scarce in that deposit, becomes inexplicably abundant. It is, therefore, not improbable that andalusite may in some places occur abundantly in Eocene or older sediments.