# *Euclase and platinum from diamond-washings in British Guiana.*

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THE euclase here described is not only from a new locality, but it represents an entirely new type of habit for this rare mineral, which is occasionally used as a gem-stone. The crystal aggregates present a strange resemblance to fossils, and fossils not having been found in British Guiana they were submitted to the Geology Department of the British Museum by Mr. R. P. Stewart of Georgetown, Demerara. They had been found by Mr. J. C. Menzies whilst engaged in washing for gold and diamonds in the neighbourhood of the Kaieteur gorge on the Potaro river, a left tributary of the Essequibo. Both of these gentlemen have interested themselves in the matter and have kindly sent further material for examination.

According to Mr. Menzies these materials are all from the conglomerates belonging to the extensive series of sandstones, grits, and conglomerates that build the Pakaraima mountains. This Kaieteurian series covers a large area in British Guiana and extends westward into Brazil and Venezuela. It is penetrated by dikes and sheets of diabase, and is of unknown age.[1] Being unfossiliferous and the rocks often reddish in colour it has been thought to be Triassic; but it has also been compared with the Torridonian sandstone of the Scottish Highlands. It may also be compared with the itacolumite of Brazil and the Vindhyan series of India, both of which are diamantiferous and probably pre-Cambrian in age.

A sample of the conglomerate received from Mr. Stewart shows well-rounded pebbles of quartz set in a friable matrix of quartz grains. The matrix is iron-stained and contains some small granular patches of

[1] J. B. Harrison, The geology of the goldfields of British Guiana. London, 1908. Official Map of British Guiana (scale 1 inch to 10 miles), 1913.

limonite. The only other minerals visible are one or two small, well-smoothed pebbles of black tourmaline. In the same lot are also some angular fragments of a pink rock and of a greenish rock. The former has rather the appearance of a rhyolite, but in thin section it is seen to consist of chalcedony with stains of red-iron-oxide. The greenish fragments at first sight suggest chalcedony, but in thin section are seen to be a quartzite with films of a pale-green chloritic mineral and some minute granules of a rhombohedral carbonate between the grains of quartz.

A sample of the 'concentrate' obtained from the conglomerate consist largely of small pebbles of quartz together with many smooth pebbles of black tourmaline. Other minerals are rarely to be seen. From the total amount of concentrate, weighing about 500 grams, eight fragments of the brown euclase were picked out. A few other small pebbles and fragments ranging in specific gravity from 3·1 to a little over 3·3 remain to be identified.

The *quartz* in the concentrate is of various kinds. In the order of their relative frequency these are: (1) Well-rounded pebbles of opaque, white quartz, sometimes milky, and grading into (2) well-rounded pebbles of transparent, colourless quartz. (3) Small, 2–6 mm., well-developed hexagonal bipyramids, without prism-faces, of white to colourless quartz. These show rounded edges, but as a rule do not appear to be much water-worn. They are exactly like the well-known corroded quartz crystals from rhyolites and quartz-porphyries. (4) Well-rounded pebbles of red and reddish-brown jasper. (5) Isolated prismatic crystals of clear or slightly cloudy quartz (rock-crystal) showing no signs of wear.

Black *tourmaline* is abundant in the concentrate. It has the form of smooth, almost polished, jet-black pebbles. A few are black with a greenish or brownish shade. They frequently show on the surface minute pores due to the presence of round cavities in the material. Specific gravity 3·0 to 3·1. They are hard, and the knife leaves a metallic mark on the surface; but they can be readily crushed to a fine powder. Under the microscope, this powder is seen to consist of minute, short-prismatic and granular crystals of pale-brown to almost colourless tourmaline. Only the darker coloured crystals are appreciably pleochroic. Colourless or pale-green crystals from the greenish-black pebbles show only slight indications of pleochroism and absorption. The identity of the mineral with tourmaline was confirmed by the density, optical characters, and a chemical test for boron. A thin section of a black pebble shows a granular aggregate of minute, pale-brown prisms, set in

which are a few rather larger crystals showing zonal structure. These pebbles of black tourmaline are very similar to those found in the Brazilian diamond-washings. They are known in Brazil as 'feijão' or 'feijão preto',[1] and are abundant and characteristic indicators of the presence of the diamond.[2]

*Euclase.*

Hitherto, euclase has been found only as single, usually loose, crystals at but few localities. It is rare in collections, and in the text-books there is some confusion in the statement of the known localities. It has been found:[3] (1) With crystals of yellow topaz in clay pockets in quartz veins at Boa Vista and Capão do Lana, both near Ouro Preto (formerly known as Villa Rica), in the State of Minas Geraes, Brazil. (2) Rarely in the diamond-bearing sands near Santa Izabel do Paraguassú, in the State of Bahia, Brazil.[4] (3) As rolled crystals in the gold-bearing sands of the Kamenka stream and some other tributaries of the Sanarka river in the southern Urals (govt. Orenburg). (4) Attached crystals with pericline in crevices in mica-schist from the neighbourhood of the Gross-Glockner in the Hohe-Tauern, Austrian Alps. Various spots on the Salzburg and the Carinthian sides have been stated on dealers' labels.[5] (5) Minute crystals in granite-pegmatite at Döbschütz near Görlitz in Prussian Silesia.[6] (6) In granite-pegmatite at Epprechtstein, Fichtelgebirge, Bavaria.[7]

The British Guiana euclase is of two distinct types:

(1) Single isolated crystals of clear, colourless material.

(2) Aggregates of crystals of opaque, coloured material.

[1] Meaning French-bean or black French-bean; plural, 'feijões pretos'. The brown and pale-coloured Brazilian 'favas' (beans) are perhaps represented in the sample of concentrate from British Guiana by one or two quite small fragments, though these are not phosphates.

[2] A. Damour, Extraits des procès-verb. Soc. Philomathique de Paris, 1852, p. 15; Bull. Soc. Géol. France, 1856, ser. 2, vol. 13, p. 546; E. Hussak, Os satellites do diamante, Rio de Janeiro (Serviço Geol. Min. Brazil), 1917, p. 11.

[3] An alleged occurrence in Tasmania, mentioned in the 1st (1893) and 2nd (1896) editions of W. F. Petterd's Catalogue of the Minerals of Tasmania, is omitted in the 3rd edition of 1910. G. Cesàro, Bull. Acad. R. Belgique, 1922, p. 559, mentions a crystal of euclase from Katanga, Belgian Congo.

[4] E. Hussak, Tsch. Min. Petr. Mitt., 1892, vol. 12, p. 473; Os satellites do diamante, Rio de Janeiro (Serviço Geol. Min. Brazil), 1917, p. 43.

[5] R. Koechlin, Tsch. Min. Petr. Mitt., 1905, vol. 24, p. 329.

[6] F. Kolbeck and M. Henglein, Centralblatt Min., 1908, p. 335.

[7] H. Bücking, Centralblatt Min., 1908, p. 425. V. Dürrfeld, Zeits. Kryst. Min., 1909, vol. 46, p. 591; 1910, vol. 47, p. 245.

The first of these is of gem quality, but lacking the green (or rare blue) colour of the Brazilian and Uralian euclase it would probably not be of any special value. One clear crystal measuring $7 \times 5 \times 3$ mm. and weighing 0·283 gram was sent by Mr. Stewart. It is water-worn, but shows a roughly rectangular outline. Except for the perfect cleavage in one direction it might easily be mistaken for a fragment of the clear variety of quartz. A cleavage-flake $b(010)$ when immersed in monobromo-naphthalene ($n = 1{\cdot}655$) showed the refractive indices $\alpha$ and $\gamma$ respectively less and greater than that of the liquid. The vibration-direction of $\gamma$ is inclined at 40° to the vertical axis of the crystal. The specific gravity of the whole crystal is about 3·05. A second, smaller crystal of the same kind was found in the sample of concentrate.

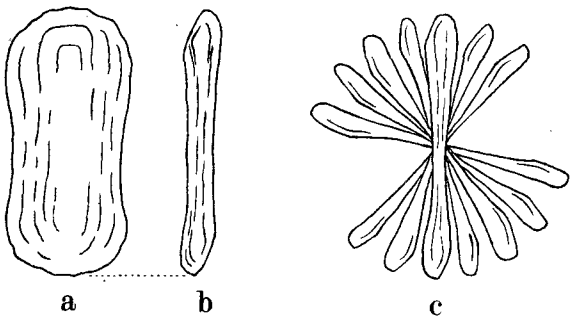


FIG. 1. Euclase from British Guiana. (*a*) and (*b*) Diagram of a simple crystal projected on $a(100)$ and $b(010)$. (*c*) Radial aggregation of simple crystals.

The aggregates of crystals might be divided into various sub-types, e. g. fungiform, reniform, sheaf-shaped, lenticular, &c. The simplest is the elongated lenticular form shown in figs. 1 *a* and *b*, which represent somewhat diagrammatically a dark-brown, opaque, water-worn crystal 4 mm. in length. When broken across it showed the bright and perfect cleavage $b(010)$, though not as a single plane surface. This crystal, although approximating to the usual habit of a well-developed crystal of euclase (i. e. flattened parallel to $a(100)$ and elongated in the direction of the vertical *c*-axis), is thus really a sub-parallel grouping of smaller individuals, and it shows a gradation to a sheaf-shaped type of aggregation.

The curious forms somewhat resembling fungi (mushrooms) or fungoid corals, represented in fig. 2, consist of a radial aggregation of crystals. They measure $\frac{1}{2}$ to $1\frac{1}{2}$ cm. in diameter and $\frac{1}{4}$ to $\frac{1}{2}$ cm. in thickness.

Each septum or element is of the more simple form of fig. 1 *b* placed on edge. The faces *b* (010) (i. e. parallel to the plane of symmetry and also the direction of cleavage) are co-planar in the several individuals and build up the flat surface of the disk. In this plane the vertical *c*-axes of the several crystals have a radial grouping, and the *a* (100) faces are all perpendicular to the same plane. This is shown diagrammatically in fig. 1 *c*. It will be seen from the photographs (fig. 2) that there is a certain amount of overlapping at the centre, whilst in the two smaller specimens one individual (set vertically on the page) continues through the centre and gives rise to a coalescence of two radial groupings. In

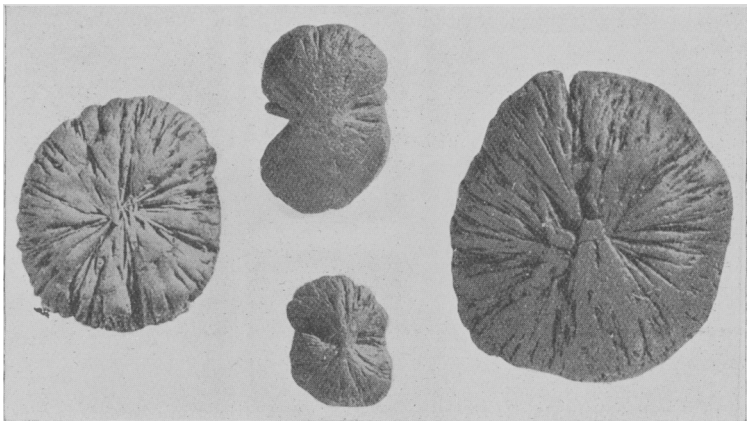

FIG. 2. Euclase from British Guiana. Photographs ×3.

the latter case it will be noticed that the whole group possesses the same degree of symmetry as a single crystal, viz. a dyad axis of symmetry perpendicular to the plane of symmetry. In other specimens the radial grouping about a central individual is only partial and sheaf-like forms result. When these aggregates are more water-worn some of the surface pattern is lost and they then resemble buttons and knobs. When broken across they separate along the perfect cleavage, and cleavage disks may be developed (since the direction of cleavage is the same in all the individuals).

In colour these aggregates are usually a dark chocolate-brown. Some few specimens show a colour banding conforming with the crystalline symmetry. The smallest specimen in fig. 2 is brownish-black on the side shown, but pure white on the opposite surface, the two coloured portions

being sharply separated by a line parallel to the plane of symmetry. The pale-grey specimen on the left-hand side (fig. 2) shows at its edge bright-red bands of colour which also are parallel to the plane of symmetry.

The aggregates present a dull surface, except occasionally when the cleavage shines up. The surface is sometimes minutely pitted (as in the tourmaline described above), and occasionally rounded cavities of appreciable size are seen in the interior. The specific gravity of whole specimens is usually near 3·05, but ranges from 2·86 to 3·10. The hardness is higher than 7, the material readily scratching quartz. Cleavage-flakes examined under the microscope are usually quite opaque except at the thin edges. The optical characters are the same as those for the clear crystals of the first type. The opacity is due to a vast number of minute granular inclusions, apparently of iron oxide.

Radial aggregates of crystals are of course well known,[1] but more usually the individual crystals radiate in all directions. If, however, crystallization takes place between the layers of shale or in narrow crevices, the radii may be confined to one plane. Examples of this are given by wavellite, stars of gypsum, and pyrites 'suns'. None of these are, however, quite like the euclase aggregates described above, which do not present the appearance of having grown in a confined space. It is possible that in this case the perfect cleavage may have exercised a controlling influence on the orientation in one plane.

### *Platinum.*

Some minute, metallic-looking particles found by Mr. Menzies in the concentrates from the conglomerate were sent for identification. One of them proved to be a grain of native platinum. It was silver-white with bright metallic lustre and showed a characteristic granulation on the surface. The weight was 20 milligrams and the loss of weight in water less than 2 milligrams. A minute fragment was cut off with a knife and proved to be malleable on an anvil. The hammered flake when treated in a drop of nitric acid on a microscope slide remained bright and unaltered. In a mixture of hot nitric and hydrochloric acids it was quickly dissolved, yielding a yellow solution. This solution gave with ammonium chloride a crop of minute, optically-isotropic octahedra of ammonium chloroplatinate. Heated to bright redness in a porcelain crucible, the grain

[1] L. J. Spencer, Curvature in crystals. Min. Mag., 1921, vol. 19, pp. 263–274 (see fig. 1, p. 266).

spurted on the surface, but showed no signs of fusion. The main mass, preserved for the collection, is now iron-black with dull lustre, with very much the appearance of some nuggets of Uralian platinum.

There appears to be no record in the literature of any finds of platinum in British Guiana. A single small nugget is recorded from French Guiana.[1] There are no records from Dutch Guiana or from Venezuela, although platinum is well known from the neighbouring states of Colombia and Brazil.

*Diamond.*

Other specimens from the same source, sent by Mr. Stewart on behalf of Mr. Menzies, include a grain of gold and three small diamonds, neither of which minerals was before represented from British Guiana in the British Museum collection. The diamond crystals are rounded by etching but show no signs of having been water-worn. (The rounding being probably the result of re-solution and corrosion, under altered conditions of temperature and pressure, in the igneous magma from which the diamond originally crystallized.) Optically, the crystals are all birefringent with uneven extinction. They are:

(1) A clear and colourless, symmetrically-developed octahedron with bright octahedral faces. In addition to rounded areas approximating to the rhombic-dodecahedron, the etching on the edges has developed surfaces, more or less plane, corresponding to the faces of a low triakis-octahedron. On the goniometer these areas give scattered images at about 1° to 3° from an octahedral face. Three readings (2° 44′, 2° 46′, and 2° 53′) agree closely with the calculated angle (2° 47½′) for the form (10 . 10 . 9), but no single, sharp image was observed. On one side, the crystal is penetrated by a deep, cleft-like cavity. The weight is 0·014 gram ($= \frac{1}{14}$ carat).

(2) A clear, colourless fragment with a few small, black enclosures. It is completely covered with prominent etch-figures and approximates in form to a rounded rhombic-dodecahedron, and is evidently a final solution-form. Weight 0·010 gram ($= \frac{1}{20}$ carat).

(3) A clear, pale-greenish fragment of irregular shape, enclosing a few dark-green spots. Weight 0·010 gram ($= \frac{1}{20}$ carat).

[1] A. Damour, Note sur la présence du platine et de l'étain métallique dans les terrains aurifères de la Guyane. Compt. Rend. Acad. Sci. Paris, 1861, vol. 52, p. 688.