Beryllium minerals (euclase and phenakite) from Africa.

By L. J. Spencer, M.A., Sc.D., F.R.S.
Keeper of Minerals in the British Museum of Natural History.

[Read June 7, 1934.]

WITH the exception of beryl, there are very few recorded occurrences of beryllium minerals in the whole of Africa. Phenakite is represented by a single small crystal from Tanganyika Territory which was described in this Magazine in 1906.[1] Chrysoberyl[2] has been found in small amount in the Somabula diamond field in Southern Rhodesia, and in Belgian Congo and Gold Coast; and gadolinite[3] in Gordonia in Cape Province. A single large crystal of euclase from Tanganyika Territory and small crystals of phenakite from South-West Africa are now to be described.

Euclase is a rare mineral of infrequent occurrence. It has been mentioned only on two occasions in this Magazine. In 1882 what was evidently believed to be a record crystal for size was described from Brazil; it measured 3·2 by 2·1 cm. and weighed 15·45 grams.[4] The largest crystal of Brazilian euclase in the British Museum collection measures 3½ by 2 cm., and weighs 13½ grams.[5] The new crystal from Tanganyika Territory is more than ten times the size. The second mention was of euclase from British Guiana.[6] In that paper a list was given of the six localities then known for this mineral;

[1] L. J. Spencer, Phenacite and other minerals from German East Africa. Min. Mag., 1906, vol. 14, pp. 178–183.

[2] Min. Abstr., 2–265, 2–266, 3–266, 5–399. [3] Min. Abstr., 4–475.

[4] M. Guyot, Description of a crystal of euclase, belonging to my collection. Min. Mag., 1882, vol. 5, p. 107, with crystallographic note by J. H. Collins, p. 108.

[5] A much larger crystal from the Urals was described and figured from a plaster cast by N. I. Koksharov (Min. Russlands, 1862, vol. 4, p. 100). It was 7½ cm. long with a width of 1½ to 2 cm., and was the sixth of the few crystals that have been found in the gold-washings in the region of the Sanarka river.

[6] L. J. Spencer, Euclase and platinum from diamond-washings in British Guiana. Min. Mag., 1924, vol. 20, pp. 186–192.

the British Guiana and Tanganyika Territory occurrences and one recently described from Trentino [1] now make nine known localities.

Euclase from Tanganyika Territory.

The specimen (B.M. 1934,116) shown in fig. 1 has been acquired for the British Museum collection of minerals from Mr. H. R. Ruggles-Brise, A.R.S.M., by whom it was found on the Lukangasi mica claim, about 5 miles south of Mikese station on the Central Railway in Morogoro district.[2] This is on an outlying hill NE. of the Uluguru Mountains. A pegmatite dike about 30 feet wide is there worked for mica, which is ruby clear or stained. The centre of the dike consists of massive quartz, and the country-rock is gneiss. The crystal was found, together with some other smaller crystals (which unfortunately were not collected), in a cavity six inches across in the pegmatite adjacent to the north wall of the dike in the open cut just above the entrance to the underground workings.

The specimen weighs 192 grams, and the main crystal is a stout prism measuring 7·2 cm. long, 3·8 cm. from back to front, and 3·5 cm. in the direction of the axis of symmetry. Attached at one end is a cluster of smaller crystals of euclase, up to 3 cm. long and 1·8 cm. across, and some cleavage plates of muscovite. The cavity was evidently lined with the smaller crystals of euclase with the one large and prominent crystal standing out and attached at one end.

The large crystal is mostly white and cloudy and not of gem quality, but on the *b*-faces it is pale bluish-green and transparent with a pearly lustre from the perfect cleavage. The cleavage is also well shown by iron staining along cracks (seen as dark lines in fig. 1). The smaller crystals are quite colourless and transparent. The large crystal is doubly terminated (a feature so rarely shown by crystals of euclase that at one time they were thought to be hemimorphic), with a full development of faces at one end, while at the attached end a few pyramid and clinodome faces are present (fig. 2). The prominent forms, determined with a contact goniometer, are *K q r*, but all the forms listed below for the smaller crystal were recognized;

[1] A. Cavinato, Nuove ricerche sull'euclasio.—Euclasio di valle Aurina, Atti (Rend.) R. Accad. Lincei, Cl. Sci. fis. nat. Roma, 1929, ser. 6, vol. 10, pp. 656–664. [Min. Abstr., vol. 4, p. 522.]

[2] This locality is about 100 km. SE. of the phenakite locality in the Kisitwi Mountains described in 1906.

also $i(141)$ and some other undetermined forms in the striated zones [001], [100], and [$\bar{1}$01]. The crystal shows sub-parallel groupings and repetitions with a tendency to a sheaf-like aggregation of smaller individuals. Inequalities and crevices on the surfaces are partly filled with a thin coating of limonite.

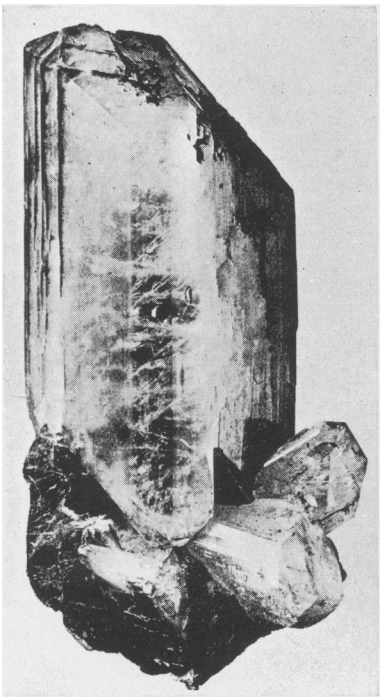

FIG. 1.

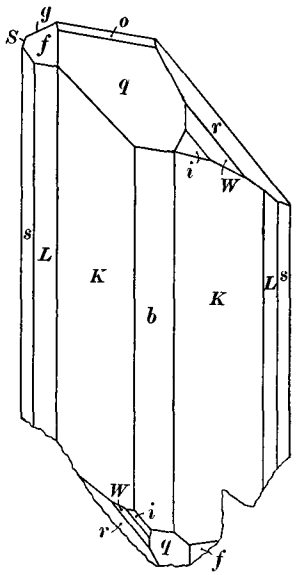

FIG. 2.

Euclase from Tanganyika Territory (actual size).
Photograph of crystal and orthographic drawing on $b(010)$.

The common habit of euclase crystals from Brazil and the Urals is a flattened, almost lenticular, and heavily striated prism-zone, owing to the large development of $s(120)$ and $m(110)$ with small angles am 17° 40′ and as 32° 30′. On the present crystals $K(140)$ is the predominating prismatic form, and the stout prism has a greater thickness from back to front than in the direction of the b-axis. The form (140) was first recorded by E. Hussak [1] on a crystal from Bahia,

[1] E. Hussak, Min. Petr. Mitt. (Tschermak), 1892, vol. 12, p. 474.

Brazil, but, as pointed out by V. Dürrfeld,[1] he had in error interchanged the a and c axes, owing to the similarity of the angles in the zones [001] and [100] (see table on p. 620). His '$R(041)$' therefore becomes (140) and his '(140)' becomes (041). His letter R was allotted by Dana and Goldschmidt to the form (041); and (140) is now relettered K.

A small, clear and colourless, crystal was detached for goniometric measurement. This is 4 mm. long in the direction of the c-axis

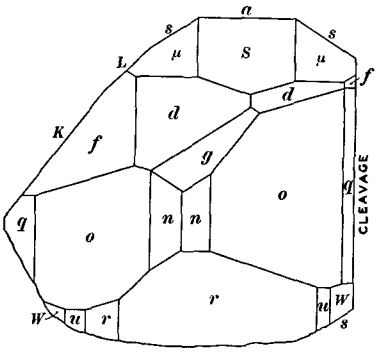

FIG. 3. Plan. ×18.

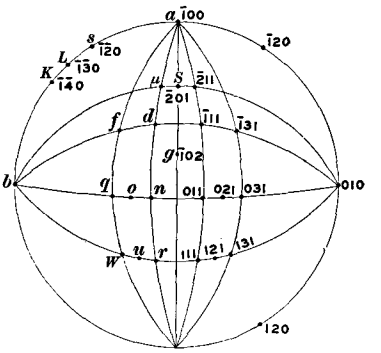

FIG. 4. Stereographic projection.

Euclase crystal from Tanganyika Territory.

and 2½ mm. across the prism-zone. It was grown in a corner between the larger crystals, and this no doubt accounts for its irregular development (fig. 3) as contrasted with the more regular growth of the larger crystals. Sixteen forms were determined, and the 28 faces (including two cleavages (010)) actually present are represented in figs. 3 and 4. The following table gives the normal angles for each of these forms (also for $i(141)$ present on the large crystal) to each of the three axial planes,[2] calculated from the axial ratios ($a:b:c$ = 0·32369 : 1 : 0·33324; $\beta = 79°\ 44'\ 4''$) which were determined with great elaboration by J. Schabus in 1852–4 on euclase crystals from Brazil.

[1] V. Dürrfeld, Zeits. Kryst. Min., 1910, vol. 47, p. 372. Dürrfeld had himself made the same error in his first description of euclase crystals from Epprechtstein, Bavaria.

[2] This method of giving a table of angles was used for schultenite, Min. Mag., 1926, vol. 21, pp. 151, 153. In the case of euclase $c(001)$ is very rarely developed and no prominent zones pass through its pole; but as shown in fig. 4 all the prominent zones pass through $a(100)$ and $b(010)$.

Forms of euclase and calculated angles to the axial planes.

Zones.	Forms.	Angle to a(100).	Angle to b(010).	Angle to c(001).
[001]	a(010)	—	90° 0′	79° 44′
	m(110) abs.	17° 40′	72 20	80 13
	s(120)	32 30	57 30	81 20
	L(130)	43 42	46 18	82 36
	K(140)	51 52	38 8	83 34
	b(010) cleav.	90 0	—	79 44
[010]	(101) abs.	39 10	90 0	40 34
	c(001) abs.	79 44	,,	—
	g($\bar{1}$02)	108 53	,,	29 9
	P($\bar{1}$01) abs.	130 52	,,	51 8
	S($\bar{2}$01)	152 23	,,	72 39
[100]	n(011)	80 15	71 51	18 9
	o(021)	81 26	56 44	33 15
	q(031)	82 42	45 28	44 32
[$\bar{1}$01]	r(111)	40 39	78 7	41 59
	u(121)	44 24	67 10	45 33
	W(131)	49 2	57 44	50 2
	i(141)	53 38	49 54	54 28
[101]	d($\bar{1}$11)	129 23	75 51	52 31
	f($\bar{1}$31)	121 19	52 55	60 20
[102]	μ($\bar{2}$11)	151 7	81 13	72 51

The measured angles were in close agreement with the calculated values. The following are given for the forms $K\,S\,W\,\mu$, since these, all with simple indices, are listed as doubtful in V. Goldschmidt's 'Atlas der Krystallformen' (1916, vol. 3) and they do not appear in Dana's 'System of Mineralogy' (6th edit., 1892).

		Measured.	Calculated.
bK =	($0\bar{1}0$):($\bar{1}\bar{4}0$)	38° 12′	38° 8′
aS =	($\bar{1}00$):($\bar{2}01$)	27 35	27 37
bW =	(010):(131)	57 43	57 44
aW	($\bar{1}00$):(131)	131 7	130 58
$b\mu$ =	(010):($\bar{2}11$)	81 —	81 13
	($0\bar{1}0$):($\bar{2}\bar{1}1$)	82 —	
$a\mu$ =	($\bar{1}00$):($\bar{2}11$)	28 47	28 53
	($\bar{1}00$):($\bar{2}\bar{1}1$)	28 52	

The faces of the form S and μ and of those in the prism-zone are striated parallel to their mutual intersections; those of d, f, and g are dull and minutely pitted; while the faces of other forms are bright and smooth.

Phenakite from South-West Africa.

A series of small specimens (B.M. 1932,1068–1071) labelled as coming from Klein Spitzkopje was acquired for the collection in 1932 from Mr. Willy Hirsch of München. The phenakite crystals on these specimens are of two distinct habits.

(1) Clear and colourless lenticular crystals, less than $\frac{1}{2}$ mm. to 4 mm. across, partly embedded in the surface of isolated crystals of

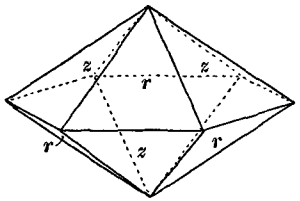

FIG. 5.

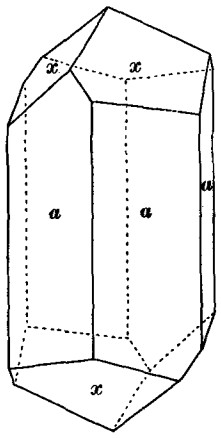

FIG. 6.

Two habits of phenakite crystals from South-West Africa.

microcline and smoky-quartz. They show an equal development of the two rhombohedra $r(100) = (10\bar{1}1)$ and $z(22\bar{1}) = (01\bar{1}1)$, and so have the appearance of a low doubly-terminated hexagonal pyramid (fig. 5), much like the bipyraminds of quartz only flatter. The crystals on quartz show these forms alone, but those on microcline show in addition a few other small faces $(a\,p\,d)$.[1] Only a few crystals are scattered over the surfaces of the quartz and microcline, but on the latter there are also a few shallow pits suggesting that other crystals of phenakite have become detached. The microcline is cream coloured with splashes of green and resembles other specimens from Klein Spitzkopje in the collection. The quartz crystal has some microcline attached at its base.

[1] Letters and indices as in Dana's System of Mineralogy, 6th edit., 1892.

(2) Prismatic crystals, up to 1 cm. long and ½ cm. across, either singly or confusedly aggregated in a small isolated group. They show a longitudinally striated and somewhat rounded or flattened hexagonal prism $a(10\bar{1}) = (11\bar{2}0)$ terminated by the rather steep rhombohedron $x(21\bar{1}) = (12\bar{3}2)$ skewly placed on the prism (fig. 6). Several of the crystals are doubly terminated. They are colourless but in part clouded by fissures and small black inclusions. Attached to them is some yellow clay, suggesting they were found in a cavity in the pegmatite.

These two habits of the crystals [1] are represented in figs. 5 and 6 and they afford a good illustration of how crystals of the same mineral may differ very markedly in appearance even when from the same locality. Phenakite in its mode of growth shows a striking contrast to quartz. In the latter the crystals grow with the *c*-axis standing out from the matrix, whereas in phenakite the *c*-axis lies on the matrix. The crystals of the lenticular habit are attached at their edge, while those of the prismatic habit are lying down. This orientation of the crystals was taken up at the commencement of their growth, and is probably a surface-tension effect.

The Klein (Little) Spitzkopje [2] is a granite hill forming a WSW. outlier, beyond the Gross (Great) Spitzkopje, of the granite of the Erongo Mountains in Damaraland. It is situated at latitude 21° 52′ S. and longitude 15° 3′ E., and 58 km. (36 miles) WNW. of Usakos on the railway from Walvis Bay. It has yielded the gem minerals beryl (aquamarine and heliodor), topaz, and tourmaline in some quantity, but there is some confusion in the statement of locality for this material. Many specimens labelled 'Namib Desert', 'Spitzkopje', 'Neu Schwaben', 'Usakos', and 'Rössing' are no doubt from Klein Spitzkopje. Gevers and Frommurze [3] in their account of the Erongo granite state that 'pegmatites . . . have been found only in a narrow zone along the western margin of the Little Spitzkopje, where they contain beryl, aquamarine, topaz and fluorite' (p. 49).

[1] The largest crystals of phenakite of these two habits in the British Museum collection are: a lenticular crystal 7 cm. wide and 3½ cm. in the direction of the *c*-axis from São Miguel de Piricicaba, Minas Geraes, Brazil; a prismatic crystal 18 cm. long and 3½ cm. across from Kragerø, Norway.

[2] Marked on the sketch-maps given by T. W. Gevers and H. F. Frommurze, Trans. Geol. Soc. South Africa, 1930, vol. 32 (for 1929), plates II and VI.

[3] T. W. Gevers and H. F. Frommurze, The geology of north-western Damaraland in South-West Africa. Ibid., pp. 31–55.

The excursion to South-West Africa organized by the International Geological Congress in 1929 and very successfully led by Dr. Gevers and Mr. Frommurze included a visit to the wonderful granite outcrops of the Erongo Mountains and the Gross Spitzkopje. A visit to the Klein Spitzkopje was unfortunately prevented by the coming dusk and the necessity of returning across the desert to Usakos. This I have regretted ever since.
