

*On paratacamite and some related copper chlorides.*¹

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PARATACAMITE.

IN the course of a study of the corrosion products formed by sea-water sprayed at a temperature of 85° F. on brass and copper sheets, a pale green compound was isolated which proved on chemical analysis to have the composition $\text{Cu}_2(\text{OH})_3\text{Cl}$. The X-ray powder diffraction pattern of the substance was found on visual comparison to differ from that of atacamite, which has the same chemical composition. The atacamite pattern was obtained from a specimen of the mineral from Moonta, on the Yorke peninsula, South Australia, that had been authenticated by both morphological measurement and optical study; identical patterns were obtained from a number of other specimens labelled atacamite. The pattern of the corrosion product proved to be identical, however, with that of two specimens in the Harvard collection labelled paratacamite. These were labelled as from Remolinos, Vallinar, Chile (no. 97523), and from Sierra Gorda, Chile (no. 82883).

Paratacamite was originally described by G. F. Herbert Smith² in 1906 as a rhombohedral species dimorphous with atacamite. The described material came from the Herminia and Generosa mines at Sierra Gorda, Chile, and another occurrence is mentioned at the Bolaco mine, San Cristobal, Chile. Paratacamite was later said by Ungemach³ on the basis of certain geometrical relations to be only twinned atacamite, and this conclusion has been accepted in standard mineralogical reference works.

The Harvard specimen from Remolinos comprised a dense mass of antlerite in which were embedded greenish-black crystals of rhombohedral habit. The observed physical properties and the chemical composition as found by analysis corresponded to the original paratacamite of Smith. The crystals, which ranged up to 2 millimetres in size, were

¹ Contribution from the Department of Mineralogy and Petrography, Harvard University, No. 308.

² G. F. H. Smith, Paratacamite, a new oxychloride of copper. *Min. Mag.*, 1906, vol. 14, pp. 170-177.

³ H. Ungemach, L'atacamite. *Bull. Soc. Franç. Min.*, 1911, vol. 34, pp. 148-216.

markedly composite with curved and irregular surfaces. Approximate morphological measurements by the reflecting goniometer identified the forms present as $c(0001)$, $r(10\bar{1}1)$, and $f(02\bar{2}1)$; an idealized drawing is given in fig. 1. The Sierra Gorda specimen comprised irregular masses of the mineral associated with caracolite and schwartzembergite.

Through the courtesy of Dr. F. A. Bannister, Deputy Keeper of Minerals in the British Museum, crystals of paratacamite from the type material (B.M. 86958) of Smith were offered for study. Another authentic specimen of paratacamite was obtained from the U.S. National Museum (no. 95146). The latter specimen bore the notation that it had been purchased in 1904 from Mr. F. H. Butler, from whom the British Museum obtained the specimens studied by Smith. The X-ray powder patterns of the above-mentioned specimens of paratacamite proved to

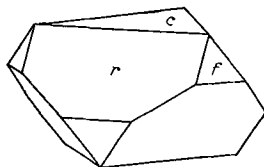


FIG. 1. Crystal habit of paratacamite from Remolinos, Chile. Forms $c(0001)$, $r(10\bar{1}1)$, $f(02\bar{2}1)$.

be identical with those of the Harvard specimens and of the corrosion product first mentioned.⁴ A comparison of the chemical analyses, optical properties, and specific gravity of the Remolinos and type Sierra Gorda material is given in table I. The thermal curves for paratacamite and

TABLE I. Chemical analyses of paratacamite.

	1.	2.	3.
Cu	14.27	14.60	14.88
CuO	56.10	55.98	55.87
Cl	15.97	16.29	16.60
H ₂ O+	14.10	13.10	12.65
H ₂ O-	—	0.03	—
	100.44	100.00	100.00
Sp. gr.	3.74	3.72	—
ω	1.842	1.843	—
ϵ	1.848	1.849	—

1. Paratacamite. Generosa mine, Sierra Gorda, Chile. Analyst, G. T. Prior (Smith, 1906).

2. Paratacamite. Remolinos, Chile. Analyst, L. C. Peck, 1948. Analysis recalculated to 100 after deducting 0.97% insoluble.

3. Cu₂(OH)₃Cl. Theoretical composition of paratacamite and atacamite.

⁴ The non-identity of paratacamite and atacamite was established independently by X-ray study by F. A. Bannister in an unpublished study made while this work was in progress.

atacamite as obtained by the differential thermocouple method are shown in fig. 2.

Optically, both the Remolinos material and the type Sierra Gorda crystals were uniaxial positive without perceptible dichroism. Many grains were biaxial, apparently due to strain, with $2V$ ranging up to about 50° and with strong dispersion of the optic axes, $r > v$. The indices of refraction, measured by the immersion method in phosphorus-

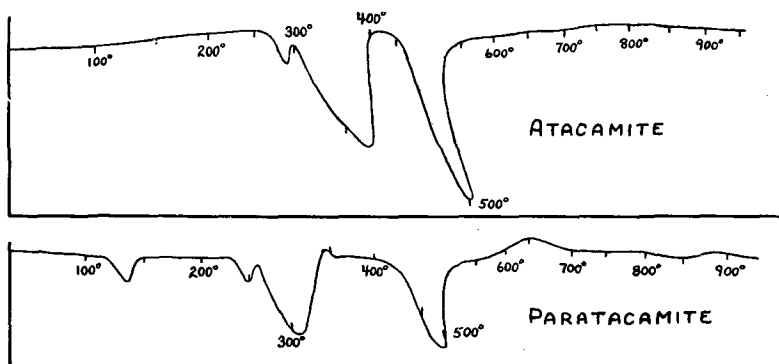


FIG. 2. Tracings of thermal curves of atacamite and paratacamite obtained by the differential thermocouple method using an Esterline-Angus graphical recorder.

methylene iodide liquids, were ω 1.843, ϵ 1.849 (Remolinos), and ω 1.842, ϵ 1.848 (Sierra Gorda), all ± 0.003 . The extinction often was undulant or patchy, and the ultra-blue was shown in most orientations. Closely spaced polysynthetic twinning lamellae were present locally in crystals from both localities. The mean (?) index of refraction of a Sierra Gorda crystal was determined by Smith by the prism method as 1.846 (Na).

An X-ray study by the Weissenberg method was made of a single-crystal from the British Museum type specimen from the Generosa mine. All of the available crystals were complexly twinned, as described by Smith;⁵ the crystal selected was a cuboid rhombohedron ($10\bar{1}1$) that contained several narrow twin lamellae on one side. These lamellae were avoided by suitably positioning the crystal in the X-ray beam, but it is not known if microscopic polysynthetic twin lamellae were also present, due to the opacity under the microscope of the relatively large-sized crystal required. The lattice-type proved to be rhombohedral.

⁵ In fig. 1 of Smith's paper, showing a twin on ($10\bar{1}1$), the form letters a and e should be transposed.

The unit-cell dimensions are a 13.65 and c 13.95 kX in hexagonal co-ordinates, with $a:c = 1:1.022$. This cell is identical with the morphological unit of Smith, who obtained $a:c = 1:1.0248$. The ideal cell contents in the hexagonal unit are $\text{Cu}_{48}(\text{OH})_{72}\text{Cl}_{24}$. The calculated specific gravity, 3.75, agrees satisfactorily with the value 3.74 directly measured by Smith on the same material. The cell dimensions in rhombohedral co-ordinates are a_{rh} 9.150 kX, α $96^\circ 28'$, and the corresponding cell contents are $\text{Cu}_{16}(\text{OH})_{24}\text{Cl}_8$. There is a very strongly marked pseudo-cell with a halved in the hexagonal unit. These findings conclusively re-establish the species validity of paratacamite. The dimorphous substance atacamite is orthorhombic, with a 6.01, b 9.13, c 6.84 kX, and the space-group $Pnam$ according to Thoreau and Verhulst.⁶ The two substances, however, are probably closely related structurally. This is indicated by a near identity in the position and relative intensity of the stronger lines in their X-ray powder patterns, and by the morphological similarities remarked by Ungemach and by Smith. The X-ray powder spacing data for artificial paratacamite is given by Rooksby and Chirnside.⁷ An angle table for the known forms of paratacamite, all originally reported by Smith, is given in table II.

TABLE II. Angle table for paratacamite.

Hexagonal—R; hexagonal scalenohedral— $\bar{3}2/m$ $a:c = 1:1.0248$; $\alpha = 96^\circ 23'$; $p_0:r_0 = 1.1833:1$; $\lambda = 82^\circ 49\frac{1}{2}'$

		ϕ	$\rho = C$	A_1	A_2
c	0001	111	—	$0^\circ 00'$	$90^\circ 00'$
a	11 $\bar{2}$ 0	10 $\bar{1}$	$0^\circ 00'$	60 00	60 00
w	20 $\bar{2}$ 5	311	30 00	25 $19\frac{1}{2}$	68 15
v	7.0 $\bar{7}$.13	922	30 00	32 30	62 16
u	40 $\bar{4}$ 7	511	30 00	34 04	60 59
r	10 $\bar{1}$ 1	100	30 00	49 48	48 $35\frac{1}{2}$
e	01 $\bar{1}$ 2	110	—30 00	30 $36\frac{1}{2}$	90 00
f	02 $\bar{2}$ 1	11 $\bar{1}$	—30 00	67 $05\frac{1}{2}$	90 00
l	24 $\bar{6}$ 1	31 $\bar{3}$	—10 $53\frac{1}{2}$	80 $55\frac{1}{2}$	71 $08\frac{1}{2}$
					49 $43\frac{1}{2}$

Synthetic paratacamite.—Paratacamite can be synthesized in several ways in addition to its formation by the action of salt-water spray on copper sheets. The substance is quickly formed when cuprous chloride

⁶ J. Thoreau and J. Verhulst, L'atacamite du Katanga. Bull. Acad. Roy. Belg., 1938, ser. 5, vol. 24, pp. 716–720. See also H. Brasseur and J. Toussaint, Structure cristalline de l'atacamite. Bull. Soc. Roy. Sci. Liège, 1942, vol. 11, pp. 555–566. [M.A. 7-389, 9-225.]

⁷ H. P. Rooksby and R. C. Chirnside, The formation of basic copper chloride and its identity with atacamite. Journ. Soc. Chem. Indust., 1934, vol. 53, pp. 33r–35r.

is exposed to a moist atmosphere or is strewn over wet filter-paper. The product gives a weak and diffuse X-ray pattern, due to a small particle size, and contains a considerable amount of non-essential water. The artificial products also usually contain more or less admixed malachite if precautions are not taken to exclude CO_2 . Specimens of nantokite, CuCl , from Nantoko, Chile, and from Broken Hill, New South Wales, that had been exposed to the air for many years, were found to have completely altered to pulverulent masses of greyish-green paratacamite. Specimens of eriochalcite (antofagastite), $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$, from Quetena mine, Chile, also were found to have altered in part to paratacamite. Another verified synthesis, originally described by Berzelius, consists of placing crinkled sheets of copper over filter-paper moistened with extremely dilute HCl . Rooksby and Chirnside⁷ have earlier noted the formation of paratacamite by the corrosion of copper wire in sea-water and in solutions of various chlorides; they refer to the substance as atacamite, but their X-ray powder spacing data are identical with those of paratacamite. Compounds with the composition $\text{Cu}_2(\text{OH})_3\text{Cl}$ but not otherwise identified have been synthesized more recently by several workers.⁸

Through the interest of Mr. R. J. Gettens of the Fogg Art Museum, Harvard University, an opportunity was had to examine the green patina and alteration crusts present on various ancient copper and bronze objects. The detailed mineralogy of the alteration products need not be described here, but both paratacamite and atacamite were identified in numerous instances. Atacamite has been earlier described from such occurrences, but paratacamite appears to be much the more common of the two substances. Crystals of atacamite up to 0.5 mm. in size were found associated with malachite, chessylite, and cassiterite on an Egyptian bronze bull of the XIXth Dynasty. Paratacamite has so far been found only as dense to pulverulent coatings and not as distinct crystals. Mr. Gettens states that instances have been observed in which freshly cleaned, acid-washed cupreous objects have become thickly coated with a flocculent green coating in the course of a few days. One such coating here examined proved to be paratacamite.

⁸ H. Martin, R. L. Wain, and E. H. Wilkinson, Studies upon the copper fungicides. *Ann. Applied Biology*, Cambridge, 1942, vol. 29, pp. 412-438. E. Montignie, Action de l'oxyde cuivreux sur divers composés. *Bull. Soc. Chim. Paris*, 1940, ser. 5, vol. 7, pp. 229-231.

ATELITE.

Atelite, described by A. Scacchi⁹ in 1873, was found on Vesuvius in fumaroles of the eruption of April, 1872. The substance occurred as more or less complete pseudomorphs after tenorite and was formed by the action on this mineral of hydrochloric acid fumes. An analysis gave CuO 45.59, CuCl₂ 38.9, H₂O and loss [16.22], total [100.00]. This analysis corresponds to Cu₃(OH)₄Cl₂.H₂O. Zambonini¹⁰ found the atelite pseudomorphs to be isotropic.

Three specimens labelled atelite were available in the Harvard collection. One of these (no. 82886) comprised a small piece of scoriaceous lava locally encrusted by green, rather pulverulent pseudomorphous crystals with an acicular or lath-like habit. Some of the crystals had a corroded core of tenorite and unaltered tenorite was present on other parts of the specimen. The X-ray powder pattern of the green mineral checked that of paratacamite exactly. Under the microscope the substance appeared to be isotropic and had a variable and relatively low mean index of refraction ranging from about 1.82 to 1.84. These differences in optical behaviour from ordinary paratacamite are attributed to aggregate polarization in a minutely crystalline mass containing non-essential water. Interior parts of the pseudomorphs immediately adjacent to the tenorite cores had a relatively deep green colour and had the highest values for the mean index of refraction. The loose label on the specimen carries the notation 'Atelite. Vesuvius', and the Museum records show only that the specimen was purchased in 1911 from the now deceased mineral dealer Mr. Lazard Cahn.

Another specimen labelled 'Atelite. Vesuvius. Eruption of 1872' (no. 90168) comprised two sealed glass tubes containing a green substance which proved to be powdered malachite. This specimen obviously is fictitious. The third available specimen (no. 82885) comprised a sealed glass tube containing a green powder. This material gave the X-ray powder pattern of paratacamite plus a number of faint extra lines due to admixture. Optically, the bulk of the sample was composed of fine granular masses and flakes of a grass-green mineral with very low birefringence which showed the ultra-blue at extinction. The mean index of refraction, somewhat variable, was mostly about 1.805 with some

⁹ A. Scacchi, *Contribuzioni mineralogiche . . . dell'incendio vesuviano . . . di aprile 1872*. Rend. Accad. Sci. Fis. Mat. Napoli, 1873, vol. 12, pp. 165-168; *Atti*, 1875, vol. 6, no. 9, pp. 1-69. (Atelite, p. 22.)

¹⁰ F. Zambonini, *Mineralogia Vesuviana*. 2nd edition, Napoli, 1935, p. 90 (eriochalcite), p. 111 (melanothallite), p. 112 (hydromelanothallite), p. 113 (atelite), [M.A. 6-504.]

grains over 1.81. Many grains appeared to be single-crystal fragments, but these too had a birefringence and indices of refraction under those of ordinary paratacamite. The cause of this divergence is not known. The sample contained about 20 % of an unidentified green acicular mineral which penetrated the paratacamite and which appeared to be an alteration product thereof. Scattered grains of several other unidentified minerals were also present. It may be concluded that atelite of Scacchi is identical with paratacamite. Particular weight must be attached to the first specimen mentioned above. While this specimen cannot be shown to be type material, it does answer the original description in every detail. Although atelite as an incompletely (*ἀτελής*) described mineral has priority, it is proposed to retain the more appropriate name paratacamite for the species.

TALLINGITE.

Tallingite, named after R. Talling of Lostwithiel, who collected the first specimens, was described by A. H. Church¹¹ in 1865 as a new hydrated cupric oxychloride. The mineral was found at the Botallack mine, St. Just, Cornwall, as blue inclining to green (turquoise-blue) minutely globular or small-botryoidal crusts. The hardness was given as 3 and the specific gravity as about 3.5. An analysis of material dried over H_2SO_4 in vacuo gave CuO 66.24, Cl 11.33, H_2O [24.99], total less O for Cl [100.00], from which was derived the formula $Cu_5(OH)_8Cl_2 \cdot 4H_2O$.

A specimen labelled tallingite from the Botallack mine, Cornwall, was available in the Harvard collection. This specimen (no. 82884) was originally from the collection of A. F. Holden and its prior history is not known. The specimen corresponds in every peculiarity to the characters of the original material as described by Church and is deemed to be authentic. The greenish parts of the crusts, in part smooth and enamel-like but mostly minutely globular and dull in lustre, were found by optical and X-ray study to be paratacamite. Optically, the mineral appears as fine-fibrous spherulitic growths or matted aggregates. The individual crystals are too small to permit precise optical measurements; the mean index of refraction is about 1.840 and individual fibres show the ultra-blue at extinction. The bluish parts of the crusts contain admixed particles of a blue mineral, which appears elsewhere on the specimen as relatively pure botryoidal crusts. This mineral could not

¹¹ A. H. Church, On some hydrated cupric oxychlorides from Cornwall. Journ. Chem. Soc. London, 1865, vol. 18 (n. ser., vol. 3), pp. 77-83. Here the description and analysis of a new mineral: the name tallingite first appeared in a later part (pp. 213, 214) of the same volume.

be identified. Since Church spoke of tallingite as being both green and blue he may have analysed a mixture.

Another specimen of tallingite was obtained for study from the British Museum (no. 36536). This specimen was bought of R. Talling in 1865, at the same time that Talling supplied material to Church, and was originally registered as atacamite and subsequently relabelled as tallingite. This specimen closely resembles that described from the Harvard collection, and was found to be a gross mixture containing paratacamite.

These observations taken alone would suggest the identity of tallingite with paratacamite. However, Dr. F. A. Bannister from a more detailed examination of other specimens concludes that tallingite is in reality an independent species. His results will be published later.

BOTALLACKITE.

Botallackite was originally found associated with atacamite and tallingite at the Botallack mine, Cornwall, and was described by A. H. Church¹² in 1865. His analysis gave CuO 66.25, Cl 14.51, H₂O 22.60, total 103.36, which indicates the formula Cu₄(OH)₆Cl₂.3H₂O. The mineral was said to form pale mountain-green crusts composed of minute interlacing crystals. The specific gravity was given as about 3.6.

A specimen of botallackite was obtained for study from the British Museum (no. 36528). This specimen had been originally obtained from Mr. Talling, who at the same time supplied specimens of the same mineral to Church, and hence can be presumed to be authentic. The physical characters of the material at hand answer the original description. The optical properties and the X-ray powder pattern of the mineral differ entirely from those of paratacamite and also from those of other known copper minerals as far as could be determined. The X-ray powder spacing data are given in table III. Optically, botallackite is biaxial positive with a moderately large 2V and strong dispersion, $r > v$. The indices of refraction are α 1.775 ± 0.003, β 1.800 ± 0.005, γ 1.846 ± 0.003. There is a good cleavage perpendicular to γ , and the mineral is weakly pleochroic in shades of bluish-green. Sufficient material was not at hand for a complete re-examination of this species. Qualitative tests and a spectrographic examination indicated the presence of only Cu, Cl, and H₂O as major constituents. Botallackite has been made identical with atacamite in both Dana's 'System of mineralogy', 6th edition, and Hintze's 'Handbuch der Mineralogie', but the

¹² A. H. Church, Notes on a Cornish mineral of the atacamite group. Journ. Chem. Soc. London, 1865, vol. 18 (n. ser., vol. 3), pp. 212-214.

present observations indicate that it is a distinct species. This same mineral has been identified by X-ray study as constituting a powdery greenish-blue incrustation on an Egyptian bronze Bast (goddess) in the

TABLE III. X-ray powder spacing data for botallackite. Copper radiation (λ 1.9418 Å.), nickel filter.

<i>d.</i>	<i>I.</i>	<i>d.</i>	<i>I.</i>	<i>d.</i>	<i>I.</i>
5.66	10	1.93	3	1.42	1
4.14	$\frac{1}{2}$	1.89	1	1.41	1
3.26	$\frac{1}{2}$	1.81	$\frac{1}{2}$	1.37	1
2.84	4	1.70	$\frac{1}{2}$	1.35	2
2.68	3	1.62	1	1.32	2
2.57	7	1.60	2	1.30	1
2.46	1	1.58	1	1.28	2
2.40	8	1.56	1	1.25	3
2.06	2	1.53	4	1.23	1
1.98	2	1.48	2		

collection of the Fogg Art Museum (no. 1943-1121B). The substance apparently is of recent origin. Another specimen supposedly of botallackite from the Botallack mine obtained from the U.S. National Museum (no. R1348) proved on examination to be brochantite.

MELANOTHALLITE AND HYDROMELANOTHALLITE.

Melanothallite was described by A. Scacchi¹³ in 1870 as black scales occurring with eriochalcite, hydrocyanite, euchlorine, and dolerophanite as a sublimation product in the crater of Vesuvius. The substance was said to change rapidly in colour from black to green on exposure, due to hydration, and to be soluble in water to a solution giving an acid reaction. An analysis by E. Scacchi¹⁴ of the green alteration product afforded CuCl 57.37, CuO 31.39, H₂O [11.24], total [100.00]. This analysis corresponds to the formula Cu₂(OH)₂Cl₂.H₂O. The original melanothallite before hydration to the green phase was thought by E. Scacchi to have the composition Cu(OH)Cl. Zambonini considered the original substance to have been CuCl₂, and introduced the name hydromelanothallite for the green alteration product thereof examined by himself and earlier by E. Scacchi. Zambonini¹⁰ also considered that a green mineral found in fumaroles on Vesuvius in 1906 and described by Lacroix¹⁵ doubtfully as melanothallite to be identical with hydromelanothallite.

¹³ A. Scacchi, Dell'erioalco e del melanotallo, nuovo specie di minerali. Rend. Accad. Sci. Fis. Mat. Napoli, 1870, vol. 9, pp. 86-89.

¹⁴ E. Scacchi, Sull'euchlorina, sull'erioalco e sul melanotallo. Rend. Accad. Sci. Fis. Mat. Napoli, 1884, vol. 23, pp. 158-165. [Min. Mag. 12-382.]

¹⁵ A. Lacroix, Les minéraux des fumarolles de l'éruption du Vésuve en avril, 1906. Bull. Soc. Franç. Min., 1907, vol. 30, pp. 219-266. (Melanothallite?, p. 224.)

Two specimens labelled hydromelanothallite from Vesuvius were available for examination. One of these, obtained from the British Museum (no. 46393), consisted of emerald-green granules without crystal form. Optically, this substance is biaxial positive with a moderately large $2V$. The indices of refraction and the pleochroism are α 1.580 (pale grass-green), β 1.605 (grass-green), γ 1.644 (bright yellow-green), all ± 0.003 . The mineral has at least two cleavage directions, one of which is perfect in quality and is perpendicular to α . A few elongated grains with a semblance of prismatic crystal outline, and other grains with an elongated shape due to cleavage, were found to give parallel extinction; hence the mineral is probably orthorhombic. A few grains of another mineral, probably dolerophanite, were found admixed in the sample. The indices of refraction are much too low for a mineral of the composition attributed to hydromelanothallite. Qualitative tests showed the presence of large amounts of sodium, potassium, and sulphate, in addition to copper, and the X-ray powder pattern proved to be identical with that of a specimen of uncertain authenticity in the Harvard collection labelled euchlorine from Vesuvius. Euchlorine is described as orthorhombic, with the supposed composition $(K,Na)_2SO_4 \cdot 2CuSO_4 \cdot CuO$, but the species is not well defined.

The second specimen of reputed hydromelanothallite examined was from the collection of the U.S. National Museum (no. R1345). Under the microscope, this material appeared as fibrous masses or coarse needle-like crystals with parallel extinction. Satisfactory optical data could not be obtained because of a surface alteration of the crystals. The mineral in general resembles that of the British Museum specimen, but the green colour inclines more towards yellow and the indices of refraction are higher. The substance is biaxial positive, with $\alpha \sim 1.591$ and $\gamma \sim 1.707$. There is a good cleavage, and γ is parallel to the elongation. Qualitative tests proved the presence of copper, sulphate, chloride, and alkalis with relatively more K than Na. The X-ray powder pattern differed from that of the mineral above described and also from that of paratacamite and of other known copper minerals in so far as could be determined. This mineral might also be euchlorine, then leaving the identity of the British Museum and Harvard specimens unknown, but more likely is a hitherto unrecognized species. In any case, neither of the specimens represents hydromelanothallite and the species validity of this mineral remains uncertain.

ERIOCHALCITE AND ANTOFAGASTITE.

The first accurate description of orthorhombic $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$ as a mineral was made by Palache and Foshag¹⁶ in 1939 on material from the Quetena mine, near Calama, Antofagasta province, Chile. Their mineral, to which the name antofagastite was given, corresponds exactly in all characters with the artificial compound. It occurs as lichen-like aggregates of crystals coating fracture surfaces of rock in the uppermost oxidized zone of the deposit and is immediately associated with atacamite and bandylite. An ill-defined but apparently similar mineral was described under the name eriochalcite in 1870 by A. Scacchi.¹³ The latter mineral occurred as pale blue, wool-like incrustations associated with melanothallite in fumaroles of the eruption of 1869 of Vesuvius. Eriochalcite was originally described as a chloride of copper on the basis of qualitative tests. A later partial quantitative analysis by E. Scacchi¹⁴ in 1884 of a water extract of the crusts gave the ratio $\text{Cu}:\text{Cl} = 1:2$ from the determined weight percentages, Cu 48.08 and Cl 51.92. In 1910, Zambonini¹⁰ examined an apparently authentic sample that had been preserved by sealing in a glass tube. The water content was determined as 20.50 %, which in conjunction with the earlier partial analysis of E. Scacchi established the composition as $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$. Zambonini, however, concluded from ambiguous optical evidence that the substance probably was monoclinic and dimorphous with the ordinary, orthorhombic form of $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$. Lacroix¹⁵ also expressed the view that the substance had the composition $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$.

An authentic specimen of eriochalcite was obtained by the Harvard Museum in 1947 from the mineral dealer Mr. Roberto Palumbo of Rome. The pale-blue, wool-like sample (no. 97927) was sealed in a short glass tube and bore a glued-on label with the notation 'Vesuvio. 1869' in the handwriting of A. Scacchi as identified from other museum labels in the Harvard collection, together with another loose label identifying the specimen as eriochalcite from the collection of E. Scacchi. A letter from Mr. Palumbo states that the specimen was given to him by the son of E. Scacchi. A comparison by X-ray and optical methods of this material with type specimens of the antofagastite of Palache and Foshag and with artificial orthorhombic $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$ has established the complete identity of the three substances. The name eriochalcite has priority and should be retained for the species. The name was originally written as erioalcalo (from $\xi\rho\iota\omicron\nu$, wool, and $\chi\alpha\lambda\acute{\kappa}\omicron\varsigma$, copper, in allusion

¹⁶ C. Palache and W. F. Foshag, Antofagastite and bandylite, two new copper minerals from Chile. Amer. Min., 1938, vol. 23, pp. 85-90. [M.A. 7-59.]

to the form of aggregation) which properly transforms to eriochalcite rather than erioalcite. The synonymous forms erythrocalcite and Erythrochalcit given by Dana¹⁷ and by Groth,¹⁸ respectively, are undesirable because they imply that the substance is red in colour, whereas the mineral actually is blue.

¹⁷ E. S. Dana, System of mineralogy. 6th edition, New York, 1892, p. 174.

¹⁸ P. Groth, Tabellarische Übersicht der Mineralien. 4th edition, Braunschweig, 1898, p. 52.
