Parahopeite $Zn_3(PO_4)_2 \cdot 4H_2O$

Crystal Data: Triclinic. *Point Group:* $\overline{1}$. Crystals are elongated along [001], flattened on {100}, with prominent {100}, {$1\overline{1}0$}, {110}, {010}, {322}, {011}, {$1\overline{1}1$}, {001}, many other forms, to 1.5 cm. Typically in subparallel fanlike aggregates. *Twinning:* Common on {100}, polysynthetic.

Physical Properties: *Cleavage:* On {010}, perfect. Hardness = 3.5–4 D(meas.) = 3.31 D(calc.) = [3.32]

Optical Properties: Transparent. *Color:* Colorless, yellow-brown, golden brown; in transmitted light, colorless. *Luster:* Vitreous, pearly on cleavages. *Optical Class:* Biaxial (+). *Orientation:* $X \simeq a$; $Y \wedge c = 30°$ on {100}. *Dispersion:* $r < v$, perceptible. $\alpha = 1.614(3)$ $\beta = 1.625(3)$ $\gamma = 1.637(3)$ 2V(meas.) = $\sim 90°$

Cell Data: *Space Group:* $P\overline{1}$. $a = 5.768(5)$ $b = 7.550(5)$ $c = 5.276(5)$ $\alpha = 93°25'$ $\beta = 91°11'$ $\gamma = 91°22'$ Z = 1

X-ray Powder Pattern: Kabwe, Zambia. (ICDD 24-1461).
7.53 (100), 2.981 (80), 4.44 (70), 5.27 (40), 2.887 (40), 5.78 (30), 3.77 (30)

Chemistry:

	(1)	(2)	(3)
P_2O_5	31.6	33.3	30.98
SiO_2		0.01	
FeO		3.23	
MnO		1.21	
ZnO	53.0	42.2	53.29
MgO		3.5	
CaO		0.04	
H_2O	15.6	[16.5]	15.73
Total	100.2	[100.0]	100.00

(1) Kabwe, Zambia. (2) Reaphook Hill, Australia; by electron microprobe, total Fe as FeO, total Mn as MnO, H_2O by difference; corresponds to $(Zn_{2.26}Mg_{0.37}Fe_{0.19})_{\Sigma=2.82}(PO_4)_{2.04} \cdot 4H_2O$. (3) $Zn_3(PO_4)_2 \cdot 4H_2O$.

Polymorphism & Series: Dimorphous with hopeite.

Occurrence: A secondary mineral in the oxidized zone of some zinc-bearing hydrothermal mineral deposits.

Association: Hemimorphite, tarbuttite, hopeite, scholzite, spencerite, pyromorphite.

Distribution: From Kabwe (Broken Hill), Zambia. In the Hudson Bay mine, Salmo, and on the Oxide claim, near Ymir, British Columbia, Canada. In England, at Roughton Gill, Caldbeck Fells, Cumbria; in the Turf Pits mine, Grassington Moor, and the Cockhill mine, Bewerley, northern Yorkshire. In Germany, from the Glücksrad mine, near Oberschulenberg, Harz Mountains; from Hagendorf, Bavaria; at Richelsdorf, Hesse. Large crystals on Reaphook Hill, near Blinman, Flinders Ranges, South Australia. From an undisclosed locality in Guangdong Province, China.

Name: From the Greek *para*, for *near*, and its dimorphous relation to *hopeite*.

Type Material: The Natural History Museum, London, England, 1907,980.

References: (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 733–734. (2) Hill, R.J. and A.R. Milnes (1974) Phosphate minerals from Reaphook Hill, Flinders Ranges, South Australia. Mineral. Mag., 39, 684–695. (3) Chao, G.Y. (1969) Refinement of the crystal structure of parahopeite. Zeits. Krist., 130, 261–266.