Churchite-(Y) $YPO_4 \cdot 2H_2O$

Crystal Data: Monoclinic. *Point Group:* $2/m$ or m. Crystals rare, to 6 mm, columnar to acicular, in flat radial aggregates; typically as crusts and coatings.

Physical Properties: *Cleavage:* On {001}, perfect; on {010} and {100}, less perfect. *Fracture:* Conchoidal. Hardness = 3 D(meas.) = 3.26 D(calc.) = [3.11]

Optical Properties: Transparent. *Color:* Colorless to snow-white; smoke-gray, with flesh-red tints; colorless in transmitted light. *Luster:* Vitreous, pearly on cleavages. *Optical Class:* Biaxial (+). *Orientation:* $X = a$; $Z \wedge c = 28°–35°$. *Dispersion:* Small to marked. $\alpha = 1.605–1.623$ $\beta = 1.600–1.631$ $\gamma = 1.645–1.657$ 2V(meas.) = Small to medium.

Cell Data: *Space Group:* $A2/a$ or Aa. $a = 5.59$ $b = 15.08$ $c = 6.17$ $\beta = 115.3°$ Z = 4

X-ray Powder Pattern: Cornwall, England.
4.21 (vvs), 7.50 (vs), 3.02 (vs), 2.82 (ms), 4.70 (m), 3.74 (m), 2.62 (m)

Chemistry:

	(1)	(2)	(3)
P_2O_5	31.10	31.15	32.28
$(Y,Er)_2O_3$	41.37	52.90	51.34
$(La,Nd)_2O_3$	7.99		
Ce_2O_3	1.05		
Fe_2O_3	1.43		
CaO	1.55		
H_2O	15.29	15.96	16.38
insol.		0.23	
Total	99.78	100.24	100.00

(1) Cornwall, England; corresponds to $[Y_{0.74}(La,Nd)_{0.11}Er_{0.07}Ce_{0.02}]_{\Sigma=0.94}PO_4 \cdot 2.02H_2O$.
(2) Auerbach, Germany. (3) $YPO_4 \cdot 2H_2O$.

Occurrence: Locally abundant; typically derived from meteoric waters, with yttrium weathered or biochemically leached from trace amounts in surrounding rocks or soil, deposited on colloidal Fe–Mn oxides; less commonly a secondary mineral in hydrothermal mineral deposits.

Association: Florencite, rhabdophane, wavellite, crandallite, turquoise, variscite, cacoxenite, beraunite, dufrénite, goyazite, gorceixite, crandallite, monazite, apatite, todorokite, lithiophorite, hematite, "limonite", clay minerals.

Distribution: In England, from Cornwall, at the Tretoil mine, Lanivet, near Bodmin, and at Wheal Pendarves, Camborne. In Germany, in the Nitzlbuch and Leonie mines, near Auerbach, Bavaria; at Rengersdorf, Saxony; from Reichenbach, near Bensheim, Hesse. At Jáchymov (Joachimsthal), Czech Republic. In the USA, in the Kelly Bank mine, east of Vesuvius, Rockbridge Co., and at the Burley pegmatite, Amherst Co., Virginia; from Girard, Burke Co., Georgia; on Indian Mountain, Cherokee Co., Alabama; found about one km south of Sausalito, Marin Co., California. In the José Pinto pegmatite, at Jaguaraçu, near Coronel Fabriciano, Minas Gerais, Brazil. From the Mt. Weld carbonatite, 35 km south of Laverton, Western Australia. At Chutukou, Yenisei Ridge, Taimyr Peninsula, Russia. Several other poorly-defined occurrences are known; probably more await recognition.

Name: To honor Arthur Herbert Church (1834–1915), English chemist, who originally analyzed and described the mineral.

Type Material: The Natural History Museum, London, England, 40636.

References: (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 773; 771–773 [weinschenkite = churchite]. (2) Claringbull, G.F., and M.H. Hey (1953) A re-examination of churchite. Mineral. Mag., 30, 211–217. (3) Milton, D.J. and H. Bastron (1971) Churchite and florencite (Nd) from Sausalito, California. Mineral. Record, 2, 166–168.