Francoanellite $(K,Na)_3(Al,Fe^{3+})_5(PO_4)_2(PO_3OH)_6 \cdot 12H_2O$

Crystal Data: Hexagonal. *Point Group:* $\overline{3}\ 2/m$ or $3m$. Minute thin pseudohexagonal plates, in nodular aggregates, to 0.2 mm; earthy or powdery to claylike pulverulent masses.

Physical Properties: *Tenacity:* Unctuous. Hardness = Very soft. D(meas.) = 2.26(2) D(calc.) = 2.295

Optical Properties: Semitransparent. *Color:* Yellowish white; colorless in transmitted light. *Optical Class:* Uniaxial (+). $\omega = 1.510(2)$ $\epsilon = 1.515(2)$

Cell Data: *Space Group:* $R\overline{3}c$ or $R3c$ (synthetic). $a = 8.692$–8.702 $c = 82.413$–82.443 Z = 6

X-ray Powder Pattern: Castellana Cave, Italy.
13.83 (100), 3.40 (65), 2.799 (62), 7.44 (60), 2.773 (51), 6.86 (50), 5.57 (37)

Chemistry:

	(1)	(2)
P_2O_5	45.23	46.00
Al_2O_3	18.32	20.65
Fe_2O_3	2.84	
CaO	trace	
Na_2O	0.98	
K_2O	9.79	11.45
$(NH_4)_2O$	trace	
H_2O	22.84	21.90
Total	[100.00]	100.00

(1) Castellana Cave, Italy; average of two analyses totaling 99.64% and 99.42%, recalculated to 100%; K, Na, and Fe by flame photometry, H_2O by the Penfield method; corresponds to $H_6(K_{2.6}Na_{0.4})_{\Sigma=3.0}(Al_{4.55}Fe_{0.45})_{\Sigma=5.00}(PO_4)_8 \cdot 13H_2O$. (2) $K_3Al_5(PO_4)_2(PO_3OH)_6 \cdot 12H_2O$.

Occurrence: An alteration product probably formed by reaction between bat guano and clay minerals (Castellana Cave, Italy); in soils developed on granite debris and bat guano mixtures, by reaction of phosphate-rich sea mist with clay minerals (Farallon Islands, USA).

Association: Taranakite (Castellana Cave, Italy); taranakite, hydroxylapatite, brushite (Little Swallow Cave, Italy); alunite, aragonite, berlinite, collophane, crandallite, gypsum, huntite, hydromagnesite, leucophosphite, nesquehonite, niter, nitrocalcite (Paddy's River mine, Australia).

Distribution: In Italy, in Puglia, from the Castellana Cave, about 40 km southeast of Bari, and in the Little Swallow Cave, near Polignaro a mare. In Australia, at the Paddy's River mine, Australian Capital Territory. Above Rabbit Cave, Farallon Islands, about 48 km west of San Francisco Co., California, USA.

Name: Honoring Franco Anelli, formerly Professor of Geography, University of Bari, Bari, Italy, who found the Castellana caves.

Type Material: Mineralogical Museum, University of Bari, Bari, Italy; National School of Mines, Paris, France.

References: (1) Balenzano, F., L. Dell'Anna, and M. Di Pierro (1976) Francoanellite, $H_6K_3Al_5(PO_4)_8 \cdot 13H_2O$, a new mineral from the caves of Castellana, Puglia, southern Italy. Neues Jahrb. Mineral., Monatsh., 49–57. (2) (1976) Amer. Mineral., 61, 1054 (abs. ref. 1). (3) Balenzano, F., L. Dell'Anna, and M. Di Pierro (1979) Francoanellite from the "Grotta della Rondinella" (Little Swallow cave) in Apulia (southern Italy): a new occurrence and new data. Neues Jahrb. Mineral., Monatsh., 363–372. (4) Dick, S. and T. Zeiske (1998) Francoanellite $K_3Al_5(HPO_4)_6(PO_4)_2 \cdot 12H_2O$: structure and synthesis by topochemical dehydration of taranakite. Zeits. Naturforsch, 53b, 711–719 (in German with English abs.). (5) (1999) Amer. Mineral., 84, 688 (abs. ref. 4). (6) Smith, J.P. and W.E. Brown (1959) X-ray studies of aluminum and iron phosphates containing potassium or ammonium. Amer. Mineral., 44, 138–142.