Dickinsonite $KNa_4Ca(Mn^{2+},Fe^{2+})_{14}Al(PO_4)_{12}(OH)_2$

Crystal Data: Monoclinic. *Point Group:* $2/m$. Crystals are minute, tabular {100}, commonly pseudorhombohedral, {011}, {$11\bar{1}$}, and many {$h0l$} forms; striated on {100} giving a triangular pattern; curved, lamellar, radiated, stellated; foliated, micaceous, to several cm; disseminated scaly massive.

Physical Properties: *Cleavage:* On {100}, perfect. *Fracture:* Uneven. *Tenacity:* Brittle. Hardness = 3.5–4 D(meas.) = 3.34–3.41 D(calc.) = 3.426

Optical Properties: Transparent to translucent. *Color:* Oil-green to olive-green, pale to dark grass-green, yellowish green to brownish green; green in transmitted light. *Streak:* White, nearly. *Luster:* Vitreous, pearly on cleavages.
Optical Class: Biaxial (+). *Pleochroism:* X = pale olive-green; Y = paler olive-green; Z = very pale yellowish green. *Orientation:* $X = b$; $Y \wedge c \simeq 15°$. *Dispersion:* $r > v$, moderate to strong. $\alpha = 1.648–1.658$ $\beta = 1.655–1.662$ $\gamma = 1.662–1.671$ $2V(meas.) = \leq 90°$

Cell Data: *Space Group:* $A2/a$. $a = 24.940(6)$ $b = 10.131(4)$ $c = 16.722(2)$ $\beta = 105.60(2)°$ $Z = 4$

X-ray Powder Pattern: Branchville, Connecticut, USA; close to arrojadite. (ICDD 24-66). 3.04 (100), 2.717 (80), 3.22 (60), 2.85 (45), 5.93 (40), 2.770 (40), 2.554 (35)

Chemistry:	(1)	(2)	(3)		(1)	(2)	(3)
P_2O_5	39.57	39.5	39.67	Li_2O	0.17	[0.17]	
Al_2O_3		2.0	2.37	Na_2O	7.46	7.8	5.77
FeO	13.25	13.3	23.42	K_2O	1.52	1.1	2.19
MnO	31.58	32.0	23.13	H_2O	1.65	[1.65]	0.84
MgO		0.0		insol.	2.58		
CaO	2.15	2.3	2.61	Total	99.93	[99.82]	100.00

(1) Branchville, Connecticut, USA. (2) Do.; by electron microprobe, total Fe as FeO, total Mn as MnO, Li_2O and H_2O from (1); corresponds to $K_{0.49}Li_{0.24}Na_{5.33}Ca_{0.87}(Mn^{2+}_{9.55}Fe^{2+}_{3.92})_{\Sigma=13.47}Al_{0.83}(PO_4)_{11.78}(OH)_{3.88}$. (3) $KNa_4Ca(Mn,Fe)_{14}Al(PO_4)_{12}(OH)_2$ with Mn:Fe = 1:1.

Polymorphism & Series: Forms a series with arrojadite.

Occurrence: A high-temperature (≈ 800 °C) primary mineral in granite pegmatites.

Association: Eosphorite, triploidite, lithiophilite, rhodochrosite, reddingite, fairfieldite (Branchville, Connecticut, USA).

Distribution: In the USA, from Branchville, Fairfield Co., and in the Strickland quarry, Portland, Middlesex Co., Connecticut; in Maine, from Auburn and Poland, Androscoggin Co., and at Hebron, Greenwood, and Newry, Oxford Co.; from the White Picacho district, Maricopa and Yavapai Cos., Arizona; in the Nickel Plate mine, near Keystone, Pennington Co., South Dakota. At the Buranga pegmatite, near Gatumba, Rwanda.

Name: In honor of the Reverend John William Dickinson (1835–1899), Redding, Connecticut, USA, an early collector of Branchville minerals.

Type Material: Yale University, New Haven, Connecticut, Brush 3090; Harvard University, Cambridge, Massachusetts, 110679, 103812; National Museum of Natural History, Washington, D.C., USA, 80561.

References: (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 717–719. (2) Moore, P.B. and J. Ito (1979) Alluaudites, wyllieites, arrojadites: crystal chemistry and nomenclature. Mineral. Mag., 43, 227–235. (3) Moore, P.B., T. Araki, S. Merlino, M. Mellini, and P.F. Zanazzi (1981) The arrojadite-dickinsonite series, $KNa_4Ca(Fe,Mn)^{2+}_{14}Al(OH)_2(PO_4)_{12}$: crystal structure and crystal chemistry. Amer. Mineral., 66, 1034–1049.