Humberstonite $K_3Na_7Mg_2(SO_4)_6(NO_3)_2 \cdot 6H_2O$

Crystal Data: Hexagonal. *Point Group:* $\overline{3}$. As hexagonal crystals, platy on {0001}, with $\{10\overline{1}1\}$, to 0.3 mm; typically in massive aggregates.

Physical Properties: *Cleavage:* Perfect on {0001}. *Fracture:* Irregular. *Tenacity:* Brittle. Hardness = ∼2.5 D(meas.) = 2.252 D(calc.) = 2.252 Soluble in H_2O.

Optical Properties: Transparent. *Color:* Colorless. *Luster:* Vitreous. *Optical Class:* Uniaxial (–). $\omega = 1.474(2)$ $\epsilon = 1.436(2)$

Cell Data: *Space Group:* $R\overline{3}$. $a = 10.9055(3)$ $c = 24.3949(9)$ Z = 3

X-ray Powder Pattern: Oficina Alemania, Chile.
3.39 (100), 2.724 (70), 8.14 (60), 8.80 (35), 4.53 (35), 2.583 (35), 1.866 (35)

Chemistry:

	(1)	(2)
SO_3	42.99	42.31
N_2O_5	9.14	9.51
MgO	7.47	7.10
Na_2O	18.43	19.11
K_2O	12.17	12.45
H_2O^+	9.78	
H_2O^-	0.40	
H_2O		9.52
Total	100.38	100.00

(1) Oficina Alemania, Chile; after removal of $NaNO_3$ impurity with acetone, $(SO_4)^{2-}$ and $(NO_3)^{1-}$ confirmed by IR. (2) $K_3Na_7Mg_2(SO_4)_6(NO_3)_2 \cdot 6H_2O$.

Occurrence: Formed by repeated natural leaching of nitrate ore with reprecipitation in irregular pods above the local regolith.

Association: Blödite, nitratine, kieserite.

Distribution: In Chile, from near Oficina Alemania and ten km west of Oficina María Elena; an ore in the Taltal nitrate district, Antofagasta; locally abundant in near-surface nitrate layers throughout the Atacama Desert.

Name: Honors James Thomas Humberstone (1850–1939), industrial chemist whose contributions permit economical extraction of nitrate from the Chilean deposits.

Type Material: National Museum of Natural History, Washington, D.C., USA, 120898.

References: (1) Mrose, M.E., J.J. Fahey, and G.E. Ericksen (1970) Mineralogical studies of the nitrate deposits of Chile. III. Humberstonite, $K_3Na_7Mg_2(SO_4)_6(NO_3)_2 \cdot 6H_2O$, a new saline mineral. Amer. Mineral., 55, 1518–1533. (2) Burns, P.C. and F.C. Hawthorne (1994) The crystal structure of humberstonite, a mixed sulfate-nitrate mineral. Can. Mineral., 32, 381–385.