Liebigite $Ca_2(UO_2)(CO_3)_3 \cdot 11H_2O$

Crystal Data: Orthorhombic. *Point Group:* $mm2$. Crystals are rare, short prismatic along [001], or equant, rounded with convex or vicinal faces, to 5 mm; scaly or granular, in aggregates, crusts, and films.

Physical Properties: *Cleavage:* On {100}. Hardness = 2–3 D(meas.) = 2.41 D(calc.) = 2.41 Radioactive; strong green to blue-green fluorescence under SW and LW UV.

Optical Properties: Transparent to translucent. *Color:* Apple-green, siskin-green, yellowish green. *Luster:* Vitreous to pearly on cleavages.
Optical Class: Biaxial (+). *Pleochroism:* X = nearly colorless; $Y = Z$ = pale yellowish green. *Orientation:* $X = a$. *Dispersion:* $r > v$, moderate. $\alpha = 1.494$–1.501 $\beta = 1.498$–1.505 $\gamma = 1.535$–1.542 2V(meas.) = 37°–42°

Cell Data: *Space Group:* $Bba2$. $a = 16.699(3)$ $b = 17.557(3)$ $c = 13.697(2)$ Z = 8

X-ray Powder Pattern: Jáchymov, Czech Republic.
6.81 (10), 8.68 (9), 5.40 (9), 4.55 (6), 3.10 (6), 3.33 (5), 3.31 (5)

Chemistry:

	(1)	(2)		(1)	(2)
CO_2	23.87	18.12	CaO	15.56	15.40
UO_2	37.11		H_2O	23.35	27.21
UO_3		39.27	Total	99.89	100.00

(1) Jáchymov, Czech Republic. (2) $Ca_2(UO_2)(CO_3)_3 \cdot 11H_2O$.

Occurrence: An uncommon secondary mineral typically formed as an alteration product of uraninite in alkaline carbonate solutions.

Association: Uraninite, schröckingerite, uranophane-beta, tyuyamunite, autunite, uranophane, bayleyite, carnotite, gypsum, calcite.

Distribution: From Edirne (Adrianople) Province, Turkey. Abundant in a number of mines around Jáchymov (Joachimsthal), Czech Republic. In Germany, from Schneeberg, Saxony; at Eisleben and Hasserode, Saxony-Anhalt; and from Müllenbach, near Baden-Baden, Black Forest. At Schmiedeberg, Poland. From Wheal Basset, Redruth, Cornwall, England. At Tyndrum, Perthshire, Scotland. From the Mas-d'Alary uranium deposit, three km south-southeast of Lodève, Hérault, France. In the USA, at the Midnite mine, Wellpinit, Stevens Co., Washington; in the Schwartzwalder mine, near Golden, Jefferson Co., Colorado; in Wyoming, in the Pumpkin Buttes area, Powder River basin, and at the Silver Cliff mine, Lusk, Niobrara Co., and in the Lucky Mc mine, Wind River basin, Fremont Co.; from the Black Ape mine, Thompsons district, Grand Co., and in the Mi Vida mine, Big Indian district, San Juan Co., Utah; at Ambrosia Lake and Westwater Canyon, Grants district, McKinley Co., New Mexico; from Mt. Pisgah, Jim Thorpe, Carbon Co., Pennsylvania. At Rabbit Lake, Saskatchewan, Canada. In the Tono mine, Gifu Prefecture, Japan. From Shinkolobwe, Katanga Province, Congo (Shaba Province, Zaire).

Name: To honor Professor Justus von Liebig (1803–1873), German chemist, University of Munich, Munich, Germany.

Type Material: American Museum of Natural History, New York, New York, USA, 16847.

References: (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 240–241. (2) Evans, H.T., Jr., and C. Frondel (1950) Studies of uranium minerals (II): liebigite and uranothallite. Amer. Mineral., 35, 251–254. (3) Frondel, C. (1958) Systematic mineralogy of uranium and thorium. U.S. Geol. Sur. Bull. 1064, 108–112. (4) Mereiter, K. (1982) The crystal structure of liebigite, $Ca_2UO_2(CO_3)_3 \cdot \sim 11H_2O$. Tschermaks Mineral. Petrog. Mitt., 30, 277-288.