The first geophytic lobivia (Cactaceae)

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Summary: *Lobivia bonnieae* was described recently in a publication of a Czech museum (Halda and Horácek, 1999) and was also featured in a hobbyist Czech magazine (Halda and Janeba, 1999). As these publications may be difficult for many readers to obtain, the following information is presented.

This species originates from the Argentine province of Catamarca, in the mountains around Fiambalá. It is closely related to *L. famatimensis*, but the tuberous roots—a unique, hitherto unrecorded character for the genus—as well the cylindrical stems differentiate it from this well-known species. This is not only the first lobivia with tuberous roots but also the only known member of the genus with stems that are eventually deciduous. Geophytism is a frequent adaptation of plants in arid zones but relatively rare in Cactaceae and previously unknown in *Lobivia* and related genera.

During a trip to Argentina in January–February, 1990, David Ferguson, Sean Hogan and Bonnie Brunkow discovered two unknown and very interesting cacti at the same locality in the Province of Catamarca. One of these has since been described as *Puna bonnieae* (Ferguson and Kiesling, 1997). Two years later the other plant was published as *Lobivia bonnieae* Halda, Hogan and Janeba (in Halda and Horácek, 1999). Both of these names honor Bonnie Brunkow of the same expedition. Independently, in December of the same year, Klaus Gilmer and Hans-Peter Thomas encountered the same species of *Lobivia*, considering it as "*Reicheocactus*" and later as *Lobivia famatimensis* (Gilmer, 1991,1993). After the publication of the first paper, Walter Rausch contacted Gilmer and went to visit the site in January–February, 1993, accompanied by Franz Kühas (Gilmer, 1995). At that time, plants of this new species were known in European collections as *Lobivia famatimensis* " var. *catamarcensis*" Rausch nom. nud. David Ferguson and Zlatko Janeba again found this species in the wild in 1994.

Visits to the same site by the present senior author were mentioned in the original description of *Puna bonnieae* (Ferguson & Kiesling, 1997). The first of these was made together with O. Ferrari and the late Silvio Meglioli in November 1994 and other trips were made in the years following in order to make additional observations of the plants and collect flowering and fruiting material. Two of these visits yielded neither flowers nor fruit, but these were found during an additional visit in November 1997 with Fernando Biurrun and J. Molina.

In both of the Czech papers the same line-drawing is used. In the second paper (Halda and Janeba, 1999), photographs of the plant and flowers were provided, as well as comments about the associated vegetation that agree closely with observations published earlier in the original description of *Puna bonnieae*. Additionally, Halda and Janeba give a discussion of the three species of the genus *Puna* (which they place in *Opuntia*).

Amplified description of *Lobivia bonnieae*

Lobivia bonnieae Halda, Hogan & Janeba in Halda & Horácek, New descriptions and combinations. *Acta Mus. Richnov, Sect. natur.* **6**(3): 234.1999. See also: J.J. Halda & Z. Janeba. Dva zajímavé argentinské kakty. *Cactus etc.* **4**: 157–160. 1999.

Type: *Z. Janeba 99061503* (PR, not seen), from "*Argentina: Catamarca (Dept. Tinogasta, prope Loro Huasi), in declivus petrosis 2000 m supra mare*".

Roots tuberous, irregularly swollen, rugose, brown, slightly suberose, ca. 10–15 cm long and 3–4 cm diam., narrowing to a 5–15 mm diam. constriction in the upper portion. Stems normally solitary, occasionally two or more, cylindrical, unbranched, 10–15(–30) cm long and 1.5–2.5 cm diam., gray-green to olive-green. Stem apex slightly depressed and densely pilose. Cortex ca. 4 mm diam., wood cylinder 10 mm diam., medulla 4 mm diam.; white crystals abundant in the cortex and medulla. Basal portion of the stems with several annular wrinkles, becoming dry in older plants. Tubercles 1–1.5 mm high and diam., forming ca. 30 vertical rows, ribs absent. Areoles 1 mm apart, oval, ca. 1 mm long and 0.8 mm wide, with white hairs and ca. 10 spines arranged in 2 lateral series, pectinate, subulate, white-hyaline, basally thickened, brown-pink, becoming gray in age, 1–1.5 mm long, completely intermeshed with the spines of neighboring areoles.

Flowers campanulate, ca. 2.5 cm long and 2.5 cm diam., receptacle with ca. 26 triangular bracteoles ca. 2 mm long and 1 mm wide, the axils with dark hairs; outer tepals dark yellow with reddish tones; inner tepals clear yellow, subulate, 1.5 cm long and 0.5 cm wide, upper margin crenulate. Ovary chamber subglobose, 4 mm diam., with numerous ovules. Style straight, ca. 1 cm long, pale yellow, stigma with ca. 5–7 lobes.

Figure 2. Single stem—note the rugose lower portion. The branching is atypical and is probably a result of injury.

Figure 1. Habitat of *L. bonnieae*.

Figure 3. Unusual specimen with several stems.

Figure 4. Two specimens, one with a three-lobed apex probably caused by fast growth after the rains.

Stamens many, inserted in a zone 4 mm to 11 mm above the base of the tube, 0.7–0.9 cm long, stigma slightly longer; filaments slender, 5–8 mm long, anthers 0.7 mm long, 0.5 mm wide.

Fruits ovoid, dark-violet**,** dehiscent by a longitudinal furrow, 1.2–1.8 cm long, 0.6–1.1 cm diam., with persistent perianth 1.1–1.5 cm long and of irregular diameter; bracteoles sparse, triangular, with pilose axils. Seeds many, approximately 300–400 per fruit, ovoid, black, slightly verruculose**,** 1.7 mm long and 1.3 mm diam., with the cuticle partially separated; area around the hilum enlarged and with two projections.

Known from Argentina, Catamarca Province, Department Tinogasta, in the mountains around the valley of Fiambalá in the Sierra de Fiambalá and the Sierra de Narváez at ca. 1700–2200 m, where it is not difficult to find in the growing season.

Material studied: Argentina. Prov. La Rioja. Dpto. Tinogasta, Ruta Nac. 45, entre Fiambalá y Paso de San Francisco, a 20 km de la primera, 29-XI-1997, *F. Biurrun, R. Kiesling et J. Molina, 4947* (SI). This specimen has several stems and roots, one flower (closed when collected), and 3 fruits. Additional specimens were studied in the field and some of them were later observed in cultivation by O. Ferrari and R. Kiesling.

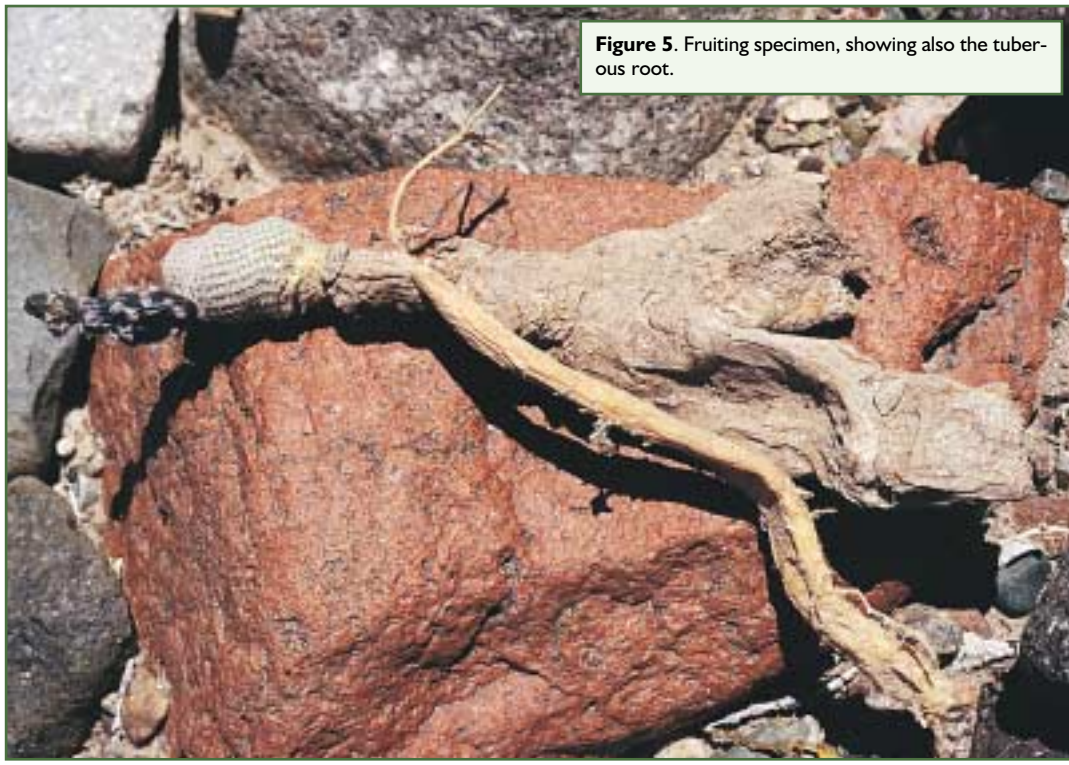

Figure 5. Fruiting specimen, showing also the tuberous root.

Lobivia bonnieae in the wild

Lobivia bonnieae differs from all other known species in the genus by its tuberous root, which is connected to the above-ground stem by a more slender portion (a "neck") where abscission of an old stem may occur during unfavorable conditions. This ability to abscise stems is not known in other species of *Lobivia*. During several excursions to the habitat we found many plants with younger stems in full growth and comparatively fewer older plants, whose growth rate appeared to be slower. One apparently very old plant, judging from its height of 30 cm, had a dead, cork-like epidermis extending more than half way up the stem. Other plants with relatively tall stems showed a similar epidermal development, though to a lesser degree. We have not observed this phenomenon in cultivated specimens nor in other species of cacti. It is possible this feature is a response to the plant's natural environment, where solar radiation and reflectance are intense and soil-surface temperatures are very high.

Figure 6. Crested specimen.

The harsh conditions experienced by *L. bonieae* in the wild are partially offset by the spines that completely cover the stems, especially on the oldest lower parts where the contraction of the stem brings the areoles closer together. These spines serve to protect the plants from the intense sunlight and also reduce water loss by transpiration. It is possible that the abundant white crystals within the stem's cortex also play an important role in minimizing internal damage from sunlight. These crystals are present in all the soft tissues, including the medulla and tuberous roots, and their distribution is more or less uniform rather than concentrated in the epidermis as in some *Opuntia* species, for example.

Lobivia bonnieae grows freely in Buenos Aires under greenhouse conditions. Small flower buds make their appearance in late winter, but since most of these abort, the plants flower only spo-

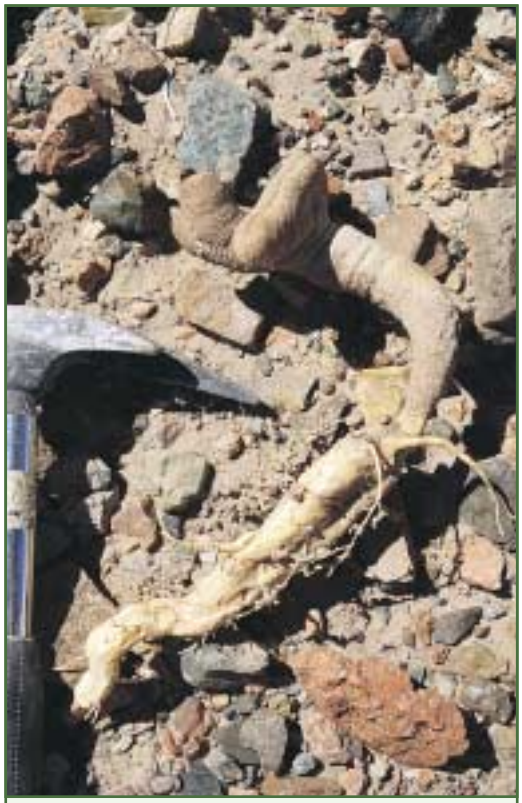

Figure 7. Crested specimen, showing the tuberous roots.

radically.

The trait of geophytism in this case is apparently facultative, as it has not been observed in cultivated plants, and evidently the stems live for several years in nature before finally drying and falling away. This response appears to be a mechanism used to survive extreme drought conditions rather than being a regular seasonal phenomenon.

In habitat the plants grow in a mixture of clay, sand and small stones. This "desert pavement" soil-type results when the wind blows away smaller particles and leaves behind a surface of pebbles. The vegetation here is very sparse, with shrubs occurring two to five meters or more apart. Shrubs occurring with *L. bonniae*, as mentioned in the publication of *Puna bonnieae*, include *Larrea divaricata*, *Lycium* sp., *Atriplex* sp. and *Grahamia ebracteata*. Sympatric cacti are represented by *Puna bonniae*, *Tephrocactus geometricus*, *Pterocactus tuberosus*, *Echinopsis leucantha* and *Opuntia sulphurea*. The presence of other species of *Pterocactus* mentioned in the publication of *Puna bonnieae* is, in the view of two of us (R.K. and O.F.), accounted for by variation within *P. tuberosus*, a very common and variable species in the area. Although these plants are not morphologically identical with other populations of the species, they can hardly be considered worthy of separate specific status; perhaps they may merit recognition at the level of subspecies.

Curiously, at the same latitude but on the other side of the Andes, grows *Eriosyce napina* ssp. *duripulpa* (syn. *Thelocephala duripulpa*), a Chilean species that has not only similar spination and stem-form but also similar tuberous roots. As illustrated by Kattermann (1994), these show notable differences from those of *L. bonnieae*. Additional differences are the bristles on the perianth of the Chilean species and in characters of the fruit. The similarities are apparently only superficial and represent a case of convergence under similarly harsh environmental conditions.

The great valley where this plant grows is possibly the driest region in Argentina, although we know of no rain-gauge data from the area. It is in the shadow of the very high Andes and so does not receive precipitation from Pacific storm systems. From the Atlantic, rain is effectively blocked by several relatively minor mountain ranges to the east of the valley. The vegetation here is more sparse than that found around the city of San Juan, where there is about 80 mm annual precipitation according to the climatic atlas (Servicio Met. Nac., 1963), and we suppose that even less rain falls where *L. bonnieae* grows. The air temperatures in summer are very high, perhaps fre-

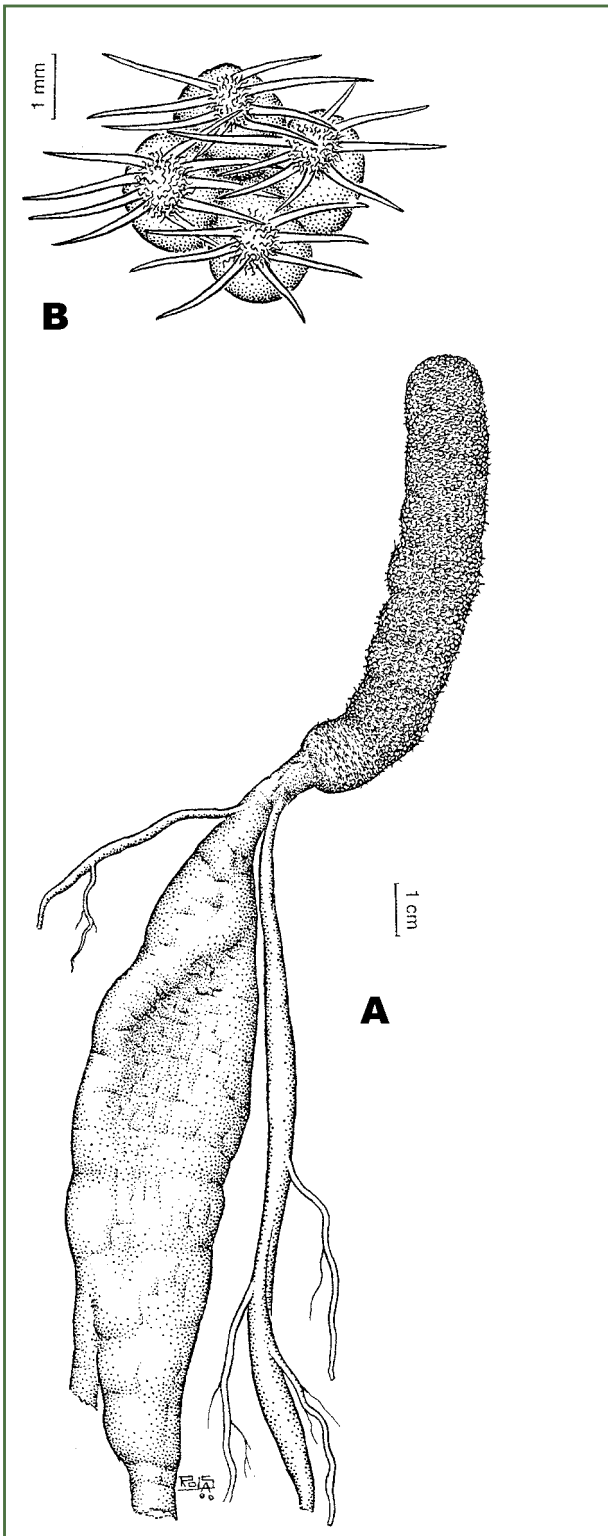

Figure A. General view of the plant with roots and stem.
Figure B. Detail of areoles and spines.

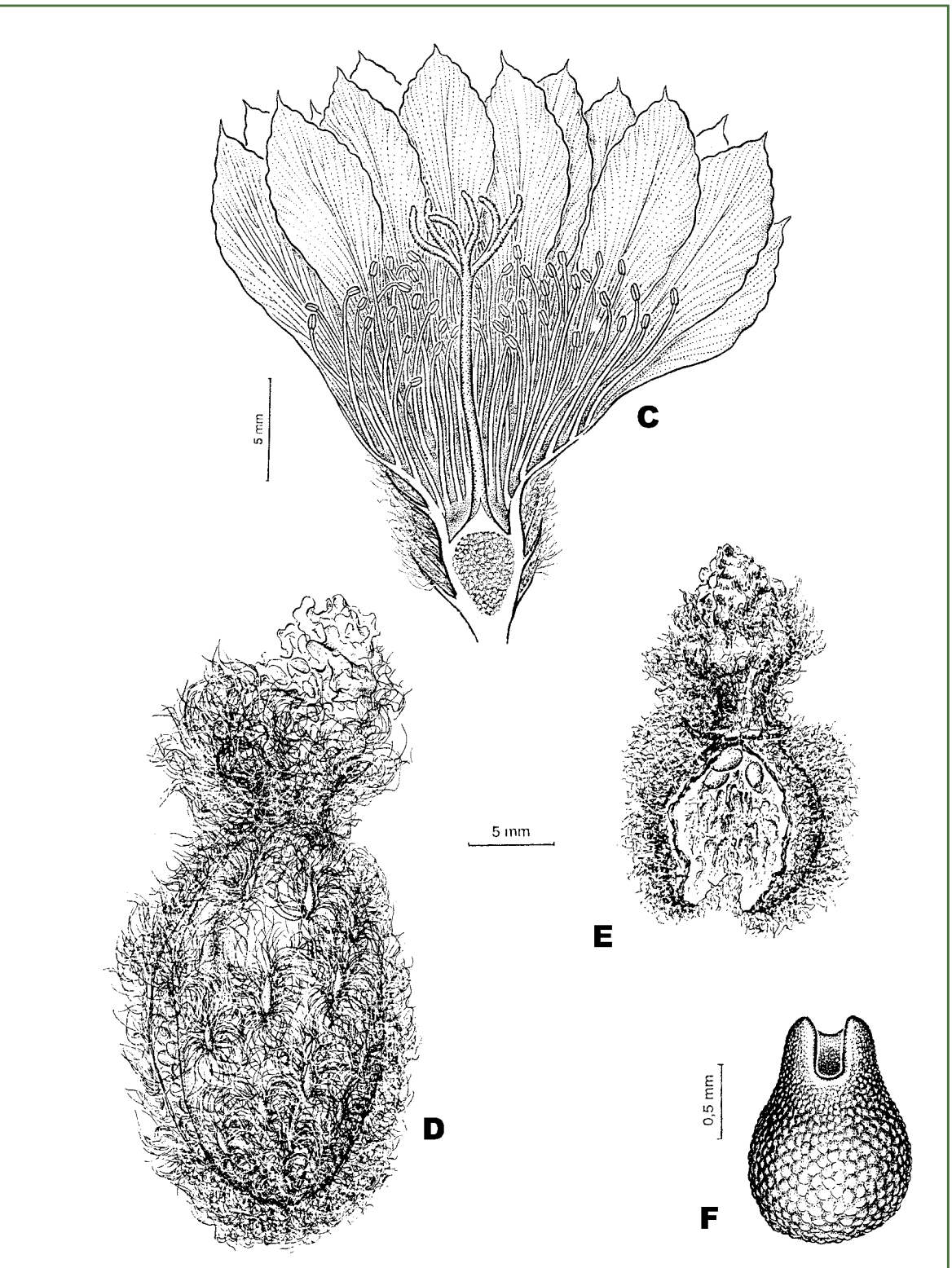

Figure C. Longitudinal section of the flower. **Figure D**. Ripe fruit. **Figure E**. A dehiscent fruit. **Figure F**. Seed, showing the two prominences around the hilum.

quently over 40°C, and without any doubt temperatures fall below freezing in winter.

Relationship with *Lobivia famatimensis* and additional notes

We consider *L. bonnieae* to be closely related to but distinct from *L. famatimensis* (Speg.) Britt. & Rose (Britton & Rose, 1922). Similarities between these two species include spination, flowers that are almost identical (except for small differences in size), and very similar fruits and seeds. An immediate difference is the presence of the tuberous root that is constricted where it meets the usually solitary stem in *L. bonnieae*. Another important difference is in the shape of the stem, which is strictly cylindrical in *L. bonnieae*, whereas in the several forms of *L. famatimensis* the stem is depressed or ovoid (becoming higher than wide only in cultivation) and is connected to the roots without any constriction.

Lobivia famatimensis grows to the south of *L. bonnieae*, ranging from the Famatina Mountains in La Rioja Province to several localities in San Juan Province. The resulting distribution gap between populations of *L. bonnieae* and *L. famatimensis* is nearly 100 km, but there may be undiscovered populations in the intermediate area. Under experimental conditions, rooted cuttings of *L. bonnieae* start to produce tubers after a few years and, although the tuber is evidently an adaptive character, it is also fixed genetically and is not dependent on environmental factors. *L. famatimensis* often grows in more humid areas but sometimes can be found at very dry localities such as around San Juan.

Lobivia famatimensis was described originally under *Echinocactus* by Spegazzini, and the type locality was given as the mountains of Famatina, as he correctly spelled the name. Hunt (1987) briefly mentions the species but under the genus *Rebutia*, and he changes the spelling to *R. famatinensis*, considering the second *m* in the specific epithet as a mistake on the part of Spegazzini. In my opinion the orthography of Spegazzini was a latinization, made with intention, and was repeated twice in another of Spegazzini's papers (1923, page 72: *Echinocactus famatimensis*, *Rebutia famatimensis*).

With regard to *Reicheocactus pseudoreicheanus* Back., the photos published by Backeberg (1959, p. 1851, Fig. 1780; and 1977, p. 741, Figs. 364 [left] and 365) compare exactly with plants of *L. famatimensis* in a population on one slope of the Famatina mountains. These plants have half-oval stems, a mauve epidermis and very short spines, and there is no doubt that *Reicheocactus pseudoreicheanus* is the same species as the one published by Spegazzini as *E. famatimensis*, later *Lobivia famatimensis*. A similar conclusion was also reached by Rausch (1986).

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