

## Neolloydia gautii Benson: a tangled taxonomic history and two new combinations

Alessandro Mosco<sup>1</sup> and Carlo Zanovello<sup>2</sup>

<sup>1</sup>Via Moreri 152, I-34135 Trieste, Italia

<sup>2</sup>Piazza Mercato 8, I-36040 Brendola (VI), Italia

**Summary:** The taxonomy of *Neolloydia gautii* and *Echinocactus beguinii* has been controversial for a long time. A closer examination of the holotype of *Neolloydia gautii* has shown that this taxon is not related to *Echinocactus beguinii*, while a careful reading of the first description of *Echinocactus smithii* has confirmed Zimmermann's hypothesis that it should be considered as conspecific with *Thelocactus conothelos*. In the light of these facts, two new combinations are made: *Echinomastus gautii* and *Turbincarpus beguinii*.

**Zusammenfassung:** Die Taxonomie von *Neolloydia gautii* und *Echinocactus beguinii* war lange Zeit kontrovers. Eine genauere Untersuchung des Holotyps von *Neolloydia gautii* ergab, dass dieses Taxon nicht mit *Echinocactus beguinii* verwandt ist, und eine genauere Betrachtung der Erstbeschreibung von *Echinocactus smithii* bestätigt Zimmermanns Hypothese, dass dieses Taxon dasselbe ist wie *Thelocactus conothelos*. Im Lichte dieser Resultate werden die folgenden beiden Umkombinationen publiziert: *Echinomastus gautii* und *Turbincarpus beguinii*.

### Historical background

At the beginning of this century J.H. Gaut collected, near Sour Lake, Hardin County, in eastern Texas, a plant that he deposited at the United States Herbarium in 1905. Seventy years later Lyman Benson rediscovered this specimen, still preserved at US, and based a new species on it, *Neolloydia gautii*. The description was published by Benson in 1974 in the *Cactus and Succulent Journal of the United States*. Almost twenty years later the botanists of the IOS began the difficult task of clarifying relationships between the different genera of the Cactaceae, to reach a greater taxonomic stability. In this context the epithet *gautii* appeared, combined by A.

Zimmermann (1991) in the genus *Turbincarpus*. To understand the reasons for all this we must go backwards in time.

Between 1893 and 1899 in France the "Dictionnaire d'Horticulture" was published, in which the part devoted to the Cactaceae was contributed by Weber. He gave descriptions of many new species, but many plants were cited by name only, and among these was *Mammillaria beguinii* Hort. Weber however realized that this plant was not a *Mammillaria* and included it, more correctly, in the genus *Echinocactus* (a very comprehensive genus at that time) with the name *Echinocactus beguinii* Weber as a synonym of *Echinocactus [horripilus] erectocentrus* (In Dict. Hort. the name *horripilus* var. *erectocentrus* does not appear, due to a mistake by the typesetter, as Weber confirmed to Schumann. See the note by Schumann in *Gesamtbeschreibung Kakteen*). Weber (1896) gave an informal, brief description, and compared this plant to *Echinocactus horripilus*: "L'*Echinocactus erectocentrus* Web. [Syn: *Echinocactus Beguinii* Web., *Mammillaria Beguinii* Hort.] est une forme à tige toujours simple et aiguillons plus nombreux, érigés."\* In the same year, on the other side of the Atlantic Ocean, Coulter described his *Echinocactus erectocentrus*.

In 1898, K. Schumann published the part of his *Gesamtbeschreibung Kakteen* where *Echinocactus beguinii* was officially described. The purpose was to validate the name of a species well-known among cactus fanciers. Unfortunately in the description of *Echinocactus beguinii*, *Echinocactus erectocentrus*, described in 1896 by Coulter, had been listed as synonym. As a consequence *Echinocactus beguinii*, a species different from *Echinocactus erectocentrus*, is a nomen illegitimum (Art. 52, ICBN

\*"E. erectocentrus Web., ..., is a form with an always simple body and with more numerous erect spines."

1994), and the latter has priority due to the fact that it had been described two years before. It seems to us very unlikely that Weber or Schumann had mixed up the two species, which are very different. More probably they did not really know the *Echinocactus erectocentrus* of Coulter. Coulter's description is in fact based on herbarium specimens and, as far as the native locality is concerned he wrote: "It seems so unlikely that this species would be found at such widely separated stations as Benson, Arizona, and Saltillo, Coahuila, that there must be a suspicion of shifted labels on the part of one of these collectors." In order to keep the epithet *beguinii*, well known and widespread among collectors, Taylor proposed in 1983 *Thelocactus beguinii* as a nomen novum, based on the Latin diagnosis of Schumann (1898), but explicitly excluding the type of *Echinocactus erectocentrus* Coulter. However the story does not end here: a little later, a new development appears in this saga of taxonomic relationships.

In 1986 Anderson published his revision of the genus *Neolloydia*. Among the taxa that he had to include, there was also "beguinii". However this epithet can be used neither in combination with *Neolloydia* nor with *Gymnocactus* (Art. 53, ICBN 1994), as both combinations are based on *Echinocactus beguinii* Schumann. So Anderson looked for another name for this species. Luckily among the Cactaceae there are plenty of synonyms and varieties and he chose *Echinocactus smithii* Muehlenpfordt. The following period of taxonomic steadiness for this species was not very long and the name *Neolloydia smithii* lasted only five years. Zimmermann, in 1991, rejected the inclusion of *Gymnocactus* in *Neolloydia* and went back to the idea of John and Riha (1981), who considered *Gymnocactus* synonymous with *Turbinicarpus*. Zimmermann also discussed the status of *Echinocactus smithii* which, in his opinion, must be identical with *Thelocactus conothelos* (Regel & Klein) Knuth. After discarding the epithet *smithii*, Zimmermann recovered *Neolloydia gautii*, published many years before by Benson, and combined it as *Turbinicarpus gautii* (L. Benson) A. Zimmermann. Zimmermann did not provide any definite facts to support his conjecture that *N. gautii* Benson and *E. beguinii* Schumann are the same plant, but gave his opinion that the information about the type locality of *N. gautii* was incorrect.

We have examined the holotype of *Neolloydia gautii* and, on this basis, we can conclude that *N. gautii* and *E. beguinii* are not the same, and we agree with Benson who considered *N. gautii* as systematically close to *Echinomastus mariposensis* Hester. Anderson (1986), in his review of the

genus *Neolloydia*, rejected Benson's opinion that *Echinomastus* was congeneric with *Neolloydia*, because he found a sufficient number of differences to maintain the separation of these two genera. Later it had been proposed to consider *Echinomastus* as congeneric with *Sclerocactus* (Hunt & Taylor eds., 1986), but Heil and Porter (1994), in their revision of the genus *Sclerocactus*, preferred to reject the inclusion of other genera in *Sclerocactus*, pending further research.

### The taxonomic position of *Echinocactus smithii*

Muehlenpfordt described *Echinocactus smithii* in 1846, without indicating a type or an illustration, but reported the Mexican State of San Luis Potosí as the type locality. Britton and Rose (1923) did not succeed in giving a clear decision about this taxon, and they included it among the species related to the genus *Thelocactus* with this remark: "We know this species from the brief description only and are unable to determine its relationship." Backeberg (1961) considered it to be a variety of *Gymnocactus beguinii*, while Kladiwa and Fittkau (1971) included it in the genus *Neolloydia* together with *beguinii*, the latter as a variety of *N. smithii*. Then in the revision by Anderson the epithet *smithii* was used in place of *beguinii*. As previously reported, Zimmermann thought that *Echinocactus smithii* had to be identical with *Thelocactus conothelos*, but he did not explain why. A careful reading of the original descriptions of *Echinocactus smithii* Muehlenpfordt (1846), *Echinocactus conothelos* Regel & Klein (1860), *Echinocactus saussieri* Weber (1896) and *Echinocactus beguinii* Schumann (1898), strengthens the conclusion of Zimmermann.

There are in fact differences and similarities, which we consider significant, in some characters of these taxa.

- 1) *E. beguinii* differs from *E. smithii* as far as the dimension of the areoles is concerned. In Schumann's description the areoles of *E. beguinii* are linear or elliptical, 3-4 mm long and 1-1.5 mm wide, whereas the areoles of *E. smithii* are 4-7 mm long, with a groove 5-6 mm long developing from the areole in the upper part of the tubercle.
- 2) Some differences may be found in the colour of the spines. The colour of the central spines of *E. smithii*, *E. conothelos* and *E. saussieri* varies from clear brown to grey, while in *E. beguinii* the colour is white with a dark brown or black tip.
- 3) The most important character from the



**Figure 1.** The holotype of *Neolloydia gautii* Benson.



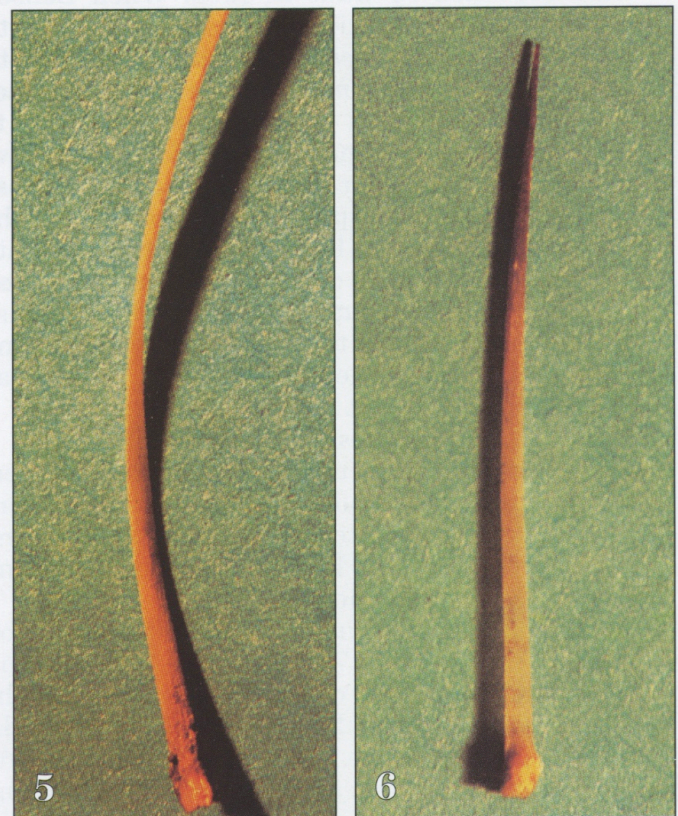
**Figure 2.** *Turbinicarpus beguinii* in habitat, near Saltillo, Coahuila, Mexico.



**Figure 3.** *Echinomastus gautii*, the central spines pointing upwards and curved towards the plant body.



**Figure 4.** *T. beguinii*, the central spines straight and more or less pointing outwards.



**Figure 5.** A typically curved and flattened spine of *E. gautii*. **Figure 6.** A straight and circular spine of *T. beguinii*.

taxonomic point of view concerns the flower. *E. smithii* Muehlenpfordt has the hypanthium covered by large cordate scales with membranous margins, *E. saussieri* Weber has a scaly floral tube (the cordate scales are present in *Thelocactus* but not in *Neolloydia* sensu Anderson) while in the description of *E. beguinii* there is no mention of the presence of scales on the flower tube. Moreover Schumann stated that it had a naked ovary, contrary to *E. smithii* for which he reports a scaly ovary.

- 4) Förster (1885) reported that the fruit of *E. smithii* is "woolly at the base, scaly at the apex", also in *Thelocactus* the fruits are scaly, while in *E. beguinii* the fruit has no scales.

We believe that on the basis of these differences it is possible to conclude that *Echinocactus smithii* Muehlenpfordt and *Echinocactus beguinii* Schumann are not the same plant.

#### **The problem of the identity of *Neolloydia gautii* Benson**

When Anderson published his revision of the genus *Neolloydia*, he ran into the problem of the identity of *Neolloydia gautii* Benson. This species had been described by Benson on the basis of a single specimen preserved in the US herbarium and deposited by Gaut in 1905. When Benson described this species, he compared it with *Neolloydia warnockii* Benson and with *Neolloydia mariposensis* (Hester) Benson, since he considered that it was systematically close to these two species. Anderson (1986) did not solve the problem of the identity of *N. gautii* and chose not to consider this species for his revision of the genus *Neolloydia*, as he believed that its identity was doubtful, until other specimens had been made available. Zimmermann (1991) was not so careful and accepted the possibility of identifying *N. gautii* with the entity long known as "beguinii". We do not agree with this solution.

The Latin diagnosis of Benson (1974) is:

"Simplex; tuberculis conicis sulcatis; aculeis rectis, centralibus 2-3 calcareis caeruleis rectis, singulo longiore porrecto, 2.5 cm. longis, 0.75 mm. diametro, radialibus 16-20, pectinatus, 9-12 mm. longis, 0.4 mm. diametro."

The description, in English, continues as follows: "Stem solitary, 7.5 cm high, 5.6 cm in diameter; mature spines chalky blue, darker at the tips; central spines 2-3, all pointing upwards, lower (principal) one exactly central in the areole, about 2 cm long, straight or slightly curving upwards, the other central spines straight and much smaller, 0.75 mm in basal diameter, tapering, basally elliptic in cross section; radial spines

about 16-20, spreading regularly in a single series and lying flat against the stem, 9-12 mm long, basally as much as 0.4 mm in diameter; flowers and fruits unknown."

The holotype of *Neolloydia gautii* Benson is a complete dried plant, originally lodged as *Mammillaria*. Examining this specimen (Figure 1) we found it has an ovoid stem, greyish-white in colour, except at the apex which is reddish. We have not succeeded in observing with certainty the grooves on the tubercles, reported by Benson in his Latin diagnosis, because it is impossible to distinguish them from some possible creases produced during the preparation of the dried sample. Only a closer examination could give an answer to this problem, but perhaps this would damage part of the specimen. The spines (Figure 3) are well preserved and are the only character that can be usefully used in order to compare this specimen with other taxa. In *N. gautii* the radial spines have a dull white colour, while in the central ones the white colour shades off to bluish-grey at the apex. In contrast *E. beguinii* (Figure 2) has translucent spines (Figure 4), glassy-white in colour; the central spines always have a brown or black tip, and the radials often have the same characteristic. The spines are also morphologically different in these two entities: in *N. gautii* the central and radial spines (Figure 5) are flattened (in *Echinomastus intertextus* (Engelm.) Br. & R., a related species, all spines are elliptic in cross section, see Benson, 1982) with a ratio of about 1:2 in the dimensions of the two axes, 0.4 mm x 0.75 mm the central ones and 0.17 mm x 0.37-0.42 the radial ones; while in *E. beguinii* all the spines (Figure 6) are circular in cross section (0.57-0.62 mm the centrals and 0.12-0.45 the radials). Moreover the central spines of *N. gautii* are slightly larger than those of *E. beguinii* (up to 0.75 mm in comparison with 0.62 mm). Also the arrangement of the central spines is different in the two plants. In *N. gautii* (we have been able to distinguish positively only one central spine, but in the upper part of the areole there are one or two extra spines that perhaps may also be considered as centrals) the central spines (Figure 3) are up to 28 mm long, pointing upwards and slightly curved towards the plant body. In *E. beguinii* there are 1 - 3 straight, erect central spines (Figure 4) up to 30 mm long, the lower one more or less pointing outwards. The micromorphology of spines may be taxonomically important, as shown by Schill et al. (1973). From scanning electron microscope analysis the spine texture of these two entities is different. The spine epidermis of *N. gautii* is fragmented (Figures 7a, b) at the cellular level. The fragmentation of the epidermis is the reason for the opaque aspect of the spines (Lüthy, 1995).

	<i>beguinii</i>	<i>gautii</i>	<i>smithii</i>
1846			<i>Echinocactus smithii</i> Muehl.
1895-6	<i>Echinocactus beguinii</i> Web. nom. nud.		
1898	<i>Echinocactus beguinii</i> Schumann nom. illeg.		
1961	<i>Gymnocactus beguinii</i> Backeb. nom. illeg.		<i>Gymnocactus beguinii</i> var. <i>smithii</i> Backeb. nom. illeg.
1971			<i>Neolloydia smithii</i> Kladiwa & Fittkau
1972	<i>Neolloydia smithii</i> var. <i>beguinii</i> Kladiwa & Fittkau nom. illeg.		
1974		<i>Neolloydia gautii</i> Benson	
1983	<i>Thelocactus beguinii</i> Taylor		
1991		<i>Turbinicarpus gautii</i> Zimmermann	

**Table 1.** Summary of the taxa taken into consideration along with the years of their descriptions or combinations.

In *E. beguinii* the epidermis is entire (Figures 7c, d) and therefore the spines appear translucent. These differences are to us sufficient to separate these two species.

#### Taxonomic treatment

We think it is useful to include *N. gautii* in a narrowly defined genus, adopting the traditional *Echinomastus*, in the absence of new data to clarify its relationships with other genera. We therefore propose the following combination:

***Echinomastus gautii* (Benson) Mosco & Zanovello comb. nov.**

Basionym: *Neolloydia gautii* L. Benson in Cact. Succ. J. (US) 46: 80 (1974). Type: U.S.A., Texas, Hardin County, Sour Lake, J. H. Gaut, 11 Apr. 1905 (US 2828362, holo.)

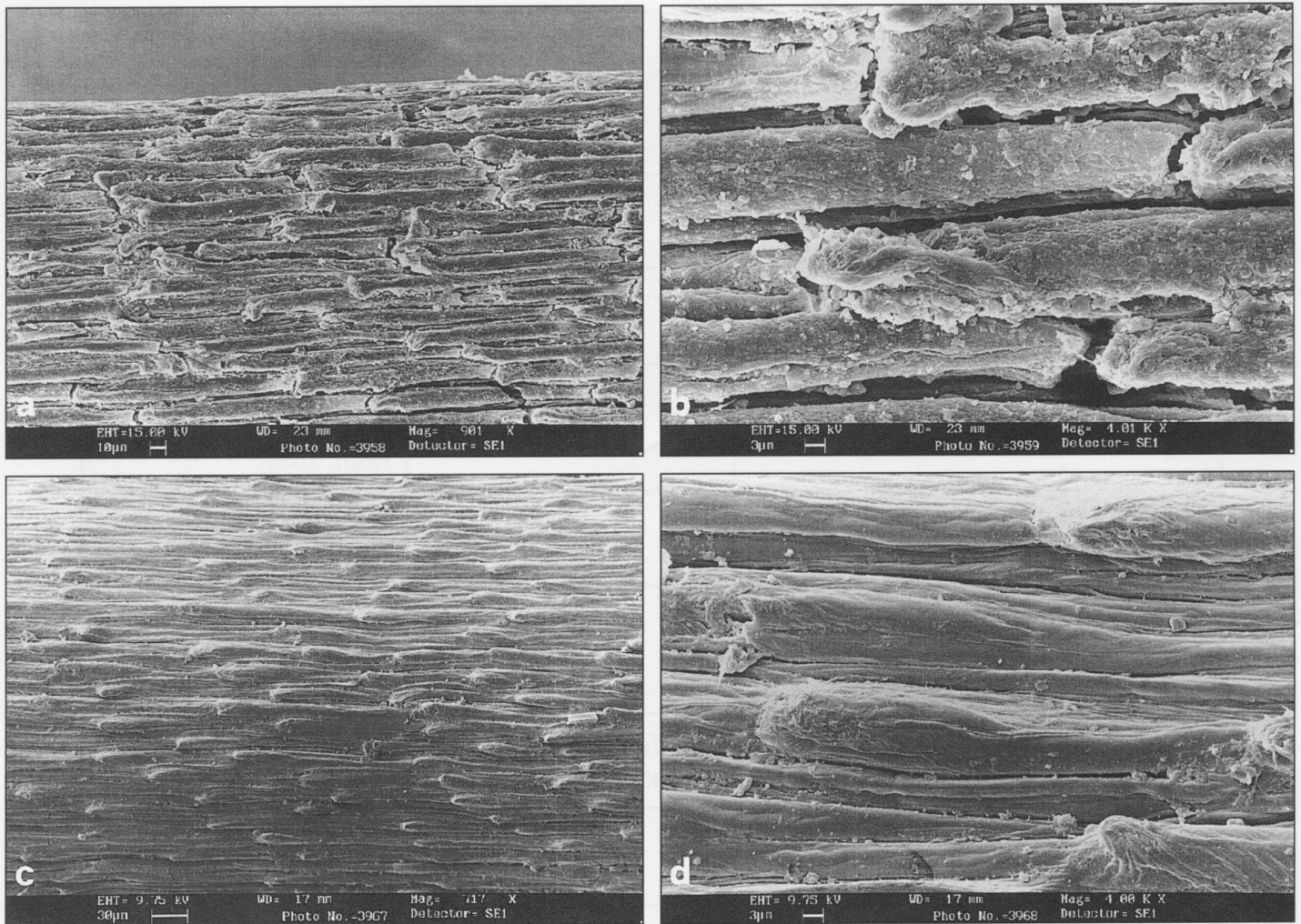
[*Turbinicarpus gautii* (L. Benson) A. Zimmermann in Bradleya 9: 91 (1991), pro parte quoad typ.]

We also have a plant, known for a long time and well characterized, for which the epithet *beguinii* is invalid if associated with *Echinocactus*, *Neolloydia* and *Gymnocactus*; the second epithet (*smithii*), equally well known, has to be considered synonymous with *Thelocactus conothelos*; the third one (*gautii*) applies to a completely different taxon based on the original description and supported by our own observations (Table 1). We propose the following, which has the merit of retaining the better known epithet *beguinii*:

***Turbinicarpus beguinii* (Taylor) Mosco & Zanovello comb. nov.**

Basionym: *Thelocactus beguinii* N.P. Taylor, in Bradleya 1: 113 in adnot. (1983). Type: Mexico, Coahuila, Weber.

*Echinocactus beguinii* Weber ex Schumann (1898), nom. illeg. (art.52, ICBN 1994) pro



**Figure 7.** Scanning electron photomicrographs of spines of *E. gautii* and *T. beguinii*. **a** *E. gautii*, the fragmented epidermis. **b** *E. gautii*, the epidermal cells divided. **c** *T. beguinii*, the whole epidermis. **d** *T. beguinii*, the epidermal cells united.

parte exl. typ.

*Neolloydia beguinii* Br. & R. (1923), nom. illeg. (art.53, ICBN 1994) non (Schumann) Br. & R. (1922) (= *Echinomastus erectocentrus* (J. Coulter) Br. & R.

*Gymnocactus beguinii* Backeb. (1961), nom. Illeg. (art.53, ICBN 1994) non (Schumann) Backeb. (1951) (= *Echinomastus erectocentrus* (J. Coulter) Br. & R.

[*Neolloydia smithii* sensu Kladiwa & Fittkau, in Krainz, Die Kakteen, Lfg. 46-47 (June 1971), non *Echinocactus smithii* Muehlenpfordt].

[*Turbincarpus gautii* sensu A. Zimmermann, in Bradleya 9: 91 (1991), non *Neolloydia gautii* L. Benson].

### Acknowledgements

Many friends and institutions have given their help, enabling us to carry our research through. We gratefully acknowledge Dr Giancarlo Cassina, Curator of the Botanic Garden of Padova, for having requested the holotype of *Neolloydia gautii*, and the US Herbarium for

having kindly allowed the loan of this specimen. We wish to thank Dr Renata Trevisan, Department of Biology of the Padova University, and Dr Piero Giulianini, Department of Biology of the Trieste University, for their careful work on the scanning electron microscope. For sending us copies of many first descriptions, otherwise not easily available, we are indebted to the Conservatoire et Jardin botaniques de la Ville de Genève; Hans-Werner Lorenz, Arbeitsgruppe Literatur DKG, Nicholas Martland, Royal Botanic Gardens, Kew; Roy Mottram and Pasquale Ruocco. Thanks are due also to Dr Luciano Battaia for having translated the Italian version into English, and to Dr Bill Wales for revising the English text.

### References

- ANDERSON, E.F. (1986): A revision of the genus *Neolloydia* B. & R. (Cactaceae). *Bradleya* 4: 1-28.
- BACKEBERG, C. (1961): *Die Cactaceae*. Vol.5. Gustav Fischer, Jena.

- BENSON, L. (1974): *Neolloydia gautii* L. Benson, sp. nov. Cact. Succ. J. (US) 46: 80.
- BENSON, L. (1982): The Cacti of the United States and Canada. Stanford Univ. Press, Stanford.
- BRITTON N.L. & ROSE J.N. (1923): The Cactaceae, Vol. 3. Carnegie Inst. Washington, Washington, D.C.
- COULTER, J.M. (1896): Preliminary revision of the North American species of *Echinocactus*, *Cereus*, and *Opuntia*. Contributions from the U. S. Nat. Herb. 3: 376. [1 Apr 1896]
- FÖRSTER, C.F. (1885): Handbuch der Kakteenkunde. Tr. Wöller, Leipzig.
- HEIL, D.K. & PORTER, J.M. (1994): *Sclerocactus* (Cactaceae): a revision. *Haseltonia* 2: 20-46.
- HUNT, D.R. & TAYLOR, N.P., eds. (1986): The genera of the Cactaceae: towards a new consensus. *Bradleya* 4: 65-78.
- JOHN, V. & RIHA, J. (1981/83): [Unkombinationen aus *Gymnocactus* in die Gattung *Turbiniocarpus*.] *Kaktusy* 17: 15-18, 19: 22. (Trans. and publ. in Eggli, U. 1984. Die Gattung *Turbiniocarpus*. Verlag Urs Eggli, Erlenbach).
- KLADIWA, L. & FITTKAU, H.W. (1971-72): Gattung *Neolloydia*. In Krainz, H., Die Kakteen, Lfg. 46-49.
- LÜTHY, J.M. (1995): Taxonomische Untersuchung der Gattung *Mammillaria* Haw. (Cactaceae). Verlag Arbeitskreis für Mammillarienfreunde e.V. & Jonas M. Lüthy, place of publication not indicated.
- MÜHLENPFORDT (1846): *Echinocactus smithii*. *Allg. Gartenz.* 14: 370.
- REGEL & KLEIN (1860): *Echinocactus conothelos*. *Ind. Sem. Hort. Petrop.* 48.
- SCHILL R., BARTHLOTT W. & EHLER N. (1973): Micromorphologie der Cactaceen-Dornen. *Trop. sub. Pflanz.* 6: 263-279.
- SCHUMANN, K. (1898): Gesamtbeschreibung der Kakteen, Lief. 7. J. Neumann, Neudamm. [15 Apr 1898]
- TAYLOR, N.P. (1983): *Thelocactus beguinii* N.P. *Taylor. Bradleya* 1: 113 in adnot.
- WEBER, F.A.C. (1896): *Echinocactus*, in Bois, *Dictionnaire d'Horticulture*. Part 15 P. Klincksiek, Paris. [Oct 1896]
- ZIMMERMANN, A.D. (1991): Notes on miscellaneous genera of Cactaceae (Hunt, D. & Taylor, N.P., eds.). *Bradleya* 9: 91.