

AN AMAZING SPECIES OF *HILDEWINTERA*
(CACTACEAE)—CHARACTERS AND SYSTEMATIC POSITION

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An amazing species of *Hildewintera* (Cactaceae)—characters and systematic position

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Photos by Eva & Voytek Foik

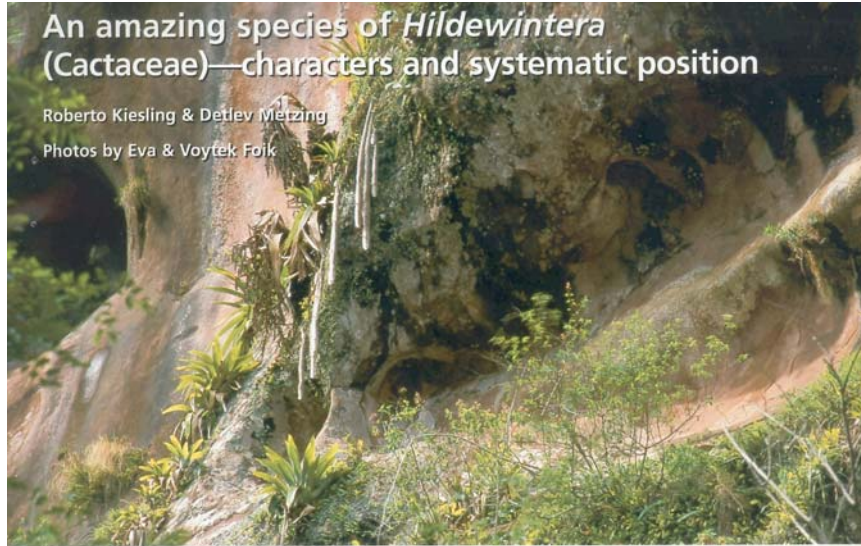


Figure 1. The type locality of *Hildewintera colademononis*, with its long white pendent stems hanging from the cliff. The rosette plants are tillandsias.

Summary: A recently described second species of *Hildewintera*, *H. colademononis* Diers & Krahn, is critically analyzed. A detailed description is given, and the systematic position and nomenclature of the species are discussed. Both species of *Hildewintera* are mainly distinguished from *Cleistocactus* by the double corolla, the different sculpturing of the seed-testa and the pendulous stems with spines directed downwards. *H. colademononis* is characterized by a flower with an axial spur, a character never previously reported for the Cactaceae. Notes on climate, affinities, nomenclature and taxonomy are also presented.

Introduction

In 1958, F. Ritter found in the Bolivian province of Florida a pendulous-stemmed member of the Borzicaetinae Buxb. with a remarkable double corolla. When he described the new species, he also established the new genus *Winteria* Ritter for it (Ritter 1962); later the name was changed to *Hildewintera* Ritter (Ritter 1966). Although not accepted by all subsequent authors (see below), the genus remained monotypic for 37 years. In 2003, a new species was described independently—and nearly at the same time—by two groups of authors as *Hildewintera polonica* V. & E. Foik and *Hildewintera colademononis* Diers & Krahn (Foik & Foik, 2003a; Diers & Krahn, 2003a).

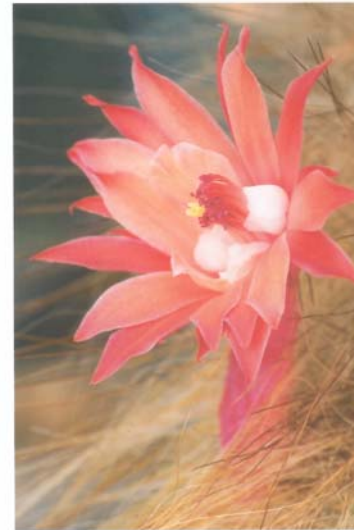


Figure 2. The expanded perianth with white inner tepals.



Figure 3. Exterior of flower showing the basal spur.



Figure 4. Interior of flower with specialized nectar cavity.

To understand the reasons for the nearly simultaneous description of two names for the same species, it is necessary to look behind the scenes. Obviously, the species was first known to inhabitants of the Bolivian village of Samaipata, for they had collected and cultivated the plants. A few years ago, a German bromeliad collector, Ewald Heßer, saw the species there and notified others of its existence. As a result, the German cactus collector Wolfgang Krahn visited the locality to study and collect the plants in the field (Diers & Krahn 2003a, b). Later and independently, the species was found in habitat in November 2002 by another group of cactus collectors, including the first author of this paper (Foik & Foik 2003b). A Dutch collector, L. Bercht, had also seen the plants in Bolivia and was the first to mention and illustrate the species in his article in the November issue of *Succulenta* (Bercht 2002), though he gave no formal description.

When the Bolivian botanist Martin Cárdenas (1899–1973) travelled from Santa Cruz to Cochabamba in 1950, he crossed this area and explored a closely similar geological formation at El Fuerte, about 20 km distant from the locality of *H. colademononis*. Evidently he did not find this

species (Cárdenas 1952b: 6). It is also curious that local or foreign botanists or cactus collectors did not find it earlier. Apparently the plant had been introduced to cultivation in Samaipata several years before, and it was these cultivated plants that between 2000 and 2002 were first seen independently by three groups of plant explorers—only subsequently was it searched for in the field.

When they first saw the cultivated plants, all the mentioned collectors instantly recognized them as a new species. Both Diers and Krahn as well as Kiesling prepared formal publications independently. In June 2003 Diers and Krahn submitted their manuscript with the new description of *H. colademononis* to the German journal, *Kaktaceen und andere Sukkulente* (“KuaS”). Kiesling had already submitted a manuscript (co-authored with E. and V. Foik) to the *Cactus and Succulent Journal* (US), naming the species in honor of the Foiks, as they had travelled with him and supplied several photos and observations of the new species. After he heard about Kiesling’s proposed article, Detlev Metzger, scientific editor of KuaS, recognized the unpleasant possibility of two names being published simultaneously for the same species. After a discussion, Kiesling agreed to have the

Description and characters

Hildewintera colademononis Diers & Krahn, Kakt. Sukk. 54 (8): 221. 2003 (date of publication: July 31, 2003). Synonym: *Hildewintera polonica* V. & E. Foik, Cactaceae etc. 13 (2): 68. 2003. (date of publication: ca. July 15, 2003); nom. inval. (Art. 32.1, 37.6).

Roots fasciculate, firmly adhering to rocks, frequently embedded in mosses or among the roots of other plants. **Stems** 3–6, branched from the base, entirely pendulous, soft, flexible, cylindrical, up to 2 m long and 3–7 cm diam., **ribs** ca. 17 (14–19), very low (ca. 1 mm), epidermis light green, completely covered with downward-pointing white spines and some honey-colored bristle-like spines. Areoles 5–6 mm apart, 1.5–2.0 mm diam. Hair-like **spines** white to translucent, ca. 15–20 or more at each areole, ca. 4–7 (–12) cm long, 0.10–0.15 mm diam.; bristle-like spines yellowish, sometimes absent or represented by 1 central and 4–7 radials, 4–7 cm long, thin and flexible, ca. 0.25 mm diam.

Floral buds contorted, zygomorphic. **Flowers** mostly ca. 1–30 cm from the apex, zygomorphic, the basal portion directed downwards but becoming sharply bent and upturned above the nectar chamber, ca. 7–8 cm long, the limb expanding about 5 cm at anthesis. **Receptacle tube** (hypanthium) cylindrical, ca. 4 cm long and 0.7 cm diam., dark magenta-red, covered with a few minute, red, deltoid scales with nearly hairless axils except around the pericarpel, where the hairs are very few (10–20) and inconspicuous, 0.5–1.0 mm long. Basal part of the flower angled and forming a conical pouch ca. 3 mm deep and 4 mm wide, with the lowest stamens attached there. **Perianth** zygomorphic, formed of two well-defined series of tepals: the outer **tepals** oblanceolate, dark red, the larger ones with an

almost violet border, inner tepals deep-orange to light-red, obtuse, all ca. 20–35 mm long and 6–7 mm wide. Inner series noticeably different: tepals tightly surrounding style and stamens, relatively few (5–10), only 10–13 mm long and half as wide, obtuse, white or with a pinkish tint, some of them smaller and inconspicuous. The lower **stamens** shorter than the style, the upper stamens exceeding it, filaments white or pink at the base, red above, 10–70 mm long; anthers red, ca. 1–2 mm long. **Style** cylindrical, 70 mm long, very pale cream, stigma 6–8-lobed, ca. 3 mm long, yellow. Nectar chamber at base of tube, short, open, without a diaphragm (Figs. 2–6).

Fruit globular, pink, about 1 cm diameter, with inconspicuous scales and hairs, irregularly dehiscent, becoming dry and black after maturity, perianth remnant persistent. **Seeds** black, rugose, ca. 1.2–1.4 mm long and 0.9 mm wide, slightly curved, with a longitudinal crest. Cells of the testa convex, prominent, more or less aligned longitudinally, smaller and less prominent near the apical hilum/micropylar region, which is oval, sunken, and narrow, 0.5 mm long × 0.3 mm wide.

Holotype: Bolivia, Prov. Florida, Cerro El Fraile, 2000, Wolfgang Krahn WK 950 (KOELN, not seen).

Studied material: Bolivia, Dept. Santa Cruz, Prov. Florida, 30 km SE from Samaipata, on vertical rocky cliffs extending above the jungle canopy, with *Tillandsia samaipatensis*, orchids, Gesneriaceae, etc., *R. Kiesling et al.* 10067, November 2002 (LPB1, SII), designated as the holotype by Foik & Foik, 2003; *Foik 1*, May 2003, flowers, cultivated in Samaipata (flowers, LPB1, SII). See figure 9 for a map of the area where this species grows.

species validly published by Diers and Krahn, while he would later publish a more detailed presentation of the species for the American journal. However, the Foiks found a periodical that would publish their own article before the KuaS issue appeared. Their description thus appeared in the Slovakian journal *Cactaceae etc.* as *Hildewintera polonica* (Foik & Foik, 2003a), using data and excerpts from the manuscript intended for the American journal. The Slovakian article was effectively distributed in mid-July 2003, while the description by Diers & Krahn (2003a) appeared only a few days later (July 31, 2003).

The aim of the present paper is to present the new species in more detail, draw attention to its unique characters and evaluate its taxonomic position. A name is just a name, and without intending to be biased, we must use the name *Hildewintera colademononis* for this species, based on the ICBN (Art. 11.4, Greuter et al., 2000; see discussion below concerning the type).

Note: In the description by Foik & Foik (2003a), two herbaria (LPB, SII) are cited as the

location of the holotype. Although the current Code (Greuter et al., 2000) for the first time allows citation of two herbaria as places of type deposition (Art. 37.2), it is not applicable in publications appearing on or after January 1, 1990 (Art. 37.6). Therefore the requirements of the Code are not fulfilled (Art. 32.1) and the name *Hildewintera polonica* has to be regarded as invalidly published. The correct name for the new species is therefore *Hildewintera colademononis*, even though it was published later than *H. polonica*.

This article is based on the non-published manuscript by the first author (RK) and Eva and Voytek Foik with revisions from the description and data from Diers & Krahn (2003a, b).

The flowers were examined and photographed in cultivation, as in the field there was no access to flowering plants. It was possible to collect only a couple of fruits, which were completely dry. They had irregularly-shaped openings and paper-thin walls.

The stem diameter—minus the spines—of the cultivated plants as stated in the Foiks' original



Figure 5. From top: outer, intermediate and inner tepals. All photos by E. & V. Foik.

description as 2–4 cm seems too thin according to the observations of wild plants by the first author (RK) and probably correspond to the dimensions of thinner stems we saw growing in shady places. Young stems are also thinner in cultivation and the hairy spines are yellowish, soon fading to pure white. According to Diers & Krahn (2003b), the stem diameter can be up to 7 cm.

The spines of this species very probably continue to grow for a long period, another character not observed in the Cactaceae until now. Young stems have short spines ca. 1–2 cm long, but on old stems they are much longer, some of them to 12 cm. Each hair-like spine has only a few (ca. 15) rows of parallel cells, with the stem-apices broken off in many cases. It will be interesting to observe the spine-length in cultivated plants after several years of growth protected from mechanical damage.

Etymology

Diers & Krahn (2003a) chose the epithet *colademononis*, derived from the Bolivian vernacular name "Cola de Mono," which means monkey tail (because of the hairy, pendulous stems). Foik &

Foik (2003a), when naming the plant, wanted to honor their country of origin, Poland, but the epithet *polonica* (= from or of Poland) is quite unsuitable for a Bolivian cactus species even if it were valid according to the ICBN. Their name has already been listed under the "misnamed" category in "Curiosities of Botanical Nomenclature" (Isaak 2003).

The peculiar floral morphology

The most peculiar morphological character of the new species is the geniculate base of the flower tube, which contains a sac-like cavity where nectar can accumulate (Fig. 3, 4 and 6). The function of the nectar accumulation, segregated from the actual nectar chamber, which is just above, is also increased by the lack of a diaphragm (which is present in *Hildeswintera aureispina* (Ritter) Ritter), allowing the nectar to flow easily into the cavity. We believe that this structure is a derived adaptation for pollination by hummingbirds. Because the nectar flows into the pouch, it is more easily accessible to the bird's tongue, but damage to the lower parts of the gynoecium is also avoided by the separation of nectar and nectaries. Such protection is common in ornithophilous plants (Hess 1983). In flowers of several taxa, the nectar is stored in a sac-like hollow called a spur. The spur can be formed by petals, sepals, or by bulge of the hypanthium (e.g., in *Tropaeolum*) (Weberling 1981, Leins 2000).

Undoubtedly, the flower of *H. colademononis* forms such a spur, although to a lesser degree than in *Tropaeolum*. The origin of the spur in *H. colademononis* is the hypanthium or receptacular tube, an axial tissue, so it is in fact an axial spur (in German, Achsensporn). An axial spur has not been reported for any member of the Cactaceae—therefore this unique character is an apomorphy of this new *Hildeswintera* species.

H. aureispina lacks such a spur (see the drawings and description of Ritter 1962 and Buxbaum 1974a, b; reproduced as Figs. 7 and 8). Moreover, its stamens are connate at the base, forming a diaphragm, so there are two distinct and related differences between these species. Although spurs have not been reported—and perhaps do not exist—in other cacti, a similar, but less pronouncedly geniculate flower is found in three species of *Cleistocactus*: *C. brookei* Cárdenas (1952a), *C. vulpis-cauda* Ritter & Cullmann (1962) and *C. xerullandiorum* Back. (1955). However, in contrast to *H. colademononis*, all these species possess a distinct diaphragm. The geniculate flower-form of these species was mentioned and illustrated by Cárdenas (1952a), Ritter & Cullmann (1962), Backeberg (1955, 1959), and Heyer (1988).

Together with *H. aurispina*, *H. colademononis* possesses the synapomorphy of a double corolla (Figs. 2, 5 and 6). The inner perianth segments are shorter than the outer ones, they are not recurved and they closely surround the stamens and style.

Systematic position of *H. colademononis*

Both Foik & Foik (2003) and Diers & Krahn (2003b) point out the close relationship of the new species with *Hildewintera aurispina*. For reasons we will explain below, we agree that *Hildewintera* is a genus deserving separation from *Cleistocactus* Lem., in which it is now placed by several authors (Hunt & Taylor 1990, Anderson 2001). The relationship of these two species is supported by several characters (cf. Foik & Foik 2003a, Diers & Krahn 2003b):

- 1) The flowers of both species have an "inner corolla" completely different from the outer one in form, shape, color, and perhaps also in function, formed from a few, very short, obtuse, almost white perianth segments (Figs. 2, 5, 6).
- 2) The outer perianth segments are not short (scale-like) as in *Cleistocactus* but measure about half the length of the flower (Fig. 2, 5, 6).
- 3) The seeds of the new species are closely similar to those of *H. aurispina* (for comparison see Bregman 1992, p. 243, Figs. 28–30, and Barthlott & Hunt 2000, Fig. 31.3, as *Cleistocactus weinerti*), and they differ from all the seeds of *Cleistocactus* s. str. that we have seen.
- 4) The downward-pointing stem-spines occur in both *Hildewintera* species, facilitating the shedding of moisture. This spine disposition differs from that observed in other cacti and is an evident adaptation of a pendulous species growing in a frequently wet habitat.
- 5) Both species are strictly epilithic, growing pendulously from rock cliffs (Fig. 1). The two species are separated by only about 40 km.

The same reasons used to show the relationship between these two species also support their differentiation from *Cleistocactus*. Although the phylogeny and generic borders of *Cleistocactus* and several allied groups (*Borsiacactus* Ricc., *Loxanthocereus* Back., etc.) are not completely understood, we present a key to differentiate *Cleistocactus* from *Hildewintera*—using the most important and consistent characters—and the two *Hildewintera* species from each other (cf. Foik & Foik, 2003a, b):

- A Floral tube ca. 3 times longer, or more, than the perianth. Perianth segments intergrading into only one series, short, deltoid, scale-like. Receptacle scales mostly with profuse hairs. Seeds with a smooth testa. Mostly terrestrial plants, erect, rarely on cliff-faces and only partially pendulous (e.g. *C. vulpis-cauda*, *C. samaiatanus*) *Cleistocactus* (including *Bolivicereus*)
- A' Floral tube about as long as the perianth. Perianth segments in two series differing in shape, size and color, conspicuous, not deltoid. Receptacle scales with few or no hairs. Seeds with a tuberculate testa. Growing on cliff-faces or on steep slopes, stems mostly pendulous *Hildewintera* > B

B Stems almost rigid, erect to suberect when young, later pendulous, ca. 2.0–2.5 cm diameter. Spines all similar, rigid, golden-yellow, 0.4–1.0 cm long. Floral tube abruptly curved at the base, without a spur. Nectar chamber closed by a diaphragm. Style arising from the center of the ovule-chamber roof *H. aurispina*

B' Stems almost flexible, completely pendulous, up to 7 cm diameter. Spines very flexible, mostly white and hair like, others bristle-like, golden-yellow, 4–7 (–12) cm long, apparently of indefinite growth. Floral tube geniculate at base, with a spur. Nectar chamber open. Style arising to one side of the center of the ovule-chamber roof *H. colademononis*

Cleistocactus s.l. and *Hildewintera* have a close relationship, as demonstrated by their stem-form and general floral morphology. Some species described under *Bolivicereus* Cárdenas appear to be intermediate, but an examination of the type species, *B. samaiatanus* Cárdenas, shows a very close affinity with *Cleistocactus* in flower structure and seed morphology (studied material: Kiesling et al. 10022, LPB, SI).

The tubular flower suggests the predominance of hummingbird pollination in all these groups of plants (Porsch 1937), but occasional visits of nocturnal or diurnal butterflies or other insects cannot be discounted. However, the formation of the inner corolla in *Hildewintera* is certainly protection against non-specific visitors. Compared to *Cleistocactus* s. str., the most significant distinguishing characters of *Hildewintera* are the outer perianth segments, which are about half the length of the flower, the series of very distinctive inner perianth segments, and the seed sculpture. An additional difference is the specialized epilithic habit—only *C. vulpis-cauda* also grows pendulously on cliffs. In both *Hildewintera* species all the spines on mature stems are directed downwards. Although the nearly violet margins of the larger tepals in *Bolivicereus* and *Hildewintera* evidently attract pollinators, this may be a result of parallel evolution through ecological adaptation rather than a synapomorphy.

Based on the above, we consider that *Cleistocactus* (including *Bolivicereus*) and *Hildewintera* represent different lines from a common ancestor. The two species of *Hildewintera* have some common characters, like the long tepals, and others that are very specialized, such as the pendent, epilithic habit or the hummingbird-pollination syndrome expressed in their double corolla. We suppose *H. colademononis* will soon be transferred to *Cleistocactus* by those who believe all these species are best confined to one genus, as we did ourselves before we became aware of the distinctive characters of *Hildewintera*.

Bregman (1992) keeps *Cleistocactus* and *Borsiacactus* separate, including *Bolivicereus* and *Hildewintera* in the latter genus. In comparison

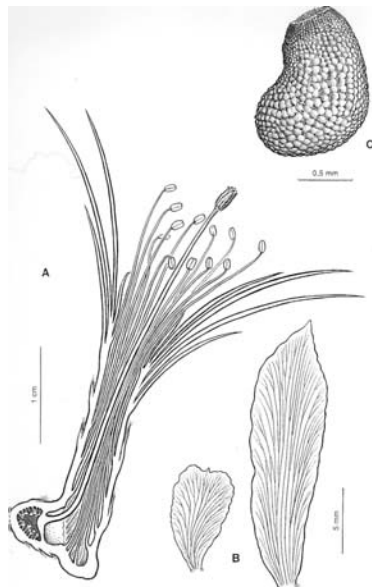


Figure 6. A. Longitudinal section of the flower of *H. colademonis* (Foik 1) showing the inner tepals and spur (note the lack of a diaphragm). B. Left, inner tepal, right, outer tepal. C. Seed. Drawing by F. Rojas.

to *Bolivicereus*, the seeds of *Hildeveintera* are distinguished by their less-wrinkled testa, a slightly curved embryo, a smaller hilum/micropylar area and less smooth, more convex testa-cells.

It is interesting to know that *H. aureispina* can easily cross with other species of Borziactinae and Trichocereae Buxbaum. Rippe (1990) and Mangutseh (1993) show showy-flowered hybrids of *H. aureispina* with a *Trichocereus thelegonus* hybrid, *Chamaecereus silvestrii* Britt. & Rose, *Echinopsis aurea* Britt. & Rose, *Matucana tuberculata* (Don.) Bregman et al., *Cleistocactus vulpis-cauda*, *Denmoza erythrocephala* Berger, and *Bolivicereus samaipatanus*. The characteristic inner corolla of *Hildeveintera* is often present also in the hybrids, especially when *Hildeveintera* served as the seed-plant (Götz & Gröner, 2000), which suggests that it is a dominant character in these hybrids.

One can speculate that *H. colademonis* is of hybrid origin. However, the uniformity of the plants (even, according to Diers & Krahn [2003b], in the second cultivated generation) and the apomorphy of the spur argue against this. The double

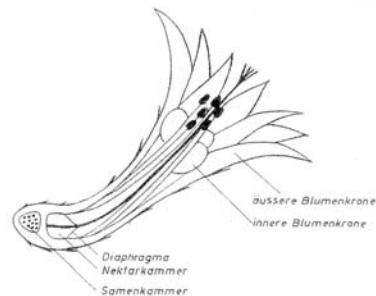


Figure 7. Original drawing (Ritter, 1962) of *H. aureispina* showing outer and inner tepals, diaphragm, nectar chamber and ovary.

corolla is unique to both *Hildeveintera* species, so if there is a case for the hybrid origin of *H. colademonis* the other *Hildeveintera* should be involved in the crossing. In that case, the putative other parental plant should possess hairlike spination, a geniculate flower and no diaphragm. *Cleistocactus vulpis-cauda*, with a pendulous habit and a geniculate flower, has a distinct diaphragm. Possible other parents, such as *Bolivicereus samaipatanus*, also have a diaphragm with hairs. Another possibility is that *H. aureispina* is a hybrid between *H. colademonis* and a *Cleistocactus* species. Further crossing experiments with members of *Cleistocactus* s.l. may be one method to solve the question. For the moment, we have to state that *H. colademonis* is a good, stabilized species even if it might have originated from past hybridization.

Ecology

Although we had no time to study the flora of the *H. colademonis* habitat in detail, the region can be assigned to the Tucumano-Boliviana Botanical Province (Cabrera, 1976; Beck et al., 1993); a semideciduous forest with trees 15–20 m tall. Detailed studies can be found in Navarro & Maldonado (2002: 371–373), in which our particular area would be classified as intermediate between the “Subandean Pluviseasonal Forest” and the “Upper Subandean Semideciduous Forest.”

The area is tropical at this altitude (ca. 1400–1500 m) and there is no freezing weather during the year, although cold winds from higher areas can blow sporadically for some hours in winter. Summer temperatures can rise to 35°C (95°F) or more. Rains are concentrated in the warm season (November to April) and are estimated at about 100 cm per year (inferred from

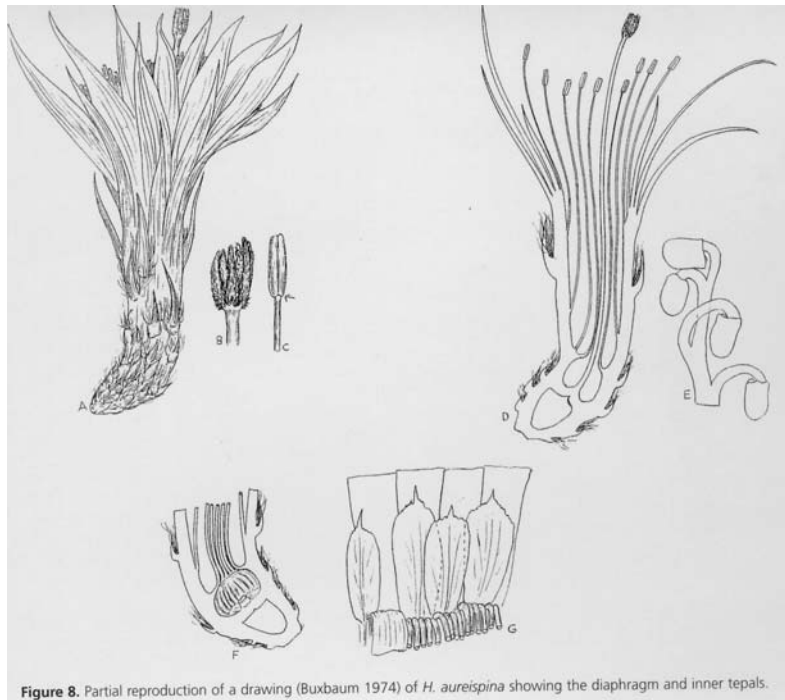


Figure 8. Partial reproduction of a drawing (Buxbaum 1974) of *H. aureispina* showing the diaphragm and inner tepals.

Navarro & Maldonado, 2002).

Perhaps the most important information for those who will one day cultivate this species is the prevalence of dew in its habitat through many nights of the year, as well as the presence of clouds blown from the east, frequently resulting in a very wet environment. In our opinion, the conspicuous downward orientation of the spines is an efficient way to disperse excess moisture, which accumulates on the spines and falls away from the plant. (In desert cacti, spines may function as condensation traps that collect water and direct it to the soil, where it can be absorbed by surface roots. In the present case, the spines apparently function in the opposite way, quickly shedding moisture from the plant and thus avoiding tissue-rot.)

Nomenclature and the history of *Hildewintera*

In 1962 Ritter described *Winteria*, with only one species, *W. aureispina*. The genus was based on the double perianth, with its few, short, wider

inner perianth segments (white to light-pink) and the outer perianth segments, which were larger and more conspicuous, forming a widely expanded orange limb with violet-margined segments. The stems are pendulous, except when very young, and on mature stems the golden-yellow spines are directed toward the ground. Ritter (1962) included three black and white photos and a drawing.

Rowley (1964) objected to the generic name because it is very similar to the earlier name, *Winteria* Murr. (Magnoliaceae), and therefore both Ritter and Backeberg independently gave it a new name. Ritter (1966) published a short note with his new name for the genus, *Hildewintera*, making the combination *H. aureispina* (Ritter) Ritter, which is the name we consider to be correct (see above, under taxonomy). Later the same year, Backeberg (1966: 455) published the new combination *Winterocercus aureispinus* (Ritter) Back., apparently because he was unaware of the recently created genus *Hildewintera*, and included a good color photo (Backeberg 1966: Fig. 456).



Figure 9. Distribution of species mentioned in this article: 1. *Hildewintera colademononis*, 2. *H. aureispina*, 3. *Cleistocactus brookei*, 4. *C. vulpis-cauda*, 5. *C. samaipatanus*. *C. wendlandiorum* was described without an exact locality ("South Bolivia?").

Buxbaum (1974a, b) reduced *Hildewintera* to a subgenus of *Loxanthocereus*, making the combination *L. aureispinus*. His analytic drawings clearly show the double perianth, the diaphragm and other floral details. In the annual list of succulent names, *Repertorium Plantarum Succulentarum* 1973 (1975), the combination *Borsicactus aureispinus* (Ritter) Rowley was also made (Rowley in Rowley & Newton 1975: 6, cf. Rowley 1978). In the second volume of his book on South American cacti, Ritter (1980: 699–701) gives more details about the plant and its discovery. Hunt (1987: 92) transferred it to *Cleistocactus* as *C. aureispinus* (Ritter) Hunt, but as this was an illegitimate homonym of *C. aureispinus* Frič (1928), he finally renamed it *Cleistocactus winteri* Hunt (in Hunt & Taylor 1988).

So for the species now known as *Hildewintera aureispina*, seven different names and combinations have already been published. How many new combinations can we expect for *H. colademononis* in the near future?

Acknowledgements

We want to thank the CSSA for its generous support toward RK's travel expenses; the staff of the Herbario Nacional de Bolivia at La Paz for its assistance during his visit there, including the drying of our specimens and shipping the duplicates to the Darwin Institute; Prof. Dr. L. Diers and W. Krahn for furnishing information about the morphology of the species and the local flora and geology; Eva and Voytek Foik for their very valuable photos, data and floral measurements; and Leo van der Hoeven and Jean-Marc Chalet for their enthusiastic assistance in the field.

We are grateful also to Prof. Dr. W. Greuter and Dr. U. Egli for discussing the validity of *H. polonica*. We regret the overlapping of hasty publications to gain priority, and we hope for closer collaboration in the future. Fortunately, the tendency in botany is to omit the author names after the names of taxa unless it is absolutely necessary, and this will reduce much needless competition.

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Glossary

acuminate tapering to a point

apomorphy an evolutionary advanced (derived) character state

dehiscence the method or process of opening a seed pod or anther at maturity

epilithic living on rocks; as epiphytic means living on plants

fasciculate in the case of roots, refers to clusters (fascicles) of thin roots, as opposed to, for instance, tap roots

geniculate bent, like a knee

gynoecium the female organs of a flower

hypanthium a cup-like or tube-like enlargement of the receptacle, on which calyx, corolla, and stamens are attached

nectar chamber an area at the inner part of the flower where nectar is produced and/or stored

oblanceolate the reverse of lanceolate; a leaf broader at the distal third than it is at the middle and tapering towards the base

ornithophilous literally "friend of the birds," used to describe flowers with bird pollination syndrome

phylogeny evolutionary relationship, the patterns of descent between organisms

receptacle part of the stem of flower axis from which all flower parts arise

s.l. "sensu lato," means in a wide sense

s. str. "sensu stricto," means in a narrow sense

synapomorphy an apomorphy shared by all members of a particular group (a genus for instance)

zygomorphic bilaterally symmetrical. Used for corollas (or complete flowers) when divisible into equal halves in one plane only, usually along an antero-posterior line. Opposite to actinomorphic, which means radial symmetry, and different to irregular flowers.

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