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Cover photographs. Front: *Pitcairnia stenophylla* inflorescence in full flower at midnight, viewed from above. The photograph is by Dr. W. Rauh and his description of the specimen is on pages 262-264. Back: Inflorescence detail of *Tillandsia klausii*, a new species from Mexico. Photograph by Renate Ehlers, description on pages 257-261.

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Genus *Puya* Molina (Pitcairnioideae): Relocation of Several Rare Species and Some Preliminary Remarks on Geographic Distributions and Species Divergence

G.S. Varadarajan

INTRODUCTION

Puya, with about 185 species, is the second largest member of the Bromeliaceae subfamily Pitcairnioideae. Its geographic range is widespread throughout the Andes, from Costa Rica to Chile. *Puya* is perhaps one of the few bromeliads that occur over extensive altitudes, from sea level to nearly 5,000 meters. Despite these outstanding distributional characteristics, only about 40% of the species may be biologically well known judging primarily from the literature, representation in herbaria, and cultivation in botanical gardens. Our knowledge concerning the remaining 60% is often limited to the type collection.

Massive growth habit is an unusual trait in the Bromeliaceae. In *Puya*, it is very striking and distinctive in a number of species such as *P. raimondii* Harms, *P. chilensis* Molina, and *P. gouditiana* Mez. The gigantic plant form is almost always associated with stiff, spiny foliage, massive, strobilate, cylindrical inflorescences with highly compacted flowers. These attributes are mostly responsible for the difficulties that one encounters while collecting in the field and processing the plants for herbarium. In a number of instances, the material available for a taxon is limited to a single leaf (often without the sheath) and a few flowers. For this reason, the descriptions of the habit, scape, inflorescence type and the like are often far from being complete. These problems are compounded by the narrow distributional ranges of species in high altitude mountains, relatively small population sizes, and highly variable flowering and/or fruiting periods. In my opinion, most, if not all of these factors may have caused the paucity of plant material as well as the underrepresentation of many puyas in herbaria.

Although "rare species" or "rare taxa" may often be ambiguous phrases, I have narrowed their use to two specific situations: taxa that were poorly collected previously and, therefore, not well represented in herbaria; taxa that are represented by very few individual plants in the natural habitats (as opposed to being abundant). As far as possible, I have attempted to differentiate these conditions through my field explorations. Field studies also aided my assessment of population size, phenological changes, as well as comparisons of specimens represented in herbaria and in natural habitats.

My first exploration in 1983-1984 covered Argentina, Bolivia, and Venezuela and some of the outcomes of these studies appeared in the *Journal*

Fig. 1.
Puya pygmaea L.B. Smith, a remarkable dwarf species from the Andes of Ecuador. Note the meter stick.

Photographs by the author

Fig. 2.
Puya clava-herculis Mez & Sodira in an *Espeletia* paramo (stems appearing on the left). A grass cover *(Festuca, Calamagrostis* community, background) appears occasionally in these high, usually barren plains.

Fig. 3.
Puya pearcei (Baker) Mez, an occasional species in moist localities in Bolivia.

Fig. 4.
Inflorescence of *Puya nana* L.B. Smith is 15 cm. (6 inches) in diameter.

last year (Varadarajan 1987a, b). My later investigations continued in Ecuador and Chile as well as in several new field areas in Argentina and Bolivia.

OBJECTIVES

I propose to summarize in this article some of my field observations on several rare species of *Puya* and to present a few preliminary remarks on the geographic distributions from the perspective of phylogeny. Also, I would like to discuss new field localities that are extensions of the previously known geographic range of a few taxa. Some of the inferences presented are tentative and require corroboration.

PUYAS OF ECUADOR

The geography. Two mountain chains, the Cordillera Oriental and Cordillera Occidental, constitute the principal Andean structural units in Ecuador that include *Puya.* These cordilleras, although near the Peruvian ranges in the south and the Colombian in the north, have their own geologic history, floristic and biogeographic peculiarities. Further, the two cordilleras have some striking differences in their ecosystems, climate, and topography (Gilmartin 1973). With some exceptions, most species of *Puya* in the Ecuadorian cordilleras are apparently endemic to narrow ranges and valleys in the north-central and south-central regions.

North-central Ecuador. Judging from the specimens in the herbaria, one may find *Puya retrosa* Gilmartin (formerly known as a part of *P. fastuosa* Mez) to qualify for the rare species category. In my expeditions, I have encountered *P. retrosa* in three localities besides the type locality on the Chimborazo-Thungurahua frontier in central Ecuador: two sites in Pichincha province in Páramo de Huamani at about 3,100 and 3,300 m elevations respectively, and one in Chimborazo province in a subparamo about 3,200 m above Juan de Velasco. Despite these additional collections, the present range of *P. retrosa* may not be considered extensive by any standard. Populations, with the exception of those in the type locality, are limited to less than fifteen individuals. The plants are 2–3 m tall and grow in rosettes. Massive inflorescences (ca. 75 cm long and 10–15 cm wide) are conspicuously placed well above the level of formidable, spiny foliage and act as firm platforms for the visiting black hummingbirds. The rust-colored scales of the inflorescence and green petals provide a remarkable visual contrast.

South-central Ecuador. *Puya sodiroana* Mez, previously known from less than ten specimens, readily fits into the rare group. This species is confined to steep slopes of the subparamo localities in Azuay province. Populations of *P. sodiroana* are discrete, with about fifteen to thirty individuals, and range from 2,500 to 2,800 m elevation. The plants display a number of striking morphological features, e.g., thick stems, 2-3-meter long, compound inflorescences with a series of conical lateral branches, and densely packed flowers. *P. sodiroana* is also remarkable in that the petals are bright green at anthesis and pale yellow when postfloral.

Azuay province may represent a significant center of species diversity for *Puya* in Ecuador. Several grass-dominated *(Calamogrostis, Stipa)* paramos in the northern sectors of Azuay adjoining the provinces of Cañar on the west and Morano-Santiago on the east include type localities of some other interesting species. At about 3,000 m elevation, I encountered two rather closely related species: *P. compacta* L.B. Smith and *P. maculata* L.B. Smith in northern Azuay. Populations of both species are relatively small and never exceed fifteen individuals. The plants are medium sized (70–80 cm tall), characterized by dense, cylindrical, compound inflorescences with highly reduced lateral branches. Enclosed by a single foliaceous bract and are two to three fertile flowers and one notable *pulvinus* (a swollen, tumorlike structure). The latter probably represents a reduced flower-producing structure. Woolly hair, frequently noted in great density in the inflorescence of several high altitude puyas such as *P. clava-herculis* Mez & Sodiro and *P. glomerifera* Mez & Sodiro, occurs only in a moderate level in *P. compacta* and *P. maculata.*

Expeditions to a few shrub-dominated *(Vaccinium, Hypericum)* paramos, namely, Páramo de Tinajillas and Páramo de Castillo (Azuay province) yielded two more remarkable species at about 3,300 m elevation. These locations may represent a few instances where *Puya* species are sympatric. *P. nutans* L.B. Smith and *P. pygmaea* L.B. Smith (fig. 1) both dwarfish, occasional herbs, occur in small, restricted patches along the swampy meadows. In some areas, these species share their habitats with *P. glomerifera* or with *P. clava-herculis* (fig. 2). *P. nutans* is a beautiful species characterized by its decurved, cylindrical inflorescence with highly compacted flowers. Its dark brown papery bracts provide a clear contrast with the dark green flowers that they subtend. Black hummingbirds spotted in these areas visit these colorful inflorescences in particular.

Although neither the flowers nor the entire inflorescence of *P. pygmaea* is attractive, some of its characteristics are notably distinct. The flowers, tubular at anthesis, are bluish green. They appear to be somewhat buried within the much condensed inflorescence axis in which the dark, stiff and foliaceous, subtending bracts provide adequate mechanical support. Scarcely more than a third of the scape is raised above the level of the foliage. These attributes suggest that pollination is done by an agent different from that of *P. nutans.*

Range extension of a Colombian puya. *Puya trianae* Baker was known originally from central Colombia (Cundinamarca dept.) and several collections were made there. I collected this species in the state of Tachira in the Mérida Andes of Venezuala in 1987 (Varadarajan 1987a). During a recent exploration I found *P. trianae* in a grass paramo in the Azuay province with *P. compacta* and

[continued on page 254]

Fig. 5.
This is *Dyckia racinae,* collected by M.B. Foster nearly 50 years ago, and just now described from a specimen grown in Mrs. Foster's garden. Dr. Smith added a note: "The present group of 7 giant dyckias is so different (very short stamen-corolla tube) that for a long time it was classified as a separate genus, *Prionophyllum."*

Fig. 6.
Dyckia racinae inflorescence.

Photos by Michael A. Spencer

A Giant *Dyckia* Mystery

Lyman B. Smith

Racine Foster recently flowered a giant *Dyckia* which she notes as "collected by M.B. Foster in 1939 or 1940 and brought home as a seedling. Nurtured at Bromel-La for 30 years!" She has searched his records for mention of the collection but in vain. Michael A. Spencer set up the plants shown on the opposite page and took the photos in April 1988.

Dyckia racinae L.B. Smith, sp. nov.

A *Dyckia selloa* (K. Koch) Baker, cui affinis, foliorum laminis subtus obscure lepidotis supra glabris, bracteis florigeris attenuatis sepala subaequantibus differt.

Plant stemless, to over 2 m (7 ft.) high. *Leaves* rosulate, spreading, over 55 cm long; sheaths pale (! Racine Foster); blades 4 cm wide, obscurely lepidote between the nerves beneath, glabrous above, laxly serrate with curved spines 5 mm long. *Scape* terminal, erect, 10 mm thick at apex; scape-bracts subfoliaceous, exceeding the internodes but exposing most of the scape. *Inflorescence* laxly and amply bipinnate, glabrous; primary bracts very narrowly triangular, much shorter than the sterile bases of the 50-cm long laxly, somewhat secundly flowered branches. *Floral bracts* attenuate from a broadly ovate base, about equaling the sepals, enlarging in fruit to 25 mm long; pedicels from very short at anthesis to stout and 6 mm long in fruit; flowers perfect. *Sepals* broadly ovate, rounded and apiculate, 17 mm long; petals spatulate, yellow; stamens slightly shorter than the petals; capsule ovoid, beaked, black; seeds with asymmetric lateral wings.

Brazil: almost certainly Rio Grande do Sul: locality unknown, April 1988 in cultivation, *Foster 3094* (holotype US, isotypes B, GH, NY).

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Terrestrial Bromeliads

Mulford B. Foster

Of the terrestrial types of bromeliads, dyckias have been the best known among collectors. Horticulturally, they have been used, I believe, more than any other terrestrial bromeliads.

In the book *Succulents for the Amateur* there is but one page devoted to the bromeliad family and on that page there are just three species mentioned, *Dyckia sulphurea,*[1] *D. rarifolia* and *Hechtia texensis*. All three of these are worthwhile subjects and do very well in almost any succulent garden in the south of Florida or California and for indoor gardens, protected from severe freezing, they do well in pots.

Generally speaking, the dyckias are not difficult subjects for the collector and do not require much pampering. Most of them enjoy a slightly acid or neutral soil and I have found that they are quite happy growing in a leaf-mold and sand mixture with pulverized dairy manure or any good organic fertilizer. They all enjoy full light conditions and while they are quite drought resistant they can take plenty of water when the drainage is good.

All of the dyckias have stiff, spine-edged succulent leaves, most of the species having green leaves. The flowers range from sulphur yellow to brilliant orange and generally appear in the spring. Unlike their cousins, the pineapples, dyckias always send their flower spike laterally from the side of the plant. The axis remains sterile and continues to grow year after year. The larger types often form a yucca-like trunk, but the smaller species cover the ground in mat formation.

Most of the dyckias are native to Brazil but neighboring South American countries have a few species. They are generally found growing on or in the crevices of rocks.

In private collections the two most common dyckias have been *D. sulphurea* and *D. rariflora*. The large botanical collections have had a few additional ones such as *D. multiflora, D. altissima, D. frigida, D. montevidensis,* and *D. remotiflora*.

From my collecting in Brazil I have introduced to this country the following known species: *D. coccinea, D. minarum, D. microcalyx, D. leptostachya, D. sordida, D. ferruginea,* as well as three of my new discoveries, *D. simulans, D. ursina* and *D. fosteriana* plus several new hybrids. Of the earlier introductions from Europe, the first two dyckias *(sulphurea* and *rariflora)* have been the only ones suitable for small collections because of their convenient size. However,

from my own collecting, the *D. coccinea, D. minarum, D. leptostachya* and *D. simulans* are all of a small enough size to interest the succulent collector limited to pot culture.

Dyckia minarum is one of the smallest sized plants in the group. I have seen this plant which averages two to three inches in diameter growing in rather large beds. When in bloom, with its six to eight inch spikes of orange-yellow flowers, it is an interesting subject. The green leaves are stiff and the plant is rather compact.

Dyckia coccinea is quite a hardy plant and grows in much more compact masses than many dyckias. When grown in the open, the individual plants do not show up as distinctly as most dyckias. The lepidote olive green leaves, four to seven inches long, are narrow with an upright growth; the red-orange flowers are on a tall, 18 inch spike, and they add a nice note of color in the early spring and summer. This species grows natively in open rocky fields and is exceptionally drought resistant.

Dyckia microcalyx is a medium sized plant but certainly the most floriferous dyckia I have ever had. It produces from one to three tall branched flower stalks each year with hundreds of yellow flowers thereon; it makes an excellent outdoor rock garden subject. The mass of curved, narrow, heavy spined leaves is a real addition to any succulent collection.

Dyckia leptostachya has been at home in our garden from the moment of its arrival from Brazil where we found it on rocky slopes in far off Matto Grosso. It grows in sun or shade, but of course blooms best in full light. It has fewer leaves than most of the dyckias. They vary from maroon to green and most of the plants have produced at least two spikes of flowers in succession each spring. It reproduces by shooting out underground stolons and new plants will continue to develop around the matured plants. The flowers, on an eighteen to twenty-four inch spike, are of a rich orange in color. I have seen solid mat beds of these dyckias eight to ten feet in diameter.

Dyckia frigida, an early bloomer coming from February to June, withstands quite a cool climate and dry conditions in sun or shade. The plants are from twelve to eighteen inches in diameter and the branched flower spike, at least three feet high, carries a good supply of orange-yellow flowers. The green leaves are glabrous.

Dyckia ursina is well named. The flower spike and even the sepals and part of the petals are covered with a brown wool an eighth of an inch thick resembling a bear's fur. It is a bit large for pot culture but as a rock garden plant it will stand extreme conditions. While I found it in the tropics it grew high in the Brazilian mountains of Minas Gerais and the cold, raw, windy morning convinced me that it had not grown the wool covering for naught. Also, the midday sun in that area

was so severe that I am sure the wool covering has still another purpose. The branched flower spike is often three to four feet high and the flower is a lovely orange almost covered with brown wool.

Dyckia fosteriana, according to Lad Cutak. . . is the gem of the genus. And indeed it is a priority plant for its spiral whorl of grey leaves appears to be made of platinum and its brilliant flowers of gold. As a pot plant it will have no rival within the dyckia tribe. The plant is three to four inches in diameter.

My dyckia hybrid Lad Cutak is the most vigorous grower and bloomer of any of the dyckia family, and it exceeds in size either of its parents. Several more of my dyckia hybrids, not yet described, will be worthwhile newcomers.

HECTIAS

These spiny, dyckia-like bromeliads are less well known than dyckias, although they are almost all natives of our neighboring country, Mexico. There are four hechtias in the United States and one in Guatemala.

In appearance the well armed hechtias resemble very closely the spiny dyckias. In fact, most of them could not be distinguished from dyckias except by the inflorescence. They generally grow in much greater masses than the dyckia colonies that I have seen. Most of them are also highly xerophytic and enjoy extremes in heat as well as fairly low temperatures. While the hechtias are of more interest to the succulent speciality collector, most of them are a bit too large for the collector who has little space. The flowers are generally borne on long branched spikes and for the most part are rather inconspicuous, being without showy colors.

The hechtias have one interesting character which is unusual in the family of bromeliads. While the flowers are monoecious, having both pistil and stamens, however, each species has what we might term masculine and feminine forms. In other words, in the male form the pistil is not fully developed enough to function. In years past in many of the species, because of the different vegetative appearance in the two forms, each sex was named as a separate species.

Many of the hechtias could hardly be noted for showy beauty, but one outstanding exception is the lovely Mexican species, *H. capituligera.* The stiff, spiny, succulent leaves of this plant when in full sun, radiate an almost transparent amber color and lend a beautiful note to the rock garden. This species as well as *H. stenopetala* are two Mexican species that should grace very southern garden.

The four Texas species, *H. scariosa, H. ghiesbreghtii, H. glomerata* and *H. texensis,* are all deserving of a place in any succulent collection. I know of no plants that ask for less attention than many forms of these hechtias.

While most hechtias are moderate in size, ranging from about eighteen inches to twenty-five in the spread of the rosette, with a flower stalk from one to four feet high, I discovered (in Mexico in 1935) a giant among the hechtias. Its rosette spread is over five feet across and its flower stalk nearly eight feet high. This proved to be a new species. *H. melanocarpa* (recently described by Lyman B. Smith), with a peculiar characteristic.

It has a central inflorescence! All other hechtias, deuterocohnias and dyckias that I am familiar with have a lateral inflorescence; several other genera have this characteristic and I wrote a paper on the subject of "Lateral Inflorescence in the Bromeliaceae" in the National Horticultural Magazine for January, 1945. While this article was on the press, the giant hechtia which I had been growing in my garden since its collection ten years previous decided to produce its first bloom. And from the center axis of the plant, (which no self-respecting hechtia should do) upsetting completely my statement that "the genera. . . regularly producing a lateral inflorescence. . . are confined (in Bromeliaceae) to hechtia, dyckia, deuterocohnia and enchlorium."

Now for a trip back to Mexico to find more hechtias which will prove or disprove that *H. melanocarpa* is the only exception.

In general, the spiny leaves of the hechtias lend themselves fittingly to rocks and blend happily in association with cacti and other succulents, thereby adding one more interesting form to the desert garden.

Reprinted from The Bromeliad Society Bulletin *15 (3):54-57; 1965; first published in* Cactus and Succulent Journal *(volume number unknown).*

Note:

1. [Various name changes in accordance with Pitcairnioideae by Smith & Downs, and New Taxa by R.W. Read follow in order of appearance in the text.

Dyckia sulphura *K. Koch* = D. brevifolia *Baker.*

D. multiflora, *not listed in Smith & Downs Pitcairnioideae or in R.W. Read New Taxa.*

D. altissima *sensu Baker* = D. princeps.

D. montevidensis *K. Koch* = D. remotiflora *var.* montevidensis *(K. Koch) L.B. Smith.*

D. coccinea = D. tuberosa.

Hechtia ghiesbreghtii *Lemaire* = H. glomerata *Zuccarini.]*

P. clava-herculis at least 2,300–2,500 kilometers south of the Colombian sites. At this time, long distance dispersal is a good explanation of the interrupted distribution of *P. trianae* in Venezuela, Colombia, and Ecuador.

Summary. The Andes of Ecuador, despite their contiguity with the Peruvian and Colombian ranges, include their own assembly of *Puya* species that may have radiated locally. Most of the rare species I collected in Ecuador exhibit a relatively small population size and are apparently endemic to single mountain ranges.

PUYAS OF BOLIVIA

Geography. *Puya* species are widely represented in two regions of the Andes in Bolivia, namely, the Altiplano and the Cordillera Oriental (Varadarajan 1986; 1987b). The Altiplano is a vast expanse of high Andean plateau extending from central Peru to northwestern Argentina. It contains, in large part, a treeless, steppe-like arid vegetation known as puna. The Cordillera Oriental is an extension of the Peruvian structural unit of the Andes. A few transitional regions between the Altiplano and the Cordillera Oriental are also important from the point of view of distributions of *Puya.* In Bolivia, with the possible exception of *P. ferruginea* (Ruiz & Pavon) L.B. Smith, the nearly 44 species may readily fit into the rare category. Although I encountered a remarkable number of these puyas in my field trips in Bolivia, the scope of this article limits my reference to a few only.

Species in the Altiplano. *Puya raimondii* is perhaps the most spectacular species of the Altiplano. Its habit, habitats, and phytosociological features have been discussed elaborately in the past (Foster 1950, Rees and Roe 1980). In the main context of this paper, I would like to stress just one character that may qualify this giant *Puya* for the rare group although neither the herbarium specimens nor the number of individuals in a stand may justify this idea. Of the two sites in Bolivia from which *P. raimondii* is presently known, no more than a single individual has been seen in flower or even known to be in any reproductive phase in a given time. This finding is corroborated by several plant explorers, ecologists, and ornithologists who have visited the sites from time to time.[1] For this reason I regard *P. raimondii* a rare species.

Aside from the giant *Puya,* the Altiplano in central Bolivia includes sites of several dwarf members including *P. humilis* Mez, *P. leptostachya* L.B. Smith, *P. tristis,* L.B. Smith, *P. tunarensis* Mez. Populations of these species are more or less evenly distributed in a given area. Their slender inflorescences are barely visible above a rough, rocky, and stony ground layer, while the remainder of the plant body is completely hidden.

Species in the cordillera and transitional regions. *Puya brittoniana* Mez, *P. fosteriana* L.B. Smith, and *P. mollis* Baker ex Mez are a few interesting but poorly known species. These puyas occur in a few restricted sites of the cordillera and the transitional regions between the Altiplano and the cordillera. For the first two taxa, my collections are next only to the type and for *P. mollis* they may be the sixth or seventh that exist in the herbaria. The natural habitats of these species are found along open, relatively moist, rocky areas within an approximate 75-km radius of La Paz. A large, cylindrical, strobilate inflorescence with dense woolly indument characterizes *P. brittoniana, P. fosteriana,* and *P. mollis.* While a simple raceme is evident in *P. brittoniana,* a compound, bipinnate inflorescence reminiscent of some Ecuadorian species *(P. glomerifera, P. retrosa)* is found in *P. fosteriana* and *P. mollis.*

The type specimen of *P. brittoniana* was described from fragments only. The plants are nearly 60 cm tall and caulescent. The inflorescence is about 30 cm long, cylindrical, and is borne on a 20-cm long, curved scape. The native habitats of *P. brittoniana* are found in a semidry puna, characterized by various grasses, at about 3,800 m. I collected *P. brittoniana* from Sorata area in Larecaja province which is less than 15 km from the type locality.

A spectacular photograph of *Puya fosteriana* appeared recently in this *Journal* in the reprinted article by M.B. Foster (1950). The specimen I collected was very similar to what one finds in the Foster photograph. Here, I would like to add a couple of points. The petals of *P. fosteriana* display gradual color changes from blue (very early preanthesis), bluish green (preanthesis), grass green (anthesis), to pinkish purple (postanthesis). These changes are evident even in a single inflorescence. *P. fosteriana* populations consist of nearly 35 individuals and are sparsely distributed over a moist puna characterized by *Stipa* and *Baccaris* community. My collection of *P. fosteriana* is from the cordillera Tres Cruces near Quime, at about 4,000 m elevation. This collection site is outside the type locality.

Puya mollis was also described only from fragments. The plants are nearly 1.5 m tall and acaulescent. At 75 mm long, 5–8 cm thick, the stiff, erect scape bears a 30–35-cm long cylindrical inflorescence. The bipinnate inflorescence displays dense lateral branches which are clothed with creamy yellow wool. I collected *P. mollis* from Zongo valley, La Paz, at about 3,300 m elevation. The surrounding vegetation is a moist shrubland characterized by *Buddleja* and *Oreopanax* that merges with patchy grass-dominated puna. Unlike *P. brittoniana* and *P. fosteriana,* populations of *P. mollis* occur in small discrete groups over an altitudinal range of 3,000–3,500 m.

In cloud forests of the Cordillera Oriental, some moist rock outcrops often provide suitable habitats for a few species of *Puya.* In several middle elevation sites (1,500–2,500 m) in La Paz and Cochabamba departments, I encountered

very large populations of *P. pearcei* (Baker) Mez (Fig. 3). The plants are 1.5–2 m tall with rosettes of leaves, and a spectacularly reddish scape. A profusely branched paniculate inflorescence with at least 30-cm tall, lateral branches is similar to that of *P. floccosa* (Linden) E. Morren ex Mez. The dark blue pre-anthesis petals clearly contrast with their dark green color at anthesis and after.

Expeditions to a few, semidry, eastern slopes of the Cordillera Oriental in Santa Cruz department yielded two other dwarf species, *Puya nana* L.B. Smith (Fig. 4) and *P. tuberosa* Mez. They grow on exposed, rocky substrates with shrub-dominated secondary vegetation. *Puya nana* displays an odd kind of inflorescence that is most common in the pitcairnioid genus *Navia* and in several members of the Bromelioideae. The scape is very short or may even be completely absent. The sessile inflorescence is basically compound, umbelliform, and consists of numerous highly condensed axes of the lateral branches and their subbending involucral bracts. The dark reddish color of the bracts and the lateral branches contrasts remarkably with the dark green foliage on the outside and the bluish green petals within. *P. tuberosa* has a slender, paniculate inflorescence that is barely visible above the foliage. The primary bracts are serrate and cover nearly half of the lateral branches. Populations of *P. tuberosa* are sparsely distributed over a 3-km range, between 1,000–2,200 m elevation, whereas those of *P. nana* are locally common between 1,700–1,800 m and are notably absent elsewhere.

Some deep canyons of the Cordillera Oriental include "prepunas" (Cabrera 1957, 1971; Sarmiento, 1975) which are semiarid woodlands with thorny, dicotyledonous species such as *Acacia, Capparis,* and *Prosopis.* Open, rocky substrata of the prepunas provide suitable habitats for *Puya sanctae-crucis* (Baker) L.B. Smith. Plants are nearly 1.5 m tall with laxly paniculate inflorescence and the populations are limited to about fifteen individuals in a given site.

Bolivia may be yet another region where the species of *Puya* have proliferated to a remarkable degree. A number of species here display compound, large, cylindrical inflorescences, *Puya hamata*-type seeds and a few other traits in common (Varadarajan 1986; Varadarajan & Gilmartin 1988). These taxa, probably differentiated from the same parental stock, are particularly concentrated in the high punas. On the other hand, a species group partly represented in Bolivia share some common features, e.g. a laxly branched paniculate inflorescence, *Puya ferruginea*-type seed. This lineage has apparently colonized deep canyons and valleys as well as relatively moist, low areas of the Bolivian cordillera, while the putative counterparts occur in Argentina (see below). In attaining the present diversity, a group of dwarf, but phyletically somewhat unrelated species, also seem to have played a key role. These taxa seem to have radiated in arid, semiarid, and mesic places in Bolivia.

[continued on page 264]

Tillandsia klausii, a New Tillandsia from Southern Mexico

Renate Ehlers

In 1985, I was collecting tillandsias in Chiapas with my husband Klaus and we discovered an attractive new species, remarkable because of its rose-lepidote inflorescence with big, blue-violet flowers, and because it turns entirely red or rose if kept outside in full sun. It grows easily and well in our collection at home in Germany.

The plants were growing on a small, very steep, rocky cliff covered with shrubs and trees, and very difficult to climb. If we climbed up some meters, we suddenly found ourselves where we started. The plants and trees had prickles and soon our scratched skin burned like fire. At first glance we thought it might be the "mala mujer," a euphorb you had better not touch since it takes some time for the wound to heal. Fortunately, it was something else, but bad enough. Finally, we reached our goal and were pleased to discover that they were tillandsias unknown to us. Klaus was with me all the time although his health was not the best.

Driving back toward Tuxtla Gutierrez we could hardly stand the itching and burning. Near the Sumidero bridge we saw a hotel with a pool and stopped, hoping the water would help. but half an hour of swimming gave little relief. We were very glad that we felt much better the next day. Still, for several days more we would encounter those small, poisonous hairs in the car and suffer again. This was really the worst place to collect tillandsias we had ever been in.

Because my husband shares all of these collecting trips and strongly supports my studies I dedicate this new species to him.

Tillsandsia klausii R. Ehlers, sp. nov.

A *Tillandsia chiapensis* Gardner, cui affinis, foliis viridibus, erectis vel patentibus, non recurvatis, inflorescentia pauciflora, bracteis florigeris rubris, rariter atroroseis, sepalis paulo majoribus differt.

A *T. mitlaensis* Weber & Ehlers foliis patentibus, viridibus, sepalis minoribus minus connatis; a *T. schatzlii* Rauh foliis pruinosis, inflorescentia pauciflora, pruinosa, bracteis florigeris paulo minoribus, sepalis minoribus minus connatis differt.

A *T. paucifolia* J.G. Baker foliis pruinosis non recurvatis, scapus inflorescentiae breviter, bracteis florigeris majoribus, ecarinatis et pruinosis differt.

Plant stemless, flowering 15 cm high, growing in clumps. *Leaves* few, forming a pseudobulbous rosette, exceeding the inflorescence, succulent, but soft and

Author

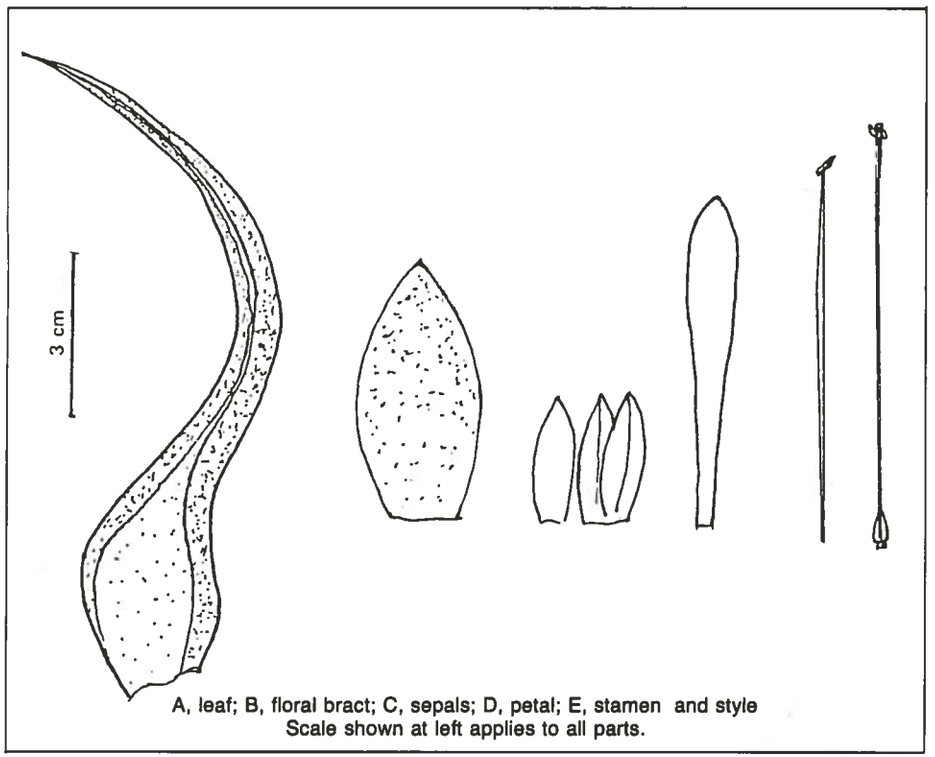
Fig. 7.
A new species from Chiapas, Mexico, *Tillandsia klausii.* A close-up of the inflorescence appears on the back cover.

fragile, to 17 cm long, green, but rose to red in bright sun, densely covered with spreading, cinereous scales. *Sheaths* broadly ovate, to 4 cm long, 3.5 cm wide, conspicuous, erect, inflated, adaxial surface brown or light brown, abaxial surface brown (or green in cultivation), densely gray lepidote on both sides. *Blades* narrowly triangular to linear, to 13 cm long and 2 cm wide, involute-subulate, the margins nearly touching each other, bearing asymmetrical scales, densely gray lepidote on both sides, erect or spreading, recurved when dehydrated. *Scape* erect, very short, only 1–2 cm long, 7 mm thick, round, hidden in the rosette. *Scape bracts* few, similar to the floral bracts but smaller, erect, densely imbricate, elliptical, short acuminate, to 3.5 cm long, green-rose, densely lepidote. *Inflorescence* erect, bipinnate, spike elliptic, complanate, 3–8 cm long, to 22 mm wide, 2–7 sessile flowers lacking fragrance. *Floral bracts* densely imbricate, concealing the rachis, erect, 3.5 cm long, up to 2 cm wide, 2–3 times longer than the rachis internodes, long elliptic-acute, more than 2 times longer than the sepals and covering them entirely, slightly nerved, ecarinate, abaxially rose or red, densely lepidote, adaxially green-rose, glabrous at base, apex laxly lepidote. *Sepals* light green, subcoriaceous, glabrous, nerved, the posterior ones sharply carinate, subfree (ca. 1 mm connate), up to 2.4 cm long and 5 mm wide, lanceolate, acute. *Petals* 5 cm long, ligulate, base 4 mm wide, apex 10 mm wide, tubular-erect, the tips very slightly spreading (1 mm), the base (covered by the sepals) white,

the upper half blue-violet. *Filaments* exserted, 1 cm longer than the petals, up to 7 cm long, flat in cross section, upper part thicker and violet, towards the base becoming white and thin (concolorous with the petals), sometimes slightly twisted. *Anthers* 3–4 cm long, 1 mm wide, yellow to light brown, subbasifixed to ⅓ fixed, versatile, pollen yellow. *Style* ca. 7 cm long, at anthesis 8 mm longer than the filaments, thin, upper part violet, base white; stigma white, erect, 3 mm high, 2 mm wide, lobes papillose and a little spreading. *Ovary* light green, 6 mm high and 2.5 mm wide, conical with flat sides.

At first glance, it seems that the new species could be related also to *T. velickiana* L.B. Smith. Sue Gardner (1982) treats this species as a synonym of *T. matudae* L.B. Smith: "A population sample of *T. matudae* from the type locality had specimens with both densely branched inflorescences and simple ones. Floral bracts varied from subglabrous to lepiodote. Other collectors report some specimens with lavender petals although a white corolla is typical."

I also studied specimens from the type locality and from other places and fully agree with Sue Gardner. Using Dr. L.B. Smith's key (1977) I did not come to *T. velickiana* since the sheaths of *T. klausii* are darker and more contrasting with the blades, and the inflorescence is over 5 cm.



A, leaf; B, floral bract; C, sepals; D, petal; E, stamen and style
Scale shown at left applies to all parts.

Drawing by the author

Fig. 8. Tillandsia klausii

Distribution: Southern Mexico: Chiapas, near Tuxtla Gutierrez, highly localized on steep rocks.

Holotype: Mexico: Chiapas, near Tuxtla Gutierrez, 20 March 1985, leg. *K. & R. Ehlers EM 85 18 01* (WU).

Dr. Walter Till, to whom I owe thanks for his cooperation, writes: "According to the classification of Sue Gardner (1982) this species belongs to 'group 1, subgroup 7' to which the following species have been assigned:

T. achyrostachys E. Morren ex Baker (inc. var. *stenolepis* L.B. Smith,
T. califanii Rauh,
T. chiapensis Gardner
T. circinnatoides Matuda,
T. mitaensis Weber & Ehlers,
T. pueblensis L.B. Smith (excl. var. *glabrior* L.B. Smith),
T. schatzlii Rauh,
T. subulifera Mez, and
T. weberi L. Hromadnik and P. Schneider.

"*Tillandsia achyrostachys* with glabrous floral bracts and yellow-green petals and *T. subulifera* with floral bracts shorter than the sepals (when dry), and yellow-white petals seem to be a little isolated in that group. The other species all have violet petals, simple or rarely branched inflorescence, floral bracts much longer than the sepals, lepidote and ecarinate, with glabrous, nerved, carinate and acute sepals, the stamens in two sets of unequal lengths. The differences are mainly in the habit, the proportions, the different dimensions of floral bracts and sepals, sepals carinate or ecarinate, and the colour."

T. paucifolia J.G. Baker was placed by Sue Gardner in her subgroup 5. In my opinion, the boundaries between subgroups 7 and 5 are sometimes indistinct and for that reason I added this species to Dr. Till's schedule which appears on the facing page.

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Stuttgart, West Germany

Table 1. Comparison of sepals

Species	Length (mm)	Shape	Indument	Nervation	Keel	Connation
T. achyrostachis	26	subacute	glabrous	str. nerv.	carinate	short conn.
T. califanii	30	subacute	glab. glauc.	nerved	post. carinate	free or short conn.
C. chiapensis	15	acute	glabrous	nerved	carinate	free or to 4mm conn.
T. circinnatoides	18	acute	white lep. (glabrous)	nerved	carinate	equ. free
T. mitlaensis	23-35	acute	glabrous	nerved	post. car.	5 mm conn.
T. pueblensis	20	acute	glabrous	nerved	carinate	6 mm conn.
T. schatzlii	27-29	subacute	sparsl. lep. (glabrous)	nerved	inconsp. carinate	to 3 mm
T. subulifera	to 22	obtuse	adpressed lep.	nerved (consp.)	unkown	equ. free
T. weberi	20	acute	glabrous	slightl.	carinate	3-4 mm
T. klausii	17-24	acute	glabrous	nerved	post. car.	1 mm con.
(T. paucifolia)[1]	20	acute	glabrous	nerved	carinate	connate

Table 2. Comparison of floral bracts

Species	Indument	Keel	Length (mm)
T. achyrostachys:	abaxial glabrous	ecarinate	25-34
T. califanii	densely gray lepidote	ecarinate	(49-53)
T. chiapensis	dense. lepidote	ecarinate	(30-48)
T. circinnatoides	dense. adpressed lepidote	ecarinate	to 23
T. mitlaensis	lepidote	ecarinate	32-45
T. pueblensis	adpr. gray lepidote	ecarinate	25-30
T. schatzlii	dense. adpressed lepidote	ecarinate	(40)-60
T. subulifera	dense. adpressed lepidote	apex car.	to 20
T. weberi	lepidote	ecarinate	25-30
T. klausii	dense. spreading lep.	ecarinate	30-50
(T. paucifolia)[2]	adpr. lepidote	ecarinate apex carin.	20-30

1. Parentheses in Tables 1 and 2 mean that these details were not part of the original description, but were found in other resources (Smith & Downs 1977, Gardner 1982, Herbar).

2. Sue Gardner placed *T. paucifolia* J.G. Baker in her subgroup 5. As I think, the borders between subgroup 7 and 5 sometimes are not quite distinct, I added this species to Dr. Till's schedule. *T. weberi* and *T. paucifolia* should be placed in the same subgroup as they seem to be closely related.

Pitcairnia stenophylla

Werner Rauh

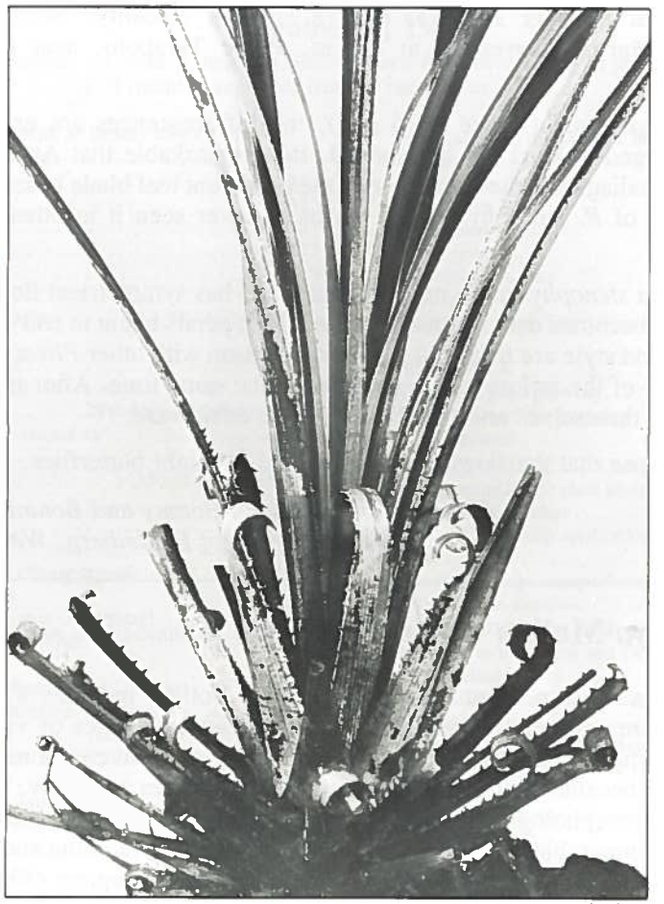
A curious and remarkable *Pitcairnia* is *P. stenophylla* André, known so far only from Colombia (Quataquicito on the Magdalena River in Tolima Province; type André 1876, *s.n.).*

We found this species for the first time in northern Peru between Tarapoto and Yurimaguas, in a region which is very rich in interesting pitcairnias. The following is a short diagnosis of our Peruvian plant:

Plant stemless, branching from the base (fig. 10); foliage dimorphic: the *basal leaves* persistent, bladeless and very spiny. *Rosette leaves* numerous, erect when young and hanging down in age. *Sheaths* conspicuous, suborbicular, 1.5 cm high and 2.5 cm wide, dark brown, glabrous above, densely white lepidote beneath. *Blades* narrow-linear-attenuate, up to 80 cm long and 0.8 cm wide, glabrous above, densely white lepidote beneath, entire, deciduous 4-5 cm above the sheath; the basal persistent, serrate at the margin, becoming stramineous and

Author

Fig. 9.
A side view of the *Pitcairnia stenophylla* inflorescence taken in the morning, showing the flowers turned toward the same side *(secund).*



Author

Fig. 10

spirally rolling in age. *Inflorescence* simple, up to 60 cm long, horizontally spreading. *Scape* up to 50 cm long, tender, 4 mm thick, glabrous, reddish brown. Basal *scape bracts* subfoliate, with a long, subulate blade; the upper ones bladeless, narrow triangular, acute, exceeding the internodes, lanate at the tip and the margins. Inflorescence ascending, simple, up to 12 cm long. *Flowers* numerous, polystichous but mostly secund (fig. 9), with the pedicels 5 cm long, first green, at anthesis pale lemon-yellow, after anthesis hanging. *Inflorescence rachis* thin, glabrous, red. *Floral bracts* erect to divergent, the basal ones longer, the upper shorter than the pedicels, glabrous, green, red at the base. *Sepals* lanceolate, acute, up to 1.7 cm long, 4 mm wide, subcarinate, glabrous, lepidote only at the tip. *Petals* linear, 4.5 cm long, 4 mm wide at the base with a small dentate ligule, curved back at anthesis. *Filaments* yellow, *anthers* greenish, included. *Style* with long papillose stigmas, somewhat exserted. *Ovary* green, ½ inferior, *ovules* caudate.

Collection number *Rauh 53 662* (8.7.1980). Locality: Northeast Peru, Dptm. San Martin. Terrestrial at 800 m, above Tarapoto, near the path to Uyrimaguas.

In the type plant (André 1876 *s.n.),* the inflorescences are erect and the spirally arranged flowers are not secund. It is remarkable that André does not mention in his diagnosis the behaviour of the persistent leaf blade bases. This is so characteristic of *P. stenophylla,* and we have never seen it in other *Pitcairnia* species.

Pitcairnia stenophylla is a night-bloomer and has symmetrical flowers. They open when it becomes dark, then their pale lemon petals begin to roll back so that the stamens and style are free (fig. 9). In comparison with other *Pitcairnia* species many flowers of the inflorescence are open at the same time. After midnight the petals extend themselves and the flowers move downward.

We suppose that the flowers are pollinated by night butterflies.

Institute for Systematic Botany and Botanical Garden of the University of Heidelberg, West Germany

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Genus *Puya* Molina (Pitcairnioideae) *[continued from page 256]*

Summary. As in other geographic areas, Bolivia includes a number of species that are apparently confined to single mountain ranges or valleys. Yet, some taxa perhaps expanded their range over fairly extensive regions and, occasionally, also became sympatric. A wide array of species assembly, distribution patterns, and morphological traits indicate that puyas of Bolivia have diversified to a degree comparable to various other regions such as Colombia and Peru. The speciation processes, however, seem to have occurred in a regime of intrinsic and extrinsic factors that appear to be unique to Bolivia.

[To be continued]

Just How Durable Are Bromeliads?

Well, they can be pretty tough if given a chance. One Australian grower had the misfortune of a greenhouse heater exploding on a cold night. The greenhouse burned to the ground, leaving the plants scorched and leafless, as well as exposed to the cold. Throw them away? No! A careful clean-up resulted in literally hundreds of pots of "stubs." It took months, but green began to show. It took a year, but life returned to those stubs. In a year and a half after the tragedy there were healthy pups growing from the stubs. Patience, care and the plants natural will to survive resulted in a truly phoenix-like happy ending. The moral to the story? Your bromeliads will do great if you give them a chance.

Reprinted from Bromeletter, *Journal of the Bromeliad Society of Australia, July-August 1982.*

Journal of the Bromeliad Society Index
Volume 38, 1988

Notations: (c) color photograph, (b&w) black & white drawing or photograph, [ ] (number supplied) front or back cover.

Kew Gardens and Bromeliads

T.U. Lineham

The Royal Botanic Gardens, Kew, are located on the Thames River southwest of, and less than an hour of travel by subway from Piccadilly Circus, London. The original nine-acre botanic garden created by Augusta, Dowager Princess of Wales, in 1759 grew to the present dimensions of 300 acres when King George III joined his neighboring estate with hers in 1772. The garden became famous because of the interest of the king and Queen Charlotte and the work of advisors such as Sir Joseph Banks, William Aiton, and Capability Brown. The garden was opened to the public in 1841.

Kew Gardens is a place of beauty attracting more than a million visitors annually. It is part of a major botanical research institute and an educational facility for both members of the staff and the public. Visitors who are trying to see all of the London area in two or three weeks are well rewarded by spending a few hours in the Gardens even if they get to see only the outdoor plantings, the flock of Canada geese, and the black swans. With more time, they can visit some of the plant houses such as the Temperate House and the new Princess of Wales Conservatory, named for Princess Diana. This new house will interest bromeliad enthusiasts of all degrees, from the hobbyist to the taxonomist.

The Princess of Wales Conservatory, covering nearly 5,400 square yards (4490 m^2) is the result of some twenty years of study. It replaces many of the older houses with a greatly expanded amount of space and provides greater efficiency. Construction began in 1984. The official opening was on 28 July 1987. It is remarkable for its long, sloping, glass planes (fig. 11) its ten climate zones supported by some remarkable technical equipment, and its displays. Since the walls of the building are below ground level, there is an unexpectedly large amount of open space. The climate zones as well as other details are shown in the accompanying drawings (figures 12 and 13).

The bromeliad collection is concentrated for the most part in the wet tropics area (fig. 13) although some species may be found in other climate areas according to their needs. For example, a *Hechtia argentea* from Mexico (fig. 15), once exhibited in Brussels in 1864, occupies a prominent place in the succulent house. Three very large *Vriesea regina*, their size overpowering when in cramped quarters, have resumed their normal scale in their new home and provide contrast with the numerous flowering tillandsias. Some of the 100 species of *Tillandsia* are located in the dry tropics area while *Broccinia* can be found in the special environment of the cloud forest.

In terms of population, a recent inventory lists 36 genera including 435 species, presumably not all on display at one time.

Author

Fig. 11.
The long, sloping, glass planes of the Princess of Wales Conservatory at Kew Gardens are emphasized here. The walls of the building are underground.

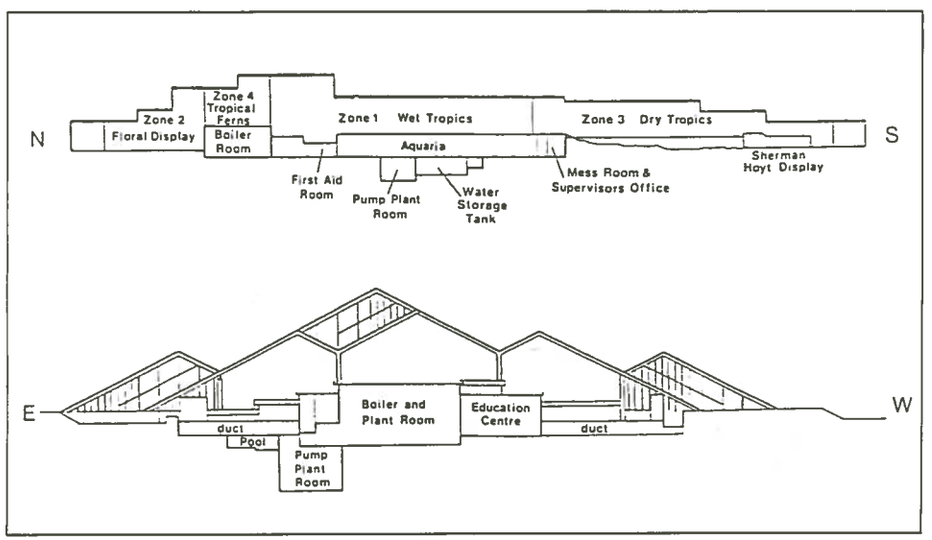


Fig. 12
Profiles of the Princess of Wales Conservatory showing the different display areas and services.

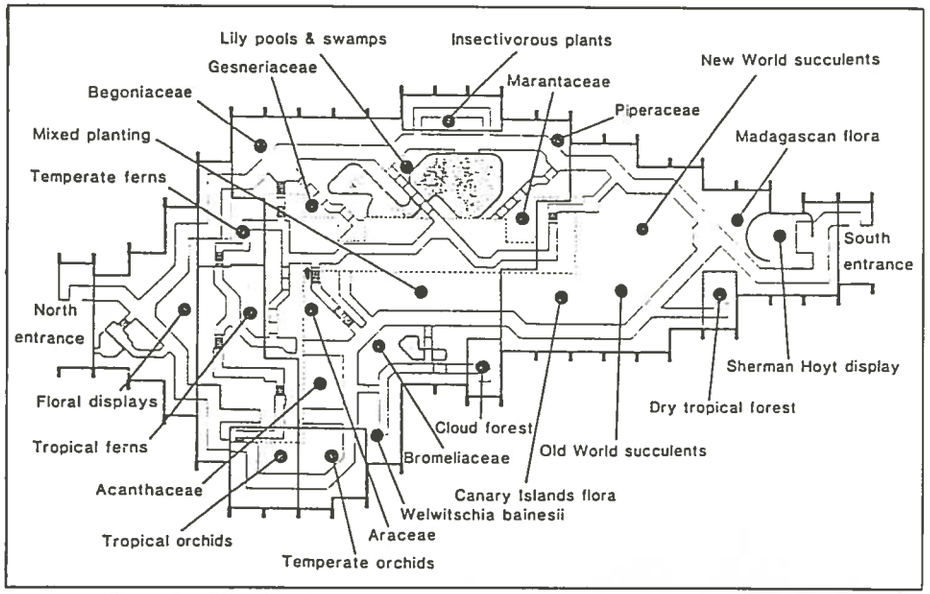
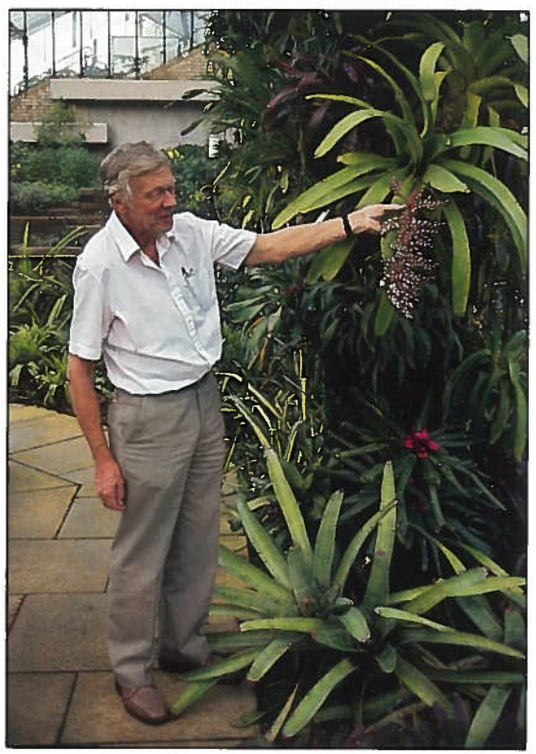
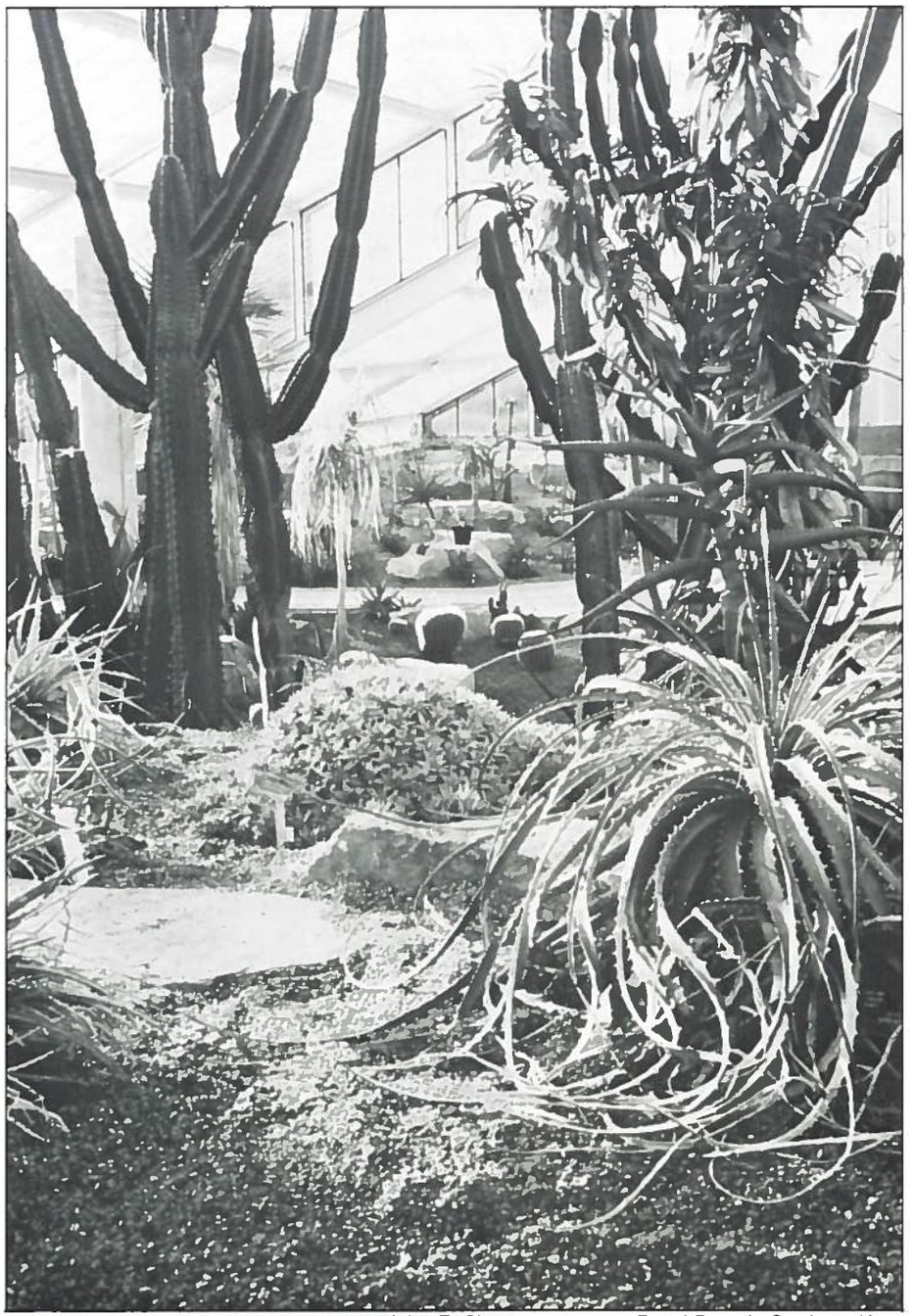


Fig. 13. Planting layout in the Princess of Wales Conservatory.



Author

Fig. 14
David Philcox, bromeliad specialist at Kew with *Aechmea dichlamydea* var. *trinitensis,* which he introduced into the collection.



By kind permission of J.B.E. Simmons, curator, Royal Botanic Gardens, Kew.

Fig. 15

Hechtia argentea is shown in the foreground of this view of the succulent house. This plant was exhibited in Brussels in 1864 and is very rare in cultivation.

The famous collection of Morren paintings is preserved at Kew. Dr. Lyman B. Smith has given us illustrated discussions of some of these paintings and Dr. Robert W. Read has photographed all of the paintings not recorded earlier by Dr. Smith. The collection is not open, but we hope that somehow money will be found for publishing reproductions of these remarkable works.

Acknowledgements:

We are indebted to the director of the Gardens and especially to Mr. John Woodhams, assistant curator, Tropical Section, for providing both written and photographic source material on which to base this article. All photographs and plans except for figs. 11 and 14 are reproduced by kind permission of the Royal Botanic Gardens, Kew; fig. 15, by kind permission of J.B.E. Simmons, curator, Royal Botanic Gardens, Kew.

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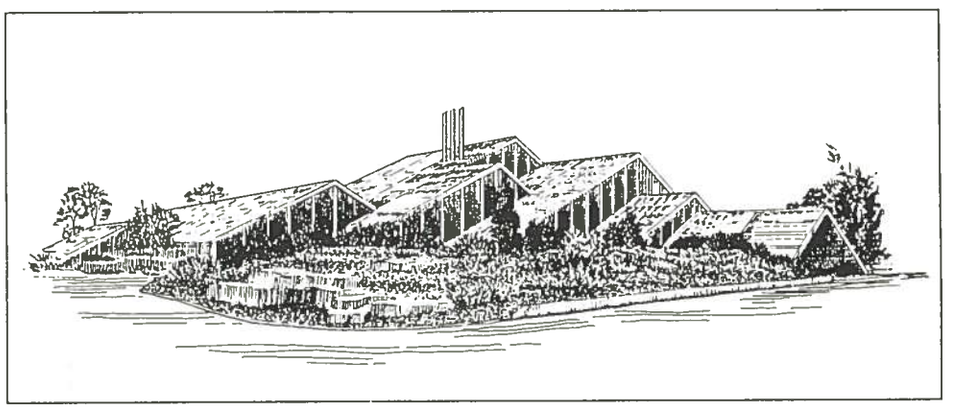


Mulford Foster's 1948 Flight Around South America (continued)

Racine Foster

[This is part 4 of Mrs. Foster's account of the Flight. Part 3 appeared in the May-June issue.]

BOLIVIA

Getting into Bolivia by air from Brazil was an all day affair in 1948. Starting near the coast in eastern Brazil from the elevated city of São Paulo, the Flight carried Mulford west over the rugged, low ranges of the state of São Paulo, then over the southern part of the state of Mato Grosso, a land of vast, low hills and big swampy areas where we had explored eight years earlier. Mulford's plan stopped in Campo Grande, but there was no time to go into town. As they flew on a northwest course near Corumbá, in western Brazil, the border town on the Rio Paraguay, Mulford recalled his explorations there and wistfully viewed Urucum, the 3,500-foot mountain rising up out of the swampy land surrounding Corumbá. It had been such an interesting exploration in 1940 that now those memories tumbled down memory lane. Across the river was Bolivia which we had viewed curiously from Corumbá in 1940. Now, the plane, came down in Puerto Suarez, Bolivia, for customs inspections.

The Flight (on Nov. 9/48) followed the ridges and rivers across the air route into Santa Cruz, Bolivia, on the edge of the beginning of the heavy mountainous area. The passengers stayed overnight at the Pan Am guest house at this airport with clean and very comfortable accommodations. The wall of mountains in the distance explained why the plane did not dare push on over the "hump" that night.

In flight the next morning, the plane climbed up to 13,000 feet to get over the hump before going down into the Cochabamba, at 6,500 feet. There it took all morning to go through customs and arrange affairs properly for collecting.

Through kind introductory letters, Lyman Smith had told Dr. Martin Cárdenas of Mulford's intended visit, so he came immediately to the hotel where they spent the afternoon getting acquainted and planning a trip to the *Puya raimondii*. Dr. Cárdenas is part Indian and, of course, speaks Quechua, as well as Spanish and English. He was most helpful in arranging men and a truck for the great expedition to see the greatest of all bromeliads.

Quoting from Mulford's letter of Nov. 14/48, Cochabamba: "My dear, how I wished that you could have been with me the first part of yesterday's trip, but no the last part! It was really a red-letter day in my life, worth all the effort it took to see the *Puya raimondii*. What a thrill! I had it pictured in my mind, yet the real

experience surpassed anything I ever anticipated. I kept all three cameras clicking as our observations continued. In other places I have climbed trees and rocky heights to procure an inflorescence, but never, even in my dreams have I seen anyone climb the inflorescence itself to procure flowers as did the Indian boy for me.[1] He had to climb twenty feet to the very top to obtain those large white flowers. I was there just in the nick of time! Another week it would not have been in bloom. Everything went off perfectly on a beautiful, sunny day.

"Then we went down the cordillera on the way to the Yuncas, the wet, tropical forest of the eastern slopes of the Andes. Up and up, then down and down, mist, rain, dripping trees, we were in the midst of the cloud forests. I thought I was in Colombia! I found three more puyas that Dr. Cárdenas had never seen before. Then down, down the mountain, wetter and warmer and slipperier. But within two kilometers of our destination for the night, a huge landslide complete blocked our way. What to do? It didn't take the driver long to do the incredible thing! He backed that truck up the narrow, curving road with many hairpin turns until we reached a place wide enough for turning around. I wouldn't care to drive that road even in daylight going forward!

"We met an Indian who told us that it was only one league to our destination. So we started walking in the rain; we left one man to guard the truck. After walking one league, we met another native who said it was still one league to the Yuncas. That was too much. We turned back, wet and cold, and very tired. It could have been Colombia; of course, you remember our misery there in similar situations!

"Tillandsia complanata, with many other tillandsias and guzmanias, was everywhere; every species looked like those in Colombia. Even at the last place, I saw *T. rubra,* the one we always thought might be *T. pyramidalis.* Remember, it followed us all the way down the Andes to Altaquer in southern Colombia? (In Bolivia the plant ranges were far from Colombia, whereas in Ecuador they were next door.)

"Finally, we reached our truck and then after a hard drive we reached Cochabamba by 9:30 p.m., wet and cold! A warm bed and a good night's rest put in fine shape for the next two day's planned trip, but next morning I learned that my plan had to be cancelled.

"So, early the following day I flew north over the vast Bolivian altiplano to La Paz, the unofficial capital of Bolivia (Sucre is the official one), 400 meters below the altiplano. . . a high valley surrounded by higher mountains, at the edge of southern Peru. . . .

"Yesterday (Nov. 20/48), I found the most beautifully colored puya yet; it was growing in rocks at the unbelievable height of 14,650 feet above sea level

1. Nat. Geog. Magazine: 98(4): 463-480; Oct. 1950, reprinted in J. Brom. Soc. 34: 147-157, 205-211; 1984.

M.B. Foster

Fig. 16
Puya fosteriana L.B. Smith collected by M.B. Foster near La Rinconada, Bolivia at 14,650 ft.

near La Rinconada, on the eastern cordillera. There may not be a record higher than this. The flowers were of the loveliest ultramarine blue protected by light green bracts covered with a lovely, light brown wool." (This was a new species named by Dr. Smith to honor Mulford, *Puya fosteriana.)*

From the La Rinconada area, Mulford's collections of many different bromeliads became a roster of many well-known collectors or authors: *Tillandsia rubella* (Baker), *T. sphaerocephala* Baker, *T. capillaris* (Ruiz & Pavon), *T. seemannii* (Baker) Mez, *T. boliviensis* Baker, *T. violascens* Mez, *T. maxima* Lillo & Hauman ("Horka"—edible). Eight puyas: *Puya sanctae-crucis* (Baker) LBS, *P. atra* LBS, *P. tunarensis* Mez, *P. meziana* Wittmack, plus one *Pitcairnia ferruginea* R&P, *Puya glabrescens, P. cardenasii* LBS, and *P. hertzogii* Wittm.

Much of Mulford's Bolivian experience is recorded in his October 1950 article in the National Geographic and was reprinted in this *Journal* (see note), so most of those details need not be repeated here.

"Dr. Cárdenas had given me a letter of introduction to the Minister of Agriculture who would help me see a group of *Puya raimondii.* So, yesterday I was climbing all over Comanche, the mountain that starts at 13,000 feet. My first

day with the single *P. raimondii* near the Cochabamba was great, but yesterday, out from La Paz, capped the climax! Forty giants were in flower, all about thirty-five feet high with the inflorescences of these as high as the whole plant at Cochabamba! A sight beyond belief!

"Now, I want to get more information on this plant because the original type plant, discovered by Antonio Raimondo in Peru far from here, has a different description of flowers than the single one I just saw in Bolivia. It will be a pity to see that fine, old desert monarch die. My fervent hope is that some of its countless millions of seeds will survive to give some other botanist a thrill fifty years from now! But that is doubtful. I have regretfully concluded that I am witnessing the extinction of a noble species!"

The great reward of the whole trip around South America was seeing the two stands of *Puya raimondii.* After this, Mulford was ready to come home. And, maybe he should have returned to Florida then because for the next five days he endured food poisoning, surviving on bottled mineral water, a tea from quinine, a strong constitution, and determination.

Author

Fig. 17
High fashion! The essence of incongruity is par in Bolivia where the pure white "Panama" hat (made in Ecuador) adorns the lowliest Indian.

PERU

Although Peru has important collecting area, Mulford had to forego much of this pleasure. He did stop in Lima just long enough to visit the big botanical garden devoted, mainly, to cacti and succulents native to the local mountains.

He continues: "Peru fooled me! It is a vast desert land. In Lima, it never rains, at least not more than a few drops for a few minutes every ten years or so!" Peru, that long country along the west coast of South America is at almost the same parallel as is Bahia, Brazil, on the east coast of the continent. But Bahia is warm, whereas Lima is cool, kept that way because of the Humboldt Current which runs along the coast.

"I tried a whole day to track down the Raimondi Herbarium, only to find that it had been deposited in Berlin. I bought the book by Augusto Weberbauer, *El Mundo Vegetal de Los Andes Peruanos,* which is dedicated to Antonio Raimondi. It is an admirable volume of 776 pages on the flora of Peru.

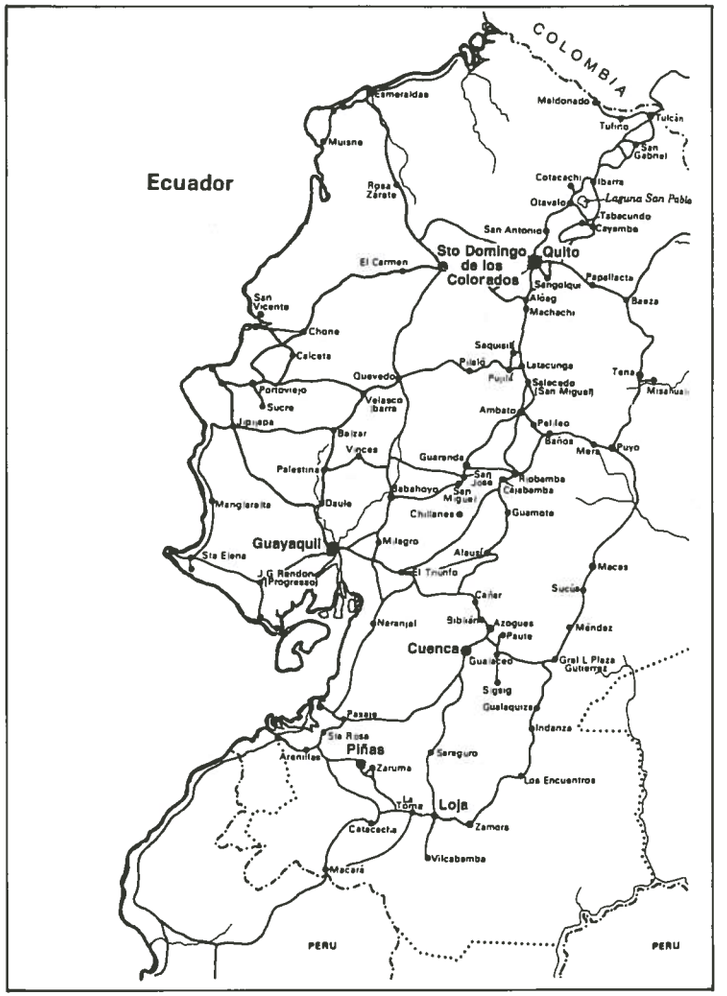
"In Peru, there are only two places where *P. raimondii* lives. One area is almost cleaned out. The other location is where the Indians make a ritual of burning them after they go to seed. It makes such a pretty spectacle at night! If the conservationists would furnish these Indians with our traditional fireworks, perhaps it would satisfy their eyes with a color-filled display that might lessen the burning of *Puya raimondii.*

"I would like to be in a position where I could make a proposal to the Peruvian government for a botanical mission to outlaw the burning of these magnificent, irreplaceable plants."

Not being able to get to the two congregations of *Puya raimondii* in Peru was disappointing to be sure, but in retrospect Mulford was satisfied that he had been in the presence of the two stands in Bolivia.

ECUADOR

"Here I am in Ecuador! Again, my schedule was upset because of poor weather conditions. Last night, Nov. 27, I flew north from Lima to Guayaquil on the west coast of Ecuador in the **big** plane as they emphasize it here. It was going on right through to Miami and I was very much tempted to go with it. I did not realize it until they served us a fine Thanksgiving dinner what day it was! We had turkey, cranberry sauce, asparagus, even an individual mince pie; it was all very nice and quite a surprise. That big plane flies at 20,000 feet for speed. The cabin is completely controlled with the proper mixing of oxygen, giving the traveller the impression there is no altitude." After half a dozen flights in small planes where one had to wear a mask to survive the altitude, this new comfort (in 1948) was worth mentioning.



"In order to get out of Peru, I had to take that large plane northwest of my destination which was in southern Ecuador. Then by taking another smaller plane southbound, I landed in Loja at 7,000 feet elevation, which is a modern-old city along the ancient Inca Trail on the spine of the Andes. Loja is one of the oldest towns in this country having been founded in 1548, four hundred years before I got here! The present population is over 71,000. It is a provincial capital with two universities, a law school and a conservatory of music.

"The region abounds in a great variety of plants and the local people are proud to tell you all about the various plants found around the town. I have often said: plants communicate a certain language between people who do not have a common spoken language."

Alexander von Humboldt, in 1802, was impressed enough to call it the garden of Ecuador. He also predicted the demise of the cinchona tree if strict

measures were not taken to control the wanton felling of this tree, the Fever Bark Tree, source of quinine. Richard Spruce, the British botanist, was sent by Queen Victoria to collect seeds which were planted in India on a vast scale. Soon Loja became world famous as the source of the Fever Bark Tree. For many other reasons Loja had a history of attracting plant collectors since it was one of the gateways to the eastern jungle of the Amazon headwaters. Quite some time later, Mulford learned these details of the botanical history of Loja.

"I had letters of introduction to two botanical men, but both were out of town. The one man I chanced to meet was an unexpected pleasure. I spent half a day with Truman Bailet. He is re-establishing the native arts of the Peruvians and Ecuadorians; a marvelous enterprise!

"I collected tillandsia #2586 in the vicinity of Loja. This had two interesting characteristics: first, a new axis develops immediately next to the old scape and secondly, the plant continues to subdivide and develop in large clusters. It is a tillandsia with the distinction of having rose-colored flower bracts and rose-colored sepals.

"The next collection around Loja was #2587, *Pitcairnia pungens.* All leaves disappear at the time of flowering, only leaf bracts at the base of the inflorescence remain; all scape and flower bracts have loose white wool, a protective coating against the high, damp cold. Of course you remember that the brown wool on many dyckias of Brazil served the same purpose."

A trip down the mountain from Loja, which is 7,000 feet, to Portovelo at 2,000 feet put Mulford in the province of Oro (gold); he was on the road from Minas Nuevas (new mines) to Cachlicarns where he arrived just in time for a welcome lunch.

"I am at the Gold Mine now. Looking down from my cabin, I see the lighted buildings and hear the engines pumping, all of which reminds me so much of Petrolea in Colombia; only here they are pumping gold, not oil (as in Petrolea) from the bowels of Mother Earth so that they can buy more oil to pump out of Mother Earth's lower bowels. My heart is pumping too, pumping away in my great longing to be home."

Outside of town, familiar bromeliads were meeting him everywhere: *Tillandsia disticha, T. multiflora* var. *descipiens, Aechmea involucrata, Pitcairnia pungens, T. fraseri.* This was guzmania country, warm and moist where Mulford collected five guzmanias that were not known to him.

"Finally, I caught up with the botanist Señor Espinosa. He is stationed at the University of Loja. He was very interested in my enthusiasm for the wild plants growing in the trees and on the rocks in all directions outside of town.

"He said he was sure it could be arranged for a truck to take me on a collecting expedition. So, next morning I went to his apartment to complete the arrangements, but he was too ill to arrange anything for me. Frustrated again, I decided to arrange things myself. I just could not stand seeing all those bromels along the way without collecting a few.

"The next morning, with the help of the hotel manager, I bargained for a car for a two-day trip. Finally, I got it! A new Chevrolet, a nice driver, and the hotel man gave me a boy helper. So, for once, on this side of the continent, I rode in comfort while collecting. I could stop anywhere and any time I wanted. It is really the best way to collect, with plenty of room to carry specimens. I took twenty-five bromels for herbarium material, a little something to show for my few days in Ecuador.

"One of the tillandsias is out of this world! The most ethereal bromel I believe I've ever seen, a silver snowball! You will like it. They grow on sheer rock walls in full sun; the flowers are rose and lavender.

"Also, I found a most interesting and beautiful succulent plant. It should be great in dish gardens; I believe the California people would grow it by the hundreds of thousands! It certainly has the flower of a peperomia (I can't place it in any other family), but it resembles a colorful sedum otherwise. It grows only in a very small area along with the silver 'snowball'.

"I caught a beautiful snake too, like a coral, but I couldn't really send *that* to you! Although I am sure that you would like to have it; you could keep it in the bathroom with my other snakes."

All his plans to meet certain people in Cuenca, that famous city north of Loja on the Inca Trail, were foiled. So he returned by bus to Loja. Then the next day, back to Portovelo by bus.

[To be continued.]

Questions & Answers

Conducted by Eloise Beach

We are very grateful to Eloise Beach for the great amount of effort that she has devoted to the "Question and Answer" column during most of this year. She has asked to be relieved of this duty to give full time and attention to her expanding greenhouse operation.

Kathy Dorr will be the new conductor of the Q&A. That is a quaint term in this sense but it really means a manager. If your questions need to be referred to a particular authority, Kathy will manage to find that authority. She will also manage to supply answers from her own extensive experience. Kathy has been an active member of the Bromeliad Society for some time. She is well known to many as the editor of the bulletin of the Bromeliad Study Group of Northern California, later the Long Beach-Lakewood Bromeliad Study Group.

We encourage all members and other readers to send their questions about any aspect of bromeliads as a hobby to the editor. We intend to answer as many questions as possible and to publish some of them with answers in each issue. —TUL.

Q. Is there anything I can do to encourage more rapid reproduction of my rare bromeliads?

A. You could experiment with cytokinin treatments. Cytokinins are plant hormones best known for their ability to promote cell division. Various formulas have been successfully used by bromeliad growers to activate dormant nodes and ultimately cause multiple offsets to develop simultaneously. Caulescent tillandsias seem to respond especially well to cytokinin treatment. One formulation used was 2% benzyl adenine in lanolin applied sparingly to the basal nodes of mature plants. More detailed information can be found in an excellent series of articles on plant growth substances written by Dr. Vernon Stoutemyer published in 1978-1980 issues of the *Journal.*

Q. I've been told that bromeliads have beneficial scales, but I thought scale was a serious insect pest of bromeliads. Which is correct?

A. Both statements are correct. There are several forms of scale insects that attack bromeliads: "soft brown" scale and hard black "fly speck" scale are the most common. These insects live under a protective shell and suck juices from the leaves. If left untreated, large scale populations may kill the more tender bromeliad varieties. Scale insects are not difficult to control if proper techniques are used.

The beneficial bromeliad scales are not insects. These scales are actually part of the leaf surfaces. They are known as peltate scales or trichomes. These trichomes are the absorptive organs of the plant which allow it to obtain water and nutrients. The gray color seen on many tillandsias is actually the

trichomes. Another example is the gray "scurf" of *Aechmea fasciata.* Bromeliad trichomes are extremely variable and some scientists believe these amazing structures can aid in distinguishing species. Many greatly magnified trichome photos have been published in past issues of the *Journal* such as July-August 1988, page 162.

Q. I live in Texas and all my varieties of *Neoregelia carolinae* bloom only in the spring, yet I see them for sale in bloom all year around. How is that possible?

A. Those plants are not special varieties that bloom during other seasons. They are simply treated with chemical growth regulators that induce blooming. Florel and Ethrel are two of the most common products used. Commercial growers use this "forcing" technique to produce blooming plants any time of the year. Best results are obtained when mature or nearly mature plants are treated rather than very young ones. Depending on the variety and time of year (faster in warm weather, slower in winter), it takes from 5-10 weeks after treatment before the bloom is well developed.

Q. What are the symptoms of too much light and too little light?

A. Plants growing in too much light become yellowish with bleached out colors. New growth will be shorter and in extreme cases, brown sunburn spots develop or entire leaves turn brown. Houseplants can sunburn quickly when exposed to direct sun.

Too little light is shown by dark green, often soft, drooping leaves that are longer and narrower than normal. Markings and bright colors fade. In low light, gray or silvery tillandsias will produce greener leaves. Keep in mind that overfertilizing will also cause the same symptoms as too little light.

Q. My neighbor said that I should not let grass and weeds grow up next to my greenhouse. I mow it regularly, so how can that be a problem?

A. Grass and weeds provide an excellent breeding place for all types of insects. These insects can enter the greenhouse through vents and other openings. A good practice is to leave a buffer zone from one to three feet wide around the greenhouse clear of all vegetation. Bare soil, rocks, mulch or plastic ground cover will all do the job. It is even more important to keep the inside of the greenhouse free of weeds—floors and pots. Large insect populations can thrive in the weeds and make control virtually impossible. Althought it is time consuming, the safest method for weeding is by hand with some type of weeding tool and a rake rather than using chemical weed killers which can easily damage your plant collection. Once the initial clean-up is finished, you will find it doesn't take as much time to maintain the cleanliness if you do a little weeding on a regular basis.

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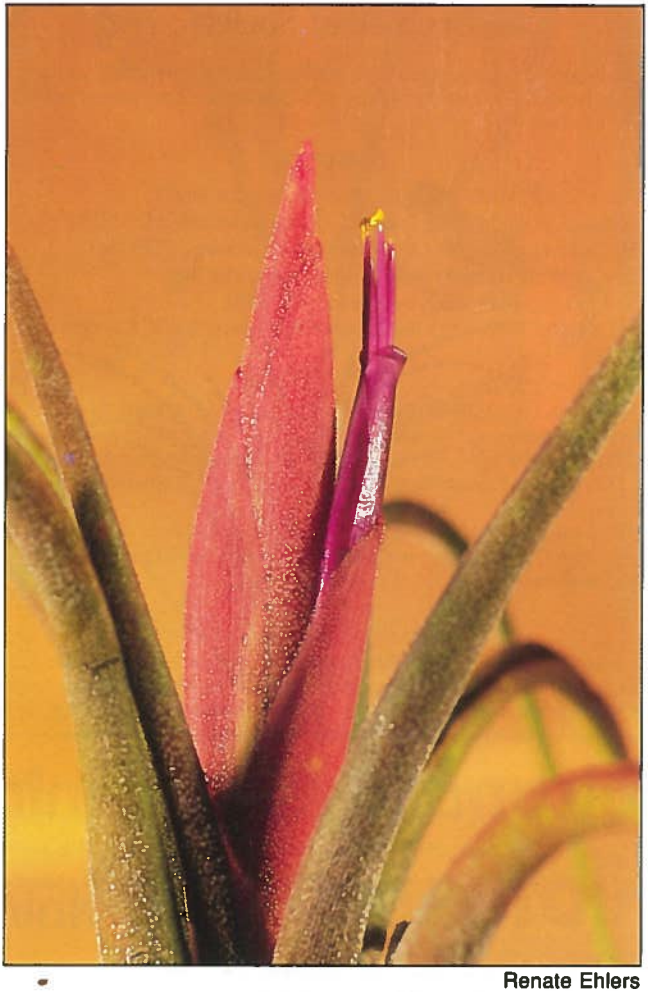

Renate Ehlers

Tillandsia klausii collected in the state of Chiapas, Mexico by Renate and Klaus Ehlers. See story beginning on page 258.