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Eulychnia iquiquensis

At Las Lomitas

Photo: D. Wede



Copiapoa hypogaea
Photo: F. Vandenbroeck



Copiapoa esmeraldana
Photo: M. Giani



Copiapoa columna-alba Between Esmeraldana and Las Lomitas
Photo: F. Vandenbroeck

During 1987 we started off from Pan de Azucar and trekked north along the coast, following the quite narrow strip of beach which runs between the edge of the waves and the foot of the long and steep rocky ascent which forms a virtual escarpment that extends all the way from Pan de Azucar to Esmeralda. Along our way we had to cross over a number of rocky outcrops that fell directly into the sea. It was whilst we were walking along this narrow beach that we found some plants of *Copiapoa taltalensis*, growing in a gritty sand, barely a stone's throw from the waters' edge. These plants were smaller than those we had found on the slopes immediately to the north of the Esmeralda valley, but were otherwise similar in appearance. At first sight, any thought of heading inland by trying to ascend the very steep slope to our right seemed to be quite out of the question. But roughly half way along this stretch of coast we struck off up the escarpment and after climbing for a while we found that it was rather less daunting than we had anticipated, finally reaching the top.

Beyond the top of the cliff-like escarpment which faced the ocean, the ground fell away inland in an undulating manner, the landscape being conspicuously lacking in vegetation. The surface of the ground was made up of rocks and sand. In the sandy patches we again found *C.taltalensis*, although we would be at an altitude of perhaps 700m. Here we were more or less at the upper limit of the mist zone, but the mist might reach these spots, coming over the coastal escarpment. Continuing our walk towards Esmeralda, we came across a patch of ground evidently favoured by the mists, resplendent with bushes and shrubs and a few *C.taltalensis*, with some specimens growing under the bushes and reaching up to four inches tall, with the green lichen like growth hanging off the bushes and straggling over these *Copiapoa*. Although these particular *Copiapoa* retained a similar appearance to those that had been found growing in the otherwise bare sandy ground, the surroundings at this particular spot were not their natural habitat and growing tall was out of character. Trekking further on our way north, we continued to loose altitude, keeping the Quebrada Grande on our right, until we arrived at Esmeralda.

.....from F.Vandenbroeck

We started off from Pan de Azucar and followed the Quebrada de Pan de Azucar inland for about 25km, along which populations of *Copiapoa columna-alba* are to be found. Then we turned northwards along the Qu Los Chilcos, where the *C.columna-alba* gradually disappeared. After about 12km, near the Cerro Morado, we took the steep track along a quebrada and came to the plateau of Las Lomitas. This is a huge sloping barren plain with a scattering of *Eulychnia* and *Trichocereus*. It was on this plain that we came across a shallow dried up river bed which was almost covered with numerous different kinds of colourful flowering herbs and small bushes. Evidently the ground below the river bed contained an amount of moisture that supported the growth of vegetation. It was in the adjacent bare sandy areas that we found lots of yellow flowers sticking their heads out of the gritty sand. We thought at first that we had come across a *Thelocephala*. But on brushing away the sand from around the flowers we found the tiny brown flat bodies of what was probably *Copiapoa hypogaea*. If they had not been in flower we would certainly not have noticed these plants. This around 600-700m altitude, the highest level that we reached at Las Lomitas. Getting closer to the cliff edge, it becomes noticeably cooler because of the constant moisture in the air. Here the *Eulychnia* and *Trichocereus* are liberally draped with all kinds of mosses and lichen, an impressive sight. Because of the dense moisture in the air, several species of bushes can also be seen growing here, among them *Euphorbia lactifluans*. On the cliff edge we found a wooden shack belonging to Conaf, from where a track ran southwards along the top of the cliffs, but it proved to be a dead end.

At a later date we travelled south wards from Esmeralda, passing through a wide valley with splendid populations of the heavily black spined *C.melanohystrix*. These plants grow very large and are hung with all kinds of mosses and lichens on their south-west sides. These plants incline towards the north-east, away from the ocean mists and towards the sun. In between them were colourful flowering herbs together with bushes of *Oxalis gigantea*. Most of the *Eulychnias* here displayed their white woolly fruits. The track rose gradually in altitude and the temperature got cooler. Then as the altitude continued to increase, most of the cacti gradually disappeared. We crossed an empty, barren plateau to visit Las Lomitas once again, seeing steadily more numerous *Copiapoa columna-alba* as we approached the coast, then turned south towards Pan de Azucar. These plants are conspicuously different from the *C.melanohystrix* which we saw closer to

Esmeralda.

.....from R.Schulz

In the Quebrada running north to south inland of Las Lomitas there are large populations of *Copiapoa columna-alba* without any lichens, but when we visited the area round Las Lomitas we came across a *Copiapoa columna-alba* which was about 20cm tall and it was carrying a coat of lichen. We were about a km inland from where we could see the mist coming over the top of the coastal ridge.

.....from F.Larsen

I have never seen any *C.grandiflora* near to the ridge which had lichen growing on them, as they grow close to the ground and not standing up like the *Eulychnias* and the *Copiapoa columna-alba*. I did find some seedlings in the gravel which may have been twenty years old but were still only the size of a small coin, near the colonies of *Copiapoa columna-alba*.

.....from C.Sherrah

Not far from Las Lomitas, at about 700m altitude and only 20 metres from the edge of the coastal cliffs, we came across a plant of *C.grandiflora* with about 6 or 8 heads which were up to about 30cm tall. There was a considerable amount of lichen growing around the lower parts of those heads. Since the fog comes in down to ground level I do not think that it is a question of height of a plant but whether there are a sufficient number and length of spines – or of heads or branches – to retain the lichen.

.....from R.Schulz

I will have been to Las Lomitas on a score of occasions over the years. Here it is pretty flat with small hillocks of about 4 to 5m above what I call a plain, which slopes gently down away from the coastal cliffs which are higher than inland. Along the track which runs north not far from the coastal ridge up to Las Lomitas, I stopped at frequent intervals on one visit there. At one stop there were a few *Copiapoa columna-alba* growing and also some *Eriocyce rhodentiophylla*. Here it was quite bleak spot and yet within 300m of the cliff top, plant life was abundant. Near the cliff edge there are lots of *Eulychnia* and some *Trichocereus* which are difficult to tell apart as they are both heavily laden with lichen. The *Eulychnia* extend inland for at least 5km. from Las Lomitas.

The small *Copiapoa* growing near Las Lomitas are a bit of a confusion. Until a few years ago I was convinced that there were some *C.hypogaea* among the *C.esmeraldana* as there seemed to be two forms of flowers, but now I think that they may be only *C.esmeraldana*. They seem to prefer to grow on gravelly ground, but owing to their being eaten by Guanacos and donkeys, one seems to be able find them only in small outcrops of weathered granite such as near to the cliff edge on rocky ground. They are mostly spineless but there are a few with very short spines with little to be seen in the way of intermediates.

There are many small plants of *C.esmeraldana* growing near to the cliff edge that are all offsprouts from taproots so that they do not show the adult form and so make identification difficult and when they flower it is from immature stems. The body of these plants is brownish in colour. No more than 2km. further inland and just off the old track, there are small populations of typical *C.esmeraldana* showing the green body – here it is about the same elevation as at Las Lomitas.

In 2001 a group of us walked from the then abandoned ranger station at Las Lomitas, north along the ridge and then down to Cachina. It took only three hours of actual walking and it was mostly downhill – with little ups and downs of small hillocks on the way – so quite easy. Along the first part of that route we came across quite a number of *C.esmeraldana* and also what I thought at the time was *C.hypogaea*. From about 400m on the way down there were many populations of *C.longistaminaea* and then a bit lower down a population of *C.grandiflora* with some huge clumps.

It is possible to drive along a track for 4 Km. to the north of Las Lomitas and then down a steep track going east, along which small *Copiapoa* were no longer to be found, but we did see one or two *C.lauii*. Less than a km to the north of that eastward turn, the form of *C.columna-alba* with strong and dark spines - commonly called *C.melanohystrix* – start to appear. The mists come over the coastal hills and keep these plants quite damp so that they carry many clumps of lichen – but not to the same extent as with the *Eulychnias*. Down the hills to the east these *C.melanohystrix* become less strongly spined and the lichen covering decreases as the altitude drops.

Also when going north along the coastal ridge there are a few *C.grandiflora* growing right on the ridge edge and also down the 60 degree slope to the west, which of course is not accessible as it is very loose and liable to slide. These plants are very spiny like the *C.grandiflora* that I have seen at 700m altitude

to the north of Esmeralda, again on some ridgetops. The heads are quite small but as one descends the heads become more typical so that at 300m altitude they become typical grandiflora.

.....from A.Delladdio

Walking round near Las Lomitas we came across a gentle slope on which there were scattered numerous flat rocks that were about half a metre across. Between one pair of these rocks there was a gap about 2.5 to 3cm wide in which we found growing three or four heads of a small Copiapoa and a few metres away another similar gap also in which again three or four small heads of another Copiapoa grew. One of this group of heads had spines which were fairly robust and about as long as the 2.5 to 3cm wide heads whilst the other group were a dirty green colour and had shorter and thinner spines. It was difficult to decide what name to put on these two plants.

.....from H.Middleditch

Looking at these two pictures (page 76, this issue) it would seem to be quite understandable that R.Schulz would observe that the small Copiapoa growing near Las Lomitas are “a bit of a confusion”.

.....from F.Larsen

Walking away from Las Lomitas, along the ridge edge, there were some C.grandiflora to be seen, which were only small plants, about 2.5cm across and with spines which would also be about 2.5cm long. I also found some huge clusters of C.grandiflora close to the ridge, about half a metre across with as many as forty heads.

.....from M.Giani

I have come across C. grandiflora both in the Quebrada Guanillos and at El Mirador, which is close to the cliff top to the south of Las Lomitas and at a lower altitude. Here, these plants grow a few metres down the cliff towards the sea, but I did not find any of these plants inland from there, but instead found C.columna-alba and C.bridgesii.

.....from C.Sherrah

On my trip to Las Lomitas, I found that it was not safe to descend the very loose cliff face going down to the sea, so I went no more than 15m down the cliffs. In places the gently sloping plateau terminates abruptly into steep cliffs, but at other places along the ridge, this change takes place over a distance of about 20 or 30 metres.

.....from R.Schulz,

I did once descend a few metres down the coastal escarpment at Las Lomitas, but it was quite scary as the ground was soft and unstable – but there are places where stable rocks allow a descent of perhaps 20 metres. But I only found the small C.esmeraldana type plants there.

.....from P.Hoxey

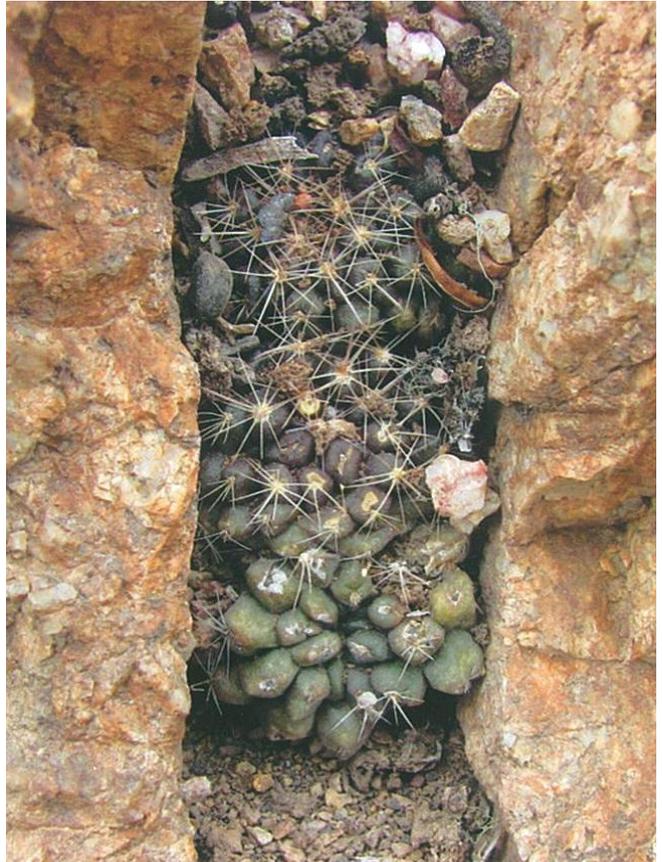
After visiting the well-known population of Copiapoa columna-alba near Esmeralda, we took a small sandy track that goes to Las Lomitas, which is faint but there are tyre tracks in the sand. We follow a small quebrada, slowly gaining in height, where we see many C.columna-alba. There is a fox in the distance and then we disturb a small group of Guanacos, who run off. There are low hills on either side of the track, and there is an increasing amount of vegetation as we gain in altitude, although there are still a lot of barren, grit covered slopes. Eventually the track climbs one last ridge and we are on a track which follows the top of the coastal hills. Below us is a very steep drop on to a small coastal plain where we see a little track following the coast. There is a little cloud but no mist in the air and visibility is quite good.

We follow this track for some way and then make a stop, at 740m altitude. There is a stiff breeze blowing, with some cloud cover, and the temperature is quite cool. All the large cacti, such as the Trichocereus deserticolus and the Eulychnia iquiquensis ‘saint-pieana’ and other plants are covered in algae or lichen which is very thick in places, but much of the ground is just bare grit. We take a quick look but do not find any smaller cacti. There is a lot of Guanaco activity here.

Heading further south, we stop as we approach the Rangers’ hut at 800m altitude, where I had been told that we would find Copiapoa hypogaea. There is lots of evidence of disturbance and digging by Guanacos. I explore the ground, heading down towards the cliff edge. Very carefully I examine the grit covering the ground and it takes a long time just to find a few tiny plants with brown or green bodies, some with very juvenile looking spination, which I recorded as C.esmeraldana. Some of the lichen covered Trichocereus here were in flower. The mist is starting to build so we take a track going south but more inland.



Copiapoa grandiflora
Near Las Lomitas



Copiapoa esmeraldana
Photos: A. Delladdio



Copiapoa columna-alba
Near Las Lomitas Photo: R. Schulz

Now at about 5 or 6km. from the coastal ridge, at 820m altitude, we make a stop close to the coordinates from A.W.Craig for his *C.grandiflora* var. *minima* location. This is a landscape of gently rolling hills, a gently spooky place with the thick fog, which is quite surprising as there is so little vegetation, the hills being covered in grit. Carefully searching, it takes us a while to find our first small *Copiapoa*. There are places where the ground has been scraped away and it looks like the Guanacos are eating the heads. In a couple of places we see tiny new heads, which are quite woolly, growing out of these scrapes. So it looks like the roots are regenerating. I assume these plants are *C.esmeraldana* and not *C.lauii*. We use our GPS to find our way in the mist and back to the car.

Continuing south down the track into the National Park, we drop out of the mist into the sunlight.

....from F.Larsen

I am told that the Pan de Azucar National park and the area round Las Lomitas is now closed to visitors, in order to protect the Guanacos and increase their numbers – what a silly idea – there is no food for them there but they need to eat something – such as the cacti.

....from M.Giani

I have been to Las Lomitas on two occasions and on both visits we came to the Conaf house on the plateau. It was here that we found some small *Copiapoa*. A few tens of meters down the steep slope facing the sea, there were some dark green plants of this *Copiapoa*, almost globular, whilst on the plateau – but near to the Conaf house – these plants were scattered, growing close to the ground and light green in colour. The difference could be due to the different exposure to the sun and to the humidity coming in from the sea. These plants on the plateau are exposed to the sun all day, from early morning to late afternoon. Those on the steep face only see the sun in the afternoon, as they face west. The youngest plants have clearly less well-defined ribs, whilst the oldest ones have clearly winding ribs. Also there is a noticeable variability in the spination, which can be present and stiff, outstanding – or absent. But the bodies are fairly soft.

....from F.Larsen

On my first visit to this part of Chile in 2003, I was in Chanaral where one of the locals took me in a car along the coast to Pan de Azucar and from there to Las Lomitas, where I was left to walk around with my tent and four days supply of food and water, taking various trails in the direction of Qu Cachina. Not long afterwards I paid another visit to Las Lomitas in company with R.Schulz, when we walked northwards along the edge of the steep ridge facing the sea until we were only a few Km from Cachina where we turned inland. Then in 2006 I set off on my own again, this time from Cachina, going along the Quebrada Grande and then to Las Lomitas, exploring around on the way.

There is a wooden house at Las Lomitas, together with some big nets about 8 metres by 12 metres held up vertically, which are used to condense the fog and convert it into drinking water. It was here on the plateau that I found several populations of a small *Copiapoa* which I was not able to identify. Then in going further north, at several points close to the steep drop down to the coast, I again came across more of these plants, even when I was two or three km from Quebrada Cachina. For some time I was quite unsure whether they should be recorded as *C.humilis*, *hypogaea*, or *esmeraldana*, but I am now sure that they are *C.esmeraldana*. Most of these plants grew under rock projections to protect them from the always hungry guanacos. I brought back with me to Denmark one of these plants and potted it up in a tall pot because it has a very large tap root unsuitable for a small pot.

....from H.Middleditch

In the Dutch Journal *Succulenta* there are a series of articles in which Buining describes his trip in company with Ritter through Chile to Peru. There is much detail regarding problems en route, the nature of overnight accommodation, and so on, together with a great many names of the cacti that they saw, but very little mention of place names en route. Fortunately, the section in the June 1971 issue has a reference to Chanaral and then ends with a reference to a gold mine, so it seems to be quite possible that this article concerns their travel between Pan de Azucar and Esmeralda. This appears to translate as follows:-

“Now we must either go back to the Pan Am highway or risk a doubtful trail to the north. We preferred the doubtful one! With much effort and good luck we crossed a waste of loose sand and after that there was no going back. After many wrong turns we finally reached the coast but now at an altitude of 1000m! We were quite uncertain about where we should turn. Before us it went down into the almost impossible sandy waste, but we could not go back again. Suddenly we found a really small cactus between the stones, some with and others without spines, growing both solitary and in small groups. It had a very

long swollen rootstock, so that at first we thought it was a Thelocephala. However, it appeared that it was a small unknown Copiapoa. Such an unexpected discovery gave us fresh courage and we went further on. The track then took us to a solitary population of Copiapoa columna-alba. Thousands of these cacti stood like little men in a sandy waste. They were handsome snow-white plants with black areoles. By an old mine we found Copiapoa longistaminaea and C.grandiflora, and then further northwards Thelocephala esmeraldana.”
.....from F.Ritter, Kakteen in Sud Amerika

Copiapoa esmeraldana spec. nov. Type locality steep coast south of Esmeralda. Discovered in 1969 by A.F.H.Buining and myself, FR 1457.

.....from H.Middleditch

As Ritter evidently only made one field trip in company with Buining, which would be the subject of Buining’s series of articles in Succulenta, it would appear that the above extract does indeed refer to this particular discovery. The “old mine” referred to by Buining may possibly have been Mina Esmeraldana.

....from F.Larsen

The picture which accompanies that article by Buining and which was probably taken near Las Lomitas, is what I would take to be Copiapoa esmeraldana.

.....from F.Vandenbroeck

This extract from the article by Buining in Succulenta describes his visit to an area which in all likelihood is Las Lomitas. However, I am now becoming more and more convinced that the small Copiapoa that I saw at Las Lomitas are probably C.hypogaea. But it remains vague and uncertain what the differences are between C.hypogaea and C. esmeraldana.

.....from H. Middleditch

In his Volume 3 of his “Kakteen in Sud Amerika” book, Ritter includes one picture – Abb.978 – (of rather poor quality) of his FR 1457 Copiapoa esmeraldana. This appears to be a plant in cultivation and is roughly globular. The ribs are vertical, protruding, clearly defined, with more or less triangular shaped tubercles. The areoles do not appear to be quite on the crown of the tubercles, but on the lower side of the crowns so that on the upper part of the body they face sideways and even at about half-height on the body they face slightly downwards. Are there any provenanced plants with this name in cultivation and do they display these features?

.....from M.Giani

I have five plants of C.esmeraldana which were grown from seed bought in 1988 from Christa’s Cactus, also one grown by A.Benzoni from seed which he collected in 1995 on a field trip in company with W.Maechler, some now being taller than broad, which all have a green body and look very similar to that in the Ritter Abb.978 picture. Yes indeed, they do display the ribs with protruding tubercles and downward facing areoles as in that picture. I have also been given a plant of FR 1457 which also has a green body.

.....from H.Middleditch

Looking at the four pictures of his FR 261 C.hypogaea in Ritter’s Kakteen in Sud Amerika, the two upper pictures in particular tend to give the impression that the epidermis on those plants does not have a smooth surface, but consists of numerous tiny wrinkles. This can also be seen in the plant illustrated in the Schulz 2006 Copiapoa book at bottom right of page 115 (not p.117 per the text). The plant with a green epidermis that is pictured bottom right on his page 114, on the other hand, does not seem to give quite the same impression of the wrinkled nature of the surface.

.....from F.Larsen

Looking at the pictures under the hypogaea section in the Schulz 2006 Copiapoa book, the plant in the picture in the lower right hand corner of his page 114 is a more olive-green colour, just like my own plants of C.esmeraldana grown from my ex-habitat specimen. So I think that the plant in that particular Schulz picture is in fact a Copiapoa esmeraldana.

.....from M.Giani

In my opinion there is indeed a difference in the epidermis, which is green and smooth for C.esmeraldana but brownish and rough for C.hypogaea – it can be described as like lizard skin. Even the plant in cultivation illustrated in Ritters’ Fig.212 displays the wrinkled epidermis, even on a swollen plant. The epidermis of C.esmeraldana is always without any of these wrinkles. My own idea is that the plant with the green epidermis on page 114 of the Schulz 2006 Copiapoa book represents a healthy growing plant of C.esmeraldana, with evident ribs.

.....from F.Vandenbroeck

The wrinkled nature of the epidermis was indeed visible on these small Copiapoa which I came across near Las Lomitas and I would also agree that this wrinkled nature of the epidermis is quite evident in the Ritter pictures of *C.hypogaea*. For some years I have had a plant of this species in cultivation and this feature of the epidermis is quite distinct.

.....from P.Klaasen

Our visit to Chile was in 2003 when we made a stop at Las Lomitas There were *Trichocereus* and *Eulychnia* to be seen around here as well as some low shrubbery and lichen, which all indicated a high air humidity. There were some plants which several members of our group regarded as *C.hypogaea*, some of them 4cm in diameter. One of these plants was dug up, to reveal a massive tap root with a distinct neck. These plants did indeed have spines whitish in colour, but predominantly on the lower areoles. However, to my eyes these plants did not have the deep brown colour and rugose epidermis that can be seen on *C.hypogaea* in cultivation.

At the ranger station at Las Lomitas we found how to take the track that runs along the edge of the cliff. There were sixteen people in five cars so we all took it in turn to walk for one km along the cliff edge, at arm's length apart, and then back along the other side of the track, to our vehicle. We did find just the one Copiapoa which was in flower, the body completely covered in grit, and that was in a small population of about a dozen plants, which we would never have found without seeing the one flower. This was the only population that we found. Just over the edge of the cliff we also found a *C.grandiflora*.

.....from H.Middleditch

The original description of *C.esmeraldana* spec. nov. in Ritter's *Kakteen in Sud Amerika* Vol.3, states that this plant has a robust root without any narrow neck between the root and the body, whilst for *C.hypogaea* (in the same book) he observes that it does have a narrow neck between the body and the rootstock. He uses the words "stark wurzelrube" for the root on *esmeraldana* and "reisiger Rubenwurzel" for *hypogaea*, but I am very uncertain as to precisely how these should be translated. In the Schulz 2006 Copiapoa book, there is a picture of what is stated to be a *C.hypogaea* which has been dug up, but it is very difficult to see if it does, or does not, have any narrow neck between the body and the more or less cylindrical shaped root.

.....from M.Giani

Unfortunately my seedlings are too young and too small to rely upon them for the shape of the roots, and my adult plants have not been repotted for some years now. However, from both memory and an examination of the roots on some young plants, I would be inclined to say that *esmeraldana* has longer, thinner roots and fatter and shorter for *hypogaea*. But neither of them have a narrow neck between the root and the body.

.....from F.Larsen

The plant which I brought back with me from near Las Lomitas was laid on the ground and a picture taken of it where we found it. The root itself is really quite large, the carrot shaped portion being about 16cm long and above 6cm wide at the thickest part, above which there is a narrow neck, above that there is a quite small overground body. The original head must have been eaten off by the Guanaco but just enough has evidently been left for it to produce a new offset – the root itself would not generate a new head. In cultivation this plant has settled down and produced three new green heads, the largest of which is distinctly taller than wide. It certainly does not have the brownish wrinkled epidermis that is associated with *C.hypogaea*.

.....from P.Hoxey

At no great distance inland from the Rangers hut at Las Lomitas we stopped to search for Copiapoa. We did manage to find a few specimens of *Copiapoa esmeraldana* which had not been damaged by the guanacos, and we excavated one of these to show the large taproot. There was no real neck between the body and the root but only a small constriction where they joined together.

.....from H.Middleditch

The original Ritter description of *C.esmeraldana* states quite clearly that this species has a greenish body and no neck between the taproot and the body, which is in line with the plant excavated by P.Hoxey. But the *C.esmeraldana* plant dug up in habitat and photographed by F.Larsen does have a narrow neck between the root and the aerial body and also produces new heads with a green epidermis. How can this

difference in the presence or absence of a neck, between the Ritter description and the plant unearthed by F.Larsen, be explained?

.....from F.Larsen

The attachment to the root to the neck may not be a typical feature of *C.esmeraldana* as it may vary according to the habitat conditions. When I repot my *Neoporteriae* I find that the roots can vary a lot even within the same species. There are plants with carrot like roots and others with fibrous roots, all of the same species!

.....from I.Crook

I believe that roots may vary in accordance with the environment in which the plants grow in habitat, but that does not explain why, in cultivation, both fibrous and tap-rooted specimens of the same species occur.

.....from H.Middleditch

Bearing in mind both the deserted nature of their surroundings and the need to reach a night stop in daylight, it would be somewhat surprising if Buining and Ritter occupied any time in digging up several of these small *Copiapoas* growing more or less level with the ground in order to check the presence of a neck between the root and the aerial body – quite possibly it may have been just the one plant – which happened to lack a narrowed neck. It appears that other plants of *C.esmeraldana* do indeed display such a neck.

.....from M.Giani

All the plants that I am growing as *C.esmeraldana* are kept in deep pots because they have a robust elongated root, which would otherwise wind round within the bottom of the pot or come out from the drain hole. I prefer to use earthenware pots for older plants, large enough for them to occupy for many years, while for younger plants I use plastic pots of a deeper than usual height, as these are more practical for repotting.

For many years I watered all my plants between early spring and mid autumn, during their growing and flowering season. However, many of my *Copiapoa* died off after being watered in this way, especially *C.solaris*, *haseltoniana*, *columna-alba*, and others. I could never afford to grow plants of *C.solaris* and *C.serpentsulcata* on their own roots. Many of my 3 to 4 year old seedlings of *Copiapoa* died off some seven days after watering – they would first exude a drop of water at the top and then turn soggy and rot, especially on hot days when the sun heats up the pots. On days without wind, and the door open, the temperature in my greenhouse can rise to above 40°C despite the shading that I use. Then I found out that in coastal Chile it is dry in the warm season and it is during the cold season that it rains. So I changed to my present watering regime for my *Copiapoas*, giving them water between autumn and spring. During that period the temperature in my greenhouse here in Italy does not fall below 3°C and over winter there is some growth and some flowering on my *Copiapoas*. Now these plants tend to grow flatter and wider rather than tall and none of them have died off when using my new watering regime for them.

My *C.esmeraldana* WM 127, grown from the ex-Berzoni seed, had been grafted on a *Hylocereus* stock, but I rerooted it and initially it was growing columnar, but now with my new watering regime it is growing larger and flat. The epidermis is green, smooth, and glossy and slightly waxy and it is now producing offsets. The body of this plant and also the size and shape of the flower is similar to my FR 1457 *C.esmeraldana*.

.....from F.Larsen

The flower on *C.grandiflora* can live up to its name the flower is huge – it will be about 6 to 7cm in diameter and my own plants of this species in cultivation produce flowers of this sort of size. It is one of the largest flowers that I have seen on a *Copiapoa*.

.....from M.Giani

My plants of *C.esmeraldana* have flowers of up to 6cm in diameter and from that I can understand the name *grandiflora* ssp. *Ritteri* being given to it by Doweld.

.....from H.Middleditch

Does this mean that here is little degree of difference between the flowers on *C.esmeraldana* and those on *C.grandiflora*? Or not?

.....from M.Giani

To me, the flowers on *C.esmeraldana* are similar to those on *C.grandiflora* not just for their size but also because the petals are like a wheel and of a pale yellow colour, sometimes a little twisted or crumpled

when fully open. By comparison the flowers on *C.hypogaea* are about 25 to 30mm across when fully open, a more deep yellow, with long narrow linear petals which are recurved downward when fully open, touching the plant body, and have a thin pistil.

.....from H.Middleditch

In his description of these two species in Kakteen in Sud Amerika, Ritter does not appear to give a flower size for *C.grandiflora*, but for “one flower” on *C.esmeraldana* he gives 4cm wide as the flower size.

.....from R.Schulz

What I call the classic *C.grandiflora* is found in the lower Guanillos and Esmeralda valleys and is the one most visitors would see. As one climbs in altitude the plants become smaller and spiner but this occurs as a gradual transition. The odd long spined small bodied Copiapoa up near Las Lomitas is a mystery to me but it may indeed be a high altitude form of *C.grandiflora*. It appears that the size of flower on *C.grandiflora* is very dependent on the health of the individual plant, the availability of water, as well as the time of flowering.

.....from F.Larsen

Of the small Copiapoa which I saw at Las Lomitas, at one spot I found several small heads which had quite strong spines, which were growing in a line in a narrow gap in otherwise solid rock. At the time I thought that they were just *C.esmeraldana* with longer spines but of course I now realise that they were *C.grandiflora*.

.....from H.Middleditch

In the picture in Succulenta of the original FR 1457 *C.esmeraldana* taken by Buining, there are two very flat heads which do not appear to display any spines. They are surrounded by what looks like a very shallow depression, as if a shallow layer of the surface grit had been removed from immediately round the sides of the plant, leaving the flat heads of the plant more or less level with the surface of the wider surrounding ground. There have been several observations from those who have visited this part of Chile that at several places the only way of finding these plants is was by running an open hand over the surface of the ground until it met with the tops of some spines which were just projecting above the surface of the ground. Or sometimes an open flower projecting above the surface of the ground was all that gave away the presence of these plants. This might suggest that Ritter had to remove the thin layer of grit covering his FR 1457 to enable Buining to take his picture of this plant. Would this suggest that where the body of a *C.esmeraldana* is exposed above the surface of the ground, that it may display a more obvious spination?

.....from R.Ferryman

My experience of seeing *C.esmeraldana* in habitat is of a plant growing flat to the ground, but sometimes slightly above the ground, or in rocky areas where it will have small spines showing. I would be confident in saying that *C.esmeraldana* can be seen with or without spines.

.....from A.Delladdio

Of the two plants of the small Copiapoa that we saw growing in the narrow gaps between the flat slabs of rock, near Las Lomitas, the heads with the fairly strong spines are quite probably *C.grandiflora*, and as the other plant does have a somewhat dark greenish coloured epidermis and a rather weaker spination, I would think that it could well be *C.esmeraldana*.

.....from F.Larsen

Looking at these two pictures taken by A.Delladdio, the less spiny plants are definitely *C.esmeraldana* and the more spiny heads in the other picture are probably *C.grandiflora* – the spines are rather like those that I have seen on other plants of *C.grandiflora* in habitat.

.....from M.Giani

At Las Lomitas I did not see any plants that I would consider to be similar to *C.grandiflora*. Nor did I expect to see any at that high altitude near the coastal cliff because I only expect them to grow at a lower altitude. Of the two pictures taken by A.Delladdio, I would think that the less spiny plant is *C.esmeraldana* but the one with the longer spines is an *Eriosyce*, possibly *E.taltalensis*.

.....from H.Middleditch

In view of the observation from R.Schulz that he found these small Copiapoa growing near Las Lomitas “a bit of a confusion” it is hardly surprising that he does not include a section for *C.esmeraldana* in his 2006 Copiapoa book. But at least the foregoing commentaries may cast a little light on the ways and means of distinguishing the various small cacti to be found growing there. Although it now appears that

there are questions surrounding the occurrence or otherwise of *C.grandiflora* at that altitude.

FINDING REBUTIA AROUND ABRA CONDOR

From T.Marshall

During one of our field trips to Bolivia, we had an overnight stop in Tarija and from there we set off along the road going towards Abra Condor. Near Tarija we saw some *Cleistocactus* on a hillside but they did not look to us like *C.strausii*. The road then ran for a very considerable distance across a fairly open countryside. We knew that several seasonal rivers ran across this area but they were still dry river beds at this November time of year. We could not see any of them as they had cut steep sided valleys some 10 to 15 feet deep into what was a sort of sandy sedimentary ground. Further along this road we could see occasional patches of *Cleistocactus*, but only in small numbers and again they did not look like *Cleistocactus strausii*.

On the approach to Juncanas we had reached the lower slopes of the mountains and we could now see some rocky outcrops not far from the road. It was here that we found some *Rebutia heliosa* which were growing in company with *Lobivia cardenasiana* and *L.tiegeliana*. When we did reach Abra Condor, there were rocky mountain slopes at either side of the road. Here again we found *R.heliosa* together with both the same species of *Lobivia*. We also saw a *Rebutia* which looked like a hybrid form of *R.heliosa*.

On the descent to the east side of the Abra Condor we were not far off Narvaez when we came into a steep sided ravine which we followed for at least 2km. It was along this ravine that we saw the first *Cleistocactus strausii* on this side of the pass, so we stopped in order to take a closer look at them. There must have been a few hundred of these *Cleistocacti* growing on the steep rocky sides of this ravine. There was very little water in the river here at this time of year so it was not too difficult to cross, although even then it would be about a foot deep. We found that the rocky side of the ravine was too steep to climb but the *Cleistocactus* managed to survive on it, although we could not get close to them.

We found quite a lot of moss growing on that rock face, probably supported by the humidity from the waters of the river, as well as by the cushions of a hardy bromeliad – an *abromeitiella* – which we had already seen at the Abra Condor. It was on this rock face that we found some *Rebutia* growing among the moss in considerable numbers.

Three years after our first visit to the Abra Condor we went back there in order to spend more time in this particular area. There is a pipeline which crosses the Cordillera from east to west that runs not far from the Abra Condor and there are various tracks leading to this pipeline from the road that runs over the pass from Juncanas to Narvaez. We were now able to follow a number of these tracks when we would not infrequently make a stop at one spot to look round, then drive on a further 100m or so and stop again to take another look round. At almost all of these stops along these tracks we did come across *Rebutia heliosa*. But from one stop to another they did not look identical, presenting some differences in their appearance, so that they evidently existed in many different forms.

....from W.Rausch. *Succulenta* 52.5.1973

With my friend Hugo I was driven for about 30km from Tarija to where the hilly landscape was overgrown with solitary sorts of cacti such as *Echinopsis* and *Opuntia*. In rocky places the snow-white *Cleistocactus* grew, as well as some hardy, thorny bushes. At a dried up stream we found a tree that gave some shade and there we made a halt. The selected spot was rather disappointing for me; everything was bare and stony with a little grass and small thorny bushes.

After having refreshments I set out disconsolately to look round, with my little pickaxe, rucksack, and camera equipment. Nothing but grass and stones – more grass and stones – until all at once there stood groups of *Lobivia tiegeliana* var.*distefanoiana*, followed once again by miserable bushes. Walking on still further I saw all at once a small white stone lying there. Involuntarily I walked down to it and on viewing it at close quarters it proved to be a small cactus. One rarely comes across a small plant with such a habit in the *Mammillarias*, really densely covered with very small white spines. Having found this solitary specimen, you know from experience that there should be still many more, consequently I crawled along the mountainside on all fours, nervous and overjoyed, ferreting as it were after the probably most handsome little *Rebutia* that I had ever collected.

Later the little plants bore 5 to 5.5cm long flowers with long, stalk-like, graceful flower tubes that

threaten to break off with the smallest breath of wind. The pericarpel is furnished with white hairs and bristles, whereby it belongs to the *Aylostera* group. This so outstandingly beautiful plant I have described in K.u.a.S. 1970 page 30, as *Aylostera heliosa*. They grow well grafted as well as on their own roots, readily making offsets, so that before long they will be found growing that way like a sunny (*heliosa*) little gem in the collections of many cactophiles.

....from K.Preston-Maffham.

Near Tarija we came across *Cleistocactus strigosus* in very typical clay hills which are similar to those outside La Paz, but at a much lower altitude. They were quite small plants – only 1.5m high – and almost no fruit or flowers were to be seen on them. But there were *Echinopsis mamillosa* to be seen in flower.

I had been told that I could find forms of *Rebutia heliosa* by taking a truck going to Narvaez and getting off when I saw *Cleistocactus strausii*. Now there were a few places where *C. strausii* was to be seen so I was told to get off at where the *strausii* were growing on a cliff near a stream, where the ledges at the top of the cliff carry *Rebutia*. This could be only a couple of miles from the famous Type locality for *Cleistocactus strausii* right by the road.

There were *heliosa* forms (or *albopectinata* v. *condorensis*) at the Narvaez pass. They were the only *Rebutia* that I saw that habitually grows in the open and in full sun – all the others grew in deep shade where it is often damp and often with water running down the rock face. Hence the dense spination. The *R. heliosa* were very hard to find – the single headed plants scattered at about two to three yard intervals. Only about 20 plants were found.

Echinopsis cardenasiana also grows here, the smaller member of the *obrepanda* group, on which there were both red and magenta flowers to be seen. The *heliosa* grew in cracks in the rocks. The petals are extremely obtuse and or extremely spathulate. So their shape is irrelevant for identification. Some have much longer and much more pointed petals.

....from R.Martin

In 1999, when we were travelling across the Condor pass towards Narvaez, we were quite close to the highest point on the road where there was a relatively flat stony area pretty well devoid of vegetation. Sticking out of this stony ground were some low rocks, which looked like they could provide the kind of shelter and shade appreciated by small cacti. We stopped and looked around, and sure enough, in amongst the rocks we found a dark bodied form of *Rebutia heliosa* v. *condorensis*, with quite a few plants spread out over several metres of the rather linear rock formation. These plants were uniformly single headed, and no more than 1cm or so across, rather wider than tall. Earlier on, we had seen a form of *R. heliosa* with a rather paler body, and orange areoles – the darker bodied plant had rather browner areoles.

Much further on towards Narvaez, having gone past some rather lush and green spots with other *Rebutias*, we came to a part of the valley where there was a small stream a few metres below the road, on the left hand side,, with a promising looking steep hillside on the opposite side of the stream. This hillside was rocky in parts, but also had a good covering of soil, with patches of grass and other small plants. In the stream itself was a huge plant of *Gunnera*, and to my surprise, just a couple of metres above, was another form of *R. heliosa* v. *condorensis*. I would never have imagined such dissimilar plants could grow naturally in such close proximity. This form of *R. heliosa* v. *condorensis* has a pale body and yellowish spines with orange areoles, but the most unusual feature was its yellow flower, the outer petals being almost green. I am sure of this flower colour, even though it was late in the day and the sun was setting; some flowers were still open. I was very excited about this, as all forms of *R. heliosa* in cultivation have either orange flowers (maybe with purple outer petals) or red flowers, as far as I am aware. Unfortunately, in cultivation, it turns out that this discovery has rather more orange flowers than in habitat. Maybe this change is due to a temperature effect, or to light levels.

Elsewhere we had also stopped to look for the type form of *R. heliosa*, having been given a GPS locality for it, but it was quite clear that the current road did not get to within more than 3 or 4km of the GPS reading; it appeared that a new road had been built, and while we could see the remains of a track leading towards the GPS reading, it was far too strewn with large boulders to drive along it. We walked along the track, but unfortunately it got dark by the time we were even moderately close to the given coordinates, so we disappointedly had to call off our search.

.....from T.Blaczkowski

Travelling along the road which goes from Villa Montes to Tarija, we had not gone as far as Narvaez when *Rebutia fiebrigii* was found at 2393m near Tambo and there was also *R.heliosa* to be seen at the same place.

.....from R.Hillmann.

Rebutia heliosa has also been found growing in the Abra Condor, at up to 3000m altitude. I have also come across this plant growing at just over 2000m altitude both at near Yesera and Alto Cajas, to the north of Abra Condor, where the river valleys run down to the Rio Pilaya. At Juncanas, the form of *R.heliosa* looks like the original plants of this species introduced by W.Rausch. There is a quite separate population of *R.heliosa* to be found at various places in the Culpina basin.

....from J.Carr,

When we were travelling along the road from Villa Montes heading in the direction of Tarija, we had not got as far as the Condor pass when we made a stop some 15km to the west of Narvaez. Here the road was running alongside the river, with steep rocky slopes at either side. There were *Cleistocacti* growing here and there on the lower slopes and we found some *Rebutia fiebrigii* growing on the rocky strata. Just above a group of *R.fiebrigii* there were some more *Rebutia* to be seen and a few of these came back home with us. They looked very similar to the rest of the *R.fiebrigii* to be seen there, but now that they are established in cultivation and are growing well, they look like different sorts, none of them *R.fiebrigii*.

One of these might be a form of *R.steinmannii*. A second form with long tubed flowers might have some affinity with *R.heliosa*, but even this does not seem to be quite right. The third form is much more slow growing and has not so far produced any offsets. It also has a flower with a shorter tube.

.....from R.Martin

I have perhaps as many as twenty distinct forms of *Rebutia heliosa* and var. *cajasensis*. It is clearly nonsense to single out three of these forms as being worthy of individual names. There are various geographic populations, one on each hill, separated by habitats unsuitable for their survival. In consequence, each population has its own slightly different gene pool, producing plants that look different from those in other spots. However, given a chance, they can all interbreed. If you are a botanist, then maybe you want just the one name in order to emphasise the similarity – but if you are a gardener then each form needs a name.

In regard to *R.heliosa* v. *theresae*, I am convinced that this is a natural hybrid between *R.heliosa* and *R.spegazzinii* – or, alternatively that these two names are the extreme forms of one and the same species. The reason that I am led to this idea is because I once sowed some seed – clearly wrongly named as *R.fiebrigii* Br. & Rose - and what came up were plants which, at the extremes, would have readily passed as these two named species, whilst the intermediates had every appearance of *R.heliosa* v. *theresae*.

.....from I.Crook

I have been dissecting *Rebutia* flowers for some years, starting with flowers on *R.heliosa*. I wanted to see if the differently described subspecies could be distinguished as separate taxa on the basis of floral morphology. I have examined the flowers on several plants with JDD, BLMT, TM, and GC labels. At first, I noted that there was some random differences between flowers in respect of the length of the stigma compared with the lengths of the stamens. Now, I think that the differences are due to the age of the flower. Young flowers seem to have anthers slightly shorter than the stigma whilst in other flowers they extend beyond the stigma.

I have noted short and long receptacle tubes on different strains of *heliosa* flowers and the length of the longest receptacle tube is about twice the length of the shortest, in my plants. But so far I have noticed a reliable difference between different subspecies of *R.heliosa*. My *R.heliosa* WR 314 and all my JDD and BLMT *heliosa* v. *condorensis* have flowers that arise from the upper surface of the areole, but initially only from areoles near to the base of the plant. A second ring of flowers may arise a little later from areoles about half way up the body of the plant when the first flowers are beginning to fade. With *R.heliosa* v. *cajasensis* the flowers initially arise from areoles about half way up the body of the plant.

.....from H.Middleditch

And are any of these variations which have been observed in flowers on *R.heliosa* also to be found between those of *R.fiebrigii* which appeared to be of solely that species when they were all collected at the one spot but now give the impression of being *R.heliosa*-like plants, or *steinmannii*-like in their appearance?

And do any such similar differences appear between the flowers identified on plants acquired as either *R.steinmannii*, *fibrigii*, or *heliosa*?

FINDING SOME ELONGATED GYMNOCALYCIUMS From F.Vandenbroeck

With the exception of *Gymnocalycium schickendantzii*, it is rather uncommon for most *Gymnocalycium* species to grow taller than wide. Rather exceptionally, however, examples of other species may be found growing in a somewhat similar manner. In my opinion, columnar growth with *Gymnocalycium* is a sign of extreme old age.

During our visit to Bolivia in July and August of 1988 our route took us through part of the Bolivian Chaco which rather amazed me as it differed considerably from the Paraguayan Chaco. The type of vegetation is very similar but the landscape is different – you never really get the flat country as the last low outlying parts of the Andes keep stretching out into the plain and strongly define the landscape, whilst in Paraguay the Chaco is as flat as a pancake. Between Camiri and Boyuibe we saw lots of bottle trees, which were leafless and most of their big globular fruits had burst open and displayed conspicuous white woolly balls. In this area the *Gymnocalycium pflanzii* were numerous.

Coming down from the Andes, we met the first specimen of this *Gymnocalycium* near Lagunillas, which lies in the transition zone between the humid forests of the higher altitudes and the dryer Chaco region. Here, the plants of *G.pflanzii* tend to remain rather small and somewhat openly spined. But to the east of La Cuevo we saw plants of a considerable size – up to 40 or 50cm tall, which were reminiscent of the *G.saglioniis*. The area around Camiri and Cuevo is rather more Chaco-like, rather dry and sandy, with lots of bushes, smaller trees, *Eriocereus*, *Platyopuntia*, *Castellanosia*, and bottle trees. But the landscape is undulating as it is not far from the Andes. Also near Cuevo we found *G.megatae* which is rather sparse hereabouts, where it grows in flat sandy soil. Between Villa Montes and as far as past Palos Blancos, *G.pflanzii* is very numerous, where clumping plants were occasionally to be seen.

In the northern part of the Paraguayan Chaco, *G.pflanzii* can be found growing in large numbers. We found the first plants at about 25km to the south of Fortin Teniente Agrippino Encisco, a military post situated on the main route through the Chaco. Around this post there is a natural reserve in which *G.pflanzii* abounds, together with forms of *G.friedrichii* and typical Chaco plants such as *Eriocereus*, *Stetsonia*, *Piptanthocereus*, and *Cleistocactus*. The *G.pflanzii* are to be found growing in very dense thornbush in company with lots of terrestrial bromeliads, and they must be pretty well in the shade in the rainy season. The *G.pflanzii* to be seen here are not as distinctly elongated and are more openly spined than those seen in the Bolivian Chaco near Cuevo.

On another occasion we were travelling in western Argentina from Hualfin up the broad open valley of the Rio Belen, going towards Belen, with the low, sloping, and gently undulating hillsides, which were mostly bare sandy and stony ground, with scattered thorny bushes, mostly about one metre tall. There were also scattered large clumps of ichu grasses, herbs, and bromeliads. This vegetation usually had a weathered appearance and is probably only greenish for a short period after the spring rainfall. On the occasion of one of our visits here, it was chokingly hot and most of the vegetation looked dead because of the severe drought.

We were able to see occasional tall *Trichocereus terscheckii* on the lower hillsides and over the hill slopes, We also found *Lobivia huascha*, *Echinopsis leucantha*, *Trichocereus strigosus*, and *Opuntia microdisca*. It was in the wide valley where there were quite a number of *Gymnocalycium pugionacanthum* to be found, commonly growing at the foot of the bushes, where the germination conditions are probably more favourable, with more moisture and less direct sunlight. Some of these *Gymnos* were growing in a columnar manner, one of them that I saw being about 20cm tall.

Nearer to the town of Belen, the valley gets very narrow and becomes a really deep quebrada, but I did not see any *Gymnocalycium* growing there. Here, the much more rocky ledges were mainly occupied by *Parodia microsperma*.

.....from M. Kirka

On an occasion when we were travelling along the Quebrada Humahuaca we made a stop where we had hoped to find some *Lobivia*, such as *L.jajoiana* or *L.rebutiodes*, but instead we found *Parodia tilcarensis* and *Gymnocalycium saglioniis*. These *Gymnocalycium* were up to 120cm long – not tall, because

these long plants were lying on the ground. We were lucky to find an undisturbed piece of ground where there were quite a few of these *Gymnocalycium* of various ages, some small, others ancient, looking like green sausages. They remained upright until they reached a height of about of about double their diameter and then leaned to one side. In my opinion, they were able to grow so large because they grew on the relatively flat ground of the valley bottom, so that they could lie on the ground, whereas on steep slopes they become uprooted by their own weight before growing really large.

....from R.Stanik

In the course of our visit to northern Argentina, we were travelling along the Quebrada Humahuaca where friends at home had told us that we would be able to see *Parodia tilcarensis* and *Gymnocalycium tilcarensis*, near Tilcara. With the wide Rio Grande on the other side of the road, we stopped where *Trichocereus*, *Lobivia ferox*, and *Gymno. tilcarensis* could be seen from the car, growing quite close to the road – but not the *Parodia*. The *Gymnocalycium* were growing on flat stony ground, fully exposed to the sun, as here was very little accompanying vegetation, just a few low growing bushes which might have been one or two metres high. The *Trichocereus* here were mostly covered by dense lichen and moss. The plants of *G.tilcarensis* were decidedly plentiful – most of these plants were a globular form but there were some of these plants that were growing taller than wide – a few of them up to almost half a metre tall. Quite a number of these tall ones had fallen over and lay on their sides.

.....from F.Vandenbroeck

I was able to observe plants of *G.saglionis* at several places in north-west Argentina, including some in the Quebrada Humahuaca to the north of Tilcara. The valley floor here was almost a kilometre wide and almost level, between rocky slopes at either side, on which numerous tall *Trichocereus pasacana* grew. None of these *Trichocereus* grew on the floor of the valley, which is covered with broken stones and large rocks, where small bushes grew of up to about a metre in height, some solitary but mostly in small groups, sparsely so that most of the ground was only bare stones with a few herbs. It was on the floor of the valley where we saw a few *G.saglionis*, of all sizes, including the tallest one that I came across in the course of my visits to Argentina. This was a plant of about one metre tall and more or less 40cm. wide, growing between some large rocks and partially surrounded by some low bushes.

In the course of our visit to Argentina in December of 1991, we set off from Cafayate going south along the long and broad valley of the Rio Santa Maria. Having passed the village of Colalao del Valle a violent thunderstorm with heavy rains came over us. In our experience these storms are usually very local, so we wanted to get out of it as quickly as possible, so we chose to continue to drive on. However, to the south of Colalao we came into a zone where river beds had to be crossed. These river beds are usually dry, but now with the heavy rains they were quickly being filled with fast flowing water. Crossing one of these river beds we must have hit upon some submerged boulders so that we remained stuck in the river bed. We had to abandon our car altogether in order to escape from the fast rising water. From the shore, in the pouring rain, we anxiously watched the car moving slowly under the pressure of the water but it finally came to a stop, with water up to the bottom of the windows. After about an hour or so, the river bed was dry again and the car was covered with layers of mud. The youth of the village, attracted by the scene, came to look at the disaster and wanted to help us. And very fortunately a travelling mechanic also stopped to help. With united forces the car was dragged out of the mud, after which the mechanic towed us to the camping site of Santa Maria where we stayed for two days whilst we had the car repaired.

....from H.Middleditch

Looking at my Argentine Automobile Club maps covering the valley of the Rio Santa Maria, they show this river running from Cafayate roughly north to south from Salta province, through Tucuman province, into province Catamarca. There are only a few village names along its length. This valley is separated from the foothills of the Andes by the high mountain ridge of the Cumbres Calchaquie (Chileans Map Compendium p.12) which is over four thousand metres in height in places, but evidently this does not keep out occasional heavy rainfalls.

.....from F.Vandenbroeck

On an earlier visit to this valley in 1985, we made stops at regular intervals when we made trips on foot up the slopes, into the lateral valleys, or on the alluvial flatlands, in the hope of finding some interesting plants. This is how we found the larger specimens of *G.saglionis*. The nature of the surroundings in this part of the valley is extremely variegated: it can vary from bushy slopes with fairly high trees, to more arid open

spaces, at times interspersed with agricultural areas – mainly vineyards. This region displays one of the most fascinating landscapes that I ever saw in Argentina. Beautiful rock formations in different colours and in endless variety are constantly to be seen. The oases with their little villages are very picturesque with their small adobe farms, and penthouses with ovens in front. Narrow lateral valleys are not uncommon. In one of such valleys we hit upon a beautiful population of *Parodia penicillata*. Near Quilmes there were all sizes of *Gymnocalycium saglionis* to be seen. Also *G.spegazzinii*, *Echinopsis leucantha*, *Echinopsis thionantha*, *Cereus aethiops* and *Opuntia weberi* can easily be found, growing interspersed among each other on sandy or more stony ground.

.....from M.Kurka

In 2012 we were in Argentina near Cafayate, from where we set off in the direction of Salta, going along the Quebrada Cafayate. The whole of this quebrada is formed of soft sandstone with low cliffs at either side of the valley floor. Shortly before the upper end of the quebrada, just south of Punilla, we stopped where there was a place to park and access to the surroundings. The low cliffs were just next to the road at one side and several hundred metres away at the other side, with flat ground in between. There was almost no grass to be seen, but other cacti growing here were *Opuntia sulphurea*, abundant *Echinopsis leucantha*, a low thin crawling *Trichocereus* – possibly *T.huascha* – a few *Trichocereus pasacana*, several *Parodias* with yellow flowers - possibly *mercedesiana*, and a few *Acanthocalycium thionanthum*. It was on this flat ground that we found *G.spegazzinii* v. *punillens*, where there was quite a lot of bushy vegetation, mostly *Cercidium* and *Acacia*. These bushes are about man-tall and do not form dense thickets but grow in groups with lots of bare sandy ground between groups. The *Gymnos* were mostly to be found growing under these bushes and most of them were flat with the ground or only 2 or 3cm above the surface of the ground. I suspect that most adult plants grow much taller than wide but most of the plant body will be pulled underground by long contractile roots. It seems to be that the plant body is only well above the surface on stony ground, but the alternative may be that on the sandy ground the sand would be washed away by flash floods, such as those in the extremely wet summer of 2011. I think that this running water might have removed some 20-30cm of sand from around some of these plants and those were the ones that were much taller than wide. The first *Gymnos* that we found were only 20 metres from the road, growing between the low bushes and the tall plants of this *Gymnocalycium* were up to approximately 18cm in diameter and 40cm tall.

.....from M.Meregalli

It is now many years ago that I saw some *G.schickendantzii* growing in the lower part of the region near Marayes, where they were not as common as in other areas. Practically all these plants were growing in a mixed sandy-gritty soil, in level to moderately sloping areas, with sometimes very dense shrubs, occasionally scattered shrubs, but not in grasses or with tall trees. They were inevitably growing in the shade of the shrubs, usually *Larrea*, generally just near the base of the shrubs, Seldom some plants were more exposed, and this occurred after the death of the shrubs. These plants were usually in poor condition, dryer and sometimes reddish and clearly suffering from their situation. Most of the *Gymnos* were of relatively large size to a very large size - there were some young plants, but not many. I saw only one which had fallen down and still happily living, but some other plants of a considerable height, possibly up to about one metre, standing upright below the shrubs

.....from H. Middleditch

In Chileans No.71 there was an article on *G.delaetii* and *G.schickendantzii* in which the differences between these two species were reviewed, following their being put into synonymy by Schumann in 1905. The most obvious feature distinguishing these two species is the form of growth, being applanate for *G.delaetii* and columnar in age in *G.schickendantzii* – as well as other less obvious features where differences do not vary from location to location in habitat.

.....from D.Metzing

It was Backeberg who treated *G.delaetii* as a variety of *schickendantzii*. Everyone else who was not just following Backeberg seems to have treated them as distinct species, including modern authors with the exception of G.Charles, followed by D.Hunt. Continental authors such as M.Meregalli, D.Metzing, and U.Eggl, continue to keep them distinct.

.....from F.Berger

In principle it can be said that *G.delaetii* and *G.schickendantzii* are from two development lines and are types of their own and so have to be regarded as two species. This can be readily seen in the bud development of the two types, with round red buds on *G.delaetii* with scales that are pink to violet, whilst on *G.schickendantzii* the flower buds are pointed and green with pale green edges. Also the round humps on *G.delaetii* are separated from one another whilst with *G.schickendantzii* the humps are connected to each other by the straight ribs. In age, the *G.schickendantzii* are short columnar, whereas *G.delaetii* are applanate. The seeds of *G.delaetii* are more helmet shaped than those of *G.schickendantzii*. The largest plant of *G.delaetii* that I have seen in habitat was near Las Curtiembres, Salta, in 1993, which was 24 cm. in diameter.

.....from M.Kurka

I have seen *G.schickendantzii* in La Rioja province and then, two weeks later, I saw *G.delaetii* in Salta. They are not only distinct morphologically but each species lives in a different environment, too. *Gymno schickendantzii* grows in open, hot dry places whilst *G.delaetii* grows in wooded areas, often in deep shade. I consider them to be two distinct species.

.....from V.Schaedlich

I agree with these comparisons of the features of *G.delaetii* and *G.schickendantzii* and as far as I am concerned they are two well differentiated species.

.....from M.Meregalli

I quite agree that *G.schickendantzii* and *delaetii* can be considered as two different species. They are clearly two distinct taxa and have relatively significant differences.

.....from H.Middleditch

Whilst quite a number of species and varietal names for *Gymnocalycium* have appeared in print in recent years, in particular in the Austrian *Gymnocalycium* publication, many of them appear to hardly justify being regarded as species in their own right and quiet a few of these names have been relegated to status of subspecies or synonymy in the Charles' *Gymnocalycium* book. But it would appear that most authors would still put *G.delaetii* and *G.schickendantzii* as separate species, which is hardly surprising since they differ to a greater degree than many between many other pairs of species of this genus.

FINDING SULCOREBUTIAS IN HABITAT.

From W.Gertel

I will try to describe some of the sites where *Sulcorebutia* are to be found growing. It is not possible to describe "the" *Sulcorebutia* habitat because each site is different from the others. However, there are some features which are to be found in almost all *Sulcorebutia* locations. Most of these plants grow on hills, more or less up on the top, but others like *S.frankiana* grow lower down on the slopes – but I have not seen a single *Sulcorebutia* site without a lot of rocks. Many *Sulcorebutia* grow in cracks in rocks where nothing else would be able to survive. So this seems to be essential – hills with more or less loose rock of all sizes. The other important thing is the absence of higher trees and bushes. For example, the place where *S.tiraquensis* grows. From the road one has to cross a slowly ascending area covered with bushes and small trees. The branches of these trees and bushes are covered with moss because there is a lot of humidity in the air and also fog coming up from the lowlands. In these surroundings you will not find a single *Sulcorebutia*, but just a few metres ahead the landscape starts to ascend more steeply. The presence of trees and bushes stops abruptly and there only remains grasses, herbs, and some very low shrubs, as well as some rocks covered with lichen – as well as the *S.tiraquensis*. So *S.tiraquensis* grows in a comparatively moist spot. There is a lot of moss between the grass and also around this cactus. The *S.tiraquensis* grows well above ground, whilst *S.steinbachii* – a very closely related species - grows more or less level with the surface of the ground, in a much drier area without trees and bushes nearby, but also in company with hardy grasses. This *S.tiraquensis* looks like a cactus grown in a greenhouse, whereas *S.steinbachii* often makes flat groups at ground level.

Another example is *S.pampagrlandensis* which grows on very sparse ground where there is hardly any other vegetation around, except for some grasses and also what I think is some kind of lichen. Another *Sulcorebutia* site with different surroundings is that of *S.canguerallii* which I found on a mountain close to

Sucre. This mountain is covered with eucalyptus trees from top to bottom. Only the uppermost part of the summit is partly free of trees where there is only a little soil and moss, are some *S.canguerallii* to be found. In the dry period, these *Sulcorebutia* are covered with sand as well as leaves from the trees. At another place where the magenta flowered *S.caniguerallii* grows, there are no trees at all, there is only grass and a few other small plants where there is a little soil, but the *Sulcorebutia* grow in cracks in the rocks. Also in the Sucre area, there is *S.vasquesiana* to be found, growing at the top of a pass between small rocks, together with only sparse low growing grasses and some lichen. Sometimes it is hard to distinguish the small plants from the *S.vasquesiana* with its yellow spines.

An example of a plant growing on the exposed hilltops – at over 3000m altitude – is *S.purpurea*, which can grow to a very large size, and does not withdraw into the ground in the dry season. On the other hand, *S.crispata* and *S.tarvitensis* grow in the rich soil in meadows and in the dry season they withdraw completely underground.

.....from W.Christie

On my first visit to Bolivia I was taken to see some *Sulcorebutia* growing in extremely high and exposed situations – often only at the very tops of hills in the most open locations. We climbed a substantial hill to the Type locality of *S.lanigeri*, but we did not find a single plant on the way up there, although there were hundreds of them at the summit. In October when I was there it was still very cold at times at these high altitudes.

.... from J. de Vries

Sulcorebutia grow mostly on flat hillsides of flat hilltops, up to 3000m altitude. Above that level, *Digitorebutia* appear. Before the last ice age I believe that *Sulcorebutias* were far more widespread and when that Age ended a huge amount of water had to flow away. The landscape would change dramatically, as rivers large and small would appear and radically altered the area where *Sulcorebutias* used to grow. In this way, most of the populations became isolated from one another so that each hill or hillside now has its own form of *Sulcorebutia*. They remain distinct, as pollinators of *Sulcorebutia* do not go from one hillside to another because of the low temperature. A lot of the individual species are not even bigger than about ten square metres and these are the difficult ones to find. Of course, a group of *Sulcorebutia* can be found over a larger area, such as *S.caniguerallii*, with forms such as *frankiana*, *pulchra*, *rauschii*, and *pasorapa*.

.....from G.Rovida

Some *Sulcorebutia* grow in habitats that may reach up to 3500 to 4000m altitude, where the night temperatures may go down to below zero, although plants growing in habitat have their roots protected from the cold by the soil.

.....from J.Carr

The altitude range where *Sulcorebutia* can be found has widened with recent findings so the range of this genus is now between 1200m and 4000m. For those *Sulcorebutia* which grow at the higher altitudes, the temperature will drop below zero at night time but it will heat up quickly during the day. This prevents the body of the plant from freezing. At 4000m regular frosts will occur for around 200 nights per year with figures of around minus five degrees not unusual. These are at their most regular in the dry season but it is not unusual at the start of the wet season.

.....from A.F.H.Buining, *Succulenta* 1975

In the course of travelling through interesting cactus country in Bolivia, in October, we arrived at Cochabamba. Our first trip out of the city was up to 2850m altitude where we came to the growing place of *S.kruegeri*. On the following day we drove out to the north-east, crossing the hill where *Parodia schwebsiana* grew. At about 30km. from the city, at 3700m, we found *Lobivia caespitosa* and forms of *S.steinbachii*. Here again rose the problem whether several species from the same genus can occur together, such as in this spot, or whether the shape and colour of the plants and flowers should be considered as varieties of the self-same sort. Anyway, it was a pleasure to be able to view these plants at their growing place.

Then we drove towards the foot of the giant mountain Tunari, via the indian village of Quillocola. First we saw forms of *Cleistocactus buchtienii*. Suddenly, at 3320m., we stood before groups of *Trichocereus tunariensis* and close beside these plants there were some fine deep-red flowering *Echinopsis* – which Vasquez regarded as a red flowering form of *E.obrepanda*. At 3650m we came across more plants of *T.tunariensis*.

Then we left Cochabamba en route for Santa Cruz, and at only 8km. outside the city at 2610m we found an interesting *Lobivia taratensis*. A splendid Andean landscape then unfurled before our eyes, the mountain slopes initially overgrown with *Cleistocactus*, *Corryocactus*, *Lobivia*, and *Echinopsis obrepanda*. Shortly after the indian village of Tiraque, at 3340m, we saw forms of *Sulco steinbachii*. Passing through Torolapa, we came into the Ayrañi valley at 3500m, where *Trichocereus totorensis* grew and by good fortune we found *Tephrocactus bolivianus* in flower with two sorts of colours. Here, too, *Sulcorebutia polymorpha* grew, well hidden.

.....from R.K.Hughes

It was in 1992 when I went to Bolivia in company with B.Bates and P.Downs. Our first sight of *Sulcorebutia* was on the way to Tarija, a short way beyond the Sama pass. The road was cut out of the hillside with a 3 or 4 foot high bank of rock at one side we stopped at seeing a bright yellow flower atop this solid rock. The hillside seemed to support bunch grass and low alpine plants on a thin layer of soil on top of the bedrock, which could be seen in patches, as well as a scattering of surface rocks. The *Sulcorebutia* were about a centimetre in diameter, embedded level with the surface of the compacted peat-like soil, which were thought to be *S.tarijensis*. Then near Sucre there is a steep hill, the Cerro Churuguilla. Among the litter of the eucalyptus trees that have destroyed it as a cactus habitat we spotted a few *S.caniguerallii*. Then approaching Ravelo we climbed over a low hill, finding some small *Sulcos* wedged in cracks in the bedrock.

Before Los Alamos we stopped on the Cuesta Barranca where it was almost level ground. A rocky area between two fields had a wall of bedrock at its centre, where we found a few tiny *S.vasqueziana* wedged in cracks. Then a short way beyond Villa Serrano there was a rocky hillside with little more than grass. In the dry earth we found some *S.crispata* peeping out, as single heads or as clumps of 2 or 3 heads.

Along the track to Cuesta de Santiago we climbed up a hill where on our right there was a low and almost level mound with much of the bedrock and gravelly ground being covered with by a colourful blanket of lichens and mosses. This was interspersed with low tufts of green or dried up grasses and other alpine herbs. It was among this mosaic of colourful camouflage that we found some *Sulcorebutias*, on an easily climbed hillside dotted with boulders where there were some low shrubs and the usual bunch grass. These were large single headed plants of up to an inch or more across, mostly the soft brown spined forms and fewer yellow spined ones. On the other side of the road it was the reverse, where most plants were multi-headed clumps of smaller head size and with yellow spines.

Then further from Aiquile we found *S.purpurea*, where the hillside gradually levelled out towards the hilltop. Near the road there was a covering of bushes and grasses with some *Echinopsis* among them. Higher up the slope the vegetation became very sparse and low growing, which was where we found the *S.purpurea* (or *S.santiaguensis*) They blended in well with the gravelly soil, their bodies having a purply brown colour despite their large size up to 3.5 inches in diameter. Further along the road from Aiquile, on our right there was a very steep hillside covered in grasses and bushes. It was so dry that only a few dessicated *Echinopsis* were to be seen there although some better ones were found on the flatter top of the hill. On the other side of the road the slope was marginally less steep with a similar vegetation but the bushes there were somewhat taller and greener. It was among the vegetation at the base of the bushes that we found *Sulcorebutias*. Although they were smaller bodied and green coloured compared with those seen at the previous stop, they were considered to be *S.purpurea*. Nearer to Aiquile we climbed a moderately steep hillside strewn with rocks but with very little vegetation to find *S.mentosa*, plants with single heads up to about an inch across.

On the way to Epizana we saw some bright red flowers in a strip of green grass between the road and a massive rock outcrop at the base of the adjacent hillside, which were *Echinopsis obrepanda*. We then took a close look at the wall of rock, most of it seemingly formed of large slabs of rock, most of which were encrusted with a heavy growth of lichens and moss, These made a good camouflage for the *S.tiraquensis*, except where their pink flowers could be seen. Returning to Cochabamba, after we crossed a narrow cultivated alley floor there was an unpromising site, a rocky spur at the foot of a rock-strewn hillside. Plainly the tussock grass and other vegetation had been burnt off. This appears to be the normal practice where farmers do it at the end of the dry season so that when he rains come their animals have nice fresh grass to eat. Most of the *S.steinbachii* there showed various degrees of burn damage. The only undamaged ones were in rock cracks or between rocks where other vegetation had not been able to grow.

.....from G.Rovida

There are many places where *Sulcorebutias* can be found growing where much of the ground has been used for cultivation so that wild plants may only have the rocky parts of land to grow on. Most of the *Sulcorebutia* that I have seen in habitat were growing in rocky ground, which may be more suitable for them as it drains quickly after rains and it also retains some heat during the night. Often they grow with their roots in crevices in the rock where there was only a small amount of soil but where they find enough humidity in the growing season. Mostly they grow in crevices in the rock which, in the absence of shrubs, offer some shade for seedlings to germinate and not be burned by the sun before they develop a dense spination.

But there are no strict rules – some *Sulcorebutia* are to be found growing in more rich and deep soil. Two examples of spp. growing in relatively rich soil are *S.mentosa* at its Type locality near Orkho Abuelo near Aiquile at about 2500m, and *S.crispata* which extends over a very large area at relatively low elevations below 3000m altitude. These two spp. do not have a real taproot which is typical for those spp. which grow on rocky ground. Plants growing in deep soil may reach a larger size, such as the *S.crispata* which is sometimes 5-6cm across, although I have never seen any spp. in habitat with a diameter of 15cm – usually *Sulcorebutia* do not grow to a size of more than 3 to 4cm across in habitat.

.....from W.Gertel

Both *S.crispata* and *S.tarvitaensis* can be found growing in rich soil meadows and in the dry season they withdraw completely underground, even when growing at 3000m with hardly any other accompanying vegetation.

.....from G.Rovida

Most *Sulcorebutia*, when collected in habitat, will be found to have a thickened carrot shaped rootstock, which at the top is about the same diameter as the plant body, but others have a branching tap root, of which each branch may be a different thickness. Plants that grow in rocky ground usually have a single carrot shaped tap root, while a loose soil may favour the formation of several thinner branches, such as those to be found on *S.mentosa*, *S.crispata*, and *S.tiraquensis*. As far as I know, there are no *Sulcorebutia* which grow in habitat with thin, thread-like fibrous roots. There are many places in an area where *Sulcorebutia* can be found growing, where much of the ground may be used for cultivation so that the wild plants may only have the rocky parts of the land to grow on.

.....from W.Gertel

Most *Sulcorebutias* have carrot shaped roots, either solitary or branching, which can differ from plant to plant. Some species have a single tap root when young which branches when they are older. There are some fibrous roots coming from the sides and the end of the tap root which are more numerous on such spp. as *S.tiraquensis* and *S.glomeriseta*, and there are some forms of *S.glomeriseta* which do have only fibrous roots and no taproot at all. But there are no other *Sulcos* with only thin fibrous roots. The seedlings of *S.tiraquensis* do start to grow a very slender taproot but very soon produce only fibrous roots so they are described as having a rudimentary taproot.

.....from J.R.Kirtley

I have grown a *S.cylindrica* which had a large carrot like rootstock, which was connected to the plant body only by a neck of quite thin root.

.....from W.Gertel

The typical root for *S.cylindrica* is a long taproot with a very narrow neck, no thicker than a match, connecting it to the body. But on *S.markusii* there is a similar form of root – but not quite the same. On *S.markusii*, *mentosa*, and *purpurea*, which have a not quite completely conical taproot, they do have strong conical taproots which narrow a bit towards the plant body. We call this a “halsrubenwurzel” which you may say as a “necked tap root”

.....from W.W.Christie

If I have learned anything from my two brief visits to Bolivia, it is that there is no such thing as a “typical” *Sulcorebutia* habitat. That said, they are commonly found in stony ground, although the soil can be quite deep on exposed hillsides. We visited several places where *S.alba* grew on a stony slope whilst *S.frankiana* was on the flat ground at the top and bottom of the same slope. Probably the least typical habitat was at 2550m altitude between Yamparuez and Presto, where we came across a then new and un-named *Sulco* species, now named *S.tarabucoensis* v.*patriciana*. These single headed plants were hard to find,

growing in cracks between rocks and among leaf litter on a hillside covered in low growing shrubs some 1 to 1.5 metre tall. I dug up very few plants in habitat but my impression is that a high proportion of *Sulcorebutia* spp. have tap roots and relatively few have fibrous roots, such as on the *S.tiraquensis* complex. The *S.christiei* which we found just before reaching Ocuri at 3740m altitude, had tap roots going straight down into the soil.

Other plants were growing in cracks in the rocks. As examples, at about 25km from Presto at 2750m, *S.gemmae* was growing in a rocky outcrop at the top of a hill. Similarly, at Estacion Bombeo (a little north of Cochabamba), the *S.verticillacantha* was growing in shallow pockets of soil on top of large rocks, at 3750m altitude. We found a small number of *S.crispata* growing under similar conditions near Nuevo Mundo at 2320m, and the same was true for *S.vasqueziana* v. *chatajillensis* near Chatajilla (near Sucre) and for *S.tiraquensis* v. *longiseta* near Rancho Rancho Zapata, (west of Monte Punco) at 3180m. The *S.langeri* were growing in what appeared to be pure sand, on top of a hill, east of Valle Grande, in what seemed to be large numbers, mostly single headed.

Of the larger growing species, the single heads of about 8cm across of *S.purpurera* at its Type locality at some 10km from Chaguarani at 2960m altitude, were growing on a very exposed hillside among rocks and grass, right at the top of the pass. There were many large plants here, some double-headed, but mostly single. The *S.tiraquensis* v. *mariana* growing at the roadside between Arani and Mizque at 3180m was also up to about 8cm in diameter – in a variety of soil types, some quite deep, others in shallow pockets between the rocks. They were to be seen over a distance of 10km or more along the road – there must have been millions of them. The single headed *S.steinbachii* v. *polymorpha* with heads up to 6cm across, had black spines and was growing in a stretch of flat stony ground about 30m wide, between the road and a tree-lined gorge at 2525m, just east of Karani.

Most of the plants that I saw in habitat were single headed but there were exceptions. Occasionally when there appeared to be clumps, they were actually groups of single headed plants. Between Epizana and Monte Punco, we spotted a spectacular *Trichocereus conacondaensis* in full flower on the side of a steep gorge, close to the road. Also growing here, on the flat ground at the top of the cliff, were large plants of *Echinopsis calorubra*. On the opposite side of the gorge we found *S.tiraquensis* v. *bicolorispina* in flower, growing amongst thick grass. There was a campesino here with a flock of about fifty sheep, who told us that the sheep did not touch the cacti but that the goats had acquired a taste for them and ate them when they were in flower.

On the way from Chaguarani (at about 10km from Aiquile), we stopped to find *S.mentosa* v. *swobodae* with typical yellow spines, growing by the hundreds amongst mosses, along a flat rocky outcrop on top of a low ridge. Across the road, brown spined plants grew on another ridge. These plants were clumping with individual heads of up to 4cm in diameter. All the *Sulcorebutia* that we saw grew in an area where most of the time it was pleasant “shirt-sleeved” weather, but there were times when it was bitterly cold.

.....from W.Gertel

There are many places where *Sulcorebutias* which do not normally offset can be seen to form clumps as a result of the original head being chewed off. As an example, *S.mentosa* seldom offsets in cultivation but to the south of Aiquile I have actually watched goats chewing the tops off *S.mentosa* and there was not a single plant to be seen there that had not been chewed off. It is a different story with *Sulcorebutias* that are naturally offsetting. They are usually so small that animals are not able to eat them. And anyway they are underground for most time of the year.

.....from J.Carr

There are certain populations of *Sulcorebutia* which clump naturally, but it is also possible to find populations that do not clump, even of the same species. It is also possible to find populations that that clump only when damaged, usually by goats. For example, *S.tarabucoensis* will clump naturally, but *S.mentosa* will only clump when damaged by goats.

.....from P.Downs

The variation to be seen within one species of *Sulcorebutia* in Bolivia was an education. For example, some of the *S.swobodae* that we saw on a hilltop at about 9km from Aiquile on the Santiago road at 2450m altitude, had pale green bodies and pale coloured spines, whilst others had dark green bodies with dark coloured spines, with few intermediate forms, all within one square metre. These plants were usually

growing in cracks on sloping flat rocks, or in small pockets of stony ground on the side of hills.

.....from J.Carr

The *S.purpurea* are normally large headed plants but along the road from San Pedro de Buena Vista we came across some plants of *S.purpurea* v. *gigantea* with individual heads up to 7 inches across. These particular plants have links to *S.crispata*. But it is not uncommon to find a variation in one species of *Sulcorebutia* at one locality. We did see a population of *S.torotoroensis* in habitat which extended over several hills, but on only one of them were these plants growing up to between 5 and 8 inches tall. They grew on a hilltop which was covered in boulders. Where they were probably more in the shade. On all the other hills where this species was seen, it was on ground covered with broken stones and the plants were smaller and fatter, only a maximum of two inches above the ground, but very heavily spined.

.....from J. de Vries

From the area around Acacio to San Pedro de Bonna Vista, we came across some *Sulcorebutia* which have been described by Halda as a subspecies of *S.purpurea*, but I consider that is wrong – they are more likely to be *S.torotoroensis* which come from the other side of the Rio Caine. The name *gigantea* is fitting according to the size that these plants can reach in habitat – we came across VZ 679 near Acacio where some solitary plants were 16cm. across. Compare the size of the flower, which is about 2.5cm across (picture, p. 94).

.....from R. Marriot

On plant size, clearly several species of *Sulcorebutia* produce heads which are comparatively much larger than other species – such as *mentosa*, *purpurea*, etc. I do have a *S.mentosa* with heads over two inches across but I have yet to see a head of five inches across on any of my plants. However, growing conditions in cultivation are much different to those in habitat - such as weaker sunlight, increased moisture availability, lack of goats, etc.

.....from K.Augustin, K.u.a.S. 42(88) 1991

In the vicinity of the tiny indian settlement of Challagua, just south of Independencia, we found populations of HS 189 and HS 189a at an altitude of 3250m, on gravelly hills about 500m apart from each other. Both populations observed certainly represented the same species. But amongst both populations it immediately became obvious that there was a great diversity of form between individual plants, particularly in regard to growth habit and spination. Indeed there were plants at these two locations equating to both *S.candiae* and *S.rauschii*, and everything in between. This led us to have grave doubts as to the validity of any “species” said to occur in this area. Especially striking, however, was the fact that these plants often had tremendously long tap roots up to 40cm long attached to a body of 2-3cm in diameter.

.....from W.W.Christie

In the course of a visit to Bolivia in October, we were at 3050m, between Epizana and Monte Punco, near Chulchungani, where we found *S.tiraquensis* on a hillside growing in shallow pockets of soil among large sandstone rocks and many of these plants were in flower. Some of them had bright red flowers whilst others had flowers with a purplish (magenta) tinge, all with a very variable spination from plant to plant. There was an adjacent field of potatoes where the green potato shoots were 30cm or so high, and were obviously growing vigorously, so there must have been a great deal of recent rains.

Travelling from Mizque, heading for Minas Ascientos, we were going along a valley, when we came to a few dwellings at Chaguarani, at 2638m altitude, also known as Cruce. Not far from the road, on the sloping ground at the foot of the sandstone cliffs, we came across quite a number of *S.cylindrica* growing in the shallow pockets of soil among bare rocks in company with little other in the way of vegetation than a few low growing herbs. These *Sulcorebutia* were globular and more or less 5cm in diameter. They were occasionally double headed and quite a number of them with open pink flowers. These have now been published as *S.cylindrica* var. *crucensis*. We did not see any of these plants here that were growing taller than wide.

Then we followed the flat valley floor for about 5km from Chaguarani at 2500m altitude, and growing there were the more familiar yellow flowered form of *S.cylindrica*. To reach the spot where B.Bates knew these plants were growing, we had to walk for some distance through a mature *Eucalyptus* plantation to an area of rocky sandstone on gentle slope, with cliffs in the far distance. These plants were white spined and elongated to 10 to 12cm long and up to 4cm in diameter with many in flower but few of these flowers were open. These plants were growing in shallow pockets of soil and hanging over the red sandstone rocks.



**Sulcorebutia
cylindrica
v. chaguarani**
At Chaguarani



**Photos:
W.Christie**

**Sulcorebutia
cylindrica**
**Near
Chaguarani**



**Sulcorebutia
VZ679**
Near Acacioitas
**Photo:
J. de Vries**

All of them were solitary, although groups of several plants grew close together. On the other side of the road there was some farming, together with some trees, in the now fairly wide floor of the valley.

In October 2003 we came across *S.vasqueziana*, *losenickyana*, *alba*, *pedroensis*, *frankiana*, *verticillacantha*, and *christiae* in flower. But we did not see any fruit on *Sulcorebutia* on any of our trips to Bolivia.

.....from J.Carr

It is thought that most *Sulcorebutia* will grow in an acid soil as the whole of the Andes is predominantly acid. However, it is well recognised that the soil around Ayopaya is alkaline in nature and there are some *Sulcorebutia* which grow here – *S.glomeriseta*, *kamiensis*, *muschii*, *candiae*, *arenacea*, and *menesii* - and all are rather unusual in that they display yellow flowers, whereas red or magenta flowers are typical for most species of *Sulcorebutia*. There are other yellow flowered species in other parts of Bolivia and some populations have a mixture of flower colours, yellow red, and magenta among them – *S.steinbachii* and *S.cantargalloensis* among them. I have seen a yellow flower on a *S.cardenasianum* when all the other flowers on the plants in that population did have the usual red or magenta flowers. Similarly in a populations of *S.cantaguensis* which extended to no more than 2 miles from Cruces. Other species have separate populations with different flower colours at each site – such as *S.cylindrica*, *azurduyensis*, and *steinbachii* among them.

On my next visit to Bolivia I have in mind to take a test kit to check the pH of the soil at some of the yellow flowered sites to see if this had any bearing on the flower colour. It will also be interesting to check the pH at sites where the colours are mixed. I had thought of using pH sensitive test strips but as they are for testing the pH of water I do not think that they would work on soil.

.....from J.Pot

In the course of a visit to Bolivia with W.Gertel we came across *S.cylindrica* with magenta flowers at G37 near Chaguarani where a soil sample was found to be pH 7.95. Near Pajcha at G 36 there were *S.cylindrica* with yellow flowers, where a soil sample was found to be pH 7.87, so there appears to be no correlation between the flower colour of this species and the acidity or alkalinity of the ground that they grow in. All my own *Sulcorebutia* and *Weingartia* are grown in the same compost and this does include plants of *S.cylindrica* with both yellow and magenta flowers.

.....from G.Rovida

For my plants I use a compost which is mostly coarse pumice – which helps to retain the humidity in summer – to which I add red-larva grit and not more than 30% of humus, usually a leafmould or a normal compost for house plants, together with an initial amount of perphosphate and potassium sulphate in order to avoid any accumulation of Calcium. *Sulcorebutias* do not like calcium sulphate at all because they want an acid soil. On my first visit to Bolivia in 1988 I took several samples of soil for which I measured the pH on my return, when most of them were found to have a pH of about 5. So that in order to avoid any accumulation of calcium in my compost, I only water with rain water. During the growing period I use a fertiliser which is rich in phosphorous and potassium but with very low nitrogen.

.....from W.Christie

My basic compost is 2 parts of John Innes ericaceous compost to one part of perlite with a generous top dressing of gravel. I use tap water to water my plants and when I refill the water barrel I add about half a cupful of vinegar to acidify the water slightly.

.....from S.Ratcliffe

For my south american cacti I use a loam or peat based compost with 50% of grit added. In recent years I have added a handful of limestone grit into my compost mixing tray. For watering I use tap water to which I add a small amount of Miracle Grow.

.....from H.Middleditch

And no problems lately from losing roots on the *Sulcorebutia* after the addition of this alkaline component - the limestone - to the compost mix?

.....from W.Gertel

I do add limestone to my compost but only for the *S.cylindrica*.

.....from J.Carr

On my last trip to Bolivia I took along with me some pH test kits in order to test the soil at some Sulco sites. I particularly wanted to test the site of yellow flowered plants as I thought that there might be a

connection between yellow flowers and an alkaline pH of the soil. The test kit involved digging out a small sample of earth from about 5cm below the surface. In some cases this had to left to dry out for several days before testing as the soil moisture affects the results. The test kit was on 1ml of soil put into the tube provided and to this was added a small amount of Barium sulphate (measure provided with the kit). The tube was then filled to the 2.5ml mark with the test solution provided, given a quick shake, then left to settle. The colour of the solution at the top of the sample tube was then compared with the chart provided. Light green was neutral and orange was slightly acid.

Eleven tests were carried out, eight of which were at yellow flowered sites. The non-yellow sites were *S.santiaguensis*, *S.albissima*, and *S.mentosa*. The results were not as expected as ten tests produced a neutral result of pH 7, and one a slightly acid result of pH 6.5. This last one was also a surprise as it as at the site of *S.kamiensis* where the result should have been slightly alkaline according to the rock formation in this area. My findings were rather surprising and I will certainly do further samples on future trips.

.....from F.Lutt

I am growing my *Sulcorebutias* in a compost of 100% pumice, which I find has a pH of 6.8 when I tested it. I adjust my water that I use for my plants to pH 6 with a mild acid used for hydroponic growing.

.....from I.Crook

I have lost some *Sulcorebutias* which have dried up after a long winter, due to them losing their roots, even though I give them a drop of water occasionally in winter. I do know of one grower who tells me that if he sees any of his *Sulcorebutia* looking a little dry in the winter, he dunks them in a bucket of water for a minute or two, then returns them to the staging, even in the depths of winter. For my compost I use equal parts of J.I. No.2 and Jojo grit, together with a handful of Perlite and water my plants with tap water.

.....from H.Middleditch

Is it possible that this problem with root loss may be associated with the use of J.I. compost, since it may not be as well drained as a mixture of mineral components? Or perhaps due to the tap water not being quite on the acidic side of neutral?

.....from J. Cooke

I grow all my plants, including the *Sulcorebutia*, in a compost made up of equal parts of J.I. No.2, Arthur Bowers potting compost, and quartz sand. And I do not have any problems with losing roots on *Sulcorebutia*, or losing these plants. For watering, I only use rain water. To root cuttings, I would normally try to pull a head off a plant which it will have a small area where it was joined to the parent and allow it two or three days to dry off, whilst if a head is sliced off it has a larger cut area and so will need about 7 – 10 days to dry off after putting a bit of flowers of sulphur on the cut. The detached cutting is then put on a sand bed with bottom heat and keep the sand moist and roots usually form in a month or so. I find it best to try this after they have flowered in the Spring – between May and July.

.....from G.Rovida

For rooting cuttings I use a coarse quartz or granite sand, but with a layer of peat below 4 to 5cm depth of sand, in order to retain some humidity for the developing roots – and I water this compost occasionally.

.....from R.Marriott

I have several hundred plants of *Sulcorebutia* which are grown in an all mineral compost – the reason that I moved to using a purely mineral compost was due to losing *Sulcorebutias* because my previous compost was not drying out quickly enough – even though I had tried varying proportions of John Innes compost and horticultural grit. My present compost is made up of equal parts of Jondo Flint Chick, Hen, and Growers grits. This makes for a mixture containing a good range of particle sizes. It allows for quick drying whilst retaining enough moisture for long enough to benefit the plants.

.....from J.Carr

My own compost used for all my plants is a mixture of equal parts of J.I. compost, peat, and grit. Because I need a lot of water for my collection I did not have enough collected rain water and so I had to use mostly tap water. For years there were persistent problems with *Sulcorebutia* losing their roots and dying off. But having read in a petroleum exploration journal that soils at their drilling sites in the Andes were almost all acidic, last year I decided to acidify my water with the use of Humic acid. The improvement in the growth of all my plants has been nothing short of remarkable, as well as now not losing roots – or plants – of *Sulcorebutia*.

.....from Augustin, Gertel & Hentzshel, Sulcorebutia 2000.

As a plant compost a predominantly mineral mix, basically of an acid nature, is recommended – as an example, a mixture of pumice, lava granules, Perlite, and quartz sand has proved to be suitable. But the most important factor with both compost and water must be that their pH value is not of an alkaline nature – a pH value of between 4.5 and 6.0 is recommended.

.....from H.Kallenowsky

In my collection I grow all my plants, including the Sulcorebutia, in a compost which is a mix of lava, sand, clay, pumice, and some coarse material. I use rainwater which is collected in a barrel and as fertilisers I add Wuxal and Fertrilon. The fresh watered soil has a pH of about 6.5. But I do have problems with my Sulcorebutias as plants sometimes lose their roots and die.

.....from H.Middleditch

Is it possible that this problem may be due to the compost used for the Sulcorebutia does not contain enough gritty material and remains too moist for these particular plants? Is there any particular component or components which it would be preferable to replace with an alternative? Or could the fertilisers be unsuitable?

.....from R.Marriott

From the materials listed I would suggest that the least desirable component is likely to be the sand, particularly if it is fairly fine and comprises anything other than a small proportion of the overall mix. The pumice is the most water retentive part of the mix but then a lot of growers on the continent use that and nothing else, with great success. The clay is also a likely suspect, assuming it refers to clay granules. Could it be that the root loss is simply down to overwatering as opposed to the compost itself? Even the best drained composts can lead to root loss if the plants are watered too frequently.

.....from G.R.Allcock

For irrigating my plants I have always used tap water which is indeed soft, but about five years ago there were some marvellous improvements in the growth of my cultivated plants after I started to make use of acidic water, brought about by the soluble nitrogen that I then made available to them. Flowering also seems to have improved. The procedure consists essentially of using a weak acid to bring the pH of the water down to about 5.0 or 5.5 and at the same time adding a soluble fertiliser as required. To acidify the water I use hydrated aluminium sulphate – a hydrogen colourant – at the rate of about 2.5ml of the powder per each 10 litre bucket of water, and for fertilizer I use 5ml of Chempak 3 per each 10 litre bucket of water.

It is very important that the acidulator should be weak, for in this way the pH is buffered to the required value. Other weak acids, such as vinegar, or other organic acids, can be used. Sulphate of iron should not be used because it produces rusty stains. As usual, a hand watering can is used to apply the acidified water. I now also add Epsom salt powder at 1ml to each 10 litre of water. There are references to the use of Epsom salts in Cactus World 28(2) 2010, 30(3)2012, and 31(3) 2013.

.....from G.Rovida

My own experience is that most Sulcorebutia which are cultivated in pots may survive low winter temperatures, which rarely go below – 5°C here in Italy, if they are completely dry. My own plants are grown in cold frames, out of doors, covered by twin-wall polycarbonate sheets. I do not water these plants between halfway through October to the beginning of March. I use 5-7cm square pots which are packed closely together, so probably reducing the cold penetration during the winter nights. My problems are mainly related to the high temperatures here in Italy in the summer, which can be as high as 35-38°C. I have to use black netting to provide some 30-50% shading in order to avoid my plants getting burned by the sun.

In the course of visiting Sulcorebutia locations in Bolivia, it became evident that most of these plants are to be found growing near the tops of hills in rocky ground amongst sparse vegetation or even in bare ground. They usually grow on the northern side of hills which means that they are facing the sun and so exposed to it for most of the day, although the air and soil never heat up too much during the day because of the elevation. Some Sulcorebutia grow in habitat even up to 3500 to 4000m. altitude. At these high altitudes the air and ground never heat up a great deal during the day because of the altitude.

.....from H.Middleditch

Does this mean that those species which grow at the highest altitudes are more capable of surviving lower winter temperatures in cultivation than those species which grow at distinctly lower altitudes?

.....from I. Le Page

My own plants are allowed to dry out as the temperature in my greenhouse gradually falls from the summer peaks to the lower levels of winter. Here in the Channel Isles our outside temperatures rarely fall below minus two or three degrees centigrade in winter, with a record of minus seven. So my plants are subjected to the occasional drop in temperature to below zero, generally only for perhaps a few days, and then probably only by a couple of degrees.

.....from J.Carr

Sulcorebutias come from a wide range of altitudes in habitat so some of them do experience frost and I have noticed some frost appears on the plants as well. Here I am sure that most would survive temperatures below zero if it was not too long in duration but if it was for days on end it would be a problem. Heating will also play a part, as dry heat will have a different effect to moist heat.

.....from G.Rovida

This year I checked my Sulco flowers for scent and I find that most of them under normal conditions have no scent. However, the yellow flowers of the northern species – like *breviflora*, *aranacea*, etc., appear to have a weak scent, but this was at the time of year when my sense of smell was affected because of the hay pollen around. But only yesterday, in late July when there was less hay pollen around, at a greenhouse temperature of 38°C, a grafted plant of *S.inflexiseta* MC 6308 had a purple flower with the same sort of scent.

.....from W.Gertel

I have not done any research into scent on *Sulcorebutia* flowers but I can tell you that it stinks like a rotten egg when the Sulcos from Ayopaya are in flower – *S.glomerata*, *S.kamiensis*, *S.muschii*, and *S.candicans*.

.....from I. le Page

My *Sulcorebutia* have only a brief flowering period, one of the shortest in the cactus family, which usually lasts from mid April to mid May, but I have been able to check the flowers on several species to see if they had any scent. I found that many of them did have scented flowers but I found no evidence that the scent varied with either the time of day or the length of time that the flowers had been open. I found that it was generally the yellow flowering species that had scent, although among those with red or magenta flowers there were some which displayed a faint scent and with many of them I could not detect any scent at all. However the presence of scent in these blooms may not be consistent throughout the life of the flowers due to such as weather conditions or time of day. I hope to give a more definitive answer to this question in the course of the coming season.

.....from J.Carr

Most of the plants which grow in the area where *Sulcorebutia* are to be found will flower after the start of the summer rains, but *Sulcorebutia* – and only *Sulcorebutia* – may flower before the start of the rainy season, so that they are an important source of pollen for honey bees in that period.

.....from H.Middleditch

In view of the comments about *Sulcorebutia* flowering before the start of the rainy season when other plants are not in flower, and so producing scent to attract bees, does this suggest that other cacti to be found in the same area also produce scent? Or flower at a different time in habitat and do not produce scent? One or two members have mentioned that they are not able to offer observations regarding scent from their *Sulcorebutia* flowers due to not having a good sense of smell. But any observations on scent in these flowers, as well as if occurs all the time the flower is open, or otherwise – perhaps related to conditions of weather or temperature, would be welcome. Or if associated in any way with flower colour.

SUBSCRIPTION RENEWAL

A subscription renewal sheet for The Chileans Volume 23 comprising issues 73 to 75 will be enclosed with this issue. It would be advisable to bear in mind that if any payment is made to The Chileans in Dollars or Euros then the UK bank receiving that payment will make a charge of £7 for handling any such payment.

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