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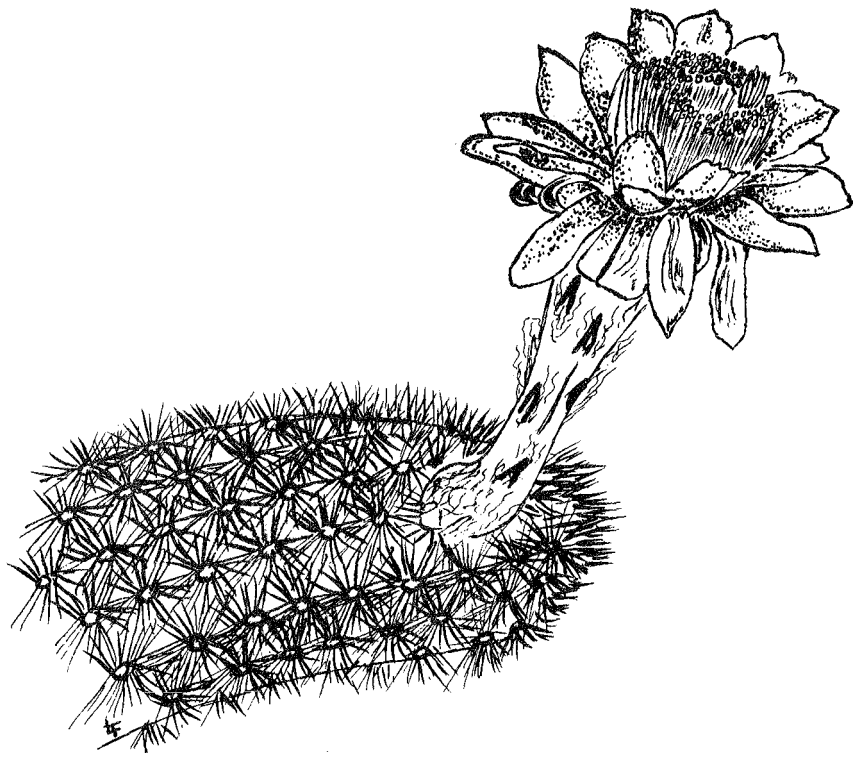
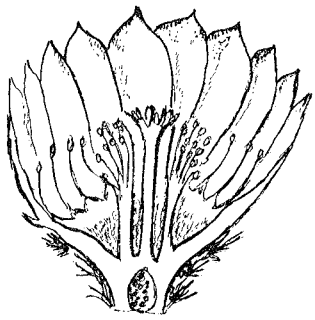
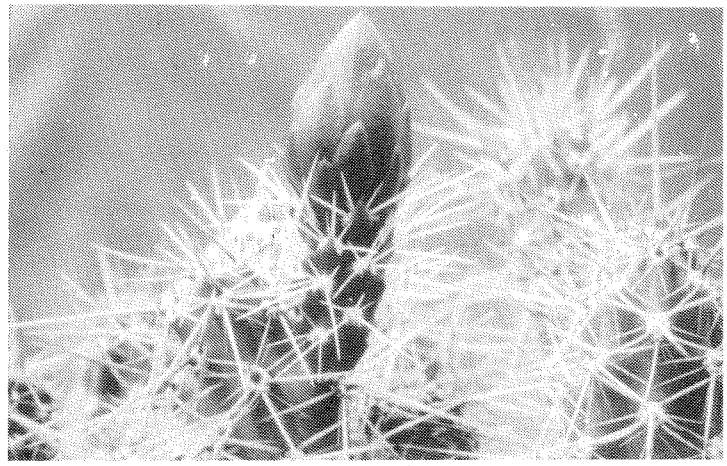


HAAGEOCEREUS DECUMBENS

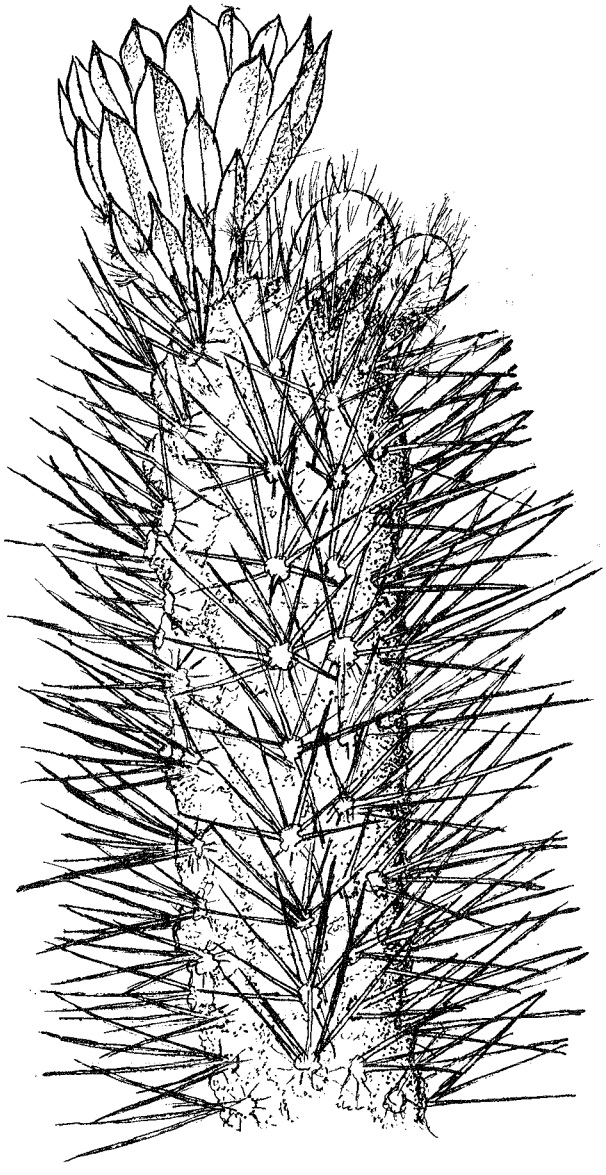
Collection - T. Lavender

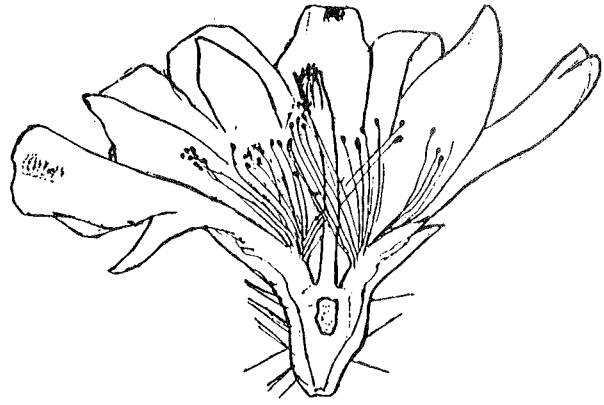




RMF 101

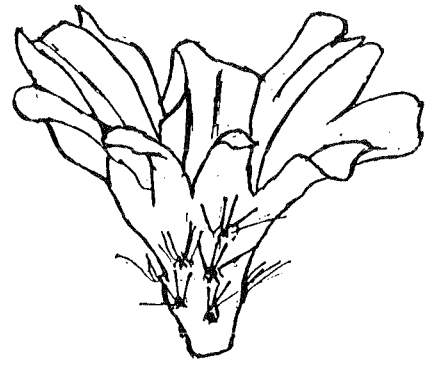
Photo & Collection - R. FERRYMAN





FLOWER SECTION RMF 81

Sketches - R FERRYMAN

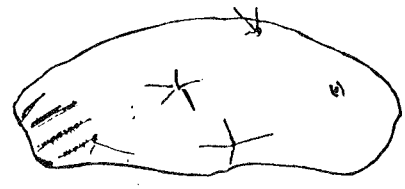


FLOWER RMF 81

Cereus philippi

Plant & Flower Section

REGEL'S GARTENFLORA 31. 1882



FRUIT RMF 81

DISCOVERING AN OPUNTIA? OR AN ERDISIA? OR AN AUSTROCACTUS? From R. Ferryman

The starting point for each of my visits to Chile was the capital city of Santiago. This city stands at about 400m altitude on a broad and fairly level plain that lies between the high Andes and the coastal mountain range. This central plain stretches away far to the south from Santiago, whilst to the north of Santiago it is enclosed by a range of hills which join the coastal mountains to the Andes. For almost two centuries, nearly every suitable patch of this central plain has been given over to farming, either arable or grazing, so that only traces of the original vegetation can now remain. The mountain slopes are unsuitable and unused for cultivation but there is some animal herding here and there. It seemed to me that the mountain valleys offered a better prospect for finding cacti than the intensely cultivated plains.

On my first visit to Chile I had two days available before leaving for the north of the country and so I made use of this time to visit one of these mountain valleys. On subsequent visits to the country I was able to travel into the valleys of the Mapocho and the Maipo and also along the tributary valleys of the R. Colorado, and R. Volcan. Although winter is the rainy season in this part of Chile, the rivers are fed in summer by the melting of the snow on the Cordillera, so they carry a good flow of water down through the mountains for most of the year. When viewed from Santiago, the mountain chain of the Andes appears to rise steeply and with great abruptness from the edge of the plain. When travelling from the city, however, the roads pass through some undulating foothills before entering more mountainous territory. Here the river valleys are narrow, but often there is still room for a strip of cultivated ground alongside the river, perhaps one or two hundred yards wide. From the road it is seldom possible to see anything beyond or behind the brow of the immediate sides of the valley, because the sides are so steep. Bends in the valley often shut out the view ahead but from time to time it was possible to catch sight of rising mountains or even glimpse the high snowclad ridge of the Andes. The flat cultivated valley floor is interrupted at intervals by narrower sections which are no wider than the river. Here the road has to find a way for two or three hundred feet up the steep sides of the valley on to the terrace, descending once again at the next cultivated strip. When there are no longer any flat patches on the valley floor, cultivation ceases, and so does the road.

The immediate sides of the river valley are frequently very steep, often in excess of 45^0 and are composed largely of a loose mixture of sand and stones. Occasionally a few bushes or trees clung precariously to these slopes. From the loose and crumbly looking nature of the surface it was considered prudent not to venture on to these particular slopes in search of cacti. The terrace above these slopes was most evident on the north side of the valley. The terrace was not flat, more of a gentle slope which became steeper as it blended into the mountainside. It varied in width and was not continuous all the way up the valley. From the terrace it was often quite possible to see more extensive views of the snow covered peaks of the Andes.

The ground making up the terrace seemed to be mostly sandy earth and stones. Over the terrace and the nearby mountainsides there are scattered trees and bushes, often with much bare ground and stones between. The stones would range in size from grit to boulders, the bare ground being a brownish yellow colour. The trees would sometimes rise up to five or six meters in height; many of them had thick glossy leaves and were probably evergreens. The trees mostly grew in company with bushes of two or three meters high. Some slopes had only a few scattered bushes and trees, others were fairly well covered. Occasionally the bushes grew so close together that it was not possible to walk between them. Often a fresh growth of herbs, many with yellow flowers, were sprinkled over the otherwise bare ground. In some places there was a profusion of Amaryllidaceae, many of them in flower, but there were also large areas without any sign of these plants. Grasses occurred almost everywhere, but only in small tufts and never forming a turf. In many places the tufts of grass were several meters apart. All the vegetation was still a fresh green colour, even though it was two months since the end of the rainy season.

Some cacti are to be found on the terraces above the valley floor but they occur rather more abundantly over the mountain slopes rising from the terraces. The cacti were found equally where the trees and bushes were quite dense, as well as where the trees and bushes were only scattered in ones or twos. Trichocereus chilensis grows here and there, often single plants quite on their own but occasionally a few plants growing several yards apart from each other. At places there was a hillside where a stand of perhaps a hundred or more Trichocereus would dominate the immediate scene, but many of the hillsides seemed to be without any Trichocereus at all. Trichocereus chilensis grows here up to 3m in height although most specimens were rather shorter than this; even those with seven or eight stems branching from the base, which were probably the older plants, were rarely as tall as 3m. On the stems the groove between the ribs is very clearly defined and the tubercles are separated by a v-shaped cross groove which almost runs into the top of the areole. At first glance this gives the impression of a tesselated rib, but the cross groove does not span the full width of the rib. Most of the plants were in flower or in bud, usually from the shoulder or from the sides near the top of the stem. There were no signs of fruit (December).

Wherever forestations of Trichocereus occur the lower growing cacti also seemed to be more abundant too, although the Neochilenia were usually more difficult to find. Being the end of the wet season, many herbs had grown above the height of these cacti. On the broken ground many of the rocks were larger than the globular cacti, whose spines did not differ greatly in colour from the surrounding stones. The bushes and shrubs also obscured the view of much of the ground so that it was less difficult to find the low growing cacti at places where the bushes and shrubs diminished in numbers. The globular cacti were quite often only four or five yards away when they first caught the eye - frequently the flowers betrayed their position; most of the dwarf shrubs possessed smaller flowers than the Neochilenia and most of the herbs carried their flowers further above the ground. Most Neochilenia were in good growth as there was fresh green epidermis to be seen in the apex. These plants were classed as Horridocactus by Backeberg and as Pyrrhocactus by Ritter who quotes both P.curvispinus and P.andicolus from this area. They seemed to occupy a wide range of altitude; at the lowest level they were found growing at about the level of the plain, around 550m altitude, and they continued to appear up to about 1850m around El Volcan. In other valleys in this area they were later found growing as high as 2300m.

There is a well known resort at Lagunillas which lies at 2000m altitude and which is reached by climbing a passable road from the Maipo valley until the last cultivated ground on the valley floor is left behind. From there onwards, it was simply a track. Long before we reached Lagunillas the tall trees had all been left behind, the bushes too. At Lagunillas we looked across a panorama of many miles of sloping mountainside towards the snow covered flanks of the Andes which

formed a long ridge in the background. There was scarcely a level patch of ground to be seen; slopes ranged from relatively easy to steep. Here and there were some almost vertical cliffs of bare rock, one or two of which comprised over a hundred feet of precipitous drop. Elsewhere patches of bare rock outcropped every few yards, separated by pale brown sandy earth. Between the rocks there grew scattered dwarf shrubs, herbs, and grasses, with much bare earth between. The shrubs would be less than half a metre high and wide, with branches close together so that they gave the appearance of a dome of leaves. Between the shrubs were clumps of grasses which did not make a sward, the clumps being some half to two metres apart. The grasses carried their flower stalks a little higher than the tops of the shrubs; there were seldom more than a dozen of these flower stalks at one spot. The leaves of the grasses were fairly short and grew close to the ground; the herbs were sprinkled around and generally had more stalk than leaf, so that neither grasses nor herbs made a strong impact on the eye. The predominating impression was of bare rock, bare earth, dwarf shrubs, and the waving flower stalks of the grasses. This covering gave a mottled green and brown appearance to the many square miles of mountainside which lay within our view.

Above this great sweep of mottled mountain slopes the green petered out into what was presumably bare rock which extended up as far as the snow. On the sides of a valley, but below the height at which I was standing, there were a few dark green patches which I took to be the upper limit of taller bushes. Between 500m altitude where the mountains ended in the plain and here at 2300m altitude there was little real change in the nature of the sandy brown earth and the rocks. Although the accompanying vegetation had changed, this was not so much in quantity as in stature, so the percentage ground cover was pretty well unchanged. At this altitude I no longer expected to find any cacti, but nevertheless there were still occasional specimens of Neochilenia curvispinus/andicola growing where rocky outcrops

Retracing our steps down to the Maipo valley from Lagunillas and heading further upstream, brought us to the River Volcan. Here the scenery continued much the same as in the Colorado valley. Once cultivation was left behind the floor of the valley comprised more or less loose rubble and grit, no real road and not much of a track. It was necessary to pick ones way between the larger stones. Vegetation was sparse - a few low trees and bushes were scattered or strung along the river banks. The valley sides were almost equally as bare, being composed of steeply sloping outcrops of bare rock interspersed with scree slopes which rose at an angle of 45^0 or more; both the scree slopes and the floor of the valley appeared to be a similar sort of rubble. The mountainsides so hemmed in the valley that nothing could be seen above the immediate steeply sloping sides. Looking further upstream it was possible to see some of the slopes above the immediate valley walls which were covered with occasional patches of bushes. Beyond that, the hilltops rose one above the other.

Because the sides of the valley were mainly loose rock, the only means of reaching the higher ground at either side was to scramble up one of the side gulleys, which rose steeply from the river. An ascent was made up one of these side gulleys near El Volcan and another near Los Valdes. The streams rushed and tumbled over the masses of stone which seemed to fill the bottom of these side gulleys, cutting here and there into what appeared to be quite deep deposits of angular stone and grit. The immediate sides of this gulley were also very rocky, so generally there was little opportunity for vegetation to become established; there was only a sprinkling of bushes, grasses, and herbs on the floor and sides. The surroundings did not look very hopeful for finding cacti, especially as the snow covered ridge at the head of the gulley seemed to tower over us as we climbed, although we might still have been a mile or two off the snow. Nevertheless there were still plants of the ubiquitous Neochilenia curvispina/andicola to be found growing between the angular stones which lay heaped besides the rushing stream. When we were high enough to be able to scramble out on to the less steep mountain slopes at either side, we were back to the dwarf bushes and clumps of grass. The more substantial bushes had been left behind in the shelter of the valley. Even the ubiquitous Neochilenia andicola seemed to have been left behind. There was no great likelihood of finding any other cacti here, but nevertheless, we decided to have a look round. We were evidently not far off the drop into the main valley, but it was only when we viewed this particular site from the same height on an adjacent slope that we discovered that we had been on the very edge of an almost vertical drop of some two or three hundred feet.

At this particular site there was the usual sandy-brown earth between the stones and a scattering of dwarf shrubs and herbs. My eye was caught by a few tiny gleams of red, something glinting in the bright sunlight. What was it? Largely out of curiosity I walked over to find out what they were. Imagine my surprise when I found a few conical heads of cacti projecting only an inch or two out of the ground. There was a minute red coloured vestigial leaf at each new areole which, together with the reddish spination on the new growth, had shimmered in the sunlight. The surrounding vegetation, growing perhaps half a meter high, might have provided a modicum of shelter to these cacti, but not much shade. Apart from a few twigs, blades of grass, or leaves of herbs, a few inches of bare earth separated the cacti from the accompanying dwarf vegetation. There was the usual scattering of lumps of stone, too. After taking a couple of shots with the camera, the next step was to dig up one or two plants. Below ground level the body changed from a reddish-brown to a cream colour but continued at a gradually reducing diameter. Further digging eventually excavated a tapering rootstock almost a foot long which branched several inches below ground level. The dozen or more small heads scattered over this small patch of ground were in all probability one and the same plant. The earth was not bone dry and at this altitude and yet the night temperature could hardly have been far above freezing point, even in summer. In winter this ground would surely be covered with snow. Small patches on the upper part of the old body which looked a bit like scorch were probably frostbite. What sort of cactus was it that survived under these conditions?

This plant was again met with on my third visit to Chile. Bearing in mind the circumstances under which it grew I am not really surprised that it has only been recollected infrequently. The finds were certainly regarded quite highly by the local cactophiles who had previously not found it themselves. On our first visit in 1982 which was made in early December to El Volcan, there were buds on the plant but no flowers or fruit. Cuttings in bud were left with Dieter Fosmann in Santiago. He planted them out in fresh air with a free root run. These buds opened in cultivation there. On my subsequent trips to Chile more finds of this plant were made at Lagunillas and Los Valdes; at the latter place there were two fruits on a plant. The fruit was yellowish green, slightly banana shaped, some 40mm long, about 18mm diameter at the centre and tapering somewhat to rounded ends. There were approx. 18 tiny areoles distributed over the surface which had up to five bristly spines, radiating, almost apressed, up to 8mm long, white to grey. Some of the areoles were not present and may have become detached. The fruit was hollow; it contained no flesh, the seeds being loose inside. The fruits were removed from the plant by a light twist and

pull; the seeds appeared to be ripe. There were less than ten seeds in each pod.

The specimen plants were cleared through export/import controls and came back with me to England; they were potted up and watered more or less like all the other Chilean plants. In the spring of 1984 a couple of buds appeared, but these aborted. Then in the late spring of 1985 more buds appeared and this time the plants were sprayed every day, rather than watered; but again the buds failed to mature. In 1986 half a dozen buds appeared near the top of the plant. As the days and weeks went by, anticipation gave way to concern over why there was no sign of the buds maturing into flowers. Once again, no flowers. By 1987 I had six clones of this species. One plant was left bone dry, one was soaked when the buds appeared in order to approximate to the effect of melting snow, one was left out in a cold frame to overwinter with no more protection than a muslin cover to deter the rodents and so forth, whilst the others were given the same treatment as all the rest of the plants in the greenhouse. It was one of these latter which succeeded in maturing one of its five buds into a flower. On the plant which had been soaked when the buds appeared, the buds changed into offsets, so now it has branches from above ground level, which is quite uncharacteristic. All the other new branches have grown up from below, or just below, ground level. A specimen being grown by Tom Jenkins also produced a fine crop of buds, but only a single flower opened into bloom. Is this due to our English summer being so much warmer than the growing and flowering season in the high Andes?

In 1988 there was more than one flower, so it gave me an opportunity to both take a flower section and try to set fruit. The fruit did mature and without any sign of splitting it eventually fell off the plant of its own accord, still green and turgid. It measured about 40mm in length and some 25 mm wide. There was a basal pore where it had detached from the plant from which the seeds, which were quite loose and dry within, simply escaped. There were between ten and twenty seeds.

As far as the identity of the plant is concerned, I am pretty well convinced that this is the plant that has appeared in the literature under various names, including Opuntia, Erdisia, and most recently as Austrocactus.

....from H. Middleditch

As to the identity of this plant, it does seem to be quite probable that this is Philippi's Opuntia (later Erdisia, later Austrocactus) spiniflora. This particular species has been moved from one genus to another by different authors. What are the reasons for this? The presence of tiny vestigial leaves or scales at each areole is commonly met with on several types of Opuntia and also in many Tephrocacti. Slides have been shown at the Chileans Weekend of tiny vestigial leaves on areoles at the growing points of Erdisia and of Corryocactus. The plants of RMF 101 certainly exhibit minute vestigial leaves on new areoles at the growing point, like Erdisia.

....from A. Johnston

Having made a close examination of each of my plants of Austrocactus, with the aid of a small hand lens, I am quite sure that there are no signs of vestigial leaves near the apex of any stem. Then I went looking for vestigial leaves on Corryocactus and Erdisia; I found them on Corryocactus and on Erdisia erecta, but I could not find any on my other Erdisias. I even looked at my young plants of Austrocactus which were in good growth but could find no trace of vestigial leaves on any of them.

....from H. Middleditch

Any determination of the identity of RMF 81 & RMF 101 has to take into account not only body habit, but also features of flower, fruit, and seed. To take the seed first; now the seed of Austrocactus is about 2mm across but less than one mm thick, with a relatively tiny hilum set in a notch in the outline of the seed. The testa appears to be a pale grey-brown colour, which may be due to a wrinkled cuticular layer. When the seed is viewed sideways the outline is not a plain curve but is formed of a series of undulations, rather like an amonite or like segments of a caterpillar. A close examination of some Austrocactus seed under the microscope which was undertaken in conjunction with G.Swales brought to light that the micropile was located outside the hilum i.e. outside the funicular scar. This was confirmed by a subsequent examination of another sample of Austrocactus seed. This disposition of the micropile differs from most other cacti seed examined to date, on which the micropile occurs within the area of the so-called hilum. However, all text book illustrations of ovules place the micropile outside the funicle, so really the seed of Austrocactus follows the text books. From the samples of seed currently available, it appears that the seed of Corryocactus and Erdisia follow the rest of the cacti in having the micropile located within the area of the so-called hilum.

In the Buxbaum-Krainz Die Kakteen, there is a sketch of a seed of Corryocactus brachypetalus exhibiting an amonite effect similar to that seen on Austrocactus seed. However on this Corryocactus seed the micropile lies within the outline of the so-called hilum, just like the majority of cactus seeds. At the Chileans' Weekend we have seen some Erdisia seed, both collected in Peru and put on electron microscope slide by R.K.Hughes. The surface of this seed looks almost level and fairly smooth, quite different to the surface of Austrocactus seed. We have also seen seed of Corryocactus ayopayana, again collected by R.K. Hughes, with testa cells having a smooth and only slightly raised surface. Again the micropyle is contained within the outline of the so-called hilum. To summarise; the seed of Austrocactus is a roughish testa surface of a dull grey-brown colour, with the micropile outside the hilum; the seed of Erdisia is shiny, smooth, blackish, and the micropile lies within the hilum.

The seed of RMF 101 has been put on slide F. Fuschillo to his usual excellent standard. It is some 2.4mm across and just over one mm thick, with a quite small hilum set in a notch in the outline of the seed; the micropile is immediately adjacent to the hilum but outside the so-called hilum area; these are all features of Austrocactus seed. However the testa surface of RMF 101 is black and glossy, the shine implying that the surface of the testa is smooth like R.K.Hughes' S.E.M. slide of Erdisia and quite unlike the testa surface on Austrocactus seed. Hence the seed of RMF 101 exhibits some features characteristic of Erdisia and others which are characteristic of Austrocactus. However there is a paucity of data relating to Erdisia and Corryocactus seed which means that it would be advisable to put more samples on to slide for comparison before firm conclusions can be drawn on this aspect.

....from A. Johnston

I have been able to take a careful look at more than a dozen fruits which set on my Austrocactus last year, and

they look quite different to the fruit off his collected plant which R.Ferryman showed us on slide. The fruits which set on my Austrocactus plants were all a hairy berry, some 12 to 15mm in diameter. The bristles are on the flower and they remain on the fruit and look very dense, due to the shrinkage of the dried fruit I suppose. When the fruit is ripe the wall becomes tough and leathery opening round the base with two or three vertical splits part way up the wall. It gradually dries up and detaches itself from the plant. It is quite easy to lift the fruit off the plant by means of the bristles which project above the top of it. Although the fruit is open at the base, almost all the seed stays in the fruit. The interior of the fruit is quite dry with no signs of pulp or flesh.

....from H. Middleditch

And what are the comparable characteristics for Erdisia and Corryocactus fruit? The fruit on Erdisia is reported to be about 20 to 30mm in diameter. The fruit on Corryocactus is reported to range from 30 to 80mm in size and to vary quite widely in size on the same species, although as A.Johnston has already observed on Austrocactus in cultivation, this may possibly be due to incomplete pollination giving less seeds and a smaller fruit. Both Erdisia and Corryocactus fruit have deciduous spines.

The fruit size on Opuntia/Erdisia/Austrocactus spiniflora is not recorded by Britton & Rose, but the illustration which they reproduce depicts a fruit which appears to be well in excess of 30mm long. It is very similar in appearance to the sketch by R. Ferryman of the fruit off RMF 81 (which he also photographed), insofar as it displays only a few areoles, each with several short spines, and there are no long bristles at the top of the fruit. This is more of a Corryocactus than an Erdisia fruit and certainly no Austrocactus fruit. The fruits found on RMF 101 may possibly be within the compass of Corryocactus-Erdisia fruits.

....from A. Johnston

It would be interesting to find out what the flower is like when R. Ferryman is able to look at the section of a flower. I have had a look at the colour prints of my Austrocactus flowers and note that all the flowers have a single ring of stamens on the outside, close to the petals, and also a bunch of stamens in the centre round the style. I also have a print of a flower section and there are no stamens at all between the ring at the top and the bunch at the base.

....from H. Middleditch

The flowers on Corryocactus appear to span a range of stamen insertion patterns. Of the Corryocactus flower sections examined to date, some have stamens inserted more or less regularly all over the wall of the tube from the base of the style up to the base of the petals. Other Corryocactus flowers display a gap between the lowermost stamens and the base of the style; yet other Corryocactus flowers exhibit two quite distinct sets of stamens, the lowermost ones curving in towards the base of the style, the upper ones more or less curving outwards, with little or no visible gap between the two sets of stamens.

....from R. Ferryman

You will have seen the slide of the flower section of this plant which I showed at The Chileans Weekend. There are a considerable number of stamens, all packed closely together over a distance of some 2.5 mm. They occupy roughly the middle third of the interior of the tube. Of course this is quite different to the arrangement of the stamens in the Austrocactus flower. The stamens can become displaced when cutting a flower in half and on the right hand side of the flower section [inside front cover] there are some stamens leaning over close to the wall of the tube. This is just what they look like on my pressed flower section, but they are not separated from the rest of the stamens.

Just before the flower opens the buds have a dark green tube about 25 mm tall, tapering fairly steadily from about 6 mm diameter at the base to about 10 mm at the top. The tube carries areoles about 5 or 6 mm apart, each with a tuft of felt some 1 to 1.5 mm diameter. The lowermost areoles carry a tiny scale, the uppermost areoles have a triangular scale probably 2.5 to 3 mm wide and tall which virtually obscures the uppermost areoles. There are five to six spines per areole, slim, white, stiff, radiating or projecting at an angle, up to 6 mm long on the lower areoles and up to 10 mm long on the uppermost areoles. [See inside front cover - H.M.]

....from A. Johnston

The flower on the collected RMF plant does not look at all like the flowers on any of my Austrocactus because it lacks the numerous hairy bristles round the top of the tube.

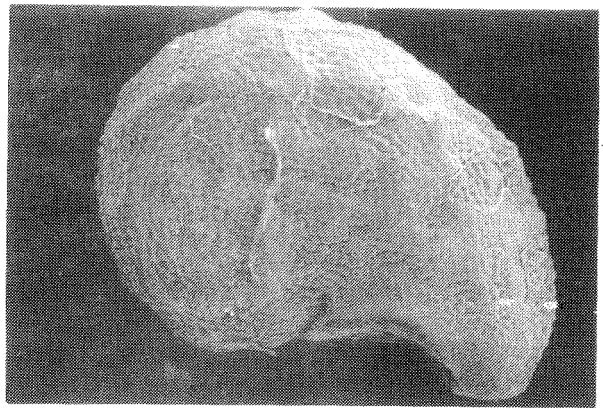
....from H. Middleditch

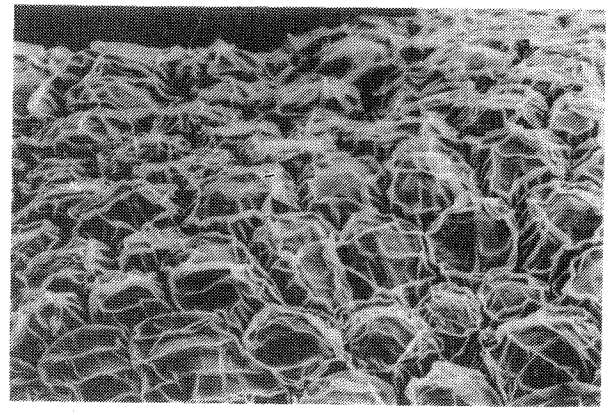
The reason for the reluctance of the flowers to open on RMF 101 may perhaps be sought not altogether in the elevated temperature of the english summer, but mostly in the higher night-time temperature to be found in an english greenhouse in summer in comparison with the low night-time temperature which the plant enjoys in the wild.

This plant is recorded by Britton and Rose from Aranas, high mountains of Chile, near Santiago and by Ritter from mountains and high altitude valleys in the Cordillera to the South-east of Santiago, from 1500-2500m altitude. None of the maps in my possession appear to plot a place named Aranas; the other habitat locations given by Ritter seems to tie in with the finding places reported by R. Ferryman. On both east and west flanks of the Andes there are numerous places where springs of warm or even quite hot water issue from the ground, usually with a fairly high mineral content. Although these warm springs were well away from any habitation and not easy of access, many of them were nevertheless the object of visits from residents of European stock who bathed in the waters. These places were usually called Banos, or baths. Such a spot is now the site of Lo Vacas, not far from where R. Ferryman encountered this plant. So regular visitations to this locality were being made in the early 19th century, which is when this plant was first discovered.

....from A. Hoffmann

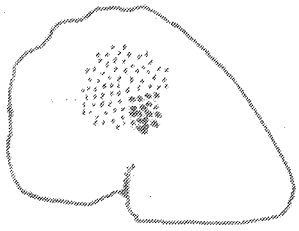
There is a book published in 1960 in Chile in which C.Munoz Pizarro provides a list of all the type localities cited by Philippi - Las especis de plantas descriteas por R.A.Philippi en el Siglo XIX. This gives the location of Las Aranas in the Prov. Santiago as 33^0 15´S and 70^0 28´W. You will see from the map that this place lies to the north-east of Santiago. It is quite probable that the plant reported from here by Philippi is the same as the plant found by R.Ferryman in El Volcan and at Lagunillas, also by myself in Banos Morales and in the Parque Nacional El Morado at about 2000 to 2500m altitude.

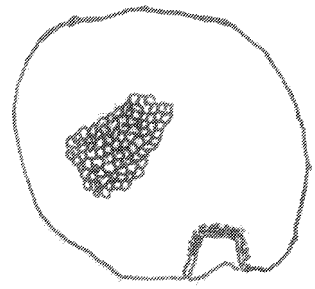




AUSTROCACTUS PATAGONICUS

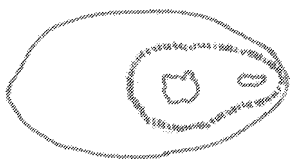
SEED and CLOSE-UP of TESTA SURFACE Photograph - Prof. W. BARTHLOTT

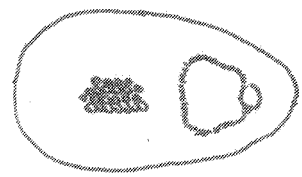


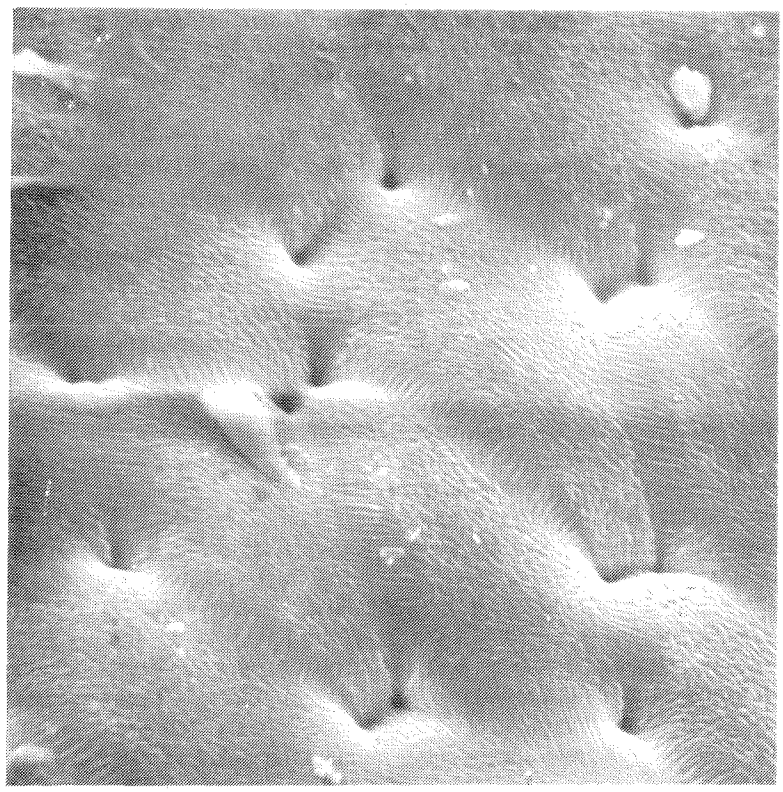


SEED
ERDISIA
KK 1274

SEED
RMF 101







SEED
ERDISIA RKH4

CLOSE-UP of TESTA SURFACE

Photograph
R. K. HUGHES

....from R. Ferryman

Banos Morales lies almost immediately to the north of Los Valdes, as does the Cerro Morado.

....from A. Johnston

Fortunately I have been able to obtain a small cutting from R. Ferryman of both RMF 81 and RMF 101. The latter has put out several thin stems up to four inches long, which are growing in various directions, almost horizontally. They look rather similar to the thin sort of growth with the short, weak spines that can sometimes be produced by small plants of Austrocactus. The RMF 101 came as a short, stout, cutting and I was beginning to doubt whether it was ever going to get established, but after a couple of years it is just showing signs of growth.

....from R. Ferryman

The collected pieces of RMF 101 are either somewhat barrelloid in shape, or short columnar, reddish brown in colour. There are six apressed radial spines and a single central which is some 15 mm long. In cultivation the new stem growth has a reddish tinge to the green, especially at the growing point; some of the new growing points are quite reddish for about 10 mm. The stems are either short columnar, some 12-15 mm in diameter, or the stronger growths are somewhat barrelloid in shape and nearly 20 mm in diameter. All the spines at the new growing points are pinkish red in colour; the base of the spines remains red for a few months whilst the upper part of the spine turns brown and finally the whole spine becomes buff in colour. The new central spines even reach a length of about 20 mm on some of the new heads, while on others they are only 10 mm long. There are up to five radial spines up to 8 mm long on some strong growths. The new growth is somewhat similar to the Chamaecereus silvestrii type found in cultivation on some Austrocactus. If Ritter brought these plants down from the high Andes and grew them on at Olmue it is not surprising that he took them for Austrocactus if they produced this sort of growth.

In addition to all the other reported locations for this plant, I gather that it has also been collected in the upper valley of the R.Maypo, by one of the people I met in Santiago. This is quite close to the Chilean border with Argentina at the Paso do la Cruz de Piedra. This means that it is not a great distance away from the northern location for the creeping Austrocactus reported by D.Ferguson.

....from D. Ferguson

It appears that many of the passes from Neuquen into Chile were quite low enough for many plants to cross, and unlike further to the south, dry enough for the cacti to do so. I suspect that the Maihuenia and Austrocactus of Chile are nothing more than stray outlyers of Argentine plants which have managed to cross the Andes and establish themselves. I have seen several field collected specimens of both genera from Chile and based on this limited acquaintance there seems to me so far to be no discernable difference. The variation in Maihuenia and in Austrocactus coxii in Argentina easily encompasses the plants from Chile. The Austrocactus coxii in particular seems to represent a cline spreading from Argentina over into Chile, with hibernus as a synonym.

I would say that Austrocactus coxii is definately rhyzomatus. I suppose that it could be called a refined form of etiolation. They send out narrow shoots, one-eighth to three-eighths of an inch thick (3 - 10 mm) which grow through soil, gravel, rock cracks, or dense cushion shrubs to resurface as much as 2 ft. away - or perhaps even further - where they begin normal growth. They often send up a few side shoots along the way. At Las Lenas I dug up one of these rhizomes, or stolons, which was in sandy soil, and followed it along, finding three fairly large plants to be interconnected, with smaller shoots appearing at the youngest and in between. These are clearly modified stems and not roots.

I have seen many cacti do this to some degree or other. Off the top of my head the following come to mind:- several Opuntia, several Echinocereus, Escobaria alversonii, several Trichocereus and others related to Trichocereus, which often send shoots out of the bottom of their pots. Some of the Opuntia rhizomes have measured in excess of 10 feet long. This was a bit of a problem with my childhood cactus garden, as Opuntias kept coming up in unexpected places and when I tried to weed out these unwanted seedlings I would usually just haul them out without a second thought (as most of them really were seedlings) and end up by unearthing half a dozen or so of my pet plants under which the rhizome had grown.

....from H. Middleditch

In the illustration of Erdisia philippi published in Britton & Rose Vol.2 Fig 157, the lower part of the stems are a distinctively pale colour, suggesting that they were growing below the surface of the ground, just as R.Ferryman describes. The thick rootstock which looks rather like an underground extension of the stem has a parallel in the underground stem growth reported on Erdisia meyenii. The underground stem growth on Austrocactus coxii reported by D.Ferguson on plants found just across the border in Argentina, is an example of parallel development under comparable environmental conditions. In just the same way, dwarf bushes on the high Puna or altiplano exhibit a very similar overall habit even though these consist of representatives not just of different genera but even of different families. Hummock shaped growth forms are also found on the Puna, not only in Tephrocacti but also in other plant families. Overall growth form can tell us more about the environment than about the plant.

....from J. Watson.

The most northerly point at which we came across Austrocactus was at El Choique, on the road from Malargue to Chos Malal. It has to be said that the vegetation types at the three sites where we found Austrocactus are fundamentally different, let alone the individual elements. I would categorize them thus:

Lagunillas: Central cordilleran mid-alpine associations, very rich in species.

Pino Hachado, P&W 6298; Northern Patagonian steppe enclave at montane level (i.e. at lowest level of Araucaria belt), between dry plain flora to the east and central-southern alpine communities to the west, moderately species rich.

El Choique, P&W 6118; Patagonian/Cordilleran summit cushion and rosette flora, species rich.

In more detail, Pino Hachado had the following elements in common with Lagunillas: Genera - Acaena, Perezia, Senecio, Festuca, Tropaeolum, Mutisia, Oxalis, Mulinum; Species - Mulinum spinosum only. Whilst El Choique had the following elements in common with Lagunillas: Genera - Acaena, Calandrinia, Sisyrinchium, Adesmia, Perezia; Species - Tristagma nivalis and T.bivalvis, Sisyrinchium arenarium. All this foregoing is from very rough observation and by no means exhaustive. But I hope that it will give some idea as to how different are the three habitats, associations, and exposures.

....from A. Hoffman

Regarding the other plants which grow in association with Austrocactus spiniflora at Las Aranas, there are quite a number, as the area where this species grows has avery diverse flora:

Chuquiragua oppositifolia
Tetraglochin alatum
Discaria trinervis
Vivianea marifolia
Wendtia reinoldsii
Adesmia spp.
Haploppapus spp.
Nardophyllum lanatum
Colliguaja intergerrima
Mulinum spinosum
Guidelia trinervis
Neoporteria curvispina

Cerastium aravense
Madia chilensis
Chaetanthera spp
Phacelia secunda
Stachys grandidentata
Scypanthus elegans
Quinchamalium chilense

Argylia adscendens
Mutisia sp (vines)
Pachylaena atriplicifolia
Perezia carthamoides
Oenothera acaulis
Oxalis spp
Acaena spp
Tropaeolum tricolor
Tropaeolum polyphyllum
Alstroemeria spathulata
Alstroemeria sp.
Rodophiala rodolirion
Tristagma nivale
Sisyrinchium junceum

Loasa spp
Calandrinia spp.
Schizanthus hookeri

. . . from H. Middleditch

To summarise: the disposition of the stamens in the flower of RMF 81 is unlike the arrangement found in Austrocactus, but it does occur in Erdisia/Corryocactus. The fruit of RMF 81 is quite dissimilar to the fruit on the Argentinian Austrocactus and although it is not the same as the fruit found on Erdisia, it does not differ greatly. In RMF 81 the shape of the seed and the disposition of the micropile differ from that found on seeds of Erdisia, but the testa surface is quite unlike that of Austrocactus seed. Hence there is a predominance of characteristics which link RMF 81/RMF 101 with Corryocactus/Erdisia whereas they display very few features which are to be found in Opuntia or Austrocactus.

CEREUS PHILIPPI Regal & Schmidt

Translated from Regel's Gartenflora No. 31 1982 by H. Middleditch

A Cereus, which Prof. Philippi has discovered in Chile. This belongs to the group of upright columnar cacti with cylindrical stems and 8-10 blunt ribs, which are humped and carry bundles of spines on the tubercles. Owing to the low growth and the moderate sized flowers this should be closely related to the Echinocereus, C.cinerascens and ebenacanthus. A bundle of spines is also illustrated, from the upper part of which a 2½ cm long, strong, stiff, straight central spine points upwards, together with 3-4 spines of almost equal length, and approximately eight radial spines half or quarter as long. The flowers are only of moderate size, more similar to those of an Echinocactus, with obovate petals, the rounded tip terminating abruptly in an upright point, yellowish with a reddish tinge. This species is however especially distinctive on account of the stamens (as shown in the illustration of the lengthways section of a flower) which are inserted in two circles separated from each other, or concentric bunches so to speak, of which the inner bundle lie upright close to the style, whilst the outer concentric series are separate and lie against the flower petals. In both series the filaments are united up to about half height and together with the separate thread-like carriers of the anthers are approximately as long as the crimson style with its lobed stigma, but almost barely half as long as the petals.

The cylindrical stem of about 3cm in diameter, of blue-green colour, branches not from the bottom but at the top. We are indebted for the illustration of this species to Messers. Haage and Schmidt, who had received same from Prof. Philippi in Santiago, who discovered this species in Chile and it was imported by Haage & Schmidt.

...from Britton & Rose The Cactaceae

Erdisia philippi, synonym Cereus philippi Regel & Schmidt. The species has been described in turn under Cereus, Echinocactus, and Echinopsis, from all of which it is distinct. It is remarkable in having the lower series of stamens united into a tube.

....from K. Schumann, Gesamtb. der Kakteen

Echinocactus philippi K. Schm. Synonym Cereus philippi Regel. Living material together with an illustration was sent from Philippi in Chile to Haage & Schmidt. This plant is only known to me by the illustration in Gartenflora; from that I must regard it as an Echinocactus and not as a Cereus. Stem upright, little or not branched (Regel writes that it branches above; the body, where he speaks of as branching sideways, appears to be flower buds).... Areoles 1.0-1.5cm apart.....flowers in the vicinity of the crown, 4cm long; exterior of ovary covered with scales which have prominent wool and weak bristles in their axils. The tube likewise with scales and hairs. Petals....yellow, reddish inside. Stamens.... an inner series around the style (really coalescing??)

....from H. Middleditch

Many of the early descriptions of cacti species include some features which may have been described in a manner which positively helps to correlate them with plants known and cultivated today. Other parts of early descriptions can be somewhat unclear or sometimes even positively misleading. The real problem lies in trying to decide which parts of an early description are helpful, and which are misleading (and why!). In Regel and Schmidt's description of Cereus philippi, my immediate reaction to the statement that the inner bundle of stamens are fused together up to about half height was one of scepticism, not to say downright disbelief. To the best of my knowledge this particular feature does not appear in any cactus flower which has an open rotate form. It was therefore most interesting to see the entry in Karl Schumann's description of this species, where he expresses the query Really coalescing?? in respect of the fused stamens. A quick search through the pages of Schumann's book reveals no other similar interjection with two question marks; from which one may reasonably surmise that he, too, was somewhat sceptical about this particular phrase in the original description. In the original publication

in Gartenflora it is stated that the illustration came from Philippi, but it seems that the description of the plant was undertaken in Europe from the sketch i.e. the description was not by Philippi. From this one may surmise that Philippi's illustration represented the inner stamens by a closely-packed series of lines which was erroneously interpreted in Europe as the inner stamens united up to about half height.

The other very interesting snippet relates to the outer stamens being united up to about half height. This may be interpreted as meaning that the filaments are united with the inner wall of the tube for about half the height of the filament. However, there is nothing visible to me on the sketch of the flower section which is suggestive of this specific feature. Is this once again a European interpretation of the sketch? At a much later date it was reported by Buxbaum that on Austrocactus flowers the lower part of the outer ring of filaments were adnate with the tube. How did it become included in the original description? Was it evident on the original sketch, but not so clear on the copy of it in my possession? Or are the outer filaments on an Austrocactus flower really adnate to the tube? Are they like this in Erdisia flowers, too?

The external view of the flower in Philippi's sketch suggests that the scales on the flower tube are quite large, right down almost to the base of the flower, which is a feature that would be associated with Austrocactus, but not with Erdisia. On the other hand the flower section in Philippi's sketch, depicts only one row of flower petals and there is no sign of large scales on the exterior of the tube; but bristles or spinelets are shown quite positively on the section of the tube. Both these features tend to be associated with Erdisia. On the new growths at the top right of the stem, there is a possibility that these are also buds, and not offsets; if indeed they are buds then the fairly obvious bristly spines may be considered to be rather more Austrocactus-like than Erdisia-like. Hence in this one plant we have some features associated the genus Erdisia and other features associated with the genus Austrocactus, so it is hardly surprising that various generic homes have been found for this plant by different authors down the years.

If one cares to look carefully at the disposition of the ribs and areoles on the original Gartenflora sketch on the inside of the front cover of this issue, it appears that there is a line of areoles (or rib) barely in view at both the left and right hand sides of the stem. Next to them is a further line of areoles on each side, which are shown at approximately the same distance in from the edge of the stem. Then there is a line of areoles which face the viewer, on the centre of the stem. A fairly wide gap remains between this middle line of areoles and the adjacent rib to the left. But in the same space to the right of the central line of areoles there is sandwiched a further vertical line of areoles. The end result does not appear to represent what is normally seen when viewing vertical ribs on a columnar stem.

There are ten areoles on the rib which runs down the centre of the stem. On the rib to the immediate left of centre there are twelve areoles. Thus the areoles cannot be correctly depicted on their naturally occurring spiral. Taken together with the peculiar rib disposition depicted, as well as the large lower scales on the exterior of the flower, and also the spiniferous areoles on the outside of the scales, it would all suggest that this sketch does not accurately represent what happens in nature. It would appear that a fair degree of discretion ought to be observed when interpreting this particular sketch.

In his Pflanzenverbreitung in Chile (Vegetation der Erde Vol VIII), Dr. Karl Reiche provides a chronological bibliography of the botanical works written by Prof. Philippi. In Leopoldina 42 1906, Dr. Ochsenius provides a comprehensive bibliography of virtually all Philippi's works. Neither of these provide a firm indication of any collecting trip to the Cordillera undertaken by Philippi, at a time shortly before the publication of this article.

ERDISIA SPINIFLORA (Philippi) Br. & R. **By G. Looser**

Translated from H. Middleditch from Catalogue Cactacearum Chilensium, Revista Chilena

On 19 September 1928 in the vicinity of Termas del Tupungato, Rio Colorado, Province Santiago, on the road to Argentina at 1500m altitude, was found a goodly number of some plants which agreed precisely with the description and figure given by Britton and Rose and which I take to be this species. They are dwarf caespitose plants, growing on fairly xerophytic slopes, at the side of dwarf bushes as if sheltering under them. Several limbs carried ripe fruit which are of yellowish colour running into reddish towards the top, smooth, succulent, insipid, bedecked with tiny areoles possessing a few spines of 8-12mm in length, white and feeble. At the top of the fruit are the remnants of the flower. The fruits measure 39-51mm long by 24-29mm in diameter and are more or less ovoid. The seeds which were unknown until now are numerous and they are enveloped by a sticky mass. They are flattened, somewhat curved at the point, black, only slightly shiny and measure 2½mm long. They are not hard. The seeds occupy the centre of the fruit, being surrounded externally by a thick juicy layer which is steadily more compact towards the epidermis. The plant lacks glochids entirely in a way that it is not possible for it to belong to Opuntia, as established by R. A. Phillipi.

....from H.Middleditch

From the illustration published by Looser one may surmise that new heads are produced on the underground part of the root or stem. As Looser himself states, this is in conformity with the description by Britton & Rose. It also matches the nature of the plants found by R.Ferryman which were apparently growing under conditions similar to those described by Looser. The illustration in Britton & Rose shows a fruit which bulges more at one side than the other, which is basically similar to the fruit shape shown on slide by R.Ferryman. The location given by Looser is some 40 km due east of Santiago, well into the Cordillera along the valley of the R.Colorado, a tributary of the R.Maipo. The locations for the plants found by R.Ferryman lie some 30 to 35km to the SE of Santiago. Comparing the descriptions given by Looser, by Britton & Rose, and from R.Ferryman, there is but a single difference and that a most remarkable one. Both Looser and Britton & Rose describe the fruit as fleshy, whereas R.Ferryman clearly states that the fruit which he found was dry and hollow.

Bearing in mind the altitude at which R.Ferryman found this type of plant, the altitude of 1500 metres quoted by Looser does seem to be rather low.

....from A.Hoffmann

I also think that there is a mistake in the altitude quoted for this location. With Looser's experience it is not likely to be a mistake in reading the altimeter but more probably a printing error; the Banos de Tupungato, which is the same as Termas del Tupungato, is higher than 1500m! In fact it is at 2700m. I have not heard of any collection of Austrocactus

made in this area in recent years.
.....from J.Watson

We did met up with this very low growing plant at 2300m elevation at Lagunillas (C&W 5175) on the 1971/72 Southern Andes Expedition. I was sharply reminded of this on our 1987/88 trip when laying down flat to take a close up of a quite different plant. I can only recall the one plant, growing in the open in fairly coarse stony ground, so that it was exceedingly difficult to see. Well in fact I felt it rather than saw it. From a print taken at the time of this incident, I see that the only plant in the immediate vicinity was Mulinum spinosum, interestingly enough one of the few unaltered Patagonian species to be found in these associations at Lagunillas, which is extremely species rich.
...from R.Ferryman

There is little doubt in my mind that all these finds of very low growing, stoloniferous, plants are those described originally as Opuntia philippi.

AUSTROCACTUS SPINIFLORUS (Phil) Ritter Sukkulentenkunde VII/VIII 1963
Translated by H. Middleditch from Kakteen in Sudamerika 3.1980

Body forming a turf with more surface than underground rooting-down stolons of 10-20 cm in length and about 1 cm thick, which are lacking or almost lacking ribs; in the latter the ribs are indicated by the lines of areoles at about 5 mm intervals, of about 1 mm diameter, with 8 to 10 fine white 1-3 mm long spinelets. These thin shoots are formed only in relatively poor light (in cultivation, exclusively, if strong light is not provided). Typical stems half upright, offsetting from root stock or from thin stolons, about 6-8 cm long, somewhat club-shaped, 2-3 cm thick, soft-fleshy, dark green. Robust swollen root of about 20 cm in length and about 5 cm thick above, conical, with somewhat narrowing rootstock. Ribs 6-8, straight, about 5mm high, faintly notched or undivided. Areoles about 2mm diameter, white felted, on the humps if such are perceptible, 10-20 mm apart. Spines needle-like, straight; radial spines 5-8 directed sideways 5-10 mm long, whitish or pale brownish; central spines 1-3, stronger, 15-25 mm long, usually somewhat flattened, usually only one projecting, the others pointing sideways; the fine radial spines can even be absent, whilst 3-5 spines with the appearance of central spines are developed, which are usually radially disposed. Flower arises from the side to well down, about 65-75 mm long with 6-7 cm wide bowl shaped opening, scentless. Pericarpel 20-27 mm long, half as thick, green, with fine reddish scales, small white wool flocks and bristles as for the fruit; ovules pale pink, on long funicles. Nectar chamber 3-4 mm long and the same in breadth, yellowish, with nectar. Tube funneliform below and 5-6 mm broad, basin-shape above the basal filaments and 15-20 mm broad, 10-15 mm long. Stamens in two series; above the nectar chamber and a sprinkling at the base of the petals; filaments white, 20-25 mm long. Anthers citron yellow to almost white, all more or less at the same height. Style white, with about 10 outspreading 7 mm long pale yellow stigma lobes, barely or not projecting above the anthers. Petals about 40 mm long, 15-20 mm broad, blunt above or with fine points, the outers paler deeper carmine, the inners yellowish white. Fruit 35-60 mm long, 15-25 mm thick, thinning at both ends, pale yellow, redder at the sunny side, with a few raised areoles, of 1 mm diameter with a few fine white stiff spiny bristles of about 5 mm length, with persisting flower remains; flesh pale green, scentless and tasteless, very viscous; the fruit remains on the plant for many months. Seeds 2.5 to 3 mm long, 1.8 to 2 mm broad, 0.8 mm thick, dorsal somewhat keeled, basally pointed but rounded in outline, with an indentation on the flanks, black, matt, very finely granulated. Hilum ventral in a depression, short oval, whitish, with micropyle at the margin. Habitat: mountains and high altitude canyons in the Cordillera to the south-east of Santiago up to about 1500 to 2500 m altitude. No. FR 462.

According to its growth form, flower, and seed type this species is undoubtedly an Austrocactus, even if probably most nearly related to Corryocactus of all Austrocactus species. It has been placed under seven different genera and in addition under four different species names. Hopefully it has now found its final systematic classification in the genus Austrocactus.
.....from H.Middleditch

There is no reference to vestigial leaves in this Ritter description; is that because there were none to be seen, possibly because the plant was examined when not in full growth? The description of the fruit is a good match for that photographed by R.Ferryman, and although Ritter's description of the seed is not entirely a match for the seed collected by R.Ferryman in Chile, the two are certainly closer than either of them are to the Argentinian Austrocactus. But the really astonishing part of this description is the stamen insertion on the flower. At the Chileans' Weekend we have seen the slides of the flower and the flower section taken by R.Ferryman on the ex-habitat plant in his own collection. That flower section displays one series of stamens inserted approximately at the middle third of the tube; this is quite different to the stamen insertion described by Ritter which is a typical Austrocactus stamen insertion pattern. There is always the possibility of one abnormal flower, just as an Austrocactus flower with an abnormal stamen insertion was described in K.u.a.S and reproduced in Chileans No.39. But the degree of divergence between the flower section from RMF 101 and that describeds by Ritter appears to be outside the bounds of an abnormal stamen insertion. Are we obliged to consider the possibility that we could have both an Austrocactus and an Erdisia growing in the high mountains to the north and east of Santiago? If so, why does the Ritter Austrocactus not have the sort of Austrocactus fruit we are used to seeing?
....from A.Johnston

But does not Ritter quote the bristle-less, green, non-splitting type of fruit both for Austrocactus spiniflorus and A.hibernus, just like the fruit on RMF 81 which we have been shown by R.Ferryman?
.....from H.Middleditch

So what is the fruit really like on cultivated plants of A.hibernus?
....from R.Ferryman

Both my collection numbers have flowered for me several times now and whilst I cannot admit to sectioning every flower, I have made and recorded flower sections on four separate occasions. None appeares to be very different and none included a two series stamen insertion. Tom Jenkins has flowered his plant of my RMF 101 collection and Dieter

Forstman in Chile has a piece off my RMF.81 which has flowered every year. I confess though that I doubt if they will be any different from the flower section which I showed to the Chileans' Weekend. It is of course possible that Ritter reported an abnormal flower but in my opinion it is rather more likely that he was working from memory and simply 'got it wrong'.

AUSTROCACTUS PHILIPPI (Regel & Schmidt) Buxb. & Ritter. Sukkulentenkunde VII/VIII 1963.
By F. Ritter, Kakteen in Sudamerika 3.1980

[The original description repeated in part, together with Schumann's later observation that the so-called side offsets appear to be buds] .... This species has not been rediscovered up to now. The dual authorship under Austrocactus is based upon a coincidence. The recombination was undertaken by both Buxbaum and myself in the same issue of Sukkulentenkunde without each others' knowledge; each of us had come to the same conclusion independently of the other on the basis of his own investigations.
....from H.Middleditch

It remains unclear why Ritter decided that both A.spiniflora and A.philippi merited separate specific status.

FROM SANTIAGO TO VOLCAN MAIPU. By F. J. F. Meyen.
Translated by H.Middleditch from Reise um die Erde 1834

The protracted delay to our ships at Valparaiso led to the decision to set out at once on a second trip, and this time to the source of the Rio Maipu and the volcano of the same name which we had already seen from the plain on our trip to San Fernando. The introductions from the Minister Don Diego Portales to the military governor of San Jose and Tollo led us to expect admission and support from them, as they had to San Fernando. We used the day following our return to Santiago to arrange our collection and to bring the diary right up to date. [Obtaining provisions delayed by feast day]. Only on 14 February were we able to leave Santiago early in the morning, bringing with us one servant, one muleteer, with three horses and one pack mule. Our horses were very unruly and constantly at a gallop [Galloping was prohibited in the streets of Santiago].

The road led us again over the Canada to one of the southernmost exits from the city, then turned away towards the high mountains, more to the east than the road which we had used on the trip to San Fernando. The surroundings were everywhere well watered by irrigation ditches and industriously cultivated, the people being motivated by the profit to be obtained from the closeness of the capital city. The irrigation water is distributed here by means of a canal, via which the water from the Rio Maipu flows through the plains to the Rio Mapocho and at high water level of the latter, even that water can be led to the plain and the Rio Maipu. From Cachon de Maipu, close to the mouth of the huge ravine out of which the Rio Mapocho enters on to the plain, the canal begins and the banks lead it through the high outcropping bedrock. (Syenite of average grain size, with white albite, greyish-white quartz, greenish-black hornblende and small isolated flakes of tobak-brown mica). It was closed by means of three sluices, whose posts had been made from the adjacent syenite. In the time of the spaniards the government attempted the work more than 40 years ago, until the very time as all the large works that this land has produced were built, under leadership of the renowned O'Higgins (Canal built 1822-1823). We came across a number of small country dwellings and found the inhabitants out and about.

The Rio Maipu forms the boundary between the districts of Santiago, Melipilla, and Rancagua; however, one also recognises in it a natural boundary, almost a dividing line, between two very different climates. North of the Maipu it never rains in summer and only very occasionally in winter; south of this river however is a greater abundance of moisture. The Mapocho plain, as we have earlier remarked, has a distinct descent at about half a league away from the Rio Maipu, and coincident with this there appears a change in the vegetation and in that way a change in the landscape. The Rugi, the chilean reed (Arundo rugi, Molina), rises extensively long the banks of the Rio Chado and the Rio Tinguiririca in the province of Cacahapoal, and is indeed extraordinarily abundant there; we have never come across it again on the right bank of the Rio Maipu. Likewise there was nothing evident here of that imposing vegetation which bordered the banks of the Rio Tinguiririca and causes the traveller so much astonishment there.

On the left bank, close besides the spot where the river comes out of its canyon into the plains, lies the fertile village of San Juan, and opposite it on the right bank, only still somewhat higher up on the mountain, lies the small village of Cachon de Maipu, consisting only of some scattered huts and a small store. From here onwards there begins a truly romantic tract of country, through which the river tumbles in huge cataracts, roaring and foaming over great masses of rock, and is confined between high and tight sides. On this broad stretch the road, which is naturally only passable for pedestrians and riders, goes close to the edge of the precipitous chasm, which is still covered with tree-like vegetation and thereby blocks out from the traveller's view the mysterious murmur of the waters in the bottom of the canyon. Some dainty houses stand here, in the ever green woodland, and one can see that the inhabitants do as well as the fertility of the ground. On the european fruit trees, which have been planted in great numbers, we often found a splendid Loranthus, whose scarlet flowers were present in such extraordinary numbers that they completely covered certain parts of the trees.

The geological formation of this area is very complicated and only a lengthy continuous investigation could yield any explanation about the sequence of the many different dioritic and porphyritic rocks, which outcrop here in great thickness. In the Mapocho plain the base strata is greenstone-porphyry and over it lies a beautiful syenite, in which large fossils are present. Further upstream on the banks of the Maipu river is a greenstone-porphyry - it appears to be the same greenstone-porphyry which forms the cap of Mount Impossible; the latter occasionally forms very regular 6 or 7 sided columns of colossal size, which are often 10 to 15 feet in diameter with a length in proportion. All this strata extends to the NNW, likewise that at the Rio Tinguiririca, as we have discussed in the previous chapter.

So we arrived at the mouth of the Rio Colorado which lies at some 8 leagues distant from Santiago. The R.Colorado comes from the NE and flows SW to S, is about 30 paces wide but at the time of the rainy season is very hazardous. It has very high banks and one must first move off upstream in order to find a clear crossing point with low banks. This crossing was possible by a bridge, which was put together in the simplest manner with baulks which are laid across from

one rock to the next, but even lacking any handrails, although it lay more than 20 feet high above the surface of the river, which ran below in powerful tumult. The crossing over this bridge without handrails was part of the most dangerous section of the trip and yet it was a easy matter to rectify, since timber stood in abundant quantity close by and many villages constantly had to make use of this road; even the shortest way over the Cordillera to Mendoza likewise went over this bridge. This pass to Mendoza is only made use of in the middle of the best season, since it is often given a very bad name because of the drifting snow which would so frequently be prevalent in this area of the Cordillera. Also on the right bank of the Rio Maipu we passed many very large quebradas, which were certainly dry at our season but in the winter time must be dreadfully swollen, to which the rubble strewn bed bore witness. Not far off the bridge which went over the Rio Colorado is a house where, because of the pass, one is questioned about any trip to or from Mendoza; declare here that one only travels to San Jose, Tollo, or the other villages on the Chilean side of the Cordillera in this area, then one may pass unhindered. [References to Miers' crossing of the Uspallata pass and Gillies' trip across the border via the Rio Yeso on 1.3.1826]

From the bridge over the Rio Colorado, up to the next village of San Jose is reckoned to be about 3 leagues the way the road goes, always close to the Rio Maipu, up hill and down dale, which is frightfully heavily wooded, until at last a broad valley opens out, which is covered with green meadows and in which San Jose is found. This place is remarkably large, it extends perhaps a full league from the Rio Maipu, and one notices within it some very large and well-to-do residences. The type of men themselves are uncommonly fair. As we arrived at San Jose towards noontime, the heat in the valley was very oppressive, and we found whole families resting in the shade of the trees in front of their dwellings. .... At the outermost edge of this place the valley disappeared on the right hand side of the river and huge walls of rock appeared to form the sides. At just this point is to be found a suspension bridge which is constructed in the same fashion as that which we have described on the occasion of our trip to San Fernando, only this one is smaller and also probably less substantial; at the end of the bridge there are open reels and pullies by means of which one can pull it tight. The road over the bridge goes to the small hamlet of Tollo, which lies close to the left bank of the Rio Maipu, and to there we directed ourselves.

Tollo consists of only a few scattered houses which mostly belong to Herr Bunster, a well-to-do mineowner very well known in Santiago; his mines lie not far away in Portillo over which goes the pass to Mendoza, and the ore from those mines is worked up here at Tollo. In the course of ur arrival at Tollo the people had just arisen from the siesta and we had to wait the best part of an hour, before anyone welcomed us. [They met the small troop of soldiers who were to escort them for the section of the journey to Volcan Maipu, together with the military commandant, who ..] ..thought it was about 20 years ago that a Frenchman came to these parts, but was not able to climb the volcano and indeed only because of the scree. But without exception we were taken for Englishmen by the common people of this country, no doubt because this stems from their curious reputation since Drake's time.

The mealtime was finished as we arrived at Tollo and so we went empty again, until we plucked some peaches. [They were obliged by the military commander to return with their escort to San Jose in order to obtain provisions as well as fresh horse and mules used to the altitude and only then doubled back to Tollo]. It was our luck to meet up with one of the Bunster brothers at Tollo, in whose company we passed some very pleasant hours. .... The climate at Tollo is extraordinarily pleasant, only at midday is it rather too hot on account of the effect of the direction of the sun's rays. On the other hand it was remarkably tolerable in the shade. [Temperature readings quoted]. At Tollo we never saw the sky clouded, whilst the foregoing observations showed an unprecedented dryness, since at 2 o'clock in the afternoon the wet-and-dry bulb thermometer showed a difference of 10·3^{0}R. Especially remarkable is the sharp drop in the temperature during the night, when the sky appears to be wonderfully bright and clear. We were inclined to put the height of Tollo at not more than 2000 ft above the plain at Santiago whilst the absolute height of the place above sea level amounts to only 3600 ft. Yet it freezes even here, not infrequently in the winter time, and even the figtree does not thrive here any longer.

We made use of the second day of our sojourn at Tollo in investigating the surroundings and collected there a large number of natural history specimens. The small permanent waters in the vicinity of Tollo were covered with the dwarf Azolla magellenica, which was just then to be found in fruit, which provided information to amend this genus. The Charadrius cayanus, the lapwing of this country, strolls around here and there in the surroundings, and a small elegant lark of reddish black colour sings unceasingly its melodious song. Tollo lies at the foot of some high mountains which are composed of pumice-stone and in the middle of two quebradas which empty into the Rio Maipu; the westerly one is the Quebrada del Sauce, which in the present summer season has almost completely dried up, but the easterly one - the Quebrada del Tollo - has good water and is quite important. In its bed we found Calceolaria aesculpii Mol. (Coronella chamissonis sp.nov.) as well as a pretty Tropidurus oxycephalus sp.nov. The self-same hydrophyte which we found in the water of the quebrada at Valparaiso also occurred here in great abundance. Fortunately we surprised here a reddish brown bird spider (Mygale scrofa sp.nov., Aranea scrofa Mol.) which stood on the road and fed on a piece of watermelon. This hairy spider was 7½ inches across its legs and had such a repulsive appearance that it would never be grasped. As it saw us approaching around it, it stood up in a defensive attitude, planting itself on its hind legs, the jaws opened widely and the forelegs stretched out ready for combat, but at the same time not letting go of its prize. Fortunately this large animal is harmless; the children will, as Molina has already related, break off the great projecting jaws and then use it as a plaything. .... We put on record here that the species of the genus Mygale only live on vegetable matter and that the legend that the bird spider waylays small birds is just a mere fairytale.

Don Bernardo, the military commandant at Tollo, had been constantly occupied with making arrangements for our trip, so it was possible for us, already on the following day after our arrival at Tollo, to set out on our trip to the Volcan Maipu. As soon as the siesta was finished, and the excessive heat had abated, we mounted on horseback and once again went over the Maipu bridge, on to the right bank of the river, where the track henceforth remained. Our troop consisted of 8 soldiers, 5 peasants from the militia, a guide, two servants and the Alcade of the surrounding district. Don Bernado himself led the troop and accompanied us some leagues further, then he pulled up, transferred the command of the caravan to the Alcade, then turned round and explained in a long discourse all that he had done to satisfy our wishes and those of the Ministers and to hope that we had been satisfied with it.

The road continued not far from the riverside and went at first along the foot of the Sierra la Aida de Almedro

which, as we saw, consisted entirely of greenstone and is quite extraordinarily precipitous. Up to a distance of more than two leagues away from Tollo, we came across single scattered houses in the vicinity of the track and later came upon large fenced-in gardens in which the inhabitants of the area kept their horses and mules in common. Soon the last trace of mankind disappeared and the track became exceptionally poor and difficult to follow. We reached a spot where it was very obvious that the valley in which the Rio Maipu was now flowing, was formed at one time by the base rock fracturing and splitting away from each other, thus forming the present sides. This grey-black stone, a very dense porphyry, is laminated and rises up on each side of the river; it extends at an angle of 45 to 50^0, but on the other hand lies horizontal now and again at other places. Three leagues away from Tollo the Rio Maipu makes a very tight double bend and the water breaks with a terrifying roar against the bare rocks, by which it is confined to its bed. There the road constantly passes uphill and down dale, so the journey went at the slowest pace of progress and not till about midnight did we reach the pleasant valley in which some dwellings were to be found, 5 leagues from Tollo. Here we stopped overnight with an old and very kind family, who received us with the greatest hospitality. Here were being cultivated the finest fruits of our continent, e.g. fine pears, sour cherries, and even figs and wine, although the last was still very late, although in the plains it was almost consumed. The largest city in south america which lies at the foot of the Cordilleras has the great advantage that at all times of year it has fresh fruit to show, because the higher it grows the ever later and later it ripens, until finally on the coast the succession begins afresh. The climate is here already less pleasant than at Tollo, in winter the snow will fall quite deeply here and remain lying a long time...

The 16th February. The valley in which we stopped overnight ran from west to east of south; to the south, on the left bank of the river, ran the Sierra del Ingenio de San Pedro Nolasco, and on the easterly side of the celebrated Sierra de San Gabriel, over which goes the road to Mendoza. We examined the rock there, that already was part of the mountain ridge of San Gabriel and found a place where the syenite was mixed with a very interesting sort of Trachyte, in which it appeared to lie oddly and stretched right alongside. The slope of the body of porphyry was itself some 500 feet high and right in the middle of it appeared the syenite.

As soon as the caravan had been got ready, we took leave of our kind hosts .. who presented us with a sack full of pears. One league from our overnight camp, the Rio de Yeso discharges into the Rio Maipu, which flows out of the mountains to the north-east. We calculate the distance between the junctions with the Rio Yeso and Rio Colorado pretty closely at 8 to 9 leagues and find it very accurately recorded on the old Spanish map of La Cruz, indeed even the tight bends on the Rio Maipu of which we have spoken above are shown on it. Further upstream however, over the Rio de Yeso, the track of the river is incorrect on that map. .... among the lumps of rock which lay along the track we found a piece of red, brittle hornstone, joined to greenstone porphyry with a reddish-brown base.

The crossing of the Rio del Yeso is, because of the narrow and simple bridge without handrails, extremely hair-raising, although fortunately for the crossing there lies right in the middle of the river a large rock of dense green epidote which again serves as a pier and thereby makes the short spans less hazardous to cross. On the other side the road goes up the Morro del San Anzico, a very striking mountain which rises aloft like a blunt cone; it is likewise composed of syenite. The table salt which had crystallised here and there in the vicinity of springs, was very pure and palatable. as also was the brine; if the spring was once cleaned it was probably so abundant that it could be used for the preparation of salt in commercial quantities...

Around noon we arrived at Queseria, a small hut where one man was to be found with his goat and cattle herds, and in which he makes cheese throughout the summer. The valley widens here somewhat and, with its alpine vegetation, affords the herds a splendid fodder. .... The millions of flies and small mosquitoes are not to be mentioned, of which the individuals completely cover these containers, and by their fermentation, with the burning heat of the sun, give an extremely disagreeable smell. For our soldiers this chilean cheese-hut was was a place for respite and with real voracious appetites they fell upon the cheese here, which here was naturally very cheap; but we had to leave the spot since even at a range of fifty paces it smelled very strongly.

By means of comparisons with the vegetation and the temperature we estimated the altitude of this spot at 9000ft. above sea level. At 2 o'clock in the afternoon the psychrometer of Herr August gave us $17{\cdot}4^0$R dry, $8{\cdot}2^0$R wet. Besides the high degree of dryness, the rapid falling off of the temperature around 2.30 p.m. was very noticeable, which could only be accounted for by the closeness of the snowline and the swift downhill cold wind. On from here one had the prospect up to the Vulcan Maipu and a vale on the great range, which was covered with permanent snow. The Vulcan was separated from the Rio del Volcan by the mountain ridge Monte Valde, behind which the Quebrada Morale ran into it. Never in the Cordillera have we seen more condors, than just here .....[Observations on Condors]

Around 3 o'clock we departed from Queseria and set out on the most difficult track which we had ever travelled over. It took over two hours and ran steadily along the slope of the high mountain chain behind, which still formed the right bank of the Rio de Volcan, and is completely covered with boulders. The body of the mountain at first consisted of a black porphyry and of alpine limestone of a blue-black colour, in which lie vertical beds; their tops form a continuous and repeatedly notched ridge, which now arises tower-like, now breaks off with steps and is set with deep notches, which looks as though they were washed out by rushing waters. This alpine limestone contains an unlimited quantity of fossils among which the ammonites make themselves particularly prominent; we even saw a specimen of 3 feet across, but such a large lump of stone could not be carted down with us on account of the rapidity with which we had to travel. ...[Observations on other fossils]

We pressed ahead along this difficult trail, which apart from some spiny leguminosae, mostly adesmia, and some shrub-like syngenesious plants (Bardnadesia lanata sp.nov., Perezia diversifolia v.crispa, sp.nov.) had only a few further plants worthy of note. The body of the mountain was found to consist entirely of porphorytic conglomerate, which at almost every thousand paces changes its colours; now it appears mottled green and white, now red and yellow, now brown and blackish, and so it goes on until the river valley expands into a plain, which runs right up into the snowfields at the crest.

Finally there opens up the Quebrada del Guilloa Muerte, at an angle of 30^0 to the Rio del Volcan; through it runs the trail, which was made very hazardous because of the rushing water and the many boulders lying in it. The Rio del Volcan here forms some very fine waterfalls; three times the mass of water cascades from ledge to ledge, of which each drop appears to be 30 to 50 feet, and is completely shrouded in fine mist from the water spray. After we had crossed over this river

and climbed a small hillock, we arrived at an extensive plain, which stretched as far as the cone of the volcano. We pitched our camp on that, under the shelter of some huge boulders which had come down the adjacent mountainside. From there we had the top of the volcano right in our view. Barely had we come to a stop than our whole caravan sprang into life. The horses and mules were let loose over the fine sward hereabouts, which covered the whole plain. Some of the peasants went off to search for wood to collect for the night fires, which was to be found only sparsely in the form of small bushes of leguminoseae and syngenesists. The soldiers had piled their arms and collected round their fire at some distance from our camp, whilst the others fetched water and stuck some meat on their bayonets to grill it.

During these operations we wandered around and collected in that place the most extraordinary treasures. Here grew Acuenea aculeata sp.nov., A.stellaris sp.nov., Plantago grandiflora sp.nov., Mutisia hookeri sp.nov., Bowlesia flexilis sp.nov., which grew in the crevices of the rocks, a new Myriophyllum which quite thickly crammed the small stream which passed through the plain and later discharged into the Rio del Volcan. Several oxalis and the pinkish red flowers of Calandrina umbellata R & P, C.denticulata Hook., and C.biflora sp.nov., covered whole patches as if with a carpet and held the eye with great pleasure. Further uphill, up to the nearest edge of the snow, extended an immense meadow which was overgrown with the finest greenery and was ornamented with isolated brightly coloured flowers. Here we collected Phleum haenkii Presl., Vilfa asperifolia sp.nov., Deyenzia velutina sp.nov., Hordeum comosum Presl., Elymus agropyroides Presl., and the fine Luzula chilensis sp.nov. As soon as the sun waned, the largest part of the flowers in this area closed up, and immediately a sensibly lower temperature set in; no small birds were left to be seen, only the condor hovered at an extraordinary height, motionless watching over us.

At 6 o'clock the psychrometer read 8·10^{0}R adry and 4·2^{0}R wet. Between 6 and 7 o'clock the peak of the volcano suddenly became enveloped in cloud, whilst it had been quite free of all vapours for the whole of the rest of the day and also usually by night. We pitched our camp on this high plain, close to the snowline, to have the crater of the volcano right in the most practical closeness of view, and to be able to take careful note of the effects. But... the whole night long the volcano did not light up one single time. In the previous night the glow was so extraordinarily fine in the bright and clear sky that we were already congratulating ourselves on coming on to the cause of that very effect quite soon. ...[Discussions about the night-time glow].

We had to contend with a very troublesome night, since after sunset the temperature of the air fell very low, and a very fierce biting wind came down from the snow fields on the mountain ridge, against which we could not keep ourselves upright. At this spot we could no longer continue the meterological observations right after 7 o'clock since the wind was so fierce that we were in a position to read off the graduations on the thermometer neither with the help of a light nor with a firebrand. So we were extremely glad when the new day dawned and strengthened ourselves with Paraguayan tea again for the work of the new day. We had decided to depart as soon as possible in order to proceed rapidly as far as the snowline, where we would again make a halt and undertake some excursions. But even here, as usual, the horses had strayed away in the course of the night and first we had to ride out in all directions in order to find them.

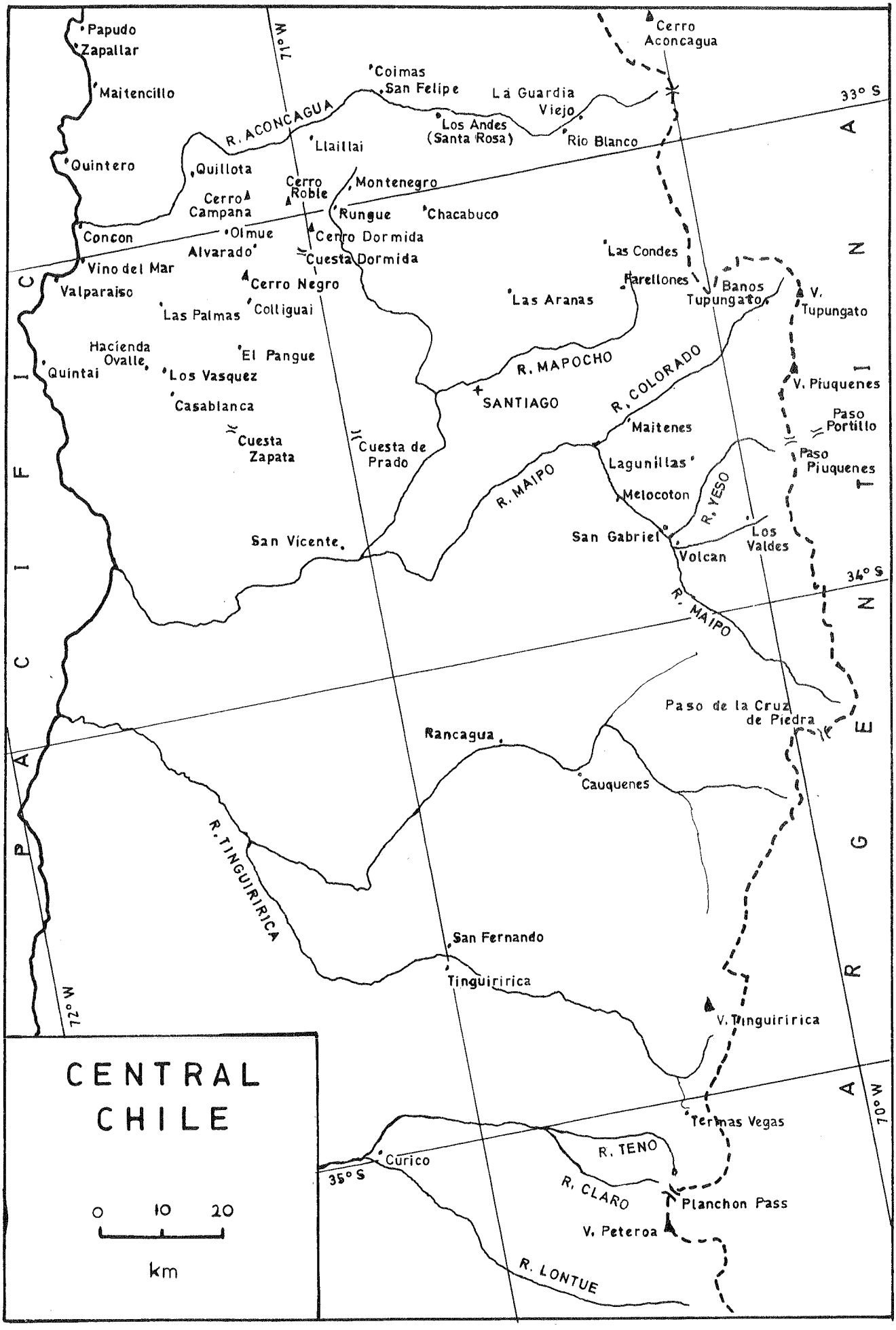
Whilst most of the men were occupied with capturing the horses, we undertook an excursion in the vicinity. We were astonished, even at this height and with the lower temperatures that had reigned during the night, to find the plain dry and without any dew. Only at isolated places of very restricted extent, as in the gulleys, through which small streamlets flowed down, or where marches had been formed, were the plants there close to the edge of the waters covered with hoar-frost. The psychrometer showed 5·5^{0}R dry and 1·60^{0}R wet at 5.30 in the morning.

With the rising sun warming up, apart from the condor we saw several birds, amongst which we shot a new duck (Anas pyrrogastra sp.nov.) and another bird from which we have established the genus Ochetorhynchus. The O.ruficaulis as we named this species, usually perches on the edge of one of the rocks lying around hereabouts, and snaps after the insects flying round there in the fashion of our robin redbreast. There exists in this region, as we have noted above, a limitless number of small mosquitoes, then afterwards there is a burning effect at different places on the hands.

. . . already on the journey of yesterday we have drawn attention to the perpendicular disposition of all the layers in the alpine limestone and to those of the porphyric-conglomerate, which is to be seen here on the left bank of the Rio del Volcan, the self-same body of rock but seen here as level strata. In the area where we had pitched our camp, a mottled and very handsomely coloured porphory like almond-stone predominates; it outcrops in the mountain range, which lay SW from our view, in vertical standing layers, to a thickness of several thousand feet. The notched or the deeply fissured ridge of this stone gives the whole a very picturesque form. Colossal boulders have tumbled down from these almost vertically rising cliffs and rolled away near or far into the plain. The larger rocks among whose shelter our camp was pitched, similarly originated from there. Before us directly to the east extended the ridge of the Cordillera, which was covered far and wide with permanent snow, although everywhere there, where any steep slope was found, one caught sight of the perpendicular, almost column-like, disposition of the strata, the pophyry as well as the alpine limestone.

Not until 9 o'clock were all the horses and mules captured, and after all the collected treasures were packed away, the troop set out again on the move. Roughly an hour later we had to cross the valley up to the east and found there several small bodies of water which were piled up with the small Charen and a Triglochin (T.chilense sp.nov.) After that there opened to the south a valley at whose end the celebrated Volcano arose. A small beck, which came down from the snowfields on the volcano, flowed through the length of the valley and supported the magnificent fields of flowers which were to be found there. Deep gulleys, huge boulders, and subsidence of the washed-together ground, conveyed the enormous force of those waters which must have moulded it centuries ago.

We visited this area at the end of summer, also at just the best season for the flora. Whole fields of considerable extent were covered with the large inch-long flower of Mimulus guttatus, whose corolla is so hansomely speckled with reddish purple. The Calceolaria nudicaulis sp.nov. alternates with the violet flower of Calceolaria arachnoidea, whose leaves are almost as densely hairy as our Stachys germanica. Thousands upon thousands of these flowers stand right alongside each other, and the spiny bushes of Adesmia with their reddish-yellow flowers, as well as some bush-like syngenistas, enclose the surroundings. No more surprising appears the transformation of the bedrock; both sides of the whole valley was composed of the most ancient creat of horizontal strata. There was even zechstein, which we had already found


Papudo
Zapallar
Maitencillo
Quintero
Quillota
Cerro Campana
Concon
Olmue
Alvarado
Vino del Mar
Valparaiso
Las Palmas
Hacienda Ovalle
Quintai
Los Vasquez
Casablanca
Cuesta Zapata
El Pangue
Cerro Negro
Colliguai
Cerro Roble
Montenegro
Rungue
Chacabuco
Cerro Dormida
Cuesta Dormida
Llaillai
Coimas
San Felipe
La Guardia Viejo
Los Andes (Santa Rosa)
Rio Blanco
Cerro Aconcagua
R. ACONCAGUA
Cuesta de Prado
R. MAPOCHO
SANTIAGO
Las Aranas
Las Condes
Farellones
Banos Tupungato
V. Tupungato
R. COLORADO
V. Piuquenes
Paso Portillo
Paso Piuquenes
Maitenes
Lagunillas
Melocoton
R. YESO
San Gabriel
Volcan
Los Valdes
R. MAIPO
San Vicente
Paso de la Cruz de Piedra
Rancagua
Cauquenes
R. TINGUIRIRICA
San Fernando
Tinguiririca
V. Tinguiririca
Termas Vegas
R. TENO
Curico
R. CLARO
Planchon Pass
V. Peteroa
R. LONTUE
71° W
72° W
70° W
33° S
34° S
35° S
CENTRAL CHILE
0 10 20
km

yesterday on the right bank of the Rio del Volcan, outcropping close to Queseria, which also composed the right side of the valley here, and was covered with an enormously thick bed of crystallised gypsum. On the left side of the valley the mountain chain rose for about 600ft. and appeared to be composed of Gypsum and a dense, finegrained limestsone of bluish-grey colour. Huge blocks of these shining white mass of crystals had been cast down everywhere and gave a very beautiful appearance to the green fields abundantly covered with flowers. But if these huge blocks of gypsumm become lit up by the sun, then from a distance it is not possible to distinguish between them and the snow or ice fields, or the dividing line between parts covered by one or by the other.

At the end of the valley we reached the snowline where we had to leave behind all the horses, because of the scree. Only here and there, often at intervals of 30 to 40 paces from one another, grew some isolated plants, which formed compressed hummocks and looked quite odd. We collected there: Phaca arnothiana Hook,, Ph. cruckshankii Hook and Arn, some find new Nassauvia (N.pyramidalis sp.nov., N. multiflorum sp. nov.) as well as N.nivalis Less, as well as the nice Alstromeria umbellata sp. nov. and some superb composites, from which we have erected the genus Metanzanthus (M.grandiflorus sp.nov., M.cacaloides sp.nov.). Distinguished above all was a new Calycera (C.ventosa sp.nov.) in which the rhyzome swells up bladder-like and serves as the base for a number of stalked or unstalked, or at least very short stalked, umbels. The umbels are, with their flowers, so closely packed against one another that they form a single compact hummock. These growths appear between small stones and look very unfamiliar; there are in this way flower heads, if we are allowed to so-call them, which have a diameter of 6 to 8 inches. A large grasshopper was the last insect that we saw here, it was indeed quite bewildered here, on the cone of the volcano.

[The party climbed the cone of the volcano and then returned to Santiago by the same route as they had taken for the outward journey, but visited the hot springs at Colina en route].

. . . from J. Watson

Meyen is familiar to me as the discoverer and author of several alpine Alstroemeria spp., one of which I know from its classical location above Santiago. So it was with some anticipation and curiosity that I read through this excerpt from his journey.

It came as quite a shock to realise how dramatically Man has altered the landscape in 150 years, no less the environs of Santiago de Chile than those of London. I found myself browsing carelessly without checking against the map, and wondering which remote country locality he was describing; thinly populated and dominated by the turbulent Rio Maipo. Reading on, it became apparent that this was the area around Puento Alto, no less, something of a barrack town today, and completely cut off from nature by the ribbon development besides the modern road and by the press of urban buildings. Beyond here the splendid Maipo gorge does become apparent, but as the speeding landscape seen from the fast, wide, concrete block road well above, an accompaniment to Bach or Beatles tapes playing on the vehicle stereo in anticipation of the glorious mountains ahead. For Meyen it was a long, slow initmate journey on horseback, full of detail and natural observation. I compared his intrepid and dangerous negotiation of the Rio Colorado confluence with the brusque command to drive on and not take photographs which we had received from the sentry posted on the fine modern road bridge.

Not far beyond here, below the rugged scrub and Trichocereus clad towering walls of the precordillera near San Jose de Maipo, we used to camp regularly. Once only at this relatively low altitude and much earlier in the season than Meyen's journey took place, we came upon the rare Austrocactus spiniflorus, during a post-prandial wander. Its solitary and obviously sizeable pink flower was disappointingly collapsing and closing almost visibly like a fist. Lamina 80 of Adriana Hoffmann's superb new pocket monograph shows us in all its glory what we missed. Surprisingly enough, San Jose de Maipo itself sounds as if it could have been at least as large and important in Meyen's time as it is today. Certainly we get the impression of a long established colonial settlement with cool squares, balconies and older buildings.

Now for a confession. Beyond here we almost invariably struck off due east into the Andes for one of our all-time favourite stamping grounds, Lagunillas. Here. up to around 2500 m, we would occasionally encounter Austrocactus, but always out of flower and quite inconspicuous, such that it once discovered me by the painful expedient of embedding itself in my thigh as I lay flat to photograph something else! We had always assumed this to be A.hibernus, but now I suspect it could be A.spiniflorus again. Somewhat lower down the commoner Eriosyce ceratistes occasionally put in an appearance and with generous formation of seed, but here too we did not see flowers, as we had often done further north at Illapel and Coquimbo. These are our sole encounters with small cacti in the Metropolitan area.

Rarely have we continued roughly southwards, like Meyen, following the course of the Maipo, but have always been seduced up one of the Andean side valleys before long; to the Yeso reservoir or to the Banos de Morales. So we have never duplicated his journey to Volcan Maipo. Meyen's hut of stinking cheese has long gone, and with it the attendant swarms of flies. Here it must be that Meyen's and our journeys diverged finally, though for a while they run parallel, ours tracking the valley of the Rio de Volcan via the Banos de Morales; his along the heights above.

At this point Meyen is close enough to our route for geological similarities to ring familiar bells, and his descriptions of the alpine heights and flora and fauna tally comfortably with our own experiences nearby. Except that we have never seen condors here: plenty in other parts of the Andes though. Everything would seem to be unspoilt now as then. There is one likely exception, today's great copper mines. Ironically, if anything these actually serve to protect the environment, as they limit public access to persons persistent or influential enough to obtain official permits in Santiago; Adriana fell into the latter category.

The same plate-like grey vertical limestones outcrop above Banos de Morales, their fossils teen and legion now as then. I staggered back with a huge slab for Adriana's collection resting on my bowed shoulders. It displayed a jumble of clean-picked fine fish bones like the aftermath of a much appreciated prehistoric dish of whitebait. The other perpendicular strata, the porphyries, beetle above the river lower down. (Andinistas climb there at today at weekends and public holidays). Fine threeads of waterfalls spin down wavering but unbroken to the valley floor. The beautiful muted dove and purple greys and subtle jades of the screes are memorable. Meyen obviously had more time to investigate the flora than we did here, and names have changed drastically since, but I can certainly relate to his freshly discovered Alstroemeria umbellata of the screes. The weird Calycera is around now as Nastanthus agglomeratus. What he calls Calandrinia umbellata must be

prostrate C.sericea which still opens up in the hot sun to hide the ground beneath, carpeting these flat upper valleys with gleaming silky wnites, pale pinks, cerises and near-magentas.

Apart from the major volcanoes, the upper valleys are often remarkably flat and accessible. Walking into Argentina across one of the many passes is simplicity itself once the snow has well and truly melted. There is a record of a red flowered cactus on some pass, perhaps an Opuntia variant, maybe an exciting Maihuenia, possibly no more than than the slip of some collector's pen, who knows. Such altitude and penetration of the Andes could seem rather extreme for any cactus at these latitudes. Nor do the plant associations correspond with normal expectations. Certainly neither Meyen nor we found it, though both of us noted the sort of flat upland plains which would make very plausible habitats for it indeed. Keep looking! ....from R.Ferryman

At the spot where we found RMF.101 near Los Valdes there would be about 50% ground cover in the shape of dwarf bushes, some grasses, and herbs. But about fifty metres away there was some ground where the moisture must come to the surface, as there was a dense patch of orchids, just like a carpet, without any stragglers at all.

THE VEGETATION AROUND SANTIAGO By Fr. Meigen

Translated by H. Middleditch from Engler's Botanische Jahrbuch Vol. XVII 1893

The following brief explanation concerns the vegetation-relationships in those parts of central Chile which lie between the Rivers Maipu in the south and Aconcagua in the north (with the exception of the coast and adjacent mountains) .....

Of minor importance for the vegetation of this region is the warmth, insofar as only the effect of mere temperature changes are concerned, but not when it comes to the temperature-dependent moisture conditions of the air and of the ground. Even in the hottest months of January and February the temperature never rises so high that all plant growth ceases in consequence. The exclusion of many of the high mountain species from the plains and lower mountains may only partially be ascribed to the greater warmth. .....

Of greater influence than the high summer temperature, which only just exceeds 35°C, is the low degree of warmth which prevails in general in the winter and in the high mountains in summer. Even if the thermometer only very rarely falls below freezing point, yet many species from lower latitudes are excluded by this and do not go south of the Aconcagua or are left behind even further to the north. The selective influence of warmth is also due not only to the high temperatures of summer, but also to the low temperatures of the winters and of the high mountains. As a formative influence it cannot be discounted but it is still not of prime importance.

In the plains the wind very rarely rises in winter and hardly ever to great fierceness in summer. By comparison the high peaks of the Cordillera are almost uninterruptedly blustered about by a strong west wind. The low growth of the high mountain plants and their compactness is perceived as a feature adapting them to the wind. Of course it must equally be added that shelter against the cold and above all against transpiration losses play a much greater part. The absence of trees at heights at which the temperature regime would still allow very good tree growth, is hardly to be accounted for by the wind, but on account of the high degre of prevailing dryness.

So these then are the most important effects exerted upon the character of the vegetation, both in respect of selecting and in shaping it. Arrangements for defence against dryness play the most significant role in the biological relationships. Only very few spp. do without them altogether and then they enjoy a thorough natural shelter. Of course in the part of central Chile that concerns us here, at no season is moisture so completely absent that the consequence becomes a universal standstill of the vegetation, although it actually happens in many places. But in the plain and in the outer ranges of the Cordilleras, that rise on average to 3,500 m., only an extremely scanty amount of rainfall is received, which nowhere at all suffices for cultivation of the land. Agriculture is everywhere only possible with the aid of ingenious irrigation.

The occasional quite sparse winter rains which depend upon the northerly wind, cease as a rule at the end of September, setting in again only around the middle of April. Yet even in summer the air is not entirely dry. Then it may often be observed that clouds form around noon on the snowcovered peaks of the Cordillera, which gradually become ever thicker and towards evening now and again send down a short drizzle, amid electrical discharges. Very often of course the cloud formation is limited to the high peaks lying in the innermost mountains, whose height exceeds 5000 m. The fore-ranges, upon which the snow melt is usually at an end about the middle of December, are then without precipitation often for weeks at a stretch. Still more rarely do the clouds extend from the mountains like a screen over the plain and only quite exceptionally do a few drops of rain reach the dried-up ground. The amount of rain in the summer is so extraordinarily small, that it cannot be taken into consideration for the maintenance of the vegetation. The degree of ground moisture also becomes almost exclusively limited by the amount of winter rainfall and in the high mountains by the volume of snow which accumulates in the cold season. The part of this territory which lies below the wintry snowline, dries up more and more in summer and by about Christmas is usually quite vegetationless. Obviously there are also sheltered spots there, of small extent, which always retain so much moisture, that they can support a scanty vegetation. The slopes which are covered by snow in the winter remain moist for much longer. But even these can only support a thin plant cover in high summer, so that the bare ground is scattered about everywhere. A plentiful vegetation is then to be found on the watercourses, which are discharged from the permanent snow of the central chain. On reaching the plains these are also led into finer and finer distribution canals as the fructifying element.

Shaded places are not frequent. The bushes which act as shade providers rarely give much shaded space as the shade is so short because of the high position of the sun in summer. Frequently however closed stands of bushes are absent and this also ensures that the ground does not have a satisfactory amount of moisture. The shade plants are therfore found pre-eminently behind large boulders, which lie individually on the ground, where moisture is also retained underneath them, and no less frequently in rock crevices. The dryer it becomes around about, the deeper they appear to retreat. Not seldom can it be observed that they have completely dried up at the entrance to small cavities or deep clefts, but in the

innermost recesses, however they have kept quite fresh. Adiantum excisum and Parietaria debilis are very pronounced shade plants whilst others also emerge into sunnier spots.

Whilst in general moisture is absent from only a few places after the end of the winter rains, the dryness retreats deeper into the mountains in the course of the summer. The hills and mountains dry up more and more. The higher the snowline retreats, the higher one must climb to find fresh vegetation, which has not yet suffered the blaze of the sun. It is clear from this that many waterplants belong to the mountains. In the subandine region particularly, all damp places stand out from afar on account of their fresh greenery. They are unique in displaying a fully closed vegetation cover. A flowing stream is synonymous with a strip of green, which interrupts the monotonous grey and brownish-yellow of the landscape. In the andine region, on the other hand, close to the margin of vegetation, the flowing water is not uncommonly devoid of plants; only at some distance away or at upwelling places where the water temperature can be somewhat higher, does the vegetation come back. The causes of this phenomena seem to be sought in the lower temperature of the water, more importantly however in the great speed with which the streams dash downwards and in their frequent changes of course where they eat into the mountain scree.

Conditions for the existence of woodlands are extraordinarily unfavourable, although solitary trees are by no means absent ..... but a closed stand cannot form, since the water supply in the ground is no longer adequate. Trees are conspicuous by their absence in the mountain region. ..... The absent woods are replaced by numerous bushes, which often collect together in dense thickets. They have their principal distribution in the mountain region at altitudes between 1000 to 2000 m. There they form almost impenetrable thickets, which are a great hindrance to every ascent, unless the herds have made a rough and ready track through them. The most conspicuous components of this formation are the Cereus quisco and Puya coarctata. Both occur as leaders in the vegetation picture. They really establish themselves at the driest spots where only few spp are able to follow them. The Cereus quisco, which grows up to 3 m high, is solitary or often also branched in candelabra fashion. Not uncommonly it presents far and wide the only chance to get even a trace of moisture, but because of the long and very sharp spines its juicy tissue is not obtainable with an ordinary pocket knife without bloodshed. It hardly ever forms pure stands, and then only on extremely dry slopes, which are shunned by the other woody vegetation. But even there great gaps are left so that one can go through without endangering one's clothing. It is almost always scattered within the rest of the general body of vegetation, but it projects up and out of that to an appreciable extent on account of its stature and height.

In association with Cereus quisco and in a similar altitude zone between about 800 and 1600 m is also found the well-known Puya. It forms huge leaf rosettes, out of the centre of which rises the 2 m. tall flower stem, which carries at its top the spike of verdigris-coloured flowers. The rosette puts out new growth from the centre and dies off below. It seems to flower only once and then falls to the ground. Since they need a long period of years before coming into flower, relatively few specimens are to be found in flower. So a long stem is gradually produced which often curves to and fro and more and more lies closer to the ground. It is furnished with the remnants of the dead leaves which are always brown to black coloured at the margin and look as if they had been burnt. Sometimes the colour undoubtedly is brought about by fire, but in most cases the cause may be sought (after the investigations by Johow) in an Ustilaginae, whose dark spores bring about the colour. The Puya also occurs always only singly and never in great numbers, but it is equally noticeable and as characteristic as the columnar Cereus quisco.

Between these two sorts are spread the general mass of other bushes. Never absent components of this evergreen bush formation and Quillaia saponaria, Kageneckia oblonga and Lithrea caustica. Just as abundant and numerous as these sorts occur, so a number of other bushes are commonly found intermingled, of which the most important will be mentioned. Frequent everywhere are Tevoa trinervis, Colliguaya odorifera, C.integerrima, Gardoquia gilliesii, Baccharis rosmarinifolia. All these spp. can still be described as abundant. But the sparsely occurring plants also still crowd forward to such an extent that they ought not to be neglected in the vegetation picture. Kageneckia augustifolia is particularly noticeable on acount of its long narrow leaves and here and there is just as abundant as the other spp. The latter also goes for Aristotelia maqui, Schinus dependens, Proustia pungens, and Colliguaya salicifolia. Subordinate components, which on the whole are hardly absent anywhere in the area involved here, are Acacia cavenia, Trevoa quinquenervia, Flourensia thurifera, Podanthus mitiqui, Berberis chilensis, Lycium chilense, Porlieria hygrometrica, and Colletia spinosa. There still remains some spp. to mention, which do not occur everywhere, but are characteristic of many places. On account of their almost leafless branches Diostea juncea is noticeable, whilst Fabiana imbricata carries very small and clearly adpressed leaves, which from afar is not dissimilar to a Thuja. Less prominent is Azara gilliesii since its leaf form is similar to that of Aristotelia. The leaves of Maytenus boaria change in form and character in accordance with the habitat.

The manifestation of the degree of humidity in the ground with trees overtopping the more or less densely packed body of bushes occurs only in very few especially favoured spots. Usually it is Quillaia saponaria or Escallonia arguta, which holds out a magnificent sight in February when it is overladen with bunches of white flowers. More rarely one finds Aristotelia maqui developing tree-like or even Lithrea caustica. Even Azara gilleisii and Maytenus boaria are infrequently like trees. On the other hand Kageneckia angustifolia generally occurs as a 3-5 m tall treelet, not especially noticeable however on account of its lesser height. Not until above 2000 m, where other tall bushes and trees no longer flourish, does it become a feature. Over 2300 m however it no longer stands out.

More abundant are smaller bushes, of which Valenzuelia trinervis and Ephedra andina are to be mentioned, which are almost never absent, but of course not where the bush formation is fragmented. Muhlenbeckia chilensis has its main distribution in the hill region, but without being absent in the mountains. From 1600 m upwards appears a very pretty and characteristic small bush, Viviania rosea, which with its white felted and widely spaced leaves and red flowers has a very characteristic appearance. Here and there are found also fine Tetraglochin strictum. Several Ribes spp are likewise not rare.

Of the numerous shrubs and annuals only a few are distinguished as particularly eyecatching. Very prominent at over a metre high, but rare, is Eryngium paniculatum with large rosettes of rigid lineolate leaves with spiky denticulatre margins. More abundant are the Alstroemeria spp which appear in various colours and push their magnificent flowers out of the shrubbery everywhere. Mutisia ilicifolia climbs upwards within the bushes and extends its dark red flower heads into the

light. A similar climbing plant with red flowers is Ecremocarpus scaber. Remaining closer to the ground are Mutisia acerosa, M.sinuata, and Calandrinia discolor. In spring the blooms unfold from Tropaeolum tricolor where it hangs from bush to bush, and from the abundantly flowering Oxalis rosea, Gilia laciniata, Sisyrinchium scirpiforma, Calandrinia compressa, etc., all with reddish flowers. Even blue flower colours are represented pretty abundantly: Pasithea coerulea, Anemone decapetala, Verbena erinioides, Schizanthus pinnatus, Solanum tomatillo, Phacelia circinata and the fine Triptilium spinosum are to be mentioned, of which the majority indeed flower in the spring. Not so abundant are spp with white flowers: chaetanthera tenella, Triptilium andinum, Valeriana spp., and Leucocoryne ixioides can be mentioned, of which of course only the last is endowed with large flowers. The prevailing colour by far is yellow as with us [Germany - H.M.], such as Sisyrinchium pedunculatum, Quinchamalium spp., numerous Adesmias, the very abundant Chaetanthera moenchioides, several Calceolarias, especially C. thrysiflora, C.corymbosa, C.polifolia, and in spring particularly Madia sativa, Haplopappus berterii, H.setigerus, and Tylloma glabratum. With these spp with more or less significant flowers are associated still some others, which likewise are to be found almost everywhere, but have small or almost no flowers, such as Bowlesia dichotoma, Acaena pinnatifida, Notochlaena hypoleuca, Plantago callosa, Poa bonariensis, Festuca robusta (only occasionally, but then in a mass), Bromus trinii, Nassella chilensis, Galium suffruticosum, the leafless Gymnophyton polycephalum, and several Adiantum spp.

With increasing altitude the bushes in the thickets stand ever closer together and contain the characteristic components of the mountain formation. At the upper boundary of the bush formation, the picture changes very significantly at about 2000m altitude. The trees diminish completely with the exception of the Olivillo, Kageneckia augustifolia, already mentioned. All tall bushes likewise remain at lower altitudes, only at the watercourses are to be found ever more lower growing brushwood of Berberis colletioides and Escallonia carmelita. Valenzuelia trinervis accompanies us yet for a while, whilst Viviania rosea andTetraglochin strictum reach their full development here. In addition Ephedra andina is to be found everywhere, but no longer the metre-high bushes as at lower altitudes. They cringe ever closer to the ground, short-branching and extremely stunted. New small shrubs appear, in particular that one very characteristic of the heights, Chuquiraga oppositifolia. By no means scarce is Berberis empetrifolia as well. Genista cummingii commonly remains very dwarf. Although abundant, these three bushes are still not as widely distributed as Acaena splendens, which completely covers slopes over a wide extent. It forms rounded clumps of about 50 cm diameter and 30 cm high from which the flower-bearing stalks project. To some extent they compare with the grassy hummocks of our north german bogs. In any case is the singular, almost stepped, surface of many slopes owed partially at least to this peculiar mode of growth. Thus in general, where Acaena is absent, the steps are absent too. In the shade of the hummocks and in the spaces between them flourish a number of other spp, without however covering the ground entirely even at favourable spots. Oxalis lineata with yellow and and O.polyantha with red flowers are particularly abundant. Several spp of Phaca are also to be found in most places. Sysirinchiums and lillies are in flower there, especially in November, also Nothoscordum poeppigii, Brodiaea porrifolia etc. On rocky and somewhat moister spots grows Wendtia reynoldsii in rank profusion. Calceolaria polifolia still grows here, while C.arachnoidea with red flowers starts to appear at this altitude. Viviania elegans is to be found not rarely at rather damper spots in the lower zone of the mountain formation. Mutisia hookeri and nardophyllum candollei are small shrubs with a high degree of development to aridity. Nicotiana scapigera is rarely absent anywhere and Lathyrus subandinus is characteristic with Acaena splendens for this formation. Galium eriocarpum, Draba gilleisii, Hexaptera pinnatifida, Calandrinia denticulata, Menonvillia trifida, Alstroemeria spathulata are still to be mentioned, with Argylia huidobriana and Mulinum spinosum for the lower zone and Strongyloma axillare and Quinchamalium parviflorum for the upper zone. Grasses are very insignificant; only Poa bonariensis is pretty abundant. The Acaena splendens formation undergoes an interruption only at the watercourses and usually over-runs all slopes which in general admit of plant growth. At higher altitudes a change takes place by degrees, roughly at 2800m with the appearance of the first hummocks of Laretia acualis signalling the Formation of the high Andes.

Three zones may be distinguished here without any difficulty, which are certainly joined to each other by transitions, whilst their typical Formations display very significant differences. The reason is the changing moisture content of the ground. At very moist spots with standing water is settled the above-mentioned plant association, which is essentially characterised by Werneria rhizoma and Anagallis alternifolia. Only here in the Andean region is found a more or less closed vegetation cover, although tne water is less utilisable because of its lower temperature. Despite the abundant amount of moisture all spp are equipped with distinctive provisions for defence against aridity, so that the whole of the vegetation cover in the Andean region retains the xerophytic character even in damp places.

At places of average moistness, and especially in the beds of the high-altitude valleys, but also often on the slopes, are to be found the characteristic hummocks of Laretia acaulis and Azorella madreporica and in association with them a further range of other spp., which are just as characteristic for the Formation. To be mentioned as the most abundant are: Viola fimbriata, Antennaria magellanica, Oxalis platypila, Cajophora coronata, Ribes cucullatum, Pernettya andina, several Senecio spp, Armeria andina, Nassauvia lagascae, Cynoctonum nummulariaefolium, Calandrinia setosa, Polygala salasiana, Erigeron spp, Draba suffruticosa, D.schoenleini, Clarionea carthamoides, Haplopappus diplopappus, Chondrochilus crenulatus, Boopis miersii, and Calandrinia rupestris. Whilst the species of the first zone produce a closed vegetation cover, here this is never the case. Bare ground appears everywhere and occupies a significantly greater space than the area covered with plants. Amalgamating into smaller or larger clumps, as attained to the greatest development in the hummocks of Azorella, is on the contrary the rule. Solitary individuals are relatively scarce. Transitions to the first Formation are formed by the spongy yielding sward of Plantago pauciflora and Clobanthus quitensis on damp ground, whilst the hard masses of Colobanthus benthamianus come quite close to the Azorella hummocks.

The purpose of this so common habit in the Cordillera is in the first place a defence against drought. This is necessary everywhere. Despite the frequent formation of clouds the air is generally dry; the ground is often covered with loose rubble which allows the water to sink well down in a very short period of time. When that is not so, the temperature of it is so low that the water absorption through the roots becomes impaired to a considerable degree and this likewise makes defence against aridity necessary. The cushion shape has a double effect, in that it serves as a water reservoir and also raises the temperature of the absorbed water. They are extradordinarily adapted to the absorption and retention of moisture, since the

rotting parts of the plant remain contained within it and thus convert the interior into a sort of sponge. It can not be a cause of astonishment the other plants seek out this favourable habitat and settle within these hummocks. Particularly frequently have I observed Polygala salasiana and Calandrinia denticulata growing in that manner.

[There follows a list of spp which reach their northern limit in the Aconcagua valley and a further list of spp which reach their northern limit in the Mapocho valley.] Apart from the river valleys themselves, the mountains between both these rivers have been less explored than those south of the Mapocho and north of the Aconcagua. It is very probable that many of those in the latter list of spp. still reach the Aconcagua, so that the significance of the Mapocho as a boundary would become that much less.

.....from H.Middleditch

A comparison between this account by Meigen and the list provided by A.Hoffmann of the spp. which are to be found at Las Aranas readily allows a correlation to be made. This may afford some degree of guidance as to the most likely places for finding this very low-growing and inconspicuous cactus plant. Although Meigen stresses the importance of the low relative humidity in this part of Chile, he does not put forward any supporting figures. However, the wet-and-dry bulb thermometer readings provided by Meyen should be convertible into relative humidity.

.....from R.Allcock

The readings given by Meyen are in degrees Reamur, which must first be converted to degrees centigrade. The relative humidity may then be read off the table which is published in The Chemical Rubber Company Handbook of Chemistry & Physics. For example, the readings taken at 2.00 p.m. at Queseria equate to 24% relative humidity. At the campsite the 6.00 p.m figure equates to 45% relative humidity and the 5.30 a.m. figure to 39% relative humidity.

.....from H.Middleditch

If the ambient temperature at Tollo, a lower altitude than Queseria, is taken to be a few degrees higher than that at Queseria, then from the readings taken at Tollo the relative humidity there would be even less than 24%. No wonder Meyen said that it was extraordinarily dry!

A SWARM OF REBUTIAS? **From K. Preston-Mafham**

During the course of my travels through Bolivia in 1988 I arrived at Iscayachi, which is high up in the Andes in the southern part of that country. From here I decided to walk along the road which rises out of Iscayachi towards the Cuesta Sama which is where the road crosses the hills and then descends to Tarija. Just outside Iscayachi, near the base of the Cuesta Sama, I came across a short quebrada with sides of vertical rock. These rocks faced more or less south so that they were shaded for most of the day - they may be lucky to get one hour of sunshine in the day. The rocks were damp and mossy, a typical Rebutia habitat. There are hundreds and hundreds of Rebutias growing at this particular spot, many of them in flower at the time of my visit. If you want to find Rebutias virtually anywhere in Bolivia you have got to look for cracks in the rocks in shady places, especially where there are bedding planes. If there is an isolated rock stuck in the middle of nowhere in Bolivia, if it has a damp bedding plane then it is worth looking for Rebutias and there is a chance of finding R.fiebrigii forms there in great variety. The fact that the habitats of Rebutia tend to be spotted around here and there means that you have got a lot of isolated populations in which only interbreeding will take place.

The climate is pretty awful, it rains most of the time during the rainy season, which is when we were there. It was very cloudy and because it was so dull and the light was so poor, all the slides taken here which I showed to The Chileans' Weekend had to be taken by flash. On the slides you could see the ferns and mosses with reproductive heads, showing just how damp it was at this time. It was also quite cold. The temperatures here really are low, these plants do not get the 90^0F we have in the greenhouse at midday in summer in this country, they would be lucky to get 50^0F here at this spot at midday in summer. They are not only in the shade but they are at 12,500 to 13,000 feet altitude and it rains a lot of the time - it is exceedingly cold in the rain at this sort of height. It is so cold that summer in Bolivia is called El Invierno, the Bolivian winter. I would imagine that as a consequence growth rates of these plants are a lot slower than they are in cultivation. I would guess that the plants here are I suppose two, three, or four years' old. They are mostly solitary and those I saw almost never had more than one flower.

The interesting thing about this quebrada is that there are obviously three completely distinctive and obviously identifiable spps. of Rebutias growing here without any obvious intergrading between them. But within two of these spp. there appears to be enormous variability, possibly including other spp. described as such by Ritter or Rausch, etc. To start with, R.pygmaea with an unusual flower colour, very similar to WR 493; it might be R. pseudodeminuta. I took a slide of virtually the only plant with two flowers. In cultivation R.pygmaea forms offsets profusely and flowers profusely; in Bolivia they are only the size of the end of your little finger and stuck down amongst the rocks - I have never seen a double headed one. You have got to look for them down amongst the mosses and the lichen where it is very damp.

Now we look at several plants in turn, growing just a few inches from each other. Here we have a flower with lots of gaps between the petals - a very lax flower - typical of the R.spegazziniana group; but it does not have a spegazziniana body, the nearest body type to that is R.sanguinaea. Next to it, a lax flower again, redder, but a much broader body with much darker spination, possibly like Rausch's tarijensis (Ritter's spherica). Close by, again a big lax flower on a very pale green body with long interlacing white spines. Next to it, a plant with a tiny pale orange flower, like R.fulviseta, but a pale green body with short black spines.

Now we come to a quite different flower, which has got overlapping petals looking like two series overlapping, no gaps between the petals like the preceeding flowers. And instead of the stamens standing well out of the flower and spreading out, here the stamens are packed close together and do not project very far out of the mouth of the tube. Next we come back to the lax spegazziniana type flower again, this one possibly being a form of R.ritterii. Then we come to a flower which is not the same as any we have seen up until now, really it is an intermediate between the two sorts. Next,yet another different flower/body combination, another form of R.pygmaea similar to R.colorea but with larger orange flowers and larger body, possibly R.escayachensis.

Then we come to a bicoloured flower, red petals with a yellow throat, that reminds me of R.steinmanii v.brachyantha, but the body is quite different to that form. Here is a little tiny thin body that looks like R.steinmanii and a flower with dark coloured filaments that is also like steinmanii. This next one remainds me of R.albiareolata. This next plant with a broad body looks like R.fiebrigii, possibly it is R.flavistyla; but it is not too far from R.muscula in spination. It can be stroked without being pricked by the spines. Only a few inches away is a plant with stiff spines typical of fiebrigii and with a slightly diffeent flower colour too.

Some of the flowers look as if the ends of the petals are a peculiar shape and this is very probably where the bees have been eating the ends of the petals. There were bees in the quebrada and they were going from flower to flower. I do hope to be able to go back to this spot at a future date but a little later in the season, with a view to photographing each sort of plant, and getting seed from each sort to find out if they breed true or if a mixture comes up.

....from J.D.Donald

Looking at these slides for the first time I am struck by the number of flower and body combinations that are quite new to me. The spegazziniana type flower on the very pale green body with long interlacing white spines is something quite new to me in that area. Again the small fulviseta flower is on a body which I do not associate with this area - it is necessary to know where a plant comes from to be able to name it. The light orange flower on a very light green body looks to be something quite novel. Possibly we have here a unique situation of a mixture of several different genotypes, or else it is a hybrid swarm. There are other hybrid swarms known to occur, such as a the group round R.margaretae near Salta which are very similar to this in having hundreds of different body forms and lots of different flower forms and flower colours. But they are all accepted as R.margaretae.

Here we are trying to fit names that have been described to actual plants. The names to be considered are spegazziniana, colorea, pygmaea, steinmanii and v.brachyantha, sanguinea, mamillosa, fiebrigii, fulviseta, iscayachensis, pseudodeminuta and flavistyla. If we look at these plants we have seen here as species showing a range of divergence within the population then the variation is beyond what I would normally accept as variation within each species. I am quite sure that if Rausch had visited this particular habitat he would not have been foolish enough to give all these new names to the plants here, his specimens must surely have come from isolated populations.

....from K. Preston-Mafham

It is my belief that no one else has visited this particular spot - I have checked the literature and there are only about two names in those you mention for Iscayachi. Are you quite confident that Rausch, who is renowned for selecting the odd-ball plant out of a population and describing it as a species (like many other european collectors do) has not done so in this case? Are you confident that he has not been to a place like this and created a number of species from the odd-balls?

....from J. D. Donald

I am not confident about it but Rausch always tells me that he is careful not to do that. In any case, if Ritter had been here I am sure that he would have commented on the diversity of flower and body.

....from K. Preston-Mafham

But the diversity is not very obvious when these plants are not in flower; most of us travel in this part of the world in the dry season for obvious reasons - it is easier to get around. It is possible that Ritter and Rausch may not be aware of this diversity.

....from P. A. Smart

But in the dry season they should have been struck by the diversity in the habit of the plant bodies. In any case, these plants we have seen on slides are blown up out of all recognition by excess water.

....from J. D. Donald

To suggest that these plants are bloated is really trying to avoid the issue. These are plants in habitat and we must take notice of them. All in all this selection of slides is an object lesson to anyone who is going to name plants.

....from P. A. Smart

Having seen the slides of the Rebutias taken in habitat by K.Preston-Mafham, mature reflection on the physical condition of the plants suggests that this particular location was visited in the middle of or towards the end of a particularly long or severe wet season. It is also feasible that this small valley is subject to an excessive amount of water due to some geological abnormality. If the low end of such a side valley were blocked by a landfall, it could easily produce an abnornmally deep and wet substrata which would take a long time to dry out after the rainy season. This would give a much longer growing season, particularly if it were sheltered from sun and wind.

....from H. Middleditch

Perhaps other travellers in the Andes have seen Rebutias growing in the wild and can tell us whether it is uncommon to find Rebutias growing in very damp spots?

....from W. Gertel

In the course of my visit to Bolivia we travelled east from Sucre, passing through Tarabuco, as far as Tomina. From here we turned round for our return journay. Before we reached Zudanez we looked for S.rauschii which we were unable to find. On our way back from the hill where we had made our unsuccessful search, we accidentally found Aylostera fiebrigii v. densiseta. This was not the first time that we had come across an Aylostera around Tarabuco and they also appeared on the Cochabamba to Santa Cruz road. Sometimes the Aylostera do grow in the company of Sulcorebutia as near Pojo. It was here that we had found S.lepida, and there were also some small Aylostera growing at the same spot. There must be a lot of moisture around here even in the dry season, as everything was very green. Close to Tarabuco we found S.tarabucoensis growing together with Aylostera fiebrigii form.

The Sulcorebutia and Aylostera grow in different ecological niches; the Aylostera usually occupy more shady areas whilst Sulcorebutias are usually out in the open. Aylostera normally grow at a very rocky sort of spot, always on a vertical rock formation, even at times on a patch of only one or two yards of rock, or perhaps even less, usually growing in the company of mosses and lichens, probably at spots which were rather wet for most of the year, and very probably they only have direct sunlight for part of the day.

....from K. Preston-Mafham

Between Tarabuco and Zudanez we also came across a spot where a form of Aylostera fiebrigii was growing. It did not look terribly different from some of the plants we saw at Iscayachi - the dark body and the flower were the same. Again it was growing in damp bedding planes between rocks.

....from L. Hoeven

In the course of making two separate visits to Bolivia I have seen Aylosteras growing in various places. One was near Totora, others near the town of Padcaya, also between Tarabuco and Zudanez, and at several places between Tarija and Narvaez. At all these places the plants were growing in the same sort of shady and very damp conditions that were shown and described to us by K.Preston-Mafham when I was at the Chileans' Weekend.

....from K. Preston-Mafham

At the place between Tarabuco and Zudanez we did not see the long-spined forms which L.Hoeven showed to us on the slides which he took at this same spot.

....from G. Charles

Surely the plant shown to us on slide by L.Hoeven was exactly the same one as that photographed by K.Preston-Mafham? It seems quite unbelievable that two people can go half way round the world independantly of each other and then take a picture of the same plant.

....from K. Preston-Mafham

But both L. Hoeven and I used the same person as driver and guide, and he has a habit of stopping at the same places along the route where he knows his fellow-travellers will be able to see some cacti.

...from D. Schweich

Three years ago I was able to spend a week in Argentina when we went from Tucuman via Cafayate and Cachi to Salta, followed by a trip to the Quebrada del Toro. On my first day we headed out of Tucuman in the direction of Tafi del Valle and because I was not aware of Rebutia habitats I missed the Rebutia (like R.minuscula) which grow in the subtropical areas east of the Abra del Infernillo. In the Quebrada del Toro there were numerous Rebutia xanthocarpa in the subtropical part of the valley up to Chorillos. By subtropical I mean that there were a lot of trees, bushes, and begonias, also a lot of wet moss with rotten Rebutias. Among these were also many steep rocks with poor vegetation, often covered with bromeliads and again R.xanthocarpa in cracks. The immediate surroundings of the Rebutias could be either wet moss or dry rock!

....from D. Ferguson

Before my trip to Argentina in Jan/Feb 1990 I was under a definate misconception, as I was surprised to find that not only the true Rebutias that we met with (excluding Mediolobivias - and we saw no Aylostera), but also most Cleistocacti as well as Echinopsis ancistrophora, occur in moist to often wet tropical conditions. They were growing with such things as Peperomias, Begonias, Rhipsalis, Pfeiffera, and Tillandsias.

....from F. Vandenbroeck

During my trip to Bolivia in 1988 I found two species of Rebutia. That found near Canaletas was probably R.kupperiana and that in the canyon of the Rio Tarija was probably R.muscula. The R.kupperiana grew embedded in peat and mosses on flat, sloping rocks exposed to the sun, whereas R.muscula clung to steep rocky walls which were often in the shade.

....from M. Nillson

Now as to what sort of conditions Rebutia grow under. My first Rebutia find was R.pseudominuscula MN.21 at El Maray, Esciope, Salta, at 2400m. I was really astonished when I found it growing in moss under grasses that were 50cm high! So it is true that some Rebutia do grow in shade, but on the other hand, a few metres away, the same species grew in cracks in bit stones, in cliffs that were in full sun. Much drier, in other words. Higher up in the same mountain, we came across R.senilis MN.22 as the Type locality, hanging from steep slopes in moist moss besides tufts of grass. In other places they grow in deep cracks, somewhat in shade.

At Volcan, at about 2200m, I found R.wessneriana MN.45 often covered with high grass and in the same area, at 2400m, R.pseudodeminuta MN45a and R.euanthema MN46, also covered with grass, or growing in full sun. Climbing up from Valle Grande to Valle Colorado at about 2600m, R.fabrisii v.aureiflora MN.123 grows in humid places with lots of trees and bushes. Along this track I found some big plants growing in almost total shadow, on a vertical cliff which was very moist. A little further on, between Valle Colorado and Santa Anna, approaching 3000m, Rebutia fabrisii MN.126 was growing quite near to the timber line, where it had a little bit more sunshine. Plants can, however, be found growing in quite dry cracks in the rock. These plants tend to be more compact (minima, according to Knize).

So I do not think that there is a pat answer, as these plants seem to be able to survive both in sun and shade. I have not seen them avoiding full sun or avoiding shadow: their growing conditions are very variable. However, for Rebutia sensu stricta (including Aylostera) a good target is to look on damp cliffs near the timber line, to look in cracks and under small bushes. Where moss and lichen grows are their favourite places.

....from J. Lambert

Entering the Quebrada del Toro we discover a small Rebutia JL-145 growing on cliffs at El Mollar; it belongs to the species R.xanthocarpa. This Rebutia was collected in the lower, moister part of the Quebrada on a rocky cliff covered with moss. The cliffs were facing east, but somehow the Rebutias appeared to be shaded from exposure to too strong sunlight. As for moisture on these rocks, it was certainly high in comparison with the amount you usually expect to find where cacti grow. Leaving the Quebrada de Humahuaca on the road to Tiraxi we found Rebutia wessneriana, again growing on humid cliffs. Here, the material of the cliff appeared to be a kind of soft limestone. At both locations the cliffs extend for no more than 200 or 300 yards and in these restricted biotypes, conditions are combined to meet their particular requirements. The plants grow in small crevices along the quite steep - and sometimes actually vertical - stone walls. Some small amounts of soil are present, but those species really are content with very little earth. Sometimes the roots are spread on the surface of

the rock, in a way which reminds one of ivy. You do not need to be surprised at Rebutias being reported from 1500 m altitude; JL-145 was found at 1625 m and JL-237 was found at 1650 m!

....from H. Middleditch

It was indicated by K.Preston-Mafham when he showed these slides that his visit to Bolivia was undertaken in December, early in the wet season. So it would not appear that these Rebutia were found in abnormally moist conditions at the end of a specially wet season. In addition, it does appear from the quite independant comments received from other field collectors that Rebutias are indeed often found on quite damp spots, apparently more or less permanently damp, on patches of rock which are often vertical rock faces. No abnormal geological conditions would appear to apply to the site photographed by K.Preston-Mafham, just normal growing conditions for many Rebutia. There may well be other sorts of Rebutia which grow under different ecological conditions.

....from J. Lambert

If your Chileans Weekend speaker who went to Bolivia did not observe any clumping Rebutias, it could well be because he met only populations of young plants. Most Rebutias, I do believe, start to proliferate with age, some of them quite profusely. For example, I noted that adult plants of R.wessneriana JL-237 were offsetting profusely, forming plants of about 10 cm in diameter. With R.xanthocarpa JL-145, proliferation was more moderate.

....from J. D. Donald

It was suggested by Cardenas that Rebutias grew up to flowering size, flowered for one season and then died.

....from K.Preston-Mafham

That would suggest that he also was used to finding these plants with only a single head.

....from L. Hoeven

On my 1989 visit to Bolivia I also took the Tarija road out of Escayachi and on the Cuesta Sama I was able to find many offsetting plants of Aylostera. This was in November and several plants were already in flower, not in abundance but this would be because it was still the dry period at that time. In my experience this is the reason for them not having many flowers out together. Plants which I brought back with me continued to put out flowers over the winter in ones and twos, but in the growing season they will be covered with flowers.

....from K. Preston-Mafham

After an overnight stop in Potosi we set off on the next morning towards Camargo. From the height of Potosi there was very little to be seen in the way of cacti until we came down steeply into Cucho Ingenio. This area was very rich in cacti — at times there must have been thousands of cacti as far as the eye could see. It was raining most of the time, as indeed it had been since we left La Paz. These were no mild showers but really heavy rain, so the cacti at these heights have to put up with this heavy rain, with the cold, and with very little sunshine whilst the dark clouds cover the sky. It was here that I met with my first Digitorebutia. It was not at all like what I had expected it to be. You have to adopt a quite different search image from the clumping plants we are used to seeing in cultivation. Here you are looking for a plant which is half an inch across or less, projecting from the ground surface so little that it is scarcely visible - and that in the wet season! Lower down these plants are to be found growing in crevices in the rocks where slightly more of the body sticks out of the ground and so they are just a bit more visible, but still tiny. They are all single headed plants, again. Rausch has described three sorts of pygmaea from this locality near Cuchu Ingenio; but I think that they can all be classed as R.pygmaea v.orurensis. Rausch has also described several sorts of R.steinmanii from here, too, and the plants we found here might be R.steinmanii v.cincinnata, which does not look a long way different from the plants we saw at Iscayachi.

It was near the end of my visit to Bolivia when I reached Tarija. Although the weather had been cloudy, dull, cold and rainy for most of my trip, it was a nice fine, warm day when I was at Tarija. My advice had been to take a lorry from Tarija to Narvaez and dismount about a couple of miles from the famous type locality for Cleistocactus strausii which is right besides the road. Here again there were some steep rocky cliffs broken up in many place into ledges where the Cleistocacti were growing and the Rebutia right alongside them. Most of the Rebutia were poking up out of a great coat of lichen so that only a little of the body showed up. From the colour of the rock I would have thought that it was limestone but I do not know for certain if it was or not. To take photographs of some of the plants I had to climb above them and lean out over the ledge they were growing on. Unlike the site near Iscayachi, the Rebutia here were all more or less the same, dozens and dozens of them, the small orange flower, the plant body, and the spination, all quite constant.

Further along this road it climbs the pass over the Sierra Condor before continuing towards Narvaez. Here we came across a Rebutia which was the only one that I saw on this trip that habitually grows out in full sun - all the others grow in deep shade where it is often damp and often with water running down the rock face. It was probably the reason for their very dense spination, as a protection from the direct sunlight. They were very hard to find, single headed plants scattered about at roughly 2 or 3 yard intervals in cracks in the rocks. We only found about twenty plants all told. We took them to be forms of R.heliosa, or they may be R.albopectinata or R.condorensis. It is a very thin flower tube, some much longer tubes than others; some flowers have much longer and much more pointed petals. The petals can be either extremely obtuse or extremely spathulate, so this particular feature is irrelevant for identification. As to the age of these plants, they do not seem to get any bigger than about three quarters of an inch across.

....from J. D. Donald

My own plants of this form reached that sort of size in about three years from seed, but to judge by the slight distinctions in the appearance of the body of the plant we looked at on these slides, the growth rate in habitat might possibly have been about three areoles deep per year, perhaps.

I must say that it was a great privilege to see all these slides of Rebutia growing in habitat as it has given me a great deal of food for thought.

SOME INTEREST IN(G) GYMNOCALYCIUM **From F. Fuschillo**

The space that I have available for growing cacti is strictly limited as I live in a block of flats. On the outside balcony I have a couple of small frames in which I can house just over a hundred plants, depending upon their size. Because the frames are quite shallow it means that I can only accommodate globular plants and it is several years since I decided to limit myself to growing Gymnocalycium.

In the days when it was possible to obtain imported plants I used to purchase ten or twenty different sorts each year. My objective was to get them established so that they would flower and set fruit. Many a plant with a developing bud has been brought indoors on to the windowsill so that I could keep a close eye on it as it flowered. Even in just watching the flowers opening I came across peculiarities - I have never seen an imported plant of the mihanovichii and friedrichii groups with flowers that open fully, and yet I have never seen a nursery grown plant that failed to open its flowers fully! A photograph was taken not only of each sort of Gymnocalycium but also of the buds, the flowers, and the fruit. Sometimes I was able to obtain the same species under a Lau collection number, a Rausch collection number and an FR number, although I might only have one of them in my collection at a time. But I am always able to make a comparison from the slides which I had taken, and detail features of buds, flowers, or fruit, are not always exactly the same on different field collections of the same species. Once I had succeeded in making a fairly complete record of a plant on slides, it would be passed on to other collectors so that I could make space for a different species of Gymnocalycium.

Usually I would cut a flower in half in order to be able to photograph the flower section, but it soon became very clear that many closely related species possessed flower sections that had very similar overall characteristics. Even in a flower section it was not always possible to see the details such as petal shape. So I hit upon the idea of separating individual parts of the flower - an inner petal, an outer petal, a lower anther, an upper anther, the style and stigma, laying them out on the faint graticule for the purpose of photographing them together. In this way the background graticule provided a ready means of measuring any of the floral components on the slide. This was much better than trying to measure these flower parts whilst the flower was on the plant and it also meant that I did not need to keep a lot of notes about flower measurements - the sizes were there on the slide whenever I wanted them.

In order to make an even closer examination of the anthers and the stigma, I took flowers from a couple of dozen different species of my Gymnocalycium and photographed in turn a pair of anthers and a stigma lobe from each sort of flower. This included a number of species from the Muscosemineae, which all have the usual pale cream coloured anthers which burst to release the pollen and then look very dark in colour, almost black. On G.pflanzii the anthers are deep red but when they burst they usually become covered with the deep yellow coloured pollen. Similarly the anthers on G.ferrarii are crimson red but again this is not often seen on an open flower because of the mass of yellow pollen around each anther. Anthers from G.weissianum which had released nearly all their pollen were also deep red. Rather a surprise were the anthers from G.bicolor, which were pinkish red.

At the same time as I was growing and taking photographic records of my Gymnocalycium, I was collecting information from the literature which gave me first descriptions and told me whereabouts the plants grew. Many of these place names did not appear on the maps of Argentina that I looked at, so I had to search for suitable maps. Some of the place names took several years before I found them on a map. Finding the references that I wanted in order to obtain copies of first descriptions meant visits to the British Museum Library and to Kew, as well as a lot of work in translating the relevant parts of Backeberg. But now I have collected together almost all the first descriptions that have been published for species of Gymnocalycium, as well as copies of the illustrations that went with them.

Sometimes I find a reference to what seems to be the earliest mention of a species name and I have to spend a great deal of time getting hold of the publication concerned, only to find that the writer merely uses the name in the course of his writing but does not provide any validating description. Take for example the name G.schickendantzii v.marsoneri, which was published by Backeberg in 1935. Somewhere or other I expect that the name G.marsoneri will have been published by Fric, but at present I have not even been able to find the name of the publication concerned - and only then will I be able to start trying to find out where a copy exists.

When I visited the I.o.S. Meeting at Frankfurt I was fortunate in making contact with several people who have since been most helpful in providing me with offsets from what I regard as very rare species of Gymnocalycium. Some of these are specially valuable as they are from original Fric plants, which are usually solitary until a ripe old age. These were seriously delayed by customs at Dover and I am very relieved that they seem to have overcome this maltreatment. I now regard it as very important to have some data about the habitat location for my plants as the records and photographs then become far more meaningful. For example, although I already have records of G.bruchii on slide, last year my imported G.bruchii from Ongamira put out its flowers in February, so these are now also on slide. Recently I was able to add to my collection two seedlings of G.acorrugatum, a G.strigelianum, as well as two offsets of G.schutzianum, a male and female, and I shall be watching their progress with interest. The flower on schutzianum is a light pink, rather similar to that on horridispinum, but even larger in size. Having only one plant of schatzlianum I did not make any special attempt to set fruit, but by some means a fruit has been set on this plant.

Fortunately I have been able to keep in touch with Roberto Kiesling since he came to The Chileans Weekend whilst he was on detachment to Kew. He has sent me a number of very valuable Gymnos which are habitat collected. Of those which arrived late 1987 there were two plants of G.ritterianum which had been collected by Ferrari, about 3 in diameter. When I visited Jorge Piltz about six years ago I acquired a small offset from his P.219 G.ritterianum, then only about half an inch across; it has now grown to about the same size as the ex-Kiesling plants of this species. All three plants look pretty similar, but when they flowered this year, the P.219 produced a few largish pink flowers with broad petals, similar to the flowers on one of the ex-Kiesling plant; but the other ex-Kiesling plant produced about ten flowers, opening only one at a time, skimpy little white flowers with petals barely quarter of an inch wide that opened out quite flat. The differences in the flowers were even more obvious because both plants flowered at about the same time.

When I first came to the Chileans Weekend in 1974 I heard G. J. Swales talking about Gymnocalycium seed and this set me thinking. Many of the features described by G. J. Swales could only be seen clearly under a microscope; as I

do not possess a microscope it was not possible to see much in the way of detail on my Gymnocalycium seeds, but it was surprising how much detail could be seen by looking at seeds through my camera with a close up lens. When I tried taking a photograph of the seed I was quite pleased with the result, especially when the slide was projected on to the screen because then it was possible to examine the detail at leisure. I quickly decided that I needed to have, on one and the same slide, both a side view and a view on the hilum of the seed. This gave me a problem. First of all it was very difficult to persuade a seed to stand on its head so that the hilum faced the camera. Then when I laid two seeds side by side, one of them laid on its side, the other with the hilum facing the camera, the depth of field of the close up lens was less than the distance between the top surfaces of the two seeds. It was necessary to cut the second seed in half and stand it on the cut face; in this way it stopped where it was put and at the same time the hilum came into the same field of view as the side of the seed alongside.

At first I took photographs of seeds from my own plants, but because I wanted to find out about seeds of other species, I started to obtain seeds from elsewhere. Some habitat collected seed was received from R.Kiesling after his visit to the Chileans Weekend, and then later from J.Lambert after his visit to Argentina in 1981. This sort of seed has a known habitat location, but I kept on finding that non-habitat seed which was supposedly of the same species was not always a match for the habitat seed. In order to eliminate any doubts about this variation, I decided some time ago to confine myself to taking photographs of seed which had been collected in habitat or taken from plants which were ex-habitat, or of valid origin.

Gymnocalycium was first divided into sections by Fric on the basis of five different seed groups. This idea was expanded by Schutz who also proposed a number of subsections, again based on seed characters. But the Microsemineae were still a bit of a hotch-potch, probably because it was difficult for amateurs with limited facilities for magnification to study details of these small seeds. The Microsemineae were subdivided into a number of sections by Buxbaum who segregated Gymnocalycium into twelve groups on the basis of the seeds, but as I demonstrated at the Chileans' Weekend, not all his allocations of species to seed groups were logical.

The most recent treatment by Schutz tidies up this situation. I have now been able to take slides of the seeds of most published species of Gymnocalcium, and so I can look at the way in which these fit into Schutz's latest division, in order to see if there are any anomalies. There are still some species for which I have not been able to obtain any seed, so I am still trying to fill the gaps. Some of these are little known or even dubious species. But from time to time I am told about one or other of these plants in collections in Europe, so I can then set away trying to obtain an offset. With proper cultivation it should produce flowers and then I can persuade it to set fruit and obtain seed.

The species and varieties around G.pflanzii were originally in the heterogeneous Microsemineae group but were separated out by Buxbaum into his Pflanziana group, together with a further section for the Saglionis group. Later, both pflanzii and saglionis were put into a single group by Schutz. The pflanzii group were again separated, this time as Pirisemineum, by Till and Hesse, in 1985. On one occasion I looked at about 1500 seeds of G.pflanzii and found them all to be pretty much identical, although quite recently I have come across some seed of a variety of G.pflanzii which is somewhat different from the other forms. However I can quite understand why Ritter puts under one species name all the various forms of pflanzii which have been published as species and varieties - it is not possible to separate them when looking at the seed. Ritter's idea about the two different colours of the fruit flesh in G.pflanzii is interesting; I had already taken a slide of a fruit with the bright red fruit flesh, but now I want to find out as much as I can about the fruit on plants which are in cultivation under names such as millaresii, lagunillasense, zegarrae, marquesii, and so on, in order to establish what is the colour of their fruit flesh.

There are quite a few species names in Gymnocalycium whose origins are obscure, or where plants of this name are very seldom available. Because there are so few plants about, even when you get a plant under one of these names it is difficult to know if you are looking at what the author intended by that name. My own plant which arrived as FR 1179 G.damsii does not really look to me to be G.damsii, but it does look like the G.paediophyllum as illustrated in the east german Literaturschau Kakteen. Is it a variation on G.damsii or is really G.paediophyllum? In his most recent review of the grouping of Gymnocalycium, Schutz places G.paediophyllum in his section Mazanensiana, but on the other hand, Hans Till insists that it is in the section Chiquitanum. Now that I have received seed that has been collected in habitat by Neuhuber I must accept that this is no Muscosemineae, so either Till or Schutz must be correct. To me the seed is related to that of G.baldianum.

The more chance I have to look at imported plants, the more I read the latest descriptions of new species, the more samples of seed I get hold of, the more difficult I find it is to draw nice neat dividing lines and say that the seed of this species is just like this, or the habit of that species is just like that. But I still keep on looking.

....from G. Charles

Yes I would agree that G.schatzlianum has a remarkably large flower, of a creamy yellow colour. It also has quite a large fruit. My own plant is one of the earliest to flower among the Gymnocalycium.

My two plants of G.eurypleurum have a projecting spination which is quite unlike any other Gymnocalycium; the larger plant produces flowers of a pale violet colour; the smaller plant is now flowering for the first time.

I have a great deal of trouble trying to grow G.griseopallidum; I have tried several plants in turn and I have got rather fed up with them going brown and snuffing it. Now it is kept in the propagator all winter at 15^{0}C, watered from time to time during the winter, and stays a nice bright green. Almost as much of a problem is G.pseudomalacocarpus, which just will not grow on its own roots for me, so I have had to graft it.

. . . from H. Middleditch

Both my plants of G.buenekeri put out an occasional flower each year - they tend to give me the impression that the anthers are rather lacking in pollen, so that it is not easy to encourage them to set fruit by a brush. If there is another Gymnocalycium flower open at the same time, then pollen can be transferred on to the stigma of the G.buenekeri and this does seem to be more successful in getting fruit to set. One flower was persuaded to set fruit in this way in 1989, generating a fairly large fruit for a Gymnocalycium. Unlike the fruits on all the other Gymnos, this one did not dry up as the winter came nearer, and indeed it stayed in the same turgid condition, shape and colour, until the following spring. By the time there were signs of new buds on this G.buenekeri, the fruit started to turn colour from a waxy green to a purply-blue infusion; at the same time it altered its shape, losing the flask-like neck and becoming almost globular. This change took place over a fairly short

period, possibly less than two weeks, culminating in the fruit splitting vertically to expose the seeds embedded in a stiff, dark gummy mass. This led me to suspect that the fruit might follow the same ripening process in habitat, so that it would remain green and relatively inconspicuous over the dormant season; on the arrival of the next growing season it would quickly ripen fully, change colour to make itself conspicuous to some animal, be eaten and so have the seeds dispersed. In this way the seeds would be ready to germinate right at the start of the growing season and have the longest time to get established before the following dormant season, so giving the young seedlings the best chance of survival.

However, in 1990 a total of four fruits were set on the two plants. But this time one of the fruits performed a very similar sort of ripening process only a month or two after it had been set, becoming detached from the plant at a slight touch. At the end of October a second fruit changed into a globular shape and began to show signs of a bluish colour infusion, but it did not split. The largest fruit of all, well over one inch tall, retains both its flask shape and a colour very similar to that of the plant body. It appears that my wonderful theory about the reproduction cycle may now have to be abandoned. Next time I must remember to mark each fruit with the date it sets, with a felt pen, in order to keep track of how long it takes to ripen.

TRAILING AFTER HAAGEOCEREUS **From R. K. Hughes**

My first visit to Peru was made in 1978 on a package tour. This included a fairly short outing from Lima to the site of an ancient settlement at Pachacamac, near the mouth of the Lurin valley. At the entrance to the archeological site there was a formal garden which was composed largely of cacti. These included a number of cereoid species which I took to be Haageocereus. The mature stems were commonly between 2 and 3 feet tall, but one plant had stems up to 4 ft in height. Some plants lacked long, prominent, projecting central spines (RKH 18), others displayed some long central spines (RKH.19, RKH.21), whilst yet others had long central spines that seemed to stick out at all angles giving a very irregular pattern of spination (RKH.20). This was early March which was late summer in that part of Peru and so there were no flowers or buds on these plants. But there were quite a few fruits which were all green in colour and between 1½ and 2 inches in diameter, tapering in a conical fashion up to the dead flower remains. The interior of the fruit was filled with a stiff white pulp in which were embedded many small black seeds.

My second trip to Peru was undertaken on my own in 1980, at the beginning of November, which is the start of the rainy season here. From Lima the bus took me to Chosica where the Santa Eulalia valley joins the Rio Rimac. From here I walked for nearly two hours along the road up the Santa Eulalia valley, to a place where I could reach a hillside covered with rubble. The whole hillside above the green irrigated valley floor was a scree of large rocks and boulders lying over the base rock, with pockets of sandy, gravelly soil. The whole hillside looked to be unstable and many dead or mutilated cacti appeared to have been victims of rock slides. The larger plants of Neoraimondia roseiflora were high up on the hill and of the lower ones there were none that were undamaged. I took one smallish plant which had numerous offsets to be a damaged Haageocereus so I did not look any closer at it, but now I realize that it might have been a Mila species. Climbing over a low dry stone wall that appeared to be there to prevent loose rock spilling over on to the road, I came across a cactus at close quarters. It was a large clump of stems, around 4 or 5 feet across, the stems being 2 to 3 inches in diameter and 1½ to 2 feet high. I suspect that it was a Haageocereus of the acranthus affinity, but it was without flowers or seeds.

Some of the Haageocereus did carry fruit. They were mainly small plants with groups of stems ranging from ground level to two feet in height and about two inches in diameter. The stems had a uniform cover of yellow to red-brown spines, all fine and needle-like (RKH.32). The stems had become blackened with age, except for the new growth at the top of the stems. One plant had eight stems, the larger ones 3 to 4 feet high, which had a less degree of blackening and a more open spination. This plant was protected behind some rocks which would account for the obvious differences. Another Haageocereus was similar to RKH.32 but had much stronger growth, i.e. stems of larger diameter for a similar height. There were only golden yellow spines against pale whitish areoles, and longer, stronger central spines. The dark green, red tinted fruits were one inch in diameter with many black seeds in the pulp (RKH.33). A similar, but smaller growing plant with less strongly growing spines carried fruits of 5/8ths inch in diameter with only thin skins (RKH.35).

At Chosica I walked along the main road which follows the Rio Rimac until the point where the road to Santa Eulalia branched off to the left. There was a dusty, scruffy, boulder strewn triangle of land between the R.Santa Eulalia and the R.Rimac. I went through holes in the hedge and the barbed wire fence towards a group of cactus stems, which were all black except for the growing tips. These were Haageocereus RKH.61 with stems 2 inches in diameter and 2 ft high, with a dense covering of fine spines that could be seen to be either yellow or chestnut brown. One plant was found with an open pink flower near the top of the stem. Other stems bore fruit which contained many black seeds within the pulp.

From here I walked along the road to a bridge over the R.Rimac, where I turned off the road and followed a track along the left bank of the river. As the ground widened into fields around some steep rocks I turned left from the river to follow a steep ravine which had been cut into the hillside. In this ravine I found groups of Haageocereus with stems 2 ft in height, RKH.62. These stems were covered in yellow spines which were longer, more robust, and stouter than the spines on RKH.61. There were quite a few flowers on these plants which were white with a green tinge. The fruits were similar to those on RKH.61. Further up the ravine I found some more Haageocereus, RKH.65, which were similar in appearance to RKH.62 but had stems up to 4 ft or more in height, and more robust. This may perhaps have been due to their occupying a favourable site on a small level patch in the bed of the ravine.

On my trip to Peru in 1981 I came back to Chosica and found the patch of ground between main road and the turn off to Santa Eulalia was now covered by new building. So I went further up the valley of the Rio Rimac and visited the same gulley site that I had been to in the previous year. As I climbed up the gulley I found only one species of Haageocereus, RKH.89. The first plant I came across had five stems, black with dirt almost up to the growing point. The stems were up to 14 inches tall, 2 inches to 3½ inches in diameter (excluding spines) and had 19 ribs. The stems were clothed in yellow spines, between 1 and 3 central spines up to 30 mm long stood out from the many radial spines. The third plant I found had stems 28 inches tall with two seed pods of 1 inch in diameter and of a maroon red colour. Higher up the hill, some larger plants were found. One had a recently withered flower that looked as if it had been white in colour.

On this same trip to Peru I went to Ilo which is on the coast at the southern end of the country. Following the road inland for a few miles across the barren desert strip we then left the road to cross the bare ground to reach the railway line along the far side of the arid valley. We followed the line until we saw a few Neoraimondias on the hilltops above a side ravine or gulley. Each side of the gulley was covered with sandy slopes whilst among the rocks on the gulley floor were strewn very dessicated and blackened Haageocerei. Although most of these were no more than dead remains I did find one good plant RKH.83 with two stems projecting out of the sand between the rocks. These stems were not decumbent but grew upward at a shallow angle to the ground; one of the stems carried a maroon coloured fruit. Shortly after finding this plant another was found with a single stem growing out of a crack in a rock and two further, quite short, new stems. A black and dried out fruit lay beneath this plant but the seeds proved to have dried up beyond any hope of germination. At the top of the gulley around the Neoraimondia there were a number of larger clumps of Haageocereus among the rocks, with no signs of flowers or fruit.

My last trip to Peru was undertaken in April/May of 1986 when I made a short stay in Arequipa. From here I was driven out past the police control at the toll gate on the Pan American Highway at Puente Uchumayo. A short way beyond this there was a point with a good view over the irrigated valley below. In the opposite direction, high up on the hill, I had spotted a Browningia candelaris overlooking the road. I was told that there were more of them some little way along the road and round a corner, so I walked this distance and then left the road to search the hillside for cacti. The first plant that I came across was a Haageocereus species that was densely clothed in dark brown to grey spines that blended in well with the similarly coloured rocks and volcanic sand around them. This dark metallic colour is surely the reason for erecting the name platinospinus as being appropriate for the Haageocereus from this spot. After seeing the first few plants, others were then more esily picked picked out from their surroundings because they bore bright coloured fruits (RKH.124). These fruits were a bright pink, red, or orange colour and oval or egg-shaped up to about three inches long. The stems must have been about three to four inches across the large central spines whilst the stem itself was hidden beneath the mass of smaller radial spines. On the larger plants the lower part of the stem had become prostrate and about a foot or so of the growing end of the stem was upright. These plants would be about three or four feet across with the stems blackened and prostrate in the centre whilst the upright growing part of the stems would be clustered round the outer edge of the clump. On some plants all the erect growing parts of the stems would be grouped to one side as if the plant was intent in moving only in that direction.

From the city of Arequipa another trip was made out to Yura, where I climbed up the dry arid hills immediately outside the village. Here I found some more Haageocereus which were of similar appearance to those I had seen a couple of days previously at Puente Uchumayo. Here the plants appeared to be somewhat more prostrate and stems less erect. Whilst the plants at Puente Uchumayo blended in with the colour of the surrounding rocks, here they contrasted with the light sandy coloured earth. The bright three-inch long red, pink, or orange oval to egg-shaped fruits stood out like beacons against the dark brown spines and some plants bore a fair number of these fruits (RKH.137). Some of these fruits were so ripe that they had fallen to the ground. These plants were similar to the brown spined Weberbaureocereus which also grew here, but the lower height and more prostrate stem of the Haageocereus made them less likely to be confused with a small Weberbauerocereus when without flowers or fruit. There were many other plants scattered on the hillsides besides the cacti, despite the aridity of the area. A few seemed to be semi-succulent and on account of the recent rainy period were in growth and flower. The sunshine of the morning vanished as cloud gathered round the volcano and spread out. Some light rain was even felt for a few minutes at this location. The bus back to Arequipa took me into rain which was quite heavy when I alighted in the city. This was despite all the assurances that Arequipa enjoys year long sunshine with a few light showers in the middle of the wet season.

From Arequipa I went on for a short stop at Nazca. A hired taxi took me south out of the town along the Pan-American highway and then along the dirt road in the direction of Puquio, travelling for some 8 km along the valley of the Rio Blanco between the green irrigated cotton fields to one side and the desert on the other side of the road. Looking across the desert towards the hills we could see columns of cerioid cacti. As I walked towards them I first reached a few isolated outliers which turned out to be Armatocereus. Close by were a few stems of a short cylindrical cactus that could be either Haageocereus or maybe Loxanthocereus. The many closely packed spines hid the bodies and were coloured so like the surrounding rocks that the plants were difficult to see. This difficulty was increased by the height or length of the stems being similar to the size of the rocks. On one plant I found some seed pods (RKH.140) which I collected even though I thought they might not be ripe. However the seeds did look to be fully developed. Some buds were seen on another plant, sufficiently developed to be able to tell that the flower would be red in colour.

From Lima I made a trip along the Rio Chillon valley using a taxi, in company with Dr. Carlos Ostolaza. The flat central green area of the valley, irrigated by the river, was narrow and enclosed at each side by the steep hillsides of the surrounding mountains of barren rock. After travelling for some distance along this valley we made our first, brief, stop. Higher up on the hillside were many Neoraimondias; the columnar plants closer to the road were Armatocereus. Interspersed among these were much smaller cylindrical stemmed plants, Haageocereus aureispinus. We then continued along the valley where there was a broad and gentler slope from the road to the steeper hillside beyond. It was on this lower slope that we found a profusion of cacti. Opuntia pachypus, Espostoa melanostele, Haageocereus aureispinus, H.acranthus, Opuntia kuen-richianus and Neoraimondia roseiflora grew almost side by side.

The Haageocereus acranthus grew stems that branched from the base, initially growing vertically upward but then they seemed to get top-heavy and lean over. Only the upper part of the stem would continue to grow upright. The lower part of thestem. leaning or prostrate, would usually start to offset then and produce more vertically growing stems. This mode of growth formed rather wide, sprawling to straggly clumps. The few ribs on the stems can be clearly seen through the sparse but very robust spination. The new spines are coloured a light yellow that hardens to grey but because there are so few spines, the tops of the stems do not show up brightly as do the other species of Haageocereus. In addition the darkening of the stems that occurs with age is not so noticeable either. Nothing was found in the way of fruits on these Haageocereus. The larger plants of Haageocereus acranthus were similar in height to those of Espostoa melanostele.

In comparison with Haageocereus acranthus the plants of H.aureispinus are much smaller, as a rule. Thev

have a dense covering of fine spines that completely hides the stem surface. The young spines of this species are bright yellow to yellowish brown and sometimes a gingery red-brown, all of which again turn black with age. The stems are usually shortish and erect, their bright yellow tops contrasting with the black lower stems and were quite conspicuous being picked out by the sunshine like torches. Being a smaller plant than H.acranthus there seemed to be more of them about. I did find some fruits on this species that appeared to be swollen and ripe although they had not changed colour from green (RKH.143.).

Some plants were found that would be taken at first glance to be H.aureispinus but the spination on the new growth was perhaps whitish-yellow with perhaps some fine hair at their base. Some erratically placed tufts of wool on the upper part of the stem however, indicated that it was a Binghamia neoclimaxia, the natural hybrid between Espostoa melanostele and Haageocereus.

[The Haageocereus found by in the Tinajas canyon by R. K. Hughes were fully reported in Chileans No. 46 p.2].

....from H. Middleditch

In cultivation we are quite used to seeing fruit carried on our plants, usually (but by no means always) when flowering has ceased. Some fruit ripen fairly rapidly in cultivation, others seem to take months to become fully ripe, but they usually seem to dry up well before the flower buds appear for next season. The report of RKH 62 carrying both flowers and fruit in habitat might suggest that the fruit had been produced by the very first flowers of the season, which must have bloomed quite a few weeks earlier. In effect they must have opened before the rainy season proper. However, R.K.Hughes also reports finding fruit on Haageocereus well after the close of the rainy season, so that the question arises, does one season's fruit hang on (literally) until the next rainy season, to give the seeds the optimum chance of germination? How long does fruit stay on Haageocereus in cultivation?

Did any of the seed collected by R.K.Hughes germinate on return to the U.K.?

....from R. K. Hughes

I have had no trouble in germinating most of my collected Haageocereus seed. The real problem is keeping them alive and growing them on in my cool conditions, especially over winter. Two plants grown from RKH.83 seed collected on the trip from Ilo, in southern Peru, hardly grew upright before making a 90^0 bend and then continued in a horizontal mode of growth, just like the plants I found in habitat.

HAAGEOCEREUS FLOWERS **From I. Le Page**

My collection includes a number of Haageocereus of which three or four have flowered. One plant of Haageocereus decumbens has been with me for about fifteen years, and although I am not sure of its precise age or origin I probably obtained it as a small seedling. It now lives in a 13½cm pot and has eight stems arising from the base, the longest being approximately 28cm in length. The stems start off by growing upright, but at some angle away from the vertical; when they are 15 cm or so long they gradually become more and more decumbent whilst at the same time the growing tips attempt to remain upright. If grown in a pot the stems gradually develop a tendency to hang over the sides in a languid sort of fashion. I suppose it would be best if it was grown in a pot or basket hanging from the greenhouse roof. It stands on an upper shelf on the southern side of the greenhouse where it receives all the sun that is going.

This Haageocereus decumbens started to flower some four or five years ago and generally it has only three or four flowers each season, normally in mid to late summer. The flowers emerge from near the apex of the stems and seem to appear by preference on the younger (possibly more vigorous?) growing stems of about 10 cm long. However this might be circumstantial as the flowers nearly always appear on the stems which are in the best light. The buds when they appear are rather scale like and distinctly oval in plan view. The flowers develop quite quickly and although I have no record of the exact timings it cannot be more than two to three weeks between their first becoming visible and their opening. The scale like appearance of the buds belies the fact that flowers develop quite a number of hairs from each of the tube scales as they expand. The flower tube tapers steadily from above the ovary to the base of the petals. The outermost petals are dark brownish green with a white margin; they bend so far open that the tops of these petals point towards the base of the tube. The next row of petals open out more or less flat, with a broad greenish brown midstripe to the upper half of each petal. The inner petals are creamy white, in the form of a funnel. The uppermost anthers are a good half way up the petals; looking into the flower, the anthers seem to be pretty evenly distributed down to below the base of the petals. The stigma projects well above the topmost anthers, with the stigma lobes roughly half open. The flower does look to me somewhat Echinopsoid in the broadest sense. This plant will set fruit quite readily and about half of all the flowers do so, apparently unaided by me; they are plum coloured with perianth remains persisting. They are approximately 3cm in diameter, the inside being filled with a white flesh of a spongy texture in which the seeds are embedded.

I am not so sure how long the fruit does take to develop but they seem to persist for quite some time. Indeed earlier this year one particular stem was still carrying a ripe fruit with right next to it there was a pair of new buds well into growth. Really I do not know how this came about as I am quite convinced that the flowers appear in July and August, or occasionally in September whilst the fruits follow later in same season apparently reaching maturity some eight to ten weeks afterwards. Perhaps I might have missed a precocious flowering because I was not looking out for buds early in the season; it would not be too difficult to overlook such an event in a crowded greenhouse. However, having said that, I suppose it is just conceivable that the fruit could have come from a bud which had held over from last year, or it is just possible that the fruit had taken a long time to develop, over the winter.

A plant of Haageocereus versicolor has now been in my possession for sixteen years according to the label, having originally been acquired from De Herdt in 1972, probably as a two to three year old seedling. It is now growing in a 17 cm pot and has two stems, the largest of them approaching 63cm high, whilst a single offset of some 10cm in length grows from the base. It is only this year that it has flowered for the first time, a single bloom from close to the top of the stem, on what would appear to be the current year's growth. The flower started to open early in the evening and was fully open at around

sunset. I was able to get a photograph of the fully open flower at 8.15 p.m. in fast fading light by using a fairly wide aperture and a slow shutter speed. The flower was 8cm long and 6cm across the petals, when fully open. The petals were a greenish shade of white, radiating outwards so they left the stamens excerted well beyond the petals. The stamens formed a fairly thick ring evenly spread round the flower, all the anthers at nearly the same height. Even though the flower had not been open very long when I took the photograph there was already some pollen shed from the anthers on to the lower petals. The stigma was carried just above the anthers and was lying in a lax manner against the lower part of the flower; the stigma lobes were fairly long and thin, greenish yellow, and partly opened in a rather untidy fashion. One observer though the flower scent was like damp straw, another said it was like soggy cardboard!

One or two other Haageocereus have flowered for me but unfortunately I have a problem in identifying several of them as some of the labels became dislodged when the plants spent a summer in the garden whilst I rebuilt my greenhouse. Have you ever tried to identify a Haageocereus from one of Backeberg's descriptions? There also seems to me to be a question over Haageocereus multicolorispinus, as Backeberg lists it both as a species in its own right and as a variety of H.decumbens. The text of the descriptions is rather similar, but not the same, whilst the habitats may conceivably be close, too. In addition, I am not clear whether the ICBN Code allows the same epithet to be used for a species and also for a variety of another species in the same genus.

...from R. Mottram

It is in fact perfectly acceptable to find the name of a species under a particular genus, and then in the same genus to have another species with a variety having the same epithet. For example, there is Rebutia aureiflora and Rebutia verticillicantha v.aureiflora.

....from D. Angus

It will be well over ten years ago that I bought a plant of Haageocereus decumbens at Whitestones for 40 (old) pence. At the time it was about 4″ high. One year later it flowered and has continued to do so since, although not every year. The buds appear in ones and twos from midsummer through to as late as October, opening late in the evening. The flower will stay wide open during the following day, with the petals reflexed like a plate and the stamens protruding well above the level of the petals. Dabbling with a brush usually results in a fruit being set, which eventually goes brilliant red and stays on the plant right through until the following summer. On one occasion the fruit fell off after this length of time when I happened to pick the plant up. Another rather similar decumbent Haageocereus which also came from Whitestones also flowers, but the two plants never seem to be out in flower on the same night. Although on this second plant I have tried poking the flowers with pollen from Cleistocactus and various other plants that happened to be out in flower at the same time, nothing that I have ever done has ever resulted in a fruit being set.

....from P. Leigh

The only Haageocereus I have as yet managed to flower is a plant which I have labelled as H.multicolorispinus. This is a nice plant with seven stems of up to 10 inches long. I grow it in a hanging basket in the roof of the greenhouse, a fact which must have helped it to flower. In addition this method of cultivation seems to suit its decumbent manner. The flower opened at dusk and remained, if not fully open at least ajar, until ten o'clock the following morning. I was able to set fruit on this flower using pollen from Matucana ritteri, which was the only other flower open at the time. The fruit enlarged to a huge size of 5 cm long and 2½ cm thick, oval to egg-shaped and a vivid pink in colour. This fruit was taken off the plant in November and sliced in half, when I found it was full of fleshy pulp and seeds. I must admit that it is difficult to validate the names of my other Haageocerei against the published descriptions, especially the yellow-to-golden spines varieties.

...from A. Johnston

My own plant of Haageocereus multicolorispinus, one of the decumbens group, has flowered when only three years from seed. I keep it on a small upper shelf above the doorway where it is quite near the roof, next to another decumbent Haageocereus, which has also flowered. Fortunately I was able to set a fruit by using pollen from one plant on the flower on the other plant. The fruit formed a barrel shaped plum coloured berry about 20 mm long by 15 mm diameter. The new fruit is fluted for its whole length, but these flutes disappear as the fruit expands. Last year it still had a bright pink fruit close to the growing point when another flower bud appeared from the next rib. Both plants produced a flower at about the same time, when I was able to take pollen from my Pilosocereus gaumeri which was also in flower and use it on both the Haageocereus flowers. Both Haageocereus set fruit but these fruits became a great deal larger than those which I had set the previous year by crossing the two Haageocereus flowers. They were also a much brighter pink colour. The shape was still the same, not globular, more of a lemon shape. I was standing in the greenhouse earlier this year when I heard a loud plop and when I looked round one of these large fruits had fallen off and burst open on striking the floor, with pulp and seeds all over the place. I sowed some of the seed almost straight away and it has germinated quite well.

....from W. W. Christie

My plant of Haageocereus australis v.subtilispinus came to me as a 6cm stem from Oak Dene nursery in 1980. Now it is a 5″ square pot with eight heads, varying in length from 4 to 30cm and 2.5cm thick, all of them decumbent and spreading from the base. On the longer branches, whether hanging down the side of the pot, or growing horizontally, the top inch or two is curved as if the growing point was attempting to grow back upright. It does not seem to be putting on much growth this year, but I suspect that it would do so if it was potted up again. There are 20 to 30 short and slender white radial spines per areole with one dark central (1cm long) which lightens as it ages. I do not see any translucent spines in the lower parts. There are 16-18 ribs and the areoles are less than one cm apart so that the overall impression is of a mass of short white spines almost covering the body whilst the dark centrals tend to be obvious only near the growing point.The only drawback with this plant, apart from its sprawling growth habit, is that it suffers from scorch on the upper surfaces. When it is dessicated during winter, it always looks rather sickly, so that at the start of the year it is usually badly shrivelled and looks a sorry sight. It plumps up splendidly after watering, however.

It has been flowering for about four years now. It tends to have two or three flushes of flowers in the year from about four of the heads. Most of the flowers appear either close to, or within an inch or two, of the growing point, but the

occasional flower will appear from further down the stem. The first set of flowers are often in July, after which a fresh lot of buds start to appear and the second lot of flowers are at about the end of August. The third set of flowers can even run into early October. The flowers usually start to open at about 5 pm and by about 8 pm they are as wide open as they will get; by morning the flower will be wilting.

Before opening the flower is about 8 cm long and it opens to about 5 cm wide. The tube is green, with bottle green scales, small at the base, becoming broader and longer upwards and finally becoming the outer sepals. The uppermost scales stand tortoise-shell like away from the tube. The tube is fluted for the whole of its length, every scale lying on a flute - or you could say that the downward continuation of the scales forms the flutes. Untidy white hairs in the axils of the scales, 2 to 3 mm long at the base of the tube increase in length to some 10mm long at the top of the tube. The inner petals are creamy white, broad, opening out roughly half way between vertical and horizontal, remaining overlapped. The outer petals (or sepals) are much narrower and do not overlap; they do not open out flat, but curve backwards, the outermost ones curving so far that they point downwards, the next rather less so, and so on. The outermost petals are dark bottle green, the next brownish, so that from outermost petals inwards there is a gradation from dark green, through brown, nearly to white, all green at the base, all with a very narrow white margin.

I did manage to section a flower without removing it from the plant. The cylindrical nectar chamber is about 14 mm long with a gap of barely one mm round the style, due to the slenderness of the tube. The wall of the tube appears to thicken slightly at the top of the nectar chamber where the lowermost stamens are inserted, thereby presumably protecting access to the nectar, although there did not seem to be a great amount of nectar when I sectioned the flower. The filaments are inserted pretty well all the way up the wall of the tube and there is a complete ring of stamens around the top of the tube. The lowermost filaments carry their anthers at about the level of the top of the tube and the filaments were roughly all the same length. The stigma lobes were clasped loosely together and did not open out, being at about midway between the lowest and highest anthers. The anthers form an open tube so it is possible to look right down the tube; if the flower is not vertical some of the inner stamens do droop down on to the lower side of the tube. This is my first attempt at a flower section and one thing which I did not notice was whether the stamens projected beyond the tops of the petals.

I have been able to persuade these flowers to set fruit by cross pollinating from whatever else was out in flower at the time; in August it was Cereus, Echinopsis, Loxanthocereus and Cleistocactus, although obviously I do not know which one did the trick. It does take about a year before the fruit ripens and is ready to fall off. In September the fruit is a small hard berry about 15 to 20mm long and some 10 to 15mm in diameter, a dark purplish-red colour. There is not much sign of change in appearance over the winter months, but in April it shows definite signs of getting bigger and also turns a light pink colour. It gives the impression that it is becoming much juicier. By late May it reaches something like 30mm in diameter and when I removed one of the fruits at this stage it was full of a sweet and very tasty pulp (grape-like) and contained about 140 seeds. Two other fruits which remained on the plant grew a little more elongated and were still pretty firmly attached even when the plant was in flower again. In the following year an elongated fruit was removed in late May and measured 30mm diameter by 52mm long, with a smooth, pink outer skin broken only be a few tiny scales with minute tufts of hair in their axils.
....from M. Muse

In October 1979 I acquired a cutting described as Haageocereus decumbens v.multicolorispinus; it was unrooted, about 1.5 cm in diameter and 5 cm long, having a moderately dense and nondescript spination. Although it was still indoors it had started to sent out roots by November so it was potted up and put in the greenhouse, even though I knew nothing about how tender or how hardy it might be. After two or three years it started to offset vigorously so that the main stem reached 4.5 cm in diameter by 23 cm in length. For the first time a pair of buds appeared in early July, then seemed to grow painstakingly slowly until late August, and the flower finally opened in the first week of September. The spination had also become much denser and stronger: 1 to 2 centrals, basally thickened, very sharp and pointing all over the place. Emergent spines rich orange brown with dark tip becoming jet black, and finally acquiring a whitish patina on which mould grows in autumn and winter, but left the plant unmarked. At that time everything my collection was dried off in late autumn as I was not heating the greenhouse throughout the winter, and there was more than one occasion when the whole collection went down to -7^{0}C. Heating was started in March when I started to water (cautiously) again; there were no losses and no marking, so I was able to conclude that my Haageocereus was not tender.

Another Haageocereus was acquired as sp. ex Nazca, a rooted top cut from a plant about two feet high which had been neglected. The spination was a rich russet-brown like a fox's coat, but more recent spine growth, though equally strong and dense, was sulphur yellow with a few russet spines, long and acicular. Could it be H.turbidus? Over the winter of 1983 temperatures went down to -12^{0}C and that put a stop to my cold overwintering experiments.
....from Mr. and Mrs. T Lavender

The plant on the front cover is one which we obtained over ten years ago from Whitestones as Haageocereus decumbens. We kept it in a fairly small pot until the single stem had reached a length of about 11" when it started to put out an offset from the base. The main stem hangs over the side of the pot just like Cleistocactus vulpis-caudae. Each areole has about 22 or 23 whitish radial spines and 3 or 4 central spines which are light brown in colour with a dark brown tip, so that the habit of the plant looks just like a bottle brush. The areole felt is a very pale fawn to straw colour which retains its colour over most of the length of the stem.

Buds appear around about the middle of August, wrapped in greyish-white wool. Usually one flower will open on its own and a few days afterwards another will open. The stamens reach up almost as far as the top of the petals. The flower stops open for more than one day.
....from H. Middleditch

It is difficult to believe that in habitat the normal method of seed dispersal for Haageocereus is simply for the fruit to drop off the plant. A dun-coloured, thin-walled fruit with dry interior would be good enough to achieve this. So why a large, bright-coloured, thick-walled fruit with a generous filling of pulp? Neither the size, nor colour, nor abundance of pulp would be of particular attraction to ants. It is possible that these features may be directed towards birds, but far more likely that these features are to attract animals who would eat the fruit. In the process they would destroy some of the seed, but they

would disperse the remainder. Smaller animals in particular are likely to confine their perambulations to a localised area where plant life provides sustenance and shade, so that they would probably disperse most of the seed over this limited area. In this way there would be minimal likelihood of the seed being dispersed over even more arid areas where it may have less chance of germination and survival.

TEPHROCACTUS FRUITS **From J. Iliff**

When I had an opportunity to participate in the Chileans' Weekend and show some of the slides which I had taken on the I.o.S. trip to Salta, there was quite stir of interest over the slide taken near Abra Pampa of a compact hummock of Opuntia which was carrying a couple of fairly prominent fruits. These measured 2.7cm in height and 2.3cm in diameter and were yellow in colour. This particular plant is what I would regard as Opuntia glomerata. The spines are not directed upwards and the complete fruit stood clear of the very top of the hummock formed by the plant. Really I think that the prominent position of the fruits is just due to the spine formation in this case. plus the fact that the fruits are noticeably larger than the segments. There were other plants of similar appearance dotted about 50 to 100 yards apart over the same level plateau, but in the time available it was simply out of the question to explore other than a very restricted area. Any other vegetation was certainly low growing and quite sparse, with a great deal of bare ground.

Opuntia glomerata tends, and I would stress tends, to have reflexed spines, that is they point somewhat downwards rather than straight out sideways from the segments. This spine formation occurs in certain biotypes, of which the Abra Pampa plant was one. Whether these biotypes are consistent enough to deserve a varietal name, as Backeberg would have it, I am not really sure. Certainly there are other forms which have more erect spines. But if the plant has somewhat reflexed spines and a rather large fruit, then the fruit will obviously be likely to squeeze above the spines. Possibly in time the action of the spines might be to lift the fruit clear, though so far as I remember this had not happened and the fruit still had to be picked. I am not absolutely sure about this, but certainly the fruit did not just roll off into my fingers. In any case, this leathery kind of fruit becomes extremely hard in all cases that I have come across. There still remains the question of dehiscence, which I think has not had sufficient thought.

On the other hand, Opuntia boliviana is characterised by erect spines, and if there is a good complement of spines (again the biotypes vary a lot) then the whole of the outer surface of the hummock will be formed of projecting spines. Obviously the fruit here will be encaged by the spines, and so detach less easily. This will be an extra handicap to fruit dispersal, but I still think that any distinction between fruit more or less encaged by spines is not all that important from the point of view of seed dispersal, since the greatest obstacle to seed dispersal will be the hardness of the fruit. There are two stages here, firstly the fruit getting free of the plant and then the seeds getting free of the fruit. I strongly suspect that predators, probably rodents, play a big part in dissemination. If this is so, then the fruit could be just as well nibbled on the plant as off it. I am sure that I have read of quite a lot of other species which have evolved to actually encourage predators and achieve dispersal by paying a tax on seed production in this way.

....from N. Wilbraham

Yes indeed in the course of the I.o.S. meeting at Salta a trip was made up the Quebrada Humahuaca with a halt at Tres Cruces, where the party disembarked from our coach. At this spot the road ran over a wide flat plain, stretching several miles before and behind us, running between two ridges that were roughly parallel, some one and a half miles apart. The road ran the length of this plain and was about half a mile from one of these ridges; on the opposite side of the road, the railway ran more or less parallel to the road and about half a mile away. I was interested in reaching the taller ridge behind the railway line; after crossing the railway I was on my way to the hills ahead when I came across a Tephrocactus so I stopped and snapped it. The clump could have been about twelve inches across, possibly less rather than more, and quite low, rising some two to threee inches above the surface of the ground. The segments were relatively small so that the numerous half-ripe fruits look quite large by comparison.

Certainly the spines do look as though they are projecting out sideways from the segments so the tips of the external segments stand right on the outside of the hummock. I have had a close look at my slide with a x10 magnifying glass and I would suggest that the spines are more perpendicular to the stem surface at their point of origin, rather than being perpendicular to the axis of the segment. I would tentatively regard this plant as Tephrocactus glomeratus, but would not altogether discount the possibility of it being T.bolivianus. This was the only plant of Tephrocactus that I can recollect seeing during this particular stop; if there were any more then they were probably fairly widely spaced. I do not recall seeing any other Tephrocacti in fruit during the Salta Convention.

....from H. Middleditch

On the display bench at our 1988 Weekend was a large plant of Tephrocactus sp. Abra Pampa from A.C.J.Hall and I am fortunate in having a small offset from it in my own collection. The segments on this plant are relatively small, and the spines do project sideways from the segments, more or less perpendicular to the stem at their point of origin. The segments are slender, conical, and pointed, so that spines only project at a low angle to the general surface of the hummock, thereby presenting an overall appearance not greatly dissimilar to the plants photographed by both J.Iliff and N.Wilbraham near Tres Cruces. After seeing these slides of different plants taken in habitat by two different photographers, I would have been happy to accept that Abra Pampas was indeed the habitat of my plant, even without the additional corroboration of the name on the label.

When we were shown the slide of the Tephrocactus in fruit by J.Iliff at our 1988 Chileans' Weekend, the fruit seemed to be so large in comparison with the size of the segments of the plant. one might have harboured suspicions that a couple of peeled apples had been carefully put on to the plant before taking the photograph. However, this impression is probably due more to the relatively small size of the segments than to an unusually large size of fruit. On the other hand, on the slide taken by N.Wilbraham in the same general locality, there are so many fruits on the plant that they are difficult to count, but I make it 72. The fruits appear to be more or less globular with a flattened or slightly dished crown. They nearly make a mat on top of the plant and obscure most of the spination.

....from F. Vandenbroeck

In the higher parts of Bolivia we saw several of the Tephrocactus bolivianus in fruit. The fruits reach an impressive size, exceeding the size of the segments of the plant. They reach about 4 cm in length (30.12.88) They are more spherical than the ovoid segments of the plant and are mostly yellow when ripe. We cut open some fruits and they are definitely dry inside - we even found one plant with an open fruit. The big brown seeds could be seen packed within. According to the photographs I took and also from memory the fruits may project above the segments of the plant.

When we were in Chile, I took a photograph near Domeyko of a Tephrocactus which also had protruding fruits. These fruits were about half the size of the segments and they were a greenish yellow colour. In addition I took a photograph of a flowering and fruiting plant near Ovalle, where both the flowers and the fruits were located at the top of the segments and apparently had no difficulty in projecting above the spination. These plants had yellow flowers and red fruits. On the other hand I remember Tephrocactus floccosus forms with yellow fruits hidden amongst the segments.

....from R. K. Hughes

In general it is not easy to remove fruit from hummock forming Tephrocacti - at least from those which I met with in southeastern Peru, If the spines do not get you then the glochids will. It is only the floral scar which indicates that a segment is in reality a fruit. Generally it is difficult enough getting a knife down amongst the spines to cut away a fruit at the base, but it then has to be prised out from the surrounding spines. Sticks and more likely stones have to be used and manouevered firstly to enable a knife to be got at the base of the fruit and then to lever out the fruit. This was most difficult on RKH 128 T.ignescens with its long and outwardly directed spines, on the puna above Arequipa at the foot of the volcanos Misti and Chacani. Least difficult was RKH 129, with spineless segments forming an open straggly clump half-hidden in the undergrowth at the rim of the Colca canyon.

When I was at Sillustani, near Puno, in 1978 and found some hummock forming Tephrocactus, I first discovered the fruits because they were yellower than the segments and some of them had detached themselves from the plant although they aere still held by the surrounding spines. Poking with a stick among the spines also separated other fruits quite easily. It was then mid-May which is autumn there; with one open orange flower plus a few other dead flowers it might have been the end of the flowering season, so the fruits that I removed could have been there for six months to a year. They could have turned yellow and become easily detachable on account of the ripening process.

....from R. Ferryman

In the course of several Chileans' Weekends we have probably seen quite a number of slides of Tephrocacti in flower, not only those which I have shown, but others from R. K. Hughes, as well as from participants in the I.o.S. Salta convention and also from our continental visitors. Many of these were compact hummock shaped plants with the outwardly projecting spines and on most of those we have seen, if not all of them, the flower was above the spines. By this I mean the flower petals were above the spines, not necessarily the whole of the body of the flower. Indeed if the flower petals were not above the top of the spines then the flower would be so surrounded by spines that it would never be able to open and pollination would be exceedingly difficult. When the fruit is formed then it would at least be level with, or possibly partially above, the tips of the spines. In this situation it could be harvested by a predator. Once the next lot of segments started to grow the fruit would then become enmeshed within the spination, in just the fashion that R.K.Hughes describes.

You have no doubt heard me mention on many an occasion the difficulty of collecting Copiapoa seeds because the ants seem to rifle the fruit immediately the seed is ripe. I am quite sure that the fruit on Tephrocactus holds little or no interest for the ants and I think that it is far more likely that some reptile or rodent would take the fruit and disperse the seeds, as suggested by J.Iliff. Indeed on one particular occasion when we were close to one of these plants in Chile, K.Preston-Maffham called our attention to a small animal which was actually walking over the surface of the spines on one of these Tephrocacti - seeking the fruit, I would have thought. Needless to say it shot off pretty smartly once we turned to look at it so I did not really have a chance to see what it looked like.

....from C. R. Pugh

We do have a positive interest in encouraging plants to set fruit and in collecting seed so that we became rather perplexed when we found that ripe fruit seemed to be continually disappearing off various plants. Somewhat later we were in the process of refurbishing that greenhouse and this involved removal of numerous hollow concrete blocks used as staging supports. Imagine our surprise to find one of these hollow blocks almost filled with fruit off Gymnocalycium baldianum! Quite clearly it had been one (or more) of our own native rodents that had been harvesting these fruits, so I would not be in the least surprised to think that the rodents out in Chile and elsewhere harvest the fruit off the Tephrocacti.

....from A. W. Craig

It is difficult to understand this suggestion that rodents may be responsible for removing the fruit from the hummock forming Tephrocacti and thereby dispersing the seeds. Surely rodents will consume seeds the same way that mice eat a husk out of an ear of corn, by holding it in their two front paws and nibbling away at it. The seed of Tephrocactus will be disposed of, not dispersed, if treated in this way. It is not only the food that the rodents will obtain from the seed, but also a small amount of moisture, because their droppings are perfectly dry.

....from H. Middleditch

I have a feeling that a British Standard mouse might have a problem if it tried to tackle a Tephrocactus fruit of about an inch across. On the other hand where Tephrocacti grow on the altiplano there may be rodents which are larger than a British Standard mouse but with similar eating habits; are there any rodents living on the Puna which could eat fruit off a Tephrocactus? At the Chileans' Weekends we have been shown a number of slides of cross sections of several Tephrocactus fruits, which were taken in habitat by R.K.Hughes. These ripe fruits had a thick wall which must contain a fair amount of moisture. Would the rodents eat the fruit in order to obtain the moisture and also any nutriment it may contain, whilst the seeds pass through the gut of the rodent and are then excreted; some seeds would surely be broken up by chewing, but would some pass through the animal more or less undamaged?

SOUTH AMERICAN ECOSYSTEMS — THE HIGH ANDES **By G. Mann**

Translated by H. Middleditch from Biogeography and Ecology in South America.
Edited by E. J. Fittkau, J. Illies, H. Klinge, G. H. Schwabe and H. Sioli, 1968.

The high altitude mountain ecosystem displays quite sharply defined adaptions to the extreme surrounding conditions of this andean stage. The greatest biological influences which come into play here are: the low atmospheric pressure, the low density of the air, the low air temperatures, the great value of the ground temperature from the direct rays of the sun, the dryness of the atmosphere, the violence of the wind and the coating of snow or ice which can cover the ground for months on end.

We may recognise the low temperatures of this region (accounted for by its altitude) as on the one hand of the greatest life-restricting importance, but on the other hand it is notable for its extraodinary uniformity over the whole stretch of the Andes. Thus for example we find at 300 m altitude [sic] average annual temperatures of 9^0C at 8^0N latitude, 8^0C at 18^0S, 8^0 at 26^0S and 6^0 at 32^0S. These low average values indicate the frequent occurence of frost, which in general occurs in those parts of South America with monthly average temperatures of under 10^0C, and this effect can have far more sweeping consequences than the low temperature itself.

Seasonal temperature differences are of no additional effect, since in general they fall within 7 or 8^0C. In sharp contrast to these equitably low day and annual average temperatures is the remarkable range between day and night. Daily ranges are 28.5^0C at 33^0S and 2,400m altitude, 21^0 to 27^0C in the altiplano in Jujuy, 10^0C at 3837m altitude in the Andes of Santiago, and 18^0C at 3950m at 10^0S latitude. These huge contrasts impress a strictly limited period of daily activity on to the plants and in an even more restrictive fashion on to the animals, which make the most of their habitat in the moments of greatest difference betwen air and ground temperatures to execute their daily routine. These striking temperature differences, which occur with the rising of the sun, or its disappearance behind a cloud, are a result of the remarkable penetration of the sun's rays through the very dry high altitude air.

The extreme conditions of existence in the area of the high mountain ecosystem of the Andes induce an exceptionally uniform adaption to the environment. In the plant kingdom, where frost resistant representatives generally go in for distinctively high concentrations of cell-sap, the following life-forms prevail: (1) Low bushes which often take on a creeping habit and which are frequently rich in oils and resins, such as Chuquiragua, Adesmia, Nassauvia, Ephedra, Baccharis, and Lepidophyllum. (2) Small woody plants whose branches form more or less dense hummocks, such as Mulinium, Azorella, and Pycnophyllum. (3) Evergreen herbs with buds just above ground level, like tussock grasses, such as Festuca, Stipa, and Poa, as well as the rosette plants adpressed to the ground surface such as Plantago, Viola, Calycera, etc. (4) Geophytes, with transient aerial organs and permanent tubers, bulbs, or rhyzomes, such as Distichlis spicata, Psila, Lilaceae, etc. The biological spectrum of the Flora, in Raunkiaer's sense, corresponds to the following divisions: Tussock grasses and rosette plants 45%, Small woody humock plants 20%, Low bushes 15% and Geophytes 18%.

The special adaptions of the Fauna includes the following: Subsurface inhabitants of the soil are scantily represented, since the rocky ground holds out no favourable circumstances. Small organisms living in or at soil surface level preponderate however. Some seek refuge in crevices in the ground, which provide especially favourable climatic conditions for only a short period; some slide under stones, in order to escape the inclemency of the weather.

The effect of the rapid warming up of individual rocks attracts an abundant community of rock-, stone-, and cave-dwelling animals such as Lagidium and Chinchilla. Effective diggers are frequent. They work together in their activities, both in the enlarging of refuge holes as well as in the search for plant food (Ctenomys, Galea) and equally for animal nourishment (Chaetophractus, Akodon). Among the species living overground, pronounced runners are abundant. We find them among the birds and the mammals.

Foragers,predators, and suckers represent the most significant life forms. The resinous, often silicat rich, hard and fibre-rich vegetation of the high Andes offers the most important nourishment. Its reduction into small pieces is brought about by powerful, prominent, and often continuously growing incisors. Capacious fermentation chambers in stomachs and intestines afford possibilities for advantageous development of cellulose utilisation symbiotically, such as in Chinchilla, Abrocoma, and Auchenidae. A particularly long intestinal tract among Iguanidae, many birds, and phytophage mammals guarentees the absorption of indegistible nourishment.

The life forms of the producers which afford nourishment for the herbivores are reviewed above. The herbivores themselves fall into the following nine groups: (1) Large browsers - Pterocnemia pennata, Vicugna, Hippocamelus; (2) Root eating rodents - Ctenmys spp.; (3) Large rock dwelling rodents, which graze mainly on tussock grasses - Lagidium, Chinchilla; (4) Small rodents of the sub-order Hystricomorpha - Cavidae, Abrocoma, Octodontomys; (5) Doves (Columbiforms) and Finches (Frigillidae), which support themselves exclusively on seeds; (6) Small rats and mice of the sub-family Cricetinae which certainly take plants as their chief nourishment, but also do not disdain animal prey; (7) Omnivorous birds - Tinamiforms, Attagis, Thinocorus; (8) Plant eating insects, most of which can readily change from one host plant to another - Dasytidae, Curculionidae, Anthomyidae, Sirphidae, larva of the Geometridae, Colias and Argynnis; (9) Lichen eating snails and small fly-like creatures. Generally many different animals which are strict feeding specialists at lower mountain altitudes, have a wide range of feeding habits at higher altitudes.

The imperfect knowledge of many groups of mammals from the high Andes still does not eanble us to understand their particular biogeographical arrangement, which is likely to approximate to the climatic zones. Certainly there are three conspicuous zoogeographic zones, which although not ecological, are however clearly defined in extent. [Northern Andes...]. In the sector of the altiplano the following characteristic species appear; Conepatus rex, Vicugna vicugna, Chinchillula sahamae, Punomys lemminus, Octodontomys gliroides, Ctenomys frater, C.fulvus, C.leucodon, C.lewisi, C.apinus, C.nigriceps, C.peruanus, Abrocoma cinerea, Lagidium peruanum, L.viscaca, Chinchilla brevicaudata, Microcavia shiptonii, M.niata, Galea musteloides, Cavia tschudi, Phymatura palluma (Iguanidae). [Southern Andes ...].

Of the four suborders which comprise the order of rodents, the suborder of cavies has the greatest evolutionary unity. These animals are found exclusively in the New World. With the exception of a single north american genus, their distribution is limited to central and south america, the Antilles and the Bahamas Is. All of these animals share a common dental pattern 1.0.1.3./1.0.1.3.. However we will not try to discuss other characteristics of this suborder, because the individual groups and species of these animals have adapted themselves to so many different habitats and habits, and in doing so have developed so many different forms, that any attempt at delineating common characteristics would be meaningless.

Murid rodents

A Octodent rodents (from the high Andes)

1, Octodontidae; 2, Ctenomyidae; 3, Abrocomidae;

A.1., Octodontidae.

Body length 125-195 mm. The chewing surface enamel of the molar teeth has a pattern of grooves shaped like a figure eight, hence the name Octodontidae.

1. Octodon degus; 2, Octodontomys gliroides; 3, Aconaemys fuscus;
4, Spalacopus cyanus; 5, Octomys mimax;

A.1.1., Octodon degus.

According to Poppig these animals are particularly common in central Chile, where hundreds of them live together in hedges and bushes. On the approach of an enemy large numbers of them dive into their burrows. Octodon degus is the only octodent rodent whose habits are reasonably well known to us.

A.2., Ctenomyidae

Body length 150-250 mm. This family consists of only one genus Ctenomys, which do not have cheek pouches. They live in the altiplano as far south as Patagonia and Tierra del Fuego and in wastelands and areas of poor vegetation. The numbers of animals living in these sparsely vegetated — sometimes completely barren — regions is astonishing. In many areas these rodents have created such a large system of interconecting tunnels and have burrowed through the earth so assiduously that anyone walking through the area will most likely find his feet breaking through the surface, and horses can even break a leg. The main requirement for the presence of Ctenomys seems to be a sandy, somewhat dry, soil. Ctenomys eat roots, bulbs, and plant stalks. They also collect provisions which they store in their burrows.

A.3., Abrocomidae.

This also consists of only one genus, Abrocoma.

1, Abrocoma cinerea; 2, Abrocoma benetii

A.3.1. Abrocoma cinerea is known only from the altiplano of southern Peru, southwestern Bolivia, northeastern Chile, and northwestern Argentina, at elevations of 3,700 to 5,000 m. These chinchillones (chinchilla rats) live in burrows in the ground or in rock cavities. Body length 150 -200 mm. The intestine is very long. The small intestine has a length of 1.5 m, the colon of 1 m and the caecum 20 cm.

B. Viscachas and Chinchillas.

B.1. Chinchillidae.

1, Lagostomus (plains viscachas); 2, Lagidium; 3, Chinchilla.

B.1.2. Lagidium viscacia

From southern Peru, west and south Bolivia, north and central Chile, and west Argentina. They live in arid rocky habitats from 3,000 to 5,000m. (Walker) 900-5,000m (Grzimkek), with poor vegetation. These mountain chinchillas live in rock faults and crevices or in rock caves in the side of hills. Their diet consists of the few plants available within the habitat, including grasses, mosses and lichens. These animals must have water and they are not to be found in areas without water. Superficially like a long tailed rabbit. Body length up to 450mm.

B.1.3. Chinchillas

In 1899 some quarter of a million chinchilla skins were exported from Chile; in 1905 216,000 skins were exported from the Chilean harbour of Coquimbo alone. These animals are totally extinct in most areas of their origianl distribution range. Zoologists' opinions differ about the systematic classification of this genus. We will agree with the classification of Haltenworth and Cabrera.

1, Chinchilla chinchilla; 2, Chinchilla lanigera.

The chinchilla lives in rock crevices and caverns. They are basically crepuscular and nocturnal animals. In captivity they do not need water as long as they can get whatever water is necessary to their survival from green plants or fruits.

Galea

1, Galea musteloides; 2, Galea wellsi; 3, Galea palistris; 4, B.spixii.

These animals occur from the altiplano of Bolivia and Peru southwards to Argentina. Body length 150-250 mm. Like cavies they will eat most types of vegetation and they compete with Cavia, Ctenomys, llamas and alpacas for food on the altiplano. Galea are diurnal in the wild being most active in the early mornings and late evenings.

Cavies

The Cavies have rootless molar teeth which grow continuously. Rows of these teeth meet towards the front of the mouth.

Caviniae. Cavies — Body length 225-335mm.

The wild cavy Cavia aperea lives at altitudes of up to 4200m. They make their homes in subterranean structures which they dig out themselves or take over from other animals. Wild cavies leave their dens at night for their feeding places. They eat all kinds of grasses, herbs, and other plant matter.

Microcavia is found in the southern parts of Argentina in more arid zones than those where Cavia and Galea are found (Walker). Microcavia occurs from southwestern Bolivia to western Argentina and throughout central Chile (Grzimkek).

....from G. J. Swales

The grasses, roots, and other herbivorous vegetation which is eaten by these residents of the high Andes, will contain quite a high proportion of fibre. The basic constituent of fibre is cellulose. The digestive system of mammmals does not produce an enzyme which is capable of breaking down, or digesting, cellulose fibre into a form that can be put to use by the animal itself. However, ruminants have a pre-digestive tract which is host to bacteria which are capable of producing the enzyme cellulase which can break down the cellulose content of the fibre in the animal's diet. As far as I am aware, cellulose is of the same nature irrespective of its occurrence in grasses, roots, or seed coats, so that the bacteria which produce cellulase may well be common to all ruminants. However, I do expect that seed coats will contain not only cellulose but other materials such as lignin and waxes. In consequence, a combination of bacteria may need to be present in order to tackle the cellulose and other constituents of the seed coat or aril on Tephrocactus seed. Bear in mind that if the regular consumer of Tephrocactus fruit is a rodent, then no rodents possess the predigestive fermentation chamber of a ruminant.

The description for the dental pattern of the New World rodents refers to half of the jaw, both top and bottom; the numbers 1.0.1.3. may be interpreted as: one incisor, no canine, one pre-molar, and three molars.

....from D. Aubrey-Jones

Since mammals are unable to produce an enzyme that will break down one of the main consituents of fibre, cellulose, all herbivores are normally adapted to digest fibre in one of two ways. Both of these utilise bacteria and other micro-organisms to 'attack' the fibre. Those which are collectively known as ruminants have an extra fore-stomach complex, the reticulo-rumen, This is in essence a huge fermentation vat where bacteria feed on the food and help to break down the fibre before it proceeds to the rest of the digestive system.

Other herbivores which include the horse (and, I suspect, the guinea pig) have a greatly enlarged caecum and colon (large intestine) which is at the outgoing end of the digestive tract. Here once again micro-organisms ferment on the contents and in the process they break down some of the cellulose. In comparison with the ruminants these herbivores suffer from the disadvantage that the products of microbiological digestion have less opportunity of being absorbed and no opportunity of being further broken down by the animals' own digestive enzymes. Consequently, some of these herbivores practice what is termed copraphagy. This is the eating of fresh faecal material, and it allows a second passage of the digestive system, thus permitting increased absorption and so better utilisation of available food. It is particularly valuable for certain vitamins that are synthesised by the micro-organisms. Whether the Cavia practice copraphagy, I do not know, but I imagine that it is quite likely.

Anyone who has kept guinea pigs will know that a major part of their diet is made up of grass or hay, etc. However, they will certainly not refuse fruit such as pieces of apple, which they are better adopted to utilise than ourselves. It would seem reasonable to suppose that in the wild they would behave in the same way. If they were lucky enough to come across any mature Tephrocactus fruits I suspect that they would eat them. This would be a welcome addition to their diet at some times of the year.

The question then arises, would Tephrocactus seeds pass whole into the digestive tract of the animals without being first cracked and split apart by the teeth. Certainly the hardness of the Tephrocactus seeds would make them fairly resistant. Once in the digestive tract the seeds would be subject to all the usual digestive processes. I believe the most likely of these to affect the seed wall would be microbial fermentation since this would break down some of the fibre. On excretion by the animal this might leave the seeds in a condition ready to germinate. I am unaware if anyone has investigated this possibility.

In regard to potential eaters of Tephrocactus seeds, in the book "The Flight of the Condor" another rodent is mentioned, a small mouse Auliscomys boliviensis. It also refers to the viscacha which in the evenings would graze alongside the mice on the cushion bogs.

. . . from H. Middleditch

Would the 'cushion bogs" be the quilted mini-hummocks of Fries Hypsela formation occurring alongside streamlets or where water appears on the ground surface (Chileans No.43 p.160)? This is likely to offer better eating than the thorny Tola bushes.

Does the "very long" intestine of the Abrocoma qualify as a "greatly enlarged caecum and colon"? Is there any information available regarding the identity of the bacteria and micro-organisms which attack the fibre in the digestive system of herbivores? How can these bacteria be obtained so that some Tephrocactus seed can be immersed in them and put up near the glass to ferment, before sowing? Or perhaps some Tephrocactus seed can be dropped with the yeast into some home made win and left to ferment? Any volunteers?

....from G. J. Swales

I suspect that it would be not so much the length of the colon that would influence its ability to digest material of high cellulose content, but rather its volume.

....from D. Aubrey-Jones

The measurements that are quoted for the intestinal lengths of the Abrocoma would support the idea that it could utilise herbiverous material with its fair sized colon and caecum. However, it is more usual to compare the actual capacity of different parts of the digestive tract rather than the lengths. I suspect that the smaller mammals of the Andes are all non-ruminant herbivores to a greater or lesser extent.

RODENTS AS SEED CONSUMERS AND DISPERSERS **By M. V. Price and S. H. Jenkins**
From Seed Dispersal, Ed. D. R. Murray, 1986

We have concentrated on north american desert-dwelling heteromyid rodents and north-temperate

forest-dwelling sciurids, systems we know best. When a graniverous rodent is foraging and encounters a seed, the seed can either be cached or eaten. If eaten, the seed dies, since graniverous rodents generally chew what they eat. Cached seeds, in contrast, have some chance of becoming established. For some plant species, however, germination may be unlikely unless seeds are handled by rodents. J. K. McAdoo et al, Jnl. Range Management, 36.1983, showed that kangaroo rats husk Indian rice grass seeds before caching them, a proceedure which markedly increased percentage germination in standard laboratory tests. In addition to husking seeds, rodents sometimes bite them, presumably to ascertain whether they are acceptable. H. G. Reynolds and G. E. Glendening, J. Range Management 2.1949, reported that Merriam's kangaroo rat tests mesquite seeds in this way, and that nicking seed coats of mesquite seeds in the laboratory increases germination from 6% to 90%. Conceivably, increasing the proportion of seeds that germinate immediately could be detrimental to the plant in the long term in a fluctuating environment.

SEED DISPERSAL BY FRUIT-EATING BIRDS AND MAMMALS IN SEED DISPERSAL, Ed. D. R. Murray, 1986 **By H. F. Howe**

Most fascinating is the enormous diversity and abundance of modern fruits which are more or less specialized for consumption by bats, large and small birds, arboreal carnivores, monkeys, and ungulates. ..... Fruits are sedentary, attractive, and often available in quantity. In contrast, the nutritional quality of fruits varies enormously, and fruits occur in quantities far larger than most animals can eat. Search time within a clump is often minimal, while that between clumps may be considerable. Observations have suggested that fruits either gnawed and dropped or ingested and passed by mammals are characteristically heavily scented, and may be green, orange, yellow or white. ... C.Janson (Science 219.1983) discovered that large (14mm) brown, green, orange, or yellow fruits, often protected by husks, were favoured primate foods in the Amazon, in contrast to smaller and more brightly coloured fruits eaten by birds. .... Ruminants, elephants, and other large terrestrial mammals are primarily grazers and browsers, but many do have a prediliction for large, oily, indehiscent fruits (A. Gautier-Hion et al., Oecologia 65,1985). .... Terrestrial mammals ingest fruits, digest some or all of the seeds and pass varying proportions of seeds in viable condition. .... Lieberman et al. Ecology 60.1979, did find that Ghanan olive baboons (Papio anubis) passed viable seeds of 59 shrub and tree species. Germination trials showed that seeds from two berries (Nauclia latifolia, Securingea virosa) and one drupe (Azadirachta indica) had enhanced germination after passing through the baboons, whilst those of another berry (Diospyros mespiliformis) did not.
....from H. Middleditch

The foregoing article quotes numerous examples of fruit-eating mammals from the Old World, Australia, and North America, but only one example from south america viz:- Camels.

PRINCIPLES OF DISPERSAL IN HIGHER PLANTS **By L. van der Pij, 1972**

In this book we study the ways and means which the higher plants employ to reach sites where a new generation can be established. More specifically, this involves the methods used to keep their descendants separated in space and to provide each with its own site, where it can compete with other plants. Both the actual disperal as studied in the field and the structural basis needed to attain this dispersal, will be considered in an ecological context. All too often the second aspect has predominated so strongly in works on dispersal that they remain examples of herbarium ecology, or worse, writing-desk ecology.

Among modern reptiles few vegetarians are left: some turtles and tortoises, a few lizards. Recently Dawson (1962) described in detail the importance of terrestrial gopher turtles for cactus fruits in the Galapagos Islands, pointing especially to the germination which rapidly ensues after defecation. The local variety of tomato can in fact germinate only after passing through a tortoise, but not through other animals (Rick C. M. and R. I. Bowman, Galapagos Tomatoes and tortoises, Evolution, 15, 1961). As a syndrome of characteristics of reptile fruits, we can at this point state that the fruits have a smell, may be coloured, and are often borne near the ground or dropped at maturity.

Dispersal by birds; birds have only a weak sense of smell, or none at all, and are purely visual animals. The botanical answer is that fruit or seeds have: an attractive edible part; an outer protection against premature eating (green/acid); an inner protection of the seed against digestion (kernel; bitter or with toxic substance); signalling colours when mature; no smell (although smell is no impediment when present); permanent attachment; no special place on the plant; no closed, hard rind; in hard fruits the seeds exposed or dangling.

Dispersal by mammals; the fruit or seeds show essentially the same characteristics as those connected naturally with birds, and the two phenomena of bird- and mammal-mediated dispersal show a parallel differentiation in methods. Many fruits are eaten by both birds and mammals. Rodents, like squirrels, rats, and hamsters destroy the seeds of oaks, pines, and cereals. They are considered to be especially harmful in American desert-like regions, although after rains, seeds always germinate, having apparently escaped the onslaught in great numbers. Burrowing rodents may abandon or cache seeds underground. Tropical porcupines may be purely destructive, but many tropical squirrels are more specifically fruit eaters, digesting primarily the fleshy parts. Burkhart (1943) quoted data on the chinchilla, which can only exist in the wild where Balsamodendron brevifolium (Leguminosiae) grows. It stores and eats the fruits (algarobillas).

Ruminants can swallow seeds and partly evacuate them intact. Many investigations have concerned the seeds in the dung of vegetarian animals, including hares. Many grasses and also leguminous herbs (like Trifolium spp.) with small pods and hard seeds can withstand digestion to some extent. For percentage of survival I refer to H.N.Ridley, The dispersal of Plants throughout the world, 1930, pp 336-341, and the tables in P.Muller, Verbreitungsbiologie der Blutenpflanzen, Verh. Geobot. Inst. Zurich, 30, 1955, pp 88-92. The differential characteristics of seeds eaten by mammals are: possession of a hard skin, which offers no impediment; a more evident protection of the seeds proper against mechanical destruction.

Ruminants in the African savanna regions rely to a considerable extent on fruits. Many leguminosiae,

especially Acacia spp., specialize in this mode of dispersal, offering leathery, nutritive pods. The fruits are often characterised incorrectly as dry. A special adaptive point is the extreme hardness of the smooth seeds, resistent to strong molars, as is evident in Tamarindus, Dichrostachys, Acacia, and those Cassia spp. with hard, indehiscent pods of the type of C.fistula. Some of those trees, including spp. of Prosopsis, Ceratonia, and Samanea, are even cultivated for their fruits in diverse parts of the world; in south america they are used as cattle fodder under the general name of algarroba - properly Ceratonia. [Discussing Leguminosiae in particular] ... The pericarp as a whole can in diverse groups become semifleshy and the fruit indehiscent for use by ruminants, etc., e.g. Tamarindus, Ceratonia.

....from !. Bowman, Desert Trails of Atacama

The algarrobo tree produces a pod with seeds; these are valuable for fodder, especially in the dry years.

....from H. Middleditch

In the last remark by van der Pijl, I suppose that one is entitled to read fruit wall as the normal definition for pericarp; so why say the pericarp as a whole? Is this because the pericarp can technically be only the outer wall? Or is it intended to mean a fruit with not only a turgid wall, but also filled with flesh? It is interesting to see the comment by van der Pijl that fruit of Leguminosiae with nutritive leathery pods are often classified incorrectly as dry. It has been common usage to describe as juicy, pulpy, or fleshy, any cactus fruits in which the ripe seeds are embedded in some form of juice, pulp, or flesh, whilst fruit is described as dry when it has either a turgid wall or a dry wall which contains no juice, pulp, or flesh around the seeds. I suppose that van der Pijl is correct in his criticism; the slides of Tephrocactus cut in half in habitat, shown at the Chileans' Weekends by R.K.Hughes, are dry internally but the fruit wall is certainly not dry. It is stated by van der Pijl that fruit eaten by mammals commonly have seeds with a hard skin, which offers no impediment - no impediment to what?

In his original description of Maihuenia, Philippi noted that on the Cordillera the plant was known as yerba del Guanaco which would translate as Guanaco food. The plant itself might pose quite a problem to eat, so was it the animal's liking for the fruit that led to Maihuenia getting this name from the natives? The fruits of Maihuenia are carried on the outside of the hummock formed by the segments, in a similar manner to those on the Tephrocactus photographed at Tres Cruces. These Maihuenia fruits would be just as accessible to animals as fruits on Tephrocactus and one might suppose that any animal using one as food would be equally attracted by the other. Is the Guanaco a ruminant? What sort of dental pattern does the Guanaco possess? Would it grind to shreds the seed from a fruit which it chewed? Or would some seeds be ground up, some broken, some cracked, and some undamaged?

....from D. Aubrey-Jones

The larger grazing animals of the Andes are almost certainly ruminants. I understand that the llamas, alpacas, guanacos and vicunas are all camelids and as such are ruminants.

A great deal of research has been conducted on the digestive physiology of ruminants, particularly with cattle and sheep, due to their commercial importance. This has revealed that there are two principle types of microbes present in the reticulo-rumen, bacteria which number some 10^9 to 10^{10} per ml of contents, and protozoa at some 10^6 per ml. Many different species of bacteria have been isolated. For example, those involved in cellulose fermenting are: Bacteroides succinogenes; Butyrivibrio fibrisolvens; Ruminococcos flavefaciens.

In young pasture typically 40% of the dry matter consists of cellulose and hemicellulose and a further 25% is water-soluble carbo-hydrates. As herbage matures the proportion of cellulose and hemi-cellulose rises, and that of water-soluble carbo-hydrates decreases. At least 50% of the celluloses are normally digested in the rumen and this can be considerably higher. However, lignin which accounts for some 2-12% of the dry matter is not digested to any significant extent, and since this is associated with cellulose high concentrations can significantly reduce the digestibility of the latter.

I am unaware of the chemical composition of the Tephrocactus seed coat and aril. It is quite possible that it has never been investigated. In Anatomy of Seed Plants Katherine Essau 1960, both cellulose structures and lignin are mentioned as components of the seed coat.

....from R. M. Ferryman.

The Guanaco which inhabit the Andes have one very well known attribute - each groups of these animals have one place on their territory which is used as a latrine, and it is this spot, and only this spot, where they will come to defecate. If the theory was correct about the Guanaco eating the Maihuenia fruit, destroying some or many of the seeds as they chewed the fruit, but passing some damaged seeds, which then became capable of germinating, then the Guanaco latrines would be over-run with Maihuenia. In fact they are not.

On the other hand, when Maihuenia is described by the natives as Guanaco food, they probably mean just that - the Guanaco eat the plant segments. It is not even necessary to go as far as Africa where the antelopes and other herbivores tear twigs off even the spiny trees and bushes for food; you only need watch cows in this country, wrapping their tongues round thistles or spiny hawthorn twigs — it all goes down! And as for goats! So I have very little doubt that the Guanaco will make a meal of a Maihuenia plant if it is that way inclined, and we must look elsewhere for what disperses the fruit.

....from M. Nillson

On a trip to north-west Argentina in 1987 I came across large hummocks of T.bolivianus near Humahuaca. I found plenty of seeds around one small cluster. They were lying all around the segments and on the ground around the plant. It took me twenty minutes to pick them all up. I have failed to germinate any of them.

....from H. Middleditch

That sounds like some rodent or reptile had made a meal of the fruit wall or walls, on the spot, and left the seeds behind.

OREOCEREUS FOSSULATUS — A DRY STORY **From K. Preston-Mafham**

During the course of 1986-87 I made an extensive journey which took me to Venezuela, Bonaire, Brazil, Bolivia, and Chile. While in Bolivia I collected fruit of Oreocereus fossulatus, also from O. trollii both at the type locality and at

another locality further south, as well as from O. celsianus at two localities. As far as i am concerned the fruits of all three species are identical in all aspects except size. Oreocereus fossulatus grows in vast quantities along with Echinopsis bridgesii in the La Paz river gorge. The plants of Oreocereus fossulatus are very variable not only in spine colour but also in hairiness. Some have very gingery spines, some have straw coloured spines. Some plants are virtually hairless, the hairless ones being just as common as the very hairy ones, so that hairiness is not a distinguishing feature of this species, although all the seedlings we have subsequently grown from the habitat collected seed have come up hairy.

Fruits which were still tight but containing the ripe seed were abundant, as were ripe fruits in which the other rind of the fruit swells greatly leaving the dry seeds loose inside. On picking the fruits off the plant the seeds can simply be poured out dry through the basal opening. On unripe fruits the seeds are packed in tightly and occupy all the available interior space. There is no room for any flesh. No cleaning is necessary as there is no flesh adhering to the seeds either in ripe or in unripe fruits. This is the same for all three species which I saw, as indeed I would expect on three species which are very closely related and obviously only recently monophyletic.

I made seven collections of Cleistocactus fruits. These are completely different, thin-skinned, fleshy with tiny seeds scattered in a gooey mess which has to be laboriously washed off the seeds before they can be packaged. Incidentally, I collected 17,000 seeds of O.fossulatus, 25,000 seeds of O.celsianus plus 14,000 seeds of O.trollii so I speak from experience.

. . . . from J. Kirtley

In the course of a trip to Bolivia undertaken in October/November 1989 in company with B. Bates, we visited the La Paz valley. On 20th November we drove out of La Paz to the south, through the built-up area. This extends through Obrajes and Calacoto on both sides of the river, nearly as far as the bridge which carries the road across to the south bank. Beyond the bridge the road winds upwards past the "Cactus Garden" coming to a fork at the football field. From here the main road continues to follow the La Paz valley through Mallasa and on to Megacarpa further downstream. Most of the ground in the vicinity of this road junction and in the area of the "Cactus Garden" is of whitish clay, darker underneath; it contains a very high proportion of pebbles of various sizes. The rain and winds shape this material into a landscape supposedly resembling that of the moon, hence the name "Valle de la Luna". It is most impressive. Most slopes are very steep indeed and as the material crumbles easily it is very difficult to climb and gain access to plants growing on the sides. To judge by the occasional plant with exposed roots, or leaning at an odd angle, it is also readily eroded by the heavy rains of the wet season. The altitude here was 3280 m, yet the temperature exceeded 32^0C.

On this barren landscape grow small numbers of Tephrocactus sp., Corryocactus sp., Oreocereus sp., Tillandsias and Bromeliads, together with very little other vegetation. The cacti were always in a poor condition. At the road fork in the vicinity of the football field, four groups (or plants) of Oreocereus were observed and photographed, three of them with stems lying horizontally where they had fallen, either washed out or cut down. A few new stems arose vertically at points along the fallen trunks. The fourth plant had had the main stem cut off and had grown new stems in candelabra fashion. Individual branches were about 1.5 m high and 80mm in diameter with straw coloured spines and white hair. Very few flowers were seen. One fruit was observed; it was still securely attached to the plan and in removing it a small portion of the base of the fruit remained on the plan, separating from the body of the fruit by a ragged tear. The fruit was slightly elongated globular shape, pale yellowish green in colour with a pinkish tinge to the upper half. Externally it was quite smooth and carried a few minute areoles. The fruit had been eaten through from one side to the other leaving a hole about 13mm in diameter, revealing many shiny black seeds embedded in a stiff white pulp (as described by Ritter, Chileans '85, page 33). The fruit came back home with us where it was cleaned out and yielded 240 seeds, B/K 67.

Shrubs which had been introduced to the area grew directly below the Oreocerei; these shrubs bore yellow trumpet shaped flowers approx. 40 mm long, around which a humming bird and two or three large bees fought an aerial battle for the nectar. The humming bird took up the nectar through the flower tube, whereas the bees pierced the nectar chamber through the wall of the petals.

Not far away there was the "Cactus Garden", which had been roughly landscaped into flat patches joined by paths. Here there grew Oreocereus sp., Trichocereus sp., Cleistocactus sp., Echinopsis sp., Opuntia sp., Agave, Aloe, Tillandsias and Mesembryanthema. Many of the taller plants had been vandalised and badly cut about, just as we found in the Cardenas Institute at Cochabamba. On some of the Oreocereus there were fruits (B/K 67a) of various sizes, some smooth, others ribbed, and not always globular. Flowers on one plant were photographed, these conforming closely to the description by R. Mottram in Chileans '85 p.30, except that the petals are more yellow where the corolla becomes zygomorphic. Ants were much in evidence here, in some cases both inside and outside of fruits which were nearly empty of both pulp and seeds.

After travelling further down the La Paz valley we turned round and drove back to La Paz itself.

. . . . from K. Preston-Mafham

The seeds of PM.145 were collected from Oreocereus fossulatus which were growing just outside of the city limits to the south, just beyond the Moon valley, a well known spot.

. . . . from H. Middleditch

It is absolutely astonishing to find such diagonally opposed observations on the fruit of O.fossulatus made by people who have looked at the plants on the ground. The collecting place for PM.145 with loose seeds in a hollow fruit appears to be the same spot at which B/K 67 was found with seeds embedded in a fruit full of stiff pulp!

. . . . from F. Ritter Kakteen in Sudamerika, Vol. 2

Oreocereus

Fruit — at an early stage of development, filled up with a juicy pulp, opening above; there forms within the genus a transformation through to a hollow fruit with dry seeds that escape from a round basal opening.

Seeds — black, which likewise go through a considerable transition; originally shiny and finely tuberculate, apically with larger tubercles, with a hilum region that is distinctly smaller than the cross section of the seed and is sunken with a larger funicular scar and smaller micropyle within the hilum region; with the species differentiated by hollow fruits the seeds are matt, with lacunae towards the apex, the hilum region the size of the cross section of the seed, not or scarcely depressed

or slightly projecting, with very small funicular scar, by which the seeds are evolving in the direction of the genus Arequipa.

Oreocereus fossulatus FR 100

. . . the most important characteristic of all of his Oreocereus fossulatus Bckbg non Labouret remained unknown to Backeberg: the fruit filled with juicy flesh whilst O.celsianus and O.trollii have hollow fruit, from which the loose seeds fall out from a circular basal opening. Under pressure the fruit yields not a watery, but a thick juice. Seeds about 1.6mm long, 1.4mm broad, 1.2mm thick, more or less with a dorsal keel, testa black, shiny, with fine closely packed tubercles, blending into apical tubercles with some lacunae; hilum region very sunken, pretty nearly the size of the seed cross section, barely oblique, funicular scar forms a considerable part of the hilum region, micropyle small.

Oreocereus fossulatus v. rubrispinus FR 100a

Fruit greenish yellow to brownish-yellow-red, ellipsoid, globular or somewhat flattened . . . filled with sweet juicy flesh that under pressure yields a watery juice. The fruit either does not split open or only splits above when over-ripe, usually they are pecked by birds and cleaned out. Since I have no seed samples of FR 100a, I do not know whether these seeds differ from O.fossulatus.

. . . . from H. Middleditch

Again there is the same difference reported in the nature of the fruit in comparison with that observed by K. Preston-Mafham. Now O.fossulatus occurs within quite a small compass in the La Paz river valley whilst similar plants under names such as O.umirensis or O.luribayensis are found in valleys that are tributaries to the R.La Paz. It is fairly evident from the slides and the account presented to the Chileans Weekend by J. D. Donald that a number of plants which grow in the La Paz valley are relatively easy of access. It does not even appear to be likely that the differences in the observations can be accounted for by collections being made from differing altitudes in the La Paz valley, or from one or other of the tributary valleys. All three field collectors appear to have worked the most readily accessible areas, i.e.: a convenient drive from base camp at the metropolis of La Paz.

A comparison of the seed descriptions given by Ritter for the genus Oreocereus and for O.fossulatus, appears to be as follows:

Genus Oreocereus with juicy fruit	Genus Oreocereus with dry fruit	Oreocereus fossulatus juicy fruit
Shiny	Matt	Shiny
Larger apical tubercles	Lacunae towards apex	Some lacunae
Hilum sunken	Hilum ± level	Hilum sunken
—	—	Hilum just oblique
Hilum smaller than seed cross section	Hilum size of seed cross section	Hilum size of seed cross section

It will be evident that the description of the seed of O.fossulatus with juicy fruit does not match precisely the characteristics which Ritter gives for the seed of Oreocereus with juicy fruit. An examination of the few slides which are available of Oreocereus seed, taken by F. Fuschillo to his usual high standard, suggested that the seeds of O. luribayensis, O.urmirensis and Oreocereus FR 100a were roughly in line with the description by Ritter for seeds of O.fossulatus, except that the hilum was pretty well basal in all three samples. The seed of O.celsianus (dry fruit) had a matt testa, significantly larger apical tubercles, no obvious lacunae, an obligque hilum region somewhat less in size than the seed cross section and slightly sunken. This does not fit Ritter's specification for the seed of Oreocereus with dry fruit.

An examination of further samples of Oreocereus seed may establish whether there is really any consistency in the characteristics of the seed from dry fruit and those of the seed from fleshy fruit.

. . . . from R. Mottram

There is quite an early reference to the different type of seed for fossulatus in Backeberg's B.f.K.

. . . . from C. Backeberg, Blatter fur Kakteenforschung, 1934-6.

Oreocereus (Berger) Riccobono (1909)

. . . The fruit is roundish, smooth and slightly swollen, the remains of the flower persisting, green to reddish green, partly hollow within; some of the seeds are loosely attached, the others are enclosed in the thready, dry flesh of the fruit. The fruits become as large as a goose's egg and finally burst open at the base. Previously Oreocereus was considered to be a monotypic genus with various varieties. But not only are the flowers differently coloured, the seeds are different also. Oreocereus fossulatus has small, bright, black seed, the other four on the contrary are larger, duller, brownish black with a large hilum.

. . . . from T. Lavender

As I have grown a selection of Cleistocacti for many years I welcomed the opportunity to undertake a comparison between some Cleistocactus seed, and the seed of FR 100a, together with one or two species of Oreocereus seed. In order to make some sketches of the seeds I made use of a 30 times microscope and simply measured the size of the seed by using a ruler.

The seed of Cleistocactus chacoanus was comparatively small, more or less pear shaped, the hilum being much smaller than any other part of the seed both in width and breadth; the hilum was also concave or depressed. The testa was a glossy black and punctate, there was a small keel to the seed and the dimples or pits were in rows parallel to the keel for three rows with a more or less random distribution elsewhere. Compared with Cl.chacoanus the seed of Cl.mendozae seed was slightly smaller in overall size, the keel was much more pronounced, and there was a very slight difference in the hilum formation, but otherwise the two were generally similar.

The seed of FR 100a could easily be recognised as quite different from these two Cleistocacti. The seed was

a glossy black but the hilum was only slightly smaller than both the greatest breadth and width of the seed, again concave or slightly depressed. Immediately above the hilum this seed was similar to the Cleistocacti seed in being slightly pitted, but then above that it differed by having progressively larger and deeper pits; there also appeared to be a raised ring round each large pit which gave the impression of an "eruption". This seed was approximately 1.5mm across and 1.75mm high.

Oreocereus magnificus was a quite different seed, being much larger at about 1.75mm across and 2mm tall, as well as having a greyish brown testa, with just a few very tiny patches that showed a shine. The hilum again was neither quite as wide or as broad as the body of the seed but this time it was quite distinctly convex. As opposed to a punctate testa there were now slightly raised testa cells.

The seed of O.trollii was much more like the size of FR 100a but had the grey brown colour to the testa with slightly raised testa cells but in places there was a fairly large pit instead of the raised testa cell. Again the hilum was not far off the breadth and width of the body of the seed and only slightly convex.

There were only four seeds of O.celsianus which had been habitat collected from Tres Cruces, Jujuy province. Basically these were the same outline shape as the two foregoing Oreocereus, also a greyish brown colour to the testa, with slightly raised testa cells, but they had a rather more irregular overall shape because of the indentations or hollows in the testa, which tended to form angles on the body of the seed. The hilum was again not much smaller than the body of the seed and, in comparison with the seeds of the other Oreocereus spp. examined, there was rather more amber coloured crystalline material on the surface of the hilum. Three of the four seeds had a concave hilum.

There were only three seeds of Borzicactus fossulatus ex Huntingdon Botanic Gardens collected at Hacienda Huajchilla, La Paz. In size, outline shape, and hilum, these seeds were similar to those of FR 100a. The testa is similar to FR 100a, black and glossy except that the "eruptions" round the hollows in the upper part of the seed were less prominent and the hollows again gave an impression of an irregular shape. The belt above the hilum was not as punctate as FR100a. The seeds of Oreocereus fossulatus collected by K. P. Maffham in the La Paz valley were about three quarters of the size of FR 100a, but otherwise similar to Borzicactus fossulatus in being black and glossy, with a punctate belt just above the hilum; the eruptions round the top of the seed were not prominent.

At this juncture I was beginning to wonder if the seed of FR 100a was old seed that might have been travelling round a bit which means that it could have had a worn and rubbed testa surface.

. . . . from H. Middleditch

As far as I am aware the seed of FR 100a was pretty new and I deliberately refrained from taking it out of the packet before forwarding it to T. Lavender, as I have had a comment or two from F. Fuschillo about old and rubbed seed being unsatisfactory for photographing. On looking at the sketches from T. Lavender of the various species of Cleistocactus seeds I felt that two of them differed somewhat from the basic impression of Cleistocactus seed which I had in my mind. However, after looking carefully at my slides of Cleistocactus seeds I did discover that one seed had been taken at a three-quarter view rather than sideways or endways, and looked rather like the Cleistocactus seed sketch from T. Lavender. After viewing slides of about thirty different species of Cleistocactus however, I found that they all had in common the basic features quoted by T. Lavender for the two species he had examined, viz: testa black and glossy, punctate, more or less obvious keel with a few rows of pits parallel to the keel and the rest of the testa having pits more or less randomly disposed; hilum oblique, hilum much smaller than width or breadth of seed body. In addition the seed of Cleistocactus is thin when viewed endways, but broad when viewed sideways, the breadth being roughly twice the thickness. Similarly the hilum is much longer than it is wide.

. . . . from Mrs. A. Lavender

We had a look at about forty slides of Cleistocactus seeds and half a dozen slides of Oreocereus seeds, which we projected on to the screen in our living room. Although I have not looked at a great many seeds, after seeing slides of several seeds which are rather similar it is surprising how quickly and easily it is possible to recognise characteristic features.

Before we were half way through the slides of the Cleistocactus seed we had become quite familiar with a seed surface which looked as if it was sprinkled with tiny dots. We had a look at two electron microscope slides which had been taken by R. K. Hughes of Cleistocactus seed which he had collected himself in Peru. One of these slides was of a small area of the surface of the seed with a tiny pocket or hole let into the surface. The second electron microscope slide was of just one of these holes, but at a much greater magnification. What had appeared up till then to be tiny dots on the surface of the seed we now knew to be very small holes, even though they only looked like dots when we looked at more slides of complete seeds.

Quite a number of the Cleistocactus seeds on the slides had been stood on their hilum so the camera was looking down at the top of the seed. In this view we could see that there was a slight bulge at one end of the seed; sometimes this bulge was as tall as it was thick, whilst on other seeds it was not quite so prominent. After seeing several seeds with this bulge at one end we realised that when we looked at the side of the seed, there was a slight difference in the way the light was reflected off the surface at one end of the seed; we realised that this was caused by the same projection, which evidently ran almost all the way up one end of the seed and even some way across the top. I suppose that this projection is rather like a keel on a boat so that is probably why it gets called a keel. Once again, when we had recognised this feature on several seeds, we were ready to look out for it when the next slide was coming up.

Another thing that we could see when the camera was looking down at the Cleistocactus seed was that it was not round; all the seeds were either elliptical or oval. Some of them were even about twice as long as they were thick. The bulge or keel was always at a narrow end. Almost all the slides had a view on the hilum end of the seed and in just the same way that the body of the seed was longer than it was wide, the hilum, too, was longer than it was wide. But that was not all, because when you were looking at the hilum end of the seed you could see the black surface of the seed all the way round the hilum, so that the hilum was not as wide as the width of the seed and not as long as the length of the seed. It was not possible to tell that the hilum was like this when looking at the side of the seed, so the hilum must have been either exactly level with the bottom of the seed or else slightly depressed.

When looking at the side of the Cleistocactus seed, the part with the hilum was not square to the body of the

seed; I am not familiar with the technical terms used with seeds but apparently this feature gets called an oblique hilum by some authors. Like all the other features, we started to recognise this one quite quickly, too, as we progressed through the slides. The different species of Cleistocactus seeds were not all identical in these features but they were certainly very similar. It was a matter for comment when one or other species showed some degree of divergence from the regular form.

There was no difficulty in recognising the seed of Oreocereus as quite different from that of Cleistocactus. But whilst all the Cleistocactus seeds that we saw were fairly similar for about thirty or more species, the five or six different sorts of Oreocereus seed were certainly not identical. One was glossy black, another dull grey-brown; most of them had the hilum square to the body of the seed which I understand some authors describe as hilum basal, but on one of them the hilum was sloping. When we looked at the side of most of the Oreocereus seed we could see the hilum quite clearly, so it must have been projecting below the base of the black body of the seed. It is not easy to find a way of describing the surface of the body of the seed but it was much rougher than the surface of the Cleistocactus seed. The Oreocereus seeds were not quite round when viewed from above but they were certainly fatter than the Cleistocactus seed. The hilum on the Oreocereus seed was almost as long and as wide as the body of the seed, quite different to the small hilum on the Cleistocactus seed.

Having looked at all these Cleistocactus seed slides we than looked at seeds of FR 100a and to me they looked as though they belonged with the Oreocereus seeds. They certainly did not look like any of the Cleistocactus seeds we had been viewing.

....from H. Middleditch

Now that T. Lavender has had an opportunity to see these slides of Cleistocactus seeds he may be able to understand why I have reservations about the impression which may be conveyed by one of the sketches.

....further from T. Lavender

After looking at all these slides of seeds of various species of Cleistocactus, and subsequently through my own stock of Cleistocactus seeds, I quite appreciated that my original sketches of the seed of C.chacoanus and C.mendozae were not typical of all the other Cleistocactus seeds. The other four sorts which I have sketched are all different to each other in some aspect but all have the basic Cleistocactus characteristics, I feel. The hilum is oblique on them all, they all have a keel more pronounced in some than others, the testa is the same, the hilum is the smallest part of the seed and it is sunken.

....from H. Middleditch

From these sketches of Cleistocactus seed it may be imagined that T.Lavender has had his eye on the shiny black surface of the seed which has a suggestion of being divided into flat-topped cells. By comparison, I tended to have my eye on the dots, where three or more cells join together. A number of Cleistocactus seeds were traced from slides by making use of my large slide viewer. These support the comments by T.Lavender on the feature of the oblique hilum.

....from T. Lavender

Quite some time after studying the various seeds of Cleistocactus and Oreocereus, we received a sample of seed of B/K.67 which had been collected in the La Paz valley. These seeds were basically the same shape as the Oreocereus FR 100a and the Oreocereus fossulatus from Murillo, La Paz, that we had looked at previously. The size of the seed of B/K.67 is roughly the same as that of FR 100a, varyying between 1.75 mm and 1.5 mm. The colour was black and there was a small amount of amber crystalline material in the hilum. There were skightly raised testa cells, but in places there were fairly large pits as in O.trollii but no signs of the eruptions observed in FR 100a. The hilum was again the width and breadth of the body of the seed and on some of the seed the hilum was quite distinctly concave, on some it was flattish, but none were convex. The overall shape of the seed was more irregular owing to the hollows or indentations in the testa, similar to O.celsianus, forming slight angles on the seed.

....from R. Bregman

The two samplesa of Oreocereus seed proved to be very interesting. I have been able to look at both of them with a scanning electron microscope. both in lateral view and, at higher magnification, at detail of the apical seed surface. The hilum is typical Oreocereus but the smooth testa is unique in this genus as far as Bolivian taxa are concerned. To my knowldege the only Oreocereus with a similar tesat surface is O.ritteri from SW Peru. In Kakteen in Sud-Amerika part IV, Ritter describes O.tacnaensis, again from SW Peru, also having shiny seeds; unfortunately I have never seen either of these seeds. In the same publication Ritter discusses the intermediate characteristics of the O.ritteri fruit between a primitive fleshy fruit and an advanced hollow fruit. Possibly the stiff white pulp which was reported to occur with O.fossulatus from La Paz represents such an intermediate fruit type.

Basically the two samples of seed of O.fossulatus, PM.145 and B/K.67, are identical. Both samples appeared to contain few normally developed seeds; the majority were either dented or damaged. Therefore the apparent differences in lateral outline between the two samples examined under the SEM are not significant. From the examination of apical detail of the testa it can be seen that the shiny nature of the seeds is due to a smooth cuticle. Verrucose Oreocereus seeds all have a wrinkled cuticle.

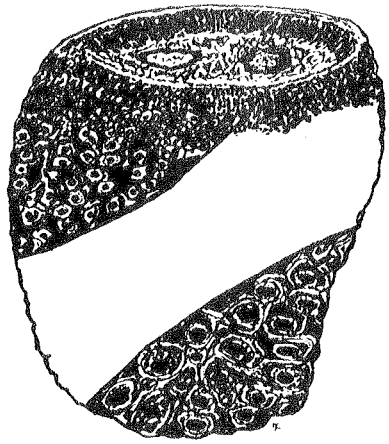
It would be interesting to know what taxa the plants from La Paz valley belong to. Could the the taxon with the fruit filled with white pulp be identical to Cleistocactus fossulatus Mottram? If this is so, then R.Mottram was wrong in placing this plant in Cleistocactus because the seeds you sent to me were 100% Oreocereus, There can be no question about that!

....from D. J. Supthut

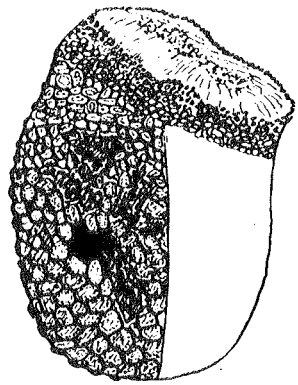
We have compared the two lots of seeds which you sent [PM.145 and B/K.67] with the Oreocereus seed which we have in our seed collection. There are no distinctive differences between our O.fossulatus FR.100, O.celsianus from Leuenberger, Arroyo 3545, and your specimens. Dr.Urs Eggli who has been my scientific colleague for the last year has come to this result.

....from R. Mottram

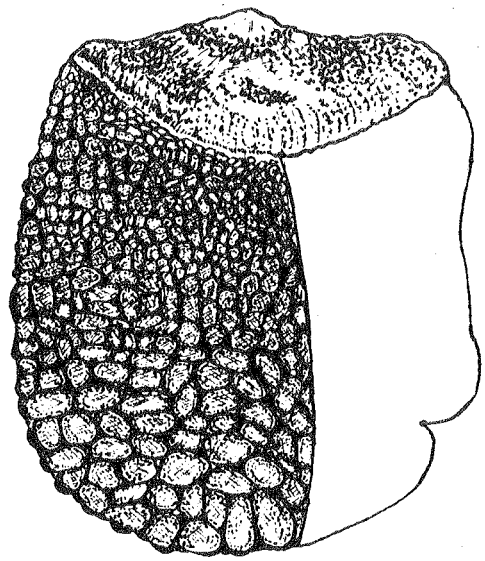
Not long ago a plant was distributed by ISI which they called O.fossulatus, from Cuchu Ingenio but, as suggested by the locality, it has proved to be O.celsianus. Is there still any doubts that fossulatus does not occur in Bolivia elsewhere than in the La Paz basin? If it is accepted that Oreocereus fossulatus sensu Backeberg does not occur in Chuquisaca, then it is incorrect to use the name combination Oreocereus fossulatus. Backeberg's name is based on a type



FR 100a



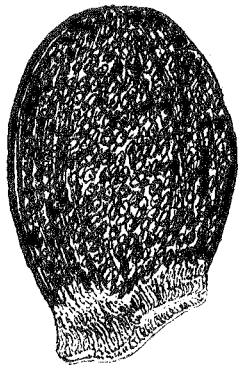
Oreocereus trollii



Oreocereus magnificus

Sketches - T. LAVENDER

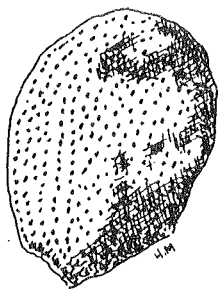
CLEISTOCACTUS GROSSEI



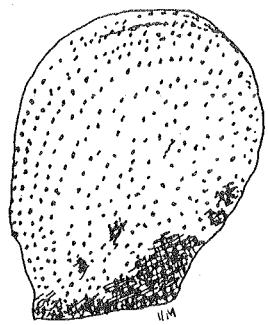
CLEISTOCACTUS CANDELILLA

CLEISTOCACTUS STRAUSII

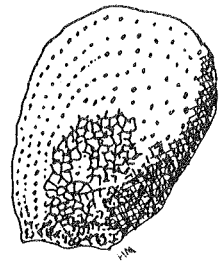
CLEISTOCACTUS SMARAGDIFLORUS



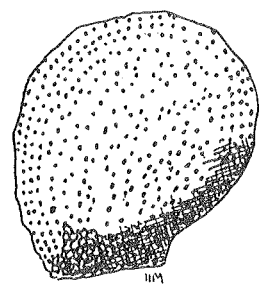
C. AYOPAYANUS



C. CANDELILLA



C. STRAUSII



C. BAUMANII

1mm

See 'Oreocereus fossulatus'

locality of Chuquisaca. Thus Oreocereus fossulatus Backeberg is a synonym of O.celsianus, the only species other than trollii from that region. If you wanted to refer to the species from the La Paz basin to Oreocereus, then you would need to invent a completely new epithet for it!

....from H. Middleditch

In the early nineteenth century a homeland of Mexico was attributed to a number of cacti from south america. Cacti from Bolivia were attributed to Chile. Plants from western Argentina were ascribed to Chile - a legacy from the appointment of Valdivia as governor of Chile in 1548 with rights to land 500 miles from the coast. The Viceroy of Peru was appointed in 1542, under whom the area of upper Peru (now Bolivia) became the audiencia of Charcas in 1559, with its capital of Charcas (now Sucre). It is to be noted that the country and the capital city carried the same name. In some early nineteenth century works the name Chuquisaca is used for what is now the city of Sucre and Chuquisaca is nowadays the name of the surrounding Department; wherever the name Chuquisaca is used in 19th century literature, caution is required when accepting a location, as the name may also have been used for Bolivia as a whole.

My own impression of O.fossulatus is that it forms a tall thin stem in comparison with the stout stem of O.celsianus. However, the Lemaire description of O.celsianus gives a height of up to 1 to 1½ m but no body width; Labouret gives O.fossulatus a body of 10 cm in diameter which I suspect is rather stout for O.fossulatus. Can the two species be separated on the basis of Labouret's notch below the areole, the areole pitch of 2½ cm, and spine length up to 4 cm for fossulatus, in comparison with Lemaire's areole pitch of 15-20 mm and spines up to 8 cm long for celsianus?

....from R. Mottram

The original description of fossulatus was made by Labouret in 1855 from a plant grown by Cels from seed from Chuquisaca. Thus it is not equivocal whether he intended to mean the department or the country. However, as Labouret used Bolivia rather than Chuquisaca throughout his Monographie, published two years before he published Pilocereus fossulatus, it suggests that he is unlikely to have intended the country by the designation Chuquisaca in the latter description. The description is based on a seedling plant 23 cm high and 9 cm in diameter, which almost certainly suggests that he was looking at Oreocereus celsianus. I do not believe that Cleistocactus fossulatus can attain this dimension in so young a specimen.

The stem of O.celsianus is about 8-10 cm in diameter in young examples, rising to 15 cm in fully mature plants which are one metre tall, or higher. Cleistocactus fossulatus is mainly about 5-6 cm diameter, but it can be as much as 9 cm (reported by Ritter). The height of O.celsianus is invariably below 2 m, but C.fossulatus is commonly above 2 m high at maturity and may be up to 4 m high. Oreocereus celsianus invariably branches very low, more or less basally, while C.fossulatus branches higher, sometimes half-way up the stem. Thus there seems to be some overlap in the dimensions, but the overall impression I get is that all the early descriptions of Pilocereus fossulatus are in fact O.celsianus. The description by Rumpler of areoles with about 100 hairs is also strongly indicative of celsianus, as fossulatus generally has 40 to 60.

Of the early descriptions, the only one which appears to definately indicate C.fossulatus as we now know it, is Pilocereus foveolatus which first appears in the catalogue of Cels. A brief description is given by Weber in 1904. Interestingly, Weber tells us that the name foveolatus refers to the 'pock-marking' of the spines, an unusual character to notice. Foveolatus is an unpublished name, but if one is convinced that it represents our present day concept of Cleistocactus fossulatus, then the epithet could be resurrected for a name combination under Oreocereus, if that was thought desirable.

The epithat fossulatus may refer to the inter-areolar fold, but this character applies in both fossulatus and celsianus, so it cannot be regarded as diagnostic.

....from K. Preston-Mafham

Yes indeed the Oreocereus celsianus that we came across were often of very uniform height at around 2m and R.Mottram is correct in saying that O.fossulatus goes to 4 m high.

....from J. Kirtley

In order to travel from Tupiza to Impora we took the road which runs for some distance northwards out of Tupiza and then turns towards the east to cross the Pampa Mochara, which is fairly level. Near to this turn in the road, right at the foot of the mountains which rise about a mile or so away to the west, we came across a large number of Oreocereus celsianus scattered over quite a large area. I happened to see a moth which was clinging to one of these plants; as it was at eye level it was easy to photograph. This moth would be a foot or more from the very top of the stem so I would put the height of these plants at two metres. There might have been over a hundred plants at that place, they were all roughly the same height, and they all leant over towards the south. We only looked closely at a few of them, but my impression is that they did indeed only branch from the base.

Earlier on we made a stop at a point about 40 km to the north of Potosi, at one side of a broad level valley. Running through the valley there was a small river whose waters were utilised for irrigation. The fields had been formed by clearing the larger stones and piling them to form to form rough walls. In this way the whole of the valley floor had been put to use for cultivation. There were Lobivia and Oreocereus growing in amongst these man-made piles of stones around the fields. At the sides of the valley the mountainside rose abruptly and also very steeply. The slopes were formed of some type of slatey material, mostly lying loose on the surface with the occasional projection of solid rock. It was very difficult to walk around on this hillside and great care had to be taken to avoid going hurtling downhill. Of course there was no cultivation on such a hillside so there were far more cacti here, Lobivia. Oreocereus, and the first Parodia we met with, so we spent between three and four hours at this site.

The Oreocereus which were growing on the level ground only had hair on the top foot or two of the stem, the rest of the stem being devoid of hair and also of spines. This might have been due to deliberate burning. Here I photographed one Oreocereus which was so tall that I had to stand well away from the stem and tilt the camera well upwards in order to get the top of the stem in the viewfinder. I suppose this plant must have been about 3 m tall. There was a branch at about half way up one of these tall stems.

....from H. Middleditch

So if we are to accept that O.celsianus is invariably below 2 m and invariably branches very low, usually

basally what name do we give to these plants?
....from R. Mottram

I have no doubt that there are some places where O.celsianus may superficially resemble fossulatus. We know that Knize has been so confused, and so was Arandia when he collected seed for ISI from Cuchu Ingenio. But all have proved to be misidentifications of O.celsianus. One possible explanation for the taller plants of Oreocereus seen by J.Kirtley near Potosi is hybridisation. Ritter reports a hybrid between Oreocereus celsianus and Cleistocactus tupizensis in the Dept. Potosi (Kakt. in Sudamer.2:697.1980).
....from J. Lambert

The most important population of Oreocereus celsianus which I observed was at Cajas, which lies not far from the Bolivian border, to the east of La Quiaca. There were hundreds of them, on slightly sloping ground. Their size varied from 1 metre to 3 metres and more in height, and a number of plants did develop branches part-way up the stem.
....from F. Vandenbroeck

In Bolivia I believe that I saw two species of Oreocereus: O.trollii and O.celsianus. I also saw the latter in northern Argentina near Yavi. My impression is indeed that O.celsianus mostly grows up to two meters tall and branches from ground level. Near Cotagaita we saw taller plants, going up to 3 m high. These taller plants tend to form smaller side branches from part way up one of the main stems.
....from H. Middleditch

There is an illustration in Backeberg's Die Cactaceae Vol.2, Fig.967, of Oreocereus maximus. This plant branches from above the base, the stems are up to 3 m high and more, about 20 cm thick. The plant is stated to emanate from the mountains east of the rivers near Tupiza. It is a good match for similar plants seen and described by J.Kirtley, by J.Lambert and by F.Vandenbroeck as noted above. It would always be possible to regard these latter plants, too, as O.maximus. Alternatively they could all be regarded as a variation of O.celsianus which is to be found growing in the company of plants which do match the traditional description for O.celsianus.
....from F. Ritter, Kakteen in Sudamerika 2

Oreocereus maximus Backbg 1949 is nothing but a regional form of O.celsianus. The size of the plants varies regionally; in higher and in dryer areas they grow smaller, often scarcely over 1 m tall, and with more abundant hair; in lower and somewhat moister places they become larger and have more sparse hair; there are gradual transitions. To make a separate species of the larger forms is totally unjustifiable. Frau Wilke, who has resided for many years at the Type location for Oreocereus maximus Bkbg., related to me that Backeberg had once briefly asked her for a more precise statement about O.maximus; she had replied to him that there was only a single species, maximus was not separable as a species on its own. But Backeberg had committed himself to the establishment of O.maximus and persevered with it.
....from H. Middleditch

The mode of occurrence of O.maximus as described by Ritter does not seem to match the other sightings noted above which were in the company of typical 2 m tall O.celsianus, at the same altitude and in the same environment. When we read Ritter's habitat observations they normally seem to be both comprehensive and sound; it is rather unusual to find the sort of incompatability that we have here. Nevertheless, a height of some 3 m and branching part-way up the stem is evidently not peculiar to O.fossulatus; but it appears to be the rule in O.fossulatus and the exception in O.celsianus/maximus. The stoutness of the stem also appears to be a distinguishing factor between the two species. There seems to be little doubt that the original O.fossulatus did come from near Sucre and no plants of the sort which we currently accept as O.fossulatus have been reported from this area. Hence it appears that we must accept the contention put forward by R.Mottram that the plants found in the La Paz valley cannot justifiably be identified by the name Oreocereus fossulatus. It would appear that Ritter also came to this same conclusion and consequently refers to this species as Oreocereus fossulatus Backeberg non Labouret.

In Chileans No.43 p.32 a map of the altiplano was published on which was plotted was plotted many reported habitat locations for Oreocereus. The finding place reported by J.Kirtley for O.celsianus at some 40 km to the north of Potosi extends the northerly distribution for this species from that plotted on this map, as may be established by means of the scale of km which is on the map.

GERMINATING TEPHROCACTUS AND MAIHUENIA SEEDS — From Members

The seed collecting trip to the Southern Andes which was undertaken by Pern & Watson during November to March of 1987-88 was reported in The Chileans No.46 p.13. Some packets of seeds were received from this expedition, mostly Maihuenia and Tephrocactus. Both these genera are traditionally reputed to be rather difficult to grow from seed. This seed was distributed to a number of Chileans members, all of whom regularly grow plants from seed. The majority did encounter difficulties of one sort or another with the P & W seed, which appears to bear out the reputation held by these genera for posing germination problems.
....from W. W. Christie

The PW seed were sown in April, using my normal cactus compost with a 2 to 3mm layer of coarse sand on top, on to which the seeds were laid. The compost and sand layer were first sterilised separately by soaking thoroughly before putting the pots in a microwave oven at full power for four minutes. The pots then went into a sealed and heated propagator under the bench in my greenhouse. At the same time I sowed some seed of Echinocerei and Ferocacti which I collected in the wild in Arizona last year. Some of the Echinocerei germinated very well indeed, but none of the Ferocactus seeds germinated at all.

I had been intrigued by a letter in the BCSSJ of March 1989 from a Mr.Moakes who, after about a month, removed his ungerminated seeds from the compost, dusted them with Murphy's rooting powder and resowed them on fresh compost to get 100% germination. His explanation was that the pH of his compost had become too alkaline. I was slightly dubious about this idea, reasoning that perhaps the plant hormone in the rooting powder was now able to penetrate the seed

coat much better so bringing about improved germination. To test this theory I dusted the surface of the compost, 6 weeks after sowing, with May & Baker rooting powder (active ingredient - napthylacetic acid). The result was immediate and complete germination of the Ferocacti seeds and many of the ungerminated seeds from my same collection trip. However, there was no effect on the PW seeds where the germination has so far been nil.
....from F. Wakefield

Before the Maihuenia seed was sown sown I chitted the seed and as it had been suggested that it might take a long time to germinate, I put the pots in a plastic bag. This was a mistake as I could not see what was going on. In fact nearly all the seeds germinated fairly quickly but what I did not see was the formation of a woolly fungus and by the time I did spot it, it was too late. I had treated the compost with Filex but clearly this had had no effect, possibly because it is a systemic.
....from M. Muse

I am having some difficulty in germinating the PW seed; two separate numbers produced one seedling each, both of which turned brown, shrivelled and died. Since the compost was warm and wet this is something of a mystery. I used my usual very open compost and sealed the seed trays with industrial shrink wrap. The same thing has happened with seeds of Echinocactus polycephalus, so I shall remove the rest of the seed and sow it in a different medium. By comparison, the seed of Tephrocactus RKH 129 germinated in November after a six week delay, this without the aid of a propagator. Perhaps it is a mistake to heat by this means since it seems likely that germination temperatures in habitat are quite low?
....from P. Leigh

To start with all the P & W seed was was given a soaking in tepid water for 24 hours. Each number was sowed in its own 3 square pot, without any plastic or other sort of cover, in a compost of 3 parts J.I No.1, one part gritty sand, and one part grit. These were immediately (October) put into an old plastic greenhouse which is basically open to the elements. This went down to -5°C in the cold week of November. If I happened to notice that any were dry, they were watered from overhead. At the end of December I gave them a good soaking and put the pots on a heated bed in my real greenhouse, again with no cover. The heating cable in the bed was set at 20°C. All the pots were kept moist. Some germination did take place; pots with no germination were allowed to dry out then thoroughly watered by capilliary action. During the month of March seedlings started to damp off intermittently, so I applied some fungicide. In desperation I tried grafting some of the seedlings on to Trichocereus, Opuntia, and Pereskiopsis, but all these grafts failed to take.

This left me with only four good seedlings of Tephrocactus PW.6473. In the middle of July these were potted up individually, they all had very long roots, twice the length of a 3½" pot! The height of these seedlings ranged from ½-2½" At the end of May I dried off all the remaining seed pots, and then started the process again, without disturbing the seeds. This was followed by additional germination of PW.6085 and PW.6469. So my message to others is, don't give up!
....from A. W. Craig

The PW seeds were treated just like all my other cactus and succulent seeds, being sown in individual pots on a compost of one third each of peat, grit, and John Innes No.3, then covered with a thin layer of fine grit. These pots were put on to a damp sand bed in my small propagator, which is set to provide a minimum of 70°F, although I expect it will get even warmer than that on a sunny day. All these pots were sprayed daily with a fine mist of diluted chinosol, as a fungus control. Once germination is under way, the pots are moved into my large propagator where they are stood in trays containing a little water. They remain covered for a few days and are then left open. Two Maihuenia damped off after less than a month from germination and so all the PW seedlings in the large propagator were raised up out of the water and placed so that they were more exposed to the fan-circulated air.

There was no germination of PW.6460A, 6469, or 6499. Of those which did germinate, there were differences to be seen in the seedlings at a very young stage indeed. The first two cotyledons on Opuntia PW.6462 were some 20 mm long and tapered steadily from about 2½ mm broad at the base to the pointed tip. On Opuntia PW.6473 the cotyledons were some 12 mm long and tapered steadily from some 4 mm wide to the pointed tip. After losing the first Maihuenia I took one of these seedlings at about 8 mm tall and barely 3 mm in diameter and grafted it on to Pereskiopsis; but it failed to take.

An experiment was then carried out with a further twenty Maihuenia seeds of the one collection number; five of these were sown as a control, following the above procedure. The hilum was carefully cut off a further ten seeds, five of which also followed the above procedure, the second lot of five being given the same compost etc. but were given no heat other than that within the greenhouse. The last five seeds were cut or notched on the back and also given the usual procedure. Of the five seeds which had the hilum cut off and were grown in heat, three germinated in four days. Of the five seeds with the hilum cut off and no heat, one germinated in about ten days. Of the seeds with the back cut or notched and grown with heat, one germinated but the root did not grow out of the seed coat. Of the five control seeds, none germinated.

Out of a packet of DJF Maihuenia seed sown several weeks earlier, only one had germinated, so I sifted round in the pot and found two of the ungerminated seeds, cut off the hilum, resowed them, and they germinated in three days. Of the P & W seed which had been sown two months earlier and still showed no germination, I dug up all the seeds I could find and cut off the hilum; after a few days there was then a germination of all but one PW number.
....from R. Moreton

This year I sowed some seed of Tephrocactus and Maihuenia from commercial sources; as usual they were sown one species to a pot using Levingtons Universal with some extra grit, which is my usual seed compost. I do not sterilise the compost; it is quite possible that naturally occurring microbes in the soil make a contribution to seed germination, a view expressed by S.Brack. The pots are then stood on a domestic warming stand on a windowsill and covered with a sheet of polythene. There are often droplets of condensation on the underside of the polythene sheet. It was interesting to see that Maihuenia patagonicus came up with fairly long, slender, cotyledons; Tephrocactus glomeratus with somewhat shorter, fatter, tapering cotyledons, and Opuntia pilifera with ovate cotyledons having pointed tips.

The PW seed was sown in early May, in my normal fashion, except that usually I would just sprinkle the seed over the compost but the Tephrocactus and Maihuenia seeds were so large that I pushed them down into the compost and covered the surface with a thin layer of grit. When raising alpines from seed I also use a covering of about quarter of an inch thickness of grit. The heating tray is switched off at night so as to provide a daily cycle of temperature; during the day it is

probably around 80°F but in the sun I expect the pots will be even warmer than this. There were germinations of both Tephrocactus and Maihuenia as well as of the single number of Austrocactus; these Austrocactus seedlings were brought along to the 1989 Chileans' Weekend.

....from R. K. Hughes

My own seed raising is done without the aid of any special heating and without purchasing any compost. All my plants and seed are now grown in 100% grit - at first I had thought of using broken brick, but this makes the pots very heavy for lifting and transport to a meeting or show. What I wanted was some other sort of gritty material which which I could add to the brick in order to cut down the weight. I had heard about Perlag but I was under the impression that it was not available in a suitable form. Then I came across some broken lightweight aerated building blocks, which proved to be just what I was looking for. Both the aerated blocks and the softer type of brick are broken down to below about 3 mm in size, then I sieve out the finer particles (probably under half a mm). It is this fine grit which I use for seed raising, without adding anything else at all to it.

All seeds are sown in individual two inch square pots by laying them on the top of the grit, where they can be seen. Nine of these pots are then put into a square plastic margarine container, where they fit snugly. The pots are then wetted with boiled water and are then sealed in the container by a layer of cling film held in place by the container lid - but the whole of the centre of the lid is first cut away and discarded, leaving only the sealing rim, barely one inch wide. In this way the seeds are kept sealed at a constant moisture content but it is quite easy to see through the cling film how they are getting along. Finally a piece of thin expanded polyurethane sheet (about two mm thick) is laid over each container, in order to diffuse the light. The container, with its contents, is then put up on to a shelf right at the very top of the greenhouse where it just has natural greenhouse temperature.

Much of my seed sowing is done in Spring, up to about May, but I also try sowing seed in September. There is no heating in the greenhouse until the weather is really cold and frosty. Nevertheless I have had seed germinate between October and December. Once seed has germinated the pots are transferred to plastic trays (without drain holes) covered with the usual type of transparent propagator cover and placed on a sunny windowsill in the house. Only then is Phostrogen added to the water.

The P & W seed was sown in May, using the above method. The Tephrocactus seed all had an aril in the form of a ring and I found no difficulty in notching into this ring and peeling off all, or almost all, of the aril. To remove the aril, or sufficient of it to expose the body of the seed, was far less trouble than when I tried to notch or remove part of the aril from Tephrocactus seed that I collected in Peru. There was one germination in Maihuenia PW.5482 and PW.6468 which both keeled over and died as cotyledons. Of two germinations in Maihuenia PW 6469, one has a brown spot on the side of the cotyledon stem where it is bending over; I have seen this before and I expect that I will lose this one, too. There has been germination in PW.6497, 6085, 6460a, and 6473. The Maihuenia have very long, slender, cotyledons, whilst those on the Tephrocactus are a stumpy triangular shape. From my own collected seeds of Tephrocactus sphaerica, the cotyledons were a short, thick, boat shape.

....from D. Aubrey-Jones

My seed raising is done in individual 2 square pots. I make up a compost mix consisting of a proprietary peat based seed compost such as Baby Bio and to this I add about one third of coarse sand. I fill the pots to the top with this mix and then soak them in a tray of tap water. When the compost is wet through I let the pots drain and then put them inside an open plastic bag before heating them in the microwave oven for about 15 minutes until they are steaming nicely! This is to sterilise the soil. On taking them out I close the bags and leave the pots until they have cooled overnight. The following day I make up a solution of Benlate fungicide in boiled water. The seeds are then sown on the surface of the compost, covered by a light sprinkling of coarse sand, and watered gently with the Benlate solution. Lastly I put the pots in fresh plastic bags and completely seal them. Apart from very occasionally watering them with cooled boiled water every few months I often leave them like this for up to a year. Provided they are kept out of the full sun on very hot days in summer when they might scorch, most cacti seedlings seem to be quite happy with this treatment. No algae grow on the surface of the compost and normally little if any damping off occurs. This method also has the advantage of needing very little maintenance. The pots, sealed in their plastic bags, are normally kept in trays on the floor of the greenhouse in summer or on a sunny windowsill indoors in winter, without any additional heating. I am convinced that the interior of the plastic bags gets quite warm during the daytime; indeed I have had one or two seedlings scorched on a really hot day. This is why I keep seedlings on the floor in the greenhouse, so that they do not get too hot during the day; also why I do not sow seed when the very young seedlings would be exposed to midsummer temperatures. Nor do I use a propagator, as I believe that a daily cycle of temperature is of advantage.

Although this method seems to suit nearly all the cacti seeds I have tried, it did not have nearly as much success with the PW seed. To avoid the possibility of the contents of the plastic bags getting too hot in mid-summer, I kept the P & W seed until autumn. Before sowing this seed, I cut off as much of the Tephrocactus aril as possible with a scalpel in order to expose the seed proper; some of the outer coating was also cut off the seed of both Maihuenia and Austrocactus. There was some germination of every number, although there was only one germination of Austrocactus. It was then that my problems started, as the Austrocactus seedling and one or two Maihuenia seedlings appeared to collapse after a while. They did not seem to like the close humid atmosphere inside the bags. The Tephrocacti seemed to be somewhat more resilient., So I opened up the tops of the enclosing plastic bags and yet I lost more Maihuenia seedlings due to damping off. In the end I took all the pots out of the plastic bags. but I have still lost all the Maihuenia. There are a number of the Tephros left. This is most unusual as I seldom if ever meet with this problem with any of the other sorts that I grow from seed.

....from F. Wakefield

If soil is to be sterilised, then it must be moistened before it is heated. It is a good idea to hold the temperature for some minutes to effect thorough sterlisation. A temperature of up to 140°F will kill most pathogenic fungi, most plant pathogenic bacteria, and many soil insects; 160°F will kill all soil insects, most plant viruses, and all plant pathogenic bacteria; 180°F will kill most weed seeds, whilst 212°F will be needed to kill a few resistant weed seeds and resistant plant viruses.

....from R. Allcock

I was fortunate enough to receive twelve seeds from each of the nine batches from the Pern & Watson Southern Andes Expedition of 1977-78. On 7 November 1988 these seeds were sown onto a fine but light and friable compost composed of equal parts of sifted loam, sifted peat, horticultural sand, and seed-grade vermiculite. The seeds were pressed flush with the compost surface, and (without adding any top dressing) the pots were then placed without cover on a high and sunny shelf within an unheated greenhouse. Here they were watered or heavily sprayed from time to time, and very especially whenever frosty nights threatened. The winter was uncommonly mild, but even so the compost surface froze on several clear nights, and upon inspection it was found that the frost heave had left the seeds considerably lower in the soil, and that some of the Tephrocactus (Maihueniopsis) had cracked open, revealing a shiny chestnut-brown kernel.

On 29 February this stratification treatment was discontinued, and the pots were placed in a crystal-top propagating tray, within a coolish propagator, running at approximately 67^0-72^0F. Here all germinations took place. As with all other seeds, they were watered from below whenever they were dry, always using Chinosol in the water as a fungicide control. The propagator was switched on day and night, but during sunny days the temperature very probably rose higher than indicated above.

There was no damping off as such, but the newly-germinating seeds of both the Maihueniopsis and the Maihuenia immediately threw out long and thick tap roots, which however failed to burrow satisfactorily into the fine compost. In an attempt to remedy this, I helped them in, but somewhat to my surprise none of the Maihuenia prospered even after this operation, and indeed some of them even perished by decay of the root tip. One of the Maihueniopsis (PW 6462) also failed to prosper. It then dawned upon me that the failure of root penetration and the subsequent slow rot of the root could both be due to the use of an excessively fine-grained compost, whereupon I transplanted the remaining sick plants into an exceedingly gritty compost, composed of dust-free loam, dust-free granite chippings and dust-free crushed soft brick, in the approximate proportions 1:1:2; the dust being removed by use of a strainer with a mesh size of 1/16 centre to centre.

This new mix was exceedingly coarse, but it saved the day, since all save one of the transplants recovered, and as of the end of 1989 are looking quite perky, except the aforementioned PW 6462, which is still struggling to regrow its damaged root.

From this experience it becomes fairly clear that Maihuenia and, to a less crucial extent, Maihueniopsis, are adapted to and demand a coarse and open substrate. It is worthwhile in this connection to remark that the great majority of cactus seedlings other than those from the Opuntieae are found in my experience to behave quite differently, in that they fail to send out any tap root, and wither away after several months of struggle, if germinated upon a similar coarse and dust-free medium.

Incidentally I once raised Maihueniopsis glomerata (4 plants from a Kohres' packet of 20) and also one or two Maihuenia without any pre-propagator treatment. The Maihueniopsis grew well and are still with me. The Maihuenia shrivelled up after several weeks. It would seem that germination is not quite such a big problem with these two genera. On the other hand, the subsequent experience with the PW Maihuenias confirmed both that the germination of Maihuenia was likely to be rather low, and the subsequent growth of the seedlings is by no means assured under normal conditions of cactus cultivation.

Thus for Maihuenia I see two problems; to get a good percentage of germination, and to make the seedlings prosper. In respect of the first, I am very impressed by the percentage germination of up to 80% following hilum removal, as reported by A.Craig at the 1989 Chileans' Weekend; far better than my 0-20%. In my experience Tephrocactus sensu stricta are exceedingly reluctant to germinate- much worse than either genus aforementioned.

I would be very interested to see some comparative appraisal when all the results come in, since some methods ought clearly to emerge as better than others.

....from H. Middleditch

I am not entirely sure that any one method for raising these types of seed would neccesarily be better than others, because there is no uniformity between greenhouses in their microclimatic regime nor in the pattern of its daily fluctuations. On the other hand I could well imagine it being advantageous to take note of certain factors which appear to have contributed to successful germination.

....from R. Ferryman.

When I have sown seed of Austrocactus or Tephrocactus, the seed pots are kept in the general body of the greenhouse and are not put in a propagator which would give them additional heat. Seed of Thelocephala and Eriosyce similarly are grown in the open greenhouse, under the bench (glass to ground) with green fine-mesh net curtaining for shade. I am firmly convinced that there is an advantage in having a daily cycle of temperature between hot in the daytime and cool at night.

The compost is pure vermiculite with a sprinkling of fine grit over the top of the seed. The pots are stood in drainless trays and watered over the top, ensuring that there is some water in the tray at all times. Equally successful, I find, is to moisten each pot with water containing quarter strength feed, then wrap the pot up in a polythene bag which is hung off a shelf of the greenhouse framing, wherever space is available. It is important to suspend the bag, not stand it on a tray or staging, as this will ensure that the condensation inside the bag runs down the sides and very little drips directly on to the compost; it is quite easy to see the excess water collected in the bottom corner of the bag.

....from A. Hill

Unfortunately I did not have any success at all with my first sowing of the P & W seed. After the 1989 Chileans Weekend when I heard about cutting away part of the outer coat of the seed, I decided to try this with the rest of the PW seed which I had kept back from my first sowing, together with some ungerminated seed salvaged out of the pots of my first sowing. In order to cut off the hilum I used a magnifying glass on a stand, holding the seed down with a finger nail and cut away at the hilum with a scalpel. I do believe that I was crushing off the hilum as much as cutting it, but I usually managed to remove a portion of hilum and/or testa without damaging the embryo.

I also pared away at some Tephrocactus seed which came from R. K. Hughes, trying to cut off the aril. My aim was to cut off as much as possible to weaken the testa case and also to make a hole so that moisture could penetrate into the

interior of the testa. My reasoning was that the seed would then germinate and split the weakened testa.

The seed is then sown in 2 square pots on a mix of 3 parts Levingtons 1 part grit sand, which are then stood in water in trays under a plastic cover, without vents. The whole lot is then put into my hot box, which has glass sides and a quarter of the top left permanently open. The heating cable is in a bed of dry sand covered with a little peat, with the surplus heating cable run round the sides and back of the box. The rod thermostat sticks down into the sand at an angle and is set to come on when the air temperature falls to 60°F. Occasionally I top up the water in the tray. Sowing took place on 8 April and there was some germination within a week. Despite being in a totally enclosed container, disaster struck in the form of sciara fly grubs but I picked them out with tweezers and scattered Bromphos dust over the pots. With some of the PW seed I had success with the radicle growing up to two inches long before one end dipped into the compost and two cotyledons appeared at the other end. One PW 6497 rested on the edge of the pot just below the cotyledons; the pot must have become very hot in the sun and I suppose burnt the stem because it withered at that point.

....further from R. K. Hughes

After hearing about the method adopted by A.Craig of chipping the black outer coat of Maihuenia seed, I tried the same procedure on some Maihuenia seed which I still had on hand, without changing anything else about my seed sowing arrangements. The results were an eye-opener; most of the seed started to germinate within days of sowing them, a far better performance than I have previously enjoyed. However there is still the problem of seedlings being lost from the roots upward, as well as the problem of some of these leggy seedlings not having the strength to stand upright.

ECOLOGICAL FEATURES OF CLIMATE IN HIGH TROPICAL MOUNTAINS By G. Sarmiento
From High altitude tropical biogeography Eds. Vuilleumeir. F. and M. Monasterio

One of the most essential climatic characteristics of the intertropical regions is the relative annual constancy in daily solar radiation and its well-known consequence, the low seasonal variation in mean air temperature. In contrast to the small variations in daily temperature from month to month, the daily cycle is quite marked. The amplitude between the minimum night temperature and the maximum day temperature is at least three times, and often more than ten times, higher than the difference between the warmest and coldest months. Climatic factors such as relative humidity show a regular daily variation inversely correlated with air temperature.

Besides their year-round constancy in mean temperature, some tropical climates show distinctive patterns in the distribution of precipitation and consequently in relative humidity and soil water availability. This annual pattern may induce slight but significant changes in the temperature regime. Since high cloudiness prevails during the rainy season, the total solar radiation at ground level decreases, whereas relatively high humidity at night greatly diminishes the coldness due to longwave outgoing radiation. These combined effects decrease the amplitude of daily temperature fluctuations. The opposite conditions prevail during the rainless periods, when low cloudiness, clear skies, and dry atmosphere lead to higher day and lower night temperatures, that is, an increase in daily temperature fluctuations. In this way, seasonality in rainfall brings thermoperiodism, an annual cycle with dampened temperature oscillations and higher night minima during the wet season and with greater temperature fluctuations and and lower night minima during the dry seasons. This variability in daily oscillations of temperature combined with humidity seasons becomes a conspicuous feature of high altitude climates.

In mountain systems the concept of regional climate loses most of its value, since the weather conditions recorded at any given site represent, at best, a small area around that site. Differences in slope or slope aspect may induce significant changes in climatic conditions. Within the tropics, direct sunshine reaches either the north or south-facing slopes, depending upon the period of year, thus erasing most of the differences between the two slopes. In contrast, the daily weather pattern may determine that insolation on west-facing slopes be significantly reduced by cloudiness during the afternoon, in contrast with east-facing slopes receiving early morning sunshine. Consequently particular microhabitats exist where living beings may escape from the full impact of adverse atmospheric conditions in high tropical mountains. All highland environments are therefore patchy and are differentiated into a rich and complex mosaic of microhabitats that often exhibit sharply contrasting patterns of temperature and humidity.

TRAVELS AMONGST THE GREAT ANDES By E. Whymper, 1892

Few persons have concerned themselves, in any part of the world, with entomology at great altitudes. Such remarks as have been made upon it have generally had reference to the stray individuals termed stragglers which, generally being windborne and found upon the surface, are those which most readily catch the eye. Thus Humboldt (who ignores what may be termed the residential population) says, in his Aspects of Nature Vol.2 pp.33-34:-

"Even butterflies are found at sea at great distances from the coast, being carried there by the force of the wind when storms come off the land. In the same involuntary manner insects are transported into the upper regions of the atmosphere, 16,000 or 19,000 feet above the plains. When Bonpland, Carlos Montufar and myself reach the height of 19,286 English feet on the eastern declivity of Chimborazo, we saw winged insects fluttering around us. We could see that they were Dipteras, but .... it was impossible to catch the insects. Somewhat lower down, at about 16,680 ft., also therefore within the line of perpetual snow, Bonpland had seen yellow butterflies flying very near the ground".

The aim and intention of this passage is to show that insects are transported involuntarily to great altitudes, and this unquestionably occurs. But it would be erroneous to assume that insect-life in the neighbourhood of the snow-line in equatorial america is limited to stragglers, or that they form a considerable percentage of it. Insects in the great Andes of the equator range higher than birds. At the greatest heights they were found less upon the surface than in the soil, sometimes living amongst stones imbedded in ice, in such situations and numbers as to preclude the idea that they were stragglers. Small in size, and unattractive in appearance, they have hitherto been entirely overlooked. Some species were found at these high situations and nowhere else, though the same species sometimes recurred at similar elevations upon widely separated mountains.

HIGH ALTITUDE ENTOMOLOGY By M. S. Mani

As is well known, the immediate effect of increase of altitude is the fall in atmospheric pressure, and with it also the reduction in the density of the air. Some of the more important known effects of reduced atmospheric pressures at high altitude include the following:

1. Reduced atmospheric pressure results in high transparency of the air.
2. The high transparency of the air favours low atmospheric temperatures, so that the dominant factor viz: atmospheric cold, results. Atmospheric cold retards evaporation from exposed surfaces and thus serves to counteract the harmful effects of atmospheric aridity.
3. Reduced atmospheric pressure leads also to reduced water vapour tension of the air and thus directly favours atmospheric aridity.
4. High transparency of the air and low water vapour tension result in greatly increased intensity of the ultra-violet part of the sun-rays, and also favour high glare.
5. The rarified and arid atmosphere favours a high rate of insolation and radiation.
6. Rapid insolation and radiation produce wide differences in the atmospheric and ground temperatures and also tend to favour great diurnal fluctuations in ground temperatures.
7. The rarified and arid condition of the atmosphere accelerates the rate of evaporation from exposed surfaces and thus favours rapid dessication of delicate and soft-bodied organisms.
8. On account of the atmospheric cold and aridity, the ecologic importance of soil temperatures and humidities for insects is greatly increased.

The difference between the atmospheric temperature in the shade and in direct sunshine is very pronounced. The difference tends to increase markedly with the increase in altitude. At an elevation of 3900 m., the temperature in the shade may read 4^0C while at the same time in bright sunshine the thermometer may register 35^0C.

As is well known, wind velocity increases with altitude on most mountains. The general effects of high wind velocities are contrary to those of insolation and the net result is a considerable lowering of the mean atmospheric temperature. High wind velocity accelerates the rate of evaporation from exposed surfaces and thus favours the dessicating action of insolation.

The denser layer of air, especially the moisture-laden air near sea level, serves to filter off a great part of the sun-rays and thus acts as a powerful protective blanket against the injurious part of the spectrum. The semi-rarified and dry air at high elevations, however, offers no such protection and thus the intensity of the solar radiation increases with altitude.

Even near sea-level, ordinary meteororological data hardly ever reflects the actual conditions prevailing in the insect's immediate environment, but at high elevations the difference between atmospheric conditions and the immediate surroundings of insects tends to be very much more pronounced. Chiefly due to their small size, insects are exposed to conditions often wholly different from those which influence human beings and other larger animals. The climate of the immediate surroundings of insects is really microclimate or the climate of square and cubic centimetres and still smaller spaces on or in the soil, under stones, on rock surfaces, in rock crevices, in underground cavities, or under vegetation mats. It is needless to state that this exaggeration of the importance of microclimate is itself a direct consequence of the atmospheric cold and aridity.

The principal local conditions of microclimatical importance includes the ruggedness of the ground, the presence of rock, the alignment of valleys and gorges, the disposition of boulders and avalanche debris, etc. The layer of air immediately above and in close contact with the ground is influenced much more by the ground irregularity than by the layer of air higher up. Such slow moving air does not, therefore, follow the general trend of the wind in the region, but often leaves behind pockets with different climatic conditions. Wind shields near large boulders, in rock crevices, in spaces under stones, etc. have exposure to local wind entirely different from the average for the locality. Irregular islands of windless calms thus exist in a vast wind-swept desert.

Irrespective of the mean atmospheric conditions, microclimatic conditions thus make possible niches of a wide variety of optimal conditions for a great many different types of insect. During the hours of bright sunshine, the rock surface becomes warmed up rapidly on exposure to direct sun-rays until the temperature of the rock surface rises to 30-35^{0}C. At the same time the temperature of shady side of the same boulder, perhaps only a few centimetres away, may range between 2-14^{0}C. In sharp contrast to the rock surface, the conditions in spaces under boulders and large stones sunk into the ground are more constant. At elevations between 4000 and 4500 metres the temperature fluctuations in the insect niches under large stones does not exceed 5-7^{0}C during the day. At elevations between 3200 and 4000 metres on a south slope, where the mean atmospheric temperature is about 16·5^{0}C, the mean temperature in spaces under large stones is about 22·5^{0}C. Sheltered from wind and rapid insolation, the rate of evaporation is naturally low, so that humidity conditions also remain fairly uniform and relatively high throughout. The relative humidity is often as high as near saturation and usually does not fall below 80-95% at temperatures ranging from 18^{0}C to 22^{0}C.

...from H. Middleditch

Although this extract concerned itself with the effect of the high altitude environment upon insect life, the ecological factors which are reviewed here apply equally to other Fauna and Flora. It may be considered that they would also have some influence on seed germination; even small seeds are likely to get impelled forward by strong winds unless or until they become lodged in some depression, cleft, or crevice. Here conditions of temperature and humidity may not be vastly different from those described as being advantageous for the continuing existence of insect life. Are these conditions also of some advantage for seed germination? Do the seeds which fall down into intersteces between pebbles or stones in habitat stand a better chance of germination? Is this why the germinated seedling of Maihuenia or Tephrocactus makes rather an unusually long stem before the cotyledons appear, because it is used to pushing its way up to the daylight? Does covering the seeds with a layer of grit in our cultivation tend to simulate natural conditions and provide desirable support for the stem of the very young seedling? Is the maintenance of a fairly high relative humidity in any way relevant for germination of Tephrocactus

seeds? And a daytime temperature of about 180 C? Once the emergent seedling has poked its head out (or partially out) of its microclimate would it normally expect to find itself in rather lower relative humidity? Do the seeds need to have the compost wetted and then be kept covered or enclosed in order to retain that moisture, without either losing or gaining any, until germination? Is a good daytime warmth without excessive temperature desirable? Also a daily cycle of temperature from warm to cool, say? And once having germinated, should the seeds be uncovered in order to drop the relative humidity?

It is observed by H.S.Mani that high transparency of the air favours low atmospheric temperatures - he does not appear to explain that the atmospheric air itself is barely heated by passage of the sun's rays, whereas the dust and water vapour in the air does absorb the heat from the sun's rays. The heated dust and water vapour then heat the air by conduction and convection. Hence the greatly reduced amount of water vapour at high altitude together with a scarcity of pollutant and other dust results in less absorption of heat from the sun's rays and in consequence a low temperature of the atmosphere. Only close to rocks and ground which is heated directly by the sun's rays does the immediately adjacent layer of air become warmed by convection, and conduction.

It is also stated that the result of high wind velocities is a lowering of the atmospheric temperature. This is not correct. High wind velocities can scalp away the layer of warm air immediately next to rocks and ground which has itself been heated by the sun's rays but this does not reduce the temperature of the general body of the atmosphere. High wind velocities will assist evaporation/transpiration from the exposed surfaces of Flora and Fauna, so that an exposure or chill factor comes into play, but the general body of the atmosphere is no colder.

GERMINATION OF SEEDS By A. M. Mayer and A. Poljakoff-Mayber, 1982.

Various mechanisms regulate the germination of seeds in their natural habitat, some of which are internal, whereas others are external environmental factors, any of which can determine whether a given seed will germinate in a certain place or not. Proof of survival value of germination-regulating mechanisms is not easily obtainable and relatively few detailed studies have been made. A spread of germination over a period of time can have survival value. This can protect the species from eradication as a result of adverse conditions which follow germination. If all seeds germinated simultaneously, under such adverse conditions, and the plants are unable to complete their life-cycle, then no further renewal of the species would be possible. The spread of germination over a period of time has been observed in many species (D.Koller, in Seed Biology Vol.2 Ed. Kozlowski, 1972).

The ecological conditions prevailing in a given habitat will affect germination. In this respect probably not overall climatic conditions but rather the micro-climatic conditions prevailing in the immediate vicinity of the seed will be the determining factors. Probably the most crucial factor in determining germination of seeds in the soil is a suitable combination of temperature and moisture. As seeds are a means of propagating the species, their germination should occur at a time which will favour survival of the seedling. Conditions favouring seedling survival differ in different climates.

In arid regions, survival of the species is determined by mechanisms which ensure that germination occurs at a time when the seedling will be able to establish itself. A variety of mechanisms has been suggested as operating in the seeds of various plants growing in such conditions. A survey of the known germination behaviours of desert seeds does not give a very clear picture, but germination inhibitors seem to play a role. However, the nature of these inhibitors has never been ascertained. Attractive as this theory is, it is still lacking proof.

Undoubtedly other mechanisms also occur. Thus Koller & Cohen showed that seeds of three Convolvulus species occurring in arid areas are impermeable to water and therefore cannot germinate. The seeds germinate only if their permeability is raised mechanically by abrasion or impaction, or chemically, by acid treatment. In nature the seeds become permeable gradually over a long period of time. It is therefore possible that each year there will be a certain number of seeds which can imbibe water and subsequently germinate, when temperature conditions become favourable. In this way not all seeds will germinate together. If, subsequent to germination, the seedlings are destroyed, the entire population will not be wiped out, as part of the seeds will still be viable, but do not germinate because of their impermeability. Survival of the species may be ensured even if germination is only restricted by lack of permeability to water. Impermeable seed coats are of very frequent occurrence, especially among the Leguminosae.

....from H. Middleditch

The close examination made by R.Allcock of the Tephrocactus seed which had shed its coat following a natural cold regime, would suggest that this may well occur in habitat. The process of cutting off a portion of the outer seed coat, mentioned in the discussion above, would appear to be one possible means of achieving the same effect.

In his Reise um die Erde, Meyen provides several observations made with a wet and dry bulb thermometer. Strictly speaking, these were taken just to the north of the northern limit of distribution of Maihuenia and so it is possible to argue that they do not represent the conditions of relative humidity under which Maihuenia have to survive. However, as no other measurements of the same nature appear to be available for within the Maihuenia area, these observations are all that we have. It is quite probable that they will approximate to the conditions encountered by Maihuenia. The readings demonstrate the wide gap between the figures for the wet and dry bulbs in daytime, with much closer figures for readings taken early and late in the day. As Meigen observes, the effects of ambient temperature on atmospheric humidity are more important than the temperature level itself. From Meyen's observations the relative humidity is clearly quite low during the day, and not that high at dusk and dawn. His surprise at the absence of morning dew after a distinctly sharp and bitter night is further indication of a relative atmospheric humidity still fairly well below 100% despite the low night time temperature.

By comparison, Meyen describes the green sward and the massed alpine flowers forming closed vegetation deck. Here the water table must be close to the surface of the ground, yet Meyen's wet-and-dry bulb thermometer shows that the air is still dry. No wonder Meigen observes that in these areas where there is a closed vegetation deck, the devices used as a protection against the prevailing aridity are still pronounced features of these plants. In effect they have damp feet and dry heads. Where ground water is not so readily available, Meigen observes that there is no closed vegetation cover, with much bare ground between the bushes. Here the plants exhibit even further accentuated features of defence against aridity,

especially a cushion form. A single long root going well down into the ground before branching is typical for certain cushion plants, like Maihuenia and Adesmia, which grow in these circumstances. One can imagine that they are having to go well down for water. But the hummock shape typifies a defence against a harsh and arid environment, so again there seems to be a condition of damp feet and dry heads. Is this why difficulties have arisen with keeping germinated seedlings of Maihuenia in a closed container, as exemplified by the comments from D.Aubrey-Jones, where condensation on the interior surface bears witness to a high humidity which does not appear to exist above ground in habitat? Would it be better to put the germinated seedlings into circulated air? Meyen describes the bitingly cold and fierce night wind at altitude whilst the prevailing westerlies of southern Chile and Patagonia - the Roaring Forties of the ancient mariners - have been referred to previously in these pages in articles concerning Patagonian cacti. The slides shown to the Chileans 1988 Weekend by J.Watson of the plants from which the P & W seed was taken suggest that exposure to these winds is their common lot.

At the cotyledon stage the seedlings, especially of Maihuenia, have a remarkably long stem. This may well be built-in to the plant to get the root going down promptly in order to reach available habitat water, so that in habitat this lengthy stem may not stick up in the air, but performs a more useful function of burrowing down for water, leaving the cotyledons in their more usual position, just above ground level. Thus at a very early stage it starts to make the long wiry, single root which the plant needs for survival in habitat. Does this mean that it rather dislikes having its stem stuck up in the air when we grow it from seed? Is this why there are so many reports of inexplicable marking and drying-up of this stem and subsequent loss of the seedling? Would it be better covering the seeds not just with a few mm of grit, but with an inch or more of coarse grit, which would protect the stem after germination? But in those circumstances, would the seed have a far more equitable temperature and humidity regime, just as M.S.Mani describes above? Insufficiently cold to cause the outer shell to break off, as R.Allcock observed? Does this mean that an inch or more of very coarse grit should top the seed compost with the seed on top of that grit, which will give the root a good chance of poking down through the generous apertures, leaving the cotyledons just above the surface?

SULCOREBUTIA — A LONG STORY **From W. Gertel**

My second visit to Bolivia was undertaken in 1986. On that occasion we saw a great many more plants in flower and the whole countryside was much greener than at the time of our first visit there four years earlier. At many places where we found Sulcorebutias, we also found handsome flowers coming out of a bulb which was usually some ten inches deep in the ground. At that time the plant had no leaves. I was told that they would belong to the Amaryllis. We found a great many other sort of plants together with the Sulcorebutias, which I cannot name or describe.

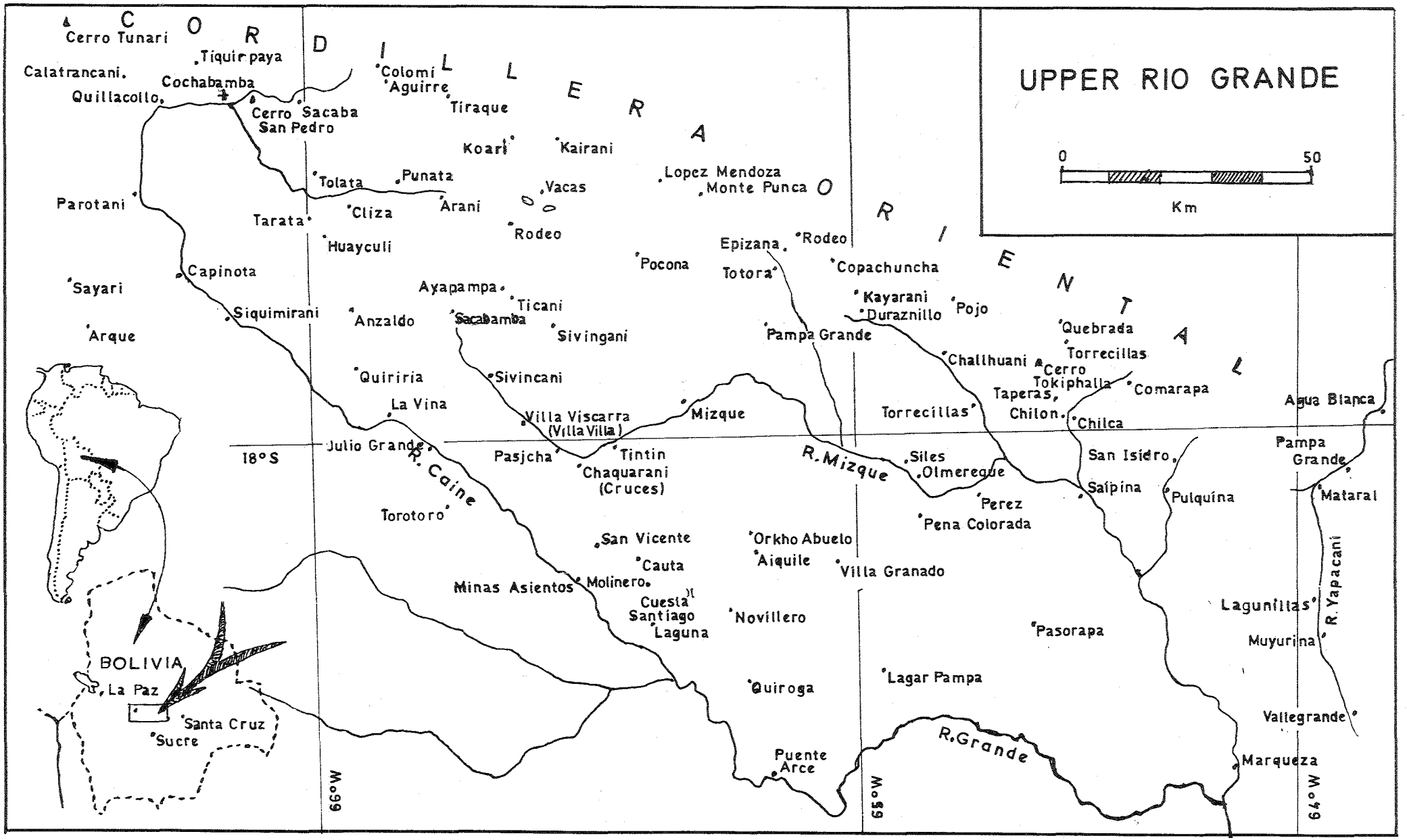
We started by making one or two day-long excursions from Cochabamba, before we set off on the road to Aiquile and Sucre. On the very first hill we came across Lobivias and Cleistocactus as well as Parodia schwebsiana v.applanata. After a diversion to the Rio Caine, we retraced our steps back to the oil pipeline, from where we set off in the direction of Vila Vila. The roads which follow the pipeline are usually fairly good by Bolivian standards, so we followed it as far as Vila Vila (Villa Vizcarra).

Then we went further on, coming to the Rio Mizque, which is only a small creek at this place. We had now reached an area of eroded sandstones with interesting rock formations, and we were heading for the type locality of S.cylindrica. Here we came across a white building which was the mysterious railway station called Pajcha which is not located on any of our maps, which we had searched for for years. This is the type locality for S.cylindrica, which we found here without any problem, in huge numbers, on rather steep slopes, as well as some way on towards Cruce. Many plants were already in bud, from which the yellow flower colour was clearly visible. This plant, perhaps half an inch across, has a remarkably substantial root, as shown on my slide. This feature was not mentioned in the original description, probably because the body had been cut off the root. Once the thick rootstock has been cut off the body, this plant does not regenerate the tap root, it only makes fibrous roots. These plants do continue to elongate with age; the biggest plant we found was at least ten inches high.

A couple of kms further on we dropped into a valley and crossed a small tributary of the Rio Mizque; on the next hillside we then found plants which looked very similar to S.cylindrica, but all with magenta flowers. Oddly enough it was relatively difficult to find small plants there. They do not grow elongate, but always stay globose and in addition this form appears to grow altogether larger. It is perhaps still worthy of note that the necked swollen root is shorter and thicker than on the yellow flowering plants, but it does produce a new tap root if the first one is cut off. Nevertheless it is certainly the same sort of root system, which is characteristic for this species. In regard to the relationship of these plants it is certain that they are to be considered a form or variety of S.cylindrica. One should be cautious about including S.vizcarrae in this group as well, since we do not really know what is S.vizcarrae sensu Cardenas. However it is quite definate, as Augustin has already correctly established, that Lau 337, HS 44, 45 & 46 also belong here. We do not know the full extent of the distribution of this species, but it is quite evident that the broad river valley is the boundary between the yellow and the magentas flowering sorts.

On our third trip to Bolivia in 1989 we again travelled from Vila Vila to Paycha, as I was intending to obtain samples of soil in the locality where S.cylindrica grew. We took in all the previous and even some new location and everywhere took soil samples from the immediate vicinity of the roots of S.cylindrica. These samples have been analysed since our return home and confirm the results for the solitary sample from besides G.37a which was taken on our 1986 trip.

The condition of the various habitat locations for S.cylindrica is to some extent alarming. I presume that the plants have suffered exceedingly under the severe drought, since of the huge numbers of the small and smallest plants, nothing more was to be found this year. One must really search here and there to find small seedlings. It did seem to us, though, that the slopes had been severely grazed since everything was trampled down and everywhere one finds the droppings of various grazing animals. Of especial interest to me was the habitat location of EH.7130 since that is a population with clear white spines plants. Helmut Alber even found the spot, but unfortunately there is a habitat there no longer. Today it is a cultivated field which stands there between the house and the place where earlier the Sulcorebutias grew. Since this habitat location is of a very limited extent (and that goes in principle for all Sulcorebutia habitat locations«, one must


UPPER RIO GRANDE
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CORDILLERA ORIENTAL
Cerro Tunari
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Quillacollo
Cerro Sacaba
San Pedro
Colomi
Aguirre
Tiraque
Koari
Kairani
Lopez Mendoza
Monte Punca
Tolata
Punata
Vacas
Parotani
Tarata
Cliza
Arani
Rodeo
Huayculi
Epizana
Rodeo
Pocona
Totora
Copachuncha
Capinota
Sayari
Ayapampa
Ticani
Kayarani
Pojo
Siquimirani
Anzaldo
Sacabamba
Durazznillo
Arque
Sivingani
Pampa Grande
Quebrada
Torrecillas
Challhuani
Cerro
Tokiphalla
Taperas
Comarapa
Quiriria
Sivincani
Chilon
Chilca
Agua Blanca
La Vina
Villa Viscarra
(Villa Villa)
Mizque
Torrecillas
18°S
Julio Grande
R. Caine
Pasjcha
Tintin
Chaquarani
(Cruces)
R. Mizque
Siles
Olmeregue
San Isidro
Pampa Grande
Salpina
Pulquina
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Perez
Pena Colorada
Torotoro
San Vicente
Orkho Abuelo
Aiquile
Cauta
Villa Granado
Minas Asientos
Molinero
Cuesta
Santiago
Laguna
Novillero
Lagunillas
R. Yapacani
Pasorapa
Muyurina
BOLIVIA
La Paz
Lagar Pampa
Quiroga
Santa Cruz
Sucre
Vallegrande
R. Grande
Puente
Arce
Marqueza
66°W
65°W
64°W

unfortunately accept that this fine population has really been exterminated. That was moreover confirmed to us by Eweld Heger who was there with his party some weeks after us.

Besides the habitat locations already located three years previously, in this year we found still similar S.cylindrica directly besides Chaguarani (G.91) and then again on the road to Cauta (G.92). We have indeed seen no flowers, though I confidently assume that both populations belong to the magenta flowering forms. I was especially filled with enthusiasm with G.92 since for once the plants are mostly with white appressed spines and secondly they are in a really splendid location. At many spots they looked just like a bed of mushrooms. Slides were taken to show just that, but unfortunately we drew a blank with flowers here, too. However I can imagine that this mountainside will present a phantastic picture when all the plants are in flower.

....from D. Aubrey-Jones.

The plant of S.cylindrica which I have had for longest has no collection number, but I do know that it was grown from seed. It is yellow flowered, is about 90 mm high and 35 mm wide at its widest point; at 70 mm height it has split into two branches. I dug it up to discover that below ground it has a tap root a couple of cms long. I have also grown some S.cylindrica from seed. The first is a plant of HS 65 that was grown from Kohre's seed; it is 75 mm tall and 25 mm wide at its widest point. Just below ground it has a tap root that narrows to 5 mm thick and then widens out to between 10 and 20 mm thick. This tap root is 50 mm deep before it narrows and curls round the bottom of the pot. This plant has not yet flowered.

At the beginning of 1987 I obtained some seeds of Lau 335 from Windyridge, harvested from his own plants. The three robust seedlings already have substantial tap roots. One plant which is 20 mm high and wide has a tap root equally as deep. The largest plant is 85 mm high, 25 mm wide at its widest point, and splits into two branches, like my original plant of this species, at a height of 50 mm. It has a tap root 50 mm deep in all. Like all the other plants, this is narrowest just below ground level after which it widens and branches.

My latest acquisition is an offset from a habitat collected Lau 335, which has grown some roots but has not yet had time to show whether it will also produce a tap root. I am wondering if there are any collection numbers which correspond to the S.cylindrica with magenta flowers as I have so far not been able to locate any reference to this version.

....from A. W. Craig

My own plants of S.cylindrica include three plants of Lau 335 which I obtained from Sargant when he was receiving imports directly from Lau. These all flower yellow. They have hardly grown any fatter since I obtained them, but reached a height of some five to six inches. I also have a couple of yellow-flowering HS collected plants, and in addition an HS 46 which is the magenta flowering version of this species. This one did get a little stouter, in the region of 1 to 1¼ in diameter, and it also grew to a height of about eight inches or more before I cut it down. More accurately I should call it a length rather than a height as it was laid out like a serpent. I get the impression that the magenta flowering version of S.cylindrica grades into S.vizcarrae, from Vila Vila.

....from J. Arnold

One of my S.cylindrica had two heads when a very young seedling. After quite a few growing seasons the two heads remain fairly similar in size. Apart from two plants grown from seedlings I also have a Lau 335 which started off as an offset from a habitat plant. All these plants flower well, with small yellow flowers. I find that this is not an offsetting species, all my plants (apart from the two-headed one from seed) being solitary. The root is just as thick as the body, so that the root merges almost imperceptably into the body. The root tapers gradually and is really quite long. They certainly grow tall, up to four inches high, but I would not say that they remained particularly slender, as one plant is about 1″ to 1¼″ wide and another is nearly 2″ wide. They certainly grow very thing for some time when raised from seed.

....from J. Kirtley

In general terms I have no problems in growing Sulcorebutia from seed, with the sole exception of S.cylindrica; this particular species obviously take a dislike to something or other in my normal seed raising process and young seedlings just keel over and pass away before they have time to generate a tap root. Even a habitat collected plant of S.cylindrica Krahn 671 which came from Oberhausen did not seem to make any great efforts to put down roots, so I cut off a good part of the top and set it on a graft where it is now doing fine. Even the remaining bottom piece is now putting out offsets which I should be able to distribute ere long. The top piece has produced a flower, well down on the stem; I would be inclined to call it reddish magenta rather than just magenta colour.

BARKING UP THE RIGHT TREE? **From E. Hansard**

Much of our family collection is fairly new and most late additions have been grown from seed. We are trying to build up a more botanic collection by buying seed with a field number or other data. New quarantine inspection charges etc. have made smaller importations of plants just too expensive. We are just within the rural area on the edge of town and our section is about 1¾ acres so space is not a problem — there are five greenhouses now! I think that you would find most of our collection and methods familiar apart from the growing mix. Some years back, Karl Johnson writing in the N.Z. Cactus Journal suggested using granulated bark instead of peat in soilless mixes. We have done this and heeded his later advice of occasional use of trace element fertiliser. I have not noticed any mention of such a mix in any overseas journals, so here is the recipe we use:-

Two buckets (10 litres) of granulated bark or orchid mix including up to 1 inch pieces; two buckets of horticultural pumice and/or very coarse propagating sand (no limestone); two buckets of very rotted sawdust (untreated), quarter to half a bucketful of charcoal slack. Also one handful of Magamp fertiliser per bucket. We add a bit of water and mix it all in a cement mixer and also with a shovel for good luck. It keeps well in plastic trash bins. After three years some plants can be potted on without removing the older mix or disturbing the roots and quite often it has not degraded much. Plants do well in it. Some of the larger pieces of the granulated bark can be used at the bottom of the pot to help drainage sometimes, or some at the top to bury an unsightly base a bit, We do not use sand or grit top or bottom. The bark and sawdust are both Pinus radiata.

....from H. Middleditch

In the last few years I seem to have seen a steadily increasing use of bark, for example on pathways of National Trust gardens and other property open to the public. Presumably it is used in this way to discourage weeds and other growth and so cut down maintenance work. It also seems to be used by Local Authorities for covering the surface of the soil around plantings in parks and gardens. When used on pathways the bark can hardly discourage the growth of grass and weeds simply by its bulk; presumably there is some constituent of the bark which will leach out and discourage growth. In which case it is difficult to see how its use around plantings of bushes and so on can discourage weeds without discouraging the plants at the same time. And how does its use as a compost for cacti not discourage these particular weeds?

....from R. Purves

I have had a word with the local Merrist Wood Agricultural College on the question of the use of bark in cactus compost. Its use in this manner is not as peculiar as one might think, only it must be previously composted - a process which takes 15 to 18 months involving turning over each batch (in concrete trays) on a regular basis. Only one firm in this country, I gather, does this in any quantity, a firm called Campark, and I have seen their finished product which is uniformly dark brown and crumbly in the fingers. Apparently when bark is used as a mulch it goes on raw and apart from the toxic effects of the tannins and turpins or resins, the bark slowly composts and decays, using up all available nitrogen which is about, thereby starving any weeds etc in the vicinity! As in New Zealand, almost all the bark used in this country is pine, and I am told is mainly Corsican pine.

CHILEANS' 1991 WEEKEND.

This event will be held at our usual venue at Cavendish Hall, Nottingham University, from September 13th to 15th, commencing with the evening meal on the friday and concluding with a buffet tea on sunday. We look forward to welcoming Jaques Lambert once again from Belgium and to hearing about his experiences in Argentina. We anticipate that, amongst other things, he can tell us about a number of Parodias that he has sought and found in habitat. We also hope to hear both from B. Bates and J. Kirtley on further aspects of his trip to Bolivia; from K. Grantham about his visit to Venezuela, and also from A. Butler about his visit to Chile. For discussion and reference a plant would be welcome of similar appearance to those in Figs. 216, 232 and 233 of Backeberg Die Cactaceae, or named Tephrocactus aoracantha. From R. Ferryman we expect to hear about the importance of humidity, especially at over-wintering temperatures. Two or three members have already offered to bring along plants to demonstrate the extent of natural variation which appears in plants grown from habitat seed of known origin. Further details will be sent as available to members who have already expressed an interest in participating and to any other member wishing to attend the event. The cost for the Weekend, inclusive of meals, accommodation, and use of services, will be £69·80 (or £68·25 if received before 16 August, 1991).

ERRATA No.46

Please add to Index:- A problem Pterocactus . . . M. Lowry . . . page 16.

The delay in the appearance of Chileans No.46 and the excess of errors therein is much to be regretted. Unfortunately the printers again failed to obtain a satisfactory translation into their Apple/Cora of the disc supplied to them in Apricot/Superwriter. The disc carrying the text for Chileans No.46 was dispatched to the printers on 19 July, 1989, followed about a week thereafter by the artwork. After three consecutive proof copies the issue was finally produced in mid-December. Unfortunately the sheer volume of errors generated by incorrect disc translation resulted in many of these being missed in the course of proof reading.

OPEN DAYS — 1991

Offers to hold Open Days have been received from: D. Aubrey-Jones, Reading, at a date yet to be fixed, whilst R. Moreton hopes to hold an Open Day later in the season.

SPARE SEEDLINGS

Several members who raise from seed have found surplus seedlings left on their hands even after supplying local interest as well as making them available to The Chileans' Weekend. Because these seedlings are mostly only available in quite small numbers, the compilation and issue of a list to all members would occupy a disproportionate amount of time and also probably result in much disappointment. Currently one or two lists of available seedlings, all with field numbers, can be sent to enquirers on receipt of a S.A.E. The envelope should be no less than A5 size and should be sent to: P. Bint, 313 Manchester New Road, Middleton, Manchester M24 1NR.

If any member has surplus seedlings, preferably with field numbers, and is prepared to parcel them up to send to a good home, please list these and send several copies of the list again to the foregoing address, so these lists can be sent out to enquirers.

NO ROOM ON THE OUTSIDE? From W. Christie

On a late holiday to Barbados, we drove around much of the island and I kept my eyes peeled all the time for Pilosocereus barbadensis. I saw a number in public and private gardens, many in flower (they were night-blooming) and fruit, although I forgot to take my telephoto lens with me unfortunately. However, I only saw four in the wild in two clumps close together on rocky knolls in the middle of a dairy farm in the north-west part of the island. From my own experience of the climate I can imagine that they are barely xerophytic. It is true that I saw less of the north-west part of the island, which is the less inhabited part, than the remainder, but it is hard to hide plants 12 feet high. I wonder whether these and other caribbean plants are not the truly endangered species rather than the rare miniatures we tend to think of in this light. In this instance, the pressure comes from agriculture and tourist development rather than from plant hunters. I suspect that there is little European

growers can do to help, because of the difficulty in reproducing the optimum growing conditions, not to mention a scarcity of 12 feet high greenhouses!

ROOM ON THE INSIDE **From G. Charles**

My intention is to replace my present large greenhouse by one of about twice the size, but most importantly, providing me with a leakproof and controlled environment, something which I have never really had before. I am especially keen to do better with Brazilian plants so I will be having a specially heated area for them. Also I should like to grow more cereiform plants as I will be able to let them grow to a fairly good height and not have to start chopping them back when they start to touch the glass long before many of them have got anywhere near flowering size.

THE MISSING DISCOCACTI **From R. Moreton**

For quite a long time my own collection has included a number of Melocacti and Discocacti, but a couple of years ago, when I was able to give somewhat more attention to my cacti again, I decided to try growing a wide range of Discocactus from seed. I was pleasantly surprised at the number of Discocactus species which I could obtain from seed catalogues. On the other hand, there are quite a few species mentioned in Buining's Discocactus book which I have not been able to find in any seed catalogue. So I am left wondering how it might be possible to obtain seeds of them. At the same time I am keen to try growing other Brazilian cacti, such as Arrojadoa.

SEEKING PARODIAS **From J. Brickwood**

Possibly like many other collectors I have a strong interest in this genus, although by no means to the exclusion of others. At present the Parodias in my collection only total some 40 plants, plus about sixty or so further names grown recently from seed. There seems to be a sad lack of choice of these plants available to enthusiasts of the genus, whereas there is a much wider range of seed available. There is certainly a lack of seed with field collection numbers on offer in seed catalogues. I would very much like to hear of any sources for such Parodia seed.

Having acquired a copy of Weskamp's book dealing with this genus, I started off by translating odd sections as and when I had a particular interest, quite simply to make it easier to read. These bits and pieces just increased until eventually they all joined up to form one! At that stage I regarded Weskamp's book as a monumental work which would provide the basis for all future work on the genus, not the least because it contains all the original descriptions, together with some excellent illustrations. However, when I was able to compare the original description (in French) for microsperma with that given in Weskamp's book, I was surprised to find that Weskamp's version did not quite match the original, as I had assumed the original descriptions in Weskamp's book were precisely that. Again, the comparison with Brandt's original description of P.mesembrina was very revealing: the description in Weskamp differs in several respects from the original, lacking most of the last paragraph and also two whole sentences of the seed description. The body size is given by Brandt as 10 by 7 cm in the Latin and 9 by 5 cm in the german, whereas it is 12 by 7 cm in Weskamp's book. It is starting to look as though more of Weskamp's descriptions are going to need checking against the originals.

SORTING OUT SOME NEOPORTERIA **From R. Ferryman**

The winter flowering of quite a few Neoporteria is helping to sort out one or two problems with plants I collected between Pichidangui and Coquimbo, as well as in places more to the east. Both N.subgibbosa and its forms look very like N.litoralis and its v.intermedia; specific names are extremely difficult to assign in the wild. Obviously the classic British standards are there and easily separated, but then what about the intermediate forms? It now seems to me that the litoralis complex are autumn/winter flowering in keeping with the more northern small flowering types like wagenknechtii and villosa. Growing alongside N.litoralis and easily confused with it from Habit alone is N.nigrihorrida, but it has large flowers (4 cm) and blooms only in summer.

At Pichidangui there are 4 species that are nearly impossible to separate by body form alone: Neoporteria subgibbosa, N.litoralis, its v.intermedia and Pyrrhocactus chilensis. Only when they are in flower can one really start to separate them. It is always possible that some of the seed from these plants which I have distributed may not be correctly named. For instance my RMF 109 is in all probability N.litoralis v.intermedia. Ritter states that this sort grows to the north of Pichidangui but I collected it to the south of that place. In all probability I have taken Ritter's distribution zones too literally and I may have been misled by them. Round Illapel I found RMF 93 and my thoughts were that it was P.chilensis; probably I never considered N.subgibbosa for the name because the site is too far inland - but the flowers told me differently!

RHIPSALIS **From A. Hill**

Over the course of many years the numbers of Rhipsalis in my collection have gradually increased and I am pleasantly surprised by the number which flower in the winter months. I would be happy to hear from any other members who have an interest in growing these particular plants. [Address will be found under Special interests on the back cover - H.M.]

CHILEANS SUBSCRIPTION

It is anticipated that the disc carrying the text for Chileans No.48 will be sent to the printers by September, 1991. Publication date will depend mainly on the ability of the printers to obtain error-free translation of the disc. A form for subscription renewal will be enclosed with Chileans No.48.

CONTENTS

SPECIAL INTERESTS

Austrocactus	A. Johnston, 11 Malvern Road, Scunthorpe, DN17 1EL
Cereanae	G. J. Charles, Briarsbank, Fosterbridge, Ketton, Stamford, PE9 3UU
Cleistocactus	T. Lavender, 'Kalanchoe', Market Place, Tetney, DN36 5NN
Copiapoa	A. W. Craig, 32 Forest Lane, Kirklevington, Yarm, TS15 9LY
Discocactus	R. Moreton, 91 Umberslade Road, Selly Oak, Birmingham B29 7SB
Echinopsis	M. Muse, 32 Fielding Road, Birstall, Leicester, LE4 3AJ
Frailea	J. Forrest, Spring Garden, 2 Darngaber Road, Quarter Hamilton
Gymnocalycium	F. Fuschillo, 55 Emberton Court, Torpion Street, London, ECIV OEP
Lobivia	R. Purslow, 130 Brighton Road, South Croydon, CR2 6AE
Matucana	D. Aubrey-Jones, 62 Rosehill Park, Caversham, Reading RG4 8XF
Melocactus	J. Arnold, Suffolk House, 2 Oak Hill, Washingborough, LM4 1BA
Neoporterianae	R. M. Ferryman,, 'Nichelia', The Street, Stonham Aspal, IP14 6AH
Opuntia	R. Crook, 35 Cardinal Close, Worcester Park, Surrey KT4 7EH
Rhipsalis	A. Hill, 8 Vicarage Road, Grenoside, Sheffield S30 3RG
Tephrocactus	R. K. Hughes, 16 Ashbourne Avenue, Bootle, L30 3SF

THE CHILEANS

ORGANISER: H. Middleditch, 5 Lyons Avenue, Hetton-le-Hole, DH5 OHS

TREASURER: R. L. Purves, 19 Brocks Drive, Guildford, GU3 3ND

MEMBERSHIP SECRETARY AND BACK NUMBERS: Mrs. G. Craig, 32 Forest Lane, Kirklevington, Yarm TS19 5LY.