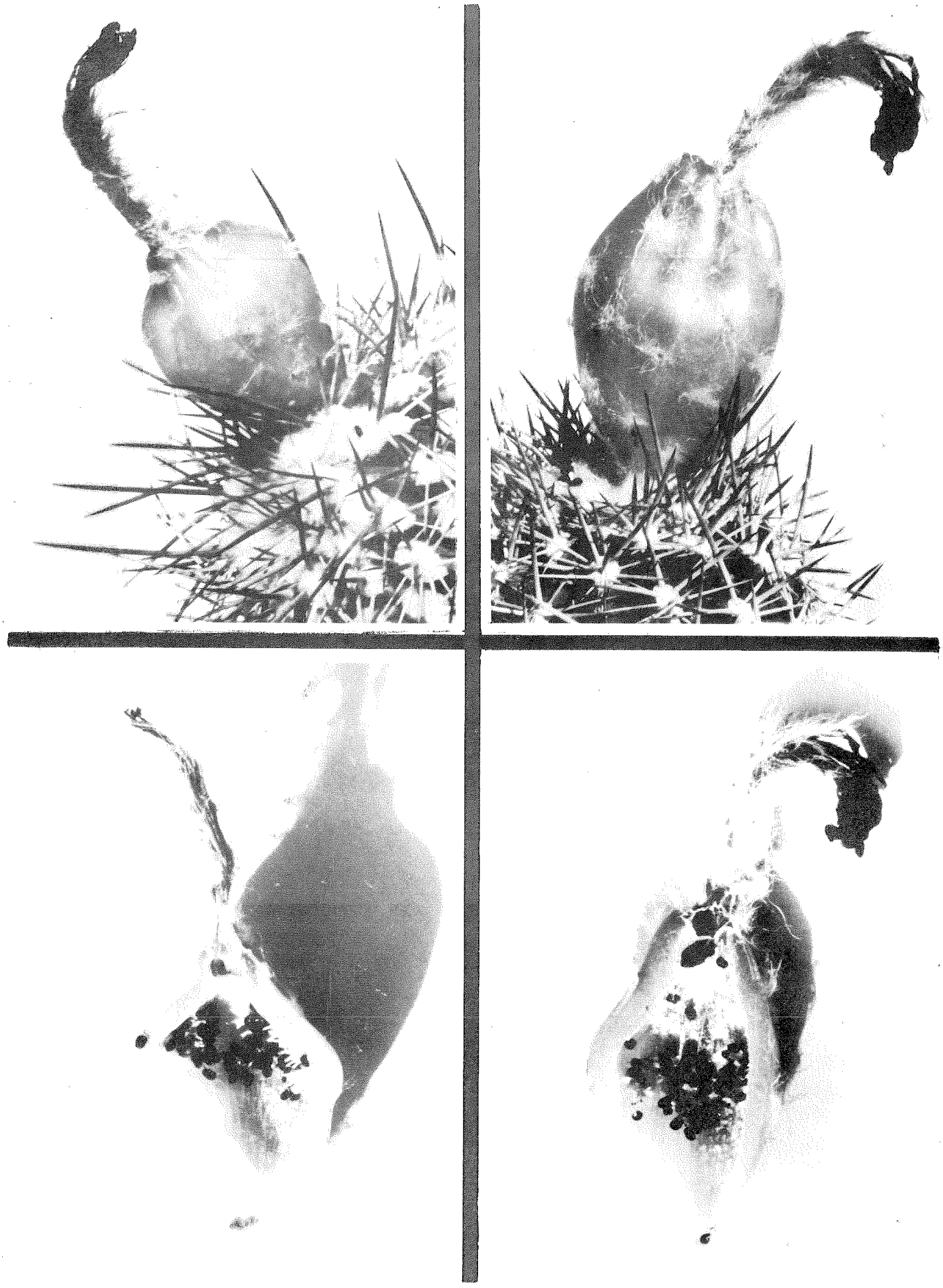
THE CHILEANS '85

VOLUME 13 NUMBER 43



AREQUIPA HEMPELIANA

AREQUIPA SOEHRENSII

Collection - P ALLCOCK

AN AREQUIPA FLOWERS **From P. Allcock**

When we were in the greenhouse at about one p.m. on a somewhat overcast September day, the bud on my Arequipa soehrensii looked as though it would open fairly shortly, for the stigma lobes and about 8mm of style were poking out through the unopened petals. At exactly half past four on the same afternoon I walked back into the greenhouse to find the flower fully opened - there had been some sunshine during the intervening period. On the following morning at about eleven a.m. the stigma lobes had opened out and on the morning after that the anthers had grown up level with the stigma lobes. Why do the filaments grow? Surely this cannot be to ensure self-pollination since I have never come across a self-fertile Arequipa, Matucana, or Submatucana. Of course all three exhibit the feature of filaments extending after the flower opens.

In the course of several years I have had flowers on just about all the species of Submatucana, on some Matucanas and Arequipas plus the odd Morawetzia, Loxanthocereus, Seticereus, and Bolivicereus and I am pretty sure that the only fruits to have set have been the results of my efforts with a brush. I think that we are looking at a mechanism designed for two quite different pollinators: when the anthers are short the pollen would fall on to the brow of a humming bird below the level of the stigma but this would be a suitable level for the pollen to catch the hairy head of a moth. A moth's imprecise flight would none-the-less allow it to collide with the longer stigma of another flower in a similar condition. Once the anthers have grown up level with the stigma, the pollen collected on the head of a humming bird would be in the correct position for the stigma of another flower. If the anthers on the second flower were elongated, the bird could easily push them out of the way and thus allow pollen to be transferred from its head to the stigma lobes. If the anthers were still short then there would be no problem anyway. Does this sound like a feasible explanation?

Presumably the hairy ring which is found in certain members of the Borzicactinae flowers is some kind of seal over the nectar chamber, perhaps a form of defence to prevent small insects creeping in. Looking at the corresponding feature in other Borzicactinae, I have found the extreme reached in FR 596 (a pale spined form of Submatucana aurantiaca) where one finds the roof of the nectar chamber is extended into a parallel sided sleeve some 4mm in length which tightly encloses the style. There is no way that even the tiniest insect could pass this barrier. Presumably the humming bird has to puncture the roof of the nectar chamber with its hard tongue in order to reach the nectar. Is this the reason for the sturdy flower on Submatucana aurantiaca, in order to withstand the probing beak and tongue of the humming bird?

There is a similar but shorter sleeve (ca. 1.5mm long) in Arequipa hempeliana. Have any comments been made about the large protrusions from the interior wall of the nectar chamber in Arequipa hempeliana? I have only noticed this feature last year; how I managed to miss it before when I have sectioned Arequipa flowers I just do not know – perhaps because I was not looking for this particular feature. Now I shall have to check on other species of Arequipa when they flower next. This year I find the protruding nectar glands are definately present in flowers on ex-KK imported Matucana huarinensis; they are very obvious being bright orange in colour in a flower which is pure pink in all its other parts, inside and out. I have not noticed them in any of the Submatucana flowers, which could be either because they are not there or because I was not looking for this particular feature. Whether they are present on only certain of the days on which the flower is open, or only at a certain period during the day, opens up a whole new set of questions – and difficult ones to answer! Matucana are not exactly prolific with flowers (as compared with Submatucana), even if they can be persuaded to flower at all.

During the latter part of 1982 three different species of Arequipa put out flowers, but in the customary manner there was virtually only one flower out at a time. For the autumn of 1983 I had in mind taking the step of keeping some pollen from the first flower in the refrigerator and using it to set fruit on the following flower, and so on. However when the first Arequipa flower did open in the summer of 1983 I was able to use pollen from Bolivicereus samaipatanus v. multiflorus as I was interested in obtaining some Arequipa seed for study purposes. This resulted in a fruit being set, so after I saw that this had worked, I did not try and store any Arequipa pollen; I knew that the Bolivicereus would have flowers and pollen available whenever it was required; it really does live up to its epithet of 'multiflorus'. With the usual perversity, when I next needed some pollen, both Arequipa hempeliana and A. soehrensii were out in flower at the same time, so I simply crossed them and obtained fruit on both plants.

If the withered flower is given a gentle tug some three or four days after pollination and it remains attached to the areole, then it usually means that pollination has been successful. After a while the fruit starts to expand, slowly, taking up a globular or perhaps a slightly flattened globular shape. On A. soehrensii the fruit is a purplish brown colour for the whole course of its development, the colour fading a little as the fruit expands. On A. hempeliana the fruit is a glossy dark green colour for a few weeks and finally turns a yellowish colour, which I assume indicates that it is mature. At this point it is about 20mm in diameter and some 35mm long. This one remained attached to the plant long enough to take to the 1983 Chileans Autumn Weekend, by which time it exhibited some signs of wrinkling. A darkish blob could be seen inside the fruit, which was presumably the seeds, giving the impression that they were not occupying the whole of the interior of the fruit, and also suggesting that the fruit could possibly have a fairly thick, turgid, semi-transparent wall.

Altogether three fruits were set and all contained apparently mature seed. This gave me an opportunity to examine the nature of the fruit on Arequipa, which (as far as I know) has not been described in detail in the literature. The seed was held in a loose bunch at the top of the fruit where it was suspended only by the more-or-less dried-up seed strings. There is no membraneous sac present such as one finds in e.g. Islaya fruit. In the Arequipa fruit which had evidently matured, many of the seeds had fallen down into the base of the fruit, where they could just be discerned when the plant was taken to the 1983 Chileans Weekend. Only a few seeds had fallen down in this way in the other two fruits, which were probably not completely mature when I examined them. When the fruit was removed from the plant a small oval disc of fruit wall was left adhering to the areole, but otherwise the fruit wall remained completely intact except for the small oval hole in the base. There was no vertical split in the fruit wall such as one expects to see in e.g. Submatucana. The fruit does not detach very easily from the plant, and in this respect it is rather like the fruit on Islaya.

During 1984 both species of Arequipa again flowered and again fruit was set on both plants. This time it was possible to bring both plants in fruit to the Chileans Autumn Weekend. On that occasion a fruit was taken off each plant and sliced in two,. Shortly afterwards both the plants and a detached and sliced fruit from each were photographed. Happily only

one or two seeds were displaced during this process so the photographs do show the hollow, thick-walled fruit pretty accurately. There is a difference in the shape of the fruit on the two plants which is evident in the sections of the fruits – spindle shaped on A. soehrensii and top shaped on A. hempeliana. In addition, another Arequipa was brought along to the 1984 Weekend by Alan Craig, a plant carrying fruits of depressed globular shape! But it will be clear that the structure of these fruits is altogether different from those which may be seen on Matucana and Submatucana; the latter do not expand to anything like the same degree as the fruit on Arequipa; on Matucana & Submatucana they are also thin-walled, dry on maturity and more or less filled with seed. Apart from the small hole in the base, the fruit on Arequipa is intact when it eventually releases its seed (similar to Islaya) whereas on Matucana/Submatucana the fruit splits vertically along three or four lines from areole to dried flower remains. As soon as you touch the fruit to try and remove it, the seeds spill out of these splits all over the top of the plant where it becomes a great deal of trouble to recover it, especially amongst dense spination. In Arequipa the complete fruit falls off at a touch when it is ripe.

Having found out that there appear to be important differences between the fruit on Arequipa and Matucana/Submatucana, it would be interesting to make comparisons between seeds from the two genera. But here there is a major problem, which is to obtain reliable seed samples of Matucana, which are not exactly profuse flowerers with me; but the greatest difficulty is that they will not set fruit despite hand pollination. The Submatucana do flower relatively easily and also set fruit fairly readily, but with Matucana I rarely if ever have had two plants of the genus – either of the same or different species – in flower at the same time. To date I have set fruit on only one species, that is Matucana huarinensis. Matucana do not seem to accept foreign pollen as the rest of the Borzicactinae seem to do quite readily. The pollen from Bolivicereus samaipatanus v. multiflorus seems to set fruit very well on Submatucana, Arequipa, Loxanthocereus, and Cleistocactus, but not on Matucana.

Of the Arequipa seed which I have obtained from various sources, they all do seem to be very similar not only in size and shape but also in regard to the presence of lacunae which appear on the testa surface. This feature does not seem to occur with seed of Matucana, but on the other hand it is found on seeds of Oreocereus. Thus although Arequipa has a body form and also a flower structure which is similar to many species of Matucana, it does appear that the fruit and seed are more closely related to Oreocereus.

. . . from H. Middleditch

It is difficult not to over-emphasize the importance of these comments and observations on Arequipa fruit and seed. The mode of dehisence was noted by Rauh in his Beitrag der Peruanische Kakteenvegetation under the heading of A.rettigii and A. erectocylindrica. This was repeated later by Simo and Schatzl in the Austrian Cactus Society magazine: "In the reference literature there exists only few particulars about the fruit of Matucana, Submatucana and Arequipa; the collector is wrapped in silence, although in just this aspect valuable work could be undertaken. Prof. Rauh notes about the fruit of A. rettigii: '. . . ripe fruit up to 2.5 cm long, yellowish, crowned by dried up flower remains, opening at the base and the matt black seeds spilling over the crown of the plant', and with the new description of A. erectocylindrica 'fruits citron yellow, similar to the preceeding species'. Fruits of the genus Matucana are top-shaped opening with several lengthwise slits. Ritter now raises the question, are the two preceeding modes of fruit opening always consistent or are there deviations?"

In that article there was no reference to the fruit on Arequipa being hollow, with the seeds occupying only a part of the internal volume. Simo and Schatzl asked "what difference if any, really exists between Matucana and Arequipa?" On the basis of the information then available such questions can hardly be criticised.

Similarly after a Chileans Weekend at which J.M. Chalet had shown us some slides that had been taken during his trip to Peru, which included some shots of Arequipa, R. Mottram observed: "My interest in the fruits of Arequipa is mainly to confirm whether or not there is a sound reason for keeping Arequipa separate from Matucana. Fruits on Matucana are especially characteristic in the way that they ripen and release the seeds via one or more basal apertures from a dry chamber. The fruit does not shrink on to the mature seeds and burst when it has no more free space to shrink into, but bursts when it is still expanding, while the wall of the fruit is quite thick. I would not describe the aperture as a split, because the edges of the aperture are not torn, but are curled inwards without exposing any of the internal tissue of the pericarp. Certainly the fruit wall does become thinner and drier after it opens. Until the Chalet slides were shown at Brooksby I had never seen either a living example or a good illustration of Arequipa fruit which could clarify whether it was a Matucana type or whether the seeds remain embedded in a pulp. The descriptive literature is unclear on the point, some describing the fruit as fleshy, whereas it is strictly only fleshy-walled, and others stating that they release seeds by a basal split, which could mean simply splitting like Echinopsis!"

One rather peculiar observation appears in K.u.a.S. 16.9.1965 in which W. Hoffmann describes his trip to Peru; not far from Arequipa city " Arequipa erectocylindrica, first described in 1956 by Rauh and Backeberg, was waiting at the type habitat (Chacani volcano) with a surprise for us. Its golden yellow dried fruits had not only the white hairs in the axils of the scales, as reported by all authors of the genus, but also frequently 1cm long dark spines. Neither Rauh nor Backeberg mentions this remarkable spination of the fruit".

The distribution of Submatucana/Matucana/Arequipa runs from about 5° S to about 20° S; at the southern end of its range it is confined to the western side of the high Andes. The northern end of this distribution range is ocupied by Submatucana, then as far as 15° S by Matucana and thence southwards by Arequipa. Humming birds are well documented as residents of this distribution area and the flowers exhibit a not surprising degree of similarity in their form and arrangement to suit this pollinator. But the climatic regime does undergo a steady change from north to south; there is a steady reduction in light intensity, average temperature and humidity. Although the pollinating agents may well be similar throughout, it is quite possible that there are changes in other fauna and that the method of seed distribution may change from one end of the distribution range to the other. In particular, it would appear to undergo a change in the vicinity of 15° S where the Matucana fruit changes to Arequipa fruit. It is relevant to note that other changes occur at about this latitude; Oreocereus makes its appearance, for example. Thus it would appear to me that we now have what we did not previously possess i.e. a reasonably sound argument for keeping Arequipa separate from Matucana.

. . . further from R. Mottram

In regard to the comment by W. Hoffmann that long dark spines had been observed on Arequipa fruit in habitat, I observed spines on fruit areoles of some plants of Matucana krahnii this year, but this is not a consistent feature.

. . . from I.le Page.

Arequipa is a strange genus; I have yet to flower one although I would have thought my plants are well beyond the stage at which flowering could be expected to occur – but no! they will not. I have seen Arequipa flowering in a friend's greenhouse – indeed I supplied him with the plant! I normally keep my house at 7° C; my friend's greenhouse is unheated where temperature can fall to zero or slightly below. The only conclusion that I can come to is that the plants require a period of vernalisation at low temperature. Come to think of it, I cannot flower Oroya either, although others seem to be able to do so with relative ease. Anyway, my new greenhouse has been divided into two sections, one of which is to be allowed to remain cold; it is going to be interesting to see what will happen.

. . . further from P. Allcock

During 1985 I was interested to see that A.rettigii and A. soehrensii, which are now both some eight inches tall, have produced offsets round the base. There are two offsets on A. retigii and A.soehrensii has three. This takes me back to the observations made by R. Ferryman and the slides which we saw at the Chileans Weekend of the clumping Arequipa in northern Chile.

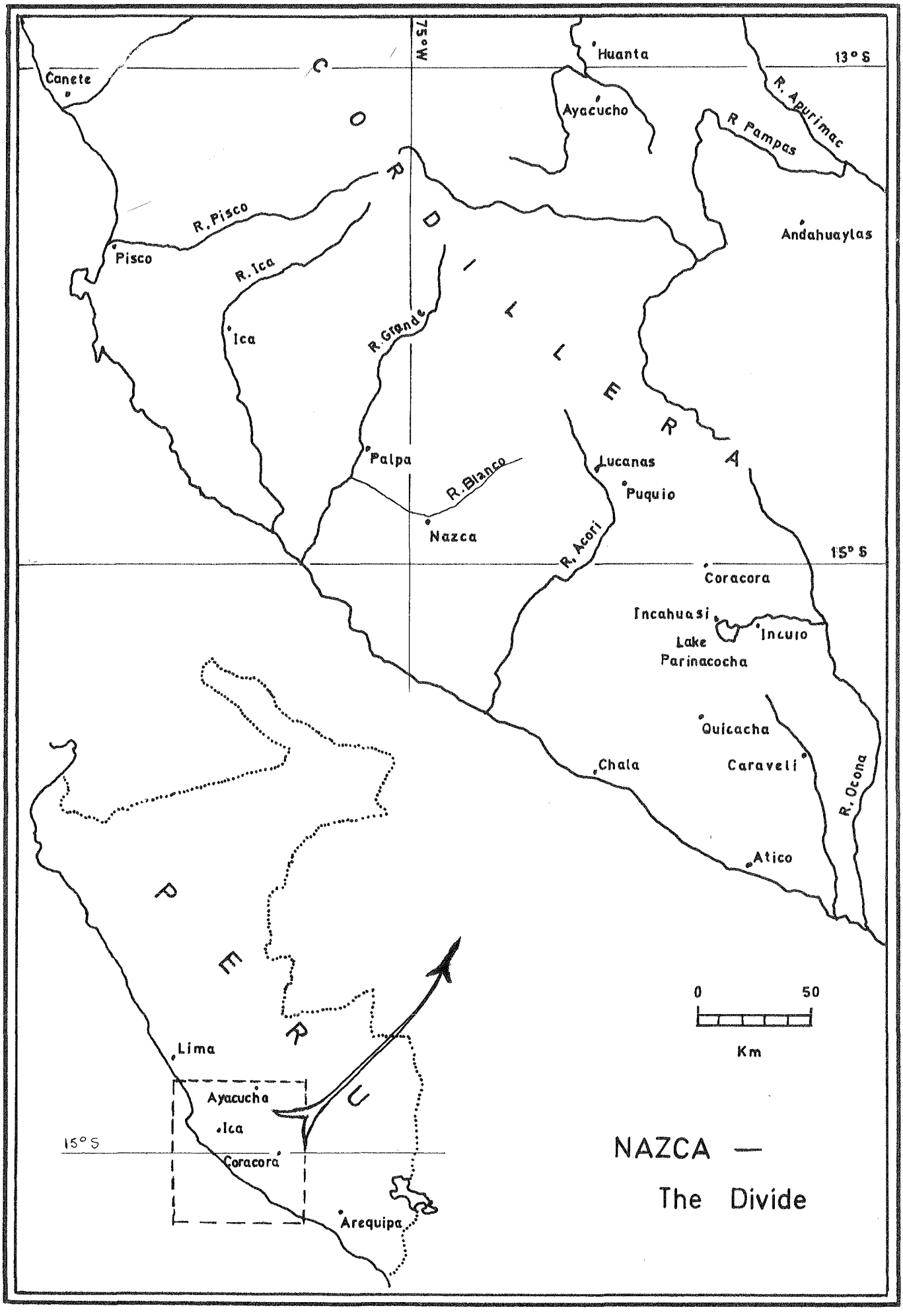
AREQUIPA **By F. Ritter**

Translated by H. Middleditch from Kakteen in Sudamerika Vol.3

Britton and Rose established this genus for one cactus species that Rose had found near Arequipa, Peru and were not able to classify it for some time. According to Oehme (Cactaceae Jahrbuch DKG, May 1940) Quehl received seeds of this species before the outbreak of the first world war with the identification "Echinocactus sp. nov. from Arequipa". Rettig grew plants from these seeds which Quehl then described as Echinocactus rettigii in 1919. However Britton and Rose in Vol.2 of their book accepted the Echinocactus leucotrichus from Chile (which had been described by Philippi in 1891) as the self-same sort and they placed the name E. rettigii as a synonym to it when they published this species under the new generic name Arequipa leucotricha (Phil) Br & R. In that matter of course they made a mistake, as I enlarge upon under Oreocereus leucotrichus (Phil) Wagenknecht. On the foregoing basis Rose's species must read: Arequipa rettigii (Quehl) Oehme, in accordance with the manner that Oehme had undertaken the recombination. According to Britton and Rose this species is the Type species of the genus Arequipa. Prior to Quehl there had already been published by Guerke in 1906 an Echinopsis hempeliana which grows in southern Peru and northern Chile. It stands very close to Arequipa rettigii and was similarly recombined into Arequipa. There were then additional species names established under Arequipa, that either belong to other species or turn out to be synonymous with rettigii or hempeliana! Allowing for two undoubtedly new Arequipa species that have been found by me – A. australis in Chile and A. spinosissima in Peru – the number of known species of the genus now amounts to four.

The habit of Arequipa is globular to short cereiform. The number of ribs amounts to 12-24, the ribs are blunt, humped; the areoles stand on the humps, often extending down into the groove there; spines numerous, pale slender radials and stout needlelike to awl-like centrals; flowers at the crown are some 6-8cm long, externally they carry small pointed scales and white or brownish upwardly pointing woolly hairs, never bristles. The nectar chamber holds copious nectar and is closed by means of a diaphragm growing up and out of the wall, which terminates in a ring of stamens; occasionally the diaphragm is only poorly developed. The tube is cylindrical or only slightly widened out towards the mouth, straight or curved outwards, usually circular in cross section, sometimes slightly flattened. The stamens stand together in a bunch around the stigma and are coloured; few stamens are inserted in the tube, almost none towards the mouth, up to a ring of stamens on the margin, the opening of the tube is just barely or not diagonal, however the stance and shape of the petals brings about a sideways opening of the flower petals; the upper petals are almost straight or inclined inwards, the lower ones are spread wide open and curved back; the colour of the flower petals is vermillion to blood red (a humming bird flower). The anthers are always yellow (in the originating genus Oreocereus violet, occasionally carmine, never yellow) and do not reach as far as the end of the petals. Style reddish, stigma lobes several mm long usually project slightly above the uppermost anthers. Fruit 1-3cm diameter, yellowish to red, spherical to barrel shaped, furnished as for the pericarpel, quite hollow, thin walled; the fruit detaches with a largish hole at the bottom out of which the seeds fall quickly. The fruit scar is not sunken and is several mm in diameter. The seeds are black, the dorsal strongly arched and somewhat keeled, with a very fine granulation of the testa, usually with some shallow lacunae as well; the hilum region is very large more or less the diameter of the seed, slanting somewhat to the ventral side, dark grey and bowed out spindle-shaped; at the top of the spindle shaped hilum is found the minute funiculus scar with a white margin, below which and rather deeper within the hilum area is the equally small micropyle without any white margin; this characteristic appearance of the seed is already reminiscent to some degree of the hollow fruited species of Oreocereus.

The genus Arequipa grows only in a very arid climate. The seeds and specifically the very characteristic appearance of the hilum area points clearly to a derivation from specialised sorts of the genus Oreocereus, which all grow in a fairly severe climate. The formation of the flower and fruit can also be traced back to Oreocereus. Arequipa is a further development of the Cereus line from Oreocereus to the Echinocactus line with axis-shortening. If a broader framework of genera was to be taken, Arequipa would have to be merged into Oreocereus. When I decided against that, it was on the following grounds: Arequipa is a well distinguished group of species which at the present time, as far as is known, have no transition forms to Oreocereus. When Backberg transferred his Oreocereus variicolor to Arequipa on account of the hairlessness of the latter, and then more recently again back to Oreocereus, this was due to insufficient knowledge for this species is, in respect of its habit, ribs, areoles, spines, flower and seeds an entirely typical Oreocereus, of close affinity with Oreocereus leucotrichus; that it has none or very few areole hairs is of no importance – Oreocereus tacnaensis is completely hairless and certainly belongs to this genus.


Canete
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Lucanas
Puquio
R. Acari
Coracora
Incahuasi
Lake
Parinacocha
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Chala
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Ayacucha
Ica
Coracora
Arequipa
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NAZCA —
The Divide

Now the species of the genus Oreocereus form a fairly long line of development, at the beginning of which stands Oreocereus tacnaensis and at the end of which is Oreocereus leucotrichus (close to O. celsianus and O.trollii). Specifically the formation of the fruit has undergone a complete change from a juicy-fleshy opening fruit attractive to birds, as in O. tacnaensis and O. fossulatus, through a dry fleshy fruit (O.ritterii) to a hollow fruit whose loose seeds are allowed to fall out from an opening in the base. To this latter line then is connected the further development towards the similarly hollow-fruited genus Arequipa with reduction in flower axis and various modifications in ribs, spination, flowers, fruit and seeds. The seeds have also been shown to be traced from this line.

If there was only Oreocereus with hollow fruit, then perhaps the differences to Arequipa would not be deemed sufficient for an independant genus. But to combine into one genus a quite typical Cereus like the bird-fruited O. tacnaensis together with typical globular cacti such as Arequipa australis and A. spinosissima, seems to be too far-reaching. Here important differences exist not only in vegetative habit of the plants but also specifically in the fruit and seeds. Since each genus diverges one from another, it is self-evident that either there are or there must have been during evolution, species which consequently occupy a halfway position between the two. Thus in questions of recognition of a genus we ought accordingly only to turn to how broad is the gap between the successively most far apart species, not according to whether intermediate species still exist today. Species such as O. leucotrichus undoubtedly have an Oreocereus imprint, even if they stand as close to Arequipa as to several other Oreocereus species. It is also noteworthy that natural hybrids are to be found between species of Oreocereus, where such grow together, even between those furthest apart such as O. tacnaensis and O. leucotrichus. On the other hand I have remarkably never once found a natural hybrid between Arequipa and Oreocereus when they are growing together, despite their frequently blooming at the same time. At the same time there are various natural hybrids between Oreocereus and Cleistocactus; between Oreocereus and Matucana; indeed I even found one between Oreocereus and Trichocereus.

One leaves the question of the recognition of the genus Arequipa as an individual genus, without thereby disregarding essentials, by noting that there are closely related species among Oreocereus; crucial for this question really is, which species stands furthest away from Arequipa, taking into account those species which unquestionably fall within Oreocereus.

. . . from H. Middleditch

Ritter suggests that "Arequipa is a further development ....from Oreocereus" However the uplift of the Andes within geologically recent times means that what is now Oreocereus was then growing at very much lower altitude levels. Oreocereus occurs at what is now a higher altitude than Arequipa; the change in climatic regime and changes in available pollinating agents during the uplift of the Andes seems more likely to have produced Oreocereus from what was there before, whereas Ritter effectively suggests that it was the other way round. From Ritter's observation that the juicy-fleshy fruit on O.tachnaensis an on O.fossulatus are attractive to birds we might be entitled to deduce that the hollow fruit on O.trollii, on O.celsianus and on O.leucotricha are not attractive to birds. This may suggest that there are not many birds co-exist either with the hollow fruited Oreocereus, or with the hollow-fruited Arequipa, other than the humming birds which pollinate the flowers. In turn this suggests that the hollow-fruited Oreocereus and Arequipa exist in a harsher environment with very restricted life support resources for birds.

There is very little doubt that the seeds of Arequipa – at least those obtained and photographed so far by F. Fuschillo to his usual excellent standard – do compare well with Oreocereus. Both have scattered lacunae on the testa, mainly in the upper half of the seed. This feature is absent in Matucana. It would therefore appear that we have two criteria on which Matucana can be considered to be separate from Arequipa: the seed, the form of fruit together with its mode of dehiscence. The question arises as to whether there is a geographical overlap in the distribution area of these characteristics; if not, then in addition to the foregoing there may be added a third criteria for separation, that of a positive geographical divide. This may not be just a geographical divide for this group of cacti, but may also be a phytogeographical divide for the Flora in general, in which case it would become an even more viable criteria for keeping Matucana and Arequipa separate. What do we know about the phytogeography of southern Peru?

A CONTRIBUTION to the KNOWLEDGE of the PERUVIAN CACTUS VEGETATION **By Prof. W. Rauh**

Translated by H. Middleditch.

Valley of the Rio Pisco

In respect of the composition of its cactus vegetation, as evidenced by the presence of Armatocereus procerus, Neoraimondia rosiflora, Haageocereus acranthus, and Melocacti, this valley still displays relationships with the valleys of central Peru. Nevertheless in the Pisco valley the plant-geography transition is already taking place to that of the southern Andean region. Not only is the absence of Espostoa melanostele noteworthy, which reaches its southern limit of distribution in the Canete valley (perhaps even initially in the valley of the Rio San Juan), but there also appears here representatives of the genera whose origin is in southern Peru.

In particular the genus Weberbauerocereus belongs here, represented by the newly discovered species W. rauhii which advances northwards as far as the Pisco valley. Also for the first time we encounter the southern representative of the genus Neoraimondia, N. arequipensis, which is distinguished from the more northerly species on account of their stems with a greater number of ribs and on account of the possession of a whiter flower.

Valley of the Rio Blanco: Nazca to Puquio

On a trip from Nazca to Puquio the vegetation cover is still more transitional from central to southern Peru than in the valley of the Rio Pisco. The route initially follows the valley of the Rio Blanco. The lower places on the western flank of the Andes exhibit an even more marked aridity which display an impoverished vegetation up to a greater altitude. To those

southern genera which first appear in the Pisco valley is now to be added Browningia candelaris. An additional noteworthy floral element of the Rio Blanco valley is Bulnesia retamo, a switch-like bush provided with green bark and small deciduous leaves. It always occupies the dry rubble terraces of the lower rainless regions up to 1000m altitude and descends as far as the coastal desert in the rubble of the dried out river beds. Bulnesia even grows in places where no other plants, not even cacti, are able to flourish. Owing to its disjunct distribution this plant is of especial interest for plant geography. Its principal habitat lies in Argentina in the scanty rainfall provinces of Catamarca, La Rioja, Cordoba, and Mendoza; a second habitat of smaller area is found in Peru between Nazca and Ica. Bougainvillea spinosa also has a very similar distribution; it only occurs in the Dept. of Moquegua in Peru and then again in Argentina.

From these observations on distribution geography the conclusion may be drawn that prior to the uplift of the Andes either a continuous distribution area must have existed or else prior to the present time an outward plant migration was posible over the then lower Andean ridge. A support for this surmise is to be found in the fossil discoveries of a Tertiary tropical Flora in the Cerro Potosi at the present day altitude of over 4000m where today there exists a high mountain flora living under a cold regime.

However at the higher altitudes and over the inter-Andean plateau the transition to the vegetation of southern Peru takes place much more markedly than in lower locations on account of the occurrence of the Tola, the dwarf shrub Lepidophyllum quadrangulare. This now extends from Puquio southwards on characteristic plateaux in immense monotonous stands as Tola heath, in which the Puna grasses play only a subordinate role. Consequently in the area of Nazca-Puquio we encountered a vegetation whose floral composition already belonged to the southern zone of the Andes.

Up to 500m altitude the vegetation in the Nazca valley outside the irrigated valley floor is only represented by Bulnesia retamo which occupies the rubble fans at the foot of the valley sides. Some cacti begin to appear at around 600m altitude but these are few in species by comparison with other valleys. They start with Armatocereus procerus, which reaches its southernmost location in the Nazca valley, initially as solitary specimens, appearing together with Bulnesia retamo, but later forming larger stands on the broad terraces of riverborn debris: from 800m it is associated with Haageocereus turbidus K105, Loxanthocereus clavispinus K106, Melocactus sp. K 108, and Neoraimondia rosiflora. Up to 800m the cacti are confined to the valley floor and the alluvial fans; above 1000m they start to occupy the rocky valley slopes as well.

The road soon quits the Rio Blanco valley and goes over a steady slope (possibly of limestone) on to a plateau heavily weathered and furrowed by erosion trenches, which is occupied by an open stand of Orthopterygium huauncani, which generally occur in the erosion gulleys in the form of 4m high trees. Of the accompanying cacti are to be noted Weberbauerocereus rauhii, Haageocereus turbidus v. maculatus K110, Loxanthocereus ferrugineus K109, and Tephrocactus mirus K111. The remaining flora is scanty and consists of small bushes, such as Kageneckia lanceolata, Croton sp., Malvestrum rusbyi, Trixus cacalioides and Verbena juniperifolia.

During the rainy season however a fairly prolific annual vegetation seems to emerge, because the slopes overgrown with Orthopterygium display numerous cattle footprints which come from grazing herds. Thus in March of 1954 the following plants were noted: Tagetes pauciflora (abundant) and some typical Loma plants such as Pterocarya laterifolia, Nolana spp., Stenomesson, Anthericum eccremorhizum and some grasses. The presence of the Loma plants brings out that in fog-rich years a Loma vegetation can still develop at this altitude of 1200-1400m.

At the upper limit of the Orthpterygium association at 1600m, Browningia candelaris appears for the first time, extending upwards as far as 3000m; it occurs together with a 2-3m tall Armatocereus (A. matucanensis?) and Corryocactus K39/1954. In the area of Nazca-Puquio the same Browningia reaches the northern boundary of its distribution area.

Between 2000 and 2700m is occupied by a dense thicket of a lowgrowing composite Grindelia montana, of up to 50cm high, which gives the impression of a secondary formation. Above 3000m these plants reduce in numbers and the pretty level, disjointed high plateaux, consisting partially of volcanic tuffs, are overgrown with taller shrubs. Here, for the first time, we came across the Tola bush, Lepidophyllum quadrangulare in association with Verbena juniperina (occasionally abundant), Proustia pugens, Balbisia verticillata, Senecio idiopappus (often forming stands on steeper slopes), Chuquiragua, Mutisia, Tetraglochin strictum, Baccharis incanum, Coreopsis and Diplostephium, intermingled with some grassy tussocks of Stipa and Festuca. Conspicuous is the wealth of cacti although remarkably few catch the eye to start with in the vegetation scene. Noteworthy is the occurrence of Loxanthocereus hystrix K112, one of the largest species of the genus growing at the highest altitude, with strong and fierce spination. Concealed in the thicket grows one of the finest Peruvian Matucana, M. hystrix K113 with an equally very strong and long spination., whose colours range from violet-reddish brown to deep black. One of the most decorative cacti of the region however is without doubt Oreocereus hendriksenianus, a typical component of the Tola heath, which brings enlivening tints to the greyish-yellow of the landscape with its clumps of white-woolly columns. This genus, with its centre of distribution in the altiplano of Bolivia, is only represented in Peru by Oreocereus hendriksenianus, of which some well-known forms exist. The type described by Backeberg carries a fox-brown crown of woolly hairs. In addition there are forms with pure white crown wool and a much denser coat of hairs (var. densilanatus) and some with about 100cm long golden yellow central spines (v. spinosissimus). Oreocereus hendriksenianus crosses over the Kondorsencha pass in that chain of the western cordillera which is nearest to the coast and colonises the adjoining eastern flanks into the Lucanas basin between 4200 and 4000m together with Matucana multicolor K115. This is indeed one of the Matucanas found growing at the greatest altitude, whose lower distribution limit had already been noted at 3800m.

In conclusion, we established that in the Nazca-Puquio area on the west side of the Andes a conspicuous change in the Flora takes place, of which it is characteristic that a number of the vegetation-determining plants that have a distribution area stretching away to the south or the south-east reach their northern limit here. For the cacti in particular the genera Browningia, Corryocactus, and Oreocereus are to be noted in this respect.

. . . from A.B.Lau US C&S Jnl 1980 Vol 52

We left Chala early in the morning.....for Lake Parinacocha.....the dirt road follows an abrupt zig-zag pattern .....until I finally reached the top of the mountain. We now enter the high plateau called the Tola heath. If you are not studying the Flora from a botanical point of view, you could easily think you were in Scotland. In the distance you get a first glimpse of

Lake Parinacochas. Soon we reach an altitude of 3800m.....among many Tephrocactus. Then we encountered the spectacular region of large colonies of Oreocereus hendriksenianus. Next we circled the large flamingo lake. On the western shore we did indeed find Matucana breviflora Lau 166, the southernmost of all habitats for the genus. Apart from the short tube of the flower, one could easily mistake the plant for M. multicolor. In the shallow waters near the shore of the lake were the flamingoes, standing traditionally on one leg.

At the tiny settlement of Quicacha, in the foothills north of Chala, I had to find Arequipa spinosissima; I had come across the name of this place in Ritter's publication of the species. It was not difficult to find, in the bed of a dry creek - Lau 113. At the same locality I found a few plants of Mila nealeana Lau 168.

. . . from H. Middleditch

Lake Parinacochas lies just south of 15° S, so providing us with the southernmost location for Matucana; the habitat location for Arequipa spinosissima is much nearer the coast, but still only a little further to the south. This appears to provide us with a very specific geographical divide between Matucana and Arequipa. From the observations made by Rauh it would appear that this divide is not only one between the distribution areas of Matucana and of Arequipa but that it falls within the area of a much more fundemental phytogeographic boundary. This would appear to reinforce the criteria for keeping Matucana and Arequipa separate.

SOUTH OF NAZCA **By W. Hoffmann**
Translated from K.u.a.S 16.6:1965 by K. Wood-Allun

The valley of the Rio Blanco which the road via Nazca, Lucanas and Puquio follows from the coastal desert to the highlands has the same maize and cotton fields which we have come to expect in the side valleys of the Andes. Only the pumping stations show that there is not sufficient river water available and that deep lying artesian wells have to fill the gap.

Until one reaches the summer rain zone the lack of water in this region dictates the type of vegetation. Rauh considers this zone so important because it constitutes the northern limit of the monotypic genus Browningia as well as the genera Oreocereus and Corryocactus. It might well also be the southerly limit of Melocactus and of Neoraimondia roseiflora Bckbg. We observed these latter in remarkably low stature. Even young plants had irregular spines up to 20cm in length.

Under H712 we collected a form of Melocactus peruvianus which is particularly strongly spined. We also found the first cristata Melocactus we have observed. It remains to be seen whether this plant will form an equally cristate cephalium. In addition we collected seed of Haageocereus turbidus Rauh et Bckbg. (syn. Haageocereus marksianus) but unfortunately there was no seed on the especially beautiful Weberbauerocereus rauhii Bckbg.

When we reached the top of a high plateau just before the Western Cordillera it was quite depressing on account of the lack of vegetation. Growing here in the erosion gulleys on trees of Orthopterygium huaucui we found a species of Tillandsia whose red upper leaves contrasted with the bluish violet flowers. Since we cannot send air freight from Lima for a few weeks these plants will hardly stand being kept for such a long time in the van.

Our first puncture interrupted our progress up the 4200m pass of Condorsencha with its clumps of Matucana and Oreocereus. If you consider Arequipa and Matucana to be one and the same genus then the area round this pass is the point of contact of the two. Matucana can be observed as far north as the Rio Santa in northern Peru whilst Oreocereus inhabits a much greater area which embraces S. Peru and the whole of high altitude Bolivia as far as N. Argentina and N. Chile. Guanacos, which have not been domesticated and which have become very rare because of their silky pelts passed us in small packs on their way to a water hole but we had to hurry in order to collect more cacti while the daylight held. Our search for Matucana hystrix yielded one specimen almost one meter tall on the Pacific side of the pass and then one further specimen on the Atlantic side amongst masses of M. multicolor. Clearly these very variable species are close to each other, and not only on account of habitat.

In Puquio we learned that we could not drive directly to the Parinacocha lagoon, the habitat of Acantholobivia incuiensis Rauh et Bckbg. The rainy season, which had already ended months ago, had washed away the road we wanted to follow to Puerto Chala, Arequipa, and Cuzco. We had therefore to return along the same road with all haste. The large amount of collected material, completed by Oreocereus hendriksenianus, made us forget our exhaustion and created new difficulties for us shortly before we reached Nazca. Several potholes on the last steep descent caused the heavy cases on the roofrack to leap into the air and the roofrack was bent some eighteen inches forward. The metal bars had to be bent back by hand and in the fierce heat many hundredweights of plants had to be lifted down and then back again. The skulls which lay on the spoiled graves of a pre-inca graveyard seemed to be grinning at us as we worked.

SOUTHERN PERU **Reported by A. Ellinger**
From G.O.K. newsletter for December 1979
Translated by F. Fuschillo

The meeting of the Upper Austria branch of the G.O.K. welcomed Oscar Instorfer and his friend who had been in Peru during the summer of that year. They brought back a rich haul of cacti and tillandsias together with a fine collection of photographs from their travels through the country. In 1000 slides they recorded the whole journey, of which we saw about 300, covering the route from Lima to La Paz.

To begin with our speaker described the land to us, the characteristics of the landscape and the population. The flight from Brussels lasted 15 hours. Before starting the journey of some 1000km to Arequipa they went sightseeing in Lima. Then they set off with a rented VW Beetle, through the vast desert. During the day it was cool, the temperature rising to 15° C and at night the thermometer read below 10° C. Wreaths of Garua mist rose repeatedly from the coast, brought about by the cold Humboldt current. Often small islands lie off the coast, which represent a paradise for birds. Every three or four years a harvest of Guano (bird-droppings) is taken from these islands. Landing on the islands in between such harvests is prohibited.

Travelling further south the long black strip of the Pan-American highway goes straight as an arrow through the desert. In the valley of Nazca past Puquio there is an extensive arid area, but after the vegetationless desert the cacti begin at a height of 700m with Armatocereus procerus on rocky slopes. We saw plants rising as high as 7m, all the stems going brown at the base and up to 30cm thick. As Herr Instorfer discovered, old areoles produce fresh spines and indeed even more than 50 to each areole which gives the stems a fearsome appearance. On young stems the spines reach 10cm in length.

Although Neoraimondia roseiflora occur mainly in central Peru, a group of these plants can be found in this valley. These plants only grow to 3m in height and that very slowly, according to Prof. Rauh by about 50cm in 20 years. Here again the lower stems are covered with long spines; areoles capable of flowering loose their spines. The flower formation is very interesting; the areoles bring forth new flowers each year and in consequence they grow longer so that on the old stems they form a stump-like protrusion which could be up to 10cm long. At this location at an altitude of 1000m the midday temperature is over 25° C. Close beside the Neoraimondia is found Haageocereus turbidus which is 1.2m high.

The first Browningia candelaris was found at 1800m. This species dominates the surroundings up to an altitude of 3000m. Plants in their best years look like candelabras, which have a height of over 5m and a stem of 50cm diameter. In youth the plants are a thickly spines solitary column 2-3m high. As it becomes capable of flowering the areoles do not form any more spines, only a few bristles, so they look almost naked. Only then does the branching commence. Offsets which would flower cannot be rooted or grafted.

Unexpectedly Instorfer found in that extremely dry area a tillandsia on a tree, perhaps a form of T. latifolia. The plant grows very well in cultivation. Clumps of Haageocereus were seen on another slide. There was also Corryocactus brevistylus 5m high with extremely long spines, 25cm long; the indians use these spines for knitting needles. In this area can be seen Loxanthocereus hystrix with procumbent stems up to 1.5m long and 10cm in diameter; the central spines up to 10cm long are very tough. Instorfer showed us a Tephrocactus whose name is still unknown. These plants are likely to be in the globulares group. Here at the uppermost limit of Browningia Instorfer was looking for Matucana hystrix but did not succeed in finding it.

At 3300m Oreocereus hendriksenianus was found for the first time. Their distribution extends to 3900m. Here it is at the northermost limit of the genus. The distribution area coincides with the Tola Heath. This plant community is associated with dwarf shrubs. Further south these plants were not seen again. The zygomorphic flower points to a morphological relationship with Borzicactus. We also saw the variety spinosissimus with long strong central spines up to 10-15cm long, with up to 1.4m long decumbent offsetting stems! Over the pass can be found variety densilanatus, a form with hardly any spines but with yellow-brown wool in the crown.

At 4100m altitude and just beyond the pass there stands Oreocereus hendriksenianus v. densilanatus. The plants are somewhat smaller, thickly covered with wool, scarcely any spines visible. At the same habitat are countless Matucana multicolor, both small and large plants to be found. This is the most southerly and also the highest location for Matucana. These plants are fairly large, globular to cylindrical, up to 20cm in diameter and 40cm in height. Looking at the growth form they are typical highland Matucanas. In the valleys Matucanas often grow much longer, hanging from the rocks, like a curved pipe. Matucana multicolor tends to form clumps. Whether this is a natural form or caused through damage by animals, Instorfer could not tell us. The spination is very variable, the radial spines vary from stout to fine bristles, similarly for the central spines. The colour of the central spines ranges from black-brown to nearly white. Instorfer was too early at the habitat for the flowers, although further to the north the Matucanas were already in flower. At this dream of a site two types of Tephrocacti are also found; one is without hair, up to two-thirds buried in the ground, whilst the second type is from the floccose group, Tephrocactus lagopus v. pachycladus which has stronger stems up to 15cm high and 6cm in diameter. They look like small Oreocereus.

Further below in the valley of the Rio Acori, in a less harsh environment, Instorfer found columns of Trichocereus puquiensis up to 4m high which grow in this area below 3700m altitude. They are named after the largest town in this area, Puquio, which happens to be the only place where it is possible to get overnight accomodation on this 500km long stretch. The stems of these Trichocerei are thickly overgrown with Tillandsia capillaris. And now our speaker was able to find Lobivias growing on the rocks between the cultivated patches at an altitude of 3,500m. They grew together with Opuntia subulata, Tephrocactus and dwarf shrubs. Until now no habitat for Lobivias was known in this area. At night it is very cold, even in the morning ice may still be seen near the road. In the evening Instorfer and his friends returned to Nazca.

TEPHROCACTUS SUBTERRANEUS — From P. A. Smart

My first plant of this species was purchased from Whitestone in August 1979. It was not on the part of the staging which housed the imported plants and probably had been part of a private collection – hence its origin was uncertain. The second plant also came from Whitestone in May 1980 as part of a consignment from K Knize. There were only four or five plants in the consignment; I purchased one of them, R Ferryman also had one of them and I believe that Roy Mottram kept the others for his own collection. The plants were labelled Tephrocactus sp. Escoipe.

On acquisition the first plant appeared to have a napiform root system. Backeberg illustrates a plant of this species in Abb 427 of his Lexicon but the photograph is rather poor. It shows rather odd marks like creases running round the stem – a feature which showed on my plant too. The second plant also exhibited this marking and had a long thin white parsnip shaped root roughly three to four times as long as the 20mm long growing parts of the stem. Its two stems both appeared to emerge from a previous single stem which had been damaged at an early date in its life. The epidermis of both plants was a dull greyish green of matt texture. The tubercles were not very prominent and were defined by a sharp crease or line in the epidermis,, with the tiny areoles placed slightly above the centre. At this time both plants had very similar spination, namely a few tiny adpressed bristly spines pointing downward like a beard as shown in the x4 sketch of the Escoipe plant. Apart from the flower both plants matched the Fries sketch and description in Britton and Rose.

During the winter of l981/82 the unfriendly behaviour of the C.E.G.B. resulted in all my glass houses spending some twenty four hours below freezing point – half this time was spent at 15-16° F! Some thin-bodied cacti were literally frozen solid. One Cleistocactus shattered into three pieces when tapped gently! The two Tephrocacti survived this experience as did nearly all the other plants – even including the three-piece Cleistocactus.

Roy Mottram visited me in 1982 and we discussed these plants. At that time my Tephrocacti were spread around the collection and not staged together. We tried to find the two plants in order that Roy could see their identical appearance. The Escoipe plant was easily found, its almost spineless grey-green stems being quite distinctive amongst neighbouring plants. The original T.subterranea could not be found anywhere. ·It had changed its outward appearance so much that we just had not recognised it. The spination consisted not of the few tiny adpressed spines it had previously exhibited but of long 'shaving-brush' tufts of pale buff-brown glochids up to 12mm long, though averaging only around 5-6mm. The newer spination however still exhibited the juvenile characteristics so that it was possible to compare the two plants and accept a very close relationship.

The original T. subterranea now fills a 4 inch pot and needs repotting. It consists of 12-13 small heads all similar in size and general outline to those of the Escoipe plant, although the older plant stems are roughly 20mm diameter – some 5mm thicker than those of the Escoipe plant. All the stems appear to grow from a common root crown and stand 35-40mm above the soil level.. There is no distinct central/main stem which hints at the plants being mat-forming rather than branching, though a few tiny offsets are formimg in the upper half of the stems. These tiny offsets have long glochid tufts at their growing point, not the juvenile spination previously described.

In early June of the same year, only a few weeks after making these observations, I was delighted to find T. subterranea in flower. Some of the tiny offsets mentioned previously had been flower buds. The temperature at the time was 100° F in direct sunlight and the air temperature was over 80° F. The flower consisted of basically two rows of rather broad, translucent shell-pink (not magenta) petals. These were distinctly spathulate and had a deeper, almost dark magenta, midrib. Very few of the petals could be regarded as sepals and were up to 11.3mm wide with a mucronate tip. The median stripe seemed to pull the tip of the petal slightly downwards, towards the flower centre, thus giving the impression of an undulate tip, almost notched – which they were not. The outer petals were just over 20mm long; the inner only slightly shorter. On taking the plant indoors to facilitate a description in cooler conditions the inner petals started to close up although the outers remained fully open in the shallow cup shape of the flower. The first flowers to open were low down in between the stems so it was difficult to observe the outside of the flower. There were long bristly spines at the base of the corolla, up to about 17mm long. The ovaries averaged 10.5mm in diameter and measured 8.7mm from plant stem to corolla.Their colour was slightly bronzed green and their shape was almost hemispherical. There was virtually no tube in the accepted sense. The areoles on the ovaries were inset and occasionally bore a few thin translucent rosy-brown undulate bristles. There was a fair quantity of brown wool around the base of the corolla.

The style was quite thick for a flower of only 45-50mm fully open, being 1.4mm diameter at a point 5mm below the stigmata. The colour was yellow below, shading to almost magenta pink in the top 4 to 5mm. The superior stigma lobes were some 7mm above the highest anthers and were creamish-white, some showing a very slight pinkish cast. This does not really match the "stigma reddish" of Backeberg's description. The filaments appeared to be inserted in two groups, one short ring near the base of the style and outer filaments which were longer and inserted nearer the base of the petals. The colour was generally creamy-white but in some flowers every fifth or sixth filament was a distinct deep pink/magenta.. These isolated coloured filaments were always at the centre of each petal base on the corolla ring. The filaments were 0.6mm diameter at a point 5mm from their bases and tapered very appreciably over their whole length. This taper narrowed to a minimum around 4mm from the anther and then the connective (at least I assume that it was) took over and tapered differently for the remaining few mm. I do not remember observing significantly tapering filaments on other genera and certainly not such a long conical connective. Is this usual in the Opuntia group? There is no reference to it in Backeberg or in Britton & Rose.

In attempting to measure the style I touched one of the outer (longer) anthers whereupon all the anthers in the outer ring curled over very quickly until they touched the style – as if to protect it (surely a pointless exercise with a superior stigma). The anthers moved through an arc of l0mm in 5 seconds. After about five minutes the anthers had moved back to their original positions.. Individual anthers ceased moving if they were touched during their movement or if they met another filament before touching the style.

Later in the year the flower remains were examined. I would expect the ovary of any Opuntia flower to resemble the stem section – and to remain turgid if not fertilised. However the ovaries on T. subterranea dried up like most cactus fruits do - and they did not contain seeds.

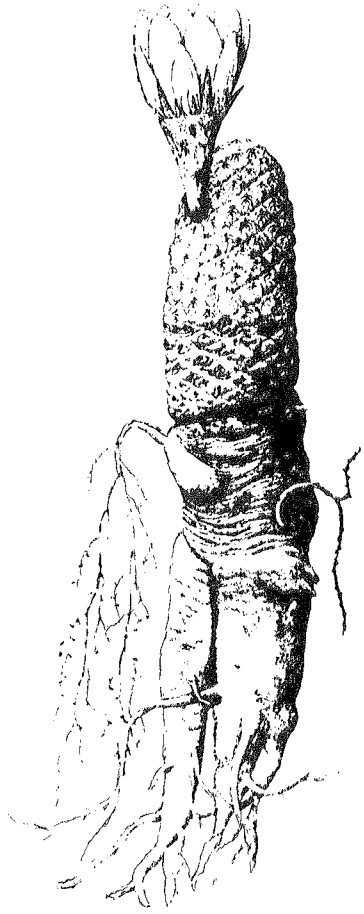
Backeberg's description of T. subterranea fits the stem of the Escoipe plant quite well as it would have fitted my T. subterranea before the growth of mature spination. ("Segments. spherical, l2mm long: spines 1-7 all radials, short. Tubercles 4-sided,flat"). The last comment is not quite right but when dehydrated in the resting state the tubercles do appear 4-sided to the casual observer. Backeberg goes on to describe the flowers as "brownish-white with a reddish tinge, 25mm diameter, sepals greenish, ovary slender, conical, spiny above". Although some of these characteristics fit my flowers the overall impression is generally different. Backeberg's notes on Opuntia variiflora however fit my flowers much better – and he infers a close relationship. Ritter's volume on Argentine cacti suggests that the two names are synonymous. I can only suspect that Backeberg described the two species from one plant with juvenile spination and another with adult spination – but where did he get the flower descriptions from? We know that he spent some time in this area. Could he have described another Opuntia flower by mistake, or did he copy someone else's description? The Fries sketch in Britton & Rose shows little of the flower but shows an ovary of an entirely different shape to the flower on my plant.

As I had never dreamed of flowering T. subterranea in captivity I must wonder what prompted it to flower. The previous winter had brought sub-arctic conditions into my glasshouses; the spring had been the hottest on record; and according to my records the plants had been dry since the previous October. Although the T. subterranea flowered on the 2nd June I had apparently not found time to get the hose-pipe out! Which, if any of these factors produced the flowers?

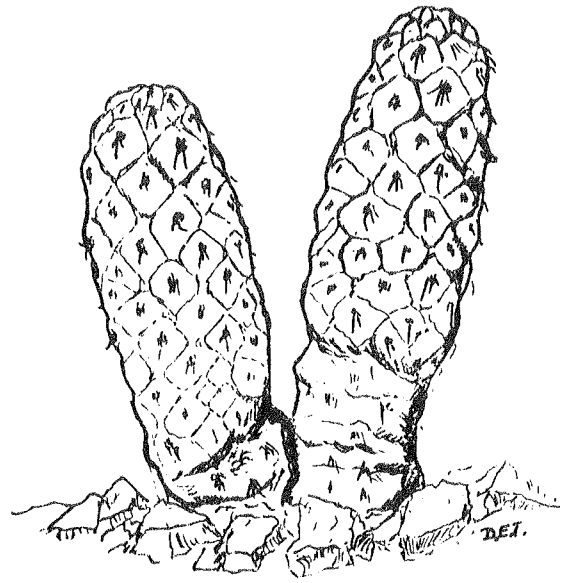
Fruit

Areoles

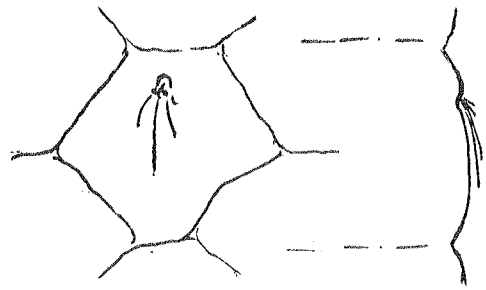
Glochid



Opuntia Subterranea
R.E.FRIES
Nov. Act. Reg. Soc. Sci. Upsalensis IV. 1. 1905

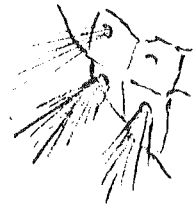


Tephrocactus sp. from Escoipe
Areole Detail x 4
Section & Front View



Opuntia Subterranea

Collection - P. SMART



Areole

TEPHROCACTUS SUBTERRANEUS

. . . from H. Middleditch.

Tephrocacti of the pentlandii type all have a far more markedly thickened rootstock than the great majority of other Tephrocacti; they are reported to occur near Vacas on the Santa Cruz road out of Cochabamba; near Tarabuco; near Potosi; and also from near Tupiza. The flower bud of T. pentlandii which is illustrated in Backeberg Die Cactaceae Vol.1 Abb 302 has the upright hairy spines rising up round the corolla from the upper areoles on the ovary, just as P. Smart describes for T. subterranea. The stout rootstock is also a feature of the plant of T. subterranea which was first discovered by Fries at Moreno. The reported location for KK collected plants of this type is at Escoipe which is 75 miles to the south of Moreno. The reported location for O. variiflora is at Villazon on the border between Argentina and Bolivia and is some 130 miles to the north of Moreno. The KK field number list includes KK 1306 O. variiflora from Potosi; this could mean Department Potosi, just over the border from Villazon, or it could mean the city of Potosi which is some 175 miles to the north of the border and into the reported distribution area for T. pentlandii. Thus an overall view of the high Andean Tephrocacti would suggest that in Peru and adjoining parts of Bolivia and Chile we find plants consisting of hundreds of heads forming large hummocks or mats; more to the south-east in Bolivia where the higher latitude and decreasing moisture probably combine to produce a rather harsher climatic regime, we find the pentlandii group of Tephrocacti with heads that are perhaps somewhat smaller and more closely packed together and in additon having a thickened rootstock; further still to the south where the climatic regime becomes even more harsh we find the T. subterranea/variiflora which is even more compact and the rootstock now forms an even larger proportion of the whole plant.

In the discussion of the genus Tephrocactus in Vol.1 of Backeberg's Die Cactaceae there would not appear to be any reference to irritable stamens. However, in Opuntiales v. Cactales, Castellanos and Lelong observe that "The stamens of Opuntia (all the species checked up to present) are irritable". This comment will no doubt include those plants which these authors consider to be Opuntia subgenus Tephrocactus.

A flower on a plant of T. strobiliformis seen and photographed by J. Lambert on the road from Cordoba to San Juan near the border with Mendoza province was a "delicate pink colour" which might suggest similarities with T. subterranea. However it may be recollected that Fries also discovered a plant of Rebutia which not only grew under the same climatic regime as T. inermis but also had a very similar appearance, with a thick rootstock as large or larger than the aerial part of the plant. Much collecting effort has produced Rebutias of this growth form which have flowers of various colours and one cannot help speculating whether similar collecting effort directed towards plants of T. subterranea/ variiflora would have yielded comparable results. An occasional pink filament among the creamy-white filaments was observed by P. Smart, located below the median stripes on some petals. I expect that the pink filament would be on a vascular bundle which branched from the same vascular bundle which conveyed the pigment to the centre of the petal, resulting in a similar colour for both.

. . . Further from P. Smart.

H. Middleditch's comments about the occasional dark coloured filament are almost certainly correct. A recent check on other notes made at the time show that the "root" of each petal was coloured a deep magenta red. The idea is quite acceptable botanically but why have I not noticed this odd feature in any other cactus flower? A deep colour on the median stripe in contrast with pale coloured petals is perhaps the norm rather than the exception in the Cactaceae and yet I have not noticed this phenomena before.

The sketch of O. subterranea in Backeberg's Lexikon still puzzles me. It is interesting to find this Fries sketch also used in Britton & Rose's Cactaceae – and again the same sketch is used to illustrate "a fleshy branched root" in Buxbaum's Morphology of Cacti. The plant body and root look quite realistic – and show the plant quite effectively for such a simple sketch. The flower on the other hand just does not look right; in fact it looks to be an afterthought! Perhaps Fries made only a cursory examination of the flower on a plant in the wild and relied on his notes for the later description?

Buxbaum, when commenting on the "large branched root" system of T. subterranea also made parallels with the root system of certain Rebutias. I have always been puzzled by the similarity between the general form of these Tephrocacti and those of the higher altitude members of the Rebutinae. Perhaps this evolved form of stout fleshy branched anchoring root and a mat-like group of stems branching from a root crown exists in all the cacti from such harsh climates?

. . . further from H. Middleditch

The cushion-like clumping habit is by no means confined to cacti from the high Andes. Years ago F. Horwood showed slides of succulent and non-succulent plants growing in arid parts of Somalia, having a similar compact cushion shape and dotted about an arid sandy plain pretty well devoid of other vegetation. At the Chileans Weekend we were shown slides taken by R. Ferryman of cushion-like mounds of Copiapoa dotted about the landscape in northern Chile; the further north the slides were taken, the less became signs of accompanying vegetation. In Patagonia, where the constant strong winds have a marked cooling and scouring effect, hummock-shaped plants are very common indeed. As the climate becomes harsher with increasing altitude or increasing latitude, the hummocks become even flatter and hunch nearer to the ground, just like conifers which grow close to the ground at the northern limit of trees and more upright as one then goes south. Hauman describes and illustrates Adesmia tabularis in the high Andes above Mendoza, with a thick wiry taproot and an almost flat mat of aerial growth. So I would be inclined to agree with the supposition by P. Smart that a mat-like growth is typical for cacti from such a harsh climate.

. . . from A.C. Hall

I have found that all the plants of the pentlandii group develop taproots, although the length and diameter of the root depends both on the species and on the amount of grit in the compost. I find that if two identical species are potted under identical conditions, except that one has a very gritty compost, then that one will develop a long and healthy taproot whilst the other will only develop a short stubby one.

. . . from J. Forrest

Having grown some of the carrot-like rooted Tephrocacti I have found them to be easy as long as you use an open gritty soil.

. . . from R. Ferryman.

The piece of Tephrocactus sp. from Escoipe that I acquired from Whitestone nursery is indeed still with me. It has not yet been out of its pot so I do not know if it has produced a thickened rootstock in cultivation. During the winter months it lives along with the other Tephrocacti above the polythene insulation, near the roof of the greenhouse. I suppose it is likely to be a bit colder there than it is for the rest of the plants in the greenhouse. Anyway the Tephrocacti seem to like the treatment as one or two of them have actually flowered.

OPUNTIA SUBTERRANEA R. E. Fries sp. nov. **By R. E. Fries**

Translated by H.Middleditch from Nov. Act. Reg. Soc. Sci. Upsalensis Series IV Vol 1 1905.

. . . from the Latin – Dwarf Opuntia, solitary or sparingly branching joints 1-2, short cylindrical with large cylindrical underground part; ribs divided into low tubercles spirally disposed; marginal spines 6-7 short, recurved, adpressed, lacking centrals; flowers from the side, dark brown; exterior of ovary without hairy covering, bristles and a few strong hairs in the axil at the base of the scales; fruit pear-shaped, glabrous.

. . . from the German — The largest part of the plant is buried in the sand, only the top with the flowers and fruit projects 1cm above the surface. Joints 1-2, green, 2-4cm long, ca. 1.5cm in diameter, short cylindrical, turgid, the lower part tapering gradually and changing gradually into the very thick root below which is provided with a single or with a pair of thick branches. The tubercles are roughly four sided, about 3 mm across, distinct at the top of the body, becoming indistinct further downwards in the older part of the body. Areoles elongated, 1 to 1.5cm long, covered with very sparse wool-felt. Glochids ca. 1mm long, in a bundle in the upper part of the areole, provided with backward-pointing barbs towards the tip. Radial spines 6-7, 1-2mm long, curved back against the side of the tubercles, reddish-brown, becoming white in the older parts and falling off. Flowers 1-2, located ca. 1cm from the top, 2.5 to 3cm overall length, funneliform. Ovary conical, shiny, with awl-shaped somewhat flattened scales, the lower 1mm long, the upper increasing in length up to 4mm; furnished with sparse hair in their axils and a pair of weak upward-pointing spines. The outer flower petals are tapering, pointed, the inner ones spathulate, pointed, 15mm long, 5mm broad, brown. The stamens reach almost up to a third of the length of the corolla. Style 18mm long, rigid; stigma lobes 7, 1 mm long. Fruit pear-shaped, shiny 12-15mm long, 8-11mm broad, flat on top. Seeds 3mm across. Seed-shell thick, rough exterior. Province Jujuy: Moreno near to Nevado de Chani in sandy plain, 3500m altitude; in flower 24 October 1901, Fr 836 – in fruit 10 December.

The species occupies a special position in the genus Opuntia and on account of its habit it is very reminiscent of the Echinopsis described above. However the presence of glochids together with the shape and the construction of the flower places this plant in the genus Opuntia. It is interesting to find that representatives of two so unrelated genera exhibit such similar habit under similar external conditions.

. . . from H. Middleditch. The "Echinopsis described above" is a plant that we would now include within Rebutia, which also exhibited a similar characteristic of having a large part of its body below ground level. That the two different sorts of plant did indeed look superficially similar in habit should not occasion surprise, since it is simply a matter of adaption to environment. Not long ago when walking in the Lake District we passed common Docks growing a yard high in the fieldside before we started climbing; well up the hillside we found on a glacial erratic a pocket of soil small enough to get lost in the palm of your hand – in it was growing and flowering a common Dock, with identical features to those in the meadow, but this time only two inches high. When standing three or four yards away it was virtually indistinguishable from plants of other genera growing in the same circumstances. If it was transplanted to the fieldside it would doubtless grow like its companions again. Is P.Smart's Opuntia subterranea showing a similar trait with its changing spines?

Just what are the conditions like under which this plant grows? Does the environment seem to be the cause of the form of growth adopted by this plant? Is this cactus species almost alone in growing in this manner in response to the conditions in the environment, or do other forms of vegetation growing under the same conditions also exhibit the influence of the environment?

CUMULOPUNTIA SUBTERRANEA (R.E.Fries) Ritt. comb nov

Translated from Kakteen in Sudamerika Vol 2. by H. Middleditch.

Synonym: Opuntia subterranea R. E. Fries
Tephrocactus subterraneus (R. E. Fries).Bckbg
Tephrocactus variiflorus Bckbg

I give a description in accordance with my own notes: body grey-green, sparsely offsetting from below, with 1-6 branches, sunk well down in the ground, so that in the wild the plants project only slightly above the ground; elongated cylindrical carrot like root with very few fibrous roots. Stem spherical or cylindrical, thinning somewhat at the end, about 15 mm thick and 30mm long; the stems are patterned with flattish tubercles, the patches of about 4mm diameter, somewhat rounded or almost rhomboidal, however not entirely enclosed but each patch is connected to the next above and the next below by a very narrow bridge; in this way more a less a dozen are to be seen in a line. Areoles at the centre of the patches, whitewoolly, ca. 0.5mm diameter, ca. 7mm apart, sunken, at the lower areoles bunches of short pale glochids, spines usually 2-7 only in the upper part of the stem, hair-thin, ca. 5mm long, pointing downwards and adpressed or lying close to the body, not stiff, white to pale brownish. Flowers (records of 4 flowers) lateral, scentless, 20-30mm long, 25-35mm wide open, closing quite early in the afternoon; receptacle top-shaped 10-15mm long up to the margin of the tube, with few or no areoles below,

at the top areoles with 2-3mm long triangular reddish green scales and with weak, whitish or reddish curved bristles of 1 up to 2cm long, without spines. Nectar chamber cone-shaped, honey yellow, ca. 1mm long, open. Tube 7-10mm long, white inside. Filaments carmine, white below, or only reddish at the upper end, lower ones slender 4-8mm long, upper ones 8-10mm long. Anthers oval, of golden yellow to almost white. Style white, reddish at top up to 1.5mm thick, more slender above and below, 13-21mm long, of which 1-1.5mm gives rise to the 4-5 cream to brownish-yellow coloured tapered stigma lobes clasped together or spreading. Petals 12-18mm long 6-10mm broad, narrow below, blunt above, pinkish carmine to carmine, occasionally pale pink or shading into yellowish-red. Fruit almost spherical ca. 15mm in diameter, with slender white somewhat curved 10-15mm long bristles around the deep fruit-bowl, not juicy. Seeds not known. Was identified by me near Villazon and La Quiaca on the Argentine-Bolivian border at ca. 3200m altitude upon the Pampa, rare. The type location is Moreno about 200km S.W. of there and ca. 50km west from Volcan near the border between Jujuy and Salta. FR 91.

Backeberg did not accept that I regarded this species as Fries' Opuntia subterranea and published it as Tephrocactus variiflorus. He wrote to me around 1960 that it did not tally with the sketch of Fries and that I had discovered a new species. In support of this..... he stated for his T. variiflorus that the tubercles were very flat and about twice as long as broad.....Backeberg may have based this observation on a specimen cultivated in inadequate light....My photograph shows that the tubercles are not so flat, are more or less as broad as long and below are broader than they are long, somewhat rhomboidal, just as they are reproduced in Fries' sketch..... If the statement of Fries about the flower was obtained almost entirely from the receptacle which had certainly not wilted, and in regard to the characteristic of the floral parts which had wilted, specifically "flower brownish", one would be able to conclude from that that he had probably not seen a freshly open flower. As is well known statements of flower colour are often unreliable, since as they wither they colour of the flower petals changes towards reddish or brownish, without that being taken into account if a fresh flower has not been seen.

. . . from H. Middleditch. There are one or two problems involved in translating this description and associated comments. It has been noted previously that Ritter uses the term Fruchtknoten – literally fruit-knob – where most authors would use either the term ovary or pericarpel; he includes this in his list of abbreviations in the introduction to his Volume 1 of Kakteen in Sudamerika; nevertheless the description for the fruchtknoten for this species appears to cover the exterior from the base of the flower to the base of the petals. From the comment made by P. Smart, that there does not appear to be any tube in this flower, it becomes possible to understand this part of the Ritter description a great deal better. Another somewhat uncommon terminology is that instead of the orthodox term 'hocker' for tubercles he uses the word 'felder' which is literally a patch or square. Now in regard to the environment in which this plant was found, when Ritter says that he found this plant on 'the Pampa' near Villazon he means the more or less level, high altitude, extensive open terrain commonly described as Puna.

The description given by Fries includes the date on which he found the plant in flower, in accordance with good practice for the description of a new species; Ritter does not give a date for his flower observations. If he had done so it could have been very useful in assessing the probability of Fries' flower observation being late in the flowering season. In doing so, account would need to be taken of possible shifts in the timing of the season due to change of location and a different year. The observation that the flower closed early in the afternoon would suggest that it is programmed for a climatic regime of afternoon thunderstorms, which have been noted by a number of travellers to be a regular feature of the high Andes.

A CONTRIBUTION TO THE KNOWLEDGE OF THE ALPINE FLORA IN NORTHERN ARGENTINA **By R.E.Fries**

Translated from Nova Acta Regiae Societatis Scientiarum Upsalensis Ser.IV Vol.1 1905, by H. Middleditch

The work published here has originated from a journey which I made as a botanist with the Swedish Chaco-Cordillera expedition of 1901-02, to the plateau which lies in northern Argentina and which carries the name Puna in these parts. This forms a part of the great plateau which stretches from the Titicaca basin in the north, southwards through Bolivia into northern Argentina, and which is divided by higher or lower mountain chains into several enclosed basins having no outlet for the surface water. One of these is the area in which I have had the opportunity to travel.

The area lies principally in the province of Jujuy; only the southernmost part of it belongs to the province of Salta. It has a length of around 280km and a breadth varying between 60 and 100km. Separated from the territory to the south by the 4800m high mountain pass Abra de Acay, the plateau extends in a nearly northward direction to the Bolivian frontier; not far from there it is effectively cut off from the Bolivian altiplano to the north of it by a watershed in the form of a low-lying ridge of hills. The eastern boundary, formed by an irregular chain of mountains, some very high, is defined by a line through the Abra de Cortaderos, Abra de la Cruz, Abra de Tres Cruces, Serra de Aguilar, Abra de Lipan, Abra del Angosto, Nevado de Chani, Abra del Palomar as well as Nevado del Acay.

Only a few botanical investigations have previously been undertaken within this area. The first was that of P.G.Lorentz and G. Hieronymus in the year 1873. Starting from Jujuy the itinerary was through the Quebrada de Humahuaca and passed Cangrejillos and Yavi upon the road to Tarija. They only touched a portion of this area, the northernmost part, although the collection which they made there and mainly in the adjacent region of the cordilleras has always formed the basis for our understanding of the Flora of this region. It was studied by Grisebach and published in his work: Symbolae ad floram argentinam. Grisebach carried out this work in the later years of his life when his eyesight had become impaired, and various errors have crept into it. A revision of this work is essential. In 1897 this area was visited by Prof. C.Spegazzini but only a couple of species descriptions were subsequently published.

On 6 October our expedition set out from Salta. The route lay along the Quebrada del Toro and over the Abra del Palomar towards Moreno, which we reached on the 15th after some brief halts en route. This tiny spot, 3480m above sea level, was chosen for our base camp. We stopped there for a couple of months and from the surroundings originate most of the observations and the largest part of the collection. However these were completed by longer or shorter excursions i.e. to Laguna Colorado, to San Antonio de los Cobres and Cuesta del Acay; to Huancar at the southern end of the Salinas Grandes, and to the Nevado de Chani. On 26 December we broke camp at Moreno, crossing the Puna northwards via Alfarsito,

Casabindo, Miraflores, Abrapampa and Cangrejillos, so that we arrived at Yavi on New Year's Eve.

Terrain and Climate. The area in question here lies to a great extent approximately 3500m above sea level, whilst the surrounding mountain chains are often of an imposing height. The plateau itself consists of an almost uniform sandy plain, formed of fine sand or stones, and often without the slightest interruption, without the slightest rise or fall for miles. Certainly here and there lies a chain of peaks, or a hill arises, or the monotony will even be interrupted by a deeply entrenched gulley of a stream; however such interruptions do not occur often. Around the plain the mountain chains reach a more or less imposing height, with occasional dominating peaks. The highest of these are the Nevado de Chani and Nevado del Acay, both covered with perpetual snow on their uppermost heights. On account of the great dryness of the atmosphere, the snowline in this area lies at a very high altitude – around 5800-5900m on the Nevado de Chani.

The mountain chains are formed largely of Granite, Trachite, and Quartzite. Generally they are rounded shapes; steep slopes are rare, possibly absent altogether. In consequence shady spots occur infrequently and hence shade plants are almost completely absent. The mountain slopes, where the solid rock is not exposed, is generally covered with larger or smaller stones or gravel; sometimes the slopes are even covered with sand, just like the plain. In some spots greater or lesser patches of loose sand occur, sometimes extending to over several thousand square metres. In sheltered places the finest, most easily movable sand has accumulated into dunes.

One of the distinctive features of the area is the widespread existence of salts. these are leached by the rainfall from the sands of the plain, carried down the streams into the middle of the elevated plain and accumulated there. On this account the water in the streams is always more or less salty. Although usually quite drinkable, the banks of the streams are very often coated with a thin crust of salt due to evaporation; other streams are so salt impregnated that they are quite unusable as drinking water. At the centre of the plateau immeasurable amounts of these salts have gradually accumulated in an immense salt crust spreading over several square miles, the Salinas Grandes, looking just like a frozen lake covered with hoar frost. During the rainy season part of the Salinas becomes a shallow lake, impregnated with salts. The sandy margins themselves are so encrusted with salts over broad stretches that they give the impression that they have been frosted, and crackle underfoot.

No humus formation takes place in this region, with the exception of damp places with denser vegetation, where a veritable peat formation exists.

Only the barest of meteorological data are available to be able to give an idea of the climate. Continuous records are available only from Cochinoca, a place in the northwestern part of this region lyimg at a height of 3732m. Unfortunately they do not cover a full year (they run from 1 June 1881 to 4 April 1882); the data from these records yields the following averages for temperature:-

	J	J	A	S	O	N	D	J	F	M
°C	8.37	6.77	8.03	12.67	15.35	16.64	14.31	15.65	15.53	14.13

Whilst at Moreno I took some observations relating to the fluctuation in the temperature during the course of the day; the average was:- 8.00am – 10.9° C; 1.00pm – 18.3° C; 7.00pm – 10.45° C. On one occasion a short, sharp hailstorm at around noon dropped the temperature down to 7° C at 1.00pm. During the night the temperature drops significantly, very often down to below freezing point. This happens very frequently, particularly during the winter months; but also in the hottest season, during which I stayed there, the water was repeatedly encrusted with up to 1 to 2 cm thickness of ice early in the morning, although shortly after dawn this quickly melts away. These frequent night frosts are obviously of outstanding significance for the vegetation.

The data presented here refers collectively to the Puna plateau. Naturally conditions differ on the surrounding high mountain chains and peaks. The temperature is lower there and the frost more frequent; I noticed that the mountains around Moreno were repeatedly covered with snow early in the morning, which remained lying there until not far off noon. Even in November and December the snowcover occasionally stretched along the slopes almost as far down as the Moreno plain.

The rainfall in the region is sparse. Observations by Lavagna at Cochinoca provide a good picture of the amount and distribution of rainfall within the Puna:-

	J	J	A	S	O	N	D	J	F	M
mm	0	0	0	0	3.7	27.2	10.6	89.9	41.2	34.7

From this becomes apparent the marked difference between a dry period from June to September and a rainfall period which falls in the summer months. During the first period there was virtually no rainfall in the year in which the observations took place, which was said to be generally the rule. The observations above amount to a total annual rainfall of somewhat more than 228mm. In addition an examination of Lavagna's records show that the rainfall was spread over 38 rainy days and that the heaviest rain on one single day (9 Jan) amounted to 33mm.

Rain showers in the Puna often appear as accompaniment to the extraordinarily frequent and fierce thunderstorms and indeed they are then very sudden and violent. As mentioned above, the precipitation often appears as snow at greater altitudes, occasionally even as hail too and indeed I observed just this even in the hottest period in December.(Tables of atmospheric humidity follow, averaging approximately 50% relative humidity over the two weeks' period of observation at Moreno, and averaging some 30% for the dry season and some 60% for the wet season for Lavagna's observations at Cochinoca, where the minima average some 9% for the dry season and some 30% for the wet season). This data does indeed point to the quite significant dryness of the air, although this is not especially remarkable. However it is to be noted that the humidity often drops to a really low value, which in conjunction with the often fierce winds must play an important role for plant life. The air is indeed so dry that the skin splits and peels on the face and hands where these are unprotected from the drying winds and exposed to the burning sun shining down from the almost invariably cloudless sky. It is

also worthy of note that the dead bodies of animals do not decompose, even those of animals as large as horses and mules, but shrivel up to dry mummies, which are often to be met with on the trails over the Puna. In "Clima de la Republica Argentina" 1902, G.G.Davies observes "In the Andine region the effect of the direction of the wind on the humidity varies according to the situation of the place with respect to its neighbouring hills, valleys and mountain ranges.

The winds often blow across the treeless Puna plain and the slopes of the mountains with unprecedented vigour, since no kind of obstacle confronts them. Only the narrowest of valleys are sheltered from their brunt, and hence from their dessicating influence; only there can the more tender plants prolong their existence. The wind direction depends largely upon the orientation of a site with respect to the surrounding mountain chains and is consequently different at each individual place in the region. Around Moreno a north wind comonly prevailed, at least during our abode there, which quite naturally followed the valley which extended southwards from Salinas Grandes towards the Abra del Palomar. Near Cochinoca it appears from the the observations of Lavagna spanning 304 days that the east wind predominated. Around Moreno the mornings usually remained calm; towards noon or in the early afternoon a north wind then arose which often raised a vast amount of dust. Whirlwinds are very frequent in the Puna zone and one often sees there high columns of fine sand lifting away and whirling upwards over the plain, ocasionally even two at the same time, at some distance from each other.

The barometric pressure naturally plays a not insignificant role for the plants in this greatly elevated terrain. The average barometric pressure at Cochinoca at 3732m altitude amounts to only 491mm and approximately the same condition applies to the remaining localities over the high plateau.

The Plant Formations.

The meteorological conditions described above give rise to an Alpine Flora and where no edaphic factors are involved, this is a markedly xerophytic flora. Naturally the intensified rarifaction of the air and exposure to light at greater altitudes in company with the more harsh climate exert their influence in such a way that above a certain altitude (which can be defined as 4500m) we come across the Azorella formation which differs in its habit and its species make-up from the Formation of different composition which occupies the relatively lower lying areas. Higher up, at a height of 5000 to 5700m this in turn has to give way to a sterile lichen waste. Apart from the foregoing, only edaphic factors have an influence on the distribution of species into different plant formations. On the whole, similar edaphic conditions appear to give rise to identical plant formations over the whole region; however it appears that conditions in the north produce somewhat different results, since some species occur there which seem to be absent in the remaining part of the region.

The edaphic factors which bring about the division into formations in the region consist of the moisture content of the ground as well as upon the chemical composition and the physical make-up of it. In most places the varying moisture content of the ground is dependant upon the descending streams. Here we meet with an impressive hydrophylic flora. In addition it passes on its moisture to the surrounding ground, to a greater or lesser extent in accordance with the local conditions, so that it generates a sort of moist meadow. If the watercourse carries with it a fair amount of salts, then instead of a meadow halophytic marshes can occur in many places, in which an xerophytic flora has arisen because of the salt content.

However watercourses only occur rarely in the Puna zone and undoubtedly the largest part of the zone consists of arid ground. Its vegetation is divided into several formations in accordance with the physical make-up and chemical composition of the ground. The sandy, stoneless ground of the high flat plain is occupied by a shrub formation (the Hoffmanseggia formation), readily distinguished from the cactus formation which occurs on the high plains covered with stones, or occupies mountain slopes with similar surface cover. On the moving sands are to be found a couple of formations, the presence or absence of salts in the ground apparently being significant for the variation in the formations. In contrast to the four foregoing formations is that of Spirobolus arundinaceous and of Lepidophyllum. The first occurs on the sandy salt-saturated banks of the Salinas Grandes, the latter occupies less salty and more marshy ground. These are briefly the plant formations which I believe must be distinguished within this region.

The Hypsela formation.

Extremely compact, low growing greenish looking meadows occur along all the streams within this region, alongside them or even spreading out to a greater or lesser degree in suitable locations. From one of their characteristic plants this can be designated a Hypsela formation. Moisture on or close below the surface of the earth, consisting of fresh or only slightly salty water, is necessary for their existence. However this can be up to several metres wide according to the nature of the stream margins which means that it stretches as wide as the water of the stream shares its moisture with the adjoining ground. In consequence the Hypsela formation is narrow in the places where the banks of the stream are steep but where they are flat it broadens out into small meadows. This formation is found both on the plateau and at the highest altitudes up to as far as 5000m. The combination of species is generally similar at the various elevations, although some species which appear at greater altitudes are absent at altitudes of between 3000 and 4000m.

There may be quoted from habitat record an example of such a meadow of around 10,000m in extent near Moreno. The ground was fairly moist, but no more than one was able to cross it unimpeded and dry shod. From a dense carpet of grasses, Hypsela oligophylla and other species, the stalks of Juncus reached as far as 200mm above the carpet of grass. This hypsela formation is distinguished by the species belonging to it being green over the whole year; on account of their green freshness they contrast sharply with the more or less grey colour of the remaining vegetation. They are also characterised by their extraordinary compactness and by having a strongly developed subterranean system, as well as by the overground parts being reduced to a minimum. Apart from the two reeds, which attain a height of 100 to 200mm, the height of the overground part of the species in a typical Hypsela formation extends only to 10 or 20mm above the level of the soil.

The rosette form occurs almost exclusively and is more or less predominant. The flowers or infloresence are carried on quite short stalks, 40mm on a Ranunculus, 10-30mm on a reed, 20mm on a grass, or the stalk is missing altogether. Of particular importance is Hypsela oligophylla, whose leaf-stalk lies largely below ground level and indeed so that the small oval shoot is barely raised above the surface, and whose flower sits on a short stalk barely 5mm long and is scarcely raised above the level of the ground, below which the lower part of the flower tube is concealed. There is also Plantago tubulosa, whose diminuitive one- or two- blossomed spicules are set as good as stalkless in the axils of the rosette leaves.

This situation of stalkless flowers or inflorescences being enveloped in such a compact carpet of plants

appears to be unfavourable for pollination and seed distribution. With Crantzia lineata and Hypsela oligophylla I observed that pollination was accomplished by ants which crept all around on the ground and with the latter by flies as well. The ants crept completely into the Hypsela flowers, the flies dipped only the front part of their bodies inside; the pollen was smeared on the back of the visitor. The flowers are protandrous; the opening of the anthers takes place in the manner customary with Lobeliaceae. Ranunculus cymbalaria is visited principally by small ants but also by small flies; Heterothalmus acaulis only by flies. Despite diligent investigation I never once saw a visit by insects to the protogynous flowers of the Mimulus spp., which are constructed for typical entomophilic pollination and furnished with irritable stigma lobes. In old flowers the lobes of the stigma are less iritable and inaddition the filaments elongate so that the anthers come to lie at the same height as the stigma, so autogamy is made possible.

For anemophilic pollination, Plantago tubulosa is well arranged; it exposes its anthers above the carpet of plants by means of 20mm long filaments just like the situation with Litorella. For the purpose of exposing the fruit, the stalk of the flower or infloresence becomes extended during the post-floration period, where it is necessary. In Cotula pygmaea the flower heads stand almost stalkless during the flowering period; up to ripening of the fruit the stalk grows up to 15mm long. In addition in Hypsela oligophylla the length becomes extended several times and it thereby raises the fruit more or less, if not completely, above the surface of the ground. With Plantago tubulosa and Gentiana podocarpa the position is comparable; however the part lying between the calyx and the ovary (Gynophor) is particularly elongated here, in the first plant by 20 or 30mm, in the second by 20mm in length.

Plants with lengthy extended overground main axes are not completely absent, but have their branches procumbent, creeping along the surface. Cotula pygmaea has a strong, creeping, overground stem some cm long, withering from behind and with internodes that are up to 15mm long, commonly much shorter; these are anchored by means of bundles of strong roots starting from the nodes which are more than 100mm long. With mimulus spp. the growth is similar but here the internodes are more widely separated and can be up to 70mm apart. Cardamine flaccida also has its branches lying above the surface of the earth and almost horizontal. Ranunculus cymbalana has stolons which radiate from the leaf rosette, that reach a length of 200-300mm and then take root. The stolons are produced from axils of the lower leaves.

The subterranean parts are strongly developed. Only a couple of spp. are annuals which grow as a dense, compact turf. All the remaining spp. of this formation are perennial and are of a different habit. Hypochaeris stenocephala has a strong tap root occasionally measuring up to 10mm in diameter. Quite a number of spp. possess bunches of branching roots which may be as close as 30mm below the surface. The reason for the firm carpet which characterises the Hypsela formation is in consequence of the branching, creeping, astonishingly intertwining rhizomes of these latter spp.

The Hoffmanseggia, Cactus, and Azorella Formation.

It may be appropriate to consider these three formations together. They all occupy an enormously extensive area of the Puna and taken together they confer a characteristic impression. They are all xerophytic bush formations and have numerous species in common. However they are clearly diferentiated by the presence or absence of some characteristic plant forms.

The Hoffmanseggia formation is confined to sandy ground and occurs where the sand is not so fine that moving dunes arise. They occupy the high plain proper as well as the mountain slopes, which are covered with fine sand or fine gravel. All stony and rocky areas are occupied by the Cactus formation, especially the mountains which arise from or around the high plain, but in addition cacti occur wherever the ground is stony. Although these two sometimes form a transition formation, nevertheless they are generally remarkably well demarcated between each other. Usually one can observe the characteristically sharp boundary between them where stony hills adjoin on to the sandy plain. Possibly the distribution of cacti themselves are most easily recognisable.

In comparison the Azorella formation is less sharply defined. It is associated with the highest altitudes on the mountains and restricted by the more rigorous climate prevailing there, so diverging in its spp. composition and physiognomy that it is quite practicable to consider it separately from the Cactus formation. However a sharp boundary between the two does not exist but both merge imperceptibly into each other. This takes place at different altitudes in different locations, so that a boundary height is difficult to establish. This may run at between 4000 and 4500m height above sea level.

On account of their overall physiognomy the three formations can be designated as "bush-steppes". The Hoffmanseggia formation is partly bushes, partly herbs, and a couple of grasses. The bushes are all between barely 0.5m up to 1m high and stand apart on the sandy ground, from half up to two meters apart, the sandy ground between them being quite bare. Only a few herbs and grasses are to be found in these gaps; they are sparse and rarely influence the physiognomy of the vegetation. The Hoffmanseggia formation is not a closed formation: the white sand is conspicuous everyhwere. Mosses and lichen are completely absent. The composition by species varies greatly from one place to another. At one place, one or two species of shrub may predominate; at another, other species can influence the overall impression.

In its general phsiognomy the Cactus formatgion very closely resembles the foregoing Hoffmanseggia formation just portrayed and exists as a stony bush-steppe. This is composed of a mixture of shrubs, which have a branching and often spiny appearance like the bushes in the Hoffmanseggia formation, but they vary more in respect of height from 1m down to only 10 or 20cm, usually diminishing in stature according to the elevation of the hill or mountain. they occur sparsely and solitary, arising from between the stones laying on the earth or in clefts in the rocks. The herbs are more numerous both in species as well as in numbers of individuals, but they do not form a continuous ground cover here either. Occasionally mosses are to be found here and there between the stones, without affecting the physiognomy of the formation. The same holds good for some crustaceous and foliate lichens growing upon stones, which frequently occur in abundance where the substrate is solid rock. The abundant appearance of various sorts of cacti perhaps most of all certainly differentiate this formation from the others and is the reason why I chose to identify it by this name. Opuntia are found here, forming either carpets or else growing in dense, hemispherical, meter-wide heaps as well as solitary, spherical, Echinocactus spp. and in certain places the columnar 5-8m high Cereus pasacana, the tallest plant in the region, occurs in great numbers.

As an illustration of the plant associations in the Cactus formation the following two examples must serve:-

1. On a stony hill near Moreno, about 3500m altitude (November 16). The bushes are 10-50cm high and comprise: Fabiana denudata, Lycium fragosum, L. confertum, L. decipiens, Chuquiraga atacamensis, Bougainvillea patagonica, Ephedra americana, Verbena seriphioides; demi-bushes consist of:- Baccharis petrophila and Salvia gilliesii. Grasses: Trioidia avenacea. Here and there occur carpets of Opuntia spp. and scattered Echinocactus spp. In addition Tillandsia pusilla is usually found as a drapery on the older branches of the bushes. Lichen and mosses are scarce, growing in clefts between the stones.

2. On a sunny mountain slope near Huancar, in the vicinity of the southern end of the Salinas Grandes, ca. 3400m altitude (November 20). The slope consists of greater or lesser angular stones or partly of massive rocks. The clefts or even the narrow gaps between the stones are filled with fine sand. The vegetation consists of the following bushes:- Chuquiraga atacamensis, Heterothalamus boiliviensis and Patagonium sp. (all abundant); of cacti, Echinocactus sp. and Opuntia sp. (scattered), Opuntia grata (isolated); as well as the following demi-bushes, herbs and grasses: Salvia gilliesii, Panicum friesii, Pennisetum chilense and Pappophorum caespitosum (abundant); Acanthonychia polycnemoides and Pelloea ternifolia (sparse), Diplachne dubia (isolated).

In certain places, on more or less steep, sheltered rocky outcrops and in company with extremely sparse humus, an association of species is supported between the stones at the foot of the cliff, composed of plants in addition to those listed in the foregoing examples.

Although the region lies generally above the tree line, trees are not completely absent. In suitable places there may be seen some representatives of tree-forms that occur in association with the Cactus formation. There is the small characteristic alpine tree Polylepis tomentella, also the "Quenoa" which occurs in small copses in especially sheltered spots in narrow, calm valleys. These "Quenoales" are scarce, however; I know them only from the area of Cochinoca and Rinconada according to the statements by other authors; I myself have had no opportunity to observe them. Polylepis tomentella is a smaller tree of ca. 5m in height, with an irregular, gnarled trunk and three-pronged or pinnate leather-hard leaves with woolly hairs, especially on the underside. The bark which covers the branches is peculiar to this tree, being formed of a thick layer of thin, brown, membranes lying loosely one upon the other and between which windless spaces may be found.

Passing on to the Azorella formation, as already indicated this will be found to agree closely with the Cactus formation of which it forms a dwarf edition, so to speak. It is also formed of bushes of unpretentious height (only 20 or 30cm). Tetraglochin strictum was seen to be quite common. A significant component of this bush formation, especially in the parts at somewhat higher elevations, is formed by the strongly aromatically scented spp. from the genera Senecio and Werneria (S. graveolens, S. trifurcifolius, W. lorentziana and W. rosenii) which are furnished with succulent leaves and stems, in addition to dwarf bushes of dense cushion-like growth such as Pycnophyllum bryoides, dwarf Verbenas and above all Azorella monanthos. Especially noteworthy is the interesting Leguminoseae Patagonicum occultum, a dwarf bush whose thick, irregularly twisting and contorted branches lie entirely in the earth; small rosettes of leaves and stemless flowers barely rise above the level of the ground; this plant occurs commonly on the slopes of Mount Chani. Grasses comprise a most significant component here as in the Cactus and Hoffmanseggia formations; they occur as bunches, a couple of dm in height and are distinguished by their sharp, stiff leaves. In certain places they occur virtually on their own together with only a few small herbs or with even smaller grasses between them.

(Fries then lists 149 species of which 39 or 26% are found in the Azorella formation, 56 or 38% are found in the Hoffmanseggia formation, and 93 or 62% are found in the Cactus formation. Many species occur in more than one of the three formations)

As already indicated above, the climate in this area is characterised by a clearly distinguishable dry period from June to September; this falls entirely within the cold season of the year and alternates with a relatively more rainy and somewhat moister season. In the first season the climate exhibits an extraordinary aridity, so that xerophytic adaption by the flora is necesary, certainly in all places where no edaphic dampness occurs. In the warmer part of the year, the summer season, the humidity of the air does not drop to a value as low as we recorded there in the winter; it is not less than we have here in Sweden in Spring, which is our driest period of the year.

Within the Hoffmanseggia, Cactus and Azorella Formations are to be found many species which have adapted to the annual distribution of moisture and indeed drop off all their transpiring surfaces in the dry season. In the case of the bushes this appears as leaf fall in winter and the development of new leaves at the start of Spring. The Flora must be studied during the winter season in order to determine which species drop their leaves, which I have not been able to do, since my residence there was at the time when the first signs of Spring were appearing. In the case of the herbs these display a similar behaviour in that many heads wither down to the ground, such as Heliotropium brachystachyum, Hoffmanseggia gracilis, etc., which all have perennial rhizomes. Overwintering can also take place by means of underground tubers or corms; to this category belong numerous representatives, such as Solanum infundibuliforme, Oxalis elegans, Portulacea rotundifolia, Peperomia peruviana, Amaryllidaceae and Allium spp. The most significant category within the periodically green plants is perhaps constituted by the annuals; but it is not always easy to be sure whether one is dealing with an annual, or a biennial. I would believe that there are no less than 35 species of annuals in these three formations.

It is self-evident that the aforementioned species do not have their assimilation surface area protected as much against trnspiration as the evergreen species, since a sufficient degree of xerophytic adaption is brought about by the drynes of the air in conjunction with the frequent winds. If for example we compare the aforementioned composites, Eupatorium and Stevia, with the winter-green Chuquiraga species, with Nassavia axillari or with both species of Baccharis – B. polifolia and B. grisebachii, the more slender, more dishevelled and larger leaf of the first strikes the eyes at once. Similarly comparisons can also be drawn in other families; for example there can be considered within the Umbellifera the deciduous Bowlesia pulchella and the winter green Azorella monanthos; within the Caryophyllaceae, the annual Drymaria cordata and the Pycnophyllum species furnished with small scale-like leaves reminiscent of withered moss. These also stand out in respect of their anatomical form, to which I will refer anon. It could not be denied that the examples quoted here have been deliberately chosen; however, they do show that a part of the less xerophytically adapted residual species can effectively

tolerate the climate if they reduce their transpiration area during the most severe season. However one cannot ascribe these plants to the Tropophytes, viz: to those which are xerophytes in one season and hydrophyte in another, although they form a transition to this group.

A few words must now be said about the remaining significant types of plants within the three plant Formations being considered here. It appears to me to be superfluous to describe these in full detail since this aspect has so often been the subject of close attention recently. Meanwhile I believe I may be allowed after all not to neglect entirely some significant types which are characteristic for this region since they imprint their stamp more than any other as a plant type upon the remaining vegetation formations in the zone.

As one could expect, a very notable development of the subterranean systems is a common feature. Usually a strong, permanent post-like root is to be found growing straight downwards. As an illustration for this may be cited the root of a Fabiana bush which was directed perpendicularly downwards for over 2m in length whilst the aerial parts only attained 20cm. A species of Trifolium matthewsii possessed a plant root of at least 40cm in length and of 1cm in diameter, whilst the trunk which lay above the ground amounted only to 1.5cm in length. Of the numerous herbs with stronger post-like but not enlarged roots may be quoted: Heliotropium brachystachyum, Portulacea perennis, etc. It is of material interest to compare the variation in the occurrence of this type of plant growth in various formations. Outside the three formations considered here, it is either rare or completely absent. In the Puna the post root type of plant appears to be confined exclusively to the xerophytic bush formations in firm (not movable) ground and in this formation it forms a very significant component.

Where the main root perishes, a bunch of adventitious roots develop, often very long and robust. for instance this is especially the case with a series of grasses growing on stony hills, in crevices in rocks, and between stones. A bunch of long, strong, white unbranched adventitious roots extend from the base of the stem. An individual Pappophorum caespitosa, whose halm did not reach 10cm in length had adventitious roots of wellnigh four times that length. It hardly requires to be even mentioned that these stretch out in this way to the deeper subsoil just like the long post-roots going down deep to where they find and draw up the moisture.

In regard to branches, we find these projecting semi-upright in the herbs as well as with the rosette type plant and also in those with extended internodes which lie partly on the surface of the ground. The last-mentioned occur but sparsely and to these belong e.g. Stevia minor, Mentzelia parvifolia, and Cajophora heptamera. Very often leaves lie pressed close to the ground and where flowers with stalks or infloresences occur, these also lie pressed close to the ground. Excellent examples of this are offered by Trichocline auriculata and Hoffmanseggia gracilis. However perhaps the most common are the species furnished with branches lying on the ground and with elongated internodes; these occur frequently among the shrubs – Mitrocarpus brevis, Solanum pulchellum, Heliotropium brachystachyum, Alternanthera microphylla, Guilleminea sp., etc., and make up the larger part of the annuals.

Lignose plants are represented in extraordinary numbers. Taking the demi-bushes all together from all the Puna formations their number amounts collectively to about 90; they also make up no fewer than about one quarter of the total number of species in the region; within the Hoffmanseggia, Cactus and Azorella formations they are also especially numerous. The occurrence of the only representative of tree-like growth, Polylepis tomentella, has been mentioned above. All the other lignose plants are bushes or demi-bushes. The tallest, Prosopsis ferox, attains a height of about 2m but occurs so rarely (in both the Hoffmanseggia and Cactus formations) that it plays an insignificant role. On all my excursions in this area I came across a couple of examples, and then always isolated. Apart from these, the bushes usually attain a height of one half to one meter, excluding the more elevated parts of the mountains as well as exposed windy locations on the crowns of hills, etc. There are bushes of various different families; most significant are the Composites, the Legumes, Solanaceas, the Verbenas and the Rosaces, and indeed roughly in that order of importance.

The bushes are particularly characterised by crooked and twisting stems; these stand upright on the plateau, whilst on the mountain they often lie lower and hug the ground more closely. Their stems possess a more or less irregular cross section, often very oddly shaped; these are often flattened and of ribbon-like appearance or irregularly cleft, which is sometimes due to the branch growing for some distance alongside the main stem and subsequently separating from it, particularly in Lippia hastulata and Patagonium species.

Several bushes attain a cushion- or pillow-shape on account of short offsetting growth as well as by repetetive branching, often displaying a dense and compact growth, although this type is not physiognomically prominent in any noteworthy fashion, in any event not in quantity, as one often finds it stated in descriptions of the Puna. To name a few which belong to this type:- a couple of Verbena and Patagonium spp., two species of Pycnophyllum which grow in less-compact cushions, but above all the Umbellifera Azorella monanthos, whose hummock can attain over one meter across and around half a meter in height and which are so compact that the tips of the shoots can only be separated with a knife or axe. Even two cacti, Opuntia grata and O. andicola, form almost meter broad, hemispherical compact cushions.

The frequent occurrence of especially short assimilation shoots in which one must see an xerophytic nature, is to be emphasized, of which the Patagonium spp., Prosopsis ferox, Bougainvillea patagonica, etc., may be offered here as examples. These often occur in association with some Prolepsis, such as Nassauvia axillaris, Verbena spp., Tetraglochin, etc., whose leaves have changed almost all their longitudinal growth into thorns which bear short assimilating shoots. At the extreme are the close packed small leaves reminiscent of the top shoots on Azorella formed by Nassauvia sp. and Verbena seriphioides.

The bushes of the three formations are often spiny, which certainly tends to be the case in arid regions. The spiny species are certainly not preponderant, but are usually prominent on account of the greater number of individuals. In the Cactus formation there is a greater abundance of spiny cacti in addition to the foregoing, as a result of which the vegetation has a predominantly spiny habit. The spinyness arises in various sorts of ways. In Nardophyllum armatum, Proustia pungens, Lippia hastulata, Fabia friesii, Lycium decipiens and L. fragosum the tips of the ordinary branches rigify into thorns. In certain Patagonicum species and in Bougainvillea, specific short growths are produced for that purpose; in other Patagonium spp. e.g. P. clarenii, P. nordenskioldii, the axis of the infloresence almost turns into a thorn. In other plants, such as Chuquiraga spp. and in Mulinum ulcinum, all leaves are pointed and sharp; or only certain leaves become developed into spines, such as

Verbena spp., Tetroglochia, etc. In Prosopsis ferox the bracts become developed in that manner.

Because of the dry climate the transpiration surfaces are naturally much reduced. However it would occupy far too long here to consider all types of leaf which are to be found among the numerous species; in addition it would be more or less a repetition of what other authors have been saying in reference to xerophytes in general. Hence it may be enough to note that leaves are commonly of small size, usually of a stiff and leather-hard consistency – particularly in the bushes, that in addition succulence occurs with extraordinary abundance (of which more below). Needle-like, thread-like, and scale-like leaves are common, as also are leaves with rolled-up or rolled-back leaf margins. Leaves periodically rolling up with each other are common amongst the grasses. Entirely without leaves are Ephedra americana v. andina and Fabiana denudata. As already indicated above, numerous species also drop their transpiration surfaces in the most severe dry period.

In regard to the provision of hairs, it is to be noted that not infrequently adpresed silken hairs occur as well as woolly hairs. Most of the latter have hair on the underside only, e.g. Gutierrezia ledifolia, Nardophyllum armatum, Baccharis ledifolia, Mutisia ledifolia, Salvia gilliesii, etc. Those which bear hair on both sides are fewer in number e.g. Filago lasiocarpa, Gnaphalium spp., Buddleia andina, etc. Leaves with adpressed silken hairs are to be met with for example on Nassauvia axillaris, Plantago serica, Verbena microphylla, Oxalis incaria, etc. Nevertheless it is to be noted that a relatively insignificant degree of hairiness occurs with the plants found here in comparison with those to which attention has already been drawn, from the northern parts of the Andean chain with the moister Paramos and which Goebel has already described explicitly. In the area that we are concerned with here it appears that in many cases hairiness has been partly replaced by the more abundant occurrence of glands and succulence. Glands are found on many plants sometimes as glandular hairs e.g. on Senecio spp., on Calceolaria bartsioefolia, Nicotiana spp., and on Patagium spp., etc., sometimes as depressed gland points, such as Bacharis and Fabiana spp. All of these secrete resinous material, which more or less covers the green parts and so minimises transpiration. These plants all adhere to the paper in the press and leave behind a good impression, consisting of expressed resin. This resin secretion is of frequent occurrence and in consequence of that a particularly strong aromatic scent often distinguishes the Hoffmanseggia, Cactus, and Azorella Formations. Among the remaining formations this feature only occurs to a degree worthy of note in the Lepidophyllum formation, in which both Lepidophyllum species are so rich in resin that their fresh and green branches burn as kindling and flare up brightly.

For an alpine region the number of succulents is extraordinarily large. The succulence is distinctly evident in the leaves or even in the whole shoot and even in representatives from widely different Families; examples are numerous in the Compositae, particularly amongst the Portulaceae and the Chenopodiaceae; likewise all cacti are naturally distinguished in this manner. Isolated examples may also be found however in other Families, such as Calycera crenata, Oxalis carnosa, Dalea hofstenii, Cotyledon peruviana, Hexaptera cuneata, Spergularia spp., Peperomia peruviana, etc. As will be shown below, succulence is also evident even within the saline halophytic formations, although the numbers are not so great; altogether the number of succulents within the region we are concerned with here amounts to over 50 i.e. about one-seventh of the total number of species. This high proportion is remarkable, if one compares it with the proportion within the Paramos of the northern part of the Andes. It scarcely needs to be noted that the abundant occurence of Succulents in this region is associated with the prevalence of a climate of much greater aridity.

To close I must pass a few words upon yet one more characteristic, namely the frequently occurring vertical attitude of the leaves. To this group belong almost all the perennial grasses which are characterised by compact bundling-together of upward-pointing leaves furnished with sharp tips (with or without the capability of opening up in moister weather). To this group belong Stipa, Calamagrostis, Poa and Festuica spp. A similar vertical attitude is found in the Dicotyledons. Examples may be quoted from among the bushes of Gutierrezia gilliesii, Baccharis microphylla, Senecio tarapacanus, S. glacialis, S. iberidifolius, some Werneria spp., etc., with leaves held upright. In addition there is Plazia daphnoides whose leaves remain only on top of the branches and are upright; they are also fairly insulated with pallisade parenchym on both sides, although in somewhat greater numbers on the upper side. On account of their upright attitude, the leaves also generate quiescent air among themselves, whilst the underside of the leaf is more exposed to the wind. Further numerous examples can be quoted from other Families.

Among the herbs are found several whose axes lie pressed close to the ground, but whose leaves arise upwards at right angles to the surface, such as Chopodium frigidum. Compound leaves often exhibit the habit of the leaflets, taking on a vertical attitude. Thus for example some Patagonium spp. are furnished with elongated leaflets which stand erect at right angles to the more or less horizontal leaf axis. Tribulus terrestris and Hoffmanseggia gracilis have the leaflets along the leaf axis which lies level with the sand and twisted around the leaflet axis to a fine vertical stance. Both of these also have generously insulated leaflets. However this insulated structure of the leaves does not depend upon the vertical stance itself but is attributable to the more vigorous development of the palisade parenchym usually occurring with the xerophytes; as evidenced by the Tribulus terrestris in the Botanic Garden at Upsala [in Sweden – H.M.] being furnished with leaves of similar structure although these had a horizontal disposition. Still more could be said about the climatic adaption of plants which belong to the Hoffmanseggia, Cactus, and Azorella Formations. Several characteristics could have been only mentioned here in passing, or may have even been overlooked; I hope to be able to return to this on another occasion. What has been said here should be enough to portray an impression of the most significant Types which commonly occur among the three formations and which are the most striking in comparison with other xerophytic regions and alpine zones.

The Lepidophyllum formation.

The Lepidophyllum formation is a halophytic shrub formation formed exclusively of both Lepidophyllum spp L. quadrangulare and L. phylicaeforme. These are around a meter high and stand more or less close together, but often having bare patches openings between one another. Undergrowth is virtually completely absent; the ground between between the bushes lies completely bare. Either the dwarf grass Distichlis humilis or humps of Frankenia triandra are able to appear only very sparsely. Perhaps there is even a distinction between the two Lepidophyllum spp in the formation so that L. phylicaeforme predominates in the rather moister places; in this species the leaves are not quite so reduced as in the preceeding one. The habit of both species is so extraordinarily reminiscent of Thuja or Juniper bushes that one is almost

taken by surprise when the yellow Composite flower heads are found occupying the tips of the branches. They are evergreens, dark green and stand out very distinctively among the rest of the Puna shrubs. All green parts have a strong aromatic smell; they are stickily coated with an abundantly secreted resin.

The Lepidophyllum formation occasionally covers larger flat areas, such as near Moreno and in the vicinity of the Salinas Grandes. Also it often occurs as narrow bands which follow the streams outside the Hypsela Formation and these run out into the Hoffmanseggia or into the cactus formation into which they form a transition. The Lepidophyllum formation is characteristically sharply defined, even though here and there on the margins the species coming to an end can naturally be intermingled to some degree with representatives from the adjoining area.

The Lepidophyllum are confined to a sandy or to somewhat argillaceous soils.

[The high-altitude lichen waste, the saline, semi-saline, and moving sand Formations are also examined in detail; these associations would not appear to be inhabited by cacti – H.M.]

Phanalogical Observations

In the foregoing the apparent periodicity of some of the species encountered was based upon the vegetative parts. Since I have also made some observations during the flowering period, and so few phanalogical observations have been made concerning south american Flora, it sems to me to be not without interest to pass them on here. It is evident that the observations made in a single vegetative season are not to be taken as generally valid without further observations. However in other years the circumstances may remain more or less similar, especially as regards the mutual relations of one species to another.

The flowering period for all species appears to fall within the warmer and rainy season, in the summer. At least I saw no firm indication that any one species had its flowering period in the dry season. However the flowering period does not occur at one and the selfsame time as the vegetation period, but one is separate from the other. [There follows a diary of those species first observed in flower, daily from October 20th to January 1st, including "November 22 – Opuntia purpurea"].

The annuals, whose seeds start to germinate at the beginning of the less dry season, go through their pre-floral phase very rapidly and during November and December the abundant annual flora which decorates the Puna stands in full bloom. These species put out flowers even when in an immature state, and then when the climate of the year allows of it, put on their main growth and again produce still more new flowers. The first example of this is perhaps afforded by Neocracca, plants which carry cleistogamous flowers even in the budding infloresence, so that the continuation of the species is assured even if the unpredictable climate should interfere with the further development of the plant.

. . . from H.Middleditch

The author of this article paints a picture for us of a mountain-girt high altitude plateau, generally nearly level or with steadily sloping terrain, with little or no shelter from the elements. It is swept by fierce winds, exposed by day to the burning sun, with a night temperature often near freezing point, having a paucity of rainfall and few watercourses. We are introduced to the very occasional meadows at favourable spots along the watercourses, as rare as oases in the desert. Fries then describes in turn the sandy area where bushes and herbs grow together with sparse cacti, then the gravelly or stony terrain where he found most of the cacti.

At the time this translation was started, it was difficult to appreciate any immediate relevance to cacti despite the admirably clear descriptions of the terrain and the painstaking descriptions of the manner of growth of the vegetation. Then P. Smart happened to mention that his Opuntia subterranea had flowered: of course! this was the very plant described by Fries from this region. As the translation proceeded it steadily became clear just how appropriately this plant fitted into its environment and how its characteristic form of growth was generally along the lines adopted by various other sorts of Puna vegetation which was designed for survival in these hostile surroundings. All of a sudden Fries' account ceased to be an interesting but almost academic exercise and took on a direct relevance in helping to understand much more clearly where and how the cacti fitted into this particular environment.

However admirable may be Fries' description of the dry, cold, winter conditions on the Puna it may not at first appear to be worthy of repetition until one considers that P. Smart's Tephrocactus subterraneus flowered in cultivatiuon after exposure to unusually low temperatures in winter and after a long (longer than usual) period without water – a faint whiff of its natural wild environment perhaps, so it responds by flowering? Similarly it would not at first seem to be worth devoting space to the very comprehensive treatment of the comparatively minute patches of green meadow, since this cannot have any relevance to cacti, can it? So where else do we go to find any observations upon pollinating agents actually seen at work on the Puna? And of course the flowers on P.Smart's Tephrocactus subterraneus appeared, as we would expect for Tephrocacti, well up the aerial stem but not at the very crown. But as Fries tells us ,only some 10mm of the top of the plant which he described projected above the ground, so how could flowers occur on a part of the body which is usually below ground level? Yet even in the green, damp oasis-like meadows Fries tells us that there are plants whose flowers have the lower parts below ground level. He also tells us that there are flowers in the green meadow which have irritable stamens – would that be to react to the same pollinating agent that visits T. subterraneanus whose flowers, P.Smart tells us, have irritable stamens? Fries tells us that Opuntia subterranea was growing in sand whereas the cushion or carpet forming Opuntias grew on the stony ground which was typical of the Cactus Formation. Do we presume that the cushion forming Tephrocacti growing in southern Peru and north-western Bolivia also grow on stony ground? Fries also tells us that hairy leaves are less in evidence on Puna plants than on those from similar altitudes growing further north; he goes on to say that, in comparison with the more northerly and moister parts of the Andes where a significant degree of hairiness occurs, plants on the Puna have hairiness partially replaced by more abundant succulence. Relating these remarks to Tephrocacti, there are very hairy species to be found in Peru – T.rauhii, T.udonis, T. lagopus for example; there is certainly an overlap of the distribution of these very hairy Tephrocacti and the cushion-forming sorts which are either much less hairy, or hairless – there is an illustration of the two growing side by side in Rauh's book on the Peruvian Cactus vegetation. The thickened rootstock appears further to the south in the pentlandii

group; then further south still we have T. subterraneanus. Thus we can see the reduction in hairiness and the increase in succulence from north to south that occurs in the Tephrocacti is in parallel with the same changes noted by Fries in other sorts of vegetation from this same altitude.

Not very distant in time from Fries' visit to the Puna of northwestern Argentina, a visit was made by Fiebrig to that part of the Puna which extends across the border into southernmost Bolivia. The boundary is purely a political one, the Puna terrain and vegetation continuing virtually unchanged across the borderline. Fiebrig was particularly struck by the aroma of ethereal oils from the Puna plants which steadily converted their baggage and their clothing to the smell of the Puna; Fries also observes that a strongly aromatic scent often distinguishes the Cactus, Hoffmanseggia, and Azorella and Lepidophyllum Formations. Is it the very persistence of this Puna smell which causes Ritter to observe that the flower on T. subterraneanus is scentless? In addition, Fries tells us about some of the insects which he found crawling in and out of some of the flowers, yet Fiebrig never mentions the insect fauna. Although Fiebrig tells us that the "soil" is so porous that those parts of the plant which are below the level of the surface can still transpire, this aspect is not mentioned by Fries. But in having accounts from two different authors of adjacent parts of what is effectively a contiguous vegetation zone, can we perhaps take comfort from one of them having noted certain aspects that the other overlooked (or alternatively was not trained to observe)? And are we so absolutely sure that there is no other relevant and important factor that bears upon the environment of the cacti and their ecology that both authors failed to record?

. . . from Baron Nordenskiold, 'Travels on the Boundaries of Bolivia and Argentina', The Geographical Journal 1903.

As it is quite un-necessary to encroach on the space of this journal by any description of our voyage out, let me beg the reader to join us at Salta, a small town in north Argentina which formed the base for our excursions on the boundary between Argentina and Bolivia. On 12 May, Fries, Bowman and I arrived at Salta; we at once began our preparations, engaging servants, procuring mules, provisions, etc.....Having made final preparations with regard to fitting out the expedition, we left Salta for Puna de Jujuy.

. . . from H.Hoek "Exploration in Bolivia", Royal Geographical Society Journal 1902.

Towards the beginning of September 1903 we found ourselves at Jujuy, the last station on the north Argentine railway, at the foot of the cordilleras. Our party consisted of Dr. Steinmann of Frieburg, Baron von Bistram, and myself; we first had the task of searching for mules and servants. On September 23 we left Jujuy, passing the night at Volcan. Here, stretching for about 2½ miles into the valley is an enormous cone of debris from the cerro in the west. For four days we rode on through the valley past Tilcara and Humahuaca. Crossing the desert-like pampa we reached Cochinoca. Here we had difficulty in replenishing our larder, the indians obstinately refusing to sell either a living sheep or dead mutton. A long ride over the plain grown with grass and tola bush brought us to Rinconada. The tola (Lepidophyllum sp.) covers an immense area; in its appearance, as well as in the manner and extent of its growth, it resembles our heather.

We then crossed the cordillera of Escaya and on October 4 reached Yavi. The river which flows past Yavi falls into the Rio San Juan to the north and from the heights to the west of the town we had a magnificent view of its barren, winding, canyon-like bed. On October 7 we proceeded over the pampa towards the north, gradually approaching the Victoria chain of mountains. This range is the boundary between the mountainous land to the west and the declining high land to the east. On October 10, after a troublesome climb, we reached what is possibly the culminating point of the Victoria chain. To our disappointment, we had a view only to the west. Some 1640 feet below us a sea of cloud blotted out the landscape. But the fact that there were no peaks visible above this pall of mist allowed of the inference that the ground falls abruptly to the east from the Victoria chain.

THE BOLIVIAN PLATEAU, ALTIPLANO, or PUNA. **By Prof Dr. T Herzog**

Translated by H. Middleditch from Die Pflanzenwelt der Bolivischen Anden (Vegetation der Erde XV) 1923

In contrast to the high mountain chain of the the Cordillera Real, which carries a mesophytic alpine meadow in a defined altitude band, the plant formations of the plateau are of an xerophytic character throughout. With its few inselbergs the plateau lies between 3700 and 4200m. Appearing there are all nuances of the Tola heath, a Formation of closely-growing dwarf bushes which is formed principally of Lepidophyllum quadrangulare and of yareta (llareta – H.M.) steppe with dominant cushion plants of the Azorella type. Over thousands of square kms of widespread Puna the climate of this barren waste is extraordinarily harsh and is marked by extremes of temperature. My diary record along this route through the Puna runs (reproduced as extracts): September 10, Oruro-Caracollo – The cushion plant steppe is the fashion-leader throughout. Several spp participate as cushion forms, principally Azorella diapensioides. The colours are a sucession of yellow-green to fresh green to blue-grey. The nearer we came to Caracollo the more intermingled became bushes of Tola in flower, the blue-green spiny bushes of Tetraglochin strictum and other dwarf shrubs. Here and there a close turf-like formation was found. Rare are a sprinkling of small round-humped Opuntia, probably O. lagopus and the Paja Brava, a silver-grey grass.... Shortly before our arrival in Caracollo we were caught in a violent thunderstorm that covered the mules with hail so that they stood in the courtyard with white backs.....September 11, Caracollo-Panduro. The vegetation remained continuous deep green Tola heath, mixed with Paja and cushion shrubs. A thunderstorm covered us with rain and hail....

This landscape however is not confined only to the plateau but extends eastwards over other parts of the high cordillera, which lack the real alpine features. The terrain descends quite gradually on the eastern side to the inter-Andean valleys (as Fiebrig described), in the form of more-or-less-parallel broad, level, undulating ridges. Indeed the predominance of Lepidophyllum quadrangulare which one must regard as west-andean does not reach out over the real plateau. However the typical Puna vegatation as an entirety is formed everywhere and is especially represented by the huge rigified cushions of Azorella diapensioides that are encountered upon the harsh heights over which the road runs from Oruro towards Cochabamba, Potosi, and Sucre.

SOUTH EAST PERU – THE TOLA ZONE **By Prof. Dr. A Weberbauer**

Translated by H. Middleditch from Die Pflanzenwelt der Peruanische Anden (Vegetation der Erde XII) 1911

Anyone travelling along the great southern highroad of Peru towards Lake Titicaca sees, high above Arequipa, somewhat prior to the station at Pampa de arrieros, a border line of plant geography rarely stamped with such clarity. The stiff columns of the Cereus species become sparse and with them a crowd of desert shrubs. The plant growth spreads over the ground in close proximity to each other. In the desert vegetation the grasses represent the tallest among the tender forms of short-lived rainy season flora – here it raises its stiff wirelike leaves everywhere in thick bunches which are left apparently unchanged by the seasons' growth. However the landscape gets its most conspicuous and most eye-catching character from the enormous numbers of dark bushes of a compact evergreen bush of ½ to 1m high of Lepidophyllum quadrangulare, called Tolas by the natives. The name Tola is also applied to other bushes, especially further to the south in Bolivia, Chile, and Argentina, bushes which like Lepidophyllum have a high resin content and are easily capable of burning, in a fresh and even in a damp condition. Lepidophyllum quadrangulare is reminiscent of many conifers on account of its closely packed scale-like leaves and the scent of its resin which secretes itself on the surfaces reinforces this similarity.

Accompanying the Lepidophyllum quadrangulare in lesser - but nevertheless still very considerable – numbers are some other small-leaved species of shrubs: Senecio graveolens and Tetraglochin strictum, both with bare fleshy leaves; the white-felted Senecio idiopappus, and Baccharis incarum which exude shiny drops of resin on the leather-like leaves; and here and there Chuquiragua rotundifolia whose tough leaves terminate in a sharp pointed tip. Whilst all these shrubs grow upright, the leafless branches of an Ephedra creep along the ground. The bundles of perennial grass belongs to various species among which Festuca orthophylla, Calamagrostis breviaristata and Stipa spp. are especially recurrent. Mingled between the grasses and shrubs are a third significant form, lowgrowing cacti of clumping compact habit, in particular the upward-arched cushions of Opuntia pentlandii; more rare are the spherical bodied forms of some Echinopsis spp., which sometimes occur solitary, sometimes together in groups. All these plants are a part of the body of the Tola Formation or Tola heath which is spread to a huge extent over a flattish, undulating, imperceptibly rising highland. The components of the formation are spaced far closer together here than in the Arequipa desert, but nevertheless there are bare patches of coarse sand which forms the ground soil visible everywhere. The Tola heath is extremely monotonous and a slight change arises from place to place only in the numerical proportions in which species occur; here and there grasses predominate, elsewhere Lepidophyllum predominates so that is formed into well-nigh thickets. The xeromorphic character of the Formation is unmistakable and attains expression in diverse ways - through the succulence of the cacti, through the rolled-up leaves of the grasses and by the shrubs whose foliage combines with small size features such as fleshy or leatherlike consistency, dense hairiness, resin secretion, etc. In that way the outward appearance of the Formation remains virtually unchanged throughout the course of the year, at least in the vegetative parts. With few exceptions such as Tetraglochin strictum which lose their needle-like leaves in the driest months, the bushes do not have deciduous leaves, so that when some scattered tender herbs awaken to a short life in the rainy season they are concealed among the stronger shrubs. The annual growth is much more in evidence in the flower formation than in the vegetative parts. Only during the dry season do the crowds of golden yellow flower heads mingle with the dark green of the Lepidophyllum bushes and the large fiery red flowers ornament the plain cushion of Opuntia pentlandii. Colour embellishment of that sort is absent in the moister part of the year, in which it is primarily the grasses that display their flowers.

Mosses and lichen only occur rarely. I know of two different species of lichen which are to be found at the foot of some shrubs.

Dotted around in the Tola formation as tiny widely dispersed patches are two other plant associations arising from special and restricted site conditions: the vegetation of the dry gulleys and that of the stream-bank meadows. The dry gulleys are distinguished by the occurrence of some bushes which grow higher than in the Tola formation; such bushes are Polylepis tomentilla, Mutisia orbigniana, Culcitium pavonii, and a Ribes. Mosses and lichen are represented more abundantly than elsewhere and establish themselves by preference on stones. The formation designated above as stream-bank meadow arises occasionally on the margins of the few brooks which cross the region where (but not everywhere where) the beds are shallow and the flow is sluggish, and also in pools. Dwarf herbs form a close, carpet-like durable green turf; bushes are entirely absent. So the stream-bank meadows contrast sharply with their surroundings. I have not investigated their composition; they probably consist of many high Andean elements and are obviously closely related to the Hypsela Formation which R.E. Fries distinguished in northern Argentina.

The lower boundary of the Tola zone, which as indicated consists almost entirely of a single Formation, is found more or less at an altitude of 3400m, where the Lepidophyllum shrubs and the columnar Cereus spp meet each other and the bunches of persistent grasses grow only still more sporadically. But already by 3700m the Tola formation starts to lose its typical character, insofar as elements penetrate from lower places, such as Diplostephium tacorense and Adesmia melamthos; moreover the frequency of Lepidophyllum quadrangulare declines and finally at between 3400 and 3300m the shrub seems to have disappeared completely from the dry gulleys which are also the collecting points for rain waters. Thereby it seems certain that its lower limit of distribution is determined by the lack of moisture.

The Tola zone extends upwards to an altitude of 4300m. Already at about 4200m Lepidophyllum quadrangulare takes on a stunted growth; it stays much below its normal size and bends over so that its branches nestle against the ground. Finally at around 4300m its place is taken by a recumbent shrub which belongs to another species of the same genus, namely Lepidophyllum rigidum. Its leaves are slim needles, not short wide scales like the previously mentioned species. At the upper boundary of the Tola zone the grass tufts also change, and the cushions of Opuntia pentlandii as well; strange to record, in both cases a pointed cone shape replaces the gentle curvature.

In addition to the Pacific flanks of the west cordillera this vegetation also appears on the inner flanks; from where the Arequipa-Puno railway has reached its highest point at Crucero Alto the highland begins to incline down gradually towards Lake Titicaca. The plants close up nearer to each other than on the western slopes of the cordillera, the grasses look a fresher green, brief abundant rainfalls make themselves evident and put an end to the habitat conditions of the Tola

formation. Lepidophyllum quadrangulare appears once more but already by 4200m it reaches its lowest limit, whilst on the west side it descends as far as 3300m. Consequently it can be said that in the latitude of Arequipa, Lepidophyllum quadrangulare and the genus Lepidophyllum generally are confined to the western flanks of the Andes. Further to the south, however, in Chile and Bolivia, Lepidophyllum quadrangulare extends its range of distribution further to the east, joined by other spp of the same genus, and reaches the east side of the Andes in Argentine territory. I have never encountered Lepidophyllum in Peru at around 12° S latitude and north of that. I regret that I have not been able to ascertain the exact northern boundary since this is very important for plant geography of the Andes. Noteworthy is the far-reaching conformity that has come to light in the distribution of the genera Lepidophyllum and Adesmia.

Comments....from H. Middleditch

The establishment of the northern boundary of the Tola heath quite evidently eluded Weberbauer; but the account given by Rauh of the vegetation in the Nazca-Puquio tract appears to place this boundary at about 15° S. A major component of the Tola heath is lepidophyllum quadrangulare, which is reported by Herzog from Guaqui on the shores of Lake Titicaca, a location which also lies not far from 15° S. Rauh shows us that this latitude is a boundary not only for non-succulent plants but also for many cacti. Although the southern boundary for the Tola heath has not been defined in the literature, there is an indication that it may lie some way south of Moreno; with some degree of justification it might be suggested that this could possibly form a southern boundary for certain cacti, too.

The Tola heath does appear to form a more-or-less consistent plant Formation extending from approx. 15° S in the Peruvian Andes to 24° S (or more) at Moreno, which is where Fries discovered Opuntia subterranea. At 15° S the formation is biased towards the Pacific side of the Peruvian Andes; in Bolivia it appears to occur on both the western and eastern rims of the Andes; by 24° S in Argentina the Tola heath appears to be confined to the western side of the eastern margin of the Altiplano. This general NW to SE orientation follows the basic pattern of the dry belt running from the Ecuador coast, via the Peru coast, through northern Chile and NW Argentina down to Mendoza and thence via the belt of the Colorado and Negro rivers, to the Atlantic.

The descriptions of the Tola heath given by Rauh, Weberbauer, Herzog, Troll, Fiebrig, Fries, and Cabrera are not identical; but they do have a great deal in common. As we have seen above, Fries carefully describes the characteristics and components of half a dozen different faces of the Puna vegetation. Rauh provides the above description of the Tola heath together with a brief description of other faces of the Puna vegetation which have as their climax the bunch grass, the short grass, the cushion and rosette plants, and the stemmed rosette plants (e.g. Puya). Troll describes the Tola heath, the Ichu grass steppe, and the cushion-plant meadows as the three principal Formations; but he also refers to the occurrence of Polylepis bushes, of Puya, and of columnar cacti. Cabrera takes the trouble to consider even more shades of variation, noting where certain plants become dominant here, others there. Each author will have seen parts of the Puna not seen by other authors, but although each account differs from the other in emphasis, there is very little, if any, confliction between them. Fries only makes brief reference to Lepidophyllum quadrangulare. The object of Fries' expedition was to study the alpine flora, and it would be expected that his account would be largely devoted to that objective. Hence we have his detailed descriptions of the rare streamside meadows – the Hypsela Formation, together with the cushion-plant and high altitude grass zones. Since the Tola heath with its thickets of bushes and almost non-existent ground-hugging Flora had no alpine aspect, Fries would understandably give it much less attention the he did to other Associations. Hence we must not interpret the scant attention given by Fries to the Tola heath as an indication of its scant existence in northwest Argentina. Indeed Hoek remarked upon how prolificly this bush was growing along the route taken during their visit to the Argentine Puna.

Cabrera makes even briefer reference to the Tola heath but does say that this (and other dwarf shrubs) are distinguished by an abundance of individuals. So the proportion of an account devoted to any particular plant or group of plants would not necessarily appear to reflect the numbers in which it exists or the extent of the area which it covers. In addition Weberbauer observes that the one to 1½ metre high bushes in the Tola heath tend to conceal the lower growing plants. Hence whenever we take note of the content of any of these accounts we must be careful to allow for those aspects that the author either did not see and/or did not record.

On this basis it would appear that we can see a clear distinction between the Puna vegetation with its Oreocereus and Tephrocactus, and the vegetation of the adjacent slopes and valleys at the next lower level. The boundary is not drawn at one specific altitude nor is it drawn like a neat line acros the landscape; some plants which thrive on one side of the boundary can exist (with a struggle) on their "wrong" side of the boundary. Just as the thickets of Polylepis in the Puna are struggling immigrants from the adjacent lower vegetation band, so are the Trichocereus pasacana. But for those with eyes to see it, a boundary exists. There appears to be the possibility that where a genus can be divided into distinctive groups, each group could be related to a given environment zone. The uplift of the Andes in geologically recent times has resulted in some groups of cacti adapting their habit to suit the higher altitude and changed environment. As a result they now display features which are intermediate between other groups of cacti which are closely related and taxonomically well defined. We may well gain a better understanding of those plants which form an intermediate and often ill-defined group if we try and find out what particular environment zone they occupy rather than by spilling too much ink over their taxonomy.

A MONTH IN SOUTH AMERICA **By J-M. Chalet**

Translated from Cactus (Belgium) 7.2.1975 by H. Middleditch

(At Tilcara)...It is a splendid day which awakens me at 0800 hours on January 28th. But very rapidly the sun plays hide and seek with the clouds. At 0930 we depart in the direction of Humahuaca (42km) at 3000m altitude and the "Cabezas de Viejo" - Oreocereus trollii. After many enquiries procured no answer, I finally obtained the desired information; beyond the railway line and the Rio Grande – which it is necessary to ford – surmount the first rocky barrier in order to reach the first plateau on which I find Parodia maasii, Pseudolobivia longispina, and Helianthocereus pasacana, together with a solitary Helianthocereus poco which seems to soar up to meet the sky. It is only four hours later, after crossing several small

valleys, that I would find other sorts of which the crown is furnished with carmine-red flowers. Continuing my trek I reach a second plateau where immense colonies of Tephrocactus extend, numerous Parodias and Austrocylindropuntia humahuaca. Fortunately I had taken the precaution to put on hiking boots incorporating a thick sole since the soil is covered with vegetation more suited to a fakir than to the soles of a cactophile. I proceed more slowly in the direction of Pucara as the altitude was making its presence felt (3400m).

My heart beats and my breathing is less comfortable. Despite an overcast sun, the high temperature level causes me to sweat profusely. It is 1430 hours; three hours have elapsed since I left Humahuaca when, at last, I see the first clump of Oreocereus trollii. The lateral branches reach up to 70cm in length. Overjoyed at this discovery, I set out again on the search for other specimens. In the two hours which followed, I came across a number of well dispersed plants. The spines are very variable (whitish-yellow to dark chestnut). At 1630 hours I arrive at the hamlet of Pucara. At the entrance to the village, the women and children retreated to the interior of their dwellings. As the natives are everywhere suspicious in regard to strangers, it requires much patience to gain their confidence. On the off chance I offered a cigarette to one of the men: a discussion ensued and after quarter of an hour he went to find his wife who brought me a cup of cocoa tea and a flat cake blended from maize. Without warning the heavens opened and I am invited inside their dwelling which consists of three rooms: the kitchen, the larder and the bedroom. The walls are of adobe, the framework is made of Helianthocereus poco and Helianthocereus pasacana, all being covered with adobe. Built outside the yard was the cereal loft. This is a structure whose walls are surmounted by Opuntia with sharp spines to thwart possible predators.

At 1800 hours I start to climb down again in the direction of Humahuaca. On the return trail I slip two cuttings of Oreocereus each 50cm long into plastic bags. Of a respectable weight, these plants become more and more difficult to carry along; the handles of the bags cut into my hands. They compel me to make frequent halts. All at once a cloud of dust appears on the horizon. Several minutes later a VW comes to a halt besides me. It is the acquaintance who comes from the USA. They take me, with my cactus, as far as Tilcara. Dead tired, I slide into bed thinking already about tomorrow's expedition.

Next morning, in company with my new friends, I make for the ruins of Pucara situated round about 1km from the hotel. They are the remains of a pre-Inca civilisation whose renovation and preservation is assured by the University of Buenos Aires. The Helianthocereus pasacana are quite numerous amongst the ruins. A stone's throw away the botanic garden offers to visitors a panorama of the flora of Jujuy. The cacti take the lion's share. To the scientific name is appended the local name. After a meal, I take leave of my friends and set off under a pitiless sun in the direction of the Sierra on the search once again for Oreocereus neocelsianus (Vicunita). Beyond the electricity generating plant the road narrows and turns into a footpath which climbs rapidly towards the first rocky barrier. I tramp along, accompanied by an indian family, on the side of a slope along a superb gorge of a hundred meters or so in depth. I am quickly outdistanced by my walking companions because their pace is very consistent.

In order to reach the other side of the gorge I descend the steep slope and ford across the river. I climb up the bed of the river weaving in and out between the rocks to gain – after a strenuous effort – a plateau on the opposite bank. At a bend in the road, a field of maize announces the existence of a hamlet. In reality it consists of three or four miserable hovels. My first cactus will be, once more, the Pseudolobivia longispina of which some plants have the epidermis covered by a bluish wax like cochineal impregnated with copper sulphate. The slope continues just as steeply. I perspire in great droplets and progress ever more slowly. My pulse is 140. Numerous Tephrocacti and Opuntia are scattered over the ground. Parodia tilcarensis makes its appearance and the colour of its flowers is extremely variable. Examining from close to the ground – which appeared to be especially good for retaining moisture at the surface – I established that the roots of the plants do not penetrate to any great depth into the soil but spread out superficially, which greatly facilitates their uprooting. I continue on my way and always no "Vicunita", when a clamour of bells makes me look upwards to see a troop of goats herded by a young girl. At first distrustful, she finished by coming nearer, agreeing to answer me and gave a location for the "Vicunita" in the direction of the mountain about half an hour's walk away. Knowing the pace of these indians, I am just about ready to give up the attempt because my watch already showed 1730 hours.

I sit down and admire the landscape and observe Carmen who threads her little fingers with extraordinary agility between the spines of a Pseudolobivia longispina. She extracts the juicy pulp and sugar from the fruits. Taking up my courage in both hands I give myself a further half hour to find Oreocereus neocelsianus. I go over to the other side of the hill. Surprise! surprise! about ten Oreocereus trollii (Cabeza de Viejo) are scattered among the grasses. Their branches are thick with large yellow fruits of which some have already had a visit from the ants. Others contain hundreds of black seeds. I fill up a plastic bag with the fruits. The spines are very variable from one plant to the next. The colour ranges from yellowish-white to brick red. What is to be thought now about all the pseudo-varieties invented by the importers? The sun is close to the horizon for it is already 1800 hours. The air is keen at this altitude between 300 and 3500m. It is time to go back down again.

After having recrossed the river I meet up with a family of indians of whom the youngest daughter of 4 years of age walks like the others in the stony tracks. The elder daughter who is 18 years old is a fine girl on whose shoulders rests a bicoloured shawl and whose long black hair hung down her back as far as her waist. Less withdrawn than the rest of the family, she enquired about what was going on in the rest of the country and in our part of the world.

The sun had already gone down when I took leave of this family and a few moments later they are no more than outlines which are merging into the gorge excavated by the river. A last wave of the hand and then nothing more.....By 0130 hours the stationmaster announces a delay of two hours. I sit down on my rucksack and make a start on removing the seeds from the fruits of Oreocereus trollii. An indian woman, at first quite puzzled, soon lent a hand with the job. The "Frontier Indians" who are going back to their Bolivian homeland, keep us company by playing songs from indian folklore.

At 0400 hours three yellow eyes come into view. With a deafening clamour and enveloped in an enormous wreath of smoke, the locomotive comes to a halt in the station at Tilcara. I hoist myself up into the first ill-lit coach. What an indescribable scene; people are not only sat on the seats but also on the elbow rests; they are laid down stretched out everywhere – in the corridor and on the platform. I settled myself as best I could, half upstanding, half sitting. Humahuaca 42km away is reached after a 1 hour run because at each slope the locomotive is puffed out. Between Iturbe and Martin the

railway crosses the Rio Grande numerous times and cuts a track in a gorge whose sides are planted out like stakes with Helianthocerus poco and Oreocereus trollii.

The number of travellers increase at each stop. Soon I count 95 people for 72 places. La Quiaca, at 3442m altitude, the last port of call in Argentine territory, is reached at 1300 hours, being 4 hours late. I steer towards the customs station to clear my two Oreocereus trollii. An official wants me to buy some special wrapping paper and to pass on to the customs. I give up and offer these two plants to a young indian.

The Bolivian frontier is 1.5km away; customs, then immigration control where the wall is hung with a series of photographs of terrorists sought by the police. I come back to the station where there prevails a feverish activity which I met with again at all halts en route between Villazon and La Paz. The women have the traditional bowler hat on their heads and have a multi-coloured shawl wrapped round their shoulders. The train is made up of carriages built in solid timber and dating from the last century. The sash windows had frequently to be kept up with string to avoid making an exit like Robertspierre. The interior of the carriage is a veritable hive of confusion; sacks of semolina,, maize, goat's cheese, cans of oil, cooking utensils, ducks.

At 1600 hours, some one hour late, the train gets under way. It runs on to a plateau covered with scraggy tufts of grass. After an hour's run, the first Oreocereus neocelsianus or maximus makes its appearance. The rate of descent becomes steeper. It is 1910 hours when the train reaches the lowest point on its route at Balcarce, 2600m. At Arenales the hills are covered with Oreocereus trollii and with Oreocereus neocelsianus or maximus.

I wake up once again on 31 January at an altitude of 4060m in an entirely different landscape. It is the altiplano with its immense expanse of dwarf herbage and scattered tussocks of grass. At Rio Mulato a branch of the railway line goes off in the direction of Potosi and Sucre via the El Condor pass at an altitude of 4785m. The capital city of Bolivia is reached at 2300 hours with a delay of eight hours, for the locomotive which had taken fire had had to be replaced. The following days took me successively to Copocabana on the borders of Lake Titicaca (3810m), to Puno in Peru, to Juliana, and to La Raya where the railway line culminates at 4321m. This station is dominated by the majestic Vilcanota (5846m) capped with permanent snow....The train arrives in the station at Cuzco (3400m) at 2315 hours on 3 February. At the hotel there is the first warm bath since leaving Tilcara in Argentina.

. . . from J. Hopkins.

I find that Lobivia longispina sometimes shows a bluish, almost shiny-waxy epidermal tinge. I have seen it on a couple of imports, but not on home-grown plants. It faded on the imports after a few months. I would have hardly described it as copper sulphate, which to my mind is an intense blue.

. . . from H. Middleditch

It would seem to be quite possible that the bluish wax coating of the epidermis of Pseudolobivia longispina provided the plant with a barrier to the intake of excess heat. Being a C.A.M. plant it would require very little heat to drive its metabolic processes, far less heat in fact than it would receive from normal insolation in habitat. Since the degree of insolation in this country is far less than that which they endure in their habitat, the plants have much less need for this heat-resistant barrier when they are in cultivation here. It seems that the plant reacts accordingly and gradually dispenses with what has become a superfluous feature in its new environment.

OREOCEREUS IN ARGENTINA — From R. Kiesling

In January and February of 1974 I went on foot through Jujuy with the objective of collecting various specimen plants for the museum. This trip took place in the rainy season and we had many problems on account of the rains and the consequent floods. It was quite a long journey, the first part taking us from Tilcara to Caspala, Santa Anna, and Valle Grande to Ledesma, a distance of around 150 to 200km in 20 days. We took two horses and a packmule. We loaded the herbaria, tent, and other camping equipment on to the animals. We ourselves always went on foot and we were drenched plenty of times. We were not able to collect any cacti because we did not have any space for them, nor could we collect any cactus seeds because it was a little early for that. Moreover, more than half the route was through the zone of the selva, which is a type of mountain forest with many trees and is without cacti.

Afterwards I went on to Humahuaca and to Palca de Aparzo and then once again as far as Santa Victoria. I was there for four days without being able to return to La Quiaca because of the rain and a river in spate. But I had a good trip for the museum, returning with some fine herbarium specimens. From La Quiaca to Santa Victoria is not a great distance, but the two places differ greatly from each other. Santa Victoria itself lies on the east-facing slope of the cordilleras and so has the benefit of rain-bearing winds; it is at an altitude of 2400m and so it is in the zone of the selva. In the selva is to be found Polylepis, Juglans australis, Alnus jorulnensis, and many other sorts of trees, with Tillandsia usneoides growing on them. Higher up the slopes the selva gives way to pasture at about 2900m and in the pasture lands these are many grasses, cosmos, lupinus, Rebutia, Lobivia, and many fine flowers.

At about 3800m the pasture gives way to what we call the Alto-andina zone and here there grows in favourable depressions and hollows Azorella, Pinophyllum, and Puya, but no cacti. The average temperature is very much different between La Quiaca and Santa Victoria, as also is the rainfall, which is about 300mm per annum at La Quiaca and about 2000mm per annum at Santa Victoria. The road from Santa Victoria to La Quiaca crosses the range of the cordillera here by a pass at a height of 4400m and then starts to drop gradually down to the Puna. Again at about 3800m, near Cajas, the Alto-andino zone starts to give way to the Puna vegetation; in the Puna there grows Psila, Fabiana, Palastrephya, Adesmia, Astragalus, Oreocereus and Tephrocactus. The Oreocereus are mostly found on the leeward slope of this cordillera and not on the plateau itself around La Quiaca.

Whilst we were there in January and February, the Oreocereus were in flower, but I did not observe any insects or birds visiting the flowers. The shrubs growing in the neighbourhood of the Oreocereus are the same as those of the Puna - Psila, Fabiana, Palastrephya, etc. The Oreocereus grows only on the west side of the Sierra de Santa Victoria, and not

on the eastern slope which faces the rain-bearing winds. They are to be found from there as far south as Humahuaca, Tilcara, Purmamarca, and El Moreno; also up into the mountains as far as 3000m above sea level and even higher in places. Nowadays they are not found near the roads, since traders and the public in general destroy them. The nature of the soil where these plants grow is variable, ranging from rocky to sandy, very dry, on hillsides or on slightly inclined surfaces but never on horizontal terrain.

Oreocereus celsianus extends only as far south as Abra Pampa; it is abundant in the vicinity of the border with Bolivia - in the Quebrada Toqueros, at Yavi and at Cajas. At Yavi and at Cajas we found Oreocereus trollii and O. celsianus growing side by side, but they do not hybridize. There are also some O. "maximus" which is only a variety of O. celsianus, rather rare in Argentina.

Oreocereus celsianus grows on the hills to the north and east, but not on the hills to the south and west. The flowers and fruit appear in the summer (December to March). In April 1975 I was in Abres de Pives, close to Purmamarca, and collected some seed from the last fruits of O. trollii. The fruits only remain on the plant for a very short period, since the ants and the birds eat the pericarpell which is somewhat succulent; the fruits dehisce at the base. The fruit is dry, hollow within, (the seeds are loose), the funicles are reabsorbed (?-R.K.) and the outer wall of the fruit (carpel and pericarpel) is some 2 to 5mm thick, with little sap, and drying up.

.....from E. Zecher, My trip to south America, translated by K. Wood-Allum from G.O.K. Bulletin for June 1973

.....Finally we reached the famous Quebrada de Humahuaca which, with its old Trichocereus pasacana which grows in stands like forests, was the impressive model for an Argentine stamp. It has been established that there was an Inca settlement in the Quebrada and it is just possible that the pasacanas flourish on the remains of that settlement.

So narrow are the roads in this part of north Argentina that almost anything can happen, as the following event shows. Coming round a corner we came across a car hanging halfway over a 300m high cliff. The vehicle was standing with only the chassis on the edge of the drop; the occupants – a family with three children – stood helpless and moreover white with fright. We gave them a tow and put the vehicle back on the road. After this event we went further on into the countryside. Here you can find Trichocereus poco. Its red flowers emerging from near the crown of the plant glow like burning torches in the evening sun. We stopped for a while in Humahuaca. This town is famous on account of its carnival which is said to be the finest in Argentina. We collected Lobivia rubescens in the area.

Then we moved on to El Aguilar, a mining community with 7000 inhabitants. Lead and zinc are mined here and the second highest football pitch in the world is situated here at 4500m above sea level. Here we found Lobivia longispina with white, yellow, or red flowers as well as Trichocereus poco. We were close to the Bolivian border. At 3500m the night temperature drops to almost 0° C from 35° C at noon. Here Lobivia chrysochete grows.

Near Santa Victoria, our next stop, we collected Lobivia pugionacantha and Tephrocactus subterraneus, a species which is particularly difficult to find. Our colleagues, the University botanists, collected herbarium material of a species of Puya. On a south-facing slope we found a forest of Oreocereus celsianus including cristates which must have weighed 30-40kg. Among the white-haired plants we saw – although admittedly only rarely - some with chocolate brown wool. In amongst the O. celsianus we also found O. trollii. If you think that there will be hybrids between the two, however, then you do not appreciate the intricacies of nature. The flowering period of the two species is separated by some weeks. Nature has therefore created a barrier to hybridisation.

Often there are no bridges over the streams and rivers and so you have to wade, up to your thighs. The only animals that live wild here are the llamas. You come across salinas, gigantic salt lakes; plants thrive on their banks. These have adapted themselves to cope with the dry seasons by becoming totally dormant for at this time the concentration of salt in the soil is too high. Only during the rainy season, when everything is flooded, does the concentration of salt drop and the plants revive. Here we found Mediolobivia einsteinii.

Immediately afterwards our car became stuck in the sand and it took quite a while before we could make any further progress. Before we ascended a 4900m pass we found Soehrensia korethroides, growing up to 60cm high, in flower and heavily spined. At the top of the pass we found L. chrysantha v. hypocyrta. On the way back we returned via the Quebrada del Toro in Salta. Here also were masses of Trichocereus pasacana and we also found Pyrrhocactus umadeave. A passiflora growing wild here was full of fruit like small oranges. From this spot we directed our steps back towards La Plata.

. . . Comments from H. Middleditch.

This brief account from Roberto Kiesling contains some very valuable observations both on the subject of Oreocereus and on the environmental regime which prevails at its habitat location. The description of the Puna vegetation given by Fries, by Weberbauer, and by Cabrera does draw a clear distinction between the Tola heath and the Cushion-plant zone. Rauh states that the Tola heath in SW Peru lies at between 3400 and 4000m altitude. Weberbauer tell us that in SW Peru the Tola heath is to be found in a zone which lies between 3300/3400m altitude and 4200/4300m altitude and that above that zone is to be found the zone of cushion and rosette plants (Azorella, Pycnophyllum, etc) or of Stipa bunch grass. Fries indicates an altitude of 4300m for the lower boundary of the cushion-plant Formation. Reiche and Pohlmann quote a band of 3500 to 4000m for the Tola heath for the headwaters of the Camerones and Vitor valleys, with cushions of Llareta starting at 4000m upwards. Here we have Kiesling telling us that on the Santa Victoria range in NW Argentina the (cushion-plant) zone of Azorella, Pcynophyllum and Puya is to be found above 3800m both on the eastern (windward) and western (leeward) slopes. When he was descending the leeward flank of the Victoria range down to the altiplano, Kiesling met the Puna vegetation with its associated Oreocereus and Tephrocactus at 3800m. Rauh also tells us that the Tola heath in SW Peru is the home of Oreocereus and Tephrocactus. But in addition Kiesling tells us that the Oreocereus are not to be found "on the plateau itself"; perhaps this comment is supported by Fries who tells us that a sharp boundary can usually be seen where the stony slopes supporting the cacti adjoin on to the sandy plain carrying the Tola heath.

Oreocereus growing on slopes scattered with stones of between fist and piano size may be seen in Ritter's photograph in his "Forty years' adventuring"; this gives a far better impression of the habitat than the same shot but including less background area that appears in Winter's 1954 catalogue. But the latter has a first class photograph of O. maximus growing on very steeply sloping ground. Similar habitat background may be seen in the illustration in Backeberg's "Stachlige

Wildnis", in Castellanos' photograph taken near Cangrejillos in Vol.2 of Backeberg's Die Cactaceae, and in Dorst's "South America". In Meyer's account of his trip to the Serra Santa Victoria (Revista Geografica Americana 10.120.1943) there is a similar photograph taken in the neighbourhood of Cajas – possibly at the very site mentioned above by Kiesling. In a photograph taken by Harry Blossfeld and published in Robert Blossfeld's 1937 cactus catalogue we have Oreocereus celsianus in great numbers again growing on a gentle slope together with dwarf bushes – presumably the Tola heath – and lots of bare stony ground between. A similar slide was shown by Roberto Kiesling to the Chileans Autumn weekend. In K.u.a.S for June 1965 there is a photograph of O. hendriksenianus growing on a slope amidst a pretty good covering of bushes. There is a superb view of Oreocereus growing on a slope in Abb 712 of Ritter's Kakteen in Sudamerika. On this collective evidence the habitat environment for Oreocereus trollii and O. celsianus seems to be fairly clearly defined: it grows by preference on sloping (as opposed to level) ground, often in company with dwarf bushes (probably Tola) and usually with stones littering the ground surface.

It is not absolutely clear just what Kiesling is telling us when he says that the Oreocereus grows on hills "to the north and east" but from the account which we are given by Zecher of his trip to Santa Victoria it appears that the Oreocereus occur on south-facing slopes. Presumably Kiesling means that Oreocereus grow on hills which rise to the north and east. At first sight it may seem odd that plants would only select slopes of a specific compass orientation, but we find that this phenomena is not peculiar to the Oreocereus growing on the margins of the Altiplano. We are told by Kuhn and Roehmeder that in the Province of Tucuman in the valleys gouged into the flanks of the Andes "one may observe in the same quebrada a notable difference in the vegetation on the two sides...the slopes which face south and south-east are in a more favourable situation in regard to the proportion of moisture they receive than the opposite slopes which face to the north or north-east, because of the direction of the prevailing moisture-bearing winds...then the same slopes benefit from the greater shade than those which face north or north-east.....in this way the two favourable effects are complimentary; more humidity and less evaporation". In his description of the Vegetation of the North-western Valleys of the Argentine Republic, Seckt observes that "the northern side of the valleys are noticeably damper and possess accordingly denser vegetation than the opposite, drier, southern side"; he quotes the Escoipe valley as a typical example. Seckt also notes that in this region that the tree-line ascends higher on the slopes facing towards the south than on the respective north-facing slopes. Thus it would appear that when Kiesling tells us that Oreocereus favour slopes which fall in a south or southwesterly direction, this is in line with observations made by other authors upon other types of vegetation in northwest Argentina.

From the account in Chileans No.38 of the trip undertaken by Reiche and Pohlmann to the Camerones and Vitor valleys in northern Chile, the altitude zone in which Oreocereus is found there between Jorona and Tacna amounts to a distance of only some 8 miles. Kiesling carefully tells us that in Argentina, near the border with Bolivia, Oreocereus are found in the Quebradas of Toquero, Yavi, and Cajas so that they presumably occur on the slopes of the quebrada and not on the level Puna; hence the area they cover will be only a minute proportion of the country between La Quiaca and the Santa Victoria chain. Meyen tells us that when he travelled from Yavi towards Santa Victoria he came across "an extensive stand o. tree-like white cardons, prominent cacti completely covered in white woolly hairs" not far from Cajas; evidently he either did not see any Oreocereus near La Quiaca or near Yavi, or perhaps he did not concern himself with looking down into the quebrada at those two places. The stand of Oreocereus near Cajas were evidently far more obvious and would presumably be where Fries' stony slopes came down to the edge of the level plain; but Meyen's "extensive" does not suggest even as much as eight miles – quite probably something much less than a mile, possibly no more than several hundred yards up the slope.

Thus we get down to a picture of Oreocereus restricted to fairly narrow discontinuous bands on the margins of the Altiplano and the slopes of adjacent quebradas, further limited to the southerly facing slopes. Whereabouts, then, are these odd patches of Oreocereus to be found?

In addition to the habitat locations for Oreocereus that are quoted by Kiesling, Backeberg tells us that he found Oreocereus not far from Tupiza; Chalet records Oreocereus at Arenales which lies at some 3,200m altitude, roughly half way between Villazon and Tupiza. Ritter also tells us in his "Forty years' adventuring" that he found Oreocereus on the road from Impora to Tupiza on the leeward side of the Morachata ridge, at an altitude of 3,700m near Mal Paso. He also found Oreocereus south of Escayache and Cardenas found it north of that place (his autobiography), both locations being on the leeward side of the northern extension into Bolivia of the Serra Santa Victoria. Cardenas also records Oreocereus from near Potosi, from near Lecori, and from near Culpina. Ritter refers to O. celsianus growing near Pulcayo, which is on the south-western slope of the Cordillera Chichas, near Uyuni. On the eastern side of the Altiplano the most northerly recorded location is at about 19° 30'S around Potosi and the most southern location is that given above by Kiesling at about 23° 30'S. On the western side of the Andes the most northerly location is at nearly 15° S on the trail from Nazca to Puquio, as quoted above by Instorfer: the most southerly location is noted by Lembke in K.u.a.S for December 1956 near San Pedro de Atacama close to the Bolivian border at nearly 23° S.At the Chileans weekend R.Ferryman showed slides of Oreocereus taken near Caspana which is only a few miles to the north of Lembcke's southernmost location. Between these two north-south orientated habitat areas on the east and on the west side of the Altiplano, the great expanse of the more-or-less level altiplano appears to be devoid of Oreocereus.

In his first reference to Oreocereus hendriksenianus in Kakteenfreund for October 1933, Backeberg observes that "these plants are like a huge trollii and form extensive thickets... The individual clumps stand a long way apart, completely isolated on the flanks of the volcanoes. It is necessary to have good luck if one of these white haired plant colonies is to be met with at all". This suggests that these plants do not form unbroken ground cover extending for many miles, but rather occur in isolated patches, probably separated by considerable distances over which the plants do not occur. This might explain how it was that Hauthal travelled past Villazon, Arenales, and Tupiza, without noting any of the Oreocereus seen there by other travellers, who could easily have diverted a mile or so off the trail in their search for cacti.

In all of the above discussion, the distribution of Oreocereus fossulatus has not been considered. This species is found, according to Ritter, in the valley of the river La Paz between Obrajes, which lies immediately downstream from the city of La Paz, to Tirata which is about 30 miles further downstream again. The Type location for the variety

rubrispinus is Valencia; this spot lies about 15 miles from La Paz down the valley of the Rio La Paz, i.e. roughly in the middle of the distribution area of the species type. Urmiri lies on a tributary of the La Paz river.

This area of the La Paz basin in which this group of Oreocereus is found is separated by a distance of some 350kms from the most northerly reported location for Oreocereus celsianus/trollii which is around Potosi. The eastern margin of the altiplano between Potosi and La Paz is indeed well-travelled country and it is rather unlikely that any decent stand of Oreocereus could have escaped the eyes of all the travellers who have passed that way. As J. Donald says, "we saw no Oreocereus on our trip from La Paz to Oruro or around Oruro".So what exactly is KK886, listed as O. hendriksenianus from Oruro? And just where was the photograph taken that appears in "Phytogeographic sketch of Latin America" by Smith and Johnston (Verdoon, 1965) that is entitled "Highlands of Oruro" and shows a a dry valley with sides sloping at a gradient of about one in four. The whole of the extensive tract of valley in the field of view is covered with scattered dwarf bushes – presumably tola bush – and several Oreocereus are to be seen in the foreground. Are these highlands actually near Oruro, so confirming Knize's Oreocereus from Oruro? Or are these highlands of the Province of Oruro, which takes in the northern end of the Cordillera Frailes? Even here, at 19° 20'S it is the northernmost record of Oroecereus trollii.

But then we have another complication, for in the KK field number list we not only have KK466 O. fossulatus from La Paz, but also several varieties of O. fossulatus from Potosi, Lecori, Cuchu Ingenio, Otavi, and Cotagaita. With the exception of Cotagaita, these other three places are located within 60km southeastwards from Potosi; Cotagaita is about 130km south of Potosi and some 75 km due north of Tupiza. In travelling over a high plateau near Cuchu Ingenio Cardenas observes (in his autobiography) a dwarf shrub formation including Hoffmanseggia gracilis, Bromeliaceae and cacti – which we may be entitled to interpret as typical puna vegetation; shortly afterwards Cardenas' party crossed the Pampa Lecori, another plateau, on which they found an extensive stand of columnar cacti of which the majority corresponded to Oreocereus celsianus. Again we might justifiably interpret this as a typical Puna scene. So just what is it that Knize has listed from southeast of Potosi and called varieties of O. fossulatus, a species which it appears that we only find in valleys well below the general level of the Puna plateau? Did these particular plants come from the deep valleys cut into the broken areas of Altiplano in this region, rather than from the plateau proper? Did Knize find that they had fruits filled with pulp, not hollow like the Oreocereus from the Puna?

. . . From R. Hauthal, Reisen in Bolivien und Peru 1911

The mountain ridge near Tupiza is mainly of a grey Palezoic schist. In consequence of tectonic movements there are extensive faults; the secondary faults are loaded with gold-bearing quartz. However, in only a few places is the gold economic to extract, such as a spot on the Rio San Juan de Oro. At great expense and with much difficulty, four large dredgers were brought here but only one was put to work, but the yield was not economic. I saw a pretty good vein of gold about 3 hours north of Tupiza near Estancia Salo at the mine 'Salo de la virgen de Copacabana en el Cerro de Kellarca de Almona'. From Salo I turned off the road which runs from Tupiza to Sucre, bearing to the west instead. At first the trail goes through a narrow valley that broadens out after some two hours. In this valley a huge volume of rubble forms a 50km high terrace, which the road ascends; the terrace blends imperceptibly into a ridge of solid stone. I had set Chorolque as my next objective, which is about one and a half days' ride from Salo. The road to it goes at first through a small but broadening valley covered with a dense thicket of bushes, in which stood a whole forest of "Old man's beard cactus". This cactus attains a height of 4m here and with its columnar upstanding stems whose dark green contrasts sharply with the white hair covering at the crown and with the glossy dark red flowers, it forms a handsome decoration to the landscape.

. . . further from H. Middleditch

This is quite an interesting puzzle, since 4m height is rather outside what would normally be expected as the maximum height for Oreocereus. So a quick conclusion may be drawn that the plants were Trichocereus poco ("up to 4.5m high" - Lexikon), possibly reinforced by Rausch's comment (Lobivia 3;1975) that "whole forests of them occur". However all the illustrations which I have seen of these (and associated) Trichocerei show upright main stems with closely adjacent parallel branches, all having fine spines or possibly hairs which differ little in length, projection, and density from top to bottom of the column. On the other hand, it is the very characteristic of long hairs at the top and shoulders of the crown standing out from the plant, whilst down the rest of the column they are far less prominent, that caused several early travellers to equate Oreocereus with Pilocereus senilis; Hauthal does remark upon this particular feature. In addition, in Abb 712 in Ritter's Kakteen in Sudamerika, there is no great difficulty in picking out the rather sprawling whitish columns branching from near the base as Oreocereus, and the somewhat stouter and somewhat tidier columns branching from part way up the main stem as Trichocereus. In Abb 17 in Hauthal's book we see somewhat sprawling columns, branching mainly from near the base, white hair more evident around the crown, the tallest columns far too slim for Trichocereus (but not for O. fossulatus!). The Oreocereus 'neocelsianus' illustrated in K.u.a.S for November 1985 has a somewhat similar habit. The balance of probability seems to lie with these plants being Oreocereus rather than with Trichocereus

It is possible to locate on the appropriate map the Estancia Salo north of Tupiza, north of that again a hamlet of Almona with the Copacabana mine nearby. West from there, beyond high ground, lies the valley of the R. Guadelope and Rancho Cotani, at the base of Chorolque mountain; the site of Hauthal's Oreocereus is probably a side valley falling into the R. Guadelope. Like other habitat locations, it appears to be on the eastern side of a ridge of mountains, that is on the lee side in respect of the rain-bearing winds.

CLEISTOCACTUS FOSSULATUS— Validation of the Name

By R. Mottram

In the Chileans Vol12 Number 42 (February 1984) a new combination was published for Cleistocactus fossulatus, which unfortunately fails to satisfy certain provisions of the International Code of Botanic Nomenclature. When a new combination explicitly excludes the type of the original basionym, the author is deemed to have published a new name,

and this new name must be validly published in accordance with Articles 32-45 of the Code (see especially Art.33, particularly 33.3 Note 1, Art. 48.1, and Art. 55.2).

It is believed that Pilocereus fossulatus Labouret(1855) was actually Oreocereus celsianus(Lemaire)Riccobono. Labouret gave the type locality as "Chuquisaca", but according to the observations of Ritter(1980) only Oreocereus celsianus and O. trollii may be found in the Department Chuquisaca. The plant described and figured by Backeberg(1934) is known only from the Department La Paz. Therefore it must be assumed that Backeberg made a misidentification, and was effectively describing a new species, although Labouret's type was not explicitly excluded. Article 55.2, example 9, covers this case explicitly, and if we substitute the appropriate names in the example, it reads as follows:

"Pilocereus fossulatus Lab. was transferred to the genus Oreocereus by Backeberg who, however, as is evident from his description, erroneously applied the new combination Oreocereus fossulatus to another species of Oreocereus, namely Oreocereus spec.(La Paz). The combination Oreocereus fossulatus(Lab)Bckbg. must not be applied to Oreocereus spec.(La Paz) but must be retained for Pilocereus fossulatus Lab when that species is placed in Oreocereus; the citation in parenthesis (under Art. 49) of the name of the original author, Labouret, indicates the type of the name."

Thus we have: Oreocereus fossulatus(Lab)Backbg = Pilocereus fossulatus Lab = Oreocereus celsianus-(Lem)Ricc. This means that it is necessary to publish a new description for the plant from La Paz, which follows:

Cleistocactus fossulatus Mottram sp. nov. ab aliis speciebus Cleistocacti areolis magnis circiter 1cm diametro praeditiis pilis albis circiter 5cm longis differt. lores pro parte maxima apice caulis portati zygomorphi viridi-rosei vel malvini. Fructus magnus circiter 5cm. diametro primo pomaceo-viridis postea flavo-virens indehiscens. Semina in pulpa alba inclusa.

Synonymy.

Oreocereus fossulatus Bckbg(1934) pro parte, excl. typ., non Pilocereus fossulatus Labouret(1853)
Oreocereus fossulatus Ritter(1980) nom. inval.(Arts.36 & 37), non (Labouret)Bckbg.

Diagnosis.

Differs from other Cleistocactus species by the large areoles, c.1cm diameter, which bear numerous white hairs, mostly c.5cm long. Flowers borne mostly near the stem apex, zygomorphic, greenish-pink or mauve. Fruit large, c.5cm diameter, apple green passing to yellowish green at maturity, indehiscent. Seeds embedded in a white pulp.

Description.

Stem: up to c.2m high, and c.5(-8) cm diameter, fresh green, with branches ascending from any part of the lower half of the plant.

Ribs: c.10(-13), straight, tuberculate, with sinuous intercostal groove, and areoles set at an angle on the upper side of each podarium.

Areoles: shield-shaped, c.1cm diameter, bearing thick white felt, sometimes pale yellowish brown in youth, and numerous white trichomes (40-60), twisting and matting together, mostly up to 5cm long.

Central spine: 1, prominent, porrect at first, directed downwards later, 2(-5)cm long and up to 1.5mm thick at the base. Often one or more secondary centrals, from the upper part of the areole, shorter.

Radial spines: mostly 10-14, up to 6mm long, like the centrals but weaker. All spines straw yellow, rarely reddish.

Flowers: mostly borne near the top of stem, long and tubular with almost naked scales, variable in colour, mostly greenish pink or mauve, up to 9cm long. Petals short, recurving (especially beneath to present a zygomorphic limb). Stamens and style exserted. Stamens inserted mostly in the lower part of the tube, decreasing towards the mouth, the uppermost on a throat-circle. Nectar chamber with prominent linear glands.

Fruit: large, c.5cm diameter, apple green turning pale yellowish green with reddish highlights at maturity, more or less naked, indehiscent, pleasantly aromatic.

Seeds: embedded in white funicular pulp, irregular in shape, c.1.7mm long. Testa shiny black, with intercellular pits.

Type: Bolivia, along the Rio de La Paz; c.1954, Friedrich Ritter FR100 cult. sub RM4.1 (K, holo.).

Distribution

Bolivia, southern Depto. La Paz, alt. 3000-3500m., along the valleys of the Rio de La Paz, and in the valleys of tributaries. Also reported by Ritter from Calacoto, near the confluence of the Rio Mauri and the Rio Desaguadero. Knize lists plants from Umiri (Oreocereus urmirensis n.n.) and Luribay (Oreocereus luribayensis n.n.) which are believed to be O. fossulatus. Place names cited in this article are shown on the map on the front cover.

Illustrations.

Backeberg: Blatter für Kakteen-Forschung 6.1934, and in Die Kakteenfreund 3(11):122.1934 (top of branch).
Ritter:Kakteen in Südamerika 2:836.1980 (flowering stem).
Andersohn: Cact. & Succ. 235.1983 (habitat scene).
Cullmann, Gotz, Gröner, Kakteen 21.1984 (top of branch with almost mature fruit).

Oreocereus fossulatus v. rubrispinus. Ritter, in Kakteen in Südamerika 2:697.1980 nom. inval. (Art.43)

Type: Bolivia, Prov. Murillo, Valencia; c.1954, Friedrich Ritter FR100a (U, holo.)

Illustrations

Ritter: Kakteen in Südamerika 2:836.1980 (top of branches with flowers and fruit).
Mottram: The Chileans 12(42).1984 (top of flowering plant).
Zahra: Brit. Cact. Succ. J.3(3):55.1985 (top of flowering plant).

The status of O. fossulatus v. rubrispinus is open to question, because it occurs right in the centre of the known distribution of Cleistocactus fossulatus, in the valley of the Rio de La Paz. Plants raised from seed of FR100a are distinctive in the constancy of the reddish spines. However, C. fossulatus is a variable species, differing slightly at each site,

and therefore it would be wise to treat "rubrispinus" as a cultivar, in the absence of clear reason for recognising it as a subspecies.

It is not possible to suggest a cultivar name here, because Art.41 of the International Code for Nomenclature of Cultivated plants(1980) states that "Publication of a cultivar name is not valid if it is against the expressed wish of its originator or his assignee". The originator, as defined by Art.55, is the "breeder or discoverer of the cultivar", which in this case is Ritter and only he, or someone else with his approval, can assign cultivar status to this plant. Moreover, the epithet "rubrispinus" is not allowable under Art.27 (latinised form published after 1.1.59). It is therefore suggested that this plant be referred to as C. fossulatus "Valencia form", or C. fossulatus FR100a, for the moment.

Discussion

Some comment has been made to the author following publication of Icones Cactearum No.1, mostly concerning the generic name, but only Nigel Taylor had spotted the invalidity of the new name.

Rene Zahra writes in BCSJ 3(3):55-57.1985 on various aspects, and concludes that Loxanthocereus may have been a better choice of genus. The Borzicactinae, as formerly circumscribed, may be divided into two natural groups, easily identified according to whether the fruits are solid or hollow at maturity. Those with hollow fruits include Oreocereus, Morawetzia, Arequipa, Matucana, and Oroya. Those with solid fruits include Cleistocactus, Borzicactus (sensu stricto), Clistanthocereus, Seticereus, Bolivicereus, Hildewinteria, and so on. Throughout both groups the flowers display an essentially bird-pollinated syndrome, with a few exceptions, and all possess stamens inserted in primary and secondary series. This feature distinguishes the Cleistocactus group from Haageocereus and Weberbauerocereus, where only a single series of filament insertion is apparent.

In Loxanthocereus, the creeping species (Maritimocereus) show an internal flower structure essentially like that of Haageocereus, with a single series of filaments, and a long nectar chamber generally associated with moth pollination, as in the Haageocereus decumbens group. On the other hand, Loxanthocereus acanthurus has copious nectar, and appears to have evolved a bird-pollination syndrome. At the same time there is no clear gap between the primary and secondary stamens as in Cleistocactus. Therefore it may be concluded that Loxanthocereus has more in common with Haageocereus than with Cleistocactus, in spite of the red zygomorphic flowers. Other columnar species sometimes included in Loxanthocereus are not wellknown in cultivation, and it is possible that they are in any case misplaced in the Loxanthocereus group.

Cleistocactus fossulatus probably belongs with certain species normally listed under Borzicactus sensu stricto or the near allies. The type species of Borzicactus, B. sepium, has quite large fruits, and fruits more or less as large as those of C. fossulatus are to be found in B. roezlii and B. tesselatus. Perhaps the closest affinity may be with B. piscoensis, whose fruits have not yet been described, but already with a chequered taxonomic history. It began life with Rauh & Backeberg as a Loxanthocereus(1956), moved into Borzicactus by Rauh(1958), and recently into Oreocereus by Ritter(1981). However, the crucial data about the fruit remains unknown.

Acknowledgements

Thanks are due to Nigel Taylor of Kew for his guidance on Nomenclatural matters, and for providing the latin version of the diagnosis. Information on the location of various place-names was supplied by Harry Middleditch.

. . . from H.Middleditch

The Department of Chuquisaca includes the province of Nor Cinti and in the northwest corner of that province we find the hamlet of Lecori, which lies not far from a tributary to the R. Vitichi. The 1975 edition of the 1:250,000 map of this area marks a quebrada Lecori; from the map alone it is not easy to establish whether this quebrada is deeply cut in to the Puna plateau. Could it be at a low enough altitude to reproduce the ecological conditions that generate a pulp-filled fruit in the La Paz and tributary valleys? Cardenas tells us that he found what he considered to be the usual Puna type Oreocereus on the plateau not far from here; Knize says that he found a version of O. fossulatus near here. If he did do so, this place is but 60km from Potosi on an old-established and well-used trail, that runs from Potosi to Camargo and thence to Villazon and Jujuy. Why should not Pilocereus fossulatus Labouret have been obtained from here (i.e. from Chuquisaca Province) by one or other of the visitors from Europe who came to these parts on mining speculations or other travels?

. . . from G. Charles

Some years ago now I acquired a selection of Oreocereus seeds from Knize under various species names, including O. urmirensis and O. luribayensis. Both of these are still with me and look no different from what I take to be O.fossulatus.

. . . from R. Zahra

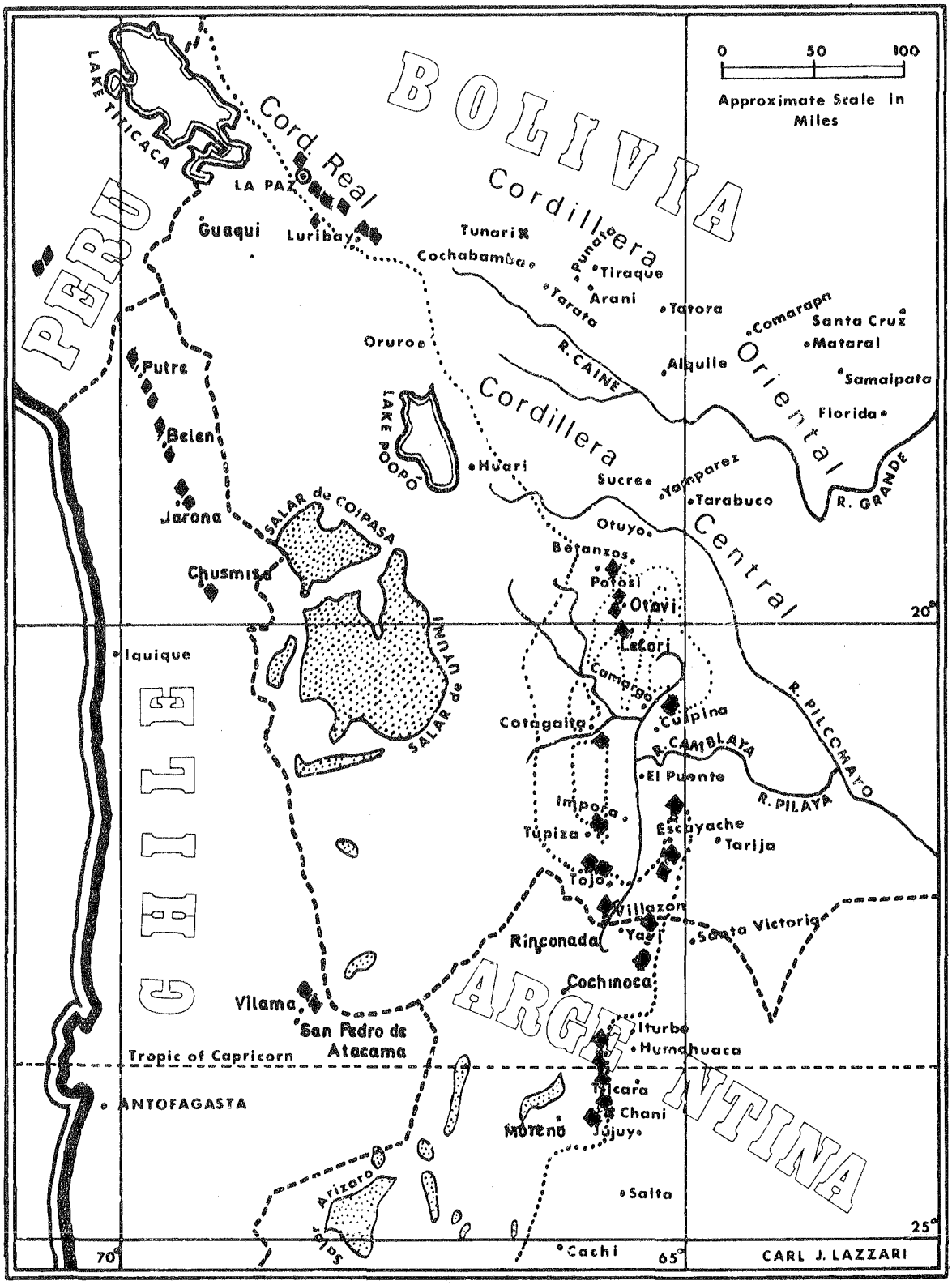
In the past few years I have grown many Oreocereus from seed which was bought directly from Knize. These include the following species names:—

O.fossulatus
- arboreus KK8943
- magnificus KK881
- ritteri KK1116
- culpinensis KK885
- densilanatus KK117

O.varicolour KK887
- hendriksenianus v. bruneispinus KK1332
- urmirensis KK888
- albilanatus KK890
- lecoriensis KK1334

O.neocelsianus v. atrohorridispinus KK893
- luribayensis KK1336
- giganteus KK893

Although I have not seen these plants in a mature form, I believe that KK890, 984, 885, 893, 892, 446, 1334, 881, and 900 are all forms or at most varieties of the old O. celsianus (or neocelsianus). Knize's KK466 and for that matter all his other O. fossulatus listed plants, some of which I have seen in other collections in Malta, are all O. celsianus. These all grow in much the same way. Their growth is slow, they are at first rather globular, and have a rather thick covering of long hairs. On the other hand KK888 and KK1336 are very similar and even though I now have plants 24 inches tall I cannot find much difference between them and my six feet tall O. fossulatus v. rubrispinus FR100a. Like Ritter's O. fossulatus they are both slender, grow rather quickly, and have little hair.



EASTERN BOUNDARY OF ALTIPLANO

REPORTED LOCATIONS FOR OREOCEREUS

GEOGRAPHICAL DISTRIBUTION OF OREOCEREUS

. . . further from R. Mottram

I have grown from Knize seed all the Oreocereus names mentioned by Rene Zahra and my conclusions as to their identity agree more or less with his. Knize's "urmirensis" KK888, and the "luribayensis" KK1336 appear to agree with Ritter's concept of C. fossulatus v. fossulatus. However as Rene says, seedlings of "lecoriensis" KK1334 are definately O. celsianus. Not only is this apparent from the plants raised from Knize seed, but I also checked the seed itself, which is unquestionably that of O. celsianus, not C. fossulatus.

Therefore, unless there is evidence to the contrary, Knize's "lecoriensis" may be discounted. All his varieties of O. fossulatus from Potosi and Chuquisaca are indeed O. celsianus assuming his seed distributions are correct, and we may not even rely on that. Knize has a terrible habit of substituting species of similar appearance to that requested by the buyer, but retaining the name requested by the buyer. Thus we have a large number of plants raised from Knize seed under the name O. densilanatus KK1117, which are now proving to be C. fossulatus; also once again I have checked a packet of Knize supplied seed labelled O. ritteri which are in fact C. fossulatus. On the other hand I received some years ago top cuts of O. densilanatus KK1117, which were correct for that species. His supplies of seed have been unreliable for most species, but even more so for columnar species. If you grow any of his Trichocereus, you are likely to have either T. chilensis or T.tacquimbalensis, irrespective of what name was shown on the packet. If you order any seed of Eulychnia, you are likely to have E. acida only. And so on. Whether the plants exist for some of the names he has raised, we can never be sure.

. . . further from H. Middleditch.

Well that does seem to put paid to any idea that Oreocereus fossulatus might be found in the Potosi-Lecori area, at any rate on the Puna in that area. But when I refer to Ritter's Kakteen in Sudamerika Vol2 Abb 700 I see that the illustration is of a plant found by Ritter near Calacoto; Ritter does not specifically say it is the Calacoto from the confluence of the rivers Mauri and Desaguadero, a location which falls into an entirely different sort of climatic regime to that which exists in the La Paz river basin. On referring to the 1:50,000 scale map of La Paz (south) I find that there is a Calacoto just downstream from Obrajes i.e. in traditional O. fossulatus distribution territory. So I would suggest that this is the Calacoto in question.

In arguing the case for having Oreocereus fossulatus placed in Loxanthocereus, rather than in Cleistocactus, Rene Zahra suggests that the deep ribs of FR100a are divided into tubercles and "this feature is not met with in Cleistocactus, except for Cl. laniceps which is not very typical of the genus". It is interesting to note that in the Buxbaum-Krainz "Die Kakteen" the description given there for Cleistocactus includes "columns with numerous low rounded ribs which are often divided by cross-grooves between the areoles"

. . . from F.Ritter, Kakteen in Sudamerika 2:1980

Oreocereus Fossulatus v. rubrispinus

Fruit greenish yellow to yellowy-brownish red, ellipsoidal, spherical or somewhat flattened, at the base somewhat pleated; scales barely visible, occurring in dimples, sparse, little hairs few or absent, bowl elongate, 5-10mm wide and 5mm deep, with persistent flower remains, filled with fairly sweet pulp, that yields watery juice under pressure. The fruit does not burst or not till overripe, usually it is picked off by birds and the inside eaten out (The pulp does not yield water under pressure, but a thick juice).

Oreocereus fossulatus v. fossulatus

Seeds about 1.6mm long, 1.4mm broad, 1.2mm thick, dorsal somewhat keeled, testa black and glossy with compact shallow tubercles, apical tubercles blending into lacunae, hilum area very depressed, nearly the size of the cross section of the seed, slightly oblique, funicular scar forms a significant part of the hilum region, micropyle small. Seeds very different from O celsianus and O. trollii but similar to O. tacnaensis (Peru). Since I have no seed samples of V. rubrispinus, I do not know whether this seed differs from v. fossulatus.

The type location for v. rubrispinus is Valencia, Rio la Paz. This variety grows from there, downstream to around Tarata. The v. fossulatus goes much further upstream and downstream. Upstream its distribution reaches Obrajes below La Paz, downstream I have not been able to establish the end of its distribution area. Below Tirata there is no longer a road, although one can travel further by mule or on foot. I rambled for several days on foot downstream into an uninhabited canyon, which is usually impassable in the rainy season. In the dry season it is made very difficult on account of the frequent crossing of the fast flowing La Paz river. I reached as far as below the confluence of the Araca river at about 1600m altitude, where v. fossulatus with stronger growth of hair is still abundant. Upstream it goes nearly up to La Paz at about 3300m. Below the confluence of the Araca, the canyon is disrupted by a very deep fissure and becomes impassable, so that this area has not been searched for cacti by me. Oreocereus fossulatus goes down to the lowest altitude of any Oreocereus spp.; it still grows at 1600m altitude in a frost free area, where bananas thrive. Both the undoubtedly valid varieties of this species are regionally variable. At the type location for v. rubrispinus, there is also v. fossulatus to be found and right there the former gets closer, with slight hair growth, that is probably due to occasional crosses. Near Caracoto the v. fossulatus is typical, but with slight hair growth. At the confluence of the R. Caracoto with the La Paz river this sort takes on a form that one could place in v. rubrispinus, which however is to be reconciled with v. fossulatus in that it is thinner, less hairy and only to some extent red spined, often even yellow spined.

. . . further from H.Middleditch

In the course of travelling down the Rio La Paz valley to the confluence with the Rio Araca, Ritter must have passed the confluence with the Rio Luribay and also with the river from Urmiri.He records that he found Oreocereus fossulatus growing as far down the La Paz valley as the junction with the Araca, so it would hardly be surprising to find that it also spread up the valley to Urmiri and up the Luribay valley. Hence the similarity of Knize's O.luribayensis and O. urmirensis to O. fossulatus.

The description given by Ritter of the differences between v. fossulatus and v. rubrispinus would seem to lie very much in the eye of the beholder, especially when taken in conjunction with his observations on variation from site to site. But it would be very interesting to find out just what Ritter had in mind when he says that the seed of O. fossulatus was not the same as that of O. trollii or O. celsianus.

THE STEINMANN, HOEK and BISTRAM EXPEDITION

By Dr. H. Hoek and Prof. Dr. G. Steinmann

Translated by H. Middleditch from Petermann's Geographische Mitteillung No.2 1906.

On 4 January we left Oruro, where the railway from Antofagasta ends. The commercial route from Oruro to La Paz, a distance of some 250km, runs more or less parallel with the great ridge of the eastern cordillera which is a continuation of the Illampu-Illimani ridge to the south of the break cut by the La Paz river. Along the whole of this route the high snow-capped mountains can be seen rising directly up from the high plateau; but this is only an illusion, because a deep and virtually impassable valley system, that of the R. Luribay, is sandwiched between mountains and plain. The R. Luribay flows northwards into the R. La Paz. In consequence Oruro is the best starting point from which to explore the Cordillera Santa Vera Cruz.

We took the route over the Pampa Oruro to Caracollo, where we left the La Paz road to follow the Cacapongo valley to the Carapecheta pass, reaching Colquiri by midday. The next day the road crossed over gentle undulations towards Ichoca; it was an arid, sterile landscape, occasionally marshy, generally bleak and monotonous,, with gloomy, misty weather. Around noon we came to the deep valley of the R. Sayaquira with Ichoca perched part way up on the opposite flank like an eagle's nest. The river ran down to the Yungas, the road took us on to Yaco. However there was no good road westwards from Yaco, only some very hazardous footpaths over the adjacent ridge and across the Luribay valley to the plateau.

To the west of Yaco as far as the Luribay valley the vegetation which is usually called the Puna in Bolivia has the character of a sterile, arid half-desert, due to the climatic regime of the high plateau with its wide range between day and night temperatures. It is very striking to observe a richer vegetation only in the area of the La Paz valleys, whose deep entrenchment makes a huge incision through the mountains. This richer vegetation is displayed even on the west side of the mountain chain for as far as the effects of the moisture and warmth of the east wind extends, that perpetually streams upwards through the gateway of the La Paz river to the cold heights.

The northward extension of the Vera Cruz group is the Quimsacruz, forming a chain of snow-covered peaks. We moved off northwards between the Quimsacruz chain and the valley of the Luribay, going uphill and downdale, over passes up to 4369m altitude. It was a most rugged, barren countryside bare of provisions. It was not possible to obtain fodder for the mules. To the west was a typical view over the numerous valleys with streams and rivers feeding the Luribay, as well as over the great trench of the Luribay valley itself across to the plateau into which this valley system had been cut. Looked at from above, the margin of the pampa opposite seemed to drop like a wall at a tremendous clean-cut brink.

For two days we worked our way northwards parallel with the Luribay river and the chain of the Quimsacruz until we reached the upper part of the Araca valley. The R. Araca flows into the La Paz. Where we first met the Araca valley it was quite broad and even, treeless, but often cultivated with several hamlets almost out of view in the rolls of ground. From here the view of the isolated peak of Illimani over the deep La Paz valley with billowing clouds down below to the east conveyed an indelible impression. We were able to visit the Vilcoto valley whose exit lies about 200m above the floor of the Araca valley.

Even on the western flanks of the mountains to the east of the Araca valley the tree vegetation in the form of Quenoa ascends nearly up to 4000m altitude. In habit this tree is similar in its slender, matt leafage to the great olive trees such as on Corfu. A traveller from Araca going to La Paz must make the long descent to the La Paz valley which is reached at about 1800m. All the water flowing to the west from the cordilleras of Illimani, Araca, Quimsacruz and Vera Cruz collects together into the La Paz river which then breaks through this chain to the east. The trail follows the La Paz valley or rises to the Finca Cotana, whose grounds stretch from the valley to the mountain snows. In sheltered nooks in the valley it grows sugar and bananas; higher up grow pears, peaches, quinces, etc whilst on the highest turf browse sheep and Llamas. From there we went to La Paz over the route so excellently described by Conway.

. . . from H. Middleditch

The writer refers to the high altitude vegetation which was encountered between Yaco to Araca and observes that it was richer than that between Oruro and Yaco. He attributes this to the warm, moist air feeding up the La Paz river system; this deduction is not correct. As Troll explains (Petermann's Mitteillung No 1/2 1927) this band of moist vegetation follows the western flank of the Eastern Cordillera over a very considerable distance. It runs from Araca, along the Quimsacruz, and Vera Cruz, then follows the Mazo Cruz to Tunari, eastwards along the Cordillera Oriental towards Santa Cruz then south as far as Santa Victoria. The eastern flank of the Vera cruz and Quimsa cruz descends rapidly to the moist lowlands below. Southwards from about Yaco the Cordillera Real splits into the Cordillera Central and the Cordillera Oriental (see map on page 30); between these two main ranges there are several mountainous ridges separating the eastern edge of the broad altiplano from the high peaks that cut off the moisture-bearing winds. Only where the one major ridge of the Cordillera Real separates the forest and the Altiplano is there enough moisture overspill on the lee side to feed rivers and form the La Paz Luribay system; so the entrenched river system and the high-altitude moist zone both cease together. Equally both were met together by the expedition travelling north from Oruro.

In speaking of the view from the flanks of the main Cordillera over the tributaries to the Luribay and over the Luribay itself, the writer refers to the margin of the "Pampa" opposite. He uses this term here in the sense of an extensive, almost level plain, irrespective of it being at high altitude.

When describing the Vilcoto as a hanging valley at its meeting with the Araca valley, the writer takes this to be the effect of glaciation in the main valley. But the physical geography is exactly the same as that so clearly displayed by the slide shown to the Chileans Weekend by R. Hughes, taken in the Sorata valley. Both sheer-walled gorges with hanging tributaries are most likely to have arisen from rapid lifting of the Andes, giving existing rivers more rapid slope and hence much enhanced erosive power, leading to them deepening their existing valley track and leaving small tributaries as hanging valleys.

. . . from H. E. Gregory, The La Paz Gorge

From Viacha to Alto the floor of the Altiplano is remarkably flat and slopes westwards at the rate of forty feet per mile. No hills rise above the gravel-strewn floor which appears to extend as an unbroken surface to the foot of majestic Illampu. At Alto a surprise awaits the traveller for here, without preliminary warning in the form of change of slopes or eastward-flowing streams, one finds himself on the brink of a canyon cut to a depth of 1500 feet. At the foot of the canyon lies the city of La Paz. On descending the canyon walls it is found that the floor of the canyon is by no means flat, but is cut by streams which flow in gorges one hundreds feet and more in depth. Between San Jorge and Obrajes the La Paz river has sunk its bed into eroded strata through deposits of gravel which stand as near vertical walls fifty to one hundred and fifty feet high. The material is excessively coarse and contains boulders of granite six inches to six feet in diameter

. . . from H.Middleditch

Once again we find clear evidence of the effect of Andean uplift where increased slope with consequent increased erosive power has enabled rivers to transport large stones from highest reaches and deposit them as terraces where the slope becomes less. That the river has subsequently been able to excavate a deep gorge into these terraces must have been due to a later, second, period of uplift. Lest it be thought that this is only of academic interest to geographers and has nothing to do with cacti, one need only refer to the frequency with which Rauh mentions that cacti are to be found on river valley terraces in Peru. The effect of these uplifts is that the Flora must adapt to a higher altitude climate. Where cacti previously growing at a lower altitude are still in the process of adapting to the higher altitude they retain certain features which display close links with their lowland bretheren and at the same time possess features common to other types of highland cacti, a situation which often cannot be readily accomodated with orthodox taxonomy.

. . . from Sir Martin Conway, The Bolivian Andes 1901

Our steamer passed down a canal cut in the shallows off Puno and so out into the bay.....we passed through the narrow Tiquina strait.....and anchored off the Bolivian port of Chilaya. A so-called Tilbury was awaiting us. It proved to be an ordinary light American wagon drawn by four mules. The whole of our drive from the lake to the edge of the La Paz basin lay along the high Bolivian plateau, here called the Puna. This plateau stretches southward for several hundred miles at about the same altitude. At the time of my journey (at the end of August) it was held in the bonds and drought of winter. One or two insignificant streams were passed, expanding into occasional ponds, the surfaces of which were so stoutly covered with ice that they had to be broken before the horses could drink. The air was bitterly cold and until the sun had climbed fairly high we suffered considerably from chill.

When the small hills of Chilaya had been left behind the great mountain range on our left became visible, the nearest mountain about twenty miles off. In the main we saw it throughout the day as a long white wall rising at the top of a series of gentle slopes cut up by deep valleys. The road was a good enough track and fairly level, so that by changing horses every couple of hours we were able to make a good pace. As the day advanced the bright sunshine and the crisp air became most exhilirating. Before noon white clouds began to mount from the hot valleys on the far side of the cordillera and showed themselves over the crest of the range; this we afterwards learnt to be a daily phenomena. In fine weather at early morning the range is generally clear, but long before sunset great masses of clouds that come up from the hot, damp east, pouring over every pass, bury the mountains out of sight and drift down onto the plain, bringing occasional thunderstorms with them. In the months of June and July I believe that this eastern cloud does not appear, but in 1898 it came regularly throughout August, September and October, gradually increasing in size and in the frequency of the storms to which it gave rise. In November and the succeeding months it settles down on the country as a rainy season, lasting until the following April or May.

Thus hour succeeded hour and we became more and more thickly enveloped in dust till there was no difference between the colour of our faces and our clothes. Before the afternoon was far advanced, a long, gentle upward slope reduced our pace and hid all view ahead. When I least expected it, the leaders dipped over the edge of a rise, turned sharp to the left, and as the carriage followed them we found ourselves, without warning, on the edge of a cliff which dropped some 1600 feet to a great basin. Below us lay red-roofed La Paz. It is the immensity of this great excavation and the barrenness of its walls that impress an observer. All the forms are those made by an apparent torrential flow of water, which cuts deep gullies and eats back into the cliffs. Yet, except in the traces of its action, there was no sign of water; all was dry and baked and bare.

THE LA PAZ BASIN **By Prof T. Herzog**

Translated by H. Middleditch from Pflanzenwelt der Bolivischen Anden, (Vegetation der Erde XV) 1923

The outlying ranges of the high glacier-dotted Cordillera Real take the form of a belt between the inter-andean tableland (Puna or altiplano) and the subtropical canyons entrenched in its margin. My profile of the vegetation takes in a cross section of the Araca section of the Quimsa Cruz, starting in the almost desert like bare rocky canyon of the La Paz river with its side valley the quebrada Araca. Here it works its way up from about 1700m to over 3000m over steep, stony slopes overgrown with cacti and Puyas that belong to the arid zone and form the characteristic picture of rock steppe with succulents and thornbush. These valley walls correspond in their vegetation to the inter-andean xerophytic associations up to a similar altitude in the Cochabamba valleys, where they carry a belt of shrubs with Psorelea and Mutisia viciaefolia at almost the selfsame altitudes. Precisely the same situation turns up again in the upper part of the Araca valley, where round about the altitude of Toropampa i.e. at the Finca Teneria, around 3200m altitude, likewise a half-mesophytic bush zone appears and covers the valley sides up to about 3700m. Psoralea and Mutisia are also very abundant here in a mixed shrubbery of Dodonaea, Kageneckia lanceolata, Schinus dependens and other representatives of this plant Association. A great part of the terraces built up in stages one above the other are converted into magnificent luxuriant gardens by means of the water conducted to them, where eucalyptus, laurels, pomegranates, and peach trees crowd and masses of roses swell over the garden walls. On open fields cereals are cultivated ; small hamlets and farms nestle in the folds of the countryside. Like the

surroundings of Cochabamba this is the region of country houses with their handsome gardens. Then follows, again with photocopying accuracy, the belt of Polylepis groves up to about 3,900m, here and there with undergrowth of Baccharis bushes and Dunalias. Also here, upwards from the bush belt, a creeping Passiflora with a riot of blooms, corresponding to the scenery near Cochabamba. Above the thickets of Quenoa (=Polylepis – H.M.) which end at about 4000m in stunted scattered outlying specimens, follows the turfed slopes of the high mountains, which ascend up to about 4600m in the walls of the scarps and reach up to the base of the mountain rock. Above that lies the rock and scree fields, in which dwarf shrubs are still to be observed.

(There follows a table of typical species collected in this area. For the mountain ridge between the La Paz valley and the Araca valley is noted "Many cacti especially silver haired Pilocereus spp. and Puya". For the bush formation on the terraces of the Finca Teneria, forty two plants are named, none of which are listed by Fries for the cactus, azorella, or hoffmanseggia formations which he describes for the Puna vegetation in northwestern Argentina; Herzog's list for this belt does however include "occasional Pilocereus and Puya". For the upper section of the half-xerophytic bush formation from 3200 to 3700m are noted "some trees and Pilocerei".The trees in question are likely to be Quenoa — H.M.)

In the La Paz valley the lowermost zone upon the drier side of mountains corresponds here to the belt of Mutisia viciafolia and Psoralea glandulosa, which we have already met with near Cochabamba (where it was located at a lower altitude) and on the valley wall near Teneria at the foot of the Quimsa Cruz Cordilleras. The lower section of the xerotherm Formation of thornbush and succulents is absent around La Paz, though starting when one descends the La Paz valley in a southwesterly direction, only a short distance downstream, where one often passes through whole thickets of cacti, planted like hedges; some Opuntia and Cerei even advance up to La Paz.

. . . from H. Middleditch

The La Paz valley and its tributary valley the Araca, are described by Herzog as subtropical canyons, despite their upper levels joining on to the harsh Puna vegetation zone. This must surely be due to the very considerable depth to which these valleys are entrenched into the altiplano. Evidently this generates an environment in the depths of the canyon which is quite different from that on the Altiplano or in the quebradas cut down for the odd hundred metres or so below the level of the plateau. It appears that Oreocereus trollii, O. celsianus, and O. hendriksenianus are to be found on the Altiplano, at the margins of the plateau either at the foot of bordering mountains or in the heads of entrenched quebradas. In comparison with the plateau, it would be expected that in these deep canyons the relationships between flowers and flower-pollinating agents are different. Also that in these canyons the conditions for seed distribution, survival, and germination, differ from the conditions existing on the plateau.

In these canyons we find Cleistocactus such as C. luribayensis with a fruit filled with stiff pulp, the sort of fruit that does not occur on the plateau. Here we also find Oreocereus fossulatus, with fruits filled with stiff pulp,like Cleistocactus. Ritter tells us that the fruit on the Oreocereus found on the Pacific flanks of the Andes vary from those that are full of stiff pulp to those that are dry and hollow on maturity. He quotes O. tacnaensis with a fleshy fruit and Johnson has already told us that this Oreocereus is found down to 2200m altitude above Tacna, a much lower level than any other reported findings on this flank of the Andes; does O. tacnaensis have a fleshy fruit because it grows at a lower altitude than the rest of the Oreocereus in that belt? Or because it comes from the northwesterly section of the distribution range where the slightly moister climate brings about the changes already noted in SW Peru? But this latter alternative is not really correct because Tacna is nearer the middle rather than at the NW end of the Oreocereus distribution range. So are we left with the lower habitat altitude as the only viable explanation for the fleshy fruit on O. tacnaensis – which appears to be an equally viable explanation for the fleshy fruit on O. fossulatus? But in the Winter seed catalogue for 1955 we find O. tacnaensis FR124 quoted from 3500-4000m altitude, which is a typical altitude for the Altiplano.

Did Knize describe as O. fossulatus some of the Oreocereus which he found to the southeast of Potosi, because they had a fleshy fruit and not a hollow fruit? And what sort of altitude do they grow at? So do we expect the "Pilocereus" found by Herzog at around 3700m altitude on the ridge between the Araca and La Paz valleys to have hollow fruit, just like the other Oreocereus which grow at this altitude under the same climatic regime? Do we expect the fruit will become steadily more fleshy as the altitude at which the plants are to be found decreases, until we are down to the altitude of O. fossulatus? It is some seventy years since Herzog made these observations and it does seem a little odd that none of the many collectors who have passed that way in the intervening years appear to have paid attention to this rather interesting patch of ground. But as Roberto Kiesling observed at the time of his visit to Britain, the extension of the railway network into NW Argentina (and southern Bolivia) in the early 20th century displaced thousands of pack mules; after the introduction of the automobile even fewer remained. So out-of-the-way places became even more inaccessible; Herzog used horses and pack mules to visit this ridge between the deep Araca and Luribay valleys which terminates at the even deeper La Paz valley. Is it difficulty of access that has put off travellers and collectors; is this why we have no material available to tell us if there is a transition from O.celsianus to O. fossulatus – from hollow fruits to fleshy fruits?

. . . from Sir M. Conway, The Bolivian Andes 1901

The three days of my stay in La Paz were fully occupied. The baggage had to be unpacked and repacked, the necessary mules hired. I was taken to the Meteorological Observatory of the Jesuits where I compared my barometer with their standard....The first work we had to undertake was the ascent of Illimani.....The exit from the great basin of La Paz is by the narrow valley of the La Paz river; this is delved out of the deep alluvial deposit whose grey and brown substance, cut up into queer shapes by the torrents of the rainy season, forms the barren sides of the gorge. A mile or two below the town comes the village of Obrajes which is not only lower and more sheltered than La Paz, but is well supplied with water and has some flat and fertile ground. Here were peach trees in blossom and cactus hedges which a few weeks later were covered with beautiful wax-like flowers of the most delicate hues. There were graceful willow trees and and quantities of lupins growing wild.

Crossing the mouth of the Calacoto valley we entered a narrow defile where traces of the powerful denuding action of the rainy season became very apparent. Our path led by steep zigzags straight up the cliff. Here there were deep

crevasses cut far down into the earth, scooped-out caves, and great hollows with narrow necks like bottles; of course the cut-up surface was of no great width – a hundred yards or so – merely fringing the top edge of the cliff. I presently discovered that the portion of the alluvium we were now traversing had a different origin from that out of which the La Paz basin had been scooped; the La Paz river in process of time cut a canyon through this material, so that today only portions of it are left. For a mile or two our way lay along the top of this terrace; the road was lined on both sides by a close hedge of cactus. We descended to the river bank to water the mules, three and a half hours from La Paz; now we mounted high up the steep slope of the left bank. The valley was no longer cut in alluvial deposits, but in the rocky substance of the hills, against which bits of terrace were plastered here and there. At last we came out on another flat terrace.

It was evident that we were descending to a substantially lower level. The air felt oppressively dense; the heat, falling directly from the sun or reflected from the bright slopes around, was most oppressive. Passing the hamlet of Carrera, we continued the descent of the valley; for the most part our way lay down a barren trough with great bare slopes rising steeply on either hand. Just at dusk we reached Huaricana; black night overtook us and at last I saw a light in the distance. It was the hacienda of Millocato where we were to spend the night.

To take advantage of the cool of the morning, I was up betimes. We trotted along the valley bottom, over a mud flat; then came again into stony ways. At Esquina de Pongo we passed the mouth of a deep side valley and in a couple of hours came to the richly cultivated oasis named Tirata, where the track passed alongside a sugar plantation. The contrast was striking between the tropical luxuriance of the foreground and the barren hillsides rising all round. Below Tirata the valley narrowed to a gorge; steep cliffs approached one another from both sides. The sun shone down into our trough with scorching power; the heat was overwhelming and the very rocks seemed to be ablaze. Two hours further down at the farm of Lurata we could quit the hot hollow and turn up towards the cool heights. The desert bottom was exchanged for a cool track among vineyards. Gaunt cactuses covered the uncultivated slopes above the farm. Soon there came in sight a large area of orchards ahead. The track widened into an avenue of Eucalyptus trees, leading to the hacienda of Cotana.

In the morning I was taken over the orchards of Cotana and shown the great plantations of peach trees, and the orchards of apples, granadillas, oranges, lemons, and vines. In the afternoon we went out shooting and made a mixed bag of pigeons and partridges.....a ride up green slopes brought us to the higher farmhouse of Caimbaya, from where I climbed a detached hill. From this commanding eminence was a full view of the long La Paz valley sweeping in a great curve round the mountain's foot; beyond arose the barren slopes stretching up to the fringe of the high Bolivian plateau. [Approaching the snow line]...we overlooked a sea of clouds that swept up the La Paz valley, hiding the lower levels from our sight and almost but never quite enveloping us. [Descending from the peak]...our descent from Caimbaya led us down to the farm of Atahuaillani..... Bidding farewell to our hosts, we descended amid an ever-increasing wealth of vegetation. Shrubs just bursting into flower, some of the most fragrant scent, over-arched the track.... Just at sunset we passed through the village of Cohoni. The air grew sensibly warmer and thicker as we descended. Dense vegetation flanked and roofed the way. A tall broom with a large blossom filled the air with rich perfume. It gave place to I know not what other tropical vegetation. The night grew blacker and blacker.....at last we came to the hacienda Taguapalca. Before pursuing our way next morning we were conducted over the orchards where coffee grows and fruits of every sort – figs, grapes, oranges, olives, apples, granadillas, lemons, peaches, bananas, chestnuts and many others....We soon entered the La Paz valley at Esquina de Pongo, and thence rode back to the city by the way we had come.

. . . further from H.Middleditch

Vegetation more different from that to be found on the Puna it would be difficult to imagine. Clearly the environment in the La Paz valley is not just slightly different from the Puna, it does indeed fit Herzog's description of a tropical valley. So it is hardly surprising that the Oreocereus growing under these conditions show an adaption to this difference from the Puna environment by their fleshy fruits.

. . . from F. Ritter Forty Years' Adventuring.

July 1953. In the dry season one can reach the hacienda Tirata in a pickup that travels daily downstream from La Paz. From there only a footpath for mules, llamas and pedestrians goes further downstream.

September 1954. Coming from La Paz I was on a lorry approaching hacienda Tahuapalca which lies at the foot of Illimani, in a gorge which empties out from the north into the La Paz gorge. I rambled upstream in this affluent and soon found a new Cleistocactus on the steep sides. I published it as Cl. granjaensis. I wished to ramble further upstream to the well-known town of Palca where I would have the chance of travelling back to La Paz on a lorry. Usually only a little brook ran in the gorge but it had swollen to a raging torrent on account of the terrific thunderstorm which had burst on the slopes of Illimani.

June 1958. This morning I went in a lorry to Mecacapa which is in the La Paz gorge, where I collected seed of the Oreocereus there and took photographs of the flowers.

A VISIT TO LA PAZ **From J. D. Donald**

In the course of a visit to Bolivia in 1984 a brief stop was made at La Paz. From here an excursion was undertaken via the shortest route over the Cordillera and down to the Yungas or forest area, as far as Corioco and Chullumani. In addition, one or two trips were made for a short distance both up and down the valley from La Paz.

The city of La Paz lies in a great hollow which has been cut down by the La Paz river and its tributaries into the more or less level surface of the Altiplano. Around La Paz this hollow is about five km from rim to rim. The floor of the hollow is of deep alluvium which is several hundred metres thick or more. At a number of places on the floor of the valley one can look across to the lower walls of the valley which are virtually vertical in places. These walls have been cut up into a facade of pillars and buttresses with re-entrant niches, interrupted to a greater or lesser extent by steep slopes. These immediate valley walls may rise to a height of up to one or even two hundred feet; above these walls there is often a flat terrace such as that on which the Miraflores section of La Paz is built. Above the terrace the valley sides run up to the rim of the great hollow, sloping steeply, cut by gulleys that could often be called ravines, running straight down the valley sides to the valley bottom. Between the major gulleys the valley side is in the form of sharp backed sloping ridges. The slope of the sides does not vary a great

deal, usually 45° or steeper. All the relief is sharp in outline for there are no gently rounded spurs or slopes.

The ground is generally covered with bare broken rock and sand, with just patches of vegetation here and there, in the form of coarse grasses, spiny shrubs, leguminoseae especially a small blue-white lupin, and several other choice andean endemics which occur within the stands of cacti. There are occasional patches of trees, but these are only in or near the bottom of the main valley. As I only saw Eucalyptus I take it that all the trees are introduced. The shrubs are mostly yellow flowered and some of the spiny shrubs have very hard spikes several cms long as bad as, if not worse than, aborescent cacti. These shrubs are usually about one to one and a half metres in height though the odd few exceed this height. Generally the shrubs stand apart from each other, often several metres apart, and only rarely do they form a thicket. Once on the slope of the valley sides, the main impression is of bare ground with a sprinkling of vegetation. This vegetation is less sparse in places, but overall there is a preponderance of bare ground. Like the other vegetation, there are more cacti in some places, but equally other patches lack cacti altogether. The general impression, outside the valley floor, is of an arid landscape with xerophytic vegetation.

Apart from the vertical walls at the edge of the terraces, there are few places on the valley sides where it is too steep to climb, or scramble. Walking up the dry bed of a gulley is usually fairly easy as it is often a modest slope; it is possible to stand upright and walk directly up most gulley sides, but much easier to tack up or down. We walked over sloping surfaces covered with a layer of stones and sand, but we saw only a few spots that might have had a fair depth of loose material and might have been as hazardous to tackle as slate scree. On one or two occasions I did lose my footing on loose stony debris on a steep slope and took a tumble, luckily without too much damage to self or camera. On the other hand we did not see any outcrop that looked like solid rock for most of the exposed ground looked like compacted alluvium.

Opuntia, Tephrocactus, Echinopsis, Corryocactus and Oreocereus grow abundantly here. Tephrocactus grows high up on the flat tops of the terraces, Corryocactus and Oreocereus on the steep sides of the ravines, Opuntia and Echinopsis at the bottom of the gulley or valley. Obviously the separation is not exactly quite as neat as that, but gives and idea of the general tendency and the favoured areas for each genus. The Echinopsis and Opuntia may even grow quite surrounded by, or alongside, grass and herbs, but other plants stand surrounded by bare ground, all usually accompanied by a scattering of bushes.

The Oreocereus are often accompanied by bushes which may be growing one or two metres apart or much more sparsely scattered. For practical purposes we did not find any Oreocereus growing on level ground; usually it occurs on the steeper slopes which make up most of the terrain. Sometimes it is clinging to an edge or step in an otherwise nearly vertical ravine wall. Occasionally two or three plants of Oreocereus will form a cluster, but mostly they grow three or four metres apart or even more scattered. One will sight a group of plants extending along a slope for one or two hundred yards and then it is usually a much greater distance before the next patch of Oreocereus appears.

The Echeverias were a real surprise to me as I had not expected to meet them at this altitude. Plants of Echeveria whitei were found to the south of the city, on the east facing side of the valley. The built up area of La Paz now extends southwards from the old city all the way through Obrajes to Calacoto, so La Florida becomes the first place where one would be sure of finding anything green and wild. Here there is an area of accessible slope about 50m wide on the north side of the river valley that is quite densely covered with scrub and herbaceous vegetation amongst which one can find Echinopsis, Opuntia, Echeveria, and non-succulent Euphorbiaceae. On the higher, steeper, bare slopes grow Corryocactus, Oreocereus and Tephrocactus which needed a little more agility to reach than I felt able to muster.

Our visit took place in the month of April, when the summer rains are nearly over, but their effect could still be seen in the green of the vegetation. An occasional bud was seen on Corryocactus, and even one or two flowers on Oreocereus, but very very little in the way of fruit. We went down the La Paz valley for some five or six km, not quite as far as Carrera, and a similar distance up the valleys of the Chocayapu and Chuquiaguilla rivers, which join at La Paz to form the La Paz valley. Plants of Oreocereus were to be seen here and there along the whole of this stretch.

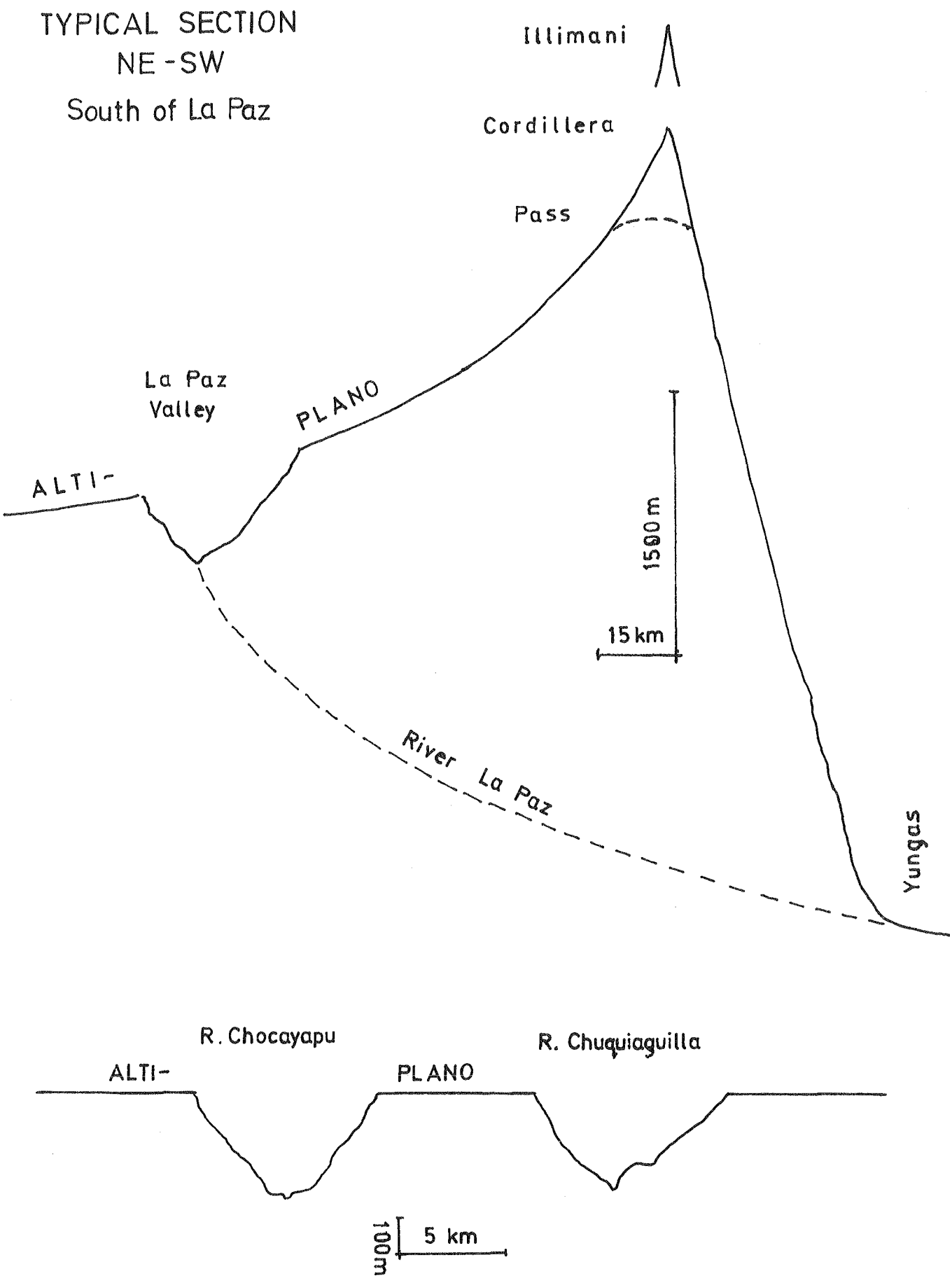
. . . from H. Middleditch. This last comment is most illuminating for it takes the occurrence of Oreocereus further upstream than I have so far found recorded in the literature. Naturally the river valley is gaining altitude upstream, but here the course of the river is at right angles to the main cordillera, to which the surface of the Altiplano also slopes upwards. At the uppermost occurrence of Oreocereus there is probably some 300 to 350 metres between the floor of the valley and the rim of the plateau. But here O. fossulatus is probably growing at some 3850 metres altitude which is a greater altitude than some of the reported finding places for O. celsianus and O. trollii.

. . . further from J. D. Donald

Looking at the copy map by Troll and Finsterwalder which was taken from Petermann's Geographische Mitteillung for 1935 and which shows the valleys immediately north of La Paz, I am really surprised at the detail, especially the contours. In the intervening time, much urbanisation has taken place along these tributaries to the La Paz valley. The city of La Paz now extends up the Rio Chocayapu beyond the uppermost loop of the railway beyond Jachiscala (now Achachicala) to Ferroviario and beyond. The river is culverted from there for most of its length down to Obrajes. We travelled by jeep along the rough tracks up both the Rio Chocayapu and Rio Chuquiaguilla, until we could not get any further. Looking at your copy map, we must have gone up the Chocayapu valley almost to the 4000m contour.The lower reach of the Chuquiaguilla is known today as the Rio Orkojahuira; we travelled up well beyond Finca Chuquiaguilla to El Carmen la Union so here we must have been between 3800 to 3900m. However I do not think that the Oreocereus grew any higher than about 3800m altitude. In any case most Oreocereus were found to the south of La Paz.

. . . further from H.Middleditch.

This does confirm the most extraordinary range of altitude occupied by this Oreocereus, which can only be accounted for by the macroclimate of the La Paz valley being pretty consistent over that part of its length in which these plants are found. The macroclimate must also be quite different from both that of the Altiplano and of the subtropical slopes that lie well above the bottom of the lower reaches of the entrenched La Paz valley. This reinforces the question of the identity of the "Pilocereus" which were recorded by Herzog from altitudes ranging between 2500 to 3700m, when he travelled along the lee slopes of the Cordillera Quimsa-cruz; most importantly, he records these plants from places well up the valley sides. All



TYPICAL SECTION NW-SE North of La Paz

evidence from travellers to the La Paz valley suggests that the Oreocereus fossulatus occupy the arid valley bottoms and immediately adjacent sides, but not reaching up the sides as far as places like Hacienda Cotani where tropical fruits can be grown. So why is "Pilocereus" reported by Herzog from Finca Teneria, which appears to be as far up the flanks of the Araca valley as Cotani is above the floor of the La Paz valley?.

Now in the same publication Herzog illustrates "Pilocereus celsianus" on the Cordillera Frailes; if the bushes surrounding those columnar cacti are indeed between half and one metre high and wide, then those columnar cactus stems are a good half a meter thick and perhaps as much as eight metres high. On this basis the flowers are between three and four inches across and the flower tube is a good inch thick, which makes these plants Trichocereus. Could the "Pilocereus" from the Araca valley also be Trichocereus? After all this site is not that far from the occurrence of Cardenas' Tricho. orurensis. Even closer is Cardenas's Tricho. herzogianus from 'Tirco, Loayza Province, at 2800m'. Although it has not been possible to locate Tirco, nevertheless the altitude quoted can only exist in one of the Rio La Paz tributary valleys. The choice of species name is not altogether without significance.

Fortunately Herzog does provide an illustration of the "succulent steppe" on the slopes of the Araca valley. To judge by the relative size of the bushes and of the Puya sp. which also appear in the photograph, the columnar cacti are probably Oreocereus fossulatus and Cleistocactus sp. This does not completely rule out the possibility that Herzog may have lumped together all the more-or-less hairy columnar cacti as Pilocereus so we could still have Oreocereus in the valley bottom and Trichocereus in a different macroclimate higher up the valley sides.

As Oreocereus are reputed to be humming-bird pollinated flowers, I wonder if J. Donald may have seen any humming birds in evidence anywhere in the La Paz valley?

....further from J. Donald. No we did not see any humming birds in the La Paz valley, although there were plenty of them once we had descended into the forest area on the eastern flanks of the Andes. Indeed there were very few birds to be seen at all around La Paz. On the other hand we did see a great many beetles crawling in and out of flowers in the La Paz valley. I suppose these beetles would be about half an inch long, quite slender, dark in colour. They did not seem to be associated with any flower in particular but appeared to visit flowers on cacti, on the spiny bushes, and indeed anything with a decent sized flower.

...from A. Dereims, Le Haut Plateau de Bolivie, Annales de Geographie, 16, 1907.

The high Bolivian plateau is a region of extreme dryness. During eight months of the year, from March to October, no rain falls at all. During the other four months, which correspond to summer in the southern hemisphere, storms bring about abundant precipitation; these occur most often in the afternoon. The average annual rainfall, based on observations made at La Paz, is 628mm and the number of rainy days is 104. Eight months of dryness is almost mortal to all vegetation. Nothing else is to be found on the surface of the ground other than scattered clumps of Tola, barely sufficient for forage for the llamas which function as beasts of burden. No trees, not even on the flanks of the mountains which surround the high plateau.

In La Paz conditions are quite different. Its altitude is notably less than that of the Altiplano, its temperature is more gentle. With the benefit of irrigation, cultivation has been established downstream in the valley. Some clumps of woodland may be seen here and there in the vicinity of La Paz, which are eucalyptus plantations. Another lateral valley at almost the same altitude joins on to that of the La Paz; this valley of Sapahaqui is a veritable oasis to anyone coming from the plateau. In the excellently irrigated orchards and fields, on sandy-clayish alluvium, I have seen cultivation of asparagus,, of artichokes, of pomegranates, of oranges and citrus fruits; I have seen veritable fields of lucerne, valuable forage for mules. At Chisivisi magnificent vines are to be admired. Almost all the wine consumed in La Paz comes from there and from Macamaca.

OREOCEREUS in NORTHERN CHILE — From R. Ferryman

During a visit to Northern Chile in October-November 1983 we were able to see Oreocereus growing at quite a number of different habitat locations. My own impressions gained at that time were that Oreocereus certainly preferred to be growing on sloping ground. Whether it was a hill or mountain or valley, the Oreocereus always grew on the sloping terrain, not on the top of the hill or mountain, not on the plain at the foot of the slope, not on the extensive plateau, and very rarely on level ground of any sort. Most of the terrain was stony to a greater or lesser degree and where the Oreocereus grew the ground was covered with stones ranging from gravel to head size and sometimes even larger.

Usually these plants would be found as a population, spread over an area. Within a population a pair of plants would occasionally be found growing close together but this was exceptional; usually the plants were far enough apart to allow me to walk between them although it was necessary to bob and weave to miss the odd semi-sprawling lower branch. Often they were even more widely separated. I expect that this would give each plant an area of ground which was adequate for the roots to obtain the moisture required for survival. In just the same way one finds trees in England usually grow far enough apart so that each has the necessary amount of root room. Usually, but not always, spiny bushes of up to about one meter in height (sometimes, but not often, even higher) were to be found growing in association with the Oreocereus. It was easy to look over several hundred yards of ground supporting a population and see the mature plants, but the younger plants were not as obvious. However, I did get the impression that regeneration was taking place for a number of young plants were to be seen, frequently (but not always) growing in the shade and shelter of a spiny bush. To judge by the state of spiny bushes growing immediately adjacent to the larger Oreocerei, once this columnar cactus had become well established it would deprive the bush of much of its water supply and eventually the bush dies off.

The populations of Oreocereus varied in extent, but did not form a continuous band of distribution. The area covered by the more extensive forestations seemed to be dictated by the contours of the land. On a long steady slope stretching upwards for several hundred yards and outwards for perhaps half a mile or more, with little undulation or change of orientation, the population could occupy most of that ground. Where the ground changed in slope or orientation after a short distance, the area covered by the population could be accordingly less. A population could be occupying both sides of a small valley, but when the valley changed direction the Oreocereus would simply disappear altogether.

Although the spiny bushes do not normally grow to a height in excess of about one meter, yet they do possess branches which are longer than one meter, but these usually grow out sideways and not directly upwards. I could well imagine that on odd branch growing above the general body of the bush would be far more exposed to dessication and possibly even to wind damage. It was remarkable to see that a great many of the Corryocactus which we saw had their main stem broken off at about 1 to 1¾m above the ground; lacking any other explanation I could only suppose that this was due to wind damage. On this account the Corryocactus could not be said to dominate the landscape where they grew, but on the other hand the Oreocereus definately did dominate the scene at their growing places.

The variations in the habit of the Oreocereus are almost indescribable. There was white wool, yellow wool, and brown wool, sometimes in great quantity, sometimes very sparse indeed, and all proportions between, sometimes standing well out from the plant body, sometimes clinging closely to the body. There were central spines in ones or twos or threes, from an inch to almost six inches in length, accompanied by radial spines numbering between four and eight, in colours ranging from black, through red, to yellow and horn colour. There was a degree of variation in all the populations, indeed it was difficult to find two identical plants in any one population. However, there was usually a preponderance in any one population of a specific combination of spine colour and wool colour, together with examples of most other permutations, some of which might be few in number. A combination of white hair and yellow spines was always to be found in any population.

We only came across one population with a preponderance of plants having red spines together with wool wrapped so closely round the stem that it was virtually impossible to see any of the body. This particular population comprised of possibly only a couple of dozen plants; it was found at a height of around 3000 to 3300 m at the western limit of distribution at that latitude. These plants were probably at the very margin of existence and could well form a dying population.

The southernmost population we encountered was at a spot about twenty km north of San Pedro de Atacama, where the plants existed in relatively small numbers and grew well apart from each other. We found not a single plant further to the south, whilst to the north of there the populations gradually became more extensive and plants grew closer together. In the little museum at San Pedro de Atacama there were no Oreocereus among the samples of plants to be found growing in that locality, which gives an indication that this is beyond the southern limit of these plants.

. . . from W.Hoffmann K.u.a.S. 16.9.1965

...from Paycachacra we took the route to Chuquibamba...The highlight of our collecting was Oreocereus hendriksenianus whose numerous habitats on the slopes of the glacier massif of the Corropuna volcano (6613m) are overgrown with Tola heath – Lepidophyllum quadrangulare. The large number of forms has led to the erection of varieties. Since all transitions exist in both spination and in the colour of hair and no difference can be observed in the flower, these varieties may be superfluous.

OREOCEREUS From Winter's 1954 catalogue

FR22a Oreocereus celsianus. White hair, yellow to red spines.

FR78 Oreocereus celsianus v. gigantea. Snow-white hair up to 8 in. long. Looks like a gigantic O. trollii

FR78a Oreocereus celsianus v. ruficeps. Like FR78 but with red-brown hair at the top.

FR44 Oreocereus trollii. Very fine commercial species, easy culture. Wrapped in snow-white curly hair. Central yellow, brown-red.

FR44a Oreocereus trollii. This variety resists great cold as it originates from altitudes of over 13,000 feet. The body is hidden by snow-white wool. Spines translucent, yellow-orange.

FR123 Oreocereus hendriksenianus. de Tacna, Peru, 4000m. Wool white, yellow or chocolate coloured.

FR123a Oreocereus hendriksenianus v. niger. Rare variety with black wool, found in one place only.

FR123b Oreocereus horridispinus Ritter et Krainz sp. nov. East of Arica, Chile, and in Peru on the Chilean border. Areoles very dense, 1cm diam.; spines wild and strong, yellow/red or base red top yellow. In spite of the absent hair one of the most beautiful Oreocereus on account of the huge coloured spines.

FR124 Oreocereus tacnaensis sp.nov. Southwest Peru, 3500-4000m 6-7cm diam., bluish grey-green, areoles ¾cm diam., 1cm apart, furnished with yellowish wool.pines brown-red to light yellow. Hairless. Shows the typical characteristic of Oreocereus in regard to flower, flower position, seed form and altitudinal distribution.

FR177a (snow white) FR177b (yellow/golden yellow/fox red). Oreocereus ritterii Krainz et Rupf. sp. nov. In central Peru, where nobody expects it any longer, I found a wonderful Oreocereus with long yellow to snow-white or fox-coloured wool. I collected the seed of the white and yellow species separately from the fox-coloured red one. I consider this Oreocereus as the most beautiful of all white-haired cacti. It surpasses O. trollii and all Espostoas. It produces such a beautiful effect because the hairs stand out considerably from the body. In this way the stems acquire a very stout appearance. The flower is deep carmine red, more beautiful than that of any Argentine/Bolivian Oreocereus. (Ritter). After attaining 20cm in height, the hairy covering developes to full splendour.

Comments....from H. Middleditch.

Variations in both the colour of the wool, as well as in the colour and length of spines, were seen by R. Ferryman to exist within most populations in northern Chile. It appears that W. Hoffmann observed similar variations in populations in Peru. Although the taxonomic validity of providing a name for each variation is clearly open to question, nevertheless the above list would at least allow a purchaser some degree of selection over what he is going to get for his money.

On looking through later Winter catalogues, I see that in 1961 FR123b becomes O. variicolor (Syn. O. horridispinus). When descending the Pacific flank of the Cordillera in southern Peru Johnson states that he came across an Oreocereus which was different on account of the fruits opening at the apex. This was probably between the altitude of Tarata at 3,500m and the lowest level for Oreocereus of 2800m mentioned by Johnson. Unfortunately Ritter makes no reference to

an Oreocereus fruit with this characteristic from Tacna province; in addition the altitude ranges which he gives do not match up with those given by Johnson. Perhaps those of our members who are fortunate enough to live in a climate which encourages Oreocereus to both flower and fruit could tell us if they have grown any FR plants which had fruit opening at the apex.

WEINGARTIA FR50 FLOWERS **From Mr. and Mrs. Lavender**

When we were on holiday in the Riviera in 1972 we paid a visit to Delroue, who has a nursery right on the edge of the French border. We bought a grafted plant of FR50 from him; it was on one of the strong, stout grafting stocks almost two inches across, which Delroue seems tc use quite often. The plant itself would not be very much broader than the stock and might have been almost three inches high.

The body of this plant is a very dark green colour indeed and perhaps because it is on such a strong stock, the tubercles are almost flat. There were no offsets on the plant when we first purchased it, but early the following year it started to produce a couple of pups. A year later it had produced about half a dozen offsets, all from the sunny side of the plant. It also looked as though it might produce a bumper crop of flowers as almost a dozen buds appeared at the areoles around the crown of the plant. Unfortunately these stopped growing when they were almost the size of currants and died off. In the following year another fine crop of buds appeared on those areoles which were mainly of the previous season's growth. Two or three of these did struggle to produce flowers but once again we were left with not quite a dozen tiny buds.

This species is always the first among the Weingartia to start showing buds in Spring and some more began to appear the next year. However on this occasion we had given the Gymnocalycium and Weingartia a watering early in March, which was before any of the buds began to appear. Thinking back to the previous years, it is quite likely that the buds had begun to appear before the plant was watered for the first time. Once again one or two flowers did come out but yet again we were left with another batch of dead buds.

The two largest offsets were removed from the plant a couple of years after we had established it, and rooted down; one was put into a John Innes based compost and the other was given a much more peaty compost. Both offsets rooted down well and both were showing buds in the following Spring at the same time that they appeared on the parent plant; this time we not only lost all the buds on the parent plant, but on the rooted offsets as well. For practical purposes we have never found how to overcome the problem and each year brings a promise of a wreath of flowers which is never fulfilled.

. . . from P.Allcock

My own plant of Weingartia neumanniana was a Lau collected import which I must have obtained round about the same time that the Lavenders acquired their FR50. Not long after becoming established, it put out three dark coloured buds, which continued to grow together. When they reached the size of about 10mm diameter by some 15mm high, the stigma protruded from two of the three unopened buds. As the buds continued to grow the stigma not only kept pace with them but also gained a bit of height and protruded a bit more. In all, this state of affairs lasted for four days. On the fifth day all three buds opened virtually simultaneously. When the flowers opened, the stigma of the third flower did not seem to be any shorter than the other two. The flowers were all of 40mm in diameter when they were fully open. I pollinated it with pollen from a Sulcorebutia kreugeri and all the flowers set seed. More recently a couple of flowers have set fruit after pollinating them from a Gymnocalycium leeanum.

. . . from C. Hall.

My Weingartia neumanniana were grown from seed in 1981/82 and are now over 1 inch high and ½ inch diameter with one inch long tap roots. Only this seedling Weingartia has what I would call a definate tap root. The Weingartia cintiensis, westii and lecoriensis seedlings which I have do not possess an especially swollen root. The W. neumanniana is a beautiful species with ashen body and short pitch black spines. I have not flowered one yet, though.

. . . further from P. Allcock

With regard to tap roots, W. lecoriensis developes a substantial tap root, long and thick. The tap root on W. cintiensis is rather like that on Neowerdermannia peruviana i.e. the body merges into a long, tapering, carrot-like root.

. . . from J.Arnold

The roots on my five-year old Weingartia neumanniana seedlings are long, tapering and carrot-like; they need a three inch pot although the body looks far too small for the size of pot. These plants certainly do not grow fast for me. The roots on W. westii and on W., lecoriensis are more what I would call a thickened rootstock.

. . . from J. Hopkins

From a packet of seeds I still have half a dozen seedlings of W. neumanniana, which were sown four or five years ago, but they are not a great deal larger than those described by C. Hall. This is probably because I believed that they came from a very arid environment and would dislike generous amounts of water, so for two or three years I was very sparing with the water. Now I have started to give them as much water as all other plants, they are growing much better.

. . . from H. Middleditch.

When Roberto Kiesling came to talk to the Chileans Autumn Weekend he included amongst the slides he showed to us, one of Weingartia neumanniana in habitat. This slide shows a two-headed plant with bodies which appear to be about 25 and 30mm across; the tubercles are obtuse, not flat, with distinctly sunken areoles. The spines appear to be straight, spreading, perhaps 4-6 per areole, and apparently up to 30mm long, which is really rather an astonishing length for this species. The plant is surrounded by stones which seem to range from finger to fist size and seems to lie in a small depression between these stones, with the body projecting possibly 30mm above the immediate ground. Unfortunately the present state of communications with Argentina seem to prevent our obtaining comment from Roberto Kiesling which might relate the habitat of this plant to a particular one of the various environmental conditions described by Fries. But the existence of stone covered ground in the habitat photograph might justify a belief that it fits into Fries' Cactus Formation. If so, it is perhaps not

too surprising that it exhibits a rootstock somewhat similar to that on Opuntia subterranea and the Rebutia sp. found by Fries in similar growing conditions.

. . . from J. Gooch

I have had a look at the slide of a long-spined FR50 plant which I understand originated from an old collection in Barry Island, south Wales, and came into the possession of P. Smart. Is this really an authentic FR50? The length of the spines is most unusual: indeed the overall appearance of this plant without its flowers is more like that of a Neoporteria or Copiapoa. On the other hand from the slide of the plant in flower I would say that the flower colour is about the same as on my plant labelled W. neumanniana v. aurantia, which I obtained from Su-ka-Flor quite a few years back, but without any field data of course.

. . . from J. Medway.

You may be surprised at the length of spine displayed by the plant in Kiesling's slide, but if you care to look at J. Donald's photograph of W. neumanniana in the N.C.S.S. Journal for September 1958 you will see that that, too, has quite long spines. Clearly I carry a different impression of this species in my mind, for all the plants that I have seen are like the illustration in Backeberg's Kakteen Lexikon Plate 452 page 738 in their body form.

. . . further from H. Middleditch.

Now I have made a more careful search I find an illustration of Spegazzinia (Weingartia) neumanniana in Backeberg's B.f.k. for 1935. In that particular photograph the spines all appear to be roughly the same length which is not far short of the body diameter; the accompanying description says that the radial spines are up to 2.2 cm long and the central spines are up to 4cm long, both yellow to black in colour. This plant originates from the "Argentine-Bolivia border"; since Backeberg was travelling there by train (Stachlige Wildnis pp160-161) it appears to be probable that this plant is found in the immediate vicinity of Villazon, a "haven in the midst of a stone-strewn Pampa, located in a quebrada. The vegetation of the stony landscape appears to be devoid of cacti. But they are difficult to see since they have almost completely withdrawn themselves into the ground" (Backeberg).

However there is quite a difference in the length of the spination on the W. neumanniana illustrated in B.f.k and that illustrated in the Kakteenlexikon Abb 452. The latter are about a quarter of the flower diameter in length, the former are longer than the flower diameter. Like J. Medway, it is the short-spined form that I take to be the British Standard sort. But I have also tended to think of FR50 and its look-alikes as having not many ribs and now I see that the plant in Abb 452 must have something like a dozen ribs. You have to look for the ribs because it appears at first to be nothing more than a collection of diamond shaped tubercles, but on closer scrutiny the grooves between the ribs are slightly more emphatic than those between tubercles. On the other hand the Illustration of W. neumanniana in B.f.k. does indeed look like a collection of tubercles, not a series of ribs; perhaps it is no accident that Backeberg's accompanying description makes no mention of the number of ribs? However by the time of his Lexikon I see the ribs are "about 14".

. . . from F. Ritter, Kakteen in Sudamerika. My Fr50 was found near Iturbe in Argentina.

. . . from J. Forrest.

My own plant came from Uhlig when I paid my first visit there in 1978; it was a two-headed plant, each head being about one inch across. It looked very like the photograph in Backeberg Die Cactaceae page 794. It established itself very quickly and has grown strongly each year since. However one head grew twice as fast as the other and is now double the size of its companion. It has flowered for the last three years, the flower being deep orange, a slightly deeper colour than the photo in Backeberg. Several seed pods formed for the first time this year; the fruit was green at first but turned reddish when ripe. The seed spills out of a crescent shaped split at the base of the seed pod, which is on the side of the seed pod away from the sun. There was an average of fifteen seeds per pod. Both Lau 908 W. fidaiana and Lau 916 W. cintiensis (Hallet 1971) have flowered but not set seed.

. . . from P.H.Sherville.

The fruits which I set on my Weingartia neumanniana together with those on W. fidaiana were quite different from the rest of the Weingartias which set fruit for me. At the time of ripening these two do not just dry up, but split horizontally to reveal the seed. They are also much larger than the fruit on the rest of the Weingartias, by a factor of two to three times. They measure 10-12mm across.

. . . further from P. Allcock

Yes indeed I have set several fruits on my Lau-collected plant of W. neumanniana. A sample of the seed was passed on to F. Fuschillo for photographing. The fruit is different both from the northern Weingartias and from Sulcorebutia in three respects. Firstly, it is borne right at the top of the plant close to the growing point, whereas the northern Weingartias bear them on the shoulders and upper sides. Secondly the flowers are produced from naked areoles near to the growing point and the spines grow on those areoles after the fruit has fallen off. Perhaps it is the spines starting to grow which topples the fruit? Or perhaps the plant simply allows the fruit to fall off when it is ripe and has split, so that it falls on the ground in the path of insects?

Thirdly, the fruit splits at maturity from top to bottom revealing seeds embedded in white, non-sticky pulp; at this point the fruit topples off the plant and onto the ground, still whole and still complete with flower remains.

SOME OBSERVATIONS on WEINGARTIA SEED PODS **From P. Smart**

During the first of a series of planned experiments on pollen compatability between Sulcorebutia and Weingartia, a large number of Weingartia dry seed capsules were examined as an incidental branch to the programme. Although basically concerned only with the northern group, pods from a few of the southern species were also examined. The following data is by no means conclusive but does reveal some interesting and enigmatic questions.

Ripening The time taken between pollination and the drying out of the fruit or the beginning of the dispersal process was much shorter than usual – presumably due to the especially good summer and my infrequent watering.

Flower remains These were all persistent and firmly attached. When left in situ the remains seem to disintegrate in time, rather than become detached, but they can be removed, leaving a firm capsule.

Size of seed capsule Within the species this was very variable – obviously depending upon the eficacy of the pollinating agent and the compatability of the pollen. The average sizes of seed capsules were noted for ovaries with 90% efficient pollination. This latter was arrived at by assessing the number of unfertilised ova along with the seed count.

Mode of dehiscion This was a little variable. Where splitting of the capsule had started it was generally on a longitudinal basis from flower to areole but some berries showed a latitudinal split, spilling seed from the attached cup after the fashion of some of the Rebutia group (possibly physical damage?). The walls of some berries were papery thin and dispersal could have been by the disintegration of the pod. In several cases the seeds were semi-absorbed into the capsule wall - possibly due to shrinkage.

Surface texture To the naked eye the surface of the berries seemed to be quite variable from sp. to sp. – from an almost shiny smooth epidermis, through a "woolly" fibrous texture to an almost cellular rough skin. However as magnification was increased these apparent differences were reduced until it became apparent that the composition of the capsule wall was similar in most cases. Veins running longitudinally gave a striated appearance to some capsules. Also on some capsules there were quite large areas of an inner almost transparent membrane through which the seeds could be clearly seen

Scales Again, examination with the naked eye was misleading. Most species had prominent scales in rings around the top (flower) end of the capsule but some capsules appeared to be naked over the remaining surface. Magnification showed that this was due to some scales being very small, some being self-coloured and adpressed and in some species not very frequent.

Even at a cursory glance it was obvious that the southern species usually had very prominent – usually dark – scales which were usually strongly reflexed away from the wall, a feature reminiscent of many Sulcorebutias. All species examined showed some scales over the whole of the capsule surface. These varied from broad obtuse through mucronate to narrow triangular in shape. Although my original notes indicate that only naked scales were observed, later examination of photographs indicates the presence of wool behind the scales of one species.

The pods were initially compared on the basis of batch numbers and not on the basis of the plant name. When arranged in order of the grading of characteristics it produced a surprisingly N to S order of species. The names on the appended table are in this order. A preliminary quick look at the seeds also seemed to indicate a grading of certain characteristics from N to S – but this may well fail to appear when a full examination is made and all characteristics compared. The only feature which did not show some semblance of N – S order in its gradation was colour, both of the pod and of the scales. This could possibly be due to the different state of maturity and of the amount of light or shade that the fruit had received, but I doubt it.

When a grading of characteristics occurred between plants under the same label, this also tallied with the N-S grading of the species. Thus Weingartia pulquiensis with weaker spination (more like W. multispina) produced lower seed counts and smaller pods (not necessarily the same thing) than the heavier spined plants. One anomaly which must surely be regarded as coincidence was the appearance of two W. hediniana pods which were significantly longer than the rest. These were the only two hediniana flowers cross pollinated with pollen from Gymnocalycium! Another inconstant feature was that in some species the interior remained sticky for up to at least a year, thus hindering the dispersal of individual seeds.

To conclude, I can only suggest that the pattern emerging from this rather sketchy research could be complete coincidence. But it certainly seems to indicate that more research is called for.

....from STACHLIGE WILDNIS by C. Backeberg 1951

[During the 1930's Backeberg made several trips to south america; in this book they are not described in chronological order nor is any event clearly related to a season. It was probably late in the Bolivian winter of 1933, when travelling from Oruro and arriving at Tupiza].....Early in the morning we were already rambling through the valleys south of this place. In them, colonies of the white and red spined Cleistocactus tupizensis stood everywhere. It is a relative of Cl. straussii. A great many plants displayed the adornment of their red narrow tubed flowers. On the next morning, to the north of Tupiza, we hit upon a longish globular cactus with broomlike spination and short yellow flowers, the like of which had only once been published up till now, specifically Weingartia cumingii discovered by the English collector Thomas Bridges around 1842, without it having been established up to the present where these freely flowering plants came from. They must grow on one of the old trade routes that run up from Chile to Bolivia that have sunk into oblivion today on account of the railway.

. . . from H.Middleditch. The somewhat less mountainous area lying to the north of Tupiza is named Pampa Mochara on the map in my possession. Geographically this is a continuation northwards from Villazon of the Puna plateau and might be expected to carry a similar sort of vegetation to that described by Fries for the Puna to the south of Villazon.

WEINGARTIA KARGLIANA Rausch sp. nov. **By W. Rausch**

Translated by H. Middleditch from K.u.a.S. 30.5.1979

As I crossed over the kilometer upon kilometer of almost bare high plateau for the umpteenth time, I noted again and again some yellow flowers and presumed to begin with that it was a form of Lobivia pugionacantha. On closer inspection it nevertheless turned out that it was a Weingartia. Weingartia kargliana Rausch is up till now the most northerly form of those plants closely related to Weingartia neumanniana Bkbg. Nevertheless it differs from that one on account of the fewer ribs and fewer spines, the flowers are larger and more or less yellow. It grows above Tupiza, Bolivia, and it is almost impossible to find when not in flower. Weingartia neumanniana occurs more to the south (near Huancabamba in Argentina) and colonises more rocky areas. I name this plant after Herr Franz Kargl, under whose supervision the Schonbrun Botanic Gardens in Vienna has risen in international esteem.

Solitary, globular, up to 50mm diameter, dark grey-green, with narrowed root neck and up to 15cm long

NAME ON LABEL	SOURCE OF PLANTS	CAPSULE				SCALES		MODE OF DEHISCENCE	MAXIMUM SEED COUNT	COMMENTS
		SHAPE	SIZE (in mm) Dia. long	COLOUR	TEXTURE	TYPE	COLOUR			
multispina	Seed only	Turnip shape	4 x 4.5	Mid buff	Fairly smooth and fibrous	Small, very inconspicuous adpressed	Mid buff	No record	45	Very short spined specimen
cumingii	Seed and habitat	Turnip shape to round	4 x 5	Dark buff	Moderately fibrous	Smallish, adpressed, almost mucronate, conspicuous by colour	Mid brown (darker than capsule)	No record	50	Spination between multispina and pulquinensis
pulquinensis	Seed and habitat	Turnip shape	5 x 5.5	Variable: mid to light buff	Fairly smooth, fibrous Sometimes prominent veins	Few lower scales, obtuse Only conspicuous by darker colour	Light brown	Longitudinal	60	Plants used have varying spination but other features identical
corroana	Believed habitat	Turnip shape	6 x 7.5	Mid to light buff	Fairly smooth, fibrous; thin veins	Moderate size, fairly prominent, not conspicuous	Mid to light buff	Longitudinal	80	Body and spination of hediana style, but not hediniana
hediniana	Seed and habitat	Turnip habitat	6 x 8	Dark buff	Moderately fibrous, fairly prominent longitudinal veins	Lower scales sparse and not conspicuous. Broad, rounded, occasionally slightly mucronate	Dark buff	Longitudinal	150	Pods often remain sticky even when dried off and splitting
fidaiana	Habitat only	Almost round	6.5 x 7.5	Almost black	No record	Broad, smooth and mucronate very prominent	Black with broad whitish border	No record	No record	Plant in collection of T. Jenkins
neumanniana	Unknown	Almost round	7 x 7.5	Mid brown	Coarse, fibrous, distinctive	Very prominent, papery, twisted and conspicuous	Mid brown with lighter edge	Longitudinal and lateral	40	The common type with black spines
FR50	Believed habitat	Turnip shape to round	8 x 10	Light to mid brown	Coarse, fibrous, distinctive	Conspicuous & prominent. Cover whole area. Thicker than most wool?	Mid to dark brown (darker) than capsule)	No record	140	Plant in G. Hole's collection

thickened rootstock. Ribs up to 10, irregular in outline, divided into six sided flattish tubercles, areoles somewhat sunken, located in the upper half of the tubercle, round to oval, up to 4mm long, white felted; radial and central spines difficult to distinguish, 1-7, broomlike to outstanding, up to 15mm long, needle-like to awl-like, brown with blacker tip and blacker base. Flower appearing close to the crown, 25mm long and 35mm diameter; pericarpel and fairly broad, funnel shaped tube yellow (to orange) with broad dark green (to orange-brown) scales, outer flower petals lanceolate (or even rounded) yellow (bronze-yellow) with orange-brown median stripe, inner flower petals lanceolate to rounded, yellow (to orange yellow) throat and filaments yellow, style and stigma (8 to10 lobes) pale green. Fruits spherical, 6mm diameter, dark green with broad pale margined scales, splitting open horizontally, dry; seeds oval and depressed, 1.2mm long, grey-black, divided into unequal flats by irregular corners, with large, oblique hilum.

Habitat: Bolivia, north of Tupiza on the Pampa Mochara at 3500m altitude.

Type: Rausch 677 deposited in Zurich city succulent collection.

(Latin diagnosis provided).

. . . from H. Middleditch.

The seeds with a testa divided into flats by irregular corners sounds suspiciously like the sort of result frequently seen when seed has ripened whilst still pressed against one another in a very confined space; I would suggest that this is not likely to be a characteristic peculiar to this particular species.

Backeberg was apparently a professional photographer and evidently built up a fine selection of photographs from his various trips. However he must have occupied himself with collecting some plants; he bemoans the fact that the Cl. tupizensis which he found in flower near Tupiza were too turgid to travel satisfactorily if crated. On a trip from Oruro by hired vehicle he records that "at the station I paid off my guide, who would return to Oruro on his own. I gave him instructions to deliver my chest of plants to my hotel and to be on the lookout for the train bringing me back from the Arque valley". The photographs, published later in books, may have been his pension, but the collected plants would pay the rent. To judge by the remarks he applies to what eventually became Weingartia kargliana, it would seem most unlikely that he failed to dispatch (or bring) any of them back to Europe in the l930's. Hence one cannot help but be surprised at their absence from the scene for such a long span of time. But is this really so? Could it be that some of the plants cultivated as FR50 or as W. neumanniana have really been W. kargliana?

The initial publication of Spegazzinia (Weingartia) fidaiana Bkbg appeared in Kakteenfreund in 1933. When I look at Backeberg's B.f.k. for 1934 I find this species is quoted from southern Potosi province; now the province of Potosi starts at Villazon on the border with Argentina and there is a strip of Puna plateau which runs from there, past Tupiza, Mochara, and Cotagaita as far as Otavi. However in Backeberg's Kakteenlexikon a more specific location of Tupiza is given for W. fidaiana, which suggests that it is the plant which he found during his stopover in Tupiza as described in his Stachlige Wildnis. But the illustration in B.f.k. is of a well-armoured plant with areoles typical of more northern Weingartias bearing fairly long (for the genus) spines, the spines on one areole crossing spines from adjacent areoles; thus it bears no resemblance to W.neumanniana in the form commonly cultivated, or to W. kargliana. The photograph of W. fidaiana in Ritter's South American Cacti looks even more like a northern type of Weingartia; unfortunately he gives no habitat location.

In his "South American Cacti" Ritter publishes a W. pygmaea from Mal Paso, which lies to the northeast of Tupiza on the highway from Tupiza to Impora. Estancia Mal Paso lies at some 3700m (1;250,000 scale map, 1973 Edition) on an extension of the Pampa Mochara. The spines on W. pygmaea are described as 'black to ivory' which may be compared with 'straw yellow to violet-black' for W. fidaiana. But since Ritter describes the ribs of W. pygmaea as having "ribs 8-15, 3-6mm high, almost completely broken up into very broad rounded tubercles which are very obtuse, without recesses between, only narrow grooves between the ribs and between the tubercles" it might be considered as a relative of Weingartia FR50 and W. neumanniana. The habitat photograph of W. pygmaea Abb 628 in Ritter's book shows a very small patch of the stony surroundings which look remarkably similar to those seen in the slide of W. neumanniana shown to the Chileans' Weekend by Roberto Kiesling. The spination is very much like the spination on the Spegazzinia (Weingartia) neumanniana illustrated in Backeberg's B.f.k., which probably came from the immediate vicinity of Villazon. Is it possible that the length of spination is not peculiar to any one location, but simply varies in the same way that has already been described (this issue) for Oreocereus? Perhaps the difference is that we have been afforded first hand observations on the variation in the habit of Oreocereus, whereas the commercial collectors have not bothered to tell us about the variation in the southern Weingartia. After all, the north-south distribution stretch for Weingartia FR50-neumanniana-kargliana-pygmaea is decidedly less than that for either O. leucotrichus, O. trollii or O. celsianus.

TO WATER . . . OR NOT TO WATER — from J. Arnold

There has been some discussion in previous issues of the Chileans on the question of just when to start watering certain plants if flowering is to be encouraged or loss of small buds is to be avoided; in particular, Oroyas seem to be the main culprits and the target of the discussion. But south american cacti in general do not appear to exhibit the same propensity for aborting their buds as the north american ones. Genera such as Sclerocactus and Pediocactus are extremely prone to this. They seem to remain in bud for a very long period of time – often over the winter – and eventually you feel that you must water the plant which is often very shrivelled, only to find that the buds disappear – sometimes within hours of being watered, even if the watering is cautious! Mexican cacti do not seem prone to this behaviour although Normanbokea valdezianus and N. pseudopectinata, also Turbinicarpus smeideckianus will always abort their buds if watered prior to the flowers opening. Other plants from Mexico like Leuchtenbergia and Coryphantha will also abort buds but I feel that this is a case of their not being watered sufficiently.

In the south american cacti, Oroya and Matucana are the worst offenders at aborting buds. I often speak to people who say their Oroyas bud in May with dozens of buds and then eventually, if they are lucky, they get one or two flowers. In Die Cactaceae, in K.u.a.S. and in Succulenta there have been some good photographs of Oroyas flowering in

habitat which suggest that these plants are flowering when the soil is dry and the surrounding vegetation is dry. The plants themselves also seem to be dry. However the literature seems to indicate that the plants are often wet and cold in winter from snow and heavy rain and sleet – Lau talks about this in his articles in the American Journal. Perhaps the strong winds, which cause the plants to hug the ground, dry the soil surface very rapidly and dessicate the surface vegetation. One or two photographs appear to show that Oroya also abort buds in habitat but it is difficult to know whether this is a correct interpretation of what can be seen.

What is the cure? I have tried most methods of cultivation in an attempt to maximise the flowering capabilities of Oroyas and Matucanas. Keeping them absolutely dry does not seem to be the right way. Come May or June in England we can usually get greenhouse temperatures of 100° F or even more, which is far too warm for these mountain plants to endure and I feel much warmer than they are used to. I am sure that they would be used to getting cooling mountain winds. In this heat they dessicate alarmingly and their buds dry up. The opposite is to give them some water all winter. They are hardy plants and in a warmed greenhouse should come to no harm if watered. This has worked for me, spectacularly with O. borchersii which is now flowering for the fourth year running on this treatment. As I write it is budding up well, the buds growing evenly and not showing any sign of aborting. They develop fairly slowly. It seems to me that with this treatment the plant remains somewhat turgid and therefore does not suddenly surge into growth at the expense of its flowers. The plants certainly do not grow during the winter as no doubt the temperature and light are too low but they do remain turgid and I have not found any which appear to resent being damp.

Unfortunately Matucanas are somewhat difficult! In my experience they resent being damp in winter and will try to grow. In my view a Matucana will only flower well and not abort its buds if it has grown vigorously and got really fat the previous year. This seems to ensure a good 'fix' of buds which expand rapidly with the improving spring weather. The Matucanas are treated just the same as all the other plants when it is time to start to water in spring, perhaps watered fairly heavily. Shrivelled plants of Matucana seldom flower. The Submatucana flower easily and do not seem to represent the same challenge to get them to flower.

However, every story has a twist! My large Oroya citriflora which is seed grown and about five inches in diameter has budded up every year for some five years now, but I have still to see a flower. The plant grows vigorously and looks extremely healthy but just will not flower, so individual plants can be odd in their behaviour. I also have one other oddity and that is a small form of Submatucana krahnii; this plant does flower and on occasions very well but usually it produces a bud at every areole, all of which abort. Again the plant is healthy and grows well, in fact very well, but still it has this strange habit. In this case I just do not think that there is anything that I can do about it as it appears just to be the nature of the beast.

I do not know of anyone else who regularly waters Oroyas in winter but there may well be someone. I think that I obtain flowers on more Oroyas than in most other collections that I have seen, so my present method does seem to work. Seedlings are in many ways a better bet than imported plants and I have even flowered very small seedlings only a few years old. Some old imported plants have never flowered. Seedling Oroyas are among the most worthwhile plants to grow because they are more reliable than the imports. Nevertheless this is still one of the most persistent problems in cultivation so I do hope that it may start a discussion; I may even learn something which will help me flower my reluctant O. citriflora!

. . . from I. Le Page

The problems associated with achieving flowering of plants in the two genera mentioned by J. Arnold are familiar ones here, too; but flower initiation and subsequent development to anthesis is often a complex and in many cases a little understood topic. There are, I feel, two aspects to the problem — one is inducing bud initiation in the first instance and secondly having achieved this is bringing the buds on to flowering. The article by J. Arnold dwells on the latter but I believe that the former is just as formidable a problem.

Photoperiodism in plants is a fascinating subject and I can do no more than recommend the book by Daphne Vince-Pine "Photoperiodism in Plants", published 1975 by McGraw-Hill, which covers the topic in great detail, outlining the factors involved at length. It is much too long as subject to summarise here.

Clues to Oroya requirements might be found by reference to their habitat where they will be subjected to large diurnal temperature ranges but at the same time receive high levels of solar radiation. Day length variation, too, is substantially different in these latitudes to that found in their habitats. It may be that they require a period of vernalisation, in other words the need to clock up a certain length of time below or possibly above a critical but at present unknown temperature. It would take quite a lengthy research programme to unravel their particular set of requirements; it is not impossible that each species has its own requirements, too. Many commercial crops like Alstromeria (another South American plant) have complex mechanisms which are only just beginning to be understood.

The second problem is equally complex and the theories put forward by J. Arnold are indeed interesting. Just why buds which have apparently become fixed and then subsequently abort is difficult to understand, obviously the plants must cease to supply the developing inflorescence with the appropriate set of hormones and or nutrients; I wonder whether the resumption of watering in the usual dry winter/moist summer cycle results in these hormones and nutrients being withdrawn from the developing bud for use at an alternative site — possibly the apical meristem, and used for growth. If this is so then J. Arnold's technique of supplying moisture throughout the year encourages his plants to 'tick-over' through the coldest months and so avoids possible depletion of photosynthentic products.

My own growing techniques have been slightly modified in recent seasons in an attempt to get more flowers, but it must be said with only limited success. I moved the Oroyas to the brightest, coolest, spot in the greenhouse, which happens to be at the southern end near the door. Eventually buds formed on two out of six plants, which were O. peruviana and its variety conaikensis. I gave them their first full watering on 7 May when the buds were approximately half formed. Prior to this the plants were mist-sprayed fairly frequently and often quite heavily.

Oroya peruviana went on to flower some 10-14 days later — all the buds visible at the time of watering opened fully. On the other hand, O. peruviana v. conaikensis which was showing six buds failed to open one, all aborting in the now familiar way. So obviously I have yet to find the correct treatment for Oroya.

. . . from P. Allcock

Certainly I would agree that Oroyas are very prone to aborting their buds, but I have not found this to be the case with Matucanas. Oroyas can be persuaded to grow at a very swift rate given plenty of food and water; to a slightly less degree, so can Matucanas. But in my experience if this is done (even with plants which have flowered in the previous year) then they will certainly not flower in the following year. On the other hand, if they are starved and given only a little water they won't flower either! I am fairly certain that the amount of sunlight and of high or low temperature that they are subjected to does not affect them much either – although I am well aware that this particular comment runs contrary to the advice usually given regarding cultivation of these plants. I feel sure that the solution lies in the amount of food and water that is given and when it is given. To water an Oroya when the buds are small seems to be fatal to the buds – they always abort. If you leave them dry until the buds are around 1cm tall and then give just a little water, the buds expand rapidly and then after this more water can be given. The exception is O. minima, which seems to be as tolerant of watering when it has small buds as Submatucana spp.

It seems like a good idea of J. Arnold's to water Oroyas in winter – as long as they are kept reasonably warm. I have not tried this myself, as any extra winter heat is reserved for Brazilian plants in my greenhouse. Having said all that, I do not want to give the impression that I flower individual plants of Oroya regularly every year. Some years a particular plant will flower, other years it will not. However it is especially noticable that a plant which has grown really well one year will invariably not flower the following year. Amongst the Borzicactinae they are most definately at the bottom of the league table for flowering reliability.

One point which may perhaps have some relevance is that Oroyas produce buds on the previous year's areoles near the crown. On the other hand Matucana, Submatucana and Arequipa produce buds mostly on the areoles of the current growing season. I say "mostly" because very occasionally a bud arises from and older areole but this is extremely rare

. . . from H.Middleditch

So if Oroya produce their buds from 'last' year's areoles, is the method of cultivation in 'last' year likely to have an even more decisive effect on bud survival on Oroya than it would on plants producing buds from 'this' year's areoles?

. . . from P. Smart

In my opinion many cacti – and come to that probably a great many other plants from arid parts of South America – produce their flowers before the onset of the rainy season. This enables them to set fruit and distribute their seed in time for the seed both to germinate during the rainy season and to achieve a size which is capable of surviving the following dry season. This means that the plants themselves flower on a minimum water supply and grow on the better water supply of the rainy season – however much or little that may be. Hence a plant given a good water supply early in the season can be expected to grow rather than flower. A lot of our plants are pretty good at flowering anyway despite generous watering early in the year - but evidently not all of them, as experience with Oroyas and with Weingartia neumanniana indicates.

. . . from H. Middleditch

Perhaps this last comment does indeed apply to many cacti and many other plants from South America. It appears to be confirmed in part by Fries' observation on the Flora in the Puna of northern Argentina that "the flowering period does not occur at one and the same time as the vegetation period, but one is separate from the other". On the other hand, Fries did observe plants flowering for the first time up to 1st January which is about half way through the rainy season; so evidently many species do not flower prior to the rainy season. Similarly records of flowering times of vegetation at Fundo Santa Laura (Mooney H.A. Convergent Evolution in Chile and California, US/IBP Synthesis series Vol 5) show five out of seven evergreen shrubs flower during or during-and-after the rainy season; only two out of seven flower prior to and during the rainy season. Do we really know when cacti are in flower out in the wild?

. . . from R.K.Hughes

Of my three trips to Peru, the first took place in early May and the following two were undertaken in the first half of November. The Peruvians are very vague about seasons because they vary so much from place to place. Often they miss out spring and autumn and refer only to summer and winter or hot and cool seasons. However, November is probably the traditional opening of the rainy season considering the geography of Peru; this applies to the mountainous areas, the seasons being reversed on the coast. When we arrived in Cuzco in May the courier apologised for the unexpected rainfall saying that it was not normal. When I mentioned that I had met rain at the pass approaching Arequipa in November, it seemed to be accepted as the start of the wet season.

In comparison with my trips undertaken in November, there were very few plants to be seen out in flower in the course of our first trip in May. There was the Erdisia in flower close to the Inca bridge at Macchu Pichu in May but this was growing on a rock wall with surroundings that were far from arid; in addition it did carry a pair of ripe fruits. The Erdisias at Pisac and Ollantaytambo also bore ripe fruit and just the odd late flower. The Trichocereus seed from Pisac was from a dried up fruit remains found below the plant. On my May visit to Sillustani I was lucky to find seed on Lobivia maximiliana; most plants were without either seed or flowers. Only one plant had the remains of a seed pod that had not completely disintegrated. The Tephrocactus had plenty of ripe seed pods as these fruits were yellowish green and came away from the plant quite easily when prodded. At Ayacucho in May all I found was seed pods on a Corryocactus and the dried up fruit remains lying below a Trichocereus.

But in November the Lobivias were in flower near Puno and near Ayacucho; not only in flower, but carrying buds and unripe fruit as well. At Puno the Lobivia pentlandii and L. maximiliana also carried fruit at all stages of ripeness. At Ayacucho buds and flowers were also seen on Cleistocactus, Corryocactus and Erdisia, on Morawetzia, Trichocereus, and on Opuntia exaltata and O. ficus-indica. Like the Lobivia, the Cleistocactus also had buds and unripe fruits while the Corryocactus and Erdisia mainly carried buds. At Huancayo, close by the river, Trichocereus and Erdisia were in flower in

November. The Tephrocacti growing at almost 1000m higher had more or less finished flowering although one or two flowers were seen on them. Some of the other vegetation in the vicinity had started into growth but others showed no sign of new growth. In November at Cuzco, Pisac and Ollantaytambo, Corryocactus and Erdisia were full of buds and at the last two places some were in flower. Trichocereus were also seen at both these places and in a garden at Cuzco with their white trumpet flowers open during the day. Lobivias were also in flower at Pisac and Ollantaytambo as were some Tillandsias, larger Bromeliads, and bulbs.

From my own observations, although they are rather limited, it does seem that flowers and fruit are scarce in winter. On the other hand I would not say that flowers generally appear before the rainy season; by November the rainy season has definately started and at the sites I visited quite a fair number of plants had obviously only just started flowering.

My own Oroya has also suffered from buds appearing and then retreating when still quite small. Surely greenhouse conditions cannot be good for plants that live at around 4000m with all the wind and rain at that altitude? Since I have started growing them outdoors with the Tephrocacti they seem to be much happier. The Lobivia maximiliana cuttings that I brought back from Sillustani have budded up well for the last couple of years; they are getting the same type of treatment as they come from similar altitudes. I am concerend that they may abort buds in a dry atmosphere so I have watered them by standing the pots in saucers. Spraying in spring is recommended by many to encourage most plants into growth; but when I saw these Lobivias out in flower near Puno the ground seemed to me to be very dry. Do they rely on the dew condensed from the atmosphere by the cold nights for their moisture?

. . . from J. Lambert.

First of all, I think that Oroyas, Sclerocactus and Pediocactus are highly specialised genera, requiring quite peculiar conditions to flower, so that their needs cannot be looked upon as the general rule for most cacti. Marcel Demunter, who visited the finding places of Oroyas in the mountains of mid-Peru, describes their biotype as a wet region, with frequent clouds, and cool moisture coming in from the nearby glaciers. This would explain why "keeping them absolutely dry does not seem to be the right way" as noted by J. Arnold. Probably the problem with Oroyas is that they will not accept a combination of heat and sun together with ample water, to which they react by dropping their buds? On the other hand, as they do not seem to withstand tree-cover since they die away where eucalyptus are planted, the answer in cultivation appears to be "cool sun"! Unfortunately I do not have any personal experience with Oroya.

If we now consider more generally the situation in Argentina, the only country which I visited, I think that the following should be taken into account: first of all there are the seasonal factors other than water, such as temperature, duration of daylight and impact angle of the sunshine. These vary of course from winter to summer, bearing in mind that there is a six months shift of seasons between the southern hemisphere and ourselves. Most cacti are no exception in comparison with other plants and will flower in spring and/or summer. Of course there are early bloomers and late bloomers, just as in any other family; in Gymnocalycium for example we have an early flowerer in G. bruchii and G. schickendantzii is a late one. Now for the water; this depends on the geographic region as the climate is not the same everywhere. In the western megapotamic region there is a distinct rainy season and the impression I acquired was that it was already approaching its end in the second half of November. I still encountered some rain whilst in the city of Cordoba and in the city of Salta (all night long) and a heavy morning shower in Villa Ojo de Agua. Also the well wooded parts in Salta, Tucuman, Catamarca, and Cordoba were still wet. But the level of the rivers seemed to have fallen a bit already. Many cacti were either flowering or carrying unripe fruits. So my impression is that in those parts of Argentina the plants flower shortly after the start of the rainy season, then set their fruits, after which the seeds enter into a resting period until the next rainy season.

In the Monte there is no such thing as a well defined rainy season. The rains are very scarce and occasional, but when they do occur they can be quite heavy. Here too the plants seem to wait for a rainy spell to flower and set fruit, whilst again the seeds will rest until the next rainy spell.

Lastly, in the high regions along the Cordillera, the plants will get covered in snow during the winter; this snow will melt in the spring and provide them with water, which the plants will take up into some sort of reserve (Think of the tuberous roots of Pterocactus). Once again they will use this reserve in late spring or in summer to set flowers and fruits. Some of the seeds, such as Maihueniopsis, may then need a cold period before being able to germinate.

Finally I would observe that that growing and flowering do not necessarily exclude one another. I know of several Gymnocalycium which will flower when they are already growing, provided that they are well fed i.e. given sufficient phosphates and potash, but not too much nitrogen. When a plant "grows vigorously and looks extremely healthy but just will not flower" as J.Arnold observes, this may well be an indication that its nitrogen balance is too generous!

. . . from J. D. Donald.

My first journey in Bolivia was undertaken in October 1983 and the second in May 1984. There was indeed a marked differences in the two seasons. There are hardly any flowers in the dry season March to September – most appear in the early part of the wet season starting in August before the rains but really only become prominent from late September to early November by which time it is getting very wet and very difficult to travel. Certainly the flowers appear before the heavy rains when the pollinators can get about and flowering virtually ceases during the wettest months December-January except for spasmodic erratics. The fruits ripen in about three months so seed is available from about January to March but this is quickly removed by ants; also, I suspect, by small rodents and birds. Very little is left on the plants from April so I am sure very little survives to germinate into seedlings.

The problems of bud abortion are in most cases not due to watering but to lack of sufficient light intensity. I have not found it too much of a problem down on the Sussex coast - renowned for its very high winter sunshine record. Of course I too have had buds abort on Oroya and Matucana, but nothing remarkable for comment. Oroyas have a miserable winter in habitat - damp and cold. The flowers appear immediately after a spell of dryness and warmer temperatures. Our winter rest under dry conditions initiates the flower bud formation and development. They do not develop further if light intensity is too low and if this situation lasts too long then the buds will abort. Plenty of air and light is all that is needed- water is not required except when the plants are actively growing and the temperature is above 15° C! A damp spray during winter will

keep them happy and turgid but no real watering and no feed!

. . . from H.H.Rusby, The Mulford Biological Expedition, Jnl N.Y. Botanical Garden, XXIII No.272,1922

My botanical collections began immediately after crossing the divide of the Quimsa-Cruz. On the slope beyond the pass, I found enough water supply in early July to maintain a scanty growth of alpine plants. From this point to Quime, at an elevation of about ten or twelve thousand feet, there was a steadily increasing display of plants in flower. There were but few trees, and these were small, but the mountain sides were abundantly clothed with shrubs, large herbs, and half-shrubby plants....At Pongo there were but few herbaceous plants in bloom..... Near Canyamina, large cacti of several species became common; a stop of several days was made..... the dry season was still in force. It is not an arid region, although very dry during the dry season. Its cacti are peculiar; since there were no blossoms or fruits I could not even guess at their identity.

A TREK AROUND AYACUCHO **From R. K. Hughes**

In the course of our guided tour through Peru in 1978 we made a stop at Ayacucho, capital town of the Department of the same name. This was my very first opportunity to get close to cacti in the wild.

Ayacucho is on the southern tourist circuit that runs from Lima to Huancayo, Ayacucho, Cusco and Puno. Travel on the Huancayo to Ayacucho stretch is usually by bus that takes over 14 hours without any hitches. Much of the journey is at high altitude in mountainous alpine terrain. From this region there is a long descent to a small town that is a regular meal stop used by all the buses. Beyond this place there is a magnificent view way down into a river valley below, whilst the surrounding mountains are almost lost in the haze. From this point onwards, one enters the hot, dry region that most people associate with cacti habitats. The terrain from here to Huanta and then to Ayacucho (4 hours travel apart) is of a similar nature. The stretch between Mayoc and Huanta is dominated by the tall blue columns of Azureocereus.

The approach to the town of Ayacucho was up the narrow valley of the R.Chacco which is often not much wider than the width of the road and river together. In places where the valley floor was not quite so closely confined between the steep slopes at either side, narrow patches of cultivated ground were to be seen on the level bottom. Often the canyon walls restricted the view of the mountain peaks, except when passing a side valley allowed one to get an idea of just how high were the surrounding mountains. In fact they rose up to a good one thousand metres above the bottom of the valley.

Coming nearer to Ayacucho the road turned up the small side valley of the R. Alameda from which it shortly emerged; now the steeply rising mountain sides had retreated a fair way from the road, perhaps more or less half a mile to each side. Ahead and to our right lay the town of Ayacucho at an altitude of 2761m on sloping ground at the base of the mountain slopes. Unseen to our left, on hilly looking ground below the level of the town, was a strip level enough and broad enough to function as a modern one runway airport. Cut into the undulating floor of this terrace or basin and hidden from our view were the narrow defiles in which ran either regular or intermittent rivers, all of which found their way into the main river valley by which we had approached Ayacucho. This broad and irregularly undulating terrace appeared to be devoid of trees or even of tall bushes (except near some habitations where they may have been introduced). Much of the ground was patchily quite bare of vegetation. The cultivated land seemed to lie on the mountain slopes between some 3000 and 4000m altitude where there were several villages, whilst most of the cacti seemed to grow in the area below this.

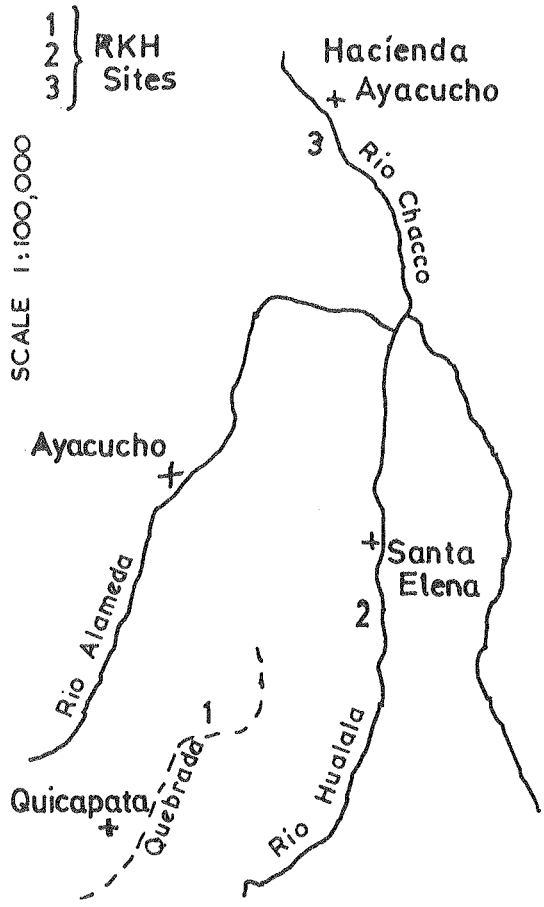
In 1978 our group of 13 people plus a Peruvian courier travelled in a minibus from Huancayo to Ayacucho on May 2nd. Due to a delayed start we only arrived at the meal stop as darkness was falling. The rest of the journey and our arrival in Ayacucho was undertaken in darkness. In 1980 I caught the early bus out of Huancayo on November 5th. We pulled out of Huanta that evening just as darkness was falling. As the light faded we had a sky of brilliant oranges, pinks and reds to the west. In other directions we saw a dry electrical storm against a pitch black sky. Sheet lightning lit the sky behind the mountains throwing them into silhouette. Classic forked lightning sizzled for seconds as it went to earth on the peaks. This natural firework display was enacted without any thunder. Then the rain started, slowly at first, until we were engulfed by the storm.

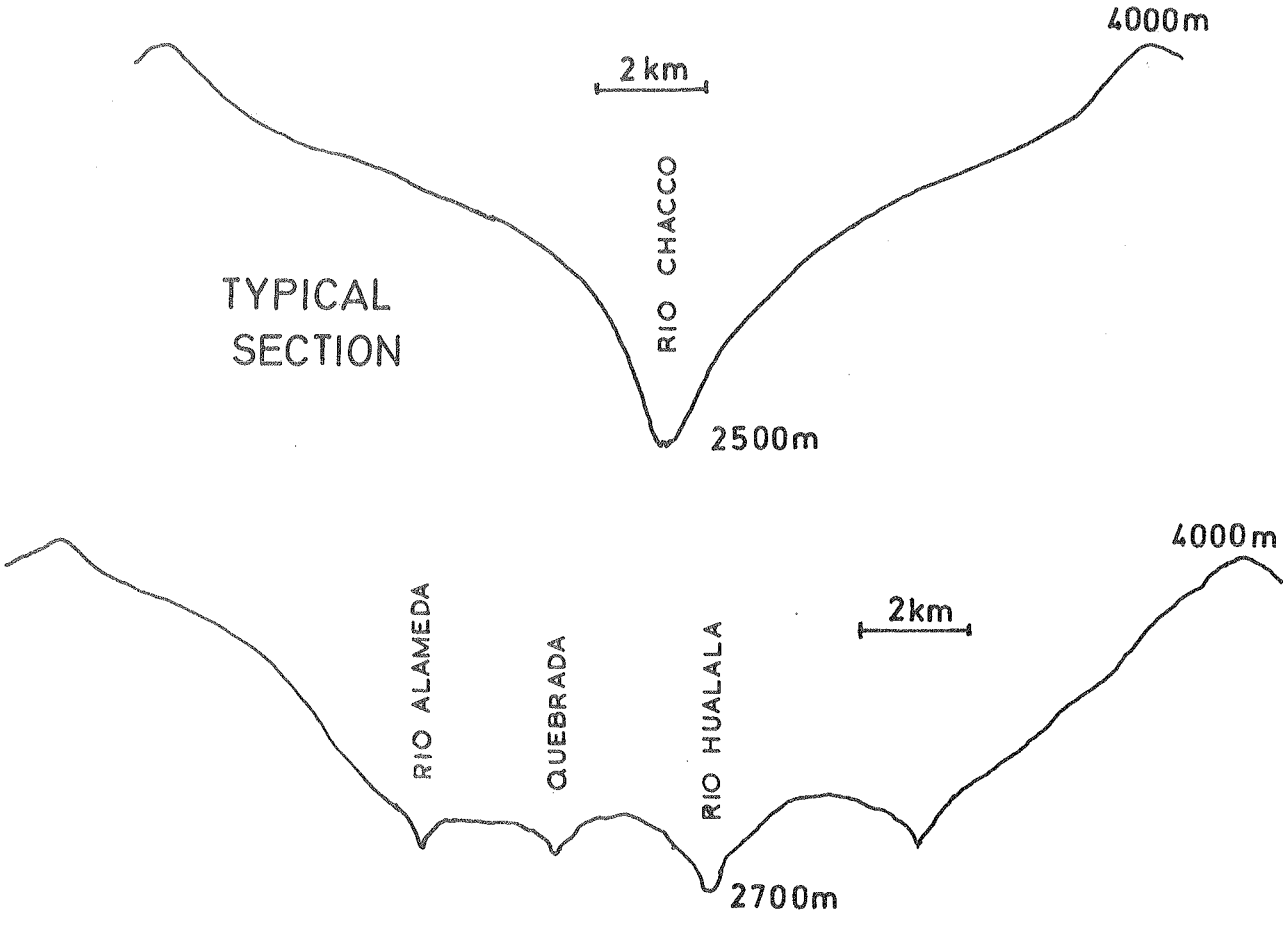
The rain sheeted down and within minutes came pouring through the closed bus windows into rivers on the floor; window seat passengers got well soaked. The loud drumming of rain on the bus was nothing to the deafening claps of thunder that cracked immediately overhead. In twenty to thirty minutes the storm was all but over with just the odd spot of rain continuing. The town of Ayacucho had been within the storm for on our arrival we found that the streets were wet and muddy. Next day the only sign of the previous day's rain were damp patches shadowed from the hot sunshine.

In 1980 I was due to leave Huancayo on October 31st by the 6 p.m. bus; the start was late and there were many delays en route. At last I was approaching Ayacucho in the daylight but the heat, and the hours of travelling had made me drowsy so there was little appreciation of the surroundings before our arrival just after noon. But appreciation of the locality came from trips out of town and later study of maps obtained from the Geografic Militar in Lima.

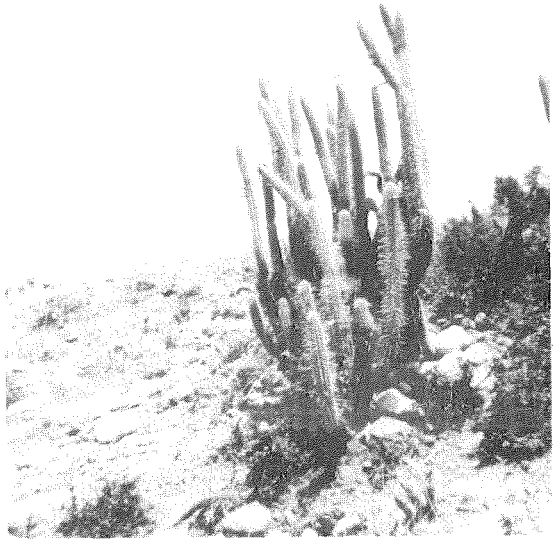
On our one day stay in the town on my first visit, we did the compulsory half day tour to the Huari tombs and then on to Quinua at the site of the Battle of Ayacucho. My three day visit in 1980 allowed me to repeat this trip, also to take a local bus to the edge of the town at Santa Elena and to walk northwards out of town, downstream in the direction of Huanta. On my full two days here in 1981 I repeated my walk along the road towards Huanta; on my return to town there was a short shower that just wet the ground and then promptly evaporated. During this stay I was also able to explore in the other direction, south above the town towards Quicapata.

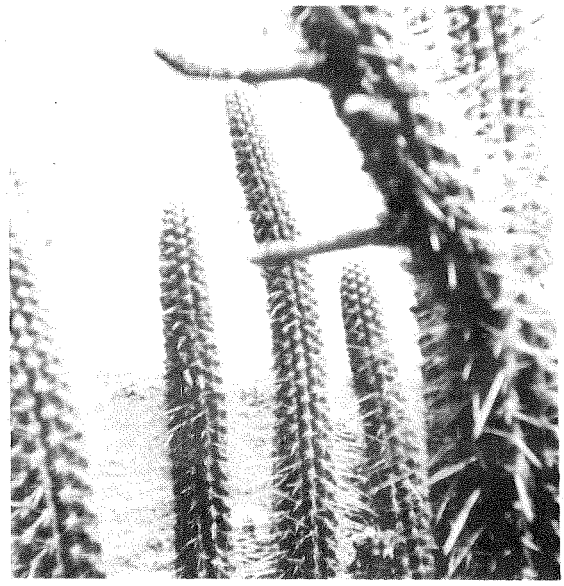
When I walked southwards out of Ayacucho by a steep climb following the river Alameda, in the direction of Quicapata, the last town house was eventually left behind. Because of the undulating nature of the ground it became difficult to see the mountainsides which lay perhaps half a mile away to the west, south, and east. The ground itself was very stony, with pieces ranging between 2inches and 9inches across of what appeared to me to be stone of volcanic origin as it was full of holes and light in weight. Although the ground was very dry, it was not really dusty when walking because so much of it was covered by stones. Among the stones there grew dwarf thorn bushes which were barely six inches tall and I do not remember





TYPICAL SECTION across AYACUCHO Basin





CLEISTOCACTUS RKH 41

SANTA ELENA - at rim of canyon

RIO CHACCO above HACIENDA AYACUCHO
Looking upstream
MORAWETZIA on slope to right

SANTA ELENA
Looking down into canyon.

AYACUCHO

Photos - R HUGHES

seeing any grass, although there may have been an occasional tuft or two. There was nothing whatsoever in the nature of trees or bushes to be seen. As I walked up the gentle slope there was a flash of bright red, which proved to be a group of stunted Erdisia or Corryocactus, not a foot and a half in height. If it had not been for the red flowers I would not have found these plants. Here there were many black ants walking in and out of the cactus flowers – the cacti being the only plants in flower. I also saw four different sorts of butterflies about.

As I walked further across the slight uphill slope it changed direction and then began to fall away with increasing steepness into a V-shaped ravine. There was a stream at the bottom of the ravine which the map indicates dries up at certain times of year. Before the ravine the slope carried plants of Opuntia exaltata, another Opuntia which I took to be tunicata, and a couple of clumps of a Cleistocactus. The aridity was testified by the rings of fallen branches around plants of O. exaltata whilst the O. tunicata produced stunted egg-shaped joints with shorter spines that were just as deadly. Due to its steep sides I was only able to see into the ravine at a bend where I could look along it. Within the ravine were a number of plants which seemed to be a species of Trichocereus of various heights, most of them out of reach on the almost vertical rock faces. Some of these plants grew much taller here than at any other place I visited in the surroundings of Ayacucho; I put this down to their inaccessibility to people with a machete although the odd one appeared to have become so large that it had torn its roots away from the rock wall. On the opposite side there was no rim to the ravine, the flank continuing to rise with decreasing steepness. Higher up the hillside I saw a shepherd with a scattered flock of sheep. Close to the rim of the ravine I found a shorter Trichocereus with a single stem that I could reach and measure. It was 28 inches tall and 4 inches in diameter, 8 inches over the spines. The areoles had 11 radial spines, one inch long, and either one or two central spines of up to 3 inches long, bleached white in the sun.

Of the couple of clumps of Cleistocacti, the larger of the two had 28 stems or branches reaching to over 4ft in height and the tallest stem was 7ft 3inches high. Below the tapered growing tip the stems were 2 inches in diameter and over the spines they measured 4 inches in diameter. The stems had twelve ribs and the areoles carried 10 radial spines and four central spines. There were a number of flowers and buds on the plant. The flowers were of a greeny-orange colour with a projecting green stigma. The length of the flower tube was 2¾ inches to the tip of the petals and the stigma projected a further quarter inch. Many ladybirds were seen round the flowers. There were a number of fruits of a greeny-olive-brown colour of ⅝ inch in diameter, but none contained ripe seed. (RKH 69).

On the occasion of my visit to Ayacucho in the previous year (1981) I took a local bus out of the town towards the south-east. Once past the southern end of the airport the town houses became quite scattered. The ground here was fairly flat and almost level, of an arid stony and dusty nature quite bare of trees and bushes (away from the habitations), just like that near Quicapata, but without the covering of porous rocks. The bus route terminated at Santa Elena where I walked around the houses to find behind them the ground fell away very abruptly into a much deeper canyon; there was a permanent river running along the floor of the canyon which lower down joined the main river valley by which we had approached Ayacucho. On the narrow valley floor there was a ribbon of green cultivation supported by irrigation from the river. There was an irrigation ditch part way down the wall of the canyon, but it was dry. The sides of the canyon, like the ground outside its rim, were also covered with stones and a dry dusty soil looking like cement dust, but in addition there were outcrops of rock here and there. Right from the very rim of the canyon the vegetation displayed a remarkable change to that on the level ground, for scattered around the sides of the canyon were many tall cacti. The sides of the canyon were pretty steep - often one stood below a plant and the base of the plant was at eye level. Here and there the odd plant which grew just below the rim of the canyon had grown tall enough to be visible as you walked towards the edge of the canyon. There were odd pieces of Opuntia tunicata that grew on the level ground and were a nuisance as they stuck to my boots,. In addition there was Opuntia exaltata, together with plants of Corryocactus and Trichocereus. Lower down the side of the canyon some bright red spots on the light brown rocky surface proved to be Lobivia flowers. Closer inspection revealed a number of scattered plants from 1 inch to 3 or 4 inches across. There were single heads or small clumps and even some of the single heads had flowers on them. Spines were relatively short but variable in length. In close-up there was really a lot of plant body to be seen and not at all that many spines. Nevertheless the overall effect of the spines gave the impression that they hid the body of the plant, probably to mimic the dried grass. All the seed pods collected proved to be unripe. A large plant bearing three open flowers was found on inspection to be loose. On lifting it up there were no roots to be seen, only a hollow in the bottom of the body. (RKH 42) Some better specimens RKH 70 were found along the road to Huanta in 1981. Unfortunately my two samples of RKH 42 passed away in winter after flowering in cultivation. The flower petals were red with a more intense median stripe, a white throat and a red stigma. At present I am growing some Lobivia zecheri from seed as I suspect that my RKH 42/RKH 70 may be that species.

Lower down the side of the canyon there were plants of Cleistocactus which were a good six feet high. On the steep slope just below the rim of the canyon there were several plants about four feet tall with a fair number of plain green stems branching from the base and reaching a height of 3 to 4 feet. The stems tapered from 2 to 3 inches in diameter at the base to less than one inch across at the top, with a great many pale coloured spines up to two inches in length. The flowers were three inches long and a greeny-orange colour, projecting horizontally from the stem, with a stigma projecting from several of those flowers which had unopened petals. I sliced one flower end to end and found three fat white fly larvae inside. A number of seed pods measuring about half an inch in diameter were found, with many black seeds in the white, dry textured pulp. (RKH 41)

On my visits to Ayacucho in both 1980 and in 1981 I walked northwards out of the town, down along the side of the tributary valley or canyon by which we had driven into the town, with the airport over the other side of the valley. This led into the main river valley again, where I turned downstream along the road going to Huanta. There were occasional bushes to be seen near this road, growing where moisture has presumably lodged in crevices in the rocks after a fall of rain. The canyon walls were full of cacti, although a non-cactophile might see only bare rock much too difficult to climb for closer examination. About two hours' walk from the town I turned to walk up the side of the main valley at a spot where the slope was less steep, where a side gulley opened to the left, taking a different line up and then down the slope in 1981 to that which I followed in 1980. That the base of the gulley was a stream in periods of rain was confirmed when I found some green grass, some damp sand shoals, and then two small stagnant pools. Here a less severe slope was encountered than that within the canyon at

Santa Elena; there was no ground covered with soft dust or with scree but all the other features such as the rocky outcrops, the stony ground and the consolidated gravelly earth, were all rather similar to the canyon at Santa Elena, Often the bare rocky surface left soil only in cracks and undulations where the cacti could grow. The most common species scattered about the hillside here was Corryocactus, and the Opuntia aff. tunicata also abounded. Red flowering Lobivias were found and fair numbers of Morawetzia doelziana v. calva. There were no Trichocereus but instead there were tree-like platyopuntias which cast shadows that were just right for sitting in the shade, out of the hot sunshine. The larger plants – those between 4ft and 6 (or 7)ft tall were pretty scattered being no closer than 30 yards apart. There were also a number of Cleistocactus which seemed to be rather similar to those seen near Quicapata and near Santa Elena.

The red flowering Lobivias were found a short distance up the slope from the road. On my 1980 visit I investigated a plant set solidly in the stony earth and it was found to have a carrot shaped root about 4 inches long, firmly embedded in the gravel between the rocks. On this occasion I found Lobivias similar to the Lobivia RKH 42 which I had encountered near Santa Elena, but here the plants had heads only 1 inch to 1½ inches across (RKH 46) and carried no flowers. However, before reaching this point in 1981 I stopped at a place along the road where a bright red flowers 2 inches across and 2½ inches long were the first indication of Lobivias. After finding the first two plants in flower, a further search yielded other plants bearing flower buds. The globular heads were between 1¼ inch and 3¾ inches in diameter, this last plant being 6 inches over the spines: but the flowering plants were all between 1½ and 2¼ inches in size. It was not possible to distinguish between radial and central spines, the 12 spines per areole being up to 1½ inches long. Both spines and bud wool were grey, the body being dull green in colour.

Beyond this site, further along the road which goes downriver in the direction of Huanta, there is a turn up a tributary valley on the opposite river bank which climbs to Quinua. Along this road the ancient Huari tombs were being excavated quite high above the road on a gently sloping hillside. Parts of the hillside had been cleared among a forest of platyopuntia bushes to expose the site of the ancient city. There were many pieces of pottery to be seen in the dry stony soil. The Opuntias were remnants of those introduced for cultivating cochineal bugs when Ayacucho cornered the market for red dye supplied to the armies of Europe for the soldiers' red coats. It was around this site, which our group visited on my very first trip to Peru, that I had my first real chance to have a close look at some cacti growing in the wild. On a west facing hillside there were some scattered shrubs growing up to about five feet high and also some dried up grasses and herbs, together with Corryocactus RKH 1 also growing up to some five feet in height. The Trichocereus (RKH 2/RKH 43) had now reappeared once more, now growing 8 or 10 feet tall, much taller than those nearer the town, where they were as stunted as most Corryocactus there. I noticed that there were some white trumpet shaped flowers open here during the day, just like there were at Pisac and at Ollantaytambo. When I again visited the Huari site in 1980, more ground had been cleared and all these plants of about five feet in height had been uprooted and removed.

Now I have growing in my greenhouse fairly well established plants from the surroundings of Ayacucho of Lobivia RKH 46 and RKH 70, of Trichocereus RKH 2 and RKH 43, of Corryocactus RKH 1 and C. ayacuchensis, as well as seedlings of Erdisia ayacuchensis and of Lobivia zecheri. Some of the seed raised plants do not seem to like the low winter temperature in my greenhouse and several of them have been badly marked.

. . . from O. Instorfer, G.O.K. Journal March 1980.

An abundant cactus vegetation prevails around the basin of Ayacucho which lies at about 2500m altitude. Most notable are two Corryocacti – the one with few ribs and slim stems is likely to be Corryocactus ayacuchoensis. A plant appears on slide which is a Corryocactus, probably C. heteracanthus, whose body is up to 20cm thick and reaches a height of 2m. Of the 2 to 5cm long central spines, one points upwards, the other diagonally downwards. Here occurs also the sworn enemy of every cactus collector, namely Opuntia tunicata originally imported from Mexico. Here it only branches after first growing columnar. A further plant that stands very close to Oreocereus is native to this dry basin, it is Morawetzia doelziana v. clava. Their stems become about 80cm long.

. . . from H.Middleditch

An obvious problem that arises out of the above account by R.K.Hughes is the identity of the Cleistocactus found near Ayacucho. On the face of it, the easy answer is Cl. morawetzianus, but on closer examination of the alternatives the situation is perhaps not so clear cut:-

	RKH 41	morawetzianus	RKH 69	pycnacanthus
Height, up to	1m+	2m	2m+	1.5m+
Ribs		14	12	10+
Spines		14	14	16
Centrals		3	4	4
Flower length	75	55	70	85
Flower colour	Greeny orange	Greenish white	Greeny orange	Deep carmine

Now Backeberg identifies the source of the plants upon which his original diagnosis of Cleistocactus morawetzianus was based as Mariscal Caceres, in the vicinity of the Rio Mantaro. In Die Cactaceae Vol 2, Backeberg observes that not far from this finding place, at Condorbamba on the road between Huancayo and Ayacucho, other plants of this species were found by C. Ochoa which had flowers with greenish white tube and pale pink petals. It has not been possible to locate this place name on any map in my possession, so it is not clear whether it is north of Mariscal Caceres, or to the south of that place i.e. in the direction of Ayacucho. Certainly the many flowers seen on a multi-stemmed specimen of Cl. morawetzianus at the Zurich City Collection were greenish-white in colour throughout.

In Rauh's Beitrag zur Kenntnis der Peruanische Kakteenvegetation, Cl. morawetzianus was also recorded

from Hacienda Carahuasi in the valley of the Rio Apurimac; this find appears to be synonymous with Johnson's Cl. apurimacensis. The location of R. K. Hughes' observations at Ayacucho is roughly in the middle of the apparent distribution area for Cl. morawetzianus. This species also appears to be the most northerly occurrence of the genus Cleistocactus.
. . . further from R. K. Hughes.

The Cleistocacti which I saw at Quicapata, at Santa Elena, along the Huanta road out of Ayacucho, and also near Huanta itself, all seemed to be the same sort. The strange greeny-orange flower tube was consistent throughout. At the ovary the tube darkens to an olive brown colour. At the other end of the tube the unopened petals are light green; when the flower finally opens the petals become reddish but the light green is retained at the tips of the petals. The petals only partially open, they do not reflex back, and the green stigma protrudes from them.

My own ten inch high plant of Cl. morawetzianus certainly seemed to be quite distinct. Checking with my slides shows a tuberculate looking stem due to the V groove below each areole that almost links the zigzag intercostal groove, a feature which can be seen on cultivated Cl. morawetzianus. I had the impression that this species came from deep, warm valleys like the Apurimac which would explain why my own plant marks with the cold in winter.
. . . from H. Middleditch.

Now that last observation is very significant for in respect of the pinkish petals it matches the flower description from Ochoa. It would suggest that the Zurich collection plant came from the northerly part of the population with greenish-white flowers and the Ochoa plant came from the population which spreads as far as Ayacucho, the sort observed by R.K.Hughes. But it still does not explain the greeny-orange colour of the flower tube seen by our writer, which has not been observed by other visitors to that site.

To the south of Ayacucho, Ritter has found a Cleistocactus in the valley of the Rio Pampas which he names Cl. Pungens; his illustration Abb 1241 in Vol.4 of his Kakteen in Südamerika shows a plant which at first sight appears to differ from Cl. morawetzianus, but a detailed examination of the diagnosis suggests that the bloodred flower tube with purple petals is possibly the most outstanding difference between the two. Ritter notes that Cl. pungens is related to Cl. morawetzianus. In the Rio Mantaro valley at Villa Azul, which lies east by north from Mariscal Caceres, Ritter has again found plants of Cleistocacti; these he names Cl. villaazulensis. He gives the flower tube as reddish with purple petals. In comparing this species with Cl. morawetzianus he says that the flowers on the latter vary from one site to another, from being similar to his villaazulensis to having greenish tubes with greenish petals. On this basis we might conclude that the greeny-orange flower tube seen by R.K.Hughes is the local version of Cl. morawetzianus from around Ayacucho and Huanta.

WANTED

. . . by P. Allcock. Beitrag zur Peruanische Kakteenvegetation, Rauh.
. . . by A. W. Craig. Morphology of cacti, Buxbaum.
. . . by R. Ferryman. Any information on Bertero's travels in Chile in about 1825.
. . . by A. W. Hill, Sheffield. Piece of Maihueniopsis fragilis.
. . . by G. Hole. U.S. Cactus & Succulent Journal for Nov-Dec 1985.
. . . by H. Middleditch. References for New Species of Cacti by Cardenas, other than U.S. Journal and Cactus France.
. . . by M. Muse. Cardenas' autobiography.

WEEKEND GATHERING 1986

Commencing in summer 1985, enquiries were made with a view to inviting a speaker from the continent to this event. Both J. Piltz and W. Gertel indicated that they could participate in our 1987 weekend, but not in 1986. A speaker from Belgium who has been to Peru, Argentina and Chile, wrote early in June 1986 to say that he would be able to come this year, in Septmeber. No date was specified. As we go to Press, a further reply is awaited in order to proceed with booking the necessary accommodation etc. We hear from N. Wilbraham that he could tell us about his visit to Salta this year, and from R. K. Hughes who has had a further visit to Peru, also from R. Mottram who has some slides of Ritter herbarium material held at Utrecht. Any other contribution will, as always, be welcomed. Although the charges made by Brooksby have not risen in line with inflation, standards of accommodation and lecturing facilities have gradually slipped. Alternative College accommodation in the same general area will probably cost about £44 per head. Considerable problems arose last year owing to bookings being received after the deadline specified by the College; in order to maximise available time for all concerned, a date of September 12/13/14th has been suggested to our potential speaker. When arrangements are firmer, further information will be sent automatically to those who participated in 1985 and to any other member who requests it.

A ROSE (Cactus) BY ANY OTHER NAME . . .?

. . . from P. Smart

Having happened to look at the spelling of Sulco. tarabucoensis reminded me of a query about the spelling of Weingartia pilcomayoensis (with an o) which seems to be the 'in' spelling of the pundits. Whilst looking at my photostat of the original description by Cardenas taken from Cactus (France) I noticed that it was described as W. pilcomayensis, without the 'o'. Does this mean that we must spell it this way or is there some ICBN procedure for altering potential printers' errors which have occurred in the original description?
. . . from R. Mottram

If this species of Weingartia was intentionally spelt in this manner by the author, then it is not necessarily an error. Thus if Cardenas repeats the name in his first description, it is probably spelt that way deliberately. There are several other instances where the correctness of the spelling can be queried; of these, there are some which I feel it would be preferable to have the name rectified and others which I would leave alone, but I recognise that there are likely to be differences of opinion on the subject. Examples are Sulcorebutia krugeri which should be spelt kruegeri, and S. pulchera

which should be spelt pulchra. The -era ending does not appear in any of the admissable terminations listed by the ICBN.

. . . from H. Middleditch

In regard to S. krugerii, I see that Brinkman states plainly that it is not correct to spell it with an umlaut over the 'u' or to spell it as kruegerii. The original spelling by Cardenas in Cactus (France) was krugerii.

. . . from J. D. Donald. Having met Anna Maria Kreuger after whom the species was named I can confirm that she prefers to spell her name with an eu in the Spanish manner.

. . . further from H. Middleditch. So does that mean that if Cardenas deliberately spelt the name krugerii then that is the spelling that should be used? Irrespective of whether or not it may be correct? Now in regard to S. pulchera, my classical latin dictionary does indeed give pulcher, pulchra, pulchrum; but mine is what I would call a working dictionary, and not an all-embracing tome.

. . . from P. Collins.

Certainly pulchra would be the regular and normal form of spelling to adopt. A classical latin dictionary in effect is a record of the mode or modes of spelling adopted in that language, so it is possible that if sufficient time was spent examining texts then it might be possible to find a spelling in the form of pulchera. But just because it may be found does not constitute a precedent by which would should abide; it is not a regular form of spelling and would be regarded as an abnormality. In addition, botanical latin is not necessarily identical to classical latin and it is the botanical latin which should be followed. One of the most persistent examples of this spelling problem is Gymnocalycium saglionis as so named by Cels. The first place in which I have come across it written G. saglione is in Britton and Rose, who must have decided that the epithet was an adjective and made it agree with the generic name, whereas it is a noun and does not change. Hence the rendering by Britton and Rose is not correct.

. . . further from H. Middleditch

The original description of G. saglionis states that the plant was named after Joseph Saglio, of Strasbourg so that the epithet is clearly a noun. From Stearn's Botanical Latin I see that when it comes to decling a noun and the case to be used then "the genetive is much used in specific epithets commemorating persons"; in the same publication a noun ending in -io is declined and does end in -ionis in the genetive. From which I assume that Mr. Cels knew his latin. However that seems to leave us still with an unanswered question about what you do with an epithet that is not spelt in the accepted fashion but appears to have been deliberately so spelt by the original author?

REPORT and ACCOUNTS CHILEANS Nos 40-42 inc.

Income		**Expenditure**	
Subscriptions	1655.55	Printing of Journals etc.	2994.87
Back Numbers	549.15	Postage, Stationary, etc.	659.91
Sale of other publications	52.45		
	2257.15		3654.78
nt and seed sales	252.27	Plant purchases	428.00
scellaneous income	102.27		
nk Interest	541.14		
	3152.83		4082.78
Balance brought forward from previous account	2074.10	Balance carried forward	1144.15
	5226.93		5226.93

The Treasurer reports that subscription income remains virtually unchanged, but total income is down by some £230. Together with a very heavy increase in total costs (not the least in printing) coupled with a loss on plant sales, the retained balance has dropped from £2074 to £1144, a loss of £930.

John Hopkins reports increased problems in obtaining an interesting variety of seedlings for plant sales; in taking what members were prepared to offer as a total package, much has remained unsold. Not only have other outlets been established for plant sales, but members growing interesting plants now appear to have little difficulty in finding good homes for spares. Consequently the Chileans plant sales activity has now been discontinued.

The typewriter purchased some 35 years ago at a price of about £50 and used for all Chileans issues, (without being a charge on these accounts) finally became beyond repair. As a replacement a word processor has been obtained, at a cost of just under £2500; although used virtually 100% for Chileans work none of this cost has been put on the Chileans account, for the simple reason that the funds will not carry the cost. Autotypesetting can be done directly from the discs, so cutting out the cost of manual typesetting. Unlike the equipment recently commissioned for the ex-Fleet Street Dailies, the less-recent equipment used by our current printers has not been able to read discs directly from current high-technology micro computers; our printers advised on 7.3.86 that they could now obtain a translation service on to their discs.

For several years it has been possible to devote five or six evenings each week for four or five hours per night to preparation of The Chileans; circumstances have now reduced this to two or three hours for each of one or two evenings and the rate of output of issues has fallen accordingly. A few long delays in receiving replies to enquiries have also contributed to this result.

A great deal of very valuable support has been received from many members whose names do not necessarily appear in the pages of The Chileans, but without their efforts it would not be possible to undertake the depth of discussion at which we aim.

STUDY GROUPS/REFERENCE COLLECTIONS

Cleistocacti	T. Lavender, Kalanchoe, Market Place, Tetney, DN36 5NN.
Copiapoa	A. W. Craig, 32, Forest Lane, Kirklevington, Yarm, TS15 9LY.
Echinopsis	M. Muse, 24a, Castle Road, Kirby Muxloe, Leicester, LE9 9AB.
Frailea	J. Forrest, Spring Garden, 2, Darngaber Road, Quarter, Hamilton, Scotland.
Gymnocalycium	F. Fuschillo, 55, Emberton Court, Tompion Street, London, EC1V 0EP.
Lobivia	J. Hopkins, Primrose Cottage, Monks Lane, Audlem, CW3 0HP.
Matucana/Borzicactinae	P. Allcock, Laneside Cottage, Fiddlers Hill, Milton Road, Shipton-under-Wychwood, OX7 6BD.
Melocactus/Discocactus	J. Arnold 4, Lonsdale Court, Churchill Park, Washingborough, LN4 1HJ.
Neoporterianea	R. Ferryman, Nichelia, The Street, Stonham Aspal, IP14 6AH.
Notocactinae	G. J. Charles, Briarsbank, Fosterbridge, Ketton, Stamford, PE9 3UU.
Opuntia/Tephrocacti	J. W. Bagnall, Wendy Cottage, 128, Huddersfield Road, Meltham.
Rebutia	P. Smart, 5, Tomlinson Avenue, Gotham, Nottingham, NG11 0JU.

THE CHILEANS

Organiser	H. Middleditch, 5, Lyons Avenue, Hetton-le-Hole, Co. Durham, England DH5 0HS.
Treasurer	R. L. Purves, 19, Brocks Drive, Fairlands, Guildford, Surrey, GU3 3ND.
Membership Sec. & Back Numbers	Mrs. G. Craig, 32, Forest Lane, Kirklevington, Nr. Yarm, TS15 9LY.
Slide Librarian	A. W. Craig, 32, Forest Lane, Kirklevington, Nr. Yarm, TS15 9LY.
Weekend Events	Mrs. M. Collins, 11, Tudor Gardens, Upminster, RM14 3DE.

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