Identification
Johan Pot

Summary
Cactus lovers like to talk about their plants. These have to be consistently named, otherwise there would be another tower of Babel. The same species should be given the same names. But can we recognize species? And are we really prepared to do something about it?

Why do I see a lobivia here?
Only a short time after I joined the guild of collectors of succulents, someone drew my attention to the greenhouse of Martine Bos in Schoorl, where you could buy good plants for a fair price. Small cacti with matching label cost 25 cents more than those without a name. For economical reasons I did not buy only labeled plants. (Fig. 1)

By chance I had read an article about a man who had a beautiful collection of cacti, in which you would not find any label. According to this man the appreciation of the plants would be reduced by small nameplates. Indeed there was something in this . But on the other hand you do like to understand what you are working with. Therefore a knowledge of the right name is indispensable.
In the early nineteen eighties Herman Rubingh called on

1 Nice plants in 1980, but partially unlabeled.

cactus lovers to participate in a studygroup, which would concentrate especially on nomenclature. This was exactly what I was looking for. However, after the first meeting it was already clear to me, that it's only rarely possible to determine the appropriate name for an unknown cactus.
Meanwhile I had taken photographs. A member of the division Zaandam of Succulenta saw slides of my lobivia's which by coincidence were all labelled. He invited me to give a presentation. I felt honoured and prepared myself very carefully.
But already during the second picture the chairman got up. "Why do I see a lobivia here?", he wanted to know, "How can I recognize a lobivia?" Somewhat abashed I had to admit, that I did not know.
Recently, more than 30 years later, I asked this question again to some enthousiasts of our association. Until now there has been no answer.
In the past a very experienced collector explained to me, that nomenclature of course[1] is extremely complex. It just takes a lot of time, before you are able to make an informed judgement. He showed me an issue of Ashingtonia of 1980, in which John Donald tried to classify plants of the genus *Rebutia* in a responsible way. For example I read *Rebutia wessneriana* Bew. subsp. *wessneriana* Bew. v. *gokrausei* (Heinr.) Don. f. *permutata* (Heinr.) Don. nov. comb.. This extraordinary insight suggests an enormous investment in time.

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[1] The word *of course* is often used in order to gag an unsure interlocutor. In that way the speaker is accepted to be right, even if he has no real support.

Nevertheless I would invite you to start a search for propagation of this taxon, up until today. But I give you little chance. Some people speak in this case of "tapeworm" names.

Computer

I started to understand the hopelessness of my mission. Probably my unknown plants would never be identified. But suddenly without prior consultation I was appointed to be the one and only computer specialist of my school. Indeed I knew the word *computer* and I also knew that such a machine was extremely expensive: the cheapest at that time cost between ƒ50 000 and ƒ100 000. So there my specialism ended.

Then the homecomputer Sinclair ZX81 appeared on the market, for only ƒ200, with no less than 1 Kb RAM memory. And a manual casu quo course book for a simple form of the computer language BASIC.

One year later the school purchased a homecomputer, a *Commodore 64*. A whole new world opened up for me. Soon I saw a possibility to put characteristics of various species of the genus *Rebutia* into the computer. If I compared an unknown rebutia afterwards with the total number of characteristics, I could possibly find out the name of this plant. This program was the precursor of the later project *SulcoMania* (1996).

Indeed the program of the Commodore 64 worked. For example you could select the characteristics *red flower* and *11 ribs*. The result was a list with all red flowering species which had 11 ribs. After defining an adequate number characteristics, just one species remained. Then the right name had been found.

It was really remarkable, that often the solution was found after only a few selected characteristics.

During the next meeting of the studygroup of Rubingh I demonstrated the program, proudly but at the same time modestly. However again something went wrong. Henk de Looze selected on purpose not a rebutia to identify, but a plant of another genus. In this case a solution was also given after a limited number of imported features. The laughter was hearty. Who would expect to recognize a parodia or a mammillaria using an identication program for *Rebutia*?

For the moment I had no answer. But now I was a forewarned person. Had I not been unable after all to explain why they call a certain plant *Lobivia*? In the same way I could not make clear how to recognize a *Rebutia*. Fortunately I was in good company as nobody else was able to either!
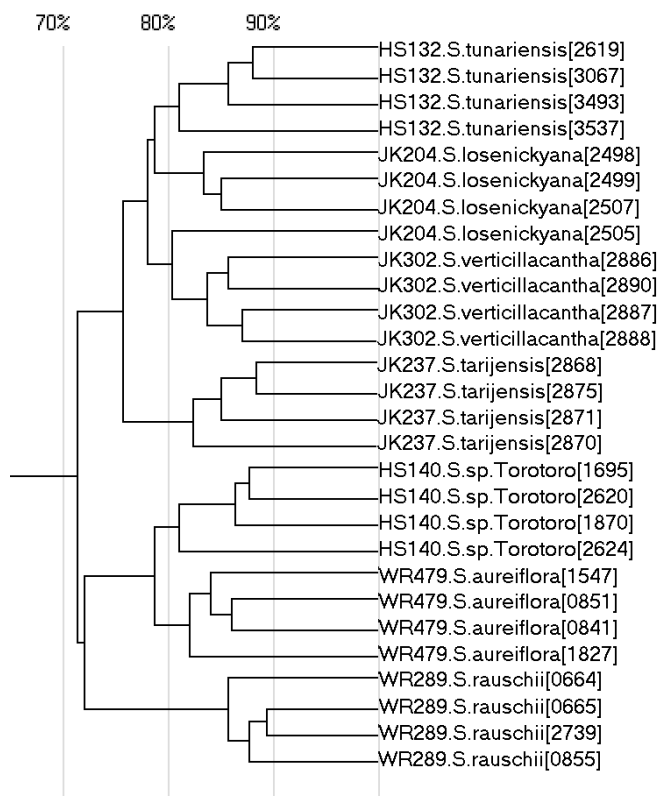
Numerical taxonomy

One night I was called by Wim Vanmaele. Something about my experiment on the computer had come to his ears. Well, he himself also was engaged using the Commodore 64, but in a very different way. He collected **many** data of individual plants of the genus *Sulcorebutia*[2]. Then he compared these characteristics with each other and using the computer he designed a cladogram. A cladogram is a diagram of a tree with various bifurcations. Similar plants will be close together like twigs on the same main branch.

The cladogram suggests a phylogenetic structure. Certainly this would be a clever way for Donald to justify his "tapeworm"-names.

As an example I show a cladogram, which was designed by my program *CactusData*, in which data of maximally 47 characteristics can be compared. From 7 different populations of *Sulcorebutia* always 4 plants were selected (Fig. 2). All of them were rooted offsets of habitat plants (Fig. 3, 4, 5, 6, 7, 8, 9).

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[2] Though no unambiguous criteria exist to split off a genus Sulcorebutia from Weingartia, I prefer to use here basionyms.

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       70%      80%      90%
                              HS132.S.tunariensis[2619]
                              HS132.S.tunariensis[3067]
                              HS132.S.tunariensis[3493]
                              HS132.S.tunariensis[3537]
                              JK204.S.losenickyana[2498]
                              JK204.S.losenickyana[2499]
                              JK204.S.losenickyana[2507]
                              JK204.S.losenickyana[2505]
                              JK302.S.verticillacantha[2886]
                              JK302.S.verticillacantha[2890]
                              JK302.S.verticillacantha[2887]
                              JK302.S.verticillacantha[2888]
                              JK237.S.tarijensis[2868]
                              JK237.S.tarijensis[2875]
                              JK237.S.tarijensis[2871]
                              JK237.S.tarijensis[2870]
                              HS140.S.sp.Torotoro[1695]
                              HS140.S.sp.Torotoro[2620]
                              HS140.S.sp.Torotoro[1870]
                              HS140.S.sp.Torotoro[2624]
                              WR479.S.aureiflora[1547]
                              WR479.S.aureiflora[0851]
                              WR479.S.aureiflora[0841]
                              WR479.S.aureiflora[1827]
                              WR289.S.rauschii[0664]
                              WR289.S.rauschii[0665]
                              WR289.S.rauschii[2739]
                              WR289.S.rauschii[0855]
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2 Cladogram with 4 plants of 7 different taxa on the basis of 42 characteristics. Notice, how nicely the plants have been arranged.

6 Sulcorebutia tarijensis JK237.

8 Sulcorebutia aureiflora WR479.

3 Sulcorebutia tunariensis HS132.

4 Sulcorebutia losenickyana JK204.

5 Sulcorebutia verticillacantha JK302.

7 Sulcorebutia sp. Torotoro HS140.

The cladogram was calculated on the basis of degrees of similarity. The individual plants are indicated in the cladogram with a field number, a name and a collection number.

9 Sulcorebutia rauschii WR289.

10 Cladogram like the one of Fig. 3, but 7 plants were replaced with a specimen from the same population. These are marked by *. Obviously the suggestion called up by a cladogram is influenced strongly by the selection of the samples.

Donald would have been elated by this cladogram. The 28 plants are neatly arranged into clusters of 4 plants of the same taxon. So there is every reason to use this method to identify unknown plants. Because you can assume, that an unknown plant will be situated in the right cluster, can't you? Unfortunately cladograms may surprise us now and then. For Fig. 10 the same populations were used, but on seven occasions a plant was replaced by another of the same population. The new cladogram suggests chaos.

"This was to be expected," some experts said, "because *of course* you have to choose the right characteristics." Unfortunately nobody could explain these "right" characteristics to me.

"*Of course* you must give the important characteristics a higher weighting", was the opinion of others. But in this case also nobody could explain which characteristics are more important. It looks like numerical taxonomy in the end is not so suitable for identifying plants.

Some experts suggested, that in a cladogram the mutual relationships were mapped in a nice way. They suggested a swarm of hybrids which came into being by rather recent foreign pollinations. Who knows? All of it may be true. But especially during the last years, where DNA-research is fashionable, possible relationship derived from only morphological characteristics may easily be questioned.

Probably we as amateurs will no longer be able to give a generally accepted interpretation of relationship. But are we still able to identify plants?

Intuition

Many collectors of sulcorebutia's accept that the plants in Fig. 11 are called *Sulcorebutia steinbachii*. Nevertheless at first sight they do not resemble each other strongly. Seeds of these plants also differ rather strongly (Fig. 12). What may be the reason, that collectors do recognize them as only one taxon?

Recently I found an article in which in easy language, the principle of *Deep Learning* was explained. A child sees an object. Daddy says: "This is a dog." Some time later the child
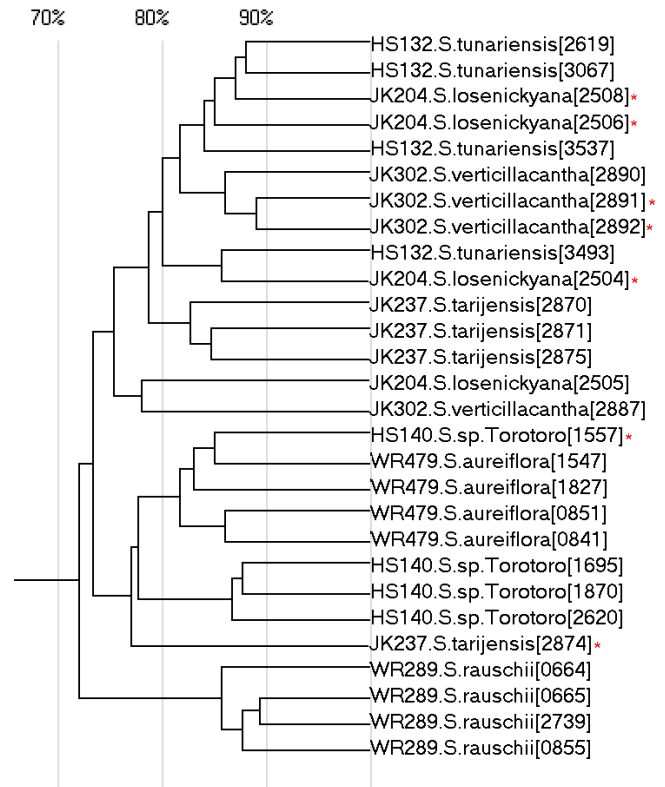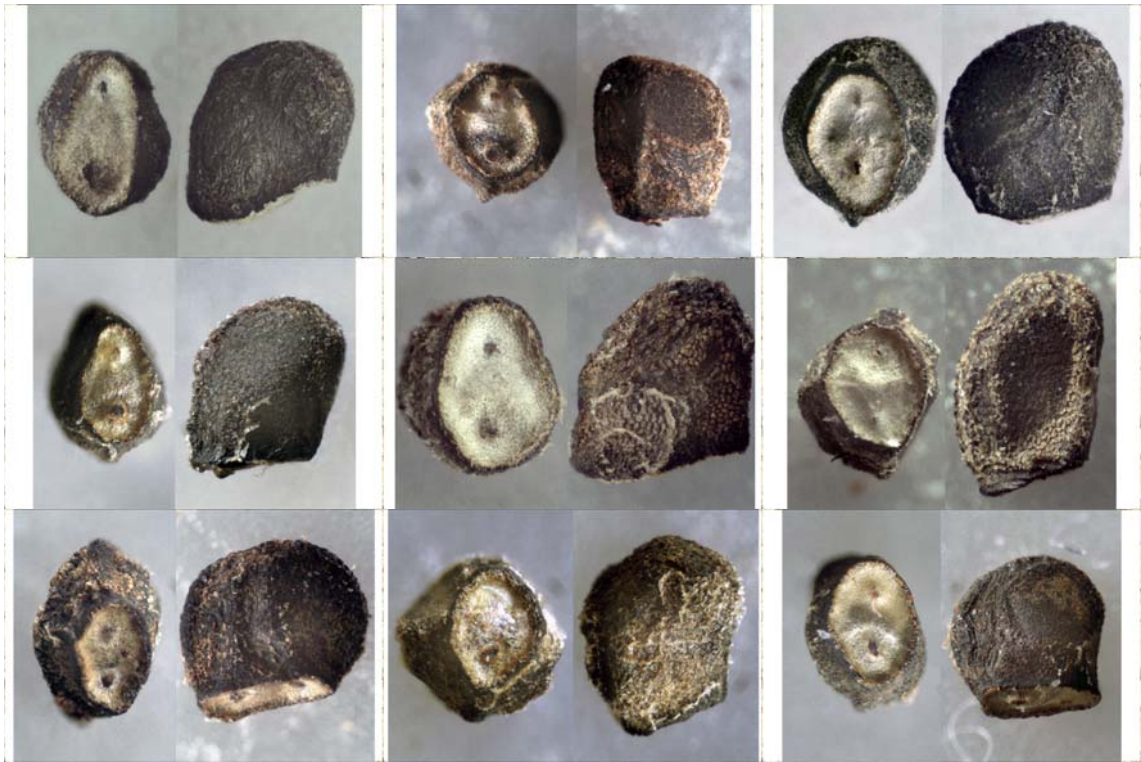
11 Plants wearing the name Sulcorebutia steinbachii in most of the collections.

G013	FK017	G123
HS180	JK091	JK092
JK104	JK105	WR056

12 Images of seeds of the plants of Fig. 11.

sees another object and asks "Dog?" Now daddy can confirm or deny. You understand, the concept *dog* will become more complete, if more objects with the name *dog* have passed.

13 All except the last are the images copied from the Grote Winkler Prins encyclopedia, 1969, Elsevier, Amsterdam. The child asks with every object if this represents a dog. Daddy will confirm or deny.

You could say, that a base for intuition is formed. (Fig. 13)[3]
Perhaps this is the method with which cactus lovers learn to recognize their plants. In this way for example the concept of *Sulcorebutia steinbachii* comes about. A mentor confirms or denies, if the enthusiast supposes to see a steinbachii. It is obvious, that somebody, who has seen many such plants, has an excellent perception of the width of variation of the taxon. For that matter enthusiasts with an extended collection no doubt have an advantage. That applies *of course* even more for people who saw the plants in their natural habitat. Indeed I have heard such people sometimes saying: "You cannot judge, as you have not been there." Some super collectors of *Sulcorebutia* even were called *Pope* with awe – and perhaps somewhat ironically ? – because of their infallible judgement.
Nevertheless I see some minor problems. In the example we assume, that the father himself has an accurate concept of a dog. But is this true? Will our mentor always unambiguously recognize a *Sulcorebutia steinbachii*? How did he acquire his knowledge? Solely from his own mentor or did he interpret himself? Is it true, that his judgement was infallible? *Of course*, but nevertheless it differed quite often from that of other mentors.
Cristiane Ritz (2007) refers to two books of Anderson, *The cactus family* (2001) and *Das große Kakteenlexikon* (2005) as support for identifying the mentioned species in her article. So Anderson is in this case a mentor. But I personally would sometimes prefer different names for some of the images presented by him. And perhaps Anderson himself was not sure about what he was doing. For example the plant, which he still identified as *Rebutia steinmannii* in 2001 was called *Sulcorebutia canigueralii (Sulcorebutia rauschii)* in 2005. Do I know now, on which plants Ritz did her research? I have certain doubts.
From the above it is clear how tricky it is to accept blindly someone's intuition as representing the truth. In 2001 Anderson had not noticed, that *Rebutia steinmannii* and *Sulcorebutia rauschii* could possibly belong to two different genera. He was not the only one. Still one month ago I read in a letter of a cactus celebrity something about rebutia's, where he really meant aylostera's. He did so, even though Ritz in 2007 had already made plausible, that these genera do not have directly the same origin.
Lechner (2016) writes: "A scientifically active biochemist, known to me, did solve the *Sulcorebutia/Weingartia*-problem for himself very pragmatically: '*Then I enter with Augustin* (well-known cactus grower and knower of weingartia) *the greenhouse, look to the right* (there are the sulcorebutia's), *look to the left* (there are the weingartia's) *and realize ..... this will not go together, never, ever*.'"

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[3] It is the intention to have the computer recognize a dog after analysing an image of it. As a computer will not be able to work intuitively, the program writer will have to be very clever.

Was not a much higher value awarded here to intuition than to the results of the research of Ritz? Admittedly, DNA research in itself does not play a major role in the recognition of a taxon. Recognition is a matter for our senses. But should not we wonder, if our intuition lets us down in this case?

However more seriously: the biochemist also prefered his intuition instead of the investigation of Hentzschel (2000): "the genus *Weingartia* (including *Sulcorebutia*) is recognizable by short-columnar or globose plants with bald buds which have cordate buds with at the bottom "small ears". Furthermore the funiculi are single or once branching. With these data one should be able to identify *every* (normal) weingartia, once more including sulcorebutia". Unfortunately I did not encounter many collectors, who take this work of Hentzschel seriously. After all it is much easier to name something on the base of intuition, where nobody can argue.

Identification

According to Cronquist species are the smallest groups that are consistently and persistently distinct and distinguishable by ordinary means. This definition is consistent with recognition. After the family of plants (*Cactaceae*) is known, we have to determine to what genus the plant belongs. Previously this option was frustrated deliberately by Henk de Looze, as a result of which a wrong solution was inevitable.

Even if we can often determine the right genus by intuition, it still is very important to have an objective control to fall back on, in the case of *Weingartia,* using the work of Hentzschel.

At the start of my tale I mentioned, that the computer program on the Commodore 64 found a name for a plant after selecting only a few character-istics. **Determination is done with a minimal number of character-istics.** After deciding the genus, I was, using the previous mentioned program CactusData, looking for the most typical plant of this taxon and for an as small as possible

14 In the column in the middle a "plant of referentie" is selected. The program examines for every plant with the same field number, if characteristics have the same value for at least 85%. If so, the colour in the left column gets red. I select a few of these characteristics, i.e. they get the weighting "1". Then I have the program examine the degree of similarity with the plant of reference. The lower limit of the result was set to 85% in this case. The result is found in the right column.

number of characteristics. I was successful, if the program found for all plants of the taxon a higher degree of similarity with the "typical plant" than for **all** 2000 other plants.

Let us take *Sulcorebutia rauschii* as an example. After much *trial and error* I found the plant with field number HS121 and collection number 1957 to be the suitable "typical" plant. If I select for this plant the colour of the radial spines, the size of the radial spines, the absence of a central spine and the colour of the flower, the result is a list with at most 11 similar plants, 9 rauschii's, an S. taratensis var. minima and an S. heinzii. (Fig. 14)

Will it be possible to find a better "typical" plant for *S. rauschii* in my collection? Or are other characteristics more favorable? Both of these possibilities are not excluded, but hardly to be worked out manually.

In the same way I was not only able to isolate the recently described *Weingartia sanpedroensis* from all other plants, but also *S. purpurea*, *S. arenacea*, *W. westii, W. neumanniana* and *S. langeri*. Every time I selected plants, which would, in my estimation, not be given a different name by anybody intuitively.

Obviously by my approach I solved the problem of important characteristics. The importance of a characteristic was determined by myself, for each taxon being possibly different. Important characteristics got the weighting 1, the others the weighting 0.

But my attempt to find favourable characteristics for *S. torotorensis* did not bring the desired success. This means, that I cannot explain in which way I can identify *S. torotorensis*. Maybe my intuition is not adequate. Maybe my mentors put me on the wrong track. Or maybe it is simply not possible to delimit *S. torotorensis* really. In that case the plants with this label do not form a recognizable group. Does it in this case make sense to maintain the name *torotorensis*?

Even more confusing is the result of *Weingartia longigibba*. Whatever plant I selected as plant of reference and whatever characteristics I tried, nothing recognizable was found. Perhaps in this case I worked with impure plants, which were the results of inaccurate pollinations. Or perhaps a recognizable taxon *W. longigibba* does not really exist.

After some time-consuming experiments I came to the conclusion that it is very labour-intensive to find a "typical" plant and matching favourable characteristics for a certain taxon. Probably it will be impossible in many cases. I would prefer to provide all not-recognizable populations with the epithet of "spec. of [name of a place]". In my expectation there are very many such populations. The genus *Weingartia* (including *Sulcorebutia* and *Cintia*) appears to be a chaos which very often surprises us through its enormous variety of forms.

Is it not strange then, that in spite of this some people by intuition label numerous populations, which they cannot verify, with a name. They even appear to be able to connect relationships to this name. And they do this so convincingly, that they are accepted to be a mentor. Exciting are discussion in which you hear cries like "never in all my life!", only motivated by intuition.

Finally, another digression. Rausch (1970) described *Sulcorebutia crispata*. Only a few clones of this taxon circulate. Nevertheless quite soon some discoveries of Alfred Lau were identified as a *S. crispata*. And meanwhile people speak of a huge area of crispata.

But the known clones of WR288 differ much from each other. In the collection of Johan de Vries you find eight of them, but Johan wonders, if these plants were really collected by Rausch himself. Would it yet be possible to select a "typical" plant with corresponding characteristics, by which we can isolate all WR288-crispata's? I cannot imagine a positive answer.

Though it is not useful for direct identification, a comparison of isoenzymes is still interesting. Lothar Diers (2016) published not only an explanation about isoenzymes, but their patterns for a number of plants which would be called *crispata* or *roberto-vasquezii* as well.

The patterns of the only three plants of the type locality WR288 are significantly less similar to each other than to those of a large number of other plants. (Fig. 15)


100 % WR288/1	*crispata*
81.8% WK986/19	*roberto-vasquezii*
81.8% L394/4	*crispata*
81.8% L394/3	*crispata*
81.8% L394/2	*crispata*
81.8% L390/1	*crispata*
81.8% L390/6	*crispata*
81.8% JK071	*tarabucoensis*
81.8% HS258/1	*crispata*
81.2% G158/1	*tarabucoensis*
81.2% G104/3	*tarabucoensis*
81.2% G049/6	*aureiflora*
77.2% WR595/1	*crispata*
77.2% WR288/3	*crispata*
77.2% WK986/29	*roberto-vasquezii*
77.2% WK986/ 9	*roberto-vasquezii*

66.6% G058/8	*tarabucoensis*
65 % G186	*sp. Rio Julpe*
63.6% WR465	*oenantha*
63.6% WR288/2	*crispata*
63.6% WK986/34	*roberto-vasquezii*

15 S. crispata WR288/1 was selected as a reference plant. In the table of similarity in patterns of isoenzymes, degrees of similarity are shown. In red the three plants with field number WR288 are shown, in blue the other crispata's. A part of the table has been omitted after WK986/9. Recognition of crispata on the basis of the used isoenzymes is impossible. Even the three plants from the type location have relatively little similarity.

I was not able yet to take photographs of seeds of *S. crispata* WR288. But if I select WR595 as a reference in the database of seeds, I find according to my algorithm the seeds of the so-called *crispata* GC11a the least similar to those of the reference plant of all 2200 samples. Well, there are some experts who believe that all seeds of *Weingartia* do not differ significantly, for example the two seeds in Fig. 16. So they actually claim that all seeds of *Weingartia* are too similar to use as a way of classifying. Would it yet be possible to do so with morphology of flowers and/or plant bodies?

Seeds and isoenzymes suggest a huge chaos. One would not expect for a moment to be able to find a recognizable taxon *crispata*.

But this is not really necessary for the intuition of the collector. Lechner (2015) devotes an article to the dispersal morphological variability of *Sulcorebutia crispata* and emends the description. Was an offset of the type plant or eventually of an unknown clone with extreme values of WR288, available to him? Or did he identify plants intuitively to be *crispata*, plants probably not from the type locality? We do not know yet with certainty where Rausch discovered his plants. Probably it will not be difficult to accept a red flowering plant intuitively to be a *S. crispata*, eventually one with black central spines. Would that really lead to greater understanding? Would such broadmindedness anyway yield an advantage?

Already for some decades people have experimented boisterously with complex names which should support postulated relationships. Relationships sometimes on the basis of only one morphological characteristic or on the basis of localities. It is fascinating to see how enthousiastic amateurs have subscribed to this theme and sell their intuition to be the only truth.
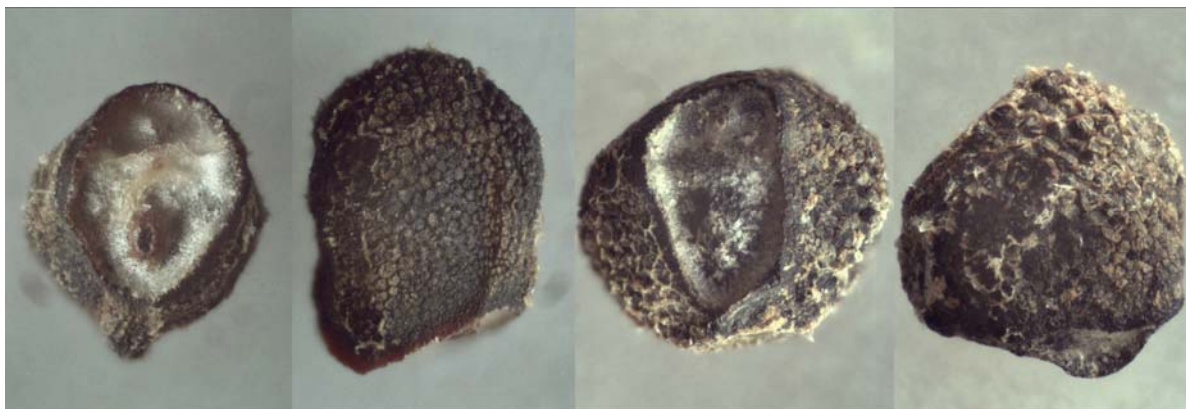
16 At the left a seed of S. crispata WR595, at the right a seed of S. crispata GC11a. Some experts find the differences negligible.

But again, it becomes more and more clear, that we as amateurs in this field cannot contribute much. DNA is *the magic word*, when it comes to relationships. We amateurs at most can indicate how to recognize a taxon.

For a complete result we need a much larger database than what I have composed myself. One has to examine enough samples of a taxon to enable recognition. For that matter my collection is not sufficient. But who will work up another 2000 individual (mature, habitat pure) plants investigating 50 characteristics? You need a firm belief in a successful outcome if you are going to start such a attempt.

The process to find a *typical* plant with corresponding discriminating characteristics for a taxon costs too much time. It is conceivable to expand my program with a routine what does the job fully automatically. But does anybody want such a thing? Who is really willing to be able to explain, how he recognizes a taxon? How much recognition was given to the work of Hentzschel?

I can imagine a simple solution: accept *Weingartia* to be a monotypical genus, recognizable with the data of Hentzschel. In that case you can remove all labels and the attention for the plants will not be diminished. Probably this suggestion will not get much support.

Presumably we will continue in the old, solely intuition based way. Maybe this will keep the hobby lively. Anyway, an advantage is that everybody will then be right!

I would like to thank Jim Gras for proofreading the English translation.

Literature

Augustin K., Gertel W., Hentzschel G. (2000), Sulcorebutia, Eugen Ulmer GmbH & Co., Stuttgart, 31.

Diers L. (2016), Über die Variabilität von *Rebutia* und *Sulcorebutia* auf Grund von Isoenzym-Analysen, Echinopseen 13(1)2016, 5-20.

Lechner P. (2015), Verbreitung und morphologische Variabilität von *Sulcorebutia crispata*, KuaS 66(2) 29-37.

Lechner P. (2016), Über den Wert von taxonoinischen Neuordnungen bei Kakteen am Beispiel der Gattung Sulcorebutia, Echinopseen 13(1)2016, 21-31.

Pot J. (1996-2016), SulcoMania, DVD met afbeeldingen and gegevens, eigen uitgave.

Rausch W., (1970), Neue Arten der Gattung Sulcorebutia, KuaS 21(6):102-105.

Ritz, C. et al. (2007). The molecular phylogeny of *Rebutia* (*Cactaceae*) and its allies demonstrates the influence of paleography on the evolution of South American mountain cacti, American Journal of Botany 94(8): 1321-1332.