

Taxonomy of cacti- a simplistic explanation

Taxonomy is the study of naming organisms based on how they have evolved. Over long periods of time, isolated populations of plants become different from other isolated populations, and in time they become so different as to be regarded (by us) as different things.

For the last 300 years or so, a global system of naming has been used. Yes, global! The whole world uses it, which makes it quite unusual for something invented by human beings. The language used is Latin, which is a dead language in that no country speaks it, so no country can get offended; a master stroke by Linnaeus, who invented the system.

We know firstly that Plants are quite different things from Animals, so all the plants are put in the “Kingdom” (the base, huge, group) Plantae.

Inside the Plantae, we know that all cacti are related to one another, in that they came from a common ancestor, many millions of years ago; and that they are more like one another than they are different from other plants. I’ll not go into how we know this; people do degrees on the subject. We put all the cacti into a “Family” which we call Cactaceae. (The Plantae are split up in several other ways before we get down to Family level, but it’s not necessary to go into it now).

Within the family Cactaceae, over time populations of the original ancestors became separated and varied in shape, size, form, habitat preference, etc., according to the environmental conditions and pressures of where they lived. Those populations which differentiated early on are more different from each other in the present day than those which differentiated more recently. Taxonomists study how closely related different groups of plants are, and give them names which reflect this.

Within Cactaceae, plants which are very closely related are given the same “Genus” (the plural is “Genera”). For example, *Mammillaria* is a Genus, and all *Mammillaria* are more closely related to each other than they are to, say, *Ferocactus*. Within the Cactaceae, taxonomists reckon there are somewhere between 100 and 200 Genera, but the exact number is argued about, as when you get down to the nitty gritty, how closely one plant is related to another is a bit subjective.

How do taxonomists do this?

Generally speaking, characteristics of living things (for example, seed shape, type of flower, etc.) tend to get passed on from parents to offspring, albeit with lots of variations. So more closely related plants will usually have more similar characteristics. Taxonomists compare how similar plants are by looking at lots and lots of different parameters, and making an index of how much similarity there is. In the past, this was done mainly by looking and measuring. Nowadays, we know that the characteristics of plants are passed from one generation to the next via their genes, and so looking at how similar the genes are (which are made of DNA) shows how closely related plants are.

Complications!

Convergent evolution is what happens when two different kinds of plant, possibly not even closely related, have the same kinds of pressures put on their populations and in time grow to look very like one another. This throws a spanner in the works when looking at characteristics in order to decide on how they have evolved. In closely related plants, their genes will be similar. However, there are several different ways in which genes may result in the same physical characteristics, and so plants which are not closely related, but which look similar, will not show such a similarity in their genes. DNA studies can therefore show differences which were not apparent before.

Looking at the DNA is a relatively recent development in science (in the last 50 years or so) and although it has become widespread right across the world, it takes time to go back through all the previous taxonomy of the many millions of organisms and rearrange them, and get agreement about it. Also, deciding how similar DNA is has an element of subjectivity, just as deciding how similar a plant's physical attributes are to another plant's, and there is inevitably a lot of argument.

The science is new, and progressing fast. The regulatory bodies which decide on what names should be, take a while to catch up with new developments, and in the case of wide sweeping changes in what we know about the relationships between plants (as is the case with Cactaceae) what was published, say, ten years ago, is probably already out of date.

Aylostera, Rebutia, and Weingartia

If you look at most books and references on the Cactaceae you will see that the genus "*Rebutia*" contains hundreds of species and includes plants which used to be known under a variety of different genera: *Sulcorebutia*, *Mediolobivia*, *Cintia*, *Weingartia*, *Aylostera*, and lots of others. The taxonomy which decided that all of these were closely related and should be placed in the same Genus was several decades ago, and before DNA studies were carried out.

In the last 30 years, we now know that the previous "*Rebutia*" actually contains three main groups of plants, which are not closely related. They look similar through convergent evolution. They are:

1. *Sulcorebutia*, *Cintia*, *Weingartia*
2. *Mediolobivia*, *Aylostera* (and a few others)
3. *Rebutia*

Taking group 1 first, we know from recent studies that these are all actually quite closely related. There is not enough difference between "*Weingartia*" and "*Sulcorebutia*" to warrant putting them into separate genera; indeed, there is more difference between individual species of *Sulcorebutia* than there is between them and some species of *Weingartia*. So, if they should all be in a single genus, what should it be called? The convention is to take whichever is the oldest name, which in this case, is *Weingartia*. This is deeply unpopular among some growers, who prefer the name *Sulcorebutia* and because the old *Weingartia* are relatively easily distinguished from the old *Sulcorebutia* in appearance, don't accept that they are so closely related.

Taking group 2, within this there are also clearly two sub-groups: the ones which look like *Rebutia*, and the ones which look like *Mediolobivia*. However, genetically, these are not different enough to warrant different genera, so taxonomists have put them all under the oldest name (*Aylostera*), and to acknowledge that there are still two groups, made two "sub-genera", *Aylostera* and *Mediolobivia*.

Taking group 3, the "true" *Rebutia*, these look remarkably like some *Aylostera* but have some really distinctive DNA which shows they evolved separately.

Down to the nitty gritty

Up to now we have just been talking about genera of plants, not species! Within each of the three "new" genera, there are lots of species. Deciding how many there are is a thorny issue as there is a lot of subjectivity, and room for egos and personalities to get involved. Everyone wants the "species" they discovered to be a new species for science. Also, what is a species, anyway? That is a subject for a different essay! For the Cactaceae the concept of species doesn't really work, as populations of cacti may be spread through several isolated groups, all evolving separately but still with differences so minor as to not warrant a different name. There may be a "cline" of variation, with plants at both ends of a mountain range being so totally different as to be certainly different species, but every form of variation between them along the miles in between.