

MURDEROUS PLANTS

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The year 2009 was the 150th anniversary of Charles Darwin's publication of *On the Origin of Species* (Darwin 1859). It was marked by many celebratory articles including a paper by Mark Chase, Maarten Christenhusz, Dawn Sanders, and Michael Fay published in *Botanical Journal of the Linnean Society* called "Murderous plants: Victorian Gothic, Darwin and modern insights into vegetable carnivory" (Chase *et al.* 2009). In line with the catchy title, the article was a very broad review of carnivorous plants, real and imaginary, along with many plants that the authors considered incomplete carnivores. The article was not a proposal that we call all these plants murderous plants. What the article did though was argue that there is a clear continuum between carnivorous and non-carnivorous plants. That is, one can make up definitions of what is and what is not a carnivorous plant, but in the end any definition is totally arbitrary. I disagree. Carnivorous plants are unique. I think there is an obvious place to draw the line between carnivores and non-carnivores. Any waffling is due to our lack of understanding the plants. However, the Chase *et al.* (2009) article ends with "We may be surrounded by many more murderous plants than we think." This is true; there are more murderous plants than we think.

The idea of "murderous" plants is not new. In his 1875 book *Insectivorous Plants*, Charles Darwin reported on studies he performed on *Saxifraga umbrosa*, *Saxifraga rotundifolia*, *Primula sinensis*, *Pelargonium zonale*, *Erica tetralix*, *Mirabilis longiflora*, and *Nicotiana tabacum* (Darwin 1875). These are all sticky-leaved plants. Darwin did tests on them as he did on his carnivorous plants: he dipped their leaves in raw meat infusions, put solutions of ammonia salts on them, and carefully observed the results. Darwin said "The most interesting case for us is that of the two species of *Saxifraga*, as this genus is distantly allied to *Drosera*. [*Saxifraga* actually is not related to *Drosera*.] Their glands absorb matter from an infusion of raw meat, from solutions of the nitrate and carbonate of ammonia, and apparently from decayed insects. This was shown by the changed dull purple colour of the protoplasm within the cells of the glands, by its state of aggregation, and apparently by its more rapid spontaneous movements." And Darwin concludes his discussion of all seven species with "It is moreover probable that the glands of some of the above named plants obtain animal matter from the insects which are occasionally entangled by the viscid secretion." That is it. That is the total extent of his conclusion. So although Darwin observed dead insects on these plants and determined the plants might actually be able to absorb nutrients from the corpses, at no point does he accuse these plants of being incomplete carnivores or anything related to carnivores. He instead uses them as examples to show that physiologically, carnivorous plants are simply doing certain things other plants do, only better. It is too bad Darwin was not into Victorian Gothic and focus on the killing part. Had he done so and called these non-carnivores "murderous plants", it would have saved a lot of confusion later.

Chase *et al.* (2009) summarized research on more species that have been assessed for potential carnivory. They discussed the sticky plants *Potentilla glandulosa*, *Geranium viscosissimum*, *Petunia violacea*, *Petunia nyctaginiflora*, and *Solanum tuberosum*, plants that use glandular hairs to protect their flowers including *Stylidium* species, *Passiflora foetida*, *Plumbago auriculata*, plants that make pitchers with their leaves including *Dipsacus fullonum*, plants that kill birds including *Puya raimondii* and *Pisonia grandis*, and more. Referring to these and "complete carnivorous plants" they

concluded “We think that it is evident from the descriptions above that many plant species have the capacity to trap and kill insects and other animals and that some have refined the carnivorous syndrome to a high degree. Intermediates (the so-called ‘proto-carnivorous’ species) clearly do exist, and it is tempting to consider many of these to be good carnivores. [...] If carnivory is far more common than previously held because of many species being subtly carnivorous, then the background comparisons of ‘carnivore vs. non-carnivore’ are also inappropriate because the latter category includes perhaps many species that are subtly carnivorous through symbioses with other organisms.” In other words, Chase *et al.* (2009) defined carnivory among plants so broadly that the concept is meaningless. Any plant could be subtly a carnivore. Is this really necessary? I think not.

All plants are or are potentially killers. All plants pack their tissues with toxic substances to stop predation. Plant predators tend to recognize what they can and cannot safely eat so we rarely see corpses on or around most plants. Plants do not just target predators; they target plant competitors as well *via* what we call allelopathy. Plants will do what they can do to survive and reproduce; this includes killing. Carnivorous plants are unique among plants in that they kill for nutrition and they do it in a direct way: kill, digest, absorb, grow, and reproduce. The non-carnivorous plants are not killing for nutrition. They are killing in a body-present-way any potential predator that blunders into them rather than deterring the predator. Other plants are a little aggressive in their methods of pollination or seed dispersal to the point of killing the messenger: you see piles of dead flies or dead birds. These plants are not carnivorous! And they are not proto-carnivorous, semi-carnivorous, para-carnivorous, sub-carnivorous, or incomplete carnivorous either! These plants are simply murderous.

Calling plants that kill in a body-present-way for purposes other than nutrition “murderous plants” is perhaps a little too cute for serious scientists. It does stretch the dictionary definition of “murder” a bit. But we need some word so we can do away with all these wanabe-carnivorous terms. Carnivory in plants is not some higher plane of existence. The carnivores we know and love are simply crippled plants that need to kill for necessary nutrition. Murderous plants are not on the road to carnivory, they are not just short of some ideal; they are simply murderous plants and I think we should call them that.

References

- Chase, M.W., Christenhusz, M.J.M., Sanders, D., and Fay, M.F. 2009. Murderous plants: Victorian Gothic, Darwin and modern insights into vegetable carnivory. *Bot. J. of the Linnean Soc.* 161: 329-356.
- Darwin, C. 1859. *On the origin of species by means of natural selection, or the preservation of favoured races in the struggle for life.* John Murray, London.
- Darwin, C. 1875. *Insectivorous plants.* John Murray, London.

Editor’s Note: John has recently added a new section to the ICPS public web site, www.carnivorousplants.org, called About Carnivorous Plants. The new section describes what makes carnivorous plants different from non-carnivores and summarizes what is known about their ecology and evolution. It includes a page on each CP genus with links to more information on ICPS web sites including CPN articles. Additional pages on special topics will be added as they are completed.