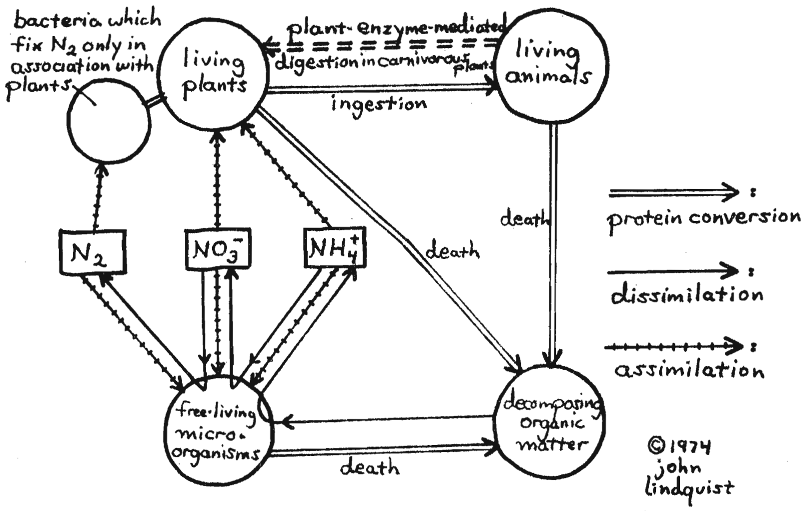



fig. 1 Abbreviated, generalized nitrogen cycle in nature

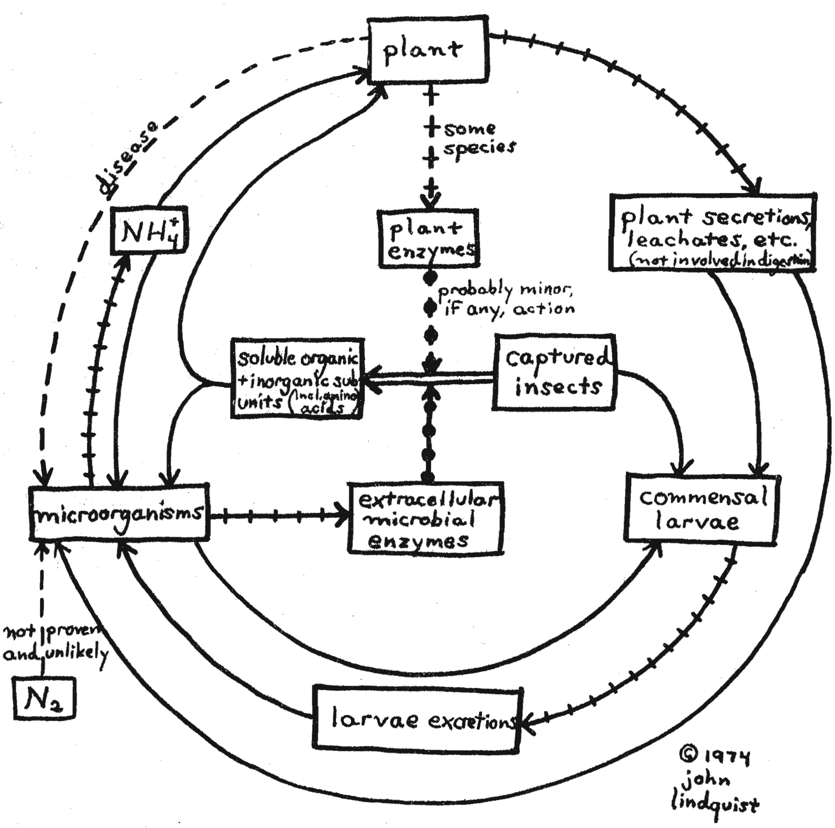
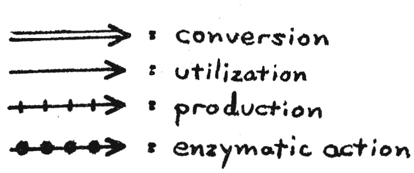



fig. 2 Activities within pitcher plant




MISCELLANEOUS OBSERVATIONS ON THE MORPHOLOGY AND NUTRITION OF PITCHER PLANTS

by John Lindquist

I've done some field observations in a relatively shaded and dry bog near Madison, Wisconsin and a relatively open and wet bog near Drummond, Wisconsin, only about 320 miles north of Madison but in a quite different climatic area. One of the more striking differences between the pitcher plants of these two bogs in the middle of summer is the venation and other anthocyanin coloration of the leaves. Whereas the mature, open leaves of the shady bog are generally green without noticeable red venation, the mature, open leaves of the sunny bog are very heavily veined with the pigment often spreading in broad patches over much of the leaf. Naturally this is explained by the fact that intense sunlight and cool weather (the nights being cooler in the north) enhance anthocyanin production;plants in the bog near Madison increase in venation with decreasing shade and cooler weather as winter approaches. Underthe snow the leaves appear maroon, but they assume their fall coloration after the snow disappears and warmer weather returns. Just what percentage of these over-wintering leaves ultimately survives through the following summer I do not know; new leaves tend to become dominant.

There is a narrow band below the hairy area inside the hood of _S. purpurea_ (zone 2 according to Lloyd (1942), p.21) which becomes quite red, and its coloration does not always coincide with the venation. So far I haven't found any explanation for this.

My particular interest in pitcher plants is primarily the bacteria which inhabit the pitcher. My M.S. thesis, tentatively titled "Preliminary Studies on the Bacteria of the Pitcher Plant _Sarracenia purpurea_", now in preparation, includes a treatment of the types, numbers and probable activities of the functional and exotic micro-organisms in this unique niche which, by the way, has been neglected by plant microbiologists for too long! My being a full-time lab instructor has greatly restricted my activities as far as what I would like to do with this project is concerned. On the few days I've been able to go "bogging" (weahter is also a factor), I've been driven out of the bog twice by surprise thunderstorms and once by gunfire. It is no fun trying to pipette pitcher fluid, do pH readings, etc. while crouching to avoid the projectiles of careless target shooters. As if the project itself isn't exciting enough...

Once in awhile I am able to use pitcher plants to explain the nitrogen cycle to the students. Somewhat expecting to be met with derision by the more "sophisticated", I continually find that the students are fascinated. My small CP collection (S. purpurea- both subspecies, S. flava, D. californica and D. muscipula) is not only decorative but also of considerable educational value.

I would like to offer two "cycles" of mine which I hope will help to explain the nitrogen cycle, not only in nature but also in the pitcher plant. Figure 1 is basically a new variation on an old theme; here dead microorganisms are considered part of the pool of decomposing organic matter. Also, where plant enzymes do the entire job of digesting insects, which is probably the case in Dionaea, is indicated by the dotted-line arrow, being a very minor part of the overall scheme. In Figure 2, which is more detailed and especially relevant to pitcher plants, commensal larvae (e.g. Wyeomyia smithii in S. purpurea) are shown to take some part in the activities within the pitcher; if they die in the pitcher they are then treated as "captured insects." The reason I indicated nitrogen fixation as being "not proven and unlikely" is because trace amounts of ammonia generally tend to inhibit nitrogen-fixation, at least of the Klebsiella or Azotobacter type. Plant leachates are indicated because they are highly important in providing nutrients for bacteria and fungi on almost any plant with a drop or film of water on it.

I put much emphasis on the fact that plants take in ammonia as well as nitrates, and certainly in carnivorous plants the intake of ammonia from insect digestion can be of considerable importance, possibly more so than intake of amino acids, depending on the species. According to a recent science yearbook, plants can absorb approximately 10% of their nitrogen requirement as ammonia through their leaves. Dionaea, however, which probably doesn't rely on bacteria for any part of the digestion process, most likely doesn't absorb ammonia from digestion, unless the prey is overly large and rots.

In the literature on carnivorous plant enzymes, many papers, old and new, have characterized digestive enzymes which were probably partially or totally contributed by bacteria. Here is an area in plant science that demands some intensive research by plant physiologists and microbiologists!

## NEPENTHES AND THE PHOTOPERIOD

by J.A. Mazrimas

Healthy Nepenthes plants are relatively easy to grow providing that one supplies a few essential conditions. Usually you can receive a plant either rooted, or as a cutting that must be rooted and established in its growing container. Here are some rules that I follow to give large-pitchered plants:

WATER. I use plain tap water on my plants which is moderately hard, but I'm careful to use only warm water--about 60° F--or else I add hot water to it from the tap.

PROPAGATION. If you receive a cutting, it is a good idea to peel one-inch strips of epidermis from the end and dip it in Rootone (a hormone powder that accelerates root growth and usually contains a fungicide to prevent stem rot). Dipping the entire cutting in a solution of Benomyl or Benlate solution for a minute or two is also beneficial in preventing fungus and mold problems that may develop during the rooting process.

MEDIUM. I use only sphagnum moss because it is an ideal medium for retaining water and allowing good drainage as well as providing an acid medium. A mixture of coarse sand and peat with perlite will also suffice. The latter mixture requires water more often than the moss.

POT: I use only plastic pots or buckets with large size drain holes. It is important to use a large planting container for Nepenthes since the black wiry roots are rather extensive and seem to grow almost exclusively around the perimeter of the pot. Use a six-inch pot for new cuttings and an eight to ten-inch container for a rapidly growing year old plant. A plant 3-4 feet high must have over a six-inch pot in order for the roots to have room to grow. Well-established plants grow well in a ten-inch diameter plastic bucket with large drain holes cut into the sides.

ROOTING A CUTTING: Over the cutting, place a plastic bag which is