

HETERO-ARCHIC ROOTS IN *ENHYDRA FLUCTUANS* LOUR.

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The plant is a native of Bengal, and is perennial "delighting in a moist soil, and often extending itself considerably over the surface of the adjoining pools of water" (2). It is held valuable in Ayurvedic medicine. The anatomical feature of the roots even when growing entirely in soil shows characteristic marshy habit in having well-developed air-spaces in the cortex (Fig. 6).

At almost every node of the floating portions of the shoot *three** different kinds of roots are given out: one kind is very thin, filiform and much-branched, while the other is many times thicker and unbranched, or, only very slightly branched near the base (Figs. 1 and 4). Those that are grown near the bank of the pool are much longer than those grown in deep water: and they enter the muddy soil underneath. The number of thicker roots at a given node is smaller (3-5, rarely more) than the thinner ones (8-12, may be more), the latter always originating from behind the former (Figs. 3 and 4). Their anatomical structures are as follows:

1. Roots growing entirely in soil—are tetrarch, have no pith, and shew secondary growth in thickness (Fig. 6).
2. Roots growing near the bank are of two kinds:—
 - (i) Thinner—triarch, pith always present, shew no secondary growth (Fig. 2c); and
 - (ii) Thicker—normally tetrarch, occasionally pentarch with or without pith, shew no secondary growth or secondary growth of vascular tissue is very slight (Figs. 2 a & b: 5).
3. Roots growing entirely in water are also of two kinds:
 - (i) Thinner—always triarch with pith but no secondary growth:
 - (ii) Thicker—tetrarch or pentarch. In tetrarch roots pith may or may not be present, but in pentarch roots pith is always present.

*The third kind which acts as breathing roots is not dealt with in this paper.

Tetrarch and pentarch roots arise from the same node with the triarch thinner roots, and are outwardly indistinguishable (Fig. 2). In all these cases one, rarely two, resin canal is found surrounded by the cells of the double endodermis above each bast group.

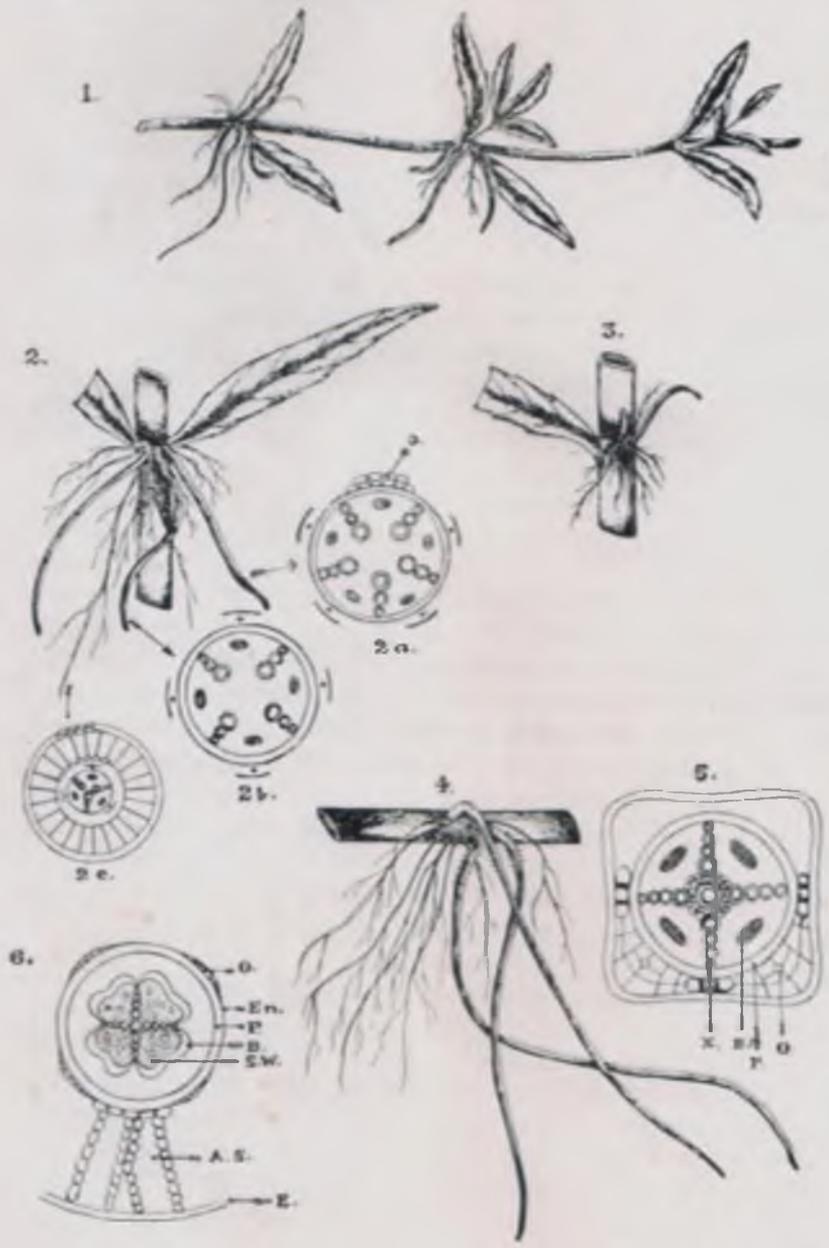
Discussion: In dicotyledonous plants the original number of bundles in the root is limited: may be 2, 3, 4 or 5. Higher numbers may occur as exception. The aerial roots of *Vitis quadrangularis* growing in the Laboratory of the Presidency College, Calcutta, shew as many as 12 or 14 xylem or phloem or phloem bundles. The number of bundles in a family appears to be fairly constant though the point has not been decided yet. The *Compositae* are very peculiar in this respect: in *Tagetes erecta* the root is diarch, in *Inula helenium* it is triarch, in *Enhydra fluctuans*, perhaps normally, it is tetrarch since this arrangement is common in roots growing in soil, in marsh or in water entirely. It is only when we come to the roots emitted in water that we find them showing tri- tetra- and penta-arch arrangements. It may be argued that one and the same root in passing from its embryonic to the adult stage shows the three types by the addition of fresh primordia for the vascular tissues. But this is not really the case. Fig. 3 shows that the three types of roots are quite distinct and separate in their origin and development though given out from the same node and they retain this character all throughout their life. Besides, they show little or no development of secondary meristem.

It is said "in the branches of the root the number remains as a rule the same or diminish if they were greater than two. In subsidiary roots springing from the stem they often increase in correspondence with the thickness of the root, amounting for example, to 6, 7, 9, 11 in *Cucurbita maxima*, 5, 6, 8 in *Legenaria*, etc. The converse may also occur as there is a diarch xylem plates in all the adventitious and the lateral roots of *Tropaeolum majus*, the main root remaining tetrarch."(1)

Enhydra differs from the above in this: the roots given out from the same node, in water, are of two kinds and show normal, reduced as well as increased number of *archs* if the tetrarch type be taken as the normal type for reasons already given above. This appears to be very interesting from the phylogenist's point of view.

The present author has, in course of his investigations on the anatomy of the roots of Bengal aquatics, come across with a few more cases that show hetro-archy in the arrangement of the vascular bundles. Under the same environmental conditions why different kinds of roots showing hetero-archy are given out, and especially in water, from the same node it is for the phylogenist to say.

MAJUMBARA—Enhydra Fluctans, Lour.



Summary.

Enhydra fluctuans Lour. gives out in water three distinct types of roots from the same node. They show hetero-archy in the number of their vascular bundles. Thinner roots are uniformly triarch, and the thicker ones though outwardly indistinguishable, are either tetrarch or pentarch. Their origin is distinct and separate and note that one is derived from the other in its onward ontogenetic development.

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Literature Cited.

1. BARY, A DE.—Comparative Anatomy of the Phanerogams and Ferns. English translation. Oxford, 1884.
2. ROXBURGH, W.—Flora Indica.
3. SOLEREDER.—Systematic Anatomy of the Dicotyledons. Vol. 1, 2. English translation. Oxford, 1908.

Explanation of Figures in the Plate.

O=Oilgland ; En.=Endodermis ; P=Pericycle ; B. P. = Bast (primary) ; B=Bast (secondary) ; S. W.=Secondary Wood ; X=Protoxylem.

- Fig. 1. A portion of the floating stem of *Enhydra fluctuans* Lour.
 Fig. 2. Tetrarch and pentarch roots, apparently indistinguishable ; a, b and c show the structure of the three types of roots in t. s.
 Fig. 3. Origin of the tri- tetra- and penta-arch roots from the same node.
 Fig. 4. A node near the bank of the pool.
 Fig. 5. T. S. of root grown partly in water and partly in soil.
 Fig. 6. T. S. of terrestrial root.