THE HIBERNACULA OF OHIO WATER PLANTS.

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Many aquatic plants that root at the bottom of streams and lakes die down in the autumn and pass the winter by means of tubers, bulbs and rhizomes, while others have developed a peculiar type of winter propagative buds at the tips of the stems. These curious buds are found in many of the pond weeds, stoneworts and bladderworts. In the late summer and early autumn the plants turn brown and die except at the tips of the stems which remain alive. The tips of the stems cease to lengthen out and are enclosed with dark green leaves which become crowded and folded so closely as to form egg-shaped bodies. They remain on the stems for some time but finally become detached and sink to the bottom of the water where they escape the cold of winter and are scattered in various directions thus becoming a means for vegetative propagation. These buds are much shortened stems and are termed Hibernacula.

A somewhat careful study was made of the hibernacula of Utricularia vulgaris since they are quite large and easily obtained. They begin to appear in the latter part of August and are formed in the manner already described, the leaves being crowded so closely and overlapping each other as to form green ball-shaped buds that are quite compact. The air spaces in the stems and leaves become much reduced and the cells are packed with starch granules which cause the buds to sink when they are detached from the stems. When the hibernacula first begin to develop, the tips of the stems and leaves secrete a mucilaginous substance, which surrounds and permeates the buds when they are formed.

In the spring when the ice has melted and the sun's rays begin to warm the water, the buds commence to grow. The starch grains that were stored up in the preceding autumn are used in the building of the new stem. Bubbles of gas are set free which are held in the mucilaginous covering and cause the buds to rise to the surface of the water. The hibernacula have changed somewhat in appearance from that in the fall as they

are more or less supplied with red coloring matter, probably a result of the low temperatures to which they have been exposed. The buds continue to expand and the enclosed stem becomes an active, growing plant. Later it may become attached in the mud by roots from the basal end.

The bladders are much reduced, or almost entirely absent from the stems bearing the hibernacula, while they are found within the buds in an immature stage. The spaces between the leaves that go to form the hibernacula, contain various algæ, such as Oscillatorias, Desmids, Diatoms and other unicellular forms.

Fig. 1. Two hibernacula of Utricularia vulgaris on a single stem.
Fig. 2. Longitudinal section through the middle of a hibernaculum of Utricularia vulgaris.
Fig. 3. Longitudinal section of an immature bladder.

The hibernacula of the Potamogetons, the Myriophyllums and Philotria canadensis, are usually more elongated and the leaves less crowded than those of Utricularia. The buds do not rise to the surface of the water in the spring but remain in the mud and develop roots and leafy shoots which grow upward toward the surface of the water.

The Lemnas, Wolffias and Spirodela produce pocket shaped buds, which contain the next years' stem, and like those of Utricularia, usually sink to the bottom of the water on the approach of winter and in the spring rise again to the surface and develop into floating plants.

The following named plants, found in Ohio, produce hibernacula:

Lemna cyclostasa (Ell.) Chev.
Lemna minor L.
Lemna triuslca L.
Spirodela polyrhiza(L.) Schleid.
Wolffia columbiana Karst.
Wolffia punctata Gris.
Philotria canadensis (Mx.) Britt.
Zannichellia palustris L.
Potomageton pusillus L.
Potomageton lonchitis Tuckerm.
Potomageton pusillus polyphyllus Morong.
Potomageton zosteræfolius Schum.
Potomageton friesii Ruprecht.
Potomageton vaseyi Robbins.
Utricularia cornuta Mx.
Utricularia gibba L.
Utricularia intermedia Hayne.
Utricularia vulgaris L.
Myriophyllum heterophyllus Mx.
Myriophyllum spicatum L.
Myriophyllum tenellum Bigel.
Myriophyllum verticillatum L.