The Morphology of Riccia Fluitans L.

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Since 1835 the Riccias have received more or less attention by the botanists. Bischoff, Lindenburg, Hoffmeister, Leibgeb, Garber, Lewis, Campbell, Black and Atwell, have in turn made many valuable contributions to our knowledge of this group. Still many problems of morphology and ecology confronts us. Several species common to Indiana remain almost unstudied as to detail. Among these none seem more interesting than the study of *R. fluitans*.

This species is widely distributed over the temperate zone and over glaciated Indiana. Botanists recognize two forms, an aquatic and a terrestrial type. The aquatic form is very abundant around Angola, Fort Wayne, Logansport and Terre Haute. During the summer and autumn mats of aquatic *R. fluitans* can be found floating in the ponds and sluggish streams. In winter these mats sink to the bottom of the ponds and remain there till spring. The continued cold does not seem to injure the plants which lie below the ice, but those plants which are frozen in the ice are much winter-killed, the apical ends alone remaining green. During the warm spring these plants make rapid growth, and by summer patches of thalli again dot the ponds and streams, showing that under favorable weather conditions the thalli reproduce vegetatively very rapidly.

Aquatic *R. fluitans* is sterile, branches dichotomously, the sprouts diverging widely, and often become recurved. The apical ends are deeply notched, and truncate. Both dorsal and ventral surfaces bear chlorophyll. Rhizoids and ventral scales are absent.

When evaporation is excessive and the ponds are low, the narrow thalli widen at their apical ends somewhat, and lose some of their characteristic color. This is especially noticeable in those plants which grew in unshaded ponds. The thalli which grew in ponds bordered by forest trees did not show a marked change in width and color, due no doubt to the protection afforded by the overhanging boughs and leaves. When single thalli are washed ashore they generally die. More often, mats of plants are washed upon the wet edges of the ponds. In favored places the thalli coming in con-

tact with the wet soil develop rhizoids, ventral scales, and open air chambers, while those whose apical ends do not touch the soil dry and soon die, giving some shade to the delicate plants below. My observations have not been conducted over a sufficient period of time to determine fully whether these plants produce sex organs and fruit as some observers would have us think actually occurred. In the Deming ponds east of the city limits of Terre Haute aquatic *R. fluitans* grows abundantly. During the summer and autumn of 1913 these loess encircled ponds became dry due to the long continued drought; however, many thalli remained alive in wet shaded places throughout the dry season. These plants remained in contact with the earth sufficiently long to fruit, judging from experiments made upon other Riccia, however, no sporophytes were found. When weather conditions were more favorable for hepatic growth searches were made for rosettes and thalli typical of terrestrial *R. fluitans* but none were found, indicating that spores had not been produced or had not had time to germinate. Weather conditions of 1914 were similar to those of the fall of 1913. At intervals during the autumn frequent observations were made but yielded no satisfactory evidence. Again in 1915 careful searching was done, without gaining additional results. Similar observations were made at Rosedale in the "Niggar Lake" region, no rosettes or thalli on the mud were found. Judging from these observations it seems very doubtful if the aquatic form ever changes into the terrestrial form or fruits but reproduces vegetatively only. It is very doubtful if the so-called terrestrial *R. fluitans* and the aquatic *R. fluitans* belong to the same species.

The terrestrial *R. fluitans* is not common in this region; however, it occurs in small patches on mud flats and wet fields during the autumn. It generally grows in rosettes due to the fact that the spores are not scattered but held within the archeground pit, and that the sporophyte is generally buried in the mud. The thalli are about one-quarter inch long and less than an eighth of an inch wide. The plants have a characteristic green which is tinged with purple late in the autumn. Numerous rhizoids develop from the ventral side. A single row of scale leaves which split into two rows grow just beneath the apical cell. The most prominent ventral mark of identification is the protruding sporophyte. The dorsal surface is cut by a furrow which deepens at the apical end into which the pores of the alternating sex organs open, and down which the sperms are carried by moisture. Above the fertilized egg develops a tongue-like projection which covers the mouth of the arche-

gonial pore, much the same as a similar structure does in Pellia. Stoma each being surrounded by four cells open into deep air chambers.

The thallus develops from one or more apical cells as do other Riccias described. This is a large triangular cell in longitudinal section, situated at the forward end of the growing thallus. The thallus is only three or four cells thick beneath the dorsal furrow. In section air chambers appear very large and numerous. They develop probably in three ways: (1) by internal splitting; (2) by the parting of cell rows for long distances; and (3) by the process so well described by Leibgeb for the hepatics.

The sex organs develop in general in the same way as described for other liverworts. The mature archegonium consists of two base cells, ventral and neck cells, four cover cells, four neck canal cells, ventral canal cell and an egg. The funnel-shaped mouth of a mature archegonium opens often just below the pore of a mature antheridium or recurves away from the growing point. This is a fine adaptation to catch the sperm as they come from the antheridium.

The antheridium consists of a stalk, a sterile coat of tabular cells, and a mass of deeply staining cubical cells. It never protrudes above the surface of the thallus but lies buried deeply in the thalloid tissue.

The sporophyte develops rapidly. In its early stages it is oval but as it matures it becomes spheroid. The sporogenous tissue round off and tetrads are produced in the usual manner. The mature spore varies much in size, being 75-90 microns wide. Its outer surface is deeply areolate, the other faces being less areolate. Three distinct walls can be seen in cross-section, an inner wall that does not stain well, a middle deeply-staining wall, and an outer which seems to separate readily. The nucleus containing a distinct nucleolus is small. Starch and oil are stored throughout cytoplasm.

Conclusions.

Botanists recognize two distinct forms of *R. fluitans*, a terrestrial and an aquatic form. It seems very doubtful if the aquatic ever changes into the terrestrial and fruits as observers have portrayed, but always reproduces vegetatively.

The thallus, sex organs, and sporophytes develop in general as described for other liverworts. The spores remain within the archegonial pit, are not generally scattered by the elements, and vary much in size.