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978-1-108-01732-9 - Water Plants: A Study of Aquatic Angiosperms

Agnes Arber

Excerpt

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PART I

WATER PLANTS AS A BIOLOGICAL GROUP, WITH A CONSIDERATION OF CERTAIN TYPICAL LIFE-HISTORIES

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“If...an inquiry into the Nature of *Vegetation* may be of good Import; It will be requisite to see, first of all, What may offer it self to be enquired of; or to understand, what our *Scope* is: That so doing, we may take our aim the better in making, and having made, in applying our Observations thereunto.”

Nehemiah Grew, *The Anatomy of Plants*, 1682.

CHAPTER I

WATER PLANTS AS A BIOLOGICAL GROUP

(1) INTRODUCTION

WE are living at the present day in what may be described botanically as the Epoch of Angiosperms, or Flowering Plants. The members of this group now represent the dominant type of vegetation and are distributed over nearly all the land surfaces of the globe. The vast majority are typically terrestrial, carrying on their existence with their flowers and leafy shoots in the air, but with their roots embedded in soil of varying degrees of moisture, from which they derive their water supply. This water supply is one of the prime necessities of their life, and in their relation thereto, the plasticity of their organisation is notably exhibited. At one end of the scale there are plants which can withstand long periods of drought and are capable of flourishing under desert conditions in which the water supply is minimal. At the other extreme we meet with hydrophytes—plants which have exchanged terrestrial for aquatic life. Those which have embraced this change most thoroughly, live with their leafy shoots completely submerged, and have, in some cases, ceased to take root in the substratum, so that all their vegetative life is passed floating freely in the water—which is to them what atmosphere and soil are to terrestrial plants. The ultimate term in the acceptance of aquatic conditions is reached in certain hydrophytes with submerged flowers, in which even the pollination is aquatic—water replacing air as the medium through which the pollen grain is transferred to the stigma. These fundamental changes in habit are necessarily associated with marked divergences from the structure and life-history of land plants. The result has been that the aquatic flowering plants have come to form a distinct assemblage, varying widely

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among themselves, but characterised, broadly speaking, by a number of features associated with their peculiar mode of life. It is the biological group thus formed which we propose to study in the present book.

There is good reason to assume that the Angiosperms were originally a terrestrial group and hence that the aquatic Flowering Plants existing at the present day can trace back their pedigree to terrestrial ancestors. If this be the case, we may interpret the various gradations existing within the hydrophytic group as illustrating a series of stages leading from ordinary terrestrial life to the completest adoption of an aquatic career. At one end of the series we have plants which are normally terrestrial, but which are able to endure occasional submergence, while at the other end we have those wholly aquatic species whose organisation is so closely related to water life that they have lost all capacity for a terrestrial existence. Between these extremes there is an assemblage of forms, bewildering in number and variety. In order to clear one's ideas, it is necessary to make some attempt to classify hydrophytes according to the degree to which they have become committed to water life. It must be realised, however, that, though such a scheme is convenient and helpful in 'pigeon-holeing' the known facts about aquatics, little stress ought to be laid upon it, except as illustrating the striking variety of form and structure met with among these plants. A classification of aquatics on biological lines is highly artificial, and, since it sometimes places in juxtaposition plants which are quite remote in natural affinity, it has only an indirect bearing on questions of phylogeny.

The classification of aquatics which forms the second part of the present chapter, is based upon a scheme put forward by Schenck¹ more than thirty years ago, which in its main outlines has never been superseded. But the wider knowledge of the group, which has been acquired since that date, has resulted, as is so often the case, in the blurring of the sharp lines of demarcation between the individual bionomic classes recognised at an

¹ Schenck, H. (1885).

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earlier stage. The present writer has freely modified Schenck's scheme, and has carried the sub-division to a further point. The various types met with amongst aquatics are arranged in a linear series for the sake of simplicity; but this plan is obviously open to the same criticisms as all other linear systems, whether biological or phylogenetic. The following classification is outlined with the utmost brevity, and aims merely at supplying a key to the biological forms encountered. The life-histories of typical plants illustrating the characters of the more important subdivisions will be considered in some detail in Chapters II-X; but the order in which the life-histories are grouped in these chapters has been determined mainly by reasons of natural affinity, and thus bears no close relation to the following scheme.

(2) BIOLOGICAL CLASSIFICATION OF HYDROPHYTES

I. *Plants rooted in the soil.*

A. Plants which are essentially terrestrial, but which are capable of living as submerged water plants, though without marked adaptation of the leaves to aquatic life.

E.g., *Achillea ptarmica*, L. (Sneezewort).

Cuscuta alba, J. and C. Presl (Dodder).

Glechoma hederacea, L. (Ground Ivy).

B. Plants which are sometimes terrestrial, but sometimes produce submerged leaves differing markedly from the air type. The air leaves are associated with the flowering stage.

E.g., Certain Umbelliferae, such as *Sium latifolium*, L. (Water Parsnip).

C. Plants which produce three types of leaf, (a) submerged, (b) floating and (c) aerial, according to the conditions—internal or environmental.

(i) Plants in which the *aerial* type of leaf is generally associated with the flowering stage.

E.g., Many Alismaceae, such as *Sagittaria sagittifolia*, L. (Arrowhead).

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- (ii) Plants in which the *floating* type of leaf is generally associated with the flowering stage.

E.g., *Nymphaea lutea*, L. (Yellow Waterlily).

Castalia alba, Greene (White Waterlily).

Various Batrachian Ranunculi (Water Buttercups).

Callitriche verna, L. (Water Starwort).

Potamogeton natans, L. (Pondweed).

D. Plants which may, in certain cases, occur as land forms, but are normally submerged and are characterised by a creeping axis bearing long, branching, leafy shoots with no floating leaves, or by a plexus of leafy, rooting shoots without a creeping rhizome.

- (i) Leafy aerial shoots produced at the flowering period.

E.g., *Myriophyllum verticillatum*, L. (Water Milfoil).

Hippuris vulgaris, L. (Mare's-tail).

- (ii) Inflorescence raised out of the water, but no aerial foliage leaves except in the land forms.

E.g., *Myriophyllum* (except *M. verticillatum*) (Water Milfoil).

Hottonia palustris, L. (Water Violet).

Many *Potamogetons* (Pondweeds).

- (iii) Inflorescence submerged, but essential organs raised to the surface.

E.g., *Elodea canadensis*, Michx. (Water Thyme).

- (iv) Inflorescence entirely submerged and pollination hydrophilous.

E.g., *Naias*.

Zannichellia (Horned Pondweed).

Zostera (Grass-wrack).

Callitriche autumnalis, L. (Water Starwort).

Halophila.

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E. Plants which in some cases may occur as land forms, but which are very commonly submerged, and are characterised by an abbreviated axis from which linear leaves arise.

- (i) Inflorescence raised above the water or borne on a land plant.

E.g., *Lobelia Dortmanna*, L. (Water Lobelia).

Littorella lacustris, L.

Sagittaria teres, Wats.

- (ii) Inflorescence sometimes raised above water or sometimes submerged.

E.g., *Subularia aquatica*, L. (Awlwort).

F. Plants which are entirely submerged as regards the vegetative organs and which have a thallus (morphologically either of root or shoot nature) attached to the substratum. The flowers are aerial.

Tristichaceae and Podostemaceae.

II. *Plants which are not rooted in the soil, but live unattached in the water.*

(A transition between I and II is found in *Stratiotes aloides*, L. (Water Soldier), which is rooted during part of the year but floats freely during another part. There are also a number of rooted plants, such as *Hottonia palustris* and *Elodea canadensis*, which are capable of living unattached for considerable periods.)

A. Plants with floating leaves or leaf-like shoots. Flowers raised into the air.

- (i) Roots not penetrating the soil.

E.g., *Hydrocharis Morsus-ranae*, L. (Frogbit).

Spirodela polyrrhiza, Schleid., } (Duck-
Lemna minor, L. and *L. gibba*, L. } weeds).

- (ii) Rootless.

Wolffia (Rootless Duckweed).

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B. Plants entirely or partially submerged.

- (i) Rooted, but roots not penetrating the soil. Floating shoots, formed at flowering time, which raise the flowers into the air.

Lemna trisulca, L. (Ivy-leaved Duckweed).

- (ii) Rootless.

- (a) Inflorescence raised out of the water.

Aldrovandia.

Utricularia (Bladderwort).

- (b) Flowers submerged; hydrophilous pollination.

Ceratophyllum (Hornwort).

CHAPTER II

THE LIFE-HISTORY OF THE
ALISMACEAE

THE Alismaceae¹ are perhaps the most typically amphibious of all water plants and they vary in appearance according to their environment in a thoroughly protean fashion. The Arrowhead, *Sagittaria sagittifolia*, L., may be chosen for description as a characteristic member of the family. Seen in ditches and backwaters in the late summer, its fine sagittate leaves and bold inflorescences² (Fig. 1, p. 10) make it one of the most striking of our water plants. It is apparently insect pollinated, but the records on the subject seem to be confined to the statement that, in the Low Countries, certain species of Fly have been observed to visit the flowers³. The present writer has once noticed a Water-snail crawling over a female flower and engaged in eating the perianth; it is conceivable that these animals may play an occasional part in pollination. The large fruits, whose hassock-shaped receptacles are completely clothed with compressed, winged achenes, give the plant a highly individual character (Fig. 2, p. 10).

In complete contrast to the flowering form, is the guise which the Arrowhead assumes in deep and rapidly-flowing water. As long ago as 1596⁴ a tuber, bearing strap-shaped leaves, was described by Gaspard Bauhin under the name of "Gramen bulbosum," while in 1620⁵ he published a figure of it,

¹ For a systematic review of the Alismaceae see Buchenau, F. (1903¹), and, for a general study of their life-history, Glück, H. (1905); Glück's work has been largely drawn upon in the present chapter.

² On the detailed structure of the reproductive organs see Schaffner, J. H. (1897).

³ MacLeod, J. (1893).

⁴ Bauhin, G. (1596).

⁵ *Ibid.* (1620).

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ALISMACEAE

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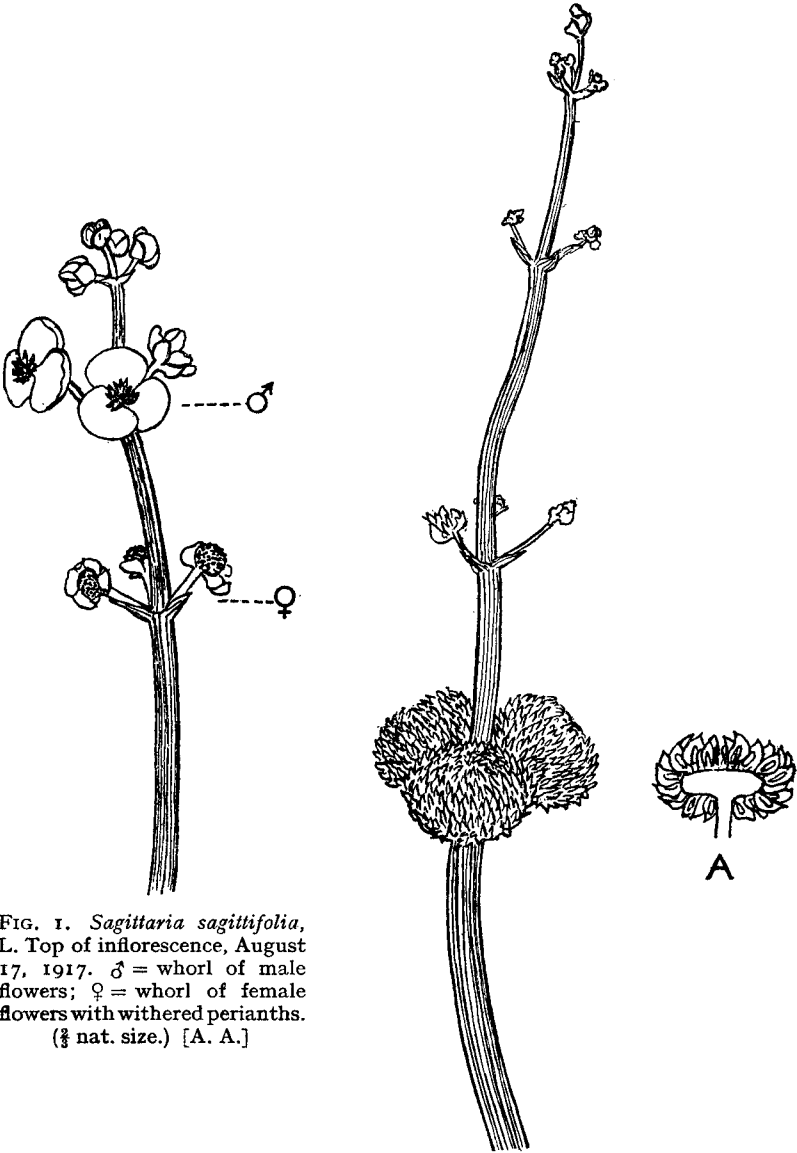


FIG. 1. *Sagittaria sagittifolia*, L. Top of inflorescence, August 17, 1917. ♂ = whorl of male flowers; ♀ = whorl of female flowers with withered perianths. ($\frac{2}{3}$ nat. size.) [A. A.]

FIG. 2. *Sagittaria sagittifolia*, L. Top of infructescence, September 8, 1917. ($\frac{2}{3}$ nat. size.) A, Longitudinal section of fruit. [A. A.]