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NOTES ON CALLITRICHE HERMAPHRODITICA JUSL.

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The genus *Callitriche* is usually subdivided into two sections, *Eu-Callitriche* and *Pseudo-Callitriche*. This division is justified by the obvious differences between the two groups. The representatives of the section Pseudo-Callitriche are always totally submerged, and so the floating rosettes found in the aquatic forms of the species belonging to the section *Eu-callitriche*, are missing. As no landforms occur, the species of Pseudo-Callitriche do not show in their leaves the great polymorphism that we find in the other section. The leaves are always fairly uniform, very thin, and of a transparent, clear green, which gives the plants a somewhat Elodea-like appearance. The flowers have no membranous prophylla.

To the section of Pseudo-Callitriche belong two species: *C. hermaphroditica* Jusl. and *C. truncata* Guss.

In the following pages we will mainly deal with the former. Our data are as yet in no wise complete; this paper only aims at stimulating further research.

The totally submerged life of *C. hermaphroditica* entails a submerged pollination of a somewhat similar kind as that of *C. hamulata* Kütz. (SCHOTSMAN, 1954). The monoecious flowers stand separately in the axils of the young leaves at the end of the stem. The female flowers bear two subulate, usually transverse styles. When young the basal parts of the styles are approximately horizontally spreading, whereas the upper parts are ascending. Each flower is so far nearly entirely wrapped up in the runnelshaped subtending leaf. Lateron the styles bend over the leaf edges on either side, and ultimately hang down. In this stage the length of the styles can be as much as ca. 10 times that of the ovary. Usually a few pairs of leaves, one above the other, bear female flowers only, after which follows a single pair of leaves with male flowers. Sometimes, however, we find in one axil of a pair of leaves a female flower and a male flower in the other. The latter consists of a single erect stamen. The anther contains colourless, very thin-walled, nearly globular pollen grains; the latter contain starch. This pollen was for the first time described by JÖNSSON (1883–'84), who moreover informs us that the grains contain oil. The flowers are placed in such a way that the hanging styles of the female flowers that are inserted above the male ones, can easily contact the dehiscing anthers and the pollen that is released by them. Whether the pollen

—as in the case of *C. hamulata*—already germinates in the anther immediately after dehiscence, is not yet known.

C. hermaphroditica is on the whole a fresh-water plant. According to SAMUELSSON (1934) it probably prefers alkaline water with a eutrophic tendency, and it thrives also in brackish water together with ubiquist species like *Phragmites communis*, *Potamogeton filiformis*, *P. perfoliatus* and *Myriophyllum spicatum*.

As to the distribution of the species, the following remarks can be made. In all probability *C. hermaphroditica* was in the Netherlands rather common during the last century, as is shown by the specimens present in the State Herbarium at Leyden. (Prov. of Groningen, Drente, Overysel, Gelderland, Utrecht, Zuid Holland, Noord Brabant). In recent years the findings have been extremely scarce. We only know of plants collected near the Zwartemeer (BAKKER and ANDREAS 1948), near Ens, N.O.P. (BAKKER 1954) and near Blokzijl (CLASON 1957). Moreover a specimen, not seen by me, was mentioned from Linschoten (v. OOSTSTROOM and REICHGELT 1956).

Whether the plant is really so rare, or whether it is only seldom observed, is as yet an open question.

The complete area of *C. hermaphroditica* is indicated by HULTÉN (1950) as boreal-circumpolar.

As to the distribution in Europe, most authors accept a northern area, including part of Great Britain and Germany, Iceland, Finland, Scandinavia, Denmark, Poland, Russia. In Great Britain the species seems to occur only north of 53° N. Lat. (PEARSON 1935; CLAPHAM, TUTIN, WARBURG 1952). In the Netherlands the species has not been found south of the localities Moerdijk and s'Hertogenbosch (spec. State Herb. Leyden). In Germany the most southern locality is situated near Schleusingen in Thüringen (Sagorski 1906. State Herb. Munich).

The map of distribution given by SOKOLOVSKAJA (1932) indicates localities in Poland and Russia, approximately north of 48° N. Lat.

In addition to the countries above mentioned PASCHER (1936), however, records France, Rumania, South-Italy, Sardinia, Sicilia, Ionia, Montenegro, Croatia and Ireland. We can entirely agree to the last-named countries. We saw plants from Ireland (Laugh Gill, Sligo. V.c. H 28. 1949. Priv. Herb. Lousley; Ross Island, Killaney. N. Kerry. V.c. H 2. 1937. Priv. Herb. Lousley; Derry Lake. Waddell 1896. State Herb. Munich), while in the herbarium of Zagreb (Yugoslavia) *C. hermaphroditica* was present from Croatia, unfortunately without further indication of the locality, but probably from the neighbourhood of Zagreb, as dr. Domac kindly informed me. Especially the plants from Croatia prove that the area of distribution reaches further south than has been assumed by most authors. In order to define more precisely the southern border of the area, the other data by Pascher would need verification. Should they prove right, then the area in Western and eastern Europe will probably form a continuous entity with but a single gap in central Europe. For, according to SAMUELSSON (1925), who extensively studied herbarium specimens,

PLATE I

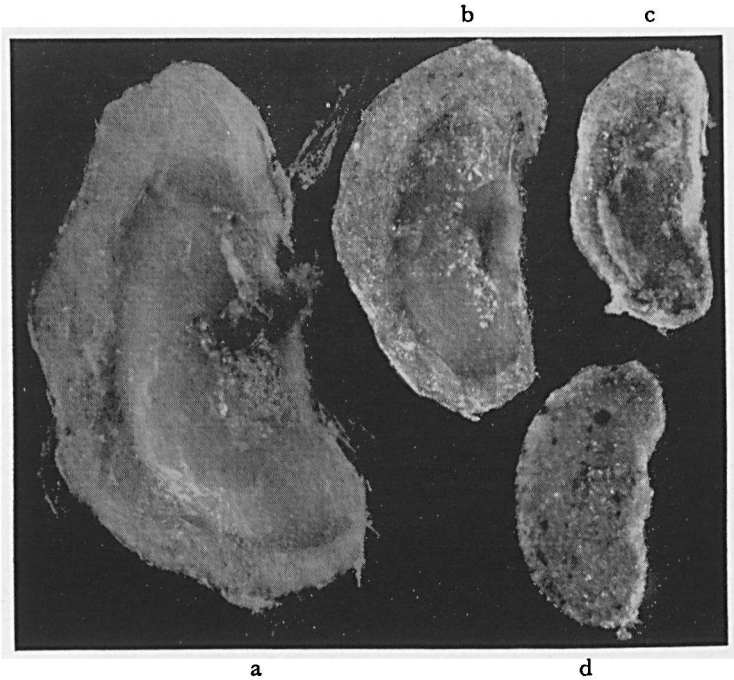


Fig. 1. Mericarps of Callitriche hermaphroditica Jusl. from various localities. *a.* Godhavn (Greenland). Porsild 1923 (C) *b.* Hamburg. In der Bille. Zincke, Herb. Beckmann (L). *c.* Ad opp. Borgå, Nyland (Finland). Lindberg 1900 (M). *d.* circa Petropolim. Hb. Pers. (L).

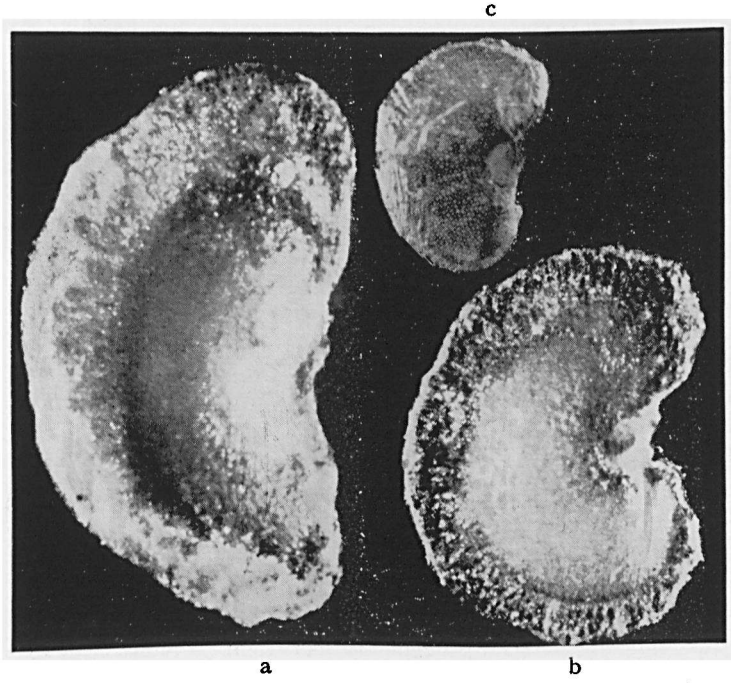
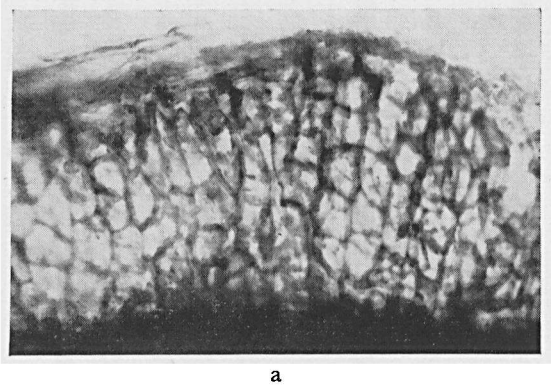
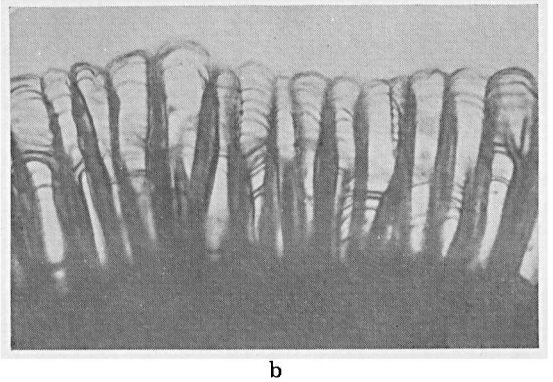


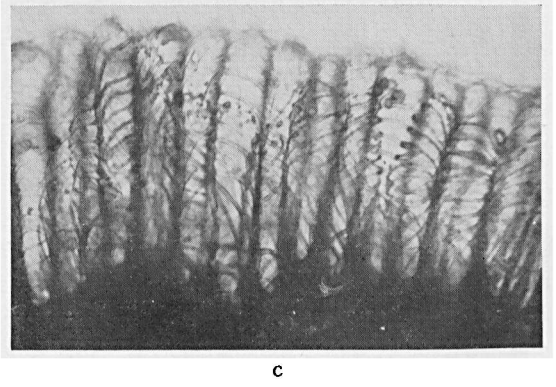
Fig. 2. *a.* Mericarp of Callitriche hermaphroditica Jusl. from Spiggie, Zetland (Mainland, Shetland Isles). Druce 1926. Priv. herb. Lousley, London. *b.* Idem from Dalles City, Oregon (U.S.A.). Suksdorf 1898 (M). *c.* Mericarp of C. truncata Guss. Vallée de la Taute, à Carentan (Manche, France). Déc. et rec. E. Lebel 1863 (L).



a



b



c

Fig. 3. Structure of the seedwing. *a.* Callitriche hermaphroditica (Hamburg. In der Bille. Zincke 1866; L). *b.* Callitriche platycarpa (Plants from Hortus "De Wolf", Haren, Netherlands). *c.* Callitriche stagnalis (Plants from Roden, Netherlands).

the species does not occur in Switzerland (see also Binz et Thommen 1953), while according to the information given by HEGI (1924) no sure finds from Austria and southern Germany are known. As far as southern Germany is concerned, we agree with Hegi's opinion. We ourselves did not find any *C. hermaphroditica* from Bavaria, when revising the Bavarian Callitriches in the Munich State-herbarium. It is not likely that in Switzerland, Austria and southern Germany the species has been entirely overlooked. Perhaps, however, some ecological factor might be responsible for the fact that the species does not occur here. As *C. hermaphroditica* is found in waters of rather different chemical structure and in different climatological areas, the nature of this factor is not obvious. In any case, here is a geographical problem requiring closer investigation.

The next item asking for closer observations, is the difference in shape and size of the fruit. First we will mention some general characteristics of the fruit. As distinct from the fruits of most of the european *Eu-Callitriche*, which are more or less keeled, we may describe the fruits of most forms of *C. hermaphroditica* as winged. The pericarp is less transparent than in *Eu-Callitriche*, so that the reticular lignified structure of the seedcoat is but slightly visible. The seed possesses a wing as well. This wing, with its polyhedral lignified cells, differs markedly from that of the *Eu-Callitriche* seed, which consists of radially elongated cells with more or less lignified radial walls and spiral thickenings (conf. Fig. 3a, b, c).

While examining herbarium specimens from different parts of the area of *C. hermaphroditica* we found that the shape and size of the fruits is not everywhere the same.

The fruits of Dutch specimens are rather alike in shape; they are approximately 1½ mm in diam. and possess a distinct wing, slightly broader at the top than at the base. This is, for the moment the most common type, found e.g. in Germany, parts of England, Poland, Sweden, Denmark (Fig. 1b).

However, there also exist deviating fruit shapes, the most striking of which we will mention.

1. Entirely unwinged fruits were found in plants from Petrograd, Russia (circa Petropolim. Hb. Pers. State Herb. Leyden; ad Nevae ripas. Leg. Rgl. State Herb. Munich; cf. Fig. 1d). This are very fragile plants with small fruits (1 mm in diam.). On account of the fact that the characteristic wing is absent, the fruit somewhat resembles that of C. palustris, which probably induced HEGELMAIER to determine the specimen as C. verna, whilst adding "habitus C. autumnalis simillimus". In the Russian flora of SCHISCHKIN and BOBROV (1949) this type of fruit is not mentioned. [1])

2. Plants from Borgå, Finland (Lindberg 1900, State Herb. Munich; cf. Fig. 1c). The fruit is small, 1–1¼ mm in diam. The wing is narrow,

[1]) In the description of *C. hermaphroditica* a dimension of 5 mm is given for the fruit. Most probably this is a printer's error; to all appearance the size mentioned is too large.

broader at the top than at the base; the pericarp is rather thin and has practically entirely vanished in the ripe fruit, so that the wall-structure of the seeds is clearly visible. The seed too has a small but rather sturdy wing.

3. In some plants from Scotland, Anglesia, the Shetlands, Greenland and Sweden very large, broadwinged seeds were observed (a.o. Herb. Copenhagen; priv. herb. Lousley; Sueciae littor. Hampe. State Herb. Munich; cf. Fig. 1a, 2a). They can attain 2½–3.3 mm in diam. As far as I know HEGELMAIER (1867) was the first who paid attention to the different sizes of the fruits of *C. hermaphroditica*. He described a plant with large fruits from Anglesia as the variety *β macrocarpa*. A specimen determined by him, is now present in the State Herbarium at Leyden. This variety is still occurring in Anglesia, for JONES (1955) a few years ago obviously gathered similar forms for his Callitriche studies.

4. As appears e.g. from the paper of FASSETT (1951), *C. hermaphroditica* can be found in many parts of the U.S.A. Fassett too observed differing shapes and sizes of the fruits among the plants he investigated. Some plants possessed broadwinged fruits, 1.2–2½ mm in width (l.c. Fig. 24), others had smaller and nearly wingless fruits, 1.0–1½ mm in width (Fig. 24g). After prolonged investigation, however, he came to the conclusion that the wingless fruits merely represented an early stage in development. In his opinion the broad wings might develop afterwards, and consequently be present on fully ripe fruits only. I did not see Fassett's herbarium specimens, so I cannot give an opinion on his conclusion. In the case of the European specimens, however, we do not consider the small and wingless fruits to be immature stages.

Finally an American plant may be mentioned, possessing fruits deviating from both Fassett's material and from the European plants studied till now. The plant comes from Oregon, U.S.A. (Suksdorf 1898. State Herb. Leyden; Fig. 2b). The habit is somewhat deviating from those of European plants; the fruit is broader than long, and has strongly curved, reniform, broadwinged mericarps. The fruits therefore remind us of large-winged fruits of *C. truncata* (conf. Fig. 2b, c). The cells of the wing are strikingly larger than the remaining cells of the seedcoat.

Especially in the last-named case the question arises whether these plants may be referred to the species C. hermaphroditica.

In order to study the taxonomical value of the forms with deviating fruit shapes and sizes, a closer investigation will have to be made into their constancy and into details of their distribution. Moreover, their cytology will have to be studied. As chromosome number we find noted in the literature $2n = 6$; this was counted by JONES, Great Britain (1955), JÖRGENSEN, Denmark (1925) and SOKOLOVSKAJA, Russia (1932). It is, however, quite possible that an examination of deviating plants will result in different chromosome numbers or in points of difference in chromosome picture.

My thanks are due to Mr. J. E. LOUSLEY for the examination of his herbarium specimens. I am indebted to Prof. M. J. SIRKS, who gave me the opportunity to photograph the seeds in the Genetical Institute of the University of Groningen, and to Mr. L. Alkema, who carefully made the photographs.

ABBREVIATIONS

M State Herb. Munich; L State Herb. Leyden; C Herb. Copenhagen.

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