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congested inflorescence. It seems most probable that these plants are natural hybrids between *multiflora* and *congesta*. No hybrids between *campestris* and the other taxa were found.

These results clearly support the retention of *Luzula campestris* as a separate species. The differences in morphology and chromosome number, and also in ecological and geographical distribution, seem to me to be sufficient to justify the consideration of *congesta* as more than a variety, or even a subspecies, of *multiflora*. Specific rank is therefore recommended for both *Luzula multiflora* (Retz.) Lej. and *L. congesta* (Thuill.) Lej.

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THE EXPERIMENTAL TAXONOMY OF EUROPEAN *CALLITRICHE*

By J. P. SAVIDGE

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THE eight species of *Callitriche* occurring in Europe can be grouped into two distinct sections of the genus : *Pseudocallitriche* and *Eucallitriche*. The *Pseudocallitriche* have flowers without bracts, linear leaves without stomata or pellucid glands, a basic chromosome number of $x = 3$ and are always completely submerged : the *Eucallitriche* have two bracts to each flower, linear to ovate leaves with stomata and pellucid glands, a basic chromosome number of $x = 5$ and can be either submerged or terrestrial. The two European *Pseudocallitriche* species, *C. hermaphroditica* L. (*C. autumnalis* L.) and *C. truncata* Guss. show little morphological variation but the six *Eucallitriche* species are extremely polymorphic and occur in a wider range of habitats.

An important aspect in the study of the polymorphic species, belonging to the *Eucallitriche*, is the investigation of characters used in the separation of the species. This has been done in two ways : (i) by making a biometric analysis of populations of the same species growing in widely different habitats, and (ii) by placing clonal sub-cultures into different habitats. Although the results of this investigation are not yet complete the data so far obtained indicate that certain characters such as leaf-shape are phenotypically extremely variable ; stamen and stigma length show some variation in size but they can be used for the separation of species providing an allowance is made for differing environmental condition ; other characters such as mericarp size, width of mericarp wing and pollen diameter show little variation.

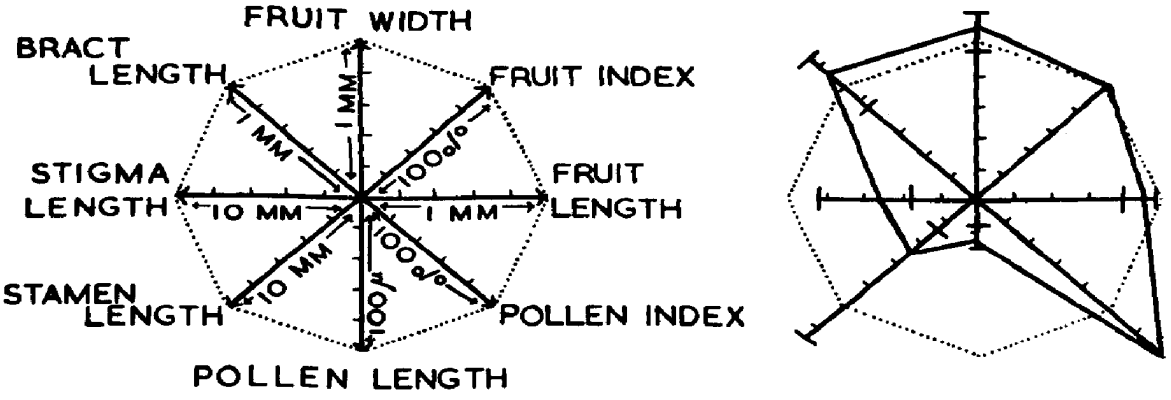
If an accurate separation of the species is required a microscope should be used for measurements of characters such as length of stamens and mericarp and width of mericarp wing. After identifying plants from a large number of populations experience is gained of other characters such as colour and texture which provide additional guides to the separation of the species

Probably the most effective means of identification is by comparing the population under investigation with a series of species polygons. The polygons used in the figure are based on 300 measurements for each character and are

obtained from plants growing in all the habitats in which the species are found.

Controlled interspecific hybridizations to determine whether it is possible to produce hybrids have been carried out. In inter-specific cross pollinations using 5,000 flowers from 140 cultures there was only one cross in which viable fruits developed. The mericarps of this cross, between *C. platycarpa* Kütz.and *C. stagnalis* Scop., took a month to germinate (three to five days is the normal germination period), grew slowly and after the development of the third pair of leaves the seedlings turned yellow and died.

Observations at localities in which three or four species of the section *Eucallitriche* grew intermingled did not reveal any plants of apparent hybrid origin, even after all four species had been flowering at the same time. Only one naturally occurring hybrid population of *Callitriche* has been found during



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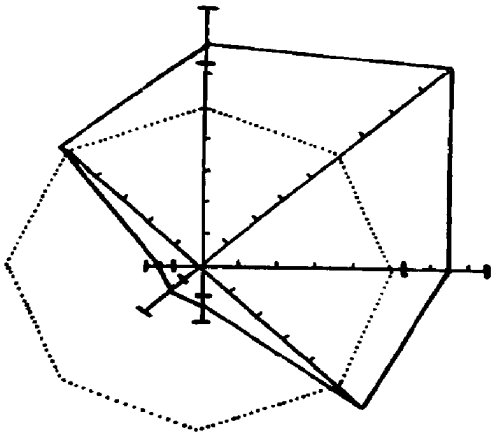
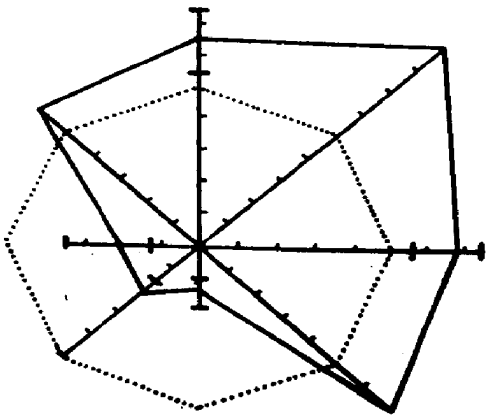


C. STAGNALIS

C POLYMORPHA



C. PLATYCARPA

Polygons of *C. platycarpa*, *C. polymorpha*, *C. stagnalis* and key-diagram. Note the intermediate position of *C. platycarpa* between the other two species. The thick continuous line linking the radii indicates the mean value for each character or character index. The extreme limits for each character are indicated by transverse lines across the relevant radii. The dotted lines and calibration markers on the radii are measuring guides. Fruit index is 100 length × width ; pollen index is 100 length/ width.

the last five years. This hybrid population was at Hillerød, some 35 km. north-west of København. Construction of a polygon indicated that it was intermediate between *C. platycarpa* and *C. polymorpha* Lönnr. and examination of first meiotic metaphase in pollen mother cells showed that it was a triploid with one quadrivalent, three bivalents and five univalents. Such pairing indicates that there was a probable ancestral relationship between the diploid and tetraploid parents of the hybrid. From a study of this hybrid population (to be presented in another paper) there is good evidence that *C. platycarpa* (2n = 20) is an allotetraploid derived from *C. polymorpha* (2n = 10) and *C. stagnalis* (2n = 10). The figure shows the intermediate position of *C. platycarpa* between the two probable parental species.

It is the presence of the three closely related species, *C. platycarpa*, *C. stagnalis* and *C. polymorpha*, in North-west Europe that has caused botanists so much difficulty over the last 130 years. Biometric studies have shown the three species to be distinct and the artificial hybridizations have indicated that *C. platycarpa* and *C. stagnalis* do not readily interbreed. The past difficulties have been mainly due to botanists failing to recognize *C. platycarpa* as a distinct species. At the best *C. platycarpa* has been given varietal rank by British botanists and a number of Continental botanists have regarded *C. platycarpa* as a synonym of *C. stagnalis*.

In Britain it has been found that *C. platycarpa* is a common lowland species but that it is extremely unlikely that *C. polymorpha* and *C. palustris* L. (*C. verna* L.), which have normally been included in British floras, occur in the British Isles. They are, however, common throughout Fennoscandia.

ASPLENIUM TRICHOMANES: A PROBLM IN THE TAXONOMY OF POLYPLOIDS.

By J. D. LOVIS
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SUMMARY

Asplenium trichomanes is an aggregate species within which are included three different cytotypes corresponding to diploid, tetraploid and hexaploid levels of polyploidy. Cytogenetic analysis of a series of artificial hybrids has demonstrated the close genetic inter-relationship of the entire species complex although hybrids formed between plants of the different cytotypes are infertile. Taxonomic description of the three cytotypes is difficult since they can be discriminated only on a basis of ' micro-characters '. The possible taxonomic treatment of the constituent parts of this species aggregate was discussed.

EVOLUTION WITHIN THE GENUS DRYOPTERIS

By S. WALKER
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MANY representatives of the genus *Dryopteris* in Europe have evolved as a result of the processes of hybridization and polyploidy. Evidence for this was shown by Manton (1950) and S. Walker (1955) from which the following examples may be cited.