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A Cytologically Deviating West-Alpine Campanula of the C. rotundifolia Group

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1. Introduction

In a previous paper on the *Campanula rotundifolia* group (1960) a large number of strains were examined cytologically. All appeared to be diploids or tetraploids (2n=34 or 68) and some of the strains contained B-chromosomes. Several strains deviated cytologically by forming large multivalent associations of chromosomes during meiosis. The large chromosome complexes and the polymorphy of the group invited a continuation of the investigations. These were extended to the whole genus although most work was still concentrated on *C. rotundifolia* and its nearest relatives, e.g. *C. scheuchzeri*, *C. gieseckiana* and others. Among the new plants brought into culture one (Cult. no. 81) showed a striking appearance and behaviour. As it also proved to have a deviating chromosome number, it was considered to deserve separate treatment.

2. Cytological observations

Chromosome number. A study of microtome slides of vigorous root tips from pot grown plants and stained with Feulgen showed that the chromosome number of Cult. no. 81 is 2n=72+4 B-chromosomes (see Figs. 1 a—b). This surprising number was definitively established by countings of some very clear meiotic first telophase plates having n=36+Bs (Figs. 1 d—e) and a corresponding stage in a single restitution nucleus, 2n=72+Bs (Fig. 1 f).

Behaviour of B-chromosomes. The four B-chromosomes belong to three size classes. The two smallest are of the same size and during meiosis they very often form a pair (Fig. 2, c, d, f, i, j). All four B-chromosomes

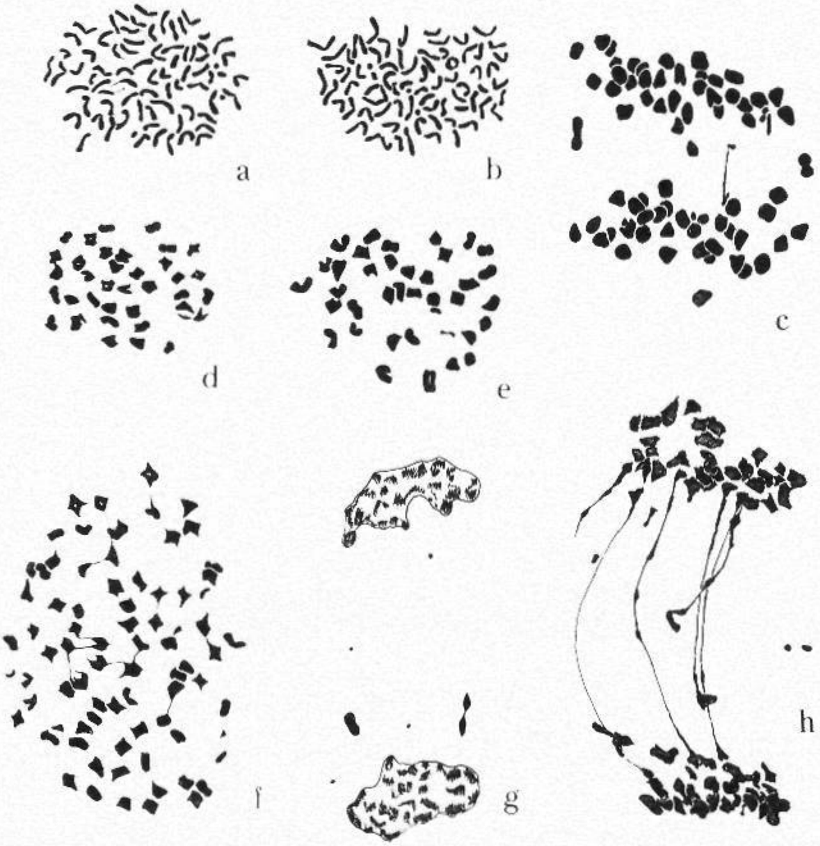

Fig. 1. *Campanula* No. 81. a—b metaphase plates from root tip mitoses (microtome slides), $2n = 72 + 4$ B. — c—h: orcein squash preparations of PMCs: — c: first anaphase showing univalent B-chromosome bridge, one dividing, one stretched and one divided and separated B-chromosome. — d—e: first telophase plates with $36 + 2$ B (in e one B constricted and dividing). — f: restitution nucleus (1 telophase) with $72 + 6$ (two of the B-chromosomes divided and separated). — g: interphase with two lagging univalents (one dividing) and two divided and separated B-chromosomes. — h: very exceptional telophase I with 6 bridges and lagging B-chromosomes (see discussion in the text); in the lower plate one B-dividing. — Scale as in fig. 2.

may undergo precocious divisions, which take place during late diakinesis (Fig. 2 g), metaphase, anaphase I (Figs. 1 c, 1 h, 2 e, 2 j) or later (Fig. 1 e, 1 f). They are frequently observed lagging at telophase I and may also divide here (Fig. 1 g). In all respects the B-chromosomes of No. 81 resemble those described in tetraploid *Campanula rotundifolia* (Böcher 1960, Figs. 10—12, 119—129, 138—166). In one case (Fig. 1 c) a bridge formed by a dividing B-chromosome was seen. The bridge may be a result of a union of two chromatid ends in a B-chromosome with a precociously divided centromere. No acentric fragment was detectable.

Number of bivalents and multivalent configurations. Very few, if any PMCs have 36 bivalents. In the cells depicted in Fig. 2 there are usually 31—32 bivalents and a number of multivalents, which corresponds to observations in a large number of other cells. The cell Fig. 2 h has only about 16—17 bivalents and may be rather exceptional. A number of cells, however, had a similar low content of bivalents but were not clear enough for a detailed analysis of their multivalent compounds. The number of chromosomes which are associated in these configurations range from 3 to 8 (Figs. 2 c—j). Squashing may sometimes have caused breakages of some of the thin threadlike connections, thus making the number of chromosomes connected in chains lower, but mostly the chromosomes in the compounds appear to be at least as closely linked as in bivalents. Rings of 4, 6 or 8 chromosomes are not uncommon. However, catenations of a similar number also occur but such chains are mostly difficult to analyse owing to the very dense chromosome connections (see chain in Fig. 2 h) which in some cases may be due to stickiness (incl. subchromatid exchanges). The fact that the number of chromosomes associated in multivalent configurations is usually low indicates that some kind of mechanism exists which suppresses multivalent formation, e.g. by reducing chiasma formation in translocated segments. The impression obtained from a study of many cells is that the plant rarely or never produces true multivalents composed of completely homologous chromosomes and that some of the bivalents are clearly heteromorphic (see Fig. 2 h about "8—9 o'clock"). Many cells at Anaphase I appeared quite normal although lagging B-univalents were common. Single bridges with acentrics indicating crossing over in an inverted segment were never observed. Thus the cell depicted in Fig. 1 h is very exceptional and the bridges found there may be due to stickiness. The two small chromosomes observed on the right in the middle may be lagging B-chromosomes and not acentrics. Two of the bridges have one or two extensions in their middle part and may perhaps be interpreted as two-side-arm bridges due to subchromatid exchanges. In some cases sticking or lagging multivalent compounds may inhibit chromosome separation in such a way that the result will be formation of a restitution nucleus. The material only contained one cell with a restitution nucleus (Fig. 1 f). A number of thin

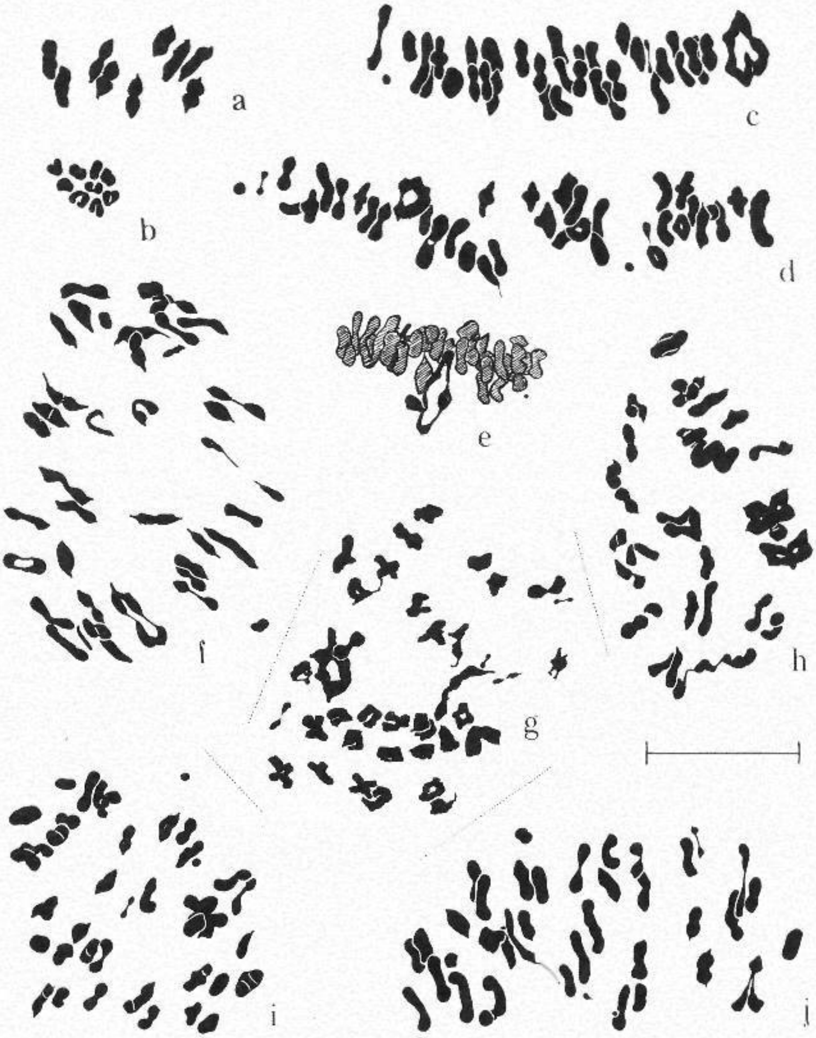

Fig. 2. Orcein squash preparations of PMCs. — a—b: *Campanula lusitanica*; $n=9$ (a metaphase I, b metaphase II). — c—j: *Campanula* No. 81; g diakinesis, the other cells metaphase I. — c: 1 VIII, 32 II, 1 B II, 1 B I (one B not detectable). — d: 1 VI, 31 II, 4 I (or 1 VI, 2 III, 29 II, 2 I), 1 B II 2 B I. — e: 1 V and one minute B probably having arisen by precocious divisions of a B-chromosome, cp. fig. j. — f: 1 IV (chain), 1 IV (ring), 31 II, 2 I, 1 B II, 2 B I (all B narrow and stretched). — g: 1 VI, 1 III, 31 II, 1 I, 4 B (all precociously dividing). — h: deviating cell probably with 2 VIII (chains), 1 V (in the centre), 4 IV (uppermost ring or cross, two double-rings on the right, one of them possibly with sticky connection to bivalent between the two double-rings), (16)—17 II, 1 I but no visible B-chromosomes. — i: 1 VI, 1 III, 31 II, 1 I, 1 B II, 2 B I. — j: 2 III, 32 II, 2 I, 1 B II, 2 B I (one divided precociously). — Scale 10 μ.

connecting strands between some of the chromosomes in the cell in question were believed to be remnants of adhesions during the preceding stages. Altogether the meiotic picture of *Campanula* No. 81 corresponds very well with a number of strains of *C. rotundifolia* with 2n=68 (cf. Böcher 1960).

3. Morphology and taxonomical position

The plants cultivated as No. 81 were raised from seeds sent to me in 1959 from the Botanical Gardens in Toulouse, France, under the name *C. rotundifolia*. The seeds had been collected in nature at Termignon in the French Alps at an elevation of 1400 m. Germination took place in May 1950. From late in May and during June 1961 all the plants flowered luxuriantly thus being very early as compared with cultures of *C. rotundifolia*. In 1962 the plants cultivated in the field attained heights of about 50—60 cm while those kept in pots were only 20—30 cm.

The plants from Termignon deviated in many characters from typical European *C. rotundifolia* L. but resembled *C. scheuchzeri* Vill. in many respects. Typical pressed specimens have been shown to Professor H. Merxmüller, Münich, who has kindly given me his opinion of the taxonomical position of the plants. According to Merxmüller the plants are not identical with either *C. rotundifolia* or *C. scheuchzeri,* but might be interpreted as belonging to a hybrid between these species. In some characters the plants approach *C. bocconei* Vill. but it is not possible to refer the plants to this taxon. They have among other things much too large flowers.

The habit of the plants appears from Figs. 3—4. They deviate from typical *C. rotundifolia* by early flowering, few large flowers, almost glabrous stem bases and the shape of the subbasal leaves with their shallow spaced dentation. The corollas are up to 2 cm long and the sepals are tapering, 1 cm long and 1 mm broad at their bases. In habit the plants resemble some referred to the arctic *C. gieseckiana,* which also have lanceolate stem leaves gathering towards the base (cf. Böcher 1960 Plate III—IV).

The Termignon plants differ from *C. scheuchzeri* by being not entirely glabrous below. They bear some poorly developed very short hairs of the same type as found in *C. rotundifolia*. They have furthermore erect or horizontal, but not drooping flowers, and never very few

Fig. 3. *Campanula* cult. No. 81 pressed May 15th, 1961 (second year of cultivation). ×1/2.

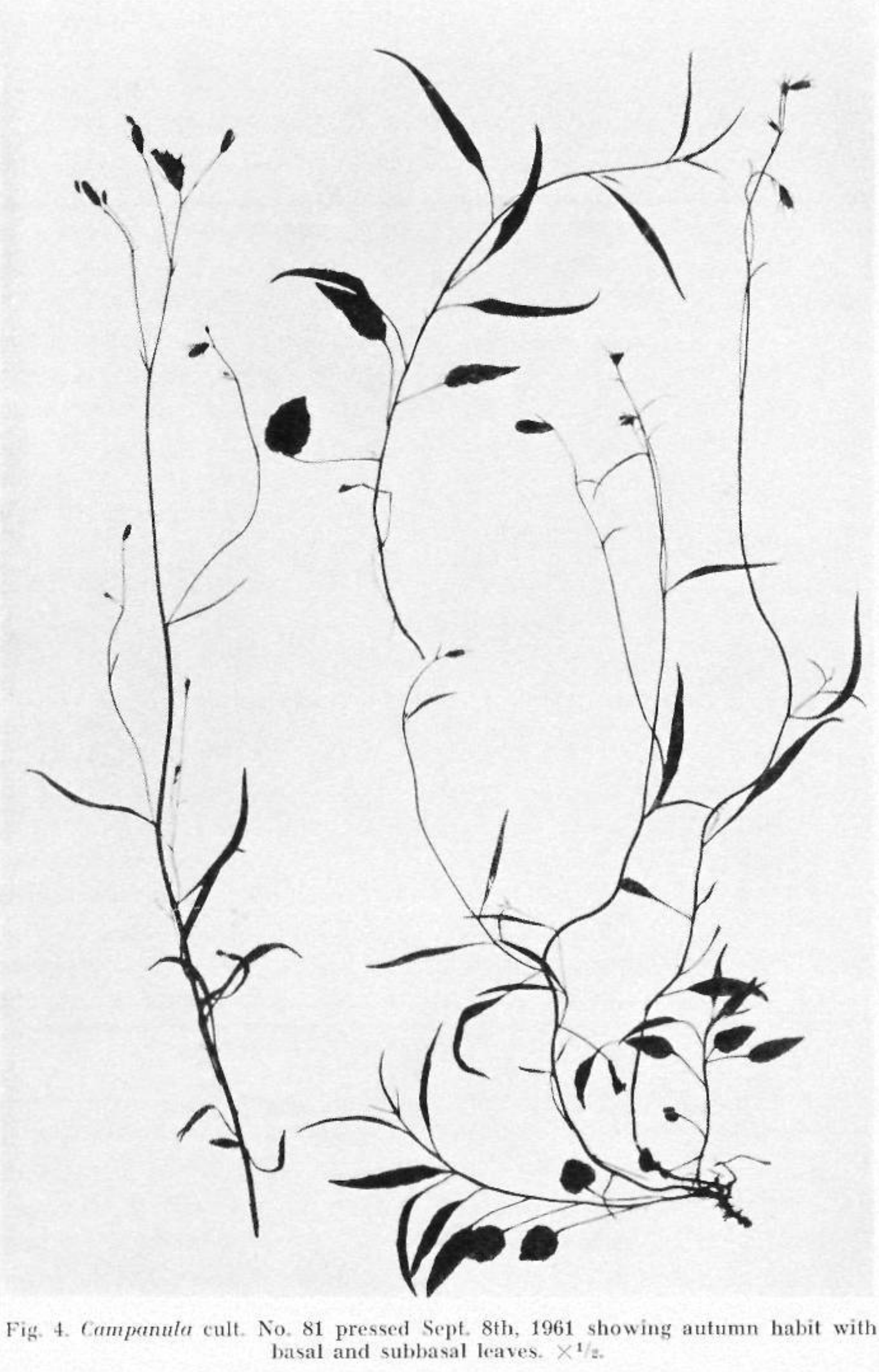

Fig. 4. *Campanula* cult. No. 81 pressed Sept. 8th, 1961 showing autumn habit with basal and subbasal leaves. ×1/2.

or a single flower only. Finally they lack hairs on the leaf-bases as found in typical *C. scheuchzeri*.

While the intermediate morphological position of No. 81 between typical *C. rotundifolia* and typical *C. scheuchzeri* supports a hybrid origin three other facts contradict such an explanation. First the chromosome number of the supposed parent species is 68, secondly there is a high pollen fertility in No. 81 (no shrivelled or empty grains, few per cent dwarf grains), and thirdly no seeds were obtained after crossings with a tetraploid *C. rotundifolia* (2n=68; "*C. linifolia* Scop." from the Botanical Gardens in Greifswald). The meiotic behaviour is difficult to interpret. The occurrence of heteromorphic bivalents, rings and other configurations may as well be the result of hybridization as of translocations or both. At the present stage of knowledge the conclusion may be drawn that the plant from Termignon (No. 81) cannot be a primary hybrid between species with 2n=68. However, it may have evolved from such a hybrid by subsequent chromosome repatterning and increase in chromosome number. In many respects it behaves as a stabilized entity which perhaps deserves taxonomical recognition.

4. Discussion of the deviating chromosome number

The deviating number 2n=72 may have arisen in two ways: (1) as an octoploid number within a series with 9 as a basic number, (2) as an aneuploid number connected with the series with 17 as a basic number (2n=34→36→72).

(1) Larsen (1954) was the first to find a *Campanula* species with 9 as the basic number, viz. *C. lusitanica* (or *loeflingii*) which has 2n=18. This number was later found also by Gadella (1962), A. Fernandes (1962) and myself (in material raised from seeds from the Coimbra Botanical Gardens, see Fig. 2 a—b). The size and shape of the chromosomes correspond with the majority of the chromosomes in No. 81.

Considering the great number of countings recently made in *Campanula* (Böcher 1960, Gadella 1962 and 1963, Merxmüller & Damboldt 1962, Podlech 1962) it is remarkable that so far only few plants with 2n=36 have been found. Before plants with 2n=18 or 36 have been found in the *C. rotundifolia* group it is obviously very doubtful whether this group consists of two lines with two basic numbers. On the other hand, as recently pointed out by A. Fernandes (1962), the number 9 would make it much easier to understand how the various 17-series arose seeing that crosses between species with 2n=16 and 2n=18 would give rise to allotetraploids with 2n=34.

(2) An aneuploid development leading from 2n=34 to 2n=36 is another possibility in spite of the fact that aneuploid numbers have only rarely been reported in the genus. Very recently, a clear case of aneuploid evolution was demonstrated by A. Fernandes (1962) who found 2n=20 in *C. transtagana*, a species described by R. Fernandes (1962) as being closely related to *C. lusitanica* which has 2n=18.

How the increase in chromosome number took place is difficult to explain. Perhaps B-chromosomes have played a rôle. As found in maize by Roman (1947) segments from A-chromosomes are sometimes translocated to the B-chromosome. Some B-chromosomes in *Campanula* may have fused with detached segments from the other chromosomes and thereby have been transformed into chromosomes which cannot be distinguished from A-chromosomes. Other possibilities for increase in number also presuppose chromosome breaks and reciprocal translocations. According to many observations translocations occur frequently in the *Campanula rotundifolia* group thus making an explanation of the chromosome number 2n=72 as an aneuploid number most probable.

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Scale Effects and Other Subjective Influences in Taxonomy

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It is generally recognized by taxonomists that their conclusions are not wholly uninfluenced by subjective factors. These do not generally vitiate the results, but can have an effect on the rank assigned to the taxa recognized and on the amount of morphological diversity allowed within a taxon.

Some of the factors which come into play in making taxonomic decisions will be discussed briefly in the hope that a greater awareness of them may help in the attempt to achieve more homogeneity within a taxonomic category. It will be assumed that the basic criteria on which genera, species etc. are founded are morphological ones, since such criteria form the only universal basis for taxonomy which is at present available.

Plants range in size from something of the order of 100 m downwards, and with the light microscope structures down to a few μ can be observed; the electron microscope, of course, enables much smaller structures to be observed indirectly. The unaided eye does not readily appreciate structures smaller than about 0.5 mm and the mind tends to attach less significance to things of this order of magnitude than to larger ones. This is particularly true when the difference in size of a small organ is used as a distinguishing character for species. If, for instance, the fruits of two species are c. 10 cm and c. 20 cm long and the anthers of two other species are c. 0.5 mm and c. 1 mm long we accept the former as a good specific character much more readily than the latter, though they may in fact be equally valuable.

This is true also of other morphological characters, where the absolute size has a profound effect on the significance attached by taxonomists to differences in shape and structure. Anyone who examines the fruits of even a small selection of *Trifolium* species (such as is found in the British Isles) with a ×10 lens must be impressed by their diversity. There are fruits which dehisce longitudinally, fruits which dehisce transversely and others which do not dehisce at all; there are fruits with several seeds, fruits with one seed, and a great variety of shape of legume. Other parts of the flower show a similar range of structure. There can be little doubt that, had the floral parts been ten times as large as they are, *Trifolium* would have been divided into a number of genera more distinct than those commonly recognized in the tribe *Genisteae*.

Similarly, we tend to take more notice of the shape of the comparatively large leaves of a large plant such as *Ulmus* than of the smaller leaves of a small plant such as *Senecio vulgaris*. But here two other factors come in: the duration of the individual and the possibility of asexual reproduction. An elm tree is not only large but outlasts several generations of botanists and is capable of multiplication by suckers, while groundsel commonly has more than one generation a year and reproduces sexually.

It seems likely that the 'small' species which have been recognized within *Senecio vulgaris* are more or less equivalent to those in *Ulmus*, but have been rejected by most botanists owing to the influence of these extraneous factors.

Not only the size but also the accessibility of flowers, which affects the ease with which they can be observed and dissected, influences taxonomy. Corner (1962) has pointed out the diversity of flower-structure in *Ficus* and sums up as follows (p. 189): ". . . if the flowers were on the outside of the head, instead of inside the fig, many would have seen without difficulty . . . that a colossal monoecious banyan with unistaminate flowers and simple stigma could not be congeneric with a slender dioecious creeper with bistaminate flowers and bifid stigma."

The number of species per botanist in a given area may also have an effect on the species concept in a particular flora. For instance in *Viola* subgen. *Viola* Fiori gives 6 species and 19 varieties for Italy, while Briquet gives 9 species, 5 subspecies and 3 varieties for Corsica. This is perhaps rather an extreme example, but a random sample of several genera shows that the number of species recorded from Corsica is about $^2/_3$ as many as are recorded from Italy, though Corsica has in reality a much smaller flora than Italy. If alpine species are excluded from the Italian total the ratio is still nearer unity and this must represent a real and considerably differences in species concept, partly no doubt owing to the idiosyncracies of the authors, but also probably in part due to the number of botanists compared with the size of the flora. The genera used in this comparison contain no Corsican endemics. The same kind of phenomenon is seen if the flora of a Scandinavian country is compared with that of a Balkan country. Taxa differing in chromosome number and small morphological characters are recognized as 'good' species in the former while in most parts of the Balkan peninsula there are so few botanists and so many plants that the species recognized are frequently not comparable with Scandinavian ones. If the area studied by an individual botanist is a small one there seems to be a tendency to 'split' and to recognize numerous varieties and forms — compare, for instance, C. C. Babington, *Manual of British Botany* and J. D. Hooker, *Flora of British India.*

Intensive work on the flora of a relatively small area delimited, for example, by political boundaries often results in the erection of what may be termed parochial species. For instance, *Minuartia cataractarum* (Janka) Prodan is recognized as a species in *Flora Rep. Pop. Rom.*, presumably because it has for long been known as a Romanian endemic. An impartial observer finds it impossible to distinguish satisfactorily from *M. frutescens* (Kit.) Tuzson which is itself usually regarded as a subspecies of *M. hirsuta* (Bieb.) Hand.-Mazetti (Mattfeld, 1922). Many other examples of this phenomenon will be familiar to all working taxonomists.

In a similar way early-flowering plants often come in for more attention than those which flower later in the summer. If the variation within such species tends to show discontinuities owing to reproductive or spatial isolation this is seized on as a basis for the erection of large numbers of taxa, usually at specific level. Autogamy in *Erophila* and the ecological isolation of *Pulsatilla* populations give rise to what may be termed 'dissected variation' and this, combined with the fact that they both flower when there is little else to interest the field botanist, has made them victims of the 'splitters'. The remarkably beautiful, large flowers of *Pulsatilla* have no doubt also helped to reduce the objectivity of the species recognized by some botanists.

Another non-morphological factor which can affect taxonomic conclusions is the choice of characters for distinguishing or classifying taxa. For instance, in the annual species of *Silene* seed-characters are frequently used, whereas in *Dianthus* such characters are almost universally ignored. This situation does not arise because seeds are valuable in the former genus and valueless in the latter. It happens simply because it is easy to collect an annual *Silene* with flowers and ripe seeds, and the seeds, being retained in the capsule, are abundantly represented in herbaria. In *Dianthus*, on the other hand, there is a long interval, often as much as two months, between flowering and the ripening of seeds, and the mature seeds rapidly fall out of the capsule; they are consequently rarely found in herbaria. In this connection it is interesting to note that seeds are much less used in distinguishing the perennial species of *Silene* than the annual ones, presumably because they are seldom found in herbarium collections.

Finally there is a strong tradition, now showing signs of breaking down, that taxonomic characters in vascular plants must be visible with a hand-lens. This is, of course, a good practical tradition and one to be preserved as far as possible, as long as it is recognized that it is purely a matter of convenience. Microscopic characters of the epidermis of grasses and the testa of *Chenopodium* seeds are accepted as respectable and so, at least in some circles, is the morphology of pollen-grains. This is only a beginning, however, and there is still a resistance to the recognition of species which can be distinguished by microscopic characters, including chromosome number, but which appear to be identical in gross morphology.

Absolute uniformity between species, even within a limited group such as angiosperms, is obviously unattainable, since there is no yardstick which we can apply, and species are anyhow intrinsically different. *Scyphostegia borneensis* is not comparable with *Quercus robur* at the present day, though presumably if we knew their phylogeny the two could be defined in comparable terms. Uniformity of taxonomic concepts between different major groups is even more difficult to approach than it is within one group.

Nevertheless, since families, genera, species, subspecies and to a lesser extent varieties and forms are our units, we should do our best to make them as objective as we can and consequently as comparable as the nature of the situation permits.

The facts of evolution and phytogeography, for instance, can be distorted or concealed by subjective taxonomy and clarified and revealed by good taxonomy which makes the units as objective as possible.

Infra-specific categories are often employed in ways more diverse than the specific category itself, yet they can be of the greatest importance in the study of evolution. More precise terms are, of course, employed in biosystematics and it may well be that this sort of precision cannot be based on morphological criteria. Perhaps the best course would be to agree to a definition of subspecies based on morphological differences and geographical or ecological isolation throughout most of their range. Then the almost meaningless categories of variety and form, which cannot be used to distinguish the response of the same genotype to different environments from that of different genotypes to the same environment, could be abandoned.

It is clearly most desirable for both taxonomists and the users of taxonomic data (i.e. all other botanists) to try to recognise and avoid the influence of subjective factors of the kind that have been mentioned.

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Experimental Control of Aposporous Apomixis in a Grass of the Andropogoneae

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Introduction

The versatility of reproductive behaviour characteristic of facultatively apomictic flowering plants depends upon the side-by-side persistence of two alternative developmental pathways, one — the normal sexual — leading to the formation of embryo sacs with the reduced chromosome number, and the other — the apomictic — leading either to the production of diploid embryo sacs in which eggs develop parthenogenetically, or to the formation directly of adventitious embryos from maternal sporophyte tissue. The factors determining the success of one system rather than the other in any particular ovule remain unknown, yet that the matter is not entirely fortuitous is revealed by several recorded instances of a varying incidence of apomixis in individual plants during the course of growth through the year (e.g. *Arabis holboellii*, Böcher, 1951; *Calamagrostis purpurea*, Nygren, 1951). Such regular variation could represent simply a response to changing internal conditions in the course of ageing, but it could also indicate a control through environmental factors such as the temperature and light regimes. Environmental control of the incidence of apomixis could have far-reaching evolutionary implications (Heslop-Harrison, 1959), and it may be noted also that the possibility of manipulation through external factors might be expected ultimately to facilitate investigation of the physiology of apomictic phenomena. The present paper reports experiments in which an unequivocal effect of the light regime upon relative numbers of reduced (sexual) and unreduced (aposporous) embryo sacs has been demonstrated in a facultatively apomictic tetraploid race of *Dichanthium aristatum* (Poir.)

C. E. Hubbard[1] (Andropogoneae). This species was selected for study since preliminary screening trials had shown the races tested to be sensitive short-day reactors, easily grown under phytotron conditions, and because versatility in reproductive behaviour had already been reported in certain cytotypes of the related *D. annulatum* (Forsk.) Stapf (Celarier & Harlan, 1957; Brookes, 1958).

Materials and Methods

The race of *D. aristatum* employed originated from Queensland, Australia (C.S.I.R.O. Accession No. 14366), and its somatic chromosome number was established as $2n=40$ from root-tip counts. In the experiments upon apomixis, the caryopses were germinated in flats, and seedlings were transferred to a peat sand mixture in 13 cm plastic pots at the 2—3 leaf stage. A standard ration of a nutrient solution was supplied every third day, and the pots were watered to run-off on the intervening days. The plants were grown in greenhouses or in growth chambers with the air temperature regulated above 22° C. The treatment hereafter termed *long-day* (LD) was given by exposing the plants to the available natural daylight supplemented with incandescent light at *c.* 100 f.c. to give a day-length exceeding 16 hrs. During *short-day* (SD) treatment illumination was provided from batteries of warm-white fluorescent tubes at 900—1000 f.c. from 9 a.m. to 5 p.m. daily, the duration of the 'night' thus being 16 hrs.

Because of the need to analyse the behaviour of each floret in whole inflorescences, sectioning methods were adopted for the cytological study. Inflorescences were cut into 2 cm lengths, numbered in serial order from the apex, and fixed in acetic alcohol or Langlet's modification of Navashin's fluid. After dehydration and wax embedding, each inflorescence segment was oriented accurately and sectioned longitudinally at 15 μ to give a ribbon including all florets. In this manner complete sequences of florets from whole inflorescences were assembled.

The typical aposporous and sexual developmental sequences described below were worked out from some thousands of sections of ovules from plants grown in various photoperiodic conditions. The evidence for a control of apomixis by the light regime was derived from one principal experiment, the form of which is explained in a later section.

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[1] Identification kindly checked by Mr C. E. Hubbard.

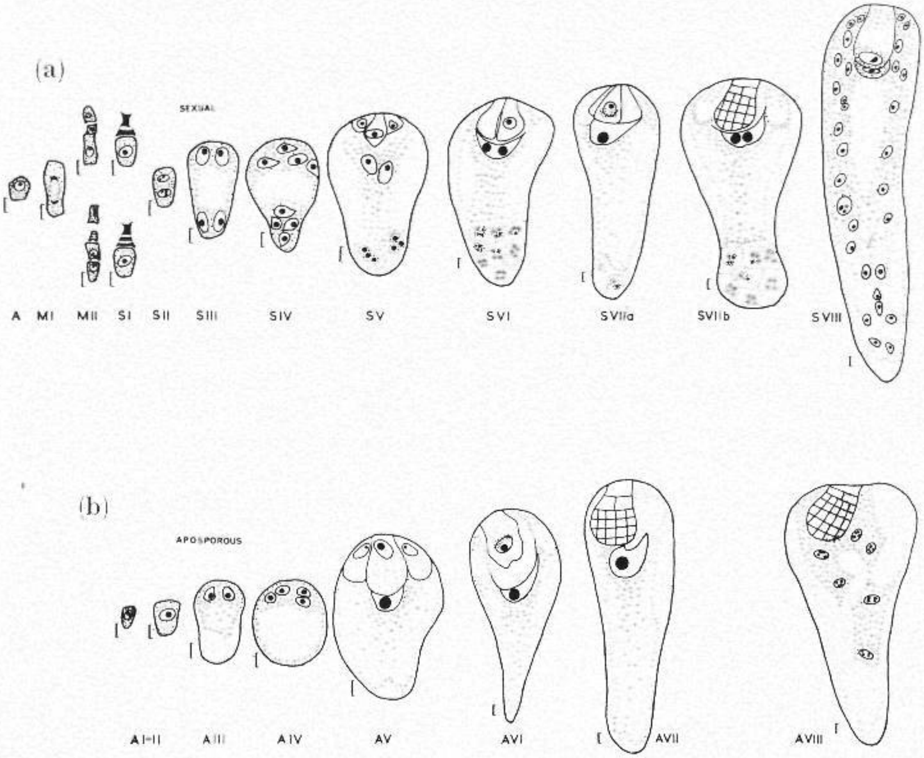


Fig. 1. Paths of development in embryo sacs of *Dichanthium aristatum*. (a) The sexual sequence; (b) The commonest aposporous sequence. The scale in each case is equal to 10 μ.

Observations

The sexual system. — The course of development of the typical reduced embryo sac is summarised semi-diagrammatically in Fig. 1 a. There is no significant departure from the pattern well established for grasses such as *Zea*, but some features may be noted because of their significance in identifying the different nuclei of the sac and in distinguishing sexual from aposporous stages. The chalazal megaspore is the functional one, and at the stage S1 of Fig. 1 a it may be associated with two or with three degenerating remnants according to whether the micropylar dyad nucleus undergoes Meiosis II or degenerates. In either case, the presence of the other meiotic products provides evidence of a reduced megaspore. In the second embryo-sac mitoses, the spindle axes are oriented at right angles to the long axis of the sac, separated by a

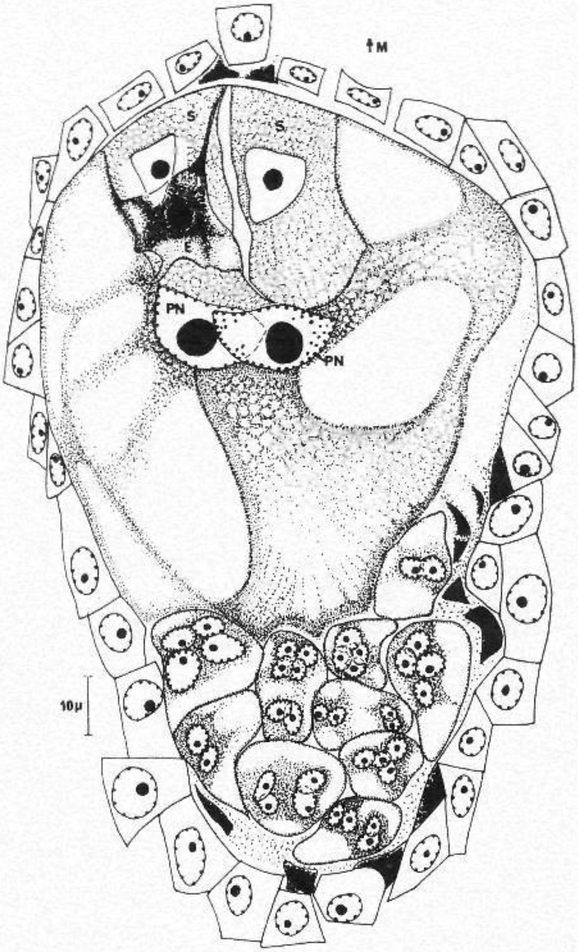
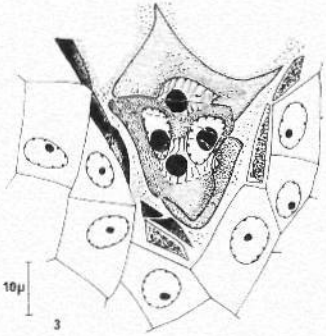


Fig. 2. A mature sexual embryo sac before the fusion of the polar nuclei (PN). E, egg cell; S, synergids, M, direction of micropyle.

central vacuole; this results in a characteristic disposition of the nuclei at the 4-nucleate stage — in pairs at the poles (Fig. 1 a, SIII).

Secondary divisions of the antipodals take place early, so that the 8-nucleate stage is no more than ephemeral. The characteristic aspect of the antipodal tissue at different stages of its formation permits its identification without great difficulty (Fig. 2—5). Mitotic divisions followed by cytokinesis produce up to twelve cells, after which amitotic divisions lead to a multinucleate condition with 2—4 nuclei per cell. The whole tissue degenerates during the final stages of maturation of the sac, although cells may survive until the early stages of endosperm formation.



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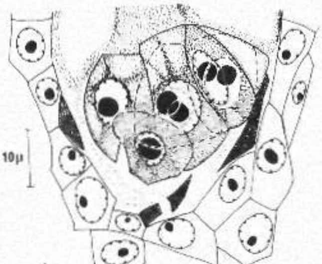

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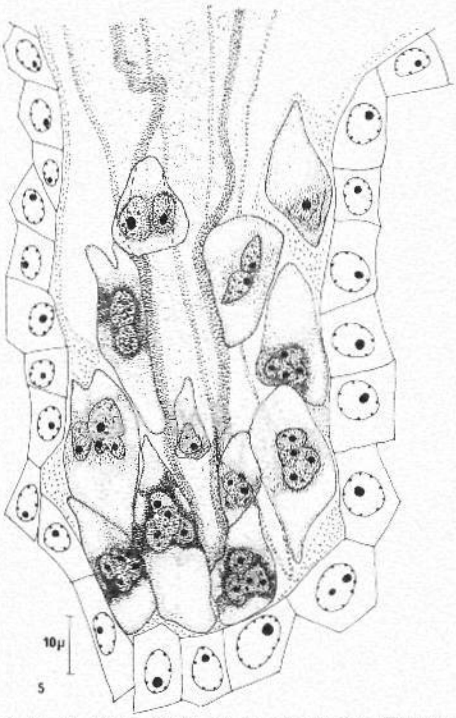

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Fig. 3. Antipodal tissue in a sexual sac in an early stage of development. Three cells are present, one binucleate. Fig. 4. Later stage of growth of antipodal tissue. Fig. 5. Antipodal tissue entering the phase of dissolution.

The micropylar nuclei assume a characteristic disposition shortly after the final mitoses, with the synergids flanking the egg (Fig. 2). The polar nuclei come to lie side-by-side just below the egg apparatus: commonly they fuse almost immediately to form a characteristically crescent shaped primary endosperm nucleus, although fusion may be delayed until the time of fertilisation. The presence of two conspicuous nucleoli in the primary endosperm nucleus (Figs. 7 & 8) or of paired adjacent nuclei may provide an indication of the sexual origin of the sac. The nucleoli may, however, coalesce at the time of fusion, so the guidance this feature provides is not infallible.

The synergids have no more than an ephemeral existence, and may not be evident in the mature sac. At the time of fertilisation, the micropylar end of the sac is commonly occupied only by the egg itself with the primary endosperm nucleus, crescent shaped in section, applied to

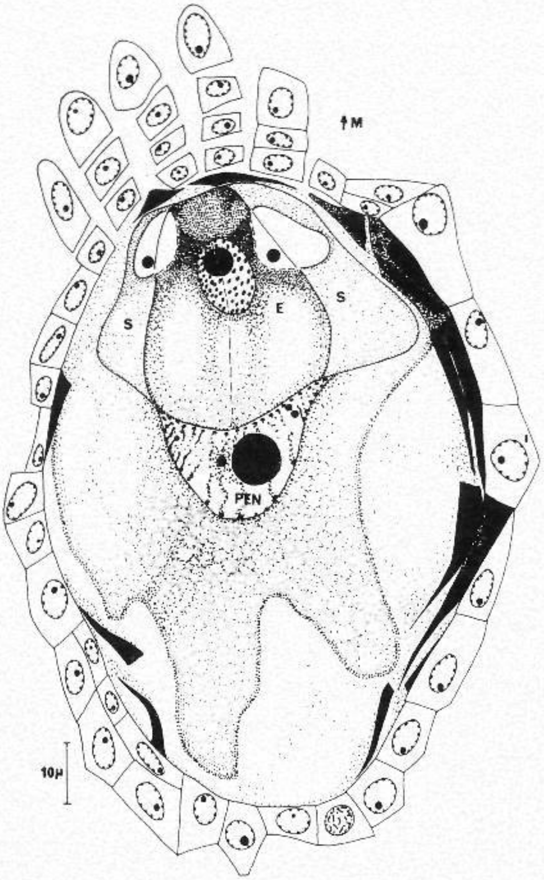
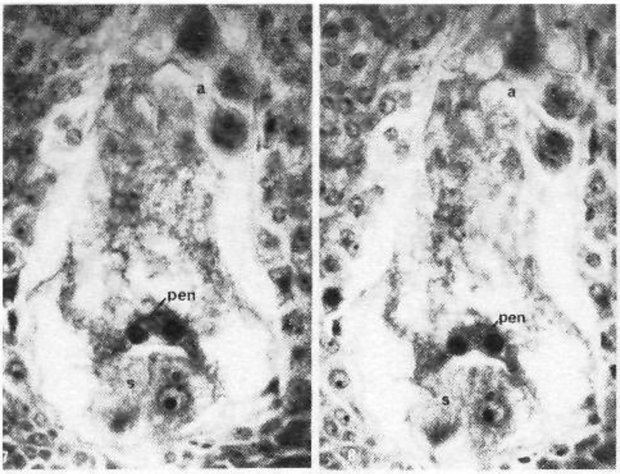
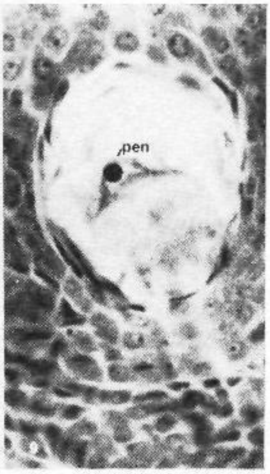


Fig. 6. Mature aposporous (unreduced) embryo sac. E, egg cell; S, synergids; PEN, primary endosperm nucleus. M, direction of micropyle.

it. The chalazal end at this time normally contains the antipodal tissue. If fertilization is delayed, this, too, degenerates (Fig. 1 a, SVII a).

During the maturation of the ovule, both embryo sac and nucellus grow in length, but the growth of the sac itself is the more rapid over all. The ratio sac-length/nucellus-length may thus be taken as an index of embryo sac development, and in Fig. 10 this ratio is related to the developmental stages of the sexual sac indicated in Fig. 1 a. The main periods of growth in the sac follow the 2-nucleate state and the final mitosis that gives the 8-nucleate state. The *relative* lengths of sac and nucellus alter very little after the sac reaches maturity and during the early stages of endosperm formation. Rarely, however, there may be a precocious division of the egg whilst antipodals are still present and





Figs. 7 & 8. A sexual (reduced) embryo sac in two focal planes, showing the egg cell (e), one synergid (s), the primary endosperm nucleus (pen) and the antipodal tissue (a). Fertilisation has occurred, and chromatin may be seen on the surface of the egg nucleus. × *c*. 430. — Fig. 9. Aposporous embryo sac showing the primary endosperm nucleus (pen) with single nucleolus. × *c*. 430.

before the onset of endosperm divisions. In such sacs the sac-length/nucellus-length ratio is abnormally low (condition SVII b of Fig. 1 a). Sacs in which fertilisation is delayed show a ratio slightly higher than usual, due no doubt to continued extension growth without the accompanying pollination-stimulated growth of the nucellus (condition SVII a of Fig. 1 a).

Apospory. — Fig. 1 b summarises what appears to be the commonest path of aposporous development in this tetraploid race of *D. aristatum*. The first evidence of a departure from the sexual pathway is discernible after the completion of meiosis, when one or more of the nucellar cells adjoining the megaspores increase in volume and acquire a more deeply staining cytoplasm and much enlarged nucleolus (Figs. 11 & 12). All of the products of meiosis may degenerate at this time, leaving only the aposporous embryo sac mother cells, or the chalazal megaspore may survive to continue in competition. In the latter event, only position is likely to betray the origin of the reduced embryo sac mother cell, since those derived from the nucellus rapidly become indistinguishable in dimensions and staining properties.

Some vacuolation commonly occurs in aposporous sacs before the

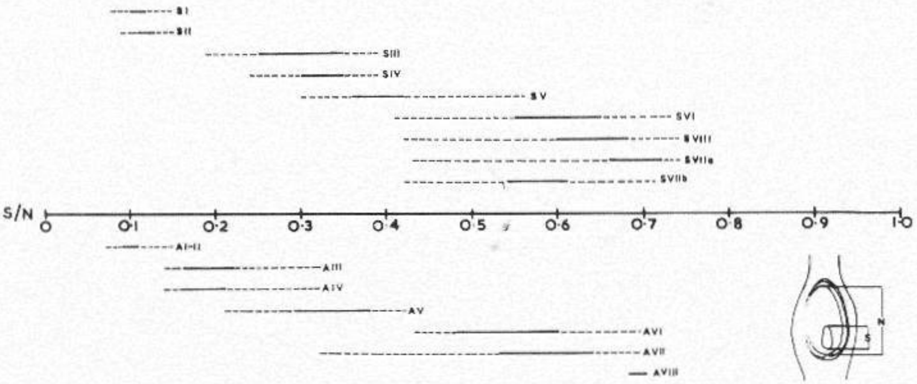
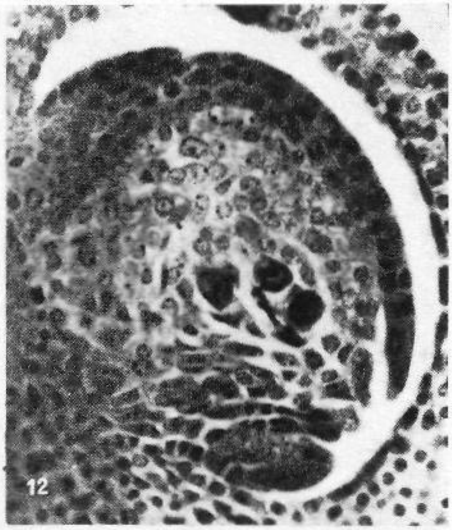


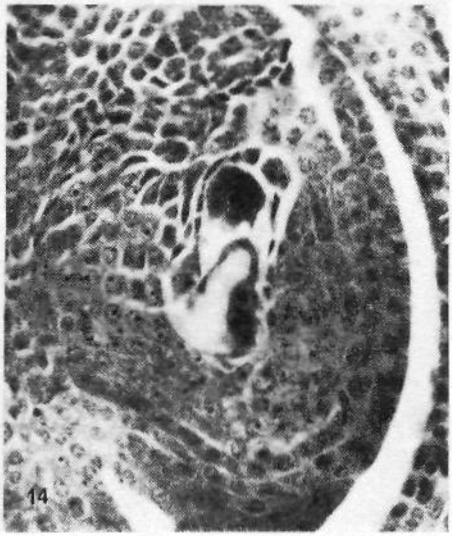
Fig. 10. The ratio sac length/nucellus length in sexual (series S) and aposporous (series A) embryo sacs at the stages shown in Fig. 1. The inset sketch shows the values measured.

first mitosis, which generally takes place at one side of the sac, with the spindle tangentially oriented (Figs. 13 & 14). At the 2-nucleate stage (Fig. 1 b, AIII) aposporous sacs are accordingly readily distinguishable from reduced sacs.

Since the daughter nuclei of the first division remain at the same pole of the sac, the second mitotic division results in a group of four nuclei placed to one side of the central vacuole (Fig. 1 b, AIV), a distribution never found at the 4-nucleate stage in reduced sacs. Moreover, there is no evidence of the regular polarity found in reduced sacs; the nuclei may lie at the micropylar or chalazal ends, or in any intermediate position.

As described by Brown & Emery (1958) for various apomictic Andropogoneae, the 4-nucleate sac is the characteristic product of aposporous development. The nuclei assemble to form a quartet simulating the micropylar group in reduced sacs, with the egg flanked by two synergids and a single nucleus assuming the position of the fusion nucleus of the sexual sac (Fig. 1 b, AV; Fig. 6). As in the sexual sac, the synergids may degenerate as the sac matures, leading to condition AVI of Fig. 1 b. At this stage there is little to distinguish an aposporous sac from a reduced one in which the antipodal tissue has been resorbed, unless the sexual sac reveals the origin of the primary endosperm nucleus in the presence of two nucleoli. However, the dimensions of sacs formed through the two possible developmental pathways do differ, since the chalazal end of the sexual sac extends through the growth of the anti-





Figs. 11 & 12. Adjacent sections of a young ovule. The degenerating remains of the megaspores resulting from the meiotic division are visible, and three aposporous embryo sac mother cells derived from the nucellus. These are identifiable by their denser cytoplasm and the conspicuous nucleoli. × c. 600. — Fig. 13. Telophase of the first mitosis in an aposporously formed embryo sac mother cell, showing the vacuolated condition and the abnormal orientation. (Hexaploid *Dichanthium annulatum*). × c. 600. — Fig. 14. Ovule with one aposporously derived 2-nucleate embryo sac and an aposporous embryo sac mother cell. × c. 600.

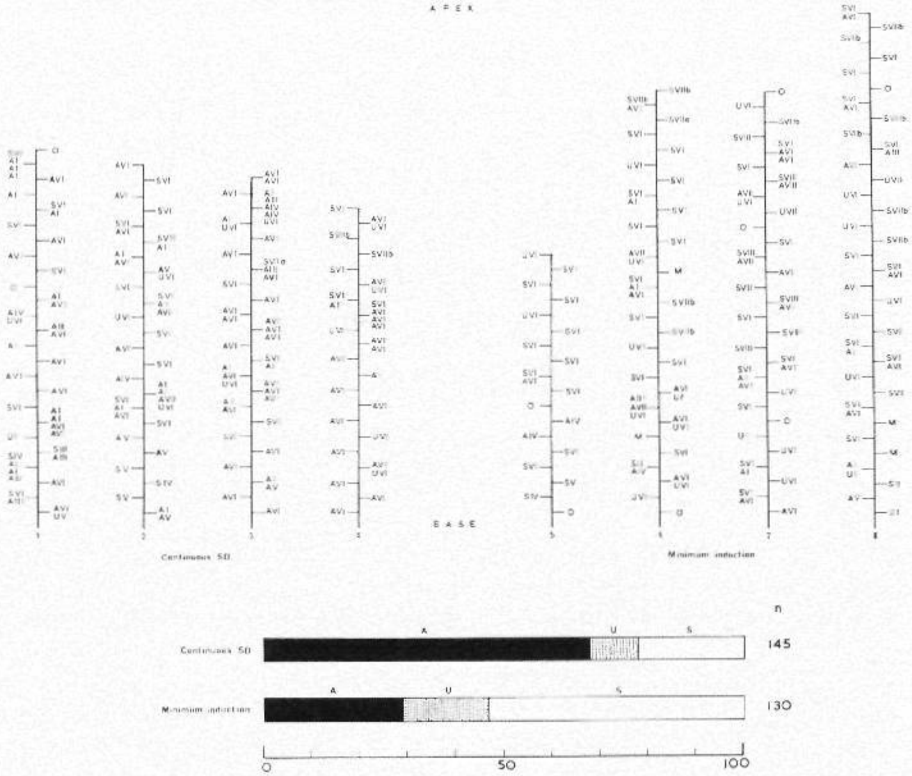


Fig. 15. Distribution of sexual (S), aposporous (A) and unclassifiable (U) embryo sacs in four inflorescences from plants grown under continuous short days and four from plants flowering in long days after 40 days of short day treatment. The classes of embryo sacs present in each ovule are coded according to Fig. 1. Complete sterility is indicated as 0. In the bar diagram the percentages of each class A, U and S present in the sample sizes indicated are shown for the two treatments. For further explanation, see text.

podals, even although these may later degenerate, whilst the aposporous sacs, which have no regular orientation, are usually abbreviated. Mean mature sac lengths in samples of 65 sacs positively assignable to sexual and aposporous origins were 175.7 ± 8.2 μ and 140.24 ± 6.5 μ respectively, the difference being highly significant.

The phasing of the development of the aposporous and reduced sacs sheds some light upon the relationship between them. The mother cells of the aposporous sacs are differentiated in the nucellus at the period when meiosis is completed, but their first mitotic division is delayed until the onset of vacuolation, whilst the nucleus of the functional megaspore undergoes a rapid mitosis before there is any appreciable vacuolation. After this initial divergence in behaviour, the nuclei of the aposporous sac behave like those at the micropylar end of the sexual sac: a further mitosis provides four nuclei which assume the orientation of the sexual micropylar quartet, and it is significant that as they do so the sac undergoes a phase of elongation corresponding to that of the sexual sac at the same period.

Although the parallel behaviour of aposporous and reduced sacs might be taken to indicate that both are responding to the same morphogenetic stimuli and that these stimuli arise from the environment provided by the other tissues of the ovule, there is no very close synchroneity in the development of different sacs in ovules where several mother cells are functional. Where a reduced sac survives, it commonly takes the lead in development, and may reach a stage corresponding to SVI of Fig. 1 a while aposporous sacs are still in the 2- or early 4-nucleate stage (Fig. 15). Aposporous sacs may differ amongst themselves in advancement, so that one sac may be in the condition of AVI of Fig. 1 while others may still be in the mother cell stage in one and the same ovule. A less extreme divergence is seen in Fig. 14.

Effects of the light regime. — For the observation of the effects of light regime upon reproductive behaviour, plants were grown from germination under LD conditions for 135 days, after which they had differentiated 8—9 leaves. They were then sorted into groups of 4, each carefully matched for stature, tillering, and numbers of leaves, and groups were exposed to 5, 10, 20, 40 and 60 short days before restoration to long days. A further group was maintained continuously under SD conditions from an age of 135 days. In this experiment, only those plants receiving more than 40 short days produced flowers, and it may be supposed that the minimum induction period under these conditions lies between 20 and 40 days. The minimum period to flower in continuous short days was 72 days, and with 40 short days, 85 days.

Detailed cytological comparisons were made between inflorescences from plants of the 40 SD and continuous SD groups. Inflorescences were selected so as to be approximately at the same stage of development: all had just completed emergence from the subtending leaf sheaths, and the florets of the upper halves of the inflorescences had exserted their stigmas. At this stage in both series mature sacs were found to predominate, and fertilisation had occurred only comparatively rarely.

The selected inflorescences were segmented and fixed, embedded and sectioned as described above. From the serial sections the contents of each ovule was determined and the embryo sacs present classified according to type. The criteria already detailed permitted an accurate assignment of most sacs as sexual (S) or aposporous (A), but a proportion could not be classified, either because the stage available, or the aspects observable in the sectioned material, did not reveal discriminant features, or because they were in some respects anomalous and not interpretable on the basis of the stages shown in Fig. 1. These unassignable sacs were classified separately (U).

The distribution of sacs of the three groups is shown in Fig. 15 for a total of 145 embryo sacs from four representative inflorescences from plants of the series exposed to continuous short days, and for 130 embryo sacs from plants of the series receiving 40 short days. The plants of the continuously induced series have a significantly higher mean number of embryo sacs per ovule than those receiving a short period of induction, 1.54 ± 0.24 compared with 1.17 ± 0.09. The supernumerary sacs are, of course, invariably aposporous in both series. In considering the effect upon the apomictic mechanism, the presence of the unassignable group of sacs forms a complication. Two extreme conditions may, however, be examined: (1) where the U-sacs are added to the aposporous A class in the continuous SD series and to the sexual S class in the 40-SD series, and (ii) where they are added to the S class in the continuous SD series and the A class in the 40-SD series. With condition (i), the percentage of aposporous sacs appears as 79.0 ± 5.01 % under continuous SD and 27.0 ± 3.60 % with 40 SD, and in condition (ii) the percentage is 68.5 ± 6.32 % under continuous SD and 46.5 ± 6.06 % with 40 SD. The difference in each condition is significant at a probability level of less than .01. Continuous exposure to the SD conditions of this experiment thus materially increases the proportion of cytologically detectable aposporous embryo sacs compared with the proportion observable following photoperiodic induction for a period approaching the minimum effective in initiating flowering.

Discussion

The apomictic mechanism in *Dichanthium aristatum* — The aposporous system described above is of a type now established for several genera of the Paniceae and Andropogoneae and recorded also for certain neighbouring tribes. The 4-nucleate aposporously derived embryo sac seems to have been described first by Narayan (1951, thesis quoted by Warmke, 1954) in *Pennisetum ruepellii* and *P. villosum*, and a full developmental account has been published by Snyder, Hernandez and Warmke (1955) for *P. ciliare*. These authors recorded the lateral orientation of the first embryo sac mitosis which leads to retention of the daughter nuclei at one end of the sac during further growth, one of the features found useful as a discriminant in the present study. The same general pattern of development has been established for other genera by Emery (1957), Brown & Emery (1957), and Harlan *et al.* (1958). Using the 4-nucleate embryo sac as an indication of apospory, Brown & Emery (1958) have carried out an important survey of Paniceae, Andropogoneae, and related groups and have revealed a remarkably widespread incidence of apomixis in this tribe of the Gramineae.

While it may be taken that the 4-nucleate embryo sac is a characteristic product of apospory in the Paniceae and Andropogoneae, 8-nucleate, non-reduced sacs of aposporous origin have been recorded. In *Paspalum secans* (Paniceae), according to Snyder (1957), the formation of 8-nucleate aposporous sacs is associated with a failure of meiosis or a very early degeneration of the megaspores, the aposporously developing nucellar cells invading the achesporial region very rapidly. Taken in conjunction with the sequences illustrated in Fig. 1, this may, in fact, reveal a developmental correlation. If the aposporous mother cell usurps the role of the functional megaspore at a very early stage, then it undergoes three mitoses in the formation of a gametophyte which is in all respects similar to that which would have arisen from a megaspore; if, however, the replacement is later, only two mitoses occur, and the quartet of nuclei formed behave like those in one half — the micropylar — of the reduced sac. It may be noted that an occasional 8-nucleate, non-reduced sac produced through the precocious development of an aposporous mother cell following failure of meiosis would escape detection in the present study, as it would in the survey of Brown & Emery (1958).

Environmental control. — The evidence given above shows that the balance between sexuality and apomixis, as judged by the proportions of reduced and non-reduced embryo sacs produced, may be affected in a systematic way in this tetraploid race of *Dichanthium aristatum* through the agency of the light regime in which plants are grown. The implications of this observation are numerous, not the least significant being that the availability of a means of experimental control greatly widens the potentialities for investigating the physiology of apospory. In the physiological connection, it may be noted that the effect has not yet been shown to be photoperiodic in the narrow sense, in that the treatment groups received different total amounts of light energy so that effects due to different levels of photosynthesis during the period of flower initiation and development are not excluded. Night-interruption experiments are now required to establish that breeding behaviour, like flowering itself in these grasses, is governed by a true photoperiodic mechanism.

The treatments adopted were selected with the intention of amplifying differences in what was known to be a complex and variable cytological system and so of permitting the readier detection of environmental effects. The growth conditions in the principal experiment did not simulate at all closely any likely to be encountered by the species within its natural distributional area, and for this reason the experiment does not provide an immediate basis for ecological conclusions. Nevertheless, there is now every reason to suspect environmental control of apomixis in facultatively aposporous species like *D. aristatum* in natural habitats, and it should not be out of the question to detect seasonal drifts by cytological surveys of population samples — although undoubtedly the task will be an exacting and time-consuming one.

Acknowledgements

We are greatly indebted to Mr C. E. Hubbard, Director of the Herbarium, Royal Botanic Gardens, Kew, for arranging the supply of material for these experiments and for checking the identification. We wish to thank the Queen's University of Belfast for the provision of the controlled-environment equipment in which some of the experimental work was carried out, and the Department of Scientific and Industrial Research for a grant towards the cost of similar facilities at Birmingham where the work was concluded.

One of us (R.B.K.) is indebted to the Agricultural Research Council for a research studentship, during the tenure of which this work was carried out.

Summary

A tetraploid $2n=40$) race of *Dichanthium aristatum* (Poir) C. E. Hubbard of Australian origin has been shown to be facultatively apomictic, the apomictic mechanism being of the aposporous type. The pathways of sexual and apomictic development have been worked out, and criteria for identifying each type of behaviour during different periods of embryo sac growth have been formulated. These include (a) the presence or absence of non-functional megaspores,

(b) the orientation of the embryo sac mitoses, and the consequent disposition of nuclei at the 4-nucleate stage, (c) the presence or absence of antipodal cells, (d) the occurrence or non-occurrence of a fusion of polar nuclei, (e) the relative growth rates of the embryo sac and the nucellus, and (f) the dimensions and shape of the mature sac. Using these criteria as the means of classifying behaviour, a survey has been made of the incidence of sexuality and apomixis in plants flowering under continuous short-day conditions (8 hrs illumination) and in long days (more than 16 hrs illumination) following a period of short-day induction near the minimum for the species. Under continuous short days, plants produced 1.54 ± 0.24 sacs per ovule, the percentage of aposporous sacs being up to 79 %, while with minimum photoperiodic induction (40 short days), 1.17 ± 0.09 sacs were formed per ovule, of which a maximum of *c.* 47 % were aposporous. The differences observed were highly significant, and it may be concluded that the light regime does govern the incidence of apomixis in this tetraploid race, continuous exposure to short days increasing the numbers of aposporous sacs produced. Some implications of these observations are discussed.

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Studies in the Genus Juncus III

Observations on the diversity of chromosome numbers

By SVEN SNOGERUP

(Meddelande från Lunds Botaniska Museum, Nr 171)

Introduction

The present paper is a preliminary report on part of an investigation of the chromosome numbers in the genus *Juncus*. The species treated are grouped according to the sections accepted by the present author. Chromosome numbers for critical groups investigated are not given here but will be published in future papers.

For each species is given a list of the collections, for which the chromosome number has been determined. The numbers given in brackets refer to the individual specimens which were the object of the determination. This material is preserved at the Botanical Museum, Lund (LD).

All countings have been done in sections of root tips fixed in the Svalöv modification of the Navashin-Karpechenko fixative and stained in gentian violet. The sections have been pre-treated in 7.5 % citric acid and kept in the stain for 12—18 hours.

Basic numbers and chromosome shape

It has been postulated by some authors that the genus *Juncus* has a single basic number. Löve (1944, 1961) proposed the number 5, Darlington and Wylie (1955) 8 or 10. These numbers have no doubt been calculated from the common somatic number $2n=40$. In fact Löve's proposal of $x=5$ has become commonly accepted, and consequently most numbers published by regional investigators have been given in multiples of 5. The result of this investigation shows, however, that a long series of secondary basic numbers exist within *Juncus*, the lowest hitherto obeserved being 9 and the highest 25. These basic numbers are in most cases kept constant within sections or groups of related species. Thus they do not represent new and frequent variations, but old and stable sets of chromosomes, kept in some cases through the earlier development of a large and widespread section. The primary basic number of the genus, from which all the secondary numbers have been derived, can not be calculated from the information available at present.

If one accepts Löve's views, much of the variation in chromosome numbers is due to polyploidy and most species should be regarded as high polyploids, some of them 20-ploid or more. In the opinion of the present author most of the diversity is due to a raize in basic number. Thus only a few species may be regarded as more than tetraploid.

According to the size and general appearance of the chromosomes the genus can be divided into two parts. One part is characterized by small chromosomes, with very little differentiation between the pairs. All or nearly all chromosomes are sphaeric or short, rodshaped. This group consists of the sections *Juncus, Subulati, Tenageia, Poiophylli* and *Genuini*. In the other part of the genus the chromosomes are larger and more variable in size. Structural differences between the pairs may often be observed and some of the chromosomes can be recognized as two-armed even in somatic metaphases. To this group belong the sections *Juncinella, Graminifolii, Septati, Ensifolii* and *Alpini*. Nothing is known at present about the cytology of the monotypic South African sect. *Singulares*.

The sections *Tenageia, Singulares* and *Alpini* are not dealt with in this paper. Sect. *Tenageia* will be the subject of a special paper, whereas no thorough investigations are planned on the sections *Singulares* and *Alpini*.

If only the chromosome numbers hitherto determined during this investigation are considered, the following scheme of the secondary basic numbers will appear:

Small chromosomes:		Larger chromosomes:	
Sect. Tenageia	x=17:18	Sect. Juncinella	x=9
Sect. Genuini	x=20:21	Sect. Graminifolii	x=19
Sect. Poiophylli	x=21:22	Sect. Ensifolii	x=20
Sect. Subulati	x=21	Sect. Septati	x=20
Sect. Juncus	x=24	Sect. Alpini	x=25

Sect. Juncus

This group has earlier been called *Thalassici* or *Thalassii* as subgenus and as section. According to the present code of nomenclature, however. it must be named *Juncus*, since Britton and Brown (1896) selected *J. acutus* as the nomenclatorial type of the genus.

All the species of sect. *Juncus* are tall perennials with terete, pungent leaves. The interior of stems and leaves is filled with a parenchyma of large, rounded cells. In this property sect. *Juncus* resembles sect. *Singulares* (Buch.) Weim., whereas in plants of all other sections the cavities are filled with an aerenchyma with large intercellular spaces, in which the cells form a network only. The number of species in this widespread section can not be given at present, as it contains several critical groups and is in need of a revision.

Besides the species listed below, the chromosome number 2n=48 has been determined for several smallflowered specimens of the *J. acutus* group. Earlier published deviating numbers may easily be explained by the special difficulties, as most of the chromosomes are extremely small. A few somewhat larger chromosomes may be observed, which are somewhat differently stained, a characteristic reminiscent of sect. *Subulati*.

J. acutus L. **2n=48** (fig. 1 A). Under this name are here included only forms with large, c. 5 mm long, rounded capsules and red anthers from Europe. The systematic position of the American and South African large-fruited forms requires further investigation. The small-fruited forms with yellow anthers which have also often been included in *J. acutus*, represent several distinct species. In the narrow sense of the name here used, *J. acutus* shows little variation, except in the form of the inflorescence, which is usually contracted but in some specimens lax and up to 30 cm long. *J. acutus* occurs only in salt marshes and on sandy seashores.

The chromosomes are extremely small and difficult to count. There is some variation in size, but no chromosome pair can with certanty be distinguished from the others.

Material used: **France:** Bouches-du-Rhone, salt marsh at Badet 7 km N of Les Stes Maries, Snogerup 1957, (no. 3360); **Italy:** sand dunes NW of the bridge 3 km N of Livorno, Snogerup 1957, (no. 1484, 1485); **Greece:** the island of Naxos, sandfields S of the town, Snogerup 1958, (no. 2619, 2620, 2654, 2656).

J. maritimus Lam. **2n=48** (fig. 1 B). Even excluding *J. arabicus* (Asch. & Buch.) Adams. several races of questionable systematic rank remain within *J. maritimus.* Thus the populations in South Africa, Australia and New Zealand and on Sokotra deviate rather much from *J. maritimus* s. str. All the material hitherto cytologically studied is from the main area of distribution (Europe, the Mediterranean area and the Orient), where the variation is slight. *J. maritimus* is most easily distinguished from smallflowered species of the *J. acutus* group by its tepals, which always lack the protruding hyaline auricles characteristic of that group.

The chromosomes resemble those of *J. acutus* as far as hitherto observed.

Material used: **Sweden:** Blekinge, Lövkvist 1958, (no. 1968); Öland, Borgholm, S of the harbour, Snogerup 1959, (no. 2889); **Greece:** the island of Ios, sandy seashore S of the harbour, Runemark 1957, (no. 2155, 2156).

Sect. Genuini (Buch.) Vierh.

All the c. 30 species, occurring in all temperate regions, are perennials with a well developed rhizome. The leaves are terete, nonseptate, even in their anatomy closely resembling the stem. The inflorescence is composed of single flowers with bracteols.

The chromosomes are small and show little variation in size. The basic numbers hitherto observed are 20 and 21. That the lower one should be 20, not 10, is concluded from the fact that the basic numbers 17 and 18 have been observed in the related sect. *Tenageia* (Snogerup 1958 and unpubl.).

J. effusus L. **$2n=42$** (fig. 1 C). This species is very variable, and an erray of varieties have been described, especially by some American botanists (cf. Fernald and Wiegand 1910). It is distinguished from its relatives by its rather smooth stems and leaves. This difference is due to a quite different anatomy. *J. effusus* has no large longitudinal ridges strengthend by sclerenchyma, which are present in other tall caespitose species of this section. The form of the inflorescence, on the other hand, can not be used for distinguishing between species of this group.

The chromosomes are small, most of them sphaeric, a few short, rodshaped.

Material used: **Sweden:** Skåne, Baldringe, calcareous fen 750 m ESE of the church, Snogerup 1958, (no. 2190); Skåne, 1.5 km NW Domsten, sandy soil near the seashore, Snogerup 1958, (no. 2242); Öland, poor fen 3 km N of Böda railway station, Snogerup 1959, (no. 2871); Öland, sand dunes 2.5 km N of Böda railway station, Snogerup 1959, (no 2880); Öland, small fen in the wood Halltorps Hage, Snogerup 1959, (no. 2884); Sörmland, Trosa-Vagnhärad, Klubben, in wood, Lagerström 1956, (no. 2208).

J. conglomeratus L. **2n**=**42** (fig. 1 E). Although often confused with forms of *J. effusus, J. conglomeratus* is a distinct species. In contradistinction to *J. effusus* it has 15—25 strong longitudinal ridges on the stem. *J. conglomeratus* has a conical elevation at the base of the stigma, which is not present in *J. effusus*. It flowers earlier than its relatives, in southern Sweden May—June.

The chromosomes are small, sphaeric and rodshaped, but one pair is a little larger than the others.

Material used: **Sweden:** Skåne, Oppmanna, fen at Tollarp, Snogerup 1957, (no. 746); Skåne, Oppmanna, pasture at the northern end of Lake Oppmannasjön, Snogerup 1957, (no 748); Skåne, Hjärsås, Angseröd, Snogerup 1957, (no. 737); Skåne, Glimåkra, Häggeryda, in a gravelpit, Snogerup 1957, (no. 743); Skåne, Sandhammaren, sandy soil S of the lighthouse, Snogerup 1958, (no. 2188).

J. inflexus L. **2n**=**40** (fig. 1 D). The material treated represents *J. inflexus* s. str. from southern Sweden. It is recognized by its reddish-black basal sheaths, the few and strong ridges of the stem, and the acute tepals. The delimitation of this species in the Mediterranean, Oriental and South African parts of its area requires further investigation.

One pair of chromosomes are larger than the other ones, which are sphaeric to short, rodshaped.

Material used: **Sweden:** Skåne, fen at Örup, Lövkvist 1958, (no. 2176, 2177).

Sect. Subulati (Buchenau 1880 pro subgen.) stat. nov.

This monotypic section was included by Vierhapper (1930) in sect. *Poiophylli*, but this arrangement was quite unwarranted. The leaves of *J. subulatus* are terete without any marked dorsal side, in contrast to the conditions in sect. *Poiophylli*. The leaves are all placed on the flowering shoots, never on special short shoots as in sect. *Genuini*.

J. subulatus Forsk. **2n**=**42** (fig. 1 F and G). The inflorescence of *J. subulatus* consists of numerous single flowers with bracteols. A special property are the enclosed stomata, found only in *J. subulatus* and in some species of sect. *Juncus*. *J. subulatus* has a thick, creeping rhizome with long internodes. It is mainly a plant of salt marshes. Its distribution is Mediterranean, with scattered localities e.g. in Sahara and in southern England (see map Willis and Davies 1960).

Of the chromosomes of *J. subulatus* 34 are always small, sphaeric to short, rodshaped. The remaning 4 pairs have a somewhat different appearence in different collections. In some plants they are all much

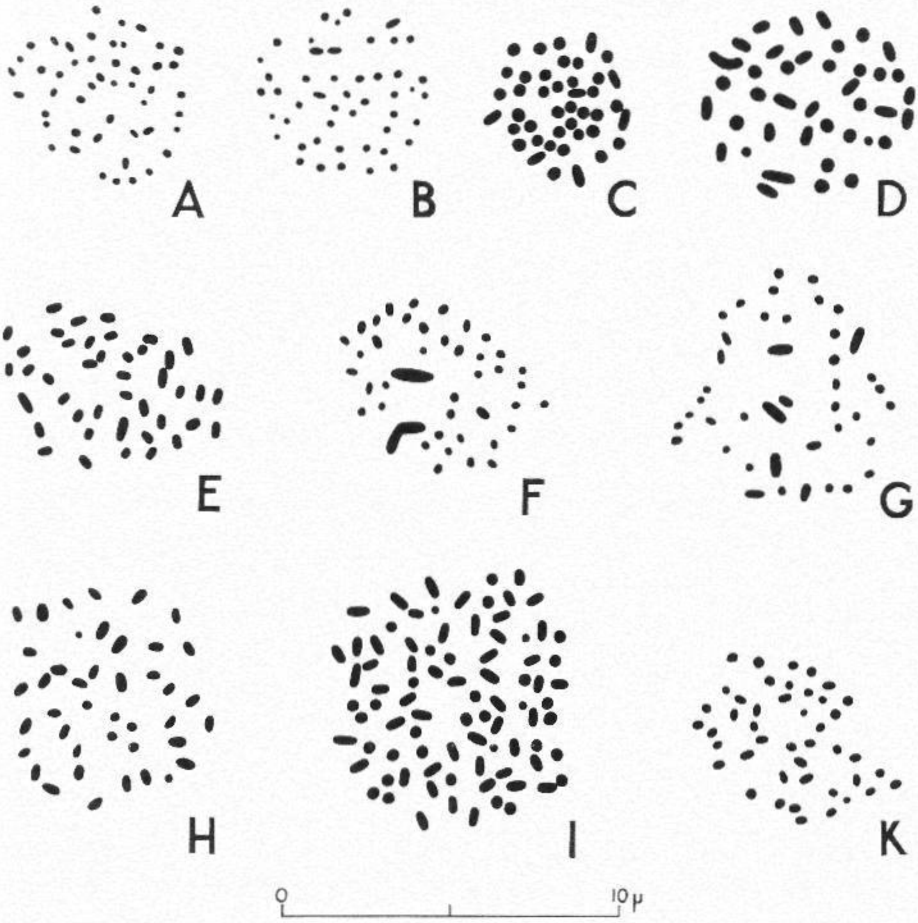


Fig. 1. A: *J. acutus* L. $2n=48$, no. 2619, Greece, Naxos. B: *J. maritimus* Lam. $2n=48$, no. 2155, Greece, Ios. C: *J. effusus* L. $2n=42$, no 2190, Sweden, Baldringe. D: *J. inflexus* L. $2n=40$, no. 2176, Sweden, Örup. E: *J. conglomeratus* L. $2n=42$, no. 737, Sweden, Glimåkra. F: *J. subulatus* Forsk. $2n=42$, no. 2923, France. G: *J. subulatus* Forsk. $2n=42$, no. 3305, Cyprus, Larnaca. H: *J. squarrosus* L. $2n=42$, no. 2238, Sweden, Domsten. I: *J. Gerardi* Lois. $2n=84$, no. 2786, Sweden, Nora. K: *J. compressus* Jacq. $2n=44$, no. 3320, Denmark, NW Fredrikssund.

larger than the other chromosomes, in other plants most of them are small, but there is always at least one pair of chromosomes which is considerably larger than the others. In most preparations the large chromosomes show an uneven surface, different from that of the small ones.

Material used: **Cyprus:** in salinas prope opp. Larnaca, Lindberg 1939, (no. 3301, 3302, 3304, 3305); in salinas prope opp. Famagusta, Lindberg 1939, (no. 3309, 3310); **France:** Southern France, seeds from the Botanic Garden of Montpellier, (no. 2921, 2922, 2923).

Sect. Poiophylli (Buch.) Vierh.

Under this section are here included only the perennial species of Buchenau's *Junci Poiophylli,* about 25 mainly American species. Their leaves vary from dorsiventrally flattened to terete, but are always characterized anatomically by the enlarged cells of the dorsal epidermis and strands of sclerenchyma in their margins. The inflorescence is composed of single flowers with bracteols.

The chromosome numbers hitherto counted in this investigation are founded on the basic numbers 21 and 22. Besides the species listed below some specimens of doubtful origin and some belonging to critical groups have $2n=84$. The chromosomes are small, sphaeric to short, rodshaped.

J. squarrosus L. **$2n=42$** (fig. 1 H). *J. squarrosus* has a rather isolated systematic position, characterized by its thick rosettes of basal leaves, its leafless culms and large fruits. Its main area of distribution is northern and central Europe, but it also occurs on Greenland.

The chromosome are a little larger and show little more variation in size than in other members of the section yet examined.

Material used: **Sweden**: Skåne, Skanörs Ljung, Snogerup 1958, (no. 1842). Skåne, 1.5 km NW of Domsten, sandy soil near the seashore, Snogerup 1958, (no. 2238); Småland, Nydala, Hjelmqvist 1957, (no. 1952); **Denmark:** Jylland, NW of Esbjerg, heath at Porsmose Bjærge, Snogerup 1960, (no. 3435); Jylland, Grygaard 3 km NW of Bramming, Snogerup 1960, (no. 3438); Jylland, the island of Römö, heath E of Lakolk, Snogerup 1960, (no. 3474).

J. gerardi Lois. **$2n=84$** (fig. 1 I). The difference in chromosome number strengthens the impression that *J. gerardi* and *J. compressus* are not as closely related as might be inferred from their similar habit. *J. gerardi* is most easily recognized by its anthers, which are 1.0—2.0 mm long, 2—4 times the length of their filaments. It also has a shorter capsule than *J. compressus* and a different leaf anatomy. It is mainly a plant of seashores and alkaline soils, sometimes occurring in calcareous fens.

The chromosomes are very small, sphaeric to short, rodshaped.

Material used: **Sweden:** Skåne, salt marsh NW of Skanör, Snogerup 1958, (no. 1838); Ångermanland, Nora, Krången, seashore, Evers 1958, (no. 2786); **Denmark:**

Jylland, the island of Römö, E. of Lakolk, Snogerup 1960, (no. 3486); **Germany:** seeds from the Botanic Garden of Greifswald, (no. 1189, 1190, 1191, 1194).

J. compressus Jacq. **2n = 44** (fig. 1 K). Contrary to *J. gerardi*, *J. compressus* is mainly an inland species, growing in fens and meadows and as a weed on paths and roads. Its anthers are 0.5—1.0 mm long, 1—2 times as long as their filaments.

The chromosomes are small, sphaeric to very short, rodshaped.

Material used: **Sweden:** Skåne, 1.5 km NW of Domsten, sandy soil near the seashore, Snogerup 1958, (no. 2239); **Denmark:** Själland, 10 km NW of Frederikssund, Snogerup 1960, (no. 3320, 3323); Czechoslovakia, Slovakia, distr. Sturovo, Bina, Krisa 1957, (no. 3048, 3049, 3052, 3053).

Sect. Juncinella (Fourr.) Weim.

This section contains 15—18 species, most of which are endemic in South Africa. The only species occurring outside that area are the widespread *J. capitatus* and the critical *J. triformis* group in western North America (Hermann 1948). All species of this section are small annuals. In other respects they resemble rather much sect. *Graminifolii*, in which all species are, however, rigid perennials.

The only chromosome number hitherto known supports the treatment of this group as a separate section. On the other hand the diversity in size and the general appearance of the chromosomes are reminiscent of sect. *Graminifolii*.

J. capitatus Weig. **2n = 18** (fig. 2 A). This species is very uniform throughout its area of distribution, which includes central and western Europe, the Mediterranean area and some African mountains as well as ruderal localities in other parts of the world. Partly dimereous dwarf forms have been described as var. *physciomitrioides* Baen., but such plants have appeared in the coarse of this investigation as progeny of normal plants in cultivation on dry sand. Seeds of dimereous dwarfs have also given rise to normal plants.

The chromosomes of *J. capitatus* show a great variation in size between the different pairs. At least the six largest pairs are two-armed.

Material used: **France:** Var, dry soil 1 km NE of Frejus, Snogerup 1957, (no. 2158, 2159, 2160, 2161); Var, on the rivulet 2.5 km 'VSW of Cavalaire, c. 15 km SW of St. Tropez, Snogerup 1957, (2222, 2227).

Sect. Graminifolii (Buch.) Vierh.

The 30—35 species, mainly occurring in subtropic and warmtemperate regions, are rigid perennials with a well developed rhizome. The inflorescence consists of one or more heads, the flowers lack bracteols. The leaves are nonseptate, dorsiventrally flattened, as a rule forming dense basal rosettes. Most species seem to have a hyaline margin along part of or almost the whole length of the leaf. However, the part carrying the hyaline margin is a part of the sheath, not of the leaf blade. According to Buchenau the seeds should lack appendages, which are, however, present in several species.

In the two species mentioned below the basic number is 19. This set of 19 chromosomes may be the basis for the higher basic numbers present in the sections *Septati, Ensifolii* and *Alpini*, especially as the chromosome morphology resembles that of those sections. On the other hand the similarity in external morphology to sect. *Juncinella* indicates a close relationship.

J. covillei Piper **2n=38** (fig. 2 B). This plant was first treated as a variety of *J. falcatus* E. Mey. (Engelmann 1868), later it was included in *J. latifolius* Buch. (Buchenau 1890). It is, however, distinguished from these and other related species by its combination of 2—3 mm broad leaves, obtuse (not retuse) capsule and a branched inflorescence of 10—15 heads.

The chromosomes are all rater large and show marked differences between the pairs.

Material used: **USA,** California, Trinity county, Weaverville, c:a 2000 ft., Rose 1955, (no. 413, 414, 415, 416, 417, 418).

J. marginatus Rostk. **2n=38** (fig. 2 C). This species has by some authors been divided in *J. marginatus* s. str., *J. biflorus* Ell. and *J. longii* Fern. A study of herbarium material has, however, given rise to the conclusion that such a division cannot be accepted. The only collection from which the chromosome number was counted was by its collector determined to *J. longii,* but it shows a mixture of characters from all the three supposed species. The main reason for a separation of *J. longii* from the rest of *J. marginatus* s. lat. is its ability to send out prolonged rhizome branches ("stolons"). This character can be changed in culture by different growth conditions.

The chromosomes of *J. marginatus* show the greatest differences between the pairs hitherto observed within the genus. Several of them are easily recognized as two-armed even in somatic metaphases.

Material used: **USA,** Washington DC, Snitland, open Sphagnum bog, Sargent 1958, (no. 2831, 2846, 2849).

Sect. Ensifolii (Rydberg 1922) nov. sect.

Type: *J. ensifolius* Wikström (1823).

Perennes. Lamina folii a latere compressa, ensiformia, pluritubulosa, imperfecte septata. Inflorescentia a capitulo unico formata vele capitulis pluribus composita.

All the 7—10 species, most of them from western North America, are perennials with a well developed rhizome. The leaves and their sheaths are laterally flattened and arranged in one plane, thus giving the plant a very characteristic habit. The sheaths are frondose in their upper part, resembling the leaf blade except for the broad parallel margins. Both leaves and sheaths contain several canals, arranged in one dorsiventral row. Each canal is provided with its own series of septa. The inflorescence is composed of one to several heads and the flowers lack bracteols.

By Buchenau and Vierhapper this group of species was included in *Septati*. This can not be correct, in spite of the occurrence of septa in both groups, because the leaf anatomy of sect. *Ensifolii* is quite different from that of species with flat leaves of sect. *Septati*. Rydberg gave no definite rank to his name *Ensifolii* and had no formal description to it. It is taken up here because there is no doubt that he meant with the name exactly the group of species for which it is used here. The name has already been used in several American floras, though without indication of rank. It is also convenient, as it is founded on the main diagnostic feature of the section. *J. ensifolius* is chosen as type species because it is obvious that Rydberg took the name of the group from it.

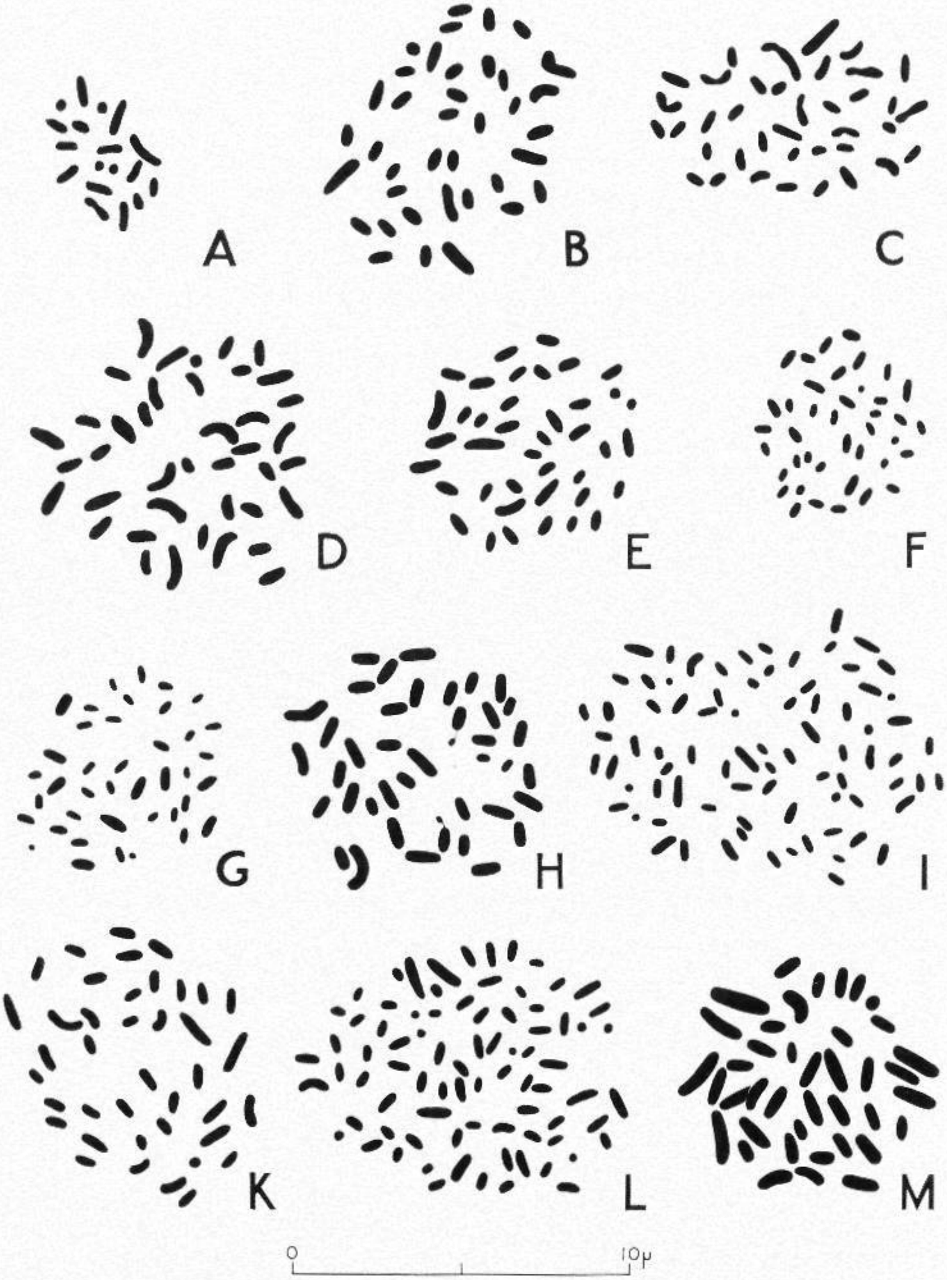
The species hitherto treated have the chromosome number 2n=40, with one pair of chromosomes markedly smaller than the others, i.e. the same condition as in sect. *Septati*.

J. xiphioides E. Mey. **2n=40** (fig. 2 D). *J. xiphioides* is distinct from its relatives by its large inflorescence, composed of many few-flowered heads, its six anthers and its green to light brown tepals. There is no doubt that Meyer's name belongs to this species, since the type specimen has been controlled and carefully described by Buchenau.

The chromosome are rather variable in size, but only the dwarf chromosome is easy to identify.

Material used: **USA,** California, S. Clara County, New Almaden, Rose 1957, (no. 1987, 1989, 1990, 1991, 1992, 1994).

J. ensifolius Wikstr. **2n=40** (fig. 2 E). This is one of the widespread members of the section, distributed from Alaska to California and in-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land to Alberta and Utah. It is recognized by its three anthers and very large, dark flowers. Its inflorescence shows some variation, but usually consists of one or few sphaeric heads c. 10 mm in diameter and has a long basal bract.

The chromosomes show clear resemblance to those of *J. xiphioides*.

Material used: **USA,** Aleutian Islands, Unalaska, moist rivulet valley, Hultén 1932, (no. 903).

Sect. Septati (Buch.) Vierh.

This section contains more than 100 species, most of them American and Mediterranean. All except two are perennials with a well developed rhizome. The leaves are terete with one or several longitudinal canals which contain septa. The dorsal side of the leaf is often marked by a flattening or furrowing or a special structure of the epidermis. The inflorescence consists of one or several heads. The flowers within the heads lack bracteols, but they may occur on isolated flowers.

The chromosome number is known for many species, because most species of sect. *Septati* are easily cultivated and their chromosomes are easy to count. All species examined cytologically have the basic number 20. That it can not be 5 or 10 is easily seen from the idiograms of the species with 2n=40. One pair of chromosomes deviate from the others by their small size and in some species some other chromosomes can also be homologized in pairs. Polyploidy is common, but no single species yet studied contains more than one chromosome number in nature.

J. subnodulosus Schrank **2n=40** (fig. 2 F). This species and some related ones form a group with a very characteristic habit. Their sterile short shoots, carrying one leaf only, gives to them a habit resembling that of the sections *Genuini* and *Juncus*. The anatomy of leaves and stems proves, however, that this similarity is a result of parallel evolu-

Fig. 2. A: *J. capitatus* Weig. 2n=18, no. 2227, France, Cavalaire. B: *J. Covillei* Piper 2n=38, no. 416, California, Weaverville. C: *J. marginatus* Rostk. 2n=38, no. 2849, Washington DC. D: *J. xiphioides* E. Mey. 2n=40, no. 1989, California, New Almaden. E: *J. ensifolius* Wikstr. 2n=40, no. 903, Unalaska. F: *J. subnodulosus* Schrank 2n=40, no. 2192, Sweden, Baldringe. G: *J. alpigenus* Koch 2n=40, no. 3039, Bulgaria, mt. Vitosa. H: *J. atratus* Krock. 2n=40, no. 3057, Czechoslovakia. I: *J. brevicaudatus* Fern. 2n=80, no. 3347, Canada. K: *J. Torreyi* Cov. 2n=40, no. 3161, Canada. L: *J. canadensis* Gay 2n=80, no. 3336, Canada. M: *J. pygmaeus* Rich. 2n=40, no. 2809, Portugal.

tion. The anatomical features of the *J. subnodulosus* group closely resemble those of other members of sect. *Septati.*

The chromosomes of *J. subnodulosus* resemble those of the other members of the section, though they are rather small.

Material used: **Sweden:** Skåne, Baldringe, calcareous fen 750 m ESE of the church, Snogerup 1958, (no. 2192, 2194).

J. alpigenus Koch **2n = 40** (fig. 2 G). This species is easily recognized by means of its leaves, which have external longitudinal ridges and a concave dorsal side. It is large and rigid with an inflorescence of few, sphaeric heads. It is distributed in the mountains from Greece and Bulgaria to Caucasus.

The chromosomes are smaller than in most other species of sect. *Septati*, with an easily distinguishable pair of very small dwarf chromosomes.

Material used: **Bulgaria,** mt. Vitosa, seeds from the Botanic Garden of Sofia 1958, (no. 3035, 3036, 3037, 3038, 3039, 3040).

J. atratus Krock. **2n = 40** (fig. 2 H). *J. atratus* comes very near to *J. alpinus* Vill. in habit as well as in flower size, shape of the tepals and leaf characters. It is distinct from that species and from all other relatives by its blackish capsule, which has a long, curved mucro. It is distributed throughout southeastern Europe.

The chromosomes are of very different sizes. The dwarf chromosomes are easily distinguished from the others, but they are not as extremely small as in *J. alpinus*. The satellites are attached to a pair of medium-sized chromosomes.

Material used: **Czechoslovakia,** seeds from the Botanic Garden of Kosica 1958, (no. 3057, 3155).

J. brevicaudatus Fern. **2n = 80** (fig. 2 I). *J. brevicaudatus* belongs to a group of species from eastern North America, which have caudate seeds in contradiction to all other species of sect. *Septati*. *J. brevicaudatus* is recognized by its long, lax inflorescence and by its capsule, which is double the length of the tepals and broadly obtuse. Its leaves and stems are always very thin.

The chromosomes are variable in size and rather large, comparable e.g. to those of *J. articulatus* L.

Material used: **Canada,** Eastern Canada, seeds from the Botanic Garden of Montreal 1957, (no. 3347).

J. canadensis Gay **2n = 80** (fig. 2 L). This species belongs to the same group as *J. brevicaudatus*. It is recognized by means of its capsule, which is only slightly longer than the tepals, and its densely caespitose habit. In other characters, floral as well as vegetative, *J. canadensis* shows an enormous variation.

The chromosomes are rather large with a marked difference in size between the pairs. In *J. canadensis,* as in other tetraploids, the dwarf chromosomes can not be recognized as easily as in diploids.

Material used: **Canada,** Eastern Canada, seeds from the Botanic Garden of Montreal 1957, (no. 3336, 3338).

J. torreyi Cov. **2n=40** (fig. 2 K). *J. torreyi* belongs to a group of American species with a very peculiar form of the capsule. The capsule is high and thin, gradually tapering to a point, and only its basal part contains seeds. *J. torreyi* is distinguished from the other members of the group through its thin, prolonged rhizome and through its capsule, which is only of the same length as the tepals.

The chromosomes are large, with rather marked differences in size between the pairs. The dwarf chromosomes are, however, not much smaller than the others and can as a rule not be identified.

Material used: **Canada:** eastern Canada, seeds from the Botanic Garden of Montreal 1958, (no. 3161, 3162).

J. pygmaeus Rich. **2n=40** (fig. 2 M). Sect. *Septati* contains two small, annual species, *J. pygmaeus* and *J. fasciculatus* Schousb., no doubt closely related to each other. In *J. pygmaeus* the tepals are of equal length and the anthers half as long as their filaments, whereas in *J. fasciculatus* the inner tepals are longer and the anthers about three times as long as their filaments. *J. pygmaeus* is always very small, rarely more than 5 cm high. It is distributed throughout western Europe and the Mediterranean area.

The chromosomes of *J. pygmaeus* are among the largest observed in the genus. They show good resemblance to those of other species of the section in the proportions between large and small ones as well as in general appearance.

Material used: **Portugal:** seeds from the Botanic Garden of Coimbra 1958, (no. 2781, 2782, 2807, 2809, 2813).

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For further references to older literature and descriptions see the works of Buchenau. For references to earlier publications concerning chromosome numbers see Löve & Löve 1961.

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Observations on Chromosome Number and Reproduction in Some Piloselloids

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In the course of our studies of *Hieracium pilosella* L. (Turesson and Turesson 1960) a few representatives of other groups of Swedish *Pilosellae* have been collected and grown by us on a small scale. Some forms have also been received from friends and colleagues, and we express our sincere thanks for this help. However, our original plan to include these and similar forms in a more comprehensive, experimental study along with *H. pilosella* L. had to be abandoned, since such an enlarged undertaking went far beyond our resources.

Although rather common the identification of the here discussed Piloselloids has been a difficult problem, and we are greatly indebted to Dr. Erik Almquist, Uppsala, for his valuable aid in checking and in determining most of the species. In dealing with the material the methods of cultivation, castration and chromosome treatment have been the same as those already described for *H. pilosella* L. (Turesson and Turesson 1960).

It should be added that the plants were all grown in the Botanical-Genetics garden of the Royal Agricultural College at Uppsala.

Table 1 lists the Piloselloids observed. The "species" — the concept taken in the sense of most hieraciologists — are collected under seven collective species, or species groups, without any attempt at grouping the latter according to an assumed relationship. As seen from the table the species groups *Auricula* L., *Macranthelum* N. et P., and *Transbottnicum* Norrl. has one and the same 2n number throughout the group (2n=27, 2n=45 and 2n=45 respectively), while in the groups *Dubium* L. and *Florentinum* N. et P. the numbers 2n=36 and 2n=45 both occur.

Table 1. List of observed species

Field No.	Species	2n	Reprod.	Locality	Province	Collector	Year of coll.
	Auricula L.						
47	*suecicum* Fr.	27		Ljungdalen	Härjedalen	H. Nordenskiöld	1948
65 a	*cochleatum* Norrl.	27		Svartberget	Västerbotten	Å. Gustafsson	,,
104	*suecicum* Fr.	27		Ragunda	Jämtland	G. Turesson	1949
110	,, ,,	27		Mattmar	,,	,,	,,
232	,, ,,	27		Funäsdalen	Härjedalen	,,	1950
	Auriculinum Almqu.						
199	*asciadium* N. et P.	36		Uppsala	Uppland	B. Turesson	1950
	Dubium L.						
169	*dubium* ("L.") Lindeb.	36	aapm.	Tällberg	Dalarna	B. Turesson	1949
170	,, ,, ,,	36	,,	,,	,,	,,	,,
107	*tenerescens* Norrl.	36	,,	Frösön	Jämtland	G. Turesson	,,
109	,, ,,	36		,,	,,	,,	,,
144	,, ,,	36		Gammelgarn	Gotland	B. Pettersson	,,
209	,, ,,	36		Bogesund	Uppland	Å. Gustafsson	1950
206	*umbelliflorum* N. et P.	36		,,	,,	,,	,,
103	*vacillans* Norrl. ?	36		Ragunda	Jämtland	G. Turesson	1949
101	,, ,,	45		Sollefteå	Ångermanland	,,	1948
	Macranthelum N. et P.						
507	*crassiusculum* Almqu.	45		Öregrund	Uppland	B. Turesson	1954
201	,, ,,	45	aapm.	Bogesund	,,	Å. Gustafsson	1950
233	,, ,,	45	,,	Bäcklösa	,,	G. Turesson	,,
208	*macranthelum* N. et P.	45		Bogesund	,,	Å. Gustafsson	,,
	Pubescens Auct.						
171	*polymnoon* N. et P.	36	aapm.	Visby	Gotland	O. Hedberg	1949
	Transbottnicum Norrl.						
106	*transbottnicum* Norrl.	45	aapm.	Stugun	Jämtland	G. Turesson	1949
111	,, ,,	45	,,	Mattmar	,,	,,	,,
65	*subdimorphum* Norrl.	45	,,	Svartberget	Västerbotten	Å. Gustafsson	1948
	Florentinum N. et P.						
160	*subgotlandicum* N. et P.	45		Hangvar	Gotland	B. Pettersson	1949
161	*Westooi* Almqu.	36	aapm.	,,	,,	,,	,,

While these chromosome numbers also are known from a few foreign Piloselloids (cf. Gentscheff 1937), the numbers found in the Swedish Piloselloids here listed, have, as far as we know, hitherto remained unknown.

A few words should be said about *suecicum* Fr. (and *cochleatum* Norrl.) in the species group *Auricula* L. To include these forms in the same group as the sexual, 2n=18 species *auricula* L. (i.e. with the species still so named by old usage) may seem rather unnecessary or incorrect. *H. suecicum* Fr. and related species in the group are taller in growth than *H. auricula* L., the hairiness of the scape is coarser, and the flower colour is a darker yellow. According to our belief *H. suecicum* Fr. is probably a triploid *H. auricula* L. The close relationship between the two types found an expression in older hieraciologic literature, where *suecicum* was regarded as a variety of *auricula*. The chromosome number of the former, 2n=27, also favours the assumption of such an origin of *H. suecicum* Fr.

A mistake in the literature as to the 2n chromosome number of *H. auricula* L. should be corrected. In a Corsican form of *H. auricula* L. Contandriopoulus (1957) found 2n=27 and writes: "Cette forme corse du *Hieracium auricula* possède le même nombre chromosomique que le type étudié par Rosenberg" (1917). Rosenberg, as is well known, never found any triploid form but only typical sexual 2n=18. Unfortunately, the mistake is repeated in Löve and Löve (1961).

Although none of the Piloselloids here treated has been investigated embryologically we know from the works of Rosenberg, Gentscheff and others that the Piloselloids hitherto examined — with the clear exception of the obligate sexual ones — are characterized by apomixis of the apospory type. Forms, which combine facultative sexuality with apomixis, as is the case in the aposporous Piloselloids, have been called *amphiapomicts*, abbreviated *aapm*, by the senior writer (Turesson 1926). It seems rather safe to assume that the Piloselloids here observed are of the very same type.

As seen from the table, castrations have been made within five of the seven species groups tabulated. Unfortunately, no castration experiments were tried in the *Auricula* L. group. Wherever castrations were made, however, all the plants fruited richly, thus proving these species to be apomictic, i.e. amphiapomictic, none being obligate sexual.

Summary

1. The paper deals with observations on chromosome number and mode of reproduction in 25 Swedish Piloselloids, grouped under seven species groups, tabulated in Table 1.
2. The assumption is made that *Hieracium suecicum* Fr. is a triploid *H. auricula* L.
3. Castration experiments in species, belonging to five of the seven species groups, showed these to be apomictic, i.e. amphiapomictic, none being obligate sexual.

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Studies in the Lichen Family Teloschistaceae I

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Introduction

The family *Teloschistaceae* Zahlbruckner (1907 p. 229, 1926 a p. 251), em. Fink (1910 p. 211) includes a group of lichens characterized by colourless, polarilocular spores, that is they are 1-septate (rarely 3-septate), thick-walled and their lumina are connected by a narrow canal ("isthmus"). This type of spores was first described by De Notaris (1847). Massalongo, another of the founders of modern lichen taxonomy based on spore morphology, treated these lichens monographically as "Lichenes blasteniospori" (1852 p. 561, 1853). In earlier lichen systems mainly founded on the external morphology of the lichen thallus, these lichens had been recorded under widely different genera, *e.g., Borrera* or *Evernia* (fruticose), *Parmelia* (foliose) and *Lecanora* (crustose). Massalongo treated the fruticose and foliose species of this spore-type under the genus *Physcia* Ach. (*e.g., Ph. flavicans, Ph. parietina* and *Ph. elegans*) and the crustose species under *Callopisma* De Not. (*e.g., C. aurantiacum*), *Blastenia* Mass. and *Pyrenodesmia* Mass. In all, Massalongo included 31 species in the blasteniosporous lichens. Among these, however, he also listed the genus *Candelaria* Mass. with 2 species (=the present *C. concolor* and *Candelariella vitellina*). As these lichens have only occasionally spores of this type, subsequent authors have generally placed them in the vicinity of *Parmelia* (1-celled spores).

Without knowing Massalongos's works, Norman (1852 p. 1) described the polarilocular spore-type and united the lichens in question under the new genus *Teloschistes*, which he considered as a series of its own, *Teloschisteae*.[1] At the same time, Trevisan in a fragmentary paper (1853) created a new genus *Blasteniospora* for a few of the same lichens.

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[1] The spelling "*Teloschistes*" used by Norman is philologically correct and must not be altered to "*Theloschistes*", as has been done by Th. Fries, Vainio, Zahlbruckner *et al.*

Th. Fries (1860 p. 66, 1861 p. 51) reserved the name of *Teloschistes* for the fruticose species only ["ex. *T. flavicans* (Sw.), *villosus* (Ach.), *chrysophthalmus* (L.)"], whereas he referred the foliose species to the new genus *Xanthoria* (Fr.) Th. Fries, (*X. parietina et al.*) which he placed in quite another family in his system. For the crustose species he created a new genus *Caloplaca* (1860 p. 118) (*e.g., C. cerina* and *C. aurantiaca*), which, however, was placed far from *Teloschistes* and *Xanthoria*, as he considered the macromorphology to be basic taxonomic principle for major groups (families, series), the spore-morphology being accepted as useful for the delimitation of genera and species. Also in Lichenographia Scandinavica (1871 p. 144 and 162), he placed *Xanthoria* and *Caloplaca* in different families, though he admitted the close affinity between some species in each genus.

Tuckerman [1872 p. (19)], who was followed by the majority of American lichenologists, united the fruticose and the foliose species as *Teloschistes*. The crustose species he referred to *Placodium* (Fam. *Lecanorei*), an ambiguous generic name often (*i.a.*, by Th. Fries) used in quite another sense, viz. *Lecanora*, sect. *Placodium* (*e.g., L. crassa* and *L. muralis*).

The ideas of Massalongo and Norman were taken up by Vainio (1890 p. 113), who brought the genera *Teloschistes, Xanthoria* and *Placodium* together as the tribe *Teloschisteae*. Zahlbruckner, the founder of the system accepted by most lichenologists of the present century, arranged the lichens in question as follows (1907 p. 226, 1926 p. 247, 1940 p. 613):

Caloplacaceae (crustose)	*Protoblastenia* *Blastenia* *Bombyliospora* *Caloplaca*
Teloschistaceae (foliose or fruticose) ..	*Xanthoria* *Teloschistes* *Lethariopsis*

The limit between these two families is, however, fluent. *Caloplaca*, sect. *Thamnoma* (Tuck.) Zahlbr. (as "*Thamnonoma*") (also ranked as a genus: *Polycauliona* Hue) has a fruticulose thallus. *Caloplaca*, sect. *Gasparrinia* (Tornab. as genus) Th. Fr. has a crustose thallus, which is more or less lobate at the circumference. Already Th. Fries (1860 p. 69 but not in later works) referred *Caloplaca elegans* to *Xanthoria*, and recently Poelt (1954 p. 11) also ranked the two related species *C. papillifera* and *C. sorediata* under the latter genus.

Fink (1910) and Malme (1926) used *Teloschistaceae s. lat.* (including also the crustose genera) for the whole group. Zahlbruckner (1931) united the genera listed above as *Caloplacaceae*. Sec. the Code of Nomenclature, the latter name is illegitimate for the family in its wider sense being antedated by *Teloschistaceae* (Fink l.c.). If the crustose genera are retained as a special family, it must be called *Caloplacaceae* Zahlbr., which takes priority over *Blasteniaceae* Dodge and Baker (1938 p. 604) and *Placodiaceae* Räsänen (1943 p. 11).

The delimitation of the *Teloschistaceae* (s. lat.) is founded, in the first place, on the morphology of the spores. The polarilocular spore-type does not exist as a constant character in other genera. Occasionally and in some species only, do similar spore-types occur also in the brown-spored series *Buelliaceae - Physciaceae, e.g.,* in *Buellia* (Malme 1927 p. 5, Imshaug 1955 p. 512), *Rinodina* (Malme 1902 p. 12), *Physcia* (Awasthi 1960 p. 8) and *Anaptychia* (Kurokawa 1962 pl. 1—3). The mischoblastiomorph, "hour glass-shaped" spore-type, *i.e.,* with a funnel-shaped sporoblast in each cell, known from several species in these genera, forms a ± fluent connexion to the polarilocular type. Cf. the figures in the papers cited.

In the second place, the occurrence of parietin is notable. It produces a yellow or orange colour in many species, sometimes only in the discs of the apothecia. This substance, which gives a blood-red colour with potassium-hydroxide (cf. Asahina & Shibata 1954 p. 152), is not known outside *Caloplacaceae - Teloschistaceae,* sensu Zahlbruckner.

Moreover, the seven genera in Zahlbruckner's series cannot be maintained as a natural group. If we lay the chief stress upon the spore-characters, *Protoblastenia,* which has parietin but simple spores should be included in the *Lecideaceae,* as has been done by Vainio (1934 p. 60). Zahlbruckner, however, considered the characters derived from the pycnidial structures to be of major importance for taxonomy: the endobasidial fulcra of *Protoblastenia* agree more with *Caloplaca* than with *Lecidea,* which has exobasidial fulcra. Many recent authors also separate *Caloplaca,* sect. *Fulgensia* as a proper genus, *Fulgensia* Mass. It has colour (parietin) and pycnidia in common with *Caloplaca,* but its simple spores (occasionally two-celled, but not polarilocular) would indicate a position in the *Lecanoraceae.*

Blastenia and *Caloplaca* are distinguished by having lecideine and lecanorine apothecia respectively (analogous to *Buellia - Rinodina, Pyxine - Physcia* and other pairs of genera). As pointed out by Malme (1926 p. 2), there is a fluent series of transitions between the apothecial types of *Blastenia* and *Caloplaca,* and they cannot be maintained as separate genera. *Bombyliospora* with pluriseptate, sometimes ± muriform spores is closely related to *Lopadium* in the *Lecideaceae.*

Xanthoria (foliose) and *Teloschistes* (fruticose) represent fairly well defined genera, though there are a few species, whose position in either genus can be discussed. *X. contortoplicata* (Ach.) Zahlbr. was referred to *Teloschistes* by Clauzade & Rondon (1959 p. 394), *Teloschistes caespitosus* (Müll. Arg.) Poelt (1962 p. 534) was earlier recorded by the same author (Poelt 1954 p. 29) as *Xanthoria elegans* var. *caespitosa.*

Lethariopsis Zahlbr. is a *Caloplaca* or *Teloschistes* growing on *Neuropogon aurantiacus* (Lamb 1948 p. 225).

Duvigneaud (1941 p. 260) described a fruticose monotypic genus from South Africa, *Xanthodactylon.* As pointed out by Santesson (1949 p. 559), it is identical to the lichen known as *Xanthoria flammea* (L. fil.) Hillm.

Santesson (1949 p. 558) described a foliose umbilicate monotypic genus from Chile, *Xanthopeltis,* which he included in the *Teloschistaceae.* Its yellow colour (parietin) is striking, but it has 2-celled (not polarilocular), curved spores. They represent a peculiar type, whose connection with other *Teloschistaceae* is difficult to interpret.

A number of genera, as a rule segregated from *Caloplaca,* have been described or reestablished in the 1930's and 40's mainly by Räsänen and Dodge, viz. *Kuttlingeria* Trevis., *Huea* Dodge and Baker, *Pyrenodesmia* Mass., *Gasparrinia* Tornab., *Polycauliona* Hue (see above), *Callopisma* De Not., *Peltata* Räs., *Thamnoma* (Tuck.) Gyelnik (see above), *Triophthalmidium* (Müll. Arg.) Räs., *Xanthocarpia* Mass. and *Mawsonia* Dodge. Their relations to *Caloplaca* should be studied further.

Leaving the position of *Xanthopeltis* open, I do not count for the present more than 3 genera belonging to *Teloschistaceae,* viz. *Xanthoria* (foliose), *Teloschistes* (fruticose) and *Caloplaca* s. lat. (crustose).

Like most groups of lichens, the *Teloschistaceae* lack a modern monographic treatment. Hillmann wrote brief world monographs of *Xanthoria* (1920 p. 1, 1922 a p. 198, cf. also 1922 b p. 313) and *Teloschistes* (1930 p. 303). His statements were, however, founded on a limited material (mainly the herbaria in Berlin and Vienna). At the same time Du Rietz (1921 p. 181, 1922 p. 210, 1925 p. 82) published studies in *Xanthoria,* especially the Scandinavian species. *Caloplaca* has been treated, as to certain groups and certain geographical districts, by *e.g.,* Malme (1926), Magnusson (1944, 1950), Poelt (1954, 1955, 1957) and Rudolph (1959).

Hillmann (1922 a, b) recorded 11 species of *Xanthoria,* but he overlooked some species described earlier, *viz. X. aurea* (Rich.) Müll. Arg. from New Zealand and *X. turbinata* Vain. from South Africa. Zahlbruckner (1926 a p. 251) estimated the number of species to be only 6, but in his Catalogus Lichenum Universalis (1931) he listed 16 species. During the last 30 years several new species have been described (*i.a.*, by Räsänen from S. America), so that the number of species now amounts to 35. Many of them are doubtful, and it is evident that the genus is in urgent need of a thorough taxonomic revision.

In connection with a revision of the South African *Teloschistaceae*, the present writer has examined considerable material from all parts of the world. At present I do not propose to extend my studies to a world monograph, but some results of my revisions will be published under the above heading. In the following pages a new species is described from Central Africa and another species from N. America is reduced to synonymy.

1. *Xanthoria africana* n. sp.

Thallus foliaceus, adpressus, rosulas 1—2(—3) cm. latas, ± confluentes formans, irregulariter lobatus, flavo-aurantiacus.

Lobi marginales 2—3 mm. longi, 0.5—1(—1.5) mm. lati, discreti vel ± imbricati, non adscendentes; superne planiusculi vel ± foveolati, non rugosi, opaci, dense flavidopruinosi, apice rotundati, leviter crenulati, ± sinuato-incisi, lobulos 0.2—0.5 mm. latos formantes; subtus corticati, ad ambitum flavidi, nudi, centrum versus alboflavescentes, rhizinis albidis sparsis muniti.

Lobi centrales sorediis aurantiacis vel flavescentibus muniti. Soredia primum maculas superficiales ± bene limitatas, c. 0.3—0.4 mm. diam. formantes (non laterales, nec apicales), deinde ad stratum sorediosum cohaerentem confluentes. Granula sorediosa c. 0.06—0.08 mm. diam.

Cortex superior paraplectenchymaticus, 10—15 μ crassus, flavidus (granulis parietinicis inspersis), KOH purpureus.

Stratum gonidiale c. 30—40 μ. Gonidia protococcoidea (*Trebouxia*), rotundata, c. 10—15 μ diam.

Medulla c. 50—100 μ, e hyphis longis albidis, c. 3 μ crassis contexta.

Cortex inferior paraplectenchymaticus, 15—20 μ crassus, decolor vel granulis parietinicis paucis inspersus.

Apothecia et *pycnidia* ignota.

Distribution

Central Africa. Kenya. Prov. Nyanza. Kisumu-Londiani: Tinderet Forest Reserve, between Camp 6 and Equator, 0°,0′,37″ N, 35°,32′ E. On isolated *Podocarpus milanjianus*, on top of hill, exposed, alt. 3200 m. 28.7.1949 R. A. Maas Geesteranus no. 5585 (LD: holotype, isotype in L). Isotype material will be distributed in Almborn, Lichenes africani, Fasc. III. Known from the original collection only.

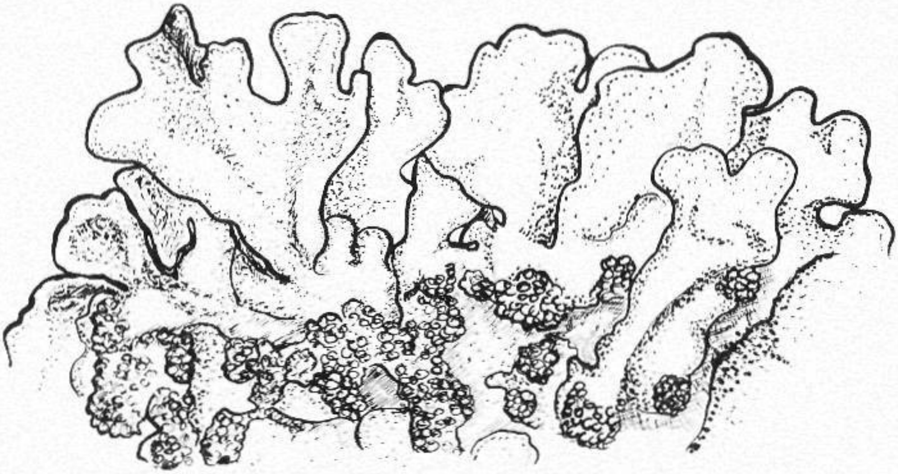

Fig. 1. *Xanthoria africana* Almb. The holotype. Part of thallus, 20×.

This conspicuous species resembles *X. parietina* (L.) Th. Fr., from which it differs in having soredia and lacking apothecia. As to size, form of lobes and interior anatomy, there are no essential differences. In many lichen genera, though not always, presence of soredia correlated with more or less absolute lack of apothecia is sufficient for specific segregation, even if there are no or few other distinguishing characters. *X. parietina* and *X. africana* constitute an analogue to several other pairs of species, one non-sorediate and fertile, the other sorediate (or isidiate) and, as a rule, sterile, *e.g., Xanthoria elegans* and *X. sorediata, Physcia pulverulenta* and *Ph. grisea, Cetraria juniperina* and *C. pinastri, Letharia californica* and *L. vulpina.* This problem was discussed in detail by Du Rietz 1924 a p. 386—391. Cf. also Lynge 1933 p. 12.

As emphasized by Du Rietz, some normally sorediate species can increase their production of soredia under the influence of ecological conditions (dust from roads etc.), so that they become quite abnormal in appearance. It is evident that such forms are modifications and should have no taxonomic rank. In the actual case, the material of *X. africana* was very rich and well developed. It had apparently grown under optimum conditions. It was very uniform and showed no transitions to *X. parietina.* The latter species was not collected at the same station.

In connection with my study of the South African *Xanthoriae*, I have

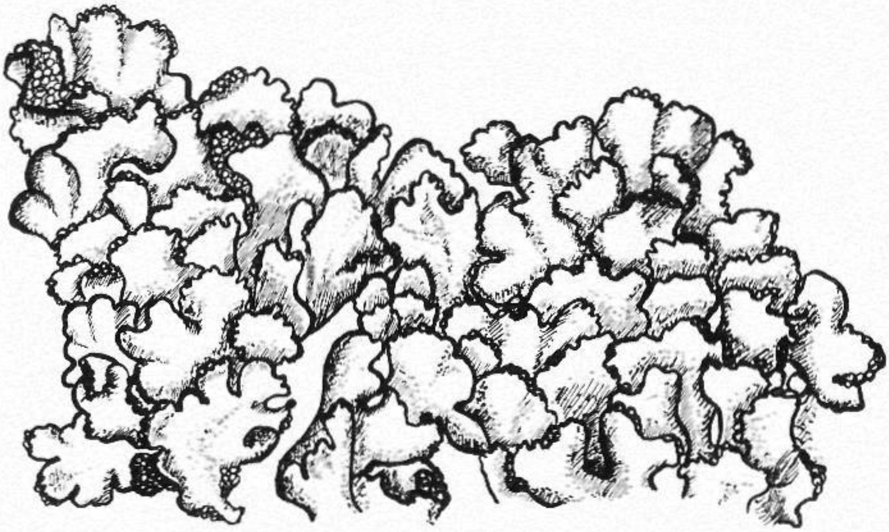

Fig. 2. *Xanthoria fallax* (Hepp) Arn. Part of thallus. 20×. From Kenya, Mt. Elgon. Hedberg no. 927.

examined hundreds of specimens of *X. parietina* from all parts of the world without finding any soredia.

The pruinosity of the marginal lobes, which gives a striking appearance to *X. africana,* is very rare in *X. parietina* (not reported from Europe or N. America). In the South African material, however, I have met with a few specimens of otherwise normal *X. parietina* (fertile, non-sorediate) with pruinose lobes. Hillmann (1922 b p. 313) described a species called *X. pruinosa* from the Cape. It is said to have thallus and apothecia covered with a whitish pruina. It is apparently identical to such forms of *X. parietina,* but as the type material in herb. Berlin was lost, no definite decision can be made.

Weber (1962 p. 317) discussed the taxonomic value of pruinosity mainly in crustose lichens (*Lecidea, Lecanora* and *Acarospora* spp.). He showed that this feature occurs widely in arid and calcareous districts and concluded that "pruinosity should be interpreted as a generally widespread response to environmental factors". This is no doubt true as a general rule and especially in the cases treated by Weber, though we must admit that the phenomenon can have a genetic background in other cases.

Physcia pulverulenta (non-sorediate, normally fertile) and *Ph. grisea* (sorediate, normally sterile) show a certain parallelism to *Xanthoria* *parietina* and *X. africana* also concerning pruinosity. *Ph. pulverulenta* often has, though not always, pruinose lobes, whereas *Ph. grisea,* as far as known, is constantly pruinose.

The genus *Xanthoria* plays no dominant part in the lichen flora of Africa. Sec. Maas Geesteranus (1955 p. 519 with map), *X. parietina* has an unequal distribution in Africa. From the whole of Central Africa it is reported from only 3 stations in Kenya, whereas it is better represented along the Mediterranean coast and in S. Africa. The saxicolous *X. elegans* is known from several districts, also from high levels, *e.g.,* Mt. Kilimanjaro in Tanganyika, alt. 4800 m. F. & R. Wettstein (W) (Zahlbruckner 1932 p. 268).

For comparison with *X. africana,* two sorediate *Xanthoria* species reported from Africa may be mentioned, *viz. X. fallax* and *X. candelaria,* which, however, are not closely related to *X. africana* and *X. parietina.*

X. fallax (Hepp) Arn. has smaller lobes (c. 1 mm broad), each divided into several lobules, plane, appressed or somewhat ascending, often deep orange red. Its soredia belong to quite another type than those of *X. africana.* They are apical—marginal or somewhat labriform, often developing lemon yellow soredial granules from the whole underside of the lobes. It is a widely distributed species at least in Europe and N. America. It is also known from the high mountains of Central Africa. I have seen it from:

Kenya. Teleki Valley, Camp No. 84 1893 J. W. Gregory (BM) — Mt. Elgon, in the crater (alpine region) on wood of giant *Senecio,* alt. 3970 m. 1948 O. Hedberg no. 927 (UPS).

Xanthoria candelaria (L.) Th. Fr.[1] comes near to *X. fallax* but is well delimited. It has a more fruticulose growth and, as a rule, a lemon yellow colour. Its lobes are narrower, coralloid and granular, developing apical—marginal soredia. It has a wide distribution, at least in Europe, N. and S. America, and is also known from the Mediterranean districts of Africa. Its occurrence in Central and Southern Africa is doubtful. At all events, the records from S. Africa refer to other species:

"*X. candelaria* f. *fibrillosa* Hillm." quoted from Namaqualand, leg. Marloth (Zahlbruckner 1926 b p. 547, Doidge 1950 p. 356), is *Candelaria concolor* sec. a specimen in W.

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[1] The combination is often quoted as (L.) Arnold (1879 p. 364). In fact, it was established already by Th. Fries (1861 p. 61). Though it is evident that Fries had *Candelaria concolor* in view ("ascis polysporis"), his combination must be applied to the *Xanthoria* species. Cf. the Code of Nomenclature, Art 55, Example f.

"*X. candelaria* var. *semigranularis* Zahlbr." (Doidge l.c.) was founded on *Teloschistes controversus* var. *semigranularis* described from the Transvaal by Müller Arg. (1887 p. 319). This lichen has, however, nothing to do with *X. candelaria.* Sec. the holotype in G it is a non-sorediate *Xanthoria* species. It will be discussed in my forthcoming paper on the South African *Xanthoriae.*

2. *Xanthoria oregana* Gyelnik

Gyelnik 1934 p. 284.

The short diagnosis runs: "Similis *X. candelariae* sed thallus rosulas perfectas maioresque formans, lobi latiores. — Habitu omnino *Xanthoriae parietinae,* sed thallus ad marginem granuloso-sorediosus".

The holotype (from U.S.A. Oregon: Corvallis, on maple 1932 leg. F. P. Sipe no. 654; herb. BP) has rather broad, ± plane, lemon-yellow, non-pruinose lobes. The soredia are formed from the margins of ± coralloid lobes, mainly in the centre of the thallus. The specimen is sterile. Undoubtedly Gyelnik's species comes within the normal variation of *X. candelaria.*

Gyelnik had earlier described a f. *aurantiaca* of *X. oregana* (1933 p. 33). The description runs "A typo (f. *citrina* Gyelnik n.f. — thallo citrino-flavo) differt thallo aurantiaco. — In valle fl. Irkut, gub. Irkutsk, ad corticem arborum, prope Tibilti (Elenkin, Lich. flor. Rossiae no. [80] sub *Xanthoria polycarpa* v. *lychnea.* Typus in mus. Budapest)".

Gyelnik did not publish a description of *X. oregana* in 1933. Thus the two forms, which were not mentioned in his paper of 1934 containing the diagnosis of the species, were never validly published. Cf. the Code of Nomenclature, Art. 43 and also Art 34: 5. The "f. *aurantiaca*" is a well developed *X. fallax* with broad lobes (sec. holotype in BP). It does not deserve any taxonomic rank under the latter species.

I wish to express my cordial thanks to Dr. R. A. Maas Geesteranus, Leiden, Dr. Rolf Santesson, Uppsala, and Dr. Clara Verseghy, Budapest, for placing material of *Xanthoria* at my disposal and to Miss Karin Nilsson, fil. kand., for drawing the figures.

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BOTANISKA NOTISER 1963 · VOL. 116 · FASC. 2 · LUND

Kromosomtal hos Hierochloë odorata i Skandinavien

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(Meddelande från Lunds Botaniska Museum, Nr 172)

Vid institutionen för systematisk botanik i Lund bedriver författaren undersökningar inom *Hierochloë odorata* (L.) Wg. (Gramineae) och närstående arter. Vissa preliminära resultat har redan erhållits.

Hos *Hierochloë odorata* och dess släktingar i Europa, Nordasien och Nordamerika har en polyploid serie med grundtalet 7 konstaterats. Publicerade uppgifter är sammanställda nedan.

2n	Art	Författare	Ursprung
14	australis	Vaarama (Tischler 1950)	
28	odorata	Kattermann 1932 (Tischler 1950)	
		Church (Myers 1947)	USA
		Nygren (Löve & Löve 1948)	
		Löve & Löve 1948	
		Löve & Löve 1956	Island
		Norstog 1960	USA
		Tutin (Löve & Löve 1961)	Storbritannien
42	odorata	Avdulov 1928, 1931	Ryssland
		Vaarama (Löve & Löve 1948)	
		Tateoka 1954 a, b	Japan
		Sokolovskaja 1960	Sachalin
	occidentalis	Church (Myers 1947)	USA
56	odorata	Church (Myers 1947)	USA
		Bowden 1960	Canada
		Norstog 1960	USA
	alpina	Flovik 1938, 1940	Spetsbergen
		Sørensen 1954	
		Tateoka 1954 a	Japan
		Sokolovskaja 1960	Sachalin
		Sokolovskaja & Strelkova 1960	Kolguevön
		Bowden 1960	Canada
63	orthantha	Sørensen 1954	Grönland

Hierochloë odorata tillhör ur växtgeografisk synpunkt (Hultén 1950) gruppen borealcirkumpolära, i Europa borealmontana växter med sammanhängande utbredning. *H. australis* tillhör gruppen osteuropeiska, kontinentala växter med anknytning till Skandinavien över Balticum. *H. alpina* tillhör gruppen cirkumpolära, arktiskt-montana växter vilka saknas i Mellaneuropas berg men har sammanhängande utbredning i norra Sibirien. *H. orthantha,* som är apomiktisk, har nyligen skilts ut ur *H. alpina.* Den förekommer på södra Grönland och i subarktiska östra Nordamerika. *H. occidentalis* förekommer i Kalifornien, Washington och Oregon.

Av de nämnda arterna förefaller *H. alpina* och *H. orthantha* bilda en från de andra väl skild artgrupp.

Vissa försök har gjorts att korrelera kromosomtalstyper med tidigare uppställda taxa av lägre rang. Kawano (1959) för *H. odorata* från Japan med $2n=42$ till var. *pubescens* Krylov. Hos Norstog (1960) föres *H. odorata* från bl.a. Michigan och Ohio (där han funnit den vara apomiktisk) med $2n=56$ till var. *fragrans* (Willd.) Richter, medan 28-kromosomigt material från bl.a. Connecticut och Europa benämnes var. *odorata.*

Sedan 1960 har levande plantor av *Hierochloë odorata* och närstående arter inskaffats för odling i Botaniska trädgården i Lund. Endast den del, som erhållits 1960 och 1961 och varav över hälften ställts till förfogande av O. Hedberg, M. Sonesson och H. Weimarck, har kromosomtalsbestämts, medan det 1962 erhållna materialet kommer att bearbetas 1963.

Följande bestämningar har gjorts:

Beteckning	Lokal	2n
AAS	Skåne, Kågeröd 15.6.61. 400 m NW kyrkan	28
AAT	Skåne, V. Sönnarslöv 15.6.61. Sluttning S Längstebäcken 50 m W landsvägsbro NW Klintarp	28
ADA	Härjedalen 7.8.60. Jelgatsåive, sluttningen mot Helags (OH)	28
ACX	Härjedalen 5.8.60. N-sluttningen av Vättafjället mot Fjällnäs, i trädgränsen (OH)	56
ACS	Härjedalen 19.6.60. Hamrafjället, S-sluttningen, nedre regio alpina (OH)	56
ACP	Ångermanland, Gottne 14.9.61. Gottne fäbodar (MS)	56
ACT	Torne lappmark, Jukkasjärvi s:n 10.7.61. Låktatjåkko ovanför Kopparåsen, regio subalpina (OH)	56
ACU	Torne lappmark, Jukkasjärvi s:n 10.7.61. Låktavagge, i övre delen av lågalpina bältet (OH)	56
AAH	Torne lappmark, Jukkasjärvi s:n 18.7.60. Ca 400 m S Låktatjåkka hpl. Gräshed ca 630 m	56

Beteckning	Lokal	2n
AAR	Torne lappmark, Jukkasjärvi s:n 22.7.60. E kanten av Kärkevagges mynning. Gräshed ca 730 m	56
ACG	Torne lappmark, Jukkasjärvi s:n .8.61. Kärkevagge, nära Slåttatjåkko (HW)	56
ACO	Torne lappmark, Jukkasjärvi s:n 22.8.61. 1 km SE Katterjokks hpl. I myrkant på hed av delvis snölegekaraktär (MS)	56
ABC	Lappland, Vittangi 7.7.61. 300 m E kyrkan, i strandkanten mellan Julkathenjärvi och landsvägen	56
ABF	Lappland, Vittangi 9.7.61. Vid NE stranden av Vittangiälven, Saarikoskis nederände ca 2 km uppströms sammanflödet med Torneälven	56
AAU	Finland 5.7.61. Nedre Saarikoski, intill E stranden av Könkämä älv	56

Två kollekter från Skåne och en från Härjedalen är alltså tetraploida. Övriga kollekter från Norrland samt den från Nordfinland är oktoploida. Såvitt författaren har sig bekant, är talet 2n=56 tidigare endast publicerat från den nordamerikanska kontinenten.

Tidigare har nämnts (Norstog 1960), att man velat hänföra material från Nordamerika med talet 2n=56 till *H. odorata* var. *fragrans*. Det vore därför tänkbart, att även den i Sverige förekommande 56-kromosomiga *H. odorata* tillhör var. *fragrans*, så mycket mer som Hartman (1849) uppger varieteten som iakttagen i Jämtland. Enligt Willdenows (1805) beskrivning karakteriseras var. *fragrans* av glatt mittblomma och i kanten icke borsthåriga blomfjäll av mycket mindre längd än skärmfjällen. Undersökta plantor med känt kromosomtal överensstämmer dock ej med denna beskrivning. Det oktoploida materialet i författarens undersökning tillhör tydligen inte var. *fragrans*.

Hartman (1849) beskriver en *H. odorata* var. *microstachya* med mindre småax. Värdet av denna enhet har betvivlats bl.a. av Hylander (1953). Någon korrelation mellan kromosomtal och skärmfjällens längd har inte heller kunnat skönjas i det tillgängliga materialet.

På det i fält pressade materialet från kollekter med känt kromosomtal mättes klyvöppningarnas längd. Plantor med 2n=56 har större klyvöppningar än sådana med 2n=28. Hos materialet finns en bred, väl definierad lucka mellan grupperna vid ca 45 µ. Vid en motsvarande mätning på 202 herbarieark, tillhandahållna av Naturhistoriska Riksmuseum, Stockholm, visade sig klyvöppningscellängden underskrida 45 µ hos flertalet plantor söder om en ungefärlig linje Strömstad—Askersund—Kalmar men överskrida detta mått hos flertalet plantor norr därom. I fjällkedjan samt i norra Norrlands inland förekommer dock en stor variation i cellängd, antydande att materialet här kan vara heterogent.

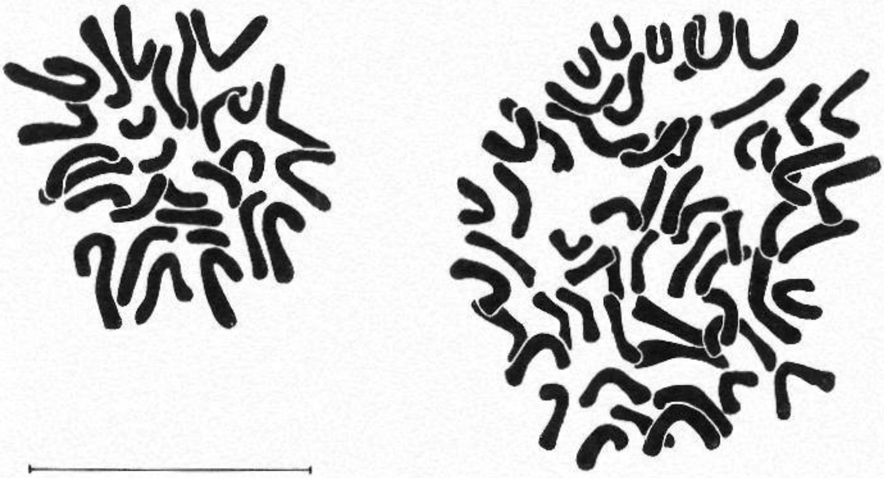

Fig. 1. *Hierochloë odorata.* Metafasplatta i rotspets av AAS 3^5, 2n=28 (t.v.) och av ACG 3^4, 2n=56 (t.h.). — Förbehandling +2°, 18 tim. Fixering i Navashin-Karpechenko, Svalövs modifikation. Snittjocklek 16 μ. Färgning i kristallviolett 15 tim. efter behandling i citronsyra 5 tim. Skala=10 μ.

En sådan geografiskt differentierad och med kromosomtalet korrelerad variation av klyvöppningscellernas längd gör existensen av kromosomtalstyper med skilda utbredningsområden i Sverige trolig. Fortsatta insamlingar och bearbetningar av material bedrives efter de riktlinjer, som dragits upp med ledning av hittills framkomna fakta.

Tillägg. — Ett antal kollekter, insamlade 1962 i Södermanland, Uppland och Dalarna, har nyligen visat sig ha kromosomtalet 2n=42. Närmare detaljer om utbredningen av denna för Sverige nya kromosomtalstyp är ännu inte bekanta.

Summary

The author presents preliminary results from an investigation on *Hierochloë odorata.* A polyploid series within the genus has been recorded in literature.

Attempts have been made previously to coordinate cytotypes with infraspecific taxa described before. A hexaploid Japanese material has been referred to *H. odorata* var. *pubescens* Krylov, octoploid material (which in Michigan and Ohio is found by Norstog to be apomictic) from North America has been referred to *H. odorata* var. *fragrans* (Willd.) Richter, and tetraploid material from the United States, Europe etc. to var. *odorata.*

A few collections from Sweden and northern Finland has in 1962 been investigated by the present author; most of them are octoploid, but two col-

lections from Scania and one from the southern part of the Scandinavian mountains are tetraploid. Records of octoploids within *Hierochloë odorata* from the Old World have not been published before.

The octoploid material from Scandinavia hitherto analyzed seems not to correspond to *H. odorata* var. *fragrans* in Willdenow's sense. No correlation between chromosome number and Hartman's var. *microstachya* has been found. An orientating study on the length of stomata makes the author presume the existence in Sweden of cytotypes with different distribution.

Recently, some collections from the eastern parts of Central Sweden have been found to be hexaploid. A more thorough investigation is not yet completed and will be continued on a broader basis.

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BOTANISKA NOTISER 1963 · VOL. 116 · FASC. 2 · LUND

Om blomning på "bar kvist"

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»Träd och buskar sägas blomma på 'bar kvist', när blomningen ss. hos al, alm, asp, hassel, sälg m.fl. äger rum före lövsprickningen», heter det i »Svensk uppslagsbok» 1929. För örterna synes den möjligheten här vara utesluten.

Blomning på bar kvist erbjuder växterna en exponering av blommorna utan störande inverkan av de först efter blomningen här utvecklade örtbladen. En dylik gynnsam utveckling av bladen först efter blomningen är dock ingalunda en allenast hos lignoserna förekommande företeelse. Vi behöva här blott erinra om örter sådana som *Petasites*-arterna och *Tussilago farfara* med sina som fjälliga stänglar utbildade blomskott och först efter blomningen utväxande, stora och breda rotblad samt den höstblommande tidlösan eller »nakna jungfrun», *Colchicum autumnale,* som först på våren året efter blomningen i samband med fruktsättningen utvecklar sitt bladverk. Erinras bör även i detta sammanhang om de båda *Equisetum*-arterna *arvense* och *telmateja* (*maximum*) med sina ogrenade, ± gulbruna floralskott och först senare utvecklade, gröna och kransgrenade rent vegetativa förökningsskott.

Såsom blommande på bar kvist uppgivas allmänt i de svenska託 florna *Populus*-arterna, ett flertal *Salix*-arter, *Myrica gale, Corylus*-arterna, *Alnus*-arterna, *Ulmus*-arterna, *Prunus spinosa, Daphne mezereum* och *Fraxinus excelsior,* samtliga lignoser. Avenboken, *Carpinus betulus,* blommar enl. Hartmans flora (XI uppl. 1879) på bar kvist, enl. Neumans flora (1901) och Lindmans flora (1918) samtidigt med lövsprickningen. Hos *Arctostaphylos alpina* slå blommorna enl. Hartman ofta ut något tidigare än bladen, enl. Neuman före ell. samtidigt med dessa.

Inom släktet *Salix* äro blomningsförhållandena i här berörda avseende i hög grad varierande. Såsom blommande på bar kvist äro främst att nämna *S. caprea, aurita* och *cinerea, S. starkeana* (*depressa*), *S. viminalis, S. repens* och *rosmarinifolia, S. purpurea, daphnoides* och *acutifolia*; till denna grupp ansluta sig närmast *S. myrsinifolia* (*nigricans*) och *S. phylicifolia*. Av fjällvidena synas *S. lanata* och *lapponum* oftast blomma på bar kvist; särskilt gäller detta ♂-buskarna, under det att ♀-individen ej sällan utveckla sina blomhängen mera samtidigt med bladen. Med dessa båda arter överensstämma ifråga om ♂- och ♀-blomningen närmast *S. arbuscula, glauca* och *myrsinites*. Hos flertalet fjällviden torde dock blomning och lövsprickning ske i det närmaste samtidigt. Såsom typiska representanter för en dylik blomutveckling synas bland fjällvidena främst vara att nämna *S. hastata, myrtilloides, reticulata, herbacea* och *polaris*. Mest påfallande framträder liktidighet i blom- och bladutveckling hos de sydliga pilarterna *S. alba* och *fragilis*. En från våra övriga *Salix*-arter helt avvikande typ är jolstern, *S. pentandra*, med bladen utvecklade före blomningen.

Björkarternas blomning kan väl närmast betecknas som samtidig med lövsprickningen. ♂-hängena visa dock här liksom hos en del *Salix*-arter tendens till blomning före bladens utveckling.

För familjen *Fagaceae* anger Neuman (1901) ♂-hängen och ♀-hängen »blommande på klädd kvist», varmed väl avses blomning först efter lövsprickningen. De vid blomningen m.el.m. »fullövade» bokarna utvisa ju också tydligt detta. Enligt Hartman (1879) har både bok och ek »samtidigt med bladen utslående blr».

Inom släktet *Prunus* möter såväl blomning på bar kvist som blomning samtidig med bladsprickningen och slutligen liksom hos *Salix*-släktet även blomning efter lövsprickningen, det sistnämnda hos hägg, *Prunus padus*. Av den på bar kvist i regel blommande slånbusken, *P. spinosa*, förekommer en i härvarande sammanhang särskilt anmärkningsvärd var. *coaetanea* Wimm., kännetecknad av »blomning samtidigt med bladen», ett blomningsförhållande som närmast utmärker såväl plommon (*P. domestica*) och krikon (*P. insititia*) som även körsbärsträden (*P. avium* o. *cerasus*).

Av våra lönnarter är den vanliga skogslönnen, *Acer platanoides*, den tidigast blommande med blomning samtidigt med den första begynnande lövsprickningen, hos naverlönn, *A. campestre*, och sykomorlönn (*A. pseudoplatanus*) liksom hos hästkastanjen (*Aesculus hippocastanum*) sker blomningen något senare efter lövsprickningen.

Ytterligare en svensk lignos, havtorn (*Hippophaë rhamnoides*), framvisar närmast blomning samtidig med lövsprickningen.

De på våren blommande *Pyrus*- och *Malus*-arterna blomma relat. tidigt efter lövsprickningen, hos *Sorbus*-arterna är bladutvecklingen påfallande längre kommen, då blomningen begynner. Våra senast blommande lövträd, lindarna (*Tilia*-arterna), börja sin blomning vid midsommartiden och ha då redan länge varit fullt lövade.

De flesta av våra buskar och risartade lignoser äro mer el. mindre fullständigt lövade före blomningen. Hos de tidigast vårblommande arterna, sådana som *Ribes*-arterna, gullregn (*Laburnum*), *Ulex* och *Cytisus*, ha dock bladen vid tiden för blomningen ej ännu på långt när nått sin slutliga storlek. Detsamma gäller i sin mån även de tidigast vårblommande skogsrisen, så främst *Vaccinium myrtillus* och *V. vitis idaea*; kråkbäret, *Empetrum* är kanske rent av trots sin vintergrönska att anse såsom blommande på »bar kvist».

De vintergröna barrträden pläga väl aldrig — på grund av sin vintergrönska — betecknas som blommande på »bar kvist». Då de såsom främst hos *Pinus*- och *Picea*-arterna slå ut sina blommor, innan de nya barren för året börjat nämnvärt utvecklas, borde väl dock även dessa rätteligen hänföras till de på »bar kvist» blommande arterna. Att de lövfällande *Larix*-arterna närmast äro att beteckna såsom sådana, torde utan vidare vara givet.

I de svenska tlororna söker man, då det gäller örterna, i regel förgäves efter uppgifter om blad- och blomutvecklingens förhållande inbördes. *Petasites*-arterna och *Tussilago* bilda ju dock, liksom *Colchicum* och de förut omnämnda båda *Equisetum*-arterna, här undantag, då man i deras här ifrågavarande blomningsförhållanden haft att göra med systematiskt viktiga särkaraktärer. Som ytterligare undantag äro här att nämna »*Pulsatilla*»-arterna: *Anemone pulsatilla, pratensis, patens* och *vernalis*. För *A. patens* uppgiver såväl Hartman (1879) som Neuman (1901) »först efter blomningen utvecklade rotblad» — vi kunna sålunda även här tala om blomning på »bar kvist». För *A. pulsatilla* och *pratensis* angives: »rotblad vid blomningen halft utvecklade» och för *A. vernalis*: »rotblad redan före blomningen utvecklade, fasta och öfvervintrande». Samtliga de tre sistnämnda *Anemone*-arterna torde dock rätteligen böra hänföras till samma grupp, vad blad- och blomutvecklingen beträffar. *A. vernalis* är vintergrön och de för året nya bladen begynna sin utveckling samtidigt med blommorna och äro vid tiden för blomningen — liksom hos *A. pulastilla* och *A. pratensis* — »halvt utvecklade» och, då de första blommorna slå ut, så föga framträdande, att man här frestas uppfatta blomningen såsom »på bar kvist». Av de förut behandlade lövträden komma de tre nämnda *Anemone*-arterna i här berörda blomningshänseende närmast den vanliga lönnen (*Acer platanoides*).

För de övriga i den svenska floran ingående örterna torde det ej kunna bliva tal om blomning på »bar kvist». Även de tidigare blommande vårarterna visa här en före blomningen inträdande bladutveckling. Hos det stora flertalet arter ha örtbladen rent av nått sin slutliga storlek redan före begynnande blomning. Några av de tidigast vårblommande örterna framvisa dock en mer el. mindre påfallande tillväxt hos framför allt basalbladen efter blomningen. Exempel härpå erbjuder lungörten, *Pulmonaria officinalis*, vars bladtillväxt särskilt uppmärksammas hos Hartman (1879, p. 79), där det i släktbeskrivningen heter »med slutl. större rotblad» och för arten *P. officinalis*: »rotbladen slutl. 3—4 tum långa, nära 2 tum breda».

Om förhållandet blom- och bladutveckling hos gräs och halvgräs synas knappast några som helst uppgifter föreligga. Det var de härutinnan avvikande förhållandena hos några av våra tidigast vårblommande *Carex*-arter, som först väckte mitt intresse för växternas blomning på »bar kvist». Under en följd av år fr.o.m. 1918 antecknade jag varje vår blomningsdata för de i Svalöfs-floran i Skåne ingående vårväxterna, och jag frapperades då alldeles särskilt av den, som jag i mina anteckningar formulerade det, på »bar kvist» blommande lundstarren, *Carex montana*. Vid blomningen äro här rosettbladen föga märkbara (jmf. fig. 1), och man kan här med allt skäl tala om »blomning på bar kvist». Under postflorationen utväxa rosettbladen starkt och nå slutligen upp över de efter blomningen avsevärt förlängda stråna. Närmast liknande blom- och bladutveckling möter hos de *C. montana* närstående, likaledes relat. tidigt vårblommande arterna *C. caryophyllea* och *C. ericetorum*. Den likaledes närstående men senare sommarblommande arten *C. pilulifera* har vid blomningen rosettbladen mer el. mindre fullständigt utväxta.

Även inom andra grupper av släktet *Carex* finna vi tidigt vårblommande arter med mer el. mindre fördröjd bladutveckling på gränsen till blomning på bar kvist. Då blomningstiden liksom för *C. montana* i frörorna uppgives »maj, juni» har man all anledning misstänka tidig blomning i förening med försenad bladutveckling. I den relat. långa raden av dylika möta, förutom de *Carex montana* närstående *C. tomentosa* och *C. pediformis*, de gruppen *Homostachyae* tillhörande arterna

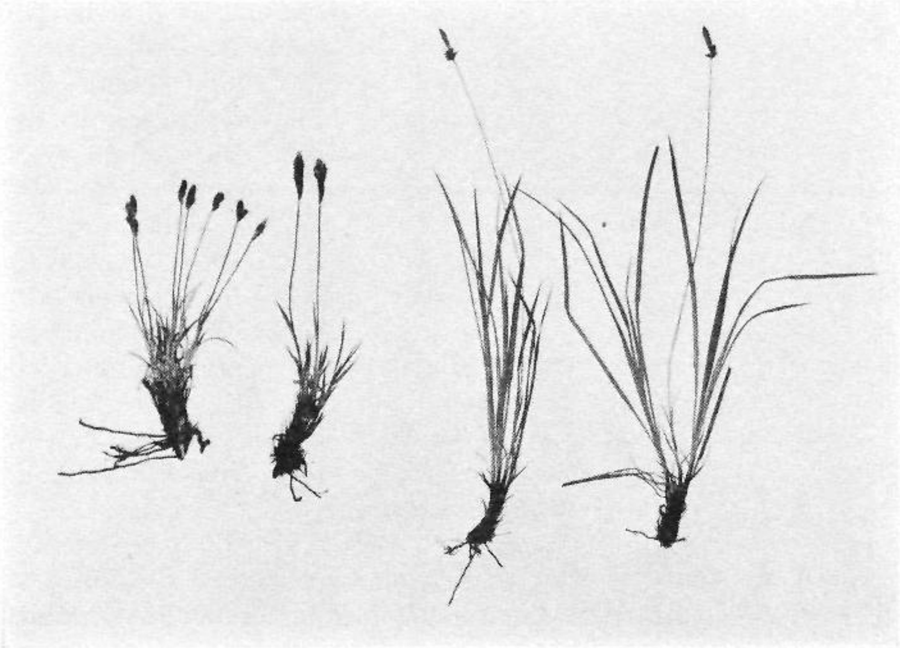

Fig. 1. *Carex montana* L. Sk. Ignaberga 21.5. (ex. t.v.) och 12.6.1930 (ex. t.h.) leg. R. von Steijern. Exemplaren d. 21.5. i föga framskridet blomningsstadium med ännu svagt utvecklade rosettblad, exemplaren t.h. i begynnande fruktstadium med c. dm-långa rosettblad. (C. 1/2.)

C. arenaria, C. disticha, C. paniculata, C. diandra (*teretiuscula*), *C. obtusata, C. pulicaris* och *C. dioeca.*

Anmärkningsvärt nog möter även inom gruppen *Carices distigmaticae* en närmast på »bar kvist» blommande art, den relat. tidigt vår-försommarblommande *C. caespitosa.* Åtminstone i Sydsverige inträder hos denna art den egentliga bladutvecklingen först efter blomningen. Vid tiden för blomningen ha bladanlagen ej ännu nått nämnvärd utveckling; senare under och efter fruktutbildningen utväxa rosettbladen till betydande längd och äro som fullvuxna ända till över halvmeterlånga. Den *C. caespitosa* närstående *C. elata* har rosett- och stjälkbladen vid tiden för blomningen korta och ännu långt ifrån fullt utväxta och kommer härvid den på »bar kvist» blommande *C. caespitosa* relat. nära.

På tal om »blomning på bar kvist» kommer givetvis även släktet *Eriophorum* med i diskussionen, främst så dess stängelförande tuvbildande arter. Det vanliga tuvdunet, *E. vaginatum,* ses ofta blomma redan i april månad, innan årets rosettblad ännu börjat visa sig. Till samma utvecklingstyp torde de båda *Trichophorum*-arterna *T. alpinum* och *T. caespitosum* närmast ansluta sig. De med bladig stjälk försedda *Eriophorum*-arterna, *E. angustifolium*, *E. latifolium* och *E. gracile*, utveckla sina örtblad samtidigt med eller något före den även här relat. tidigt på våren inträdande blomningen.

Även *Luzula*-arterna förtjäna i detta sammanhang omnämnas. Hos den tidigast vårblommande arten, vårfryle (*L. pilosa*), är örtbladsutvecklingen vid tiden för blomningens inträde så föga i ögonen fallande, att man här blir benägen tillgripa benämningen »blomning på bar kvist». Den något senare vårblommande *L. campestris* företer vid blomningen något mera utvecklade och framför allt grönare örtblad, vilka dock även här nå sin fulla utveckling först efter blomningen. Hos den avgjort ännu senare blommande *L. multiflora* är bladutvecklingen relat. långt framskriden redan vid blomningen.

Av gräsen, *Gramineae*, är det blott ett fåtal som i här berörda avseenden kunna bliva föremål för diskussion. Det gäller här några av de tidigast vårblommande perennerna. Den redan i april-maj blommande *Sesleria coerulea* har vid blomningens inträde ännu så svagt utvecklade bladanlag, att man här närmast torde kunna tala om blomning på »bar kvist». Av allt att döma gäller detta även den tidigt blommande *Stipa pennata*. Hos båda synes den egentliga bladutvecklingen inträda först efter blomningen. Likartat torde förhållandet vara hos den likaledes relat. tidigt vårblommande *Poa bulbosa*. De i maj blommande *Melica*-arterna *M. nutans* och *M. uniflora* med sina efter blomningen allt starkare utväxande blad torde ävenledes i detta sammanhang förtjäna omnämnas. Såsom »blommande på bar kvist» synes dock av samtliga våra gräs *Hierochloë odorata* (fig. 2) komma i första rummet. De enda blad, som här finnas vid blomningen, äro de ± förkrympta stråbladen; de efter blomningen till över halvmeterslängd utväxande basalbladen äro vid tiden för blomningen ännu ± fullständigt outvecklade. Samma blom-bladutvecklingstyp torde jämväl fjällmyskan, *Hirochloë alpina*, närmast anses tillhöra. De *Hierochloë*-arterna systematiskt närstående *Anthoxanthum*-arterna ha vid blomningen ännu ofullständigt utvecklade, först efter blomningen slutligt utväxande strå- och basalblad.

»Blomning på bar kvist» är enligt gängse diagnos förbehållen träd och buskar. Då en dylik blomning innebär blomutveckling på bladlöst stadium, är en sådan givetvis tänkbar jämväl hos icke lignoser. Ett

Fig. 2. *Hierochloë odorata* (L.) PB. Sk. Svalöf, Ekebo maj 1920 (ex. t.v.) och sept. 1928 (ex. t.h.) leg. N. Sylvén. Ex. t.v. ännu utan rosettblad, »blommande på bar kvist», ex. t.h. bladrosett på hösten. (C. $^{2}/_{5}$.)

flertal exempel härpå ha i det föregående anförts. Den biologiska betydelsen av en dylik blomning är givetvis också densamma för såväl lignoser som icke lignoser. Att för samtliga växter med först efter blomningen inträdande bladutveckling använda en och samma benämning har då mycket som talar för sig, och varför då icke den sedan gammalt välkända: »blomning på bar kvist».

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The Genus Borbonia L. Incorporated in Aspalathus L.

By ROLF DAHLGREN

(Meddelande från Lunds Botaniska Museum, Nr 173)

During the work on the revision of the genus *Aspalathus* (*Genisteae, Papilionaceae*) I have often noticed great similarities between certain species of this genus and some species hitherto treated in the much smaller genus *Borbonia,* similarly limited to South Africa. This genus has in the last 150 years been regarded as a distinct, easily defined genus, and no suggestions of a particularly great affinity to *Aspalathus* have been put forward. It has also hardly ever been placed next to *Aspalathus* (cp. Harvey 1862, pp. 27 and 94; Phillips 1951, pp. 403 and 407; Adamson & Salter 1950, pp. 462 and 472). The single leaves with distinct—prominent parallel veins are very characteristic of the genus and not found in other related genera.

However, a couple of species when studied more in detail turned out to be surprisingly similar to certain conventional *Aspalathi.* The similarities are not limited to particular parts, but practically every feature corresponds closely, and the only major difference is that the *Aspalathus* species referred to have trifoliolate and the former *Borbonia* species "simple" leaves. But also the "simple" leaf of some of the latter is in details ± similar to each of the leaflets of these conventional *Aspalathus* species, e.g., in the pattern of the veins, the minutely crenulate-tuberculate margins, and the trichomes, and it seems probable that the "single leaf" of the former *Borbonia* corresponds to one of the leaflets of the similar *Aspalathus* species.

We may suppose that at some time in the phylogeny a reduction in leaflet number has occurred, a case which is quite common in *Leguminosae*. From a morphological point of view this is also of interest as the leaves in many genera of the subtribe *Crotalariinae* with "simple" leaves (e.g., *Borbonia*) previously have been thought to be phyllodinous (cp. Bentham 1843, p. 456, and 1848, p. 585).

Borbonia (the name given after Gaston Bourbon, Duke of Orleans) was not originally used for plants belonging to *Leguminosae*. Plumier described a genus with that name already in 1703 (p. 3). Linnaeus, who readopted the name in the "Appendix" of his Hortus Cliffortianus (L. 1737, p. 494), used the name in a different sense. He concluded that, as Plumier's name was used for laurels, it was appropriate to transfer the name to a not yet named genus of evergreen plants, viz., that considered here. Two species were treated: "*BORBONIA foliis cordatis acuminatis integerrimis multinerviis*" and "*BORBONIA foliis lanceolatis acuminatis trinerviis*". These later on in Species Plantarum (L. 1753, p. 707) bore the names *Borbonia cordata* and *trinervia* respectively. However, the latter was based mainly on an imperfect specimen of *Cliffortia ruscifolia* L. [cp. Bentham 1843, p. 460; this may explain the surprising statement in Genera Plantarum, 2nd ed. (L. 1742, p. 345) about the pod: "*Legumen subrotundum*"].

Borbonia was revivified in the original sense, as used by Plumier, by Adanson in his "Familles des Plants" (1763, p. 341), where *Borbonia* after Linnaeus's sense was treated as the genus *Bootia* Adans. (non Neck., nec Bigel.), a name under which fortunately no further species were treated. However, several species belonging to diverse genera of *Lauraceae* were later treated as "*Borbonia*" (Gaertner 1805—07; Presl 1846; House 1922).

In Species Plantarum 5 species were included, 3 of which were finally accepted as *Borbonia* species (*lanceolata, cordata, crenata*). Lamarck (1783, pp. 436—438) and Thunberg (1800, p. 122; 1811) soon described several new ones. However, in the early days also some *Priestleya* species were treated in *Borbonia*.

De Candolle (1825, p. 120) accepted as many as 11 species in the genus. Among the plants collected by Ecklon & Zeyher (E. & Z. 1836, pp. 163—164) 12 species were distinguished, and among those collected by Drège and published in Meyer 1836 (pp. 15—17) there were 10 species. Naturally several of the names in the mentioned publications were synonyms and later included under other species. In the revision made by Bentham 1843 (pp. 460—463) 12 species were accepted, and Harvey who treated the genus in Flora Capensis (vol. II, 1862, pp. 27—31) rather closely followed Bentham's treatment and accepted 13.

In 1920 *Borbonia* was revised by Phillips. All the species in Flora Capensis (Harvey 1862) were accepted without further change than the promotion of a variety to species and the establishment of two more species, whereby the species became 16 in number. The cause of this slight change hardly depended on the perfectness of previous works, and much remains to be cleared up. For example, "*Borbonia villosa* Harv." is a later homonym of *B. villosa* Thunb. and "*B. trinervia* Thunb." an incorrect interpretation of *B. trinervia* L.; both the older homonyms were based on plants outside the genus.

It seems as if 13 species deserve recognition. At present a few nomenclatural problems remain to be solved, and the present article is intended only as a preliminary report. The new combinations and names necessary to establish

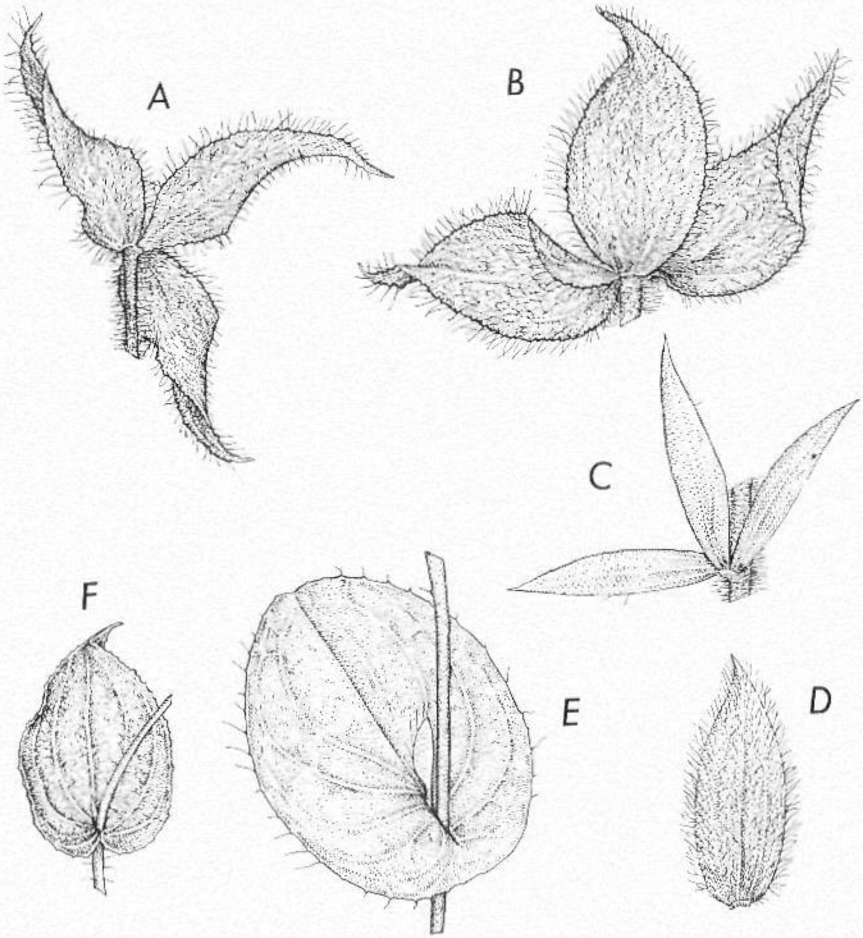

Fig. 1. Comparison of leaves. — A—B: *Aspalathus latifolia* Bol. (Peterson & Dahlgren no. 987). — C: *A. lanata* E. Mey. (Peterson & Dahlgren no. 984). — D: *A. lanifera* R. Dahlgr. (Acocks no. 19879). — E: *A. perforata* (Thunb.) R. Dahlgr. (Esterhuysen no. 21080). -- F: *A. commutata* (Vog.) R. Dahlgr. (Esterhuysen no. 18450). — (All ×2.5.)

due to a revision of the species and their inclusion in *Aspalathus* will be published in a coming paper.

Only a few species of *Aspalathus* (in the limited hitherto accepted sense) and of the former *Borbonia* will be compared here. The former, *A. lanata* E. Mey. and *latifolia* Bol. represent "the *A. lanata* group" treated in Dahlgren 1960, p. 335. The former *Borbonia* species in order to be commented had to be renamed. The indispensable new combinations and descriptions are found at the end of the article.

The plants are all woody shrublets. The branches are often (sometimes very sparsely) furnished with long spreading hairs. The inflorescences are sometimes sparse racemes but commonly consist of a single flower. The branching mode on both sides of the previous generic border often tends to be sympodial, as a branch, developed in the axil of the uppermost vegetative leaf below the inflorescence, is favoured in growth and often pushes the terminal inflorescence aside so that this appears ± lateral (cp. figure 3, and Dahlgren 1960, figures 118—120).

A. latifolia and *lanata* having trifoliolate leaves (figure 1 A—C) were from the beginning treated in *Aspalathus*. Figure 1 D—F represent leaves of species hitherto treated in *Borbonia*. It is seen that the veins of the laminas are longitudinal and ± parallel to the margins or middle line in both cases, that the leaves of both kinds may be covered by long hairs, and that especially the margins are often covered with minor tubercles (consisting of several cells) in the middle of which a trichome emerges. This is valid for, e.g., *A. latifolia* (figure 1 A—B) as well as *A. perforata* (Thunb.) R. Dahlgr. (=*Borbonia perforata* Thunb.) (figure 1 E). The leaf of *A. lanifera* R. Dahlgr. (=*Borbonia villosa* Harv., non Thunb.) (figure 1 D) greatly resembles one of the laminas in, e.g., *A. latifolia*. In *A. commutata* (Vog.) R. Dahlgr. (=*Borbonia undulata* Thunb., *B. commutata* Vog.) the margins are covered with short rigid tubercles consisting of lateral processes from the outer veins running in the very margins of the leaf. In other forms these processes are considerably longer. Trilobate leaves have never been seen, nor any with two or considerably unequal folioles. It is supposed that the simple leaves of the former *Borbonia* are homologous to one of the leaflets of the trifoliolate leaves.

In spite of the conspicuous difference in the leaf, *A. commutata* in floral characters greatly resembles *A. lanata* (figure 2). Also the flowers of *A. lanifera* (figure 3) are very similar to those of, e.g., *A. lanata,* and in extreme cases these species may be very similar (although the leaves always differ in the number of laminas). The illustrations of the flowers, the ala and carina petals, and the pistils of the two former species make it perfectly clear that these must be closely related and should be treated in the same genus. Differences, such as the degree of pubescence and the length of calyx lobes are of little significance; within *A. lanata* and *commutata* the variation is great in these respects. Also the pods of, e.g., *A. latifolia* and *commutata* (figure 2 I—J) are quite similar.

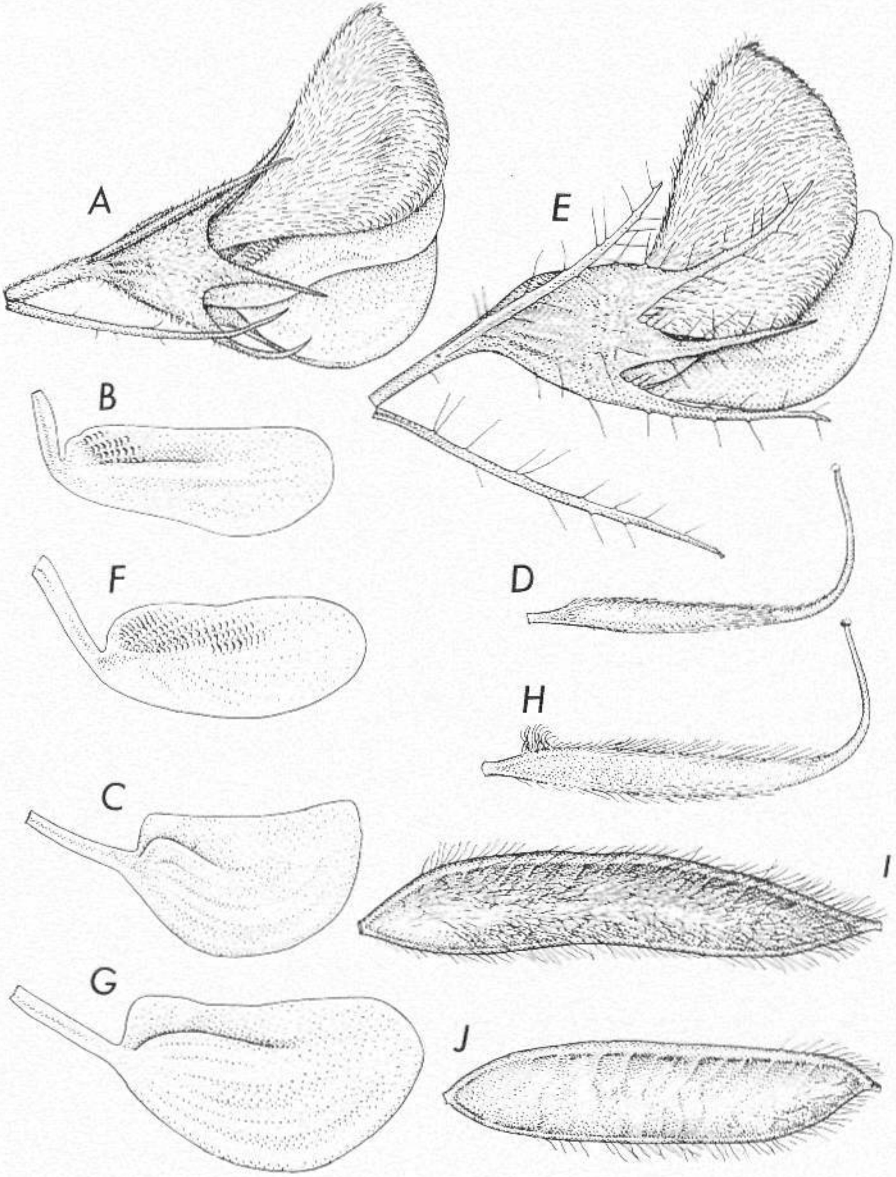

Fig. 2. Comparison of flowers and pods. — A—D: *Aspalathus lanata* E. Mey. (Peterson & Dahlgren no. 984). E—H and J: *A. commutata* (Vog.) R. Dahlgr. (E—H: Esterhuysen no. 15161; J: Esterhuysen no. 18450). I: *A. latifolia* Bol. (Peterson & Dahlgren no. 987). — A and E: Flowers. — B and F: Ala petals. — C and G: Carina petals. — D and H: Pistils. — I and J: Pods. — (A—H ×5; I—J ×2.5.)

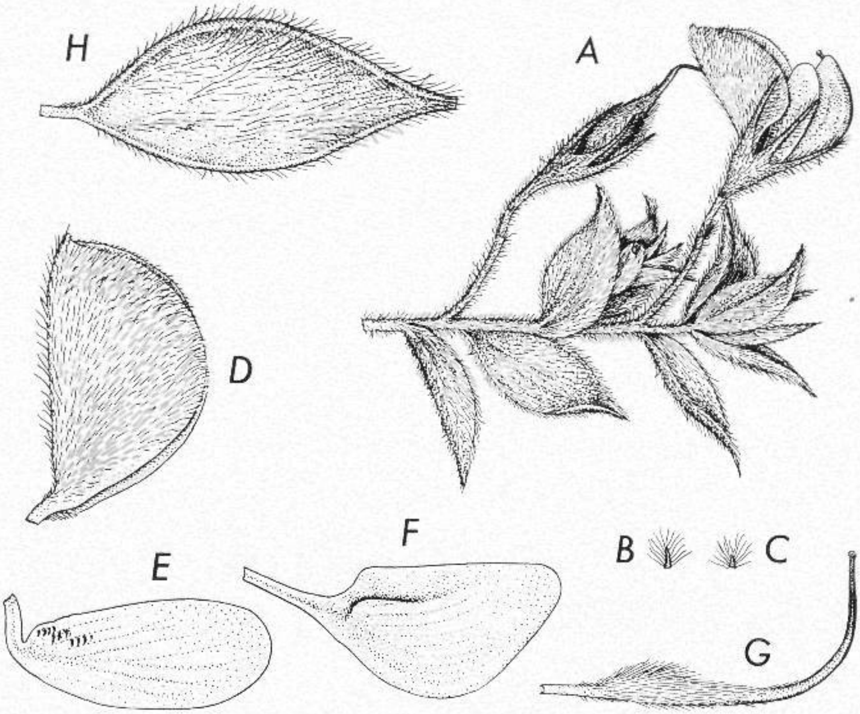

Fig. 3. *Aspalathus lanifera* R. Dahlgr.; Esterhuysen no. 19826. — A: Part of branch; notice the sympodial branching system. — B: Bract. — C: Bracteole. — D: Vexillum. — E: Ala petal. — F: Carina petal. — G: Pistil (in this specimen with 2 ovules). — H: Pod. — (A ×2.5; B—H ×5.)

It is regrettable for several reasons that *Borbonia* L. has to disappear as a genus; not because the admired G. Bourbon may risk falling into oblivion, but because the genus has long since been wellknown by the quite characteristic appearance, especially with respect to the leaves, and now, as merely a part (not even a subgenus) of *Aspalathus* it will lack a proper designation. In addition *Aspalathus*, already previously a large genus, by the addition of the former *Borbonia* becomes even less perspicuous. However, the consequences of the above must necessarily result in the inclusion.

New species, names, and combinations

Aspalathus lanifera R. Dahlgr. sp. nov. — [=*Borbonia villosa* Harvey 1862, p. 28, non Thunberg 1823, p. 560.] — Fruticulus prostratus, tegetiformis, ramis ad > 50 cm longis, plerumque rubrifuscis, longe lanatis. Folia simplicia, plana, anguste ovata, elliptica, vel lanceolata, c. 7—18×2.5—8 mm, acuminata, flexilia, sparse (vel supra plerumque dense) et longe lanata, indistincte nervosa (vel subtus ± distincte trinervia). Inflorescentia uniflora (raro 2—3-flora et sparse racemulosa), pedunculata, terminalis. Pedunculus plerumque 5—20 (—30) mm longus, sparse lanatus. Pedicelli plerumque 2—7 mm longi, sparse lanati. Bracteae et bracteolae triangulares—lineares, ciliatae. Tubus calycis infundibuliformis, lanatus; lobi lineares, 3—5.5 mm longi, flexiles, acuminati, villosi. Petala flava, vel in parte violacea. Lamina vexilli late obovata, (5.5—) 7.0—9.7×(6.5—)7.5—11 mm, dorso breviter tomentella. Laminae alarum (4.6—)6.0—7.3×2.1—2.9 mm, glabrae. Laminae carinae lunatae, c. (5.3—) 5.9—6.7×3.1—4.1 mm, glabrae. Ovarium et basis styli pilosa, ovula 2—4. Legumen lanceolatum—falciforme, c. 10—15×c. 4 mm, sparse lanatum. — Coll. orig.: Esterhuysen 19826: Sneeuwgat prope Tulbagh (BOL; LD, holotypus; NBG). — Icon.: Fig. 3.

Aspalathus commutata (Vog.) R. Dahlgr. comb. nov. — *Borbonia commutata* Vogel 1836, p. 596. — [=*Borbonia undulata* Thunberg 1800; this name cannot be transferred to *Aspalathus*, as there is already an *A. undulata* Eckl. & Zeyh. (=*A. fasciculata* (Thunb.) Druce).] — Coll. orig.: "*Borbonia commutata* Vogel — C. b. sp. — M. & M." (Mund & Maire) (K, neotypus).

Aspalathus perforata (Thunb.) R. Dahlgr. comb. nov. — *Borbonia perforata* Thunberg 1800, p. 122. — Coll. orig.: Thunberg: "*Borbonia perforata*" (LD; UPS, lectotypus).

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Chromosome Numbers in the Calenduleae I.

With discussions on relationships, hybridization, and phytogeography

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Within the tribe *Calenduleae* only the Mediterranean genus *Calendula* has as yet been the subject of a fairly thorough cytological investigation. Of the rest, apparently only two *Dimorphotheca* species and two reliably determined *Osteospermum* species are included in publications on chromosome numbers. The *Dimorphotheca* species I have in mind are *D. pluvialis* (L.) Mnch and *D. sinuata* DC., annual ornamental plants from South Africa, which are cultivated in Eurasia, as well as in North America, even far to the north, and the *Osteospermum* species referred to are *O. Ecklonis* (DC.) T. Norl., also a decorative plant from South Africa, and *O. Vaillantii* (Decne) T. Norl., a northern hemisphere plant belonging to the subgenus *Tripteris*, for which species the distribution area extends from northern Tanganyika and Uganda as far as the Mediterranean, viz. Mt. Sinai and Mt. Petra in Transjordania.

In 1950 I decided to extend my investigations on the genera of the tribe *Calenduleae* (Norlindh 1943 and 1946, etc.)[1] to include also their cytology and embryology. It has taken me a long time to obtain a representative selection of species from the different genera and their different subgenera and sections for cultivation in the Botanical Gardens of the University of Lund, where I have carried out my main investigations on these plants. However, almost every year I have received viable seed, or cuttings, of one or a few species which I did not previously have in cultivation. In all, I have during these years succeeded in obtaining quite a large number of species belonging to this tribe. The

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[1] In the references to my treatises "Studies in the Calenduleae" I and II I have used the shortest possible designations, namely a Roman one (I) and two (II).

breeding experiments with some of these species have proved to be fairly difficult and requiring great patience. Voucher specimens of all species investigated are preserved in the Botanical Museum of the University of Lund.

This report is the first in a proposed series dealing with the chromosome numbers in the tribe *Calenduleae*, the gene centre of which is situated in South Africa.

Methods

For the cytological investigations fixations were at first made of root tips. In those cases where the chromosome number has proved to be high, flower buds have been fixed also. The root tips were fixed in Nawashin-Karpechenko's medium. In most cases the root tips were taken from seed which had germinated on filter-paper under a belljar. However, this method has not always proved to be favourable, because in some species, e.g. *Osteospermum clandestinum* (Less.) T. Norl. and *O. hyoseroides* (DC.) T. Norl. the wall of the achenes becomes mucilaginous when the fruits are sown on moist filter-paper, and the result of the germination is very unsatisfactory. In such cases the seed was sown in pots and the root tips were then selected from the clean roots which had reached the wall of the pot. The root tips were stained in gentian-violet. After pretreatment in Carnoy's solution the buds were fixed in Nawashin-Karpechenko's medium and were later stained in Feulgen's fuchsine.

The chromosomes of many species are unusually long, and on study of the slides, the chromosomes have often proved to be more or less bent and partly covering each other, thus an exact count, using root tip sections, was found to be extremely difficult. This is of course particularly the case with species having a high number of chromosomes. During the first years of research, the root tips were fixed without previous cooling of the plant when making slides. However, when fixing root tips during the last few years the method of cooling the plant has been used in order to cause contraction of the long chromosomes so that these will be more easily distinguished and counted. The drawings of chromosome figures have been prepared with the aid of a camera lucida.

Dimorphotheca Vaill. ex Mnch

I, pp. 32, 38—76. — II, pp. 483, 497, 498, 503. — T. Norlindh, Bot. Notiser 1957, vol. 110, pp. 141—150.

Basic numbers 9, 10.

The South African *Dimorphotheca* has here been understood in its narrowest sense, viz. that which I have indicated in my monograph on this genus. In horticulture it is represented by two fairly well known species, *D. pluvialis* (L.) Mnch and *D. sinuata* DC. These were cytologically investigated already in 1934 by Harrison in garden material (without known locality) when he counted the number of chromosomes in both as 2n=18. However, the material of the latter species, on which Harrison based his investigations, was not named *D. sinuata*, but was determined partly as "*D. aurantiaca*", partly as *D. pseudoaurantiaca*, and he published the chromosome number for each of these plants thinking that they were different species. These two names, which often occur in seedman's lists and garden literature, I have found to be synonyms of *D. sinuata* (1, pp. 56, 61). The true *Dimorphotheca aurantiaca* DC. (non Hort.), which is a shrub or undershrub with the chromosome number 2n=20, has proved to be a synonym of *Castalis tragus* (Ait.) T. Norl. Not until 1951 is the valid name *Dimorphotheca sinuata* found in a chromosome list with the count 2n=18 made by Bilquez.

According to my own experience from the breeding experiments of many years, *Dimorphotheca pluvialis* and *D. sinuata* form hybrids quite easily, when they grow together in gardens. However, in their native country, the distribution areas overlap only to a small degree and spontaneous hybrids are only rarely formed there (I, Maps 1 and 2, p. 404). Hitherto hybrids are known only from the Piquetberg, Clanwilliam and Van Rhynsdorp districts.

Harrison counted the chromosomes of one more ornamental plant, described as *Dimorphotheca*, viz. *D. Ecklonis* DC., and he found in it the number 2n=20. In the middle of the 1930's I received from the Botanical Gardens of Copenhagen cuttings of *D. Ecklonis* which I have had in cultivation since then. As it always proves to have ♀-sterile disc florets and the style shape closely agreeing with that in *Osteospermum*, I transferred it in 1943 from the genus *Dimorphotheca* to *Osteospermum* (I, pp. 244—246). Already when De Candolle established it as a species he was so uncertain where to place it that he put a question-mark for the genus and remarked that the capitulum was almost as in *D. pluvialis* but the fruits almost as in *Osteospermum*. In fact, this shrub or undershrub, about one metre high, has not much similarity with the small, annual *D. pluvialis*, except for the colour of the flowers. Further, they differ regarding the chromosome number, the basic number of the former being 10, and that of the latter 9.

De Candolle based on his *D. Ecklonis* a new section which he called *Osteospermopsis*, and in conjunction with his description of this section he pointed out that it perhaps has a closer affinity to *Osteospermum* than to *Dimorphotheca* but that the flowers in all *Osteospermum* species are yellow. Contrary to De Candolle, I do not consider the colour of the flowers to be decisive when delimiting the genera *Dimorphotheca* and *Osteospermum* from each other. The white- and blue-flowered type species of the genus *Dimorphotheca, D. pluvialis,* and its yellow-flowered sister-species *D. sinuata,* which have equal chromosome numbers, are from the genetical and morphological points of view so closely allied to each other that they easily form hybrids. As the genus *Dimorphotheca* is allowed by De Candolle and others to comprise white- and blue-flowered as well as yellow-flowered species (I, pp. 43—44) it is a logical consequence that the closely allied genus *Osteospermum* may also comprise species with a different flower colour. The organs of fructification present good characters. However, the flower colour is a less essential character and in this case it is not useful for distinguishing genera.

Several of the species described as *Dimorphotheca* which proved to have ♀-sterile disc florets with fructification organs of a more or less pronounced *Osteospermum* type, were transferred in 1943 by me to this genus in spite of their ray florets being normally non-yellow, viz. species belonging to the sections *Acanthotheca* and *Blaxium* (I, pp. 191 and 237). As to the chromosome number, *Osteospermum Ecklonis* agrees with the type species of sect. *Blaxium, O. fruticosum,* and also regarding other characters it is so closely allied to the species of the latter section that I consider it justified to place it there.

As to the identity of the plant named "*Dimorphotheca Barberiae*" in which Pienaar counted the chromosome number 2n=38—40 (Darlington and Wylie 1955) I wish to refer the reader to the treatment of sect. *Blaxium* of *Osteospermum* (p. 202).

Dimorphotheca montana T. Norl. s. lat. is a widely distributed and variable species (Norlindh 1957). According to herbarium labels the specimens of this perennial herb are decumbent with stems rooting at nodes and widely spreading from the rootstock, forming ± circular prostrate mats, with a diameter of about one metre. The ray achenes are more or less distinctly 3-winged as are those in *Dimorphotheca chrysanthemifolia* (Vent.) DC. of sect. *Arnoldia* (Cass.) DC. *Dimorphotheca montana,* like the former species, holds an isolated position in the genus and deserves to be treated as a section of its own, but I do not wish to describe a new section *Montanae* in this paper, because I intend to publish a revision of the whole genus soon. It shows a clear affinity to *Castalis nudicaulis* (see p. 199).

As to the shape of leaves and the colour of ray florets *Dimorphotheca montana* varies considerably. However, it is more surprising that also

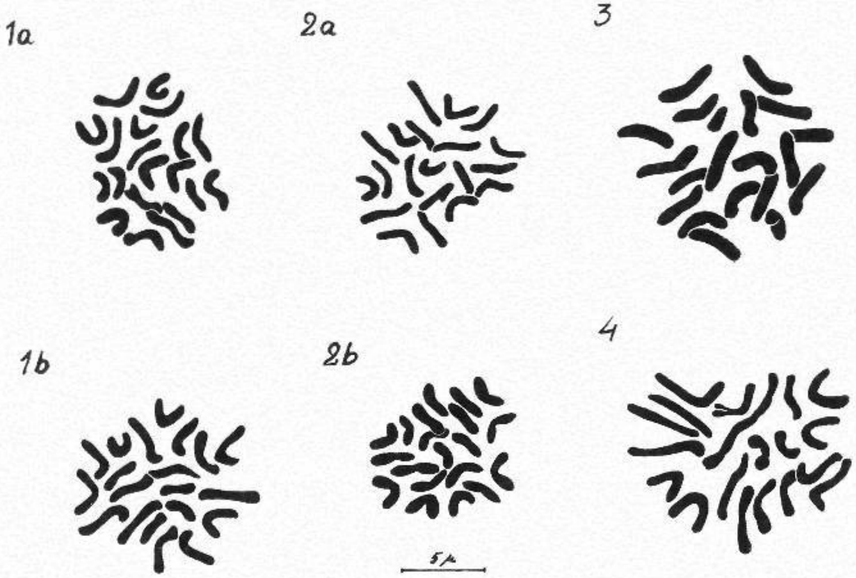

Fig. 1—4. Mitosis in root tips. — Fig. 1 *a, b. Dimorphotheca montana* var. *hortensis* T. Norl. in sched., $2n=20$. — Fig. 2 *a, b. Castalis tragus* (Ait.) T. Norl. s. str., $2n=20$. — Fig. 3. *Castalis spectabilis* (Schltr) T. Norl., $2n=20$. — Fig. 4. *Castalis nudicaulis* (L.) T. Norl. s. str., $2n=20$.

the 3-winged ray achenes vary. The margins of the wings are, namely, not always entire but may be more or less lobated or divided.

In 1958 I received from Captain Hitchcock of Brighton cuttings of an unnamed *Dimorphotheca* species, seed of which had been sent to horticulturists in England by Miss Stanford of Stellenbosch. It throve well in the Botanical Gardens of Lund, and when growing in the open during the summer it developed several almost one metre long trailing stems from the collar of the root. In the autumn the branching stems with their fairly dense foliage had formed a tightly woven mat. The plant produced many heads having deep wine-red rays with glistening bronze reverses, and a few ray and disc achenes. When the plant was fertile I was able to identify it as a variety of *Dimorphotheca montana,* closely allied to var. *venusta* (Norlindh 1957, p. 147) but differing from it in having only slightly winged ray achenes. No doubt it originates from one of the higher mountains in the Cape region. This beautiful horticultural plant distributed from Miss Stanford's Garden of Stellenbosch has been called by me var. *hortensis*. The chromosome number of this variety is $2n=20$ (Fig. 1 *a, b*).

In the *Dimorphotheca montana* complex there are other taxa with a considerably higher chromosome number, viz. var. *amoena* and var. *venusta*. Miss Elsie Esterhuysen kindly sent me viable seed of these varieties from their natural habitats in the Worcester District. Specimens raised from these seeds seem to have chromosome numbers about twice as high as in var. *hortensis*.

Castalis Cass.

I, pp. 32, 77, 81.

Basic number 10.

No species of this small genus, which differs from all other genera in the tribe *Calenduleae* by having sterile ray florets, has been cytologically investigated earlier. However, I have succeded in obtaining living material of all three species.

Professor Rycroft of the National Botanic Garden of South Africa, Kirstenbosch, kindly sent me in 1957 viable seed of the type species of the genus, *Castalis tragus* (Ait.) T. Norl. (syn.: *Castalis Ventenati* Cass.). From these I raised several specimens which developed as sparingly branched shrubs with a lignified stem. At flowering stage this stem was about 1.2 m high and, without support, it seemed to stay upright only with difficulty. My specimens of this plant are becoming so strongly lignified that it must rather be designated a shrub or undershrub than a perennial herb, as I wrote in my monograph. The flowering heads are large, up to 9 cm diam. when fully expanded, orange-coloured and very showy. *Castalis tragus*, which has its distribution centre in the Namaqua region, is somewhat xerophytic and has glaucous, somewhat succulent leaves. A somatic number of 20 was found (Fig. 2 *a*, *b*).

Castalis spectabilis (Schltr) T. Norl. has been raised from seed which I obtained in 1955 from the Botanical Reserve at Brummeria, Pretoria (coll. O. A. Leistner). This perennial herb, with stems rising from a strongly lignified subterranean caudex and beautiful mauve flower heads, up to 7 cm in diam., has so far only been found in the Transvaal, where it grows mainly in the central and south-eastern part. As the species is very difficult to cultivate in greenhouses, no flower buds could be obtained for embryological investigation. However, the seed germinated quite well and I obtained good material of root tips for cytological investigation. The chromosome number proved to be $2n=20$ (Fig. 3), just as in the former species.

Castalis nudicaulis (L.) T. Norl. differs considerably from the two other species of the genus and it shows a clear affinity to the *Dimorphotheca montana* complex. No doubt *C. nudicaulis* has differentiated during a relatively late period from the genus *Dimorphotheca* by reduction of the pistils of the ray florets, which have become sterile.

In 1954 I received from Professor Jordaan viable seed of *Castalis nudicaulis* s. str. (syn.: var. *latifolia* Harv.) from Jan Marais Park in Stellenbosch (STE 681). The plants raised from this seed thrive well in the greenhouses. The chromosome number was counted as 2n=20 (Fig. 4).

Osteospermum L.

I, pp. 33, 98. — T. Norlindh: Further contributions to the genus Osteospermum, in Svensk Bot. Tidskr. Bd 48 (1954), pp. 148—154. — T. Norlindh: Additions to the Monograph on Osteospermum, in Bot. Notiser, Vol. 113 (1960), pp. 385—399.

Basic numbers 8, 9, 10, 12(?).

The cytology of the genus *Osteospermum* has hitherto been almost unknown. Only two reliably determined species, apportioned to two of the sixteen sections of the genus, viz. *Blaxium* (Cass.) T. Norl. and *Tripteris* (*Trifenestrata* T. Norl.), have earlier been subject to cytological investigations.

During the last decade I have received for my investigations viable seed and cuttings of many taxa belonging to this large genus which, however, must still be regarded from the cytological point of view as insufficiently known. As it has proved difficult to settle with certainty the chromosome numbers in certain *Osteospermum* species, viz. such having long and numerous chromosomes, I have for the present postponed their publication. When after using the method of cooling the plants, new slides have been made, it will probably be possible to count their chromosome number exactly.

Subgenus *Osteospermum* (Euosteospermum T. Norl.)

I, pp. 99—100, 116—118.

For my cytological investigations of this large subgenus, comprising 12 sections with 43 species in all, I have unfortunately only succeeded in obtaining 7 species, distributed on three sections. Not less than four of these species belong to the section *Blaxium* which holds such an isolated position in the genus that it may rather be questioned, whether it ought to be raised to the rank of a subgenus and thus be placed on a par with the subgenera *Osteospermum* and *Tripteris*. However, before probably changing the rank of *Blaxium* I will wait for the result of my embryological investigations of one more species in this taxon.

Sect. 8. ***Xenismia*** (DC.) T. Norl. — I, p. 180.

O. muricatum E. Mey. ex DC., a bicentric species with the most extensive distribution (I, Map. p. 411) of all taxa in the genus belongs to this section. Between its two centra there is a gap in distribution of almost 4000 km. From the species population in its northern area, British Somaliland and Yemen, I have, unfortunately, not yet received any living material. However, I have during many years been able to cultivate a couple of *O. muricatum* collections from its large southern distribution area, viz. from an unspecified locality in the Transvaal and from Besner Kobila, Matopos, in Southern Rhodesia (Miller, n. 1737). On counting the chromosomes there has proved to be a number of 2n=18 (Fig. 5) in the biotypes from these two localities.

Sect. 11. ***Osteospermum*** (Spinosa T. Norl.) — I, p. 218.

As the type species of the genus *Osteospermum*, *O. spinosum* L., is included in this section it must, according to the present rules, have the name *Osteospermum* and the former section name *Spinosa* has to be reduced to a synonym. In his description of the genus, Linnaeus, *Gen. plant.* (1754), p. 395, indicated with an asterisk that he had investigated living specimens of *Osteospermum*. No doubt he had in view the specimens growing in Clifford's Garden which he first described in *Hortus Cliffortianus* (1737) under the phrase "*Osteospermum spinis ramosis*". According to a specimen in Clifford's Herbarium in the British Museum the plant studied by Linnaeus was identical with *Osteospermum spinosum* var. *runcinatum* Berg.

In 1955 I received viable seed from Professor Jordaan of Stellenbosch, of a plant similar to that which in former times was cultivated in Clifford's Garden, in the Medical Garden of Amsterdam, and in Leiden, viz. *Osteospermum spinosum* var. *runcinatum* Berg. This plant (STE 686), which originates from Jan Marais Park in Stellenbosch, has proved to have a chromosome number of 2n=16 (Fig. 6).

The type specimen of *Osteospermum spinosum* in Linnaeus' own herbarium corresponds to the type of Bergius' *O. spinosum* var. *integrifolium*. This taxon has not yet been investigated cytologically.

Osteospermum spinescens Thunb. was, under the name of *O. pachypteris* DC., included by De Candolle in the same section as *O. spinosum* L. and in my monograph I kept this arrangement, though with some hesitation. They are both highly xeromorphous and spiny but differ from each other as to the leaves and achenes: *O. spinescens, inter alia,* in having glabrous, often glaucous leaves, and always homomorphous achenes with broad wings. In 1961 I received for cytological investigation viable seed of *O. spinescens* from Miss Esterhuysen which was collected by her (n. 29078) in the karroid plains near Richmond. The chromosome number was counted 2n=36 (Fig. 7). Thus, these two taxa have different basic numbers, viz. *O. spinosum* var. *runcinatum* 8 and *O. spinescens* 9.

In future investigations it will probably be seen that *O. leptolobum* (Harv.) T. Norl., which morphologically is closely allied to *O. spinescens,* has the same basic number as this species. In that case it should be well motivated to establish a subsection for the latter two species.

Sect. 12. *Blaxium* (Cass.) T. Norl.

I, pp. 237—239. — H. Cassini in Dict. Sc. Nat. XXX (1824), p. 328 (pro gen.).

Blaxium, established by Cassini as a genus of its own, comprises a group of species which in certain respects forms a transition between *Osteospermum* and *Dimorphotheca.* In those species of *Blaxium* investigated so far, an embryo-sac is formed in each disc floret but as far as I am able to find out, the embryo-sacs come to a standstill in their development before they attain maturity for fertilization. Thus they are subject to reduction and are ♀-sterile, contrary to the disc florets in the true *Dimorphotheca* species. In the other sections of *Osteospermum,* the embryology of which has been investigated, no embryo-sacs are formed in the disc florets.

As mentioned above (p. 195), *Osteospermum Ecklonis* (DC.) T. Norl. was studied by Harrison in 1934 (under the name of *Dimorphotheca Ecklonis*), and he found in it the chromosome number 2n=20. This is in agreement with the counts on the material which I received from the Botanical Gardens of Copenhagen (Fig. 10 *a, b*).

No doubt the specimens Pienaar has investigated under the name of "*Dimorphotheca Barberiae*" belong to the section *Blaxium*. However, it is probably not the rare species *Osteospermum Barberiae* (Harv.) T. Norl. with the lobes of the outer disc florets bearded on the outside (I, p. 258, Map p. 415), but a garden plant called "*Dimorphotheca Barberiae*" which he has investigated. I have received living material of the false "*Barberiae*" from Captain Hitchcock of Brighton, and he wrote to me that this plant originates from Miss Stanford's garden at Stellenbosch; she has made many crossings and other experiments with plants cultivated in her garden. In this material it proved to be difficult to count the many long chromosomes exactly and no more than a good estimate of the number could be made. I obtained about the same number as Pienaar found ($2n=38$—40). The false "*Barberiae*" has no bearded lobes on the disc florets and is similar to *Osteospermum jucundum* (E. P. Phill.) T. Norl.

In 1960 I received viable seed of *O. jucundum* from its natural habitat in the Woodbush area of the north-eastern Transvaal, collected by Miss Sheila Thompson, and it has proved to have a chromosome number of $2n=20$ (Fig. 9). The garden plant mentioned above may be a tetraploid form of *O. jucundum* but it also shows traces of *Dimorphotheca montana* T. Norl. the wild forms of which have a high chromosome number (about $2n=40$). I have not yet finished my cytological investigations on these plants but hope soon to be able to solve the problem of the horticultural "*Dimorphotheca Barberiae*".

Not until in 1961 did I succeed in obtaining living material of the type of the old genus *Blaxium*, viz. the littoral species *Osteospermum fruticosum* (L.) T. Norl. (syn.: *Blaxium decumbens* Cass.). Miss Esterhuysen of Cape Town kindly sent me by air cuttings of this species from its natural habitat at Rheboksdam near Cape Point, which had been collected by Mr H. C. Taylor (n. 2596). As this plant mostly occurs on sand dunes it was grown in Lund on sandy soil in a greenhouse with artificial light. It developed characteristically with entire or almost entire, succulent leaves, long trailing stems, lignified in their basal part, and rays white with violet reverses. When investigating the disc florets I noted that styles were shallowly cleft, lobes not divergent after having grown up through the anther tube, and stigmatic swellings absent, thus sterile as in all other specimens I have seen of the pure species.

Already Cassini (1824) observed that the disc florets of this species were different from his *Meteorina* (*Dimorphotheca*) species by not

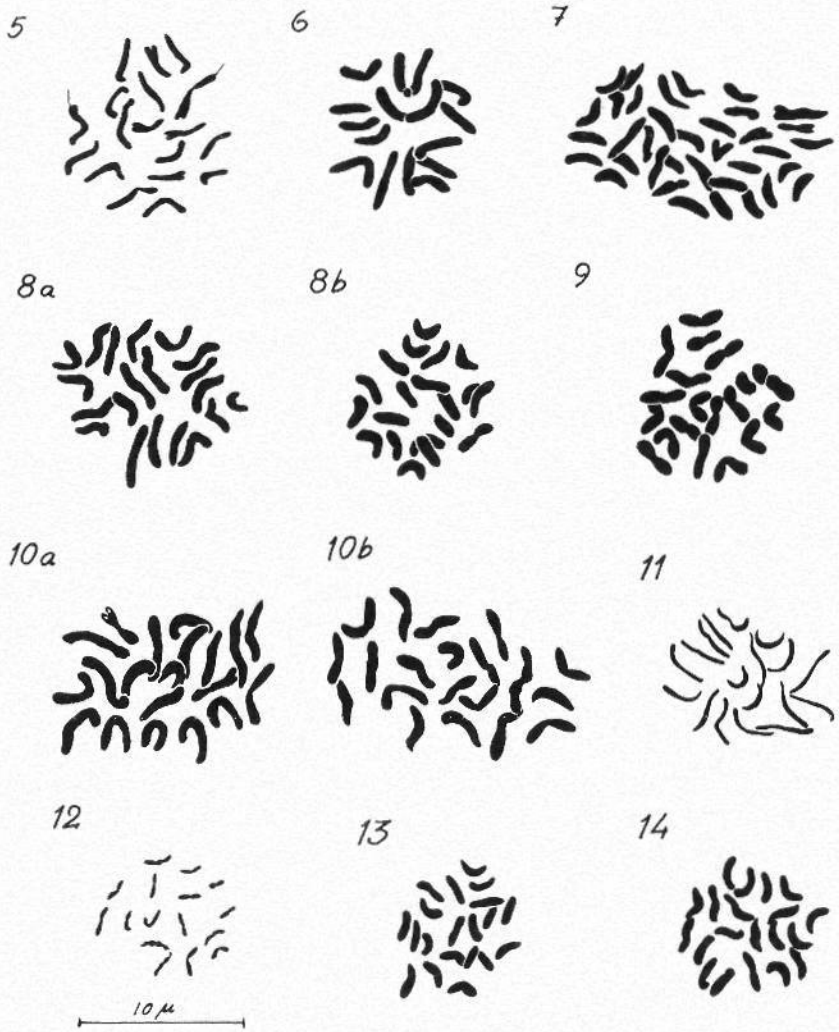

Fig. 5—14. Mitosis in root tips. — Fig. 5. *Osteospermum muricatum* E. Mey. ex DC., $2n=18$. — Fig. 6. *Osteospermum spinosum* var. *runcinatum* Berg., $2n=16$. — Fig. 7. *Osteospermum spinescens* Thunb., $2n=36$. — Fig. 8 *a*, *b*. *Osteospermum fruticosum* (L.) T. Norl., $2n=20$. — Fig. 9. *Osteospermum jucundum* (E. P. Phill.) T. Norl., $2n=20$. — Fig. 10 *a*, *b*. *Osteospermum Ecklonis* (DC.) T. Norl., $2n=20$. — Fig. 11. *Osteospermum oppositifolium* (Ait.) T. Norl., $2n=18$. — Fig. 12. *Osteospermum clandestinum* (Less.) T. Norl., $2n=16$. — Fig. 13. *Gibbaria ilicifolia* (L.) T. Norl., $2n=20$. — Fig. 14. *Chrysanthemoides monilifera* (L.) T. Norl. s. str., $2n=20$.

being ♀-fertile, and therefore he established it as an independent genus, *Blaxium*.

The chromosome number of *Osteospermum fruticosum* has proved to be 2n=20 (Fig. 8 *a, b*). All species of the taxon *Blaxium* hitherto investigated have this number.

Subgenus *Tripteris* (Less.) T. Norl.

I, pp. 100, 269—272.

I have received viable seed of all three sections of this subgenus, but in this paper I have not published the chromosome numbers of all species investigated, because in some cases I am not quite sure of the actual number and will make new slides according to another method before publishing them.

Only one of the species of this subgenus, *Osteospermum Vaillantii* (Decne) T. Norl., has earlier been investigated cytologically, viz. by Negodi (1938). He published its haploid chromosome number as 12 calling the species *Tripteris Vaillantii*. However, the plant I have had in culture during more than 20 years does not have 2n=24 but a higher number.

Sect. 13. *Tripteris* (Trifenestrata T. Norl.) — I, pp. 269, 270.

According to the present rules this section must be called *Tripteris* instead of *Trifenestrata*, because it includes the type of the old taxon *Tripteris*, viz. *T. arborescens* (Jacq.) Less.=*Osteospermum dentatum* Burm. f.

It is the largest section in the genus *Osteospermum*, comprising not less than 18 species. Two of these have been described by me (Norlindh 1954) after the publication of my monograph on the genus. From the morphological point of view it has proved difficult to subdivide this section into taxa of higher rank than species. However, in the future, when the chromosome numbers of all or most species in the section are known, these numbers will perhaps form useful characters which should facilitate a division of it into natural groups, classified as subsections.

Two closely allied species in this section, viz. *Osteospermum oppositifolium* (Ait.) T. Norl. [syn.: *O. glabratum* (Thunb.) Less.] and *O. sinuatum* (DC.) T. Norl., which are both xerophilous shrubs with all leaves opposite and with homomorphous 3-winged achenes, have been cultivated by me. The former I received as seed from Professor Jordaan of Stellenbosch. It was collected in 1954 by Mr Crafford (STE 683) near Springbok in Little Namaqualand. The latter was collected and sent as seed to me in 1961 by Miss Esterhuysen (n. 29077) from Beaufort West Division in the Great Karroo. These very characteristic species prove to have the same chromosome number 2n=18 (Fig. 11. *O. oppositifolium*).

As mentioned above *O. Vaillantii* has been investigated cytologically by Negodi, but the chromosome number he counted, n=12, is much lower than that in the plant cultivated by me. However, before publishing the number of chromosomes in my plant I intend to renew the investigation using the method of cooling the material when making fixations of it.

In 1954 I received viable seed of *Osteospermum monocephalum* (O. et H.) T. Norl. from Dr Wild of Salisbury in Southern Rhodesia and several specimens were raised but most of them died during the long, dark winter. However, after some experiments with different soils and artificial light in the greenhouses I have succeeded in keeping the remainder alive and this geophyte has developed a subterranean, strongly lignified caudex. *O. monocephalum*, which is widely distributed in the montane regions of tropical Africa (I, 417, Map), is owing to the big subterranean caudex very resistant against veld fires. Just as in the former case it has proved difficult to count the exact chromosome number. Hitherto, the somatic number is found to be about 36. The method of cooling the plant has also to be applied in this case in order to get contractions of the long chromosomes before the fixation.

Sect. 14. ***Unifenestrata*** T. Norl. — I, pp. 269, 328

This section, characterized by the homomorphous, 3-winged achenes having one fenestra only, comprises only two annual species which are very closely allied to each other.

I received the type species of the section, *Osteospermum clandestinum* (Less.) T. Norl., in 1954 as seed from Professor Jordaan of Stellenbosch, where it grows in the University grounds. *O. clandestinum* is native to the south-western Cape. Moreover it occurs as a weed on cultivated land and has been introduced also outside South Africa, viz. in Australia. It has a chromosome number of 2n=16, thus the same as the type of the genus *Osteospermum*, but in the morphology (Fig. 12) it differs considerably from that of the type (Fig. 6). In *O. clandestinum* the chromosomes are namely much narrower and provided with constrictions and one pair of them is moniliform (Fig. 12).

The other species, the long-rayed *Osteospermum hyoseroides* (DC.) T. Norl., mainly occurs in the Namaqua Region. I received viable seed of it from the National Botanic Garden of Kirstenbosch already in the 1930's. It also has the chromosome number 2n=16. The morphology of the chromosomes will be discussed in a following paper.

Gibbaria Cass.

I. pp. 32, 358—366. — II. pp. 495, 497, 505. — T. Norlindh, Bot. Notiser 1962, vol. 115, pp. 441, 443, 445.

Basic number 10.

The South African genus *Gibbaria* which as to the shape of the achenes represents a line of evolution almost convergent with that shown by the Mediterranean genus *Calendula,* comprises only two species.

I have not yet succeeded in obtaining living material of the type of the genus for cytological and embryological investigations. However, in 1956 Dr G. J. Lewis sent me viable seed of the other species, *Gibbaria ilicifolia* (L.) T. Norl., which was collected in Cape Peninsula on slopes of the Table Mountain in the Orange Kloof at an altitude of about 500—600 m. The shrubs raised from the seed thrive well in the greenhouses of Lund and, in spite of the relatively moist air, they develop hard and stiff *Ilex*-like leaves, thus behaving even under such conditions like typical sclerophytes. The plant is much branched and has grown about $^1/_2$ m high. The chromosome number has proved to be 2n=20 (Fig. 13).

Chrysanthemoides Tourn. ex Medik.

I, pp. 33, 367—403. — II, pp. 479, 492—493, 497, 505.

Basic number 10.

This genus is very remarkable inasmuch as it produces drupes which are edible and similar to blackberries (I, p. 376, Fig. 41). Otherwise, in the family *Compositae* drupaceous achenes only seem to occur in two South American genera belonging to the tribe *Helianthoideae,* viz. *Clibadium* L. and *Wulffia* Neck.

Chrysanthemoides has a very wide distribution area (II, pp. 479, 493, Maps). Apart from four large intervals in the lowlands of tropical East

Africa it extends from the Cape to the neighbourhood of Kilimanjaro. The genus comprises two species only, but one of them, *C. monilifera* (L.) T. Norl., is extremely polymorphous and has been divided by me into six groups of geographical races, classified as subspecies.

The south-western Cape race, *C. monilifera* s. str., characterized, *inter alia,* by globose or subglobose putamina, has been cultivated by me for more than thirty years. During this time one specimen grew to a small tree. The chromosome number of this taxon was counted as 2n=20 (Fig. 14).

Acknowledgements

To my colleague, Professor Henning Weimarck, Director of the Botanical Gardens of the University of Lund, I am indebted for his readiness in granting me, every year since 1950, the use of space in the greenhouses and gardens for my breeding experiments with these plants. To the Swedish Natural Science Research Council I wish to express my gratitude for contributions for technical assistance in making slides. As a rule I studied the slides just as they were finished and at the same time I sketched and counted the chromosomes. As they are, as mentioned above, in several cases unusually long and difficult to distinguish from each other I have had a collaborator controlling my countings of the chromosome number before publishing this work. I wish to thank Mrs. Elene Nyman for her valuable aid in counting the chromosomes and for the drawings of chromosome figures. I also wish to thank the Directors of Botanical Gardens and other botanists who have kindly sent seed and cuttings of the species treated here, viz. Dr. R. A. Dyer, Pretoria, Miss Elsie Esterhuysen, Cape Town, Captain G. E. W. Hitchcock, Brighton, England, Professor P. G. Jordaan, Stellenbosch, Drs G. J. Lewis and M. R. Levyns, Cape Town, Professor H. B. Rycroft, Cape Town, and Dr. H. Wild, Salisbury, Southern Rhodesia.

Summary

Apart from *Calendula* itself the chromosome numbers of only a few taxa in the tribe *Calenduleae* have been determined earlier, viz. the following:

Dimorphotheca pluvialis (Harrison 1934, Negodi 1938, Bilquez 1951)	2n=18
— *sinuata* [syn.: "*D. aurantiaca*" Hort. and *D. pseudoaurantiaca*] (Harrison 1934, Bilquez 1951)	2n=18
Osteospermum (*Dimorphotheca*) *Ecklonis* (Harrison 1934, Norlindh 1963)	2n=20
— (*Tripteris*) *Vaillantii* (Negodi 1938)	2n=24

I have been able to confirm the chromosome number of *O. Ecklonis.* However, the number given by Negodi for *O. Vaillantii* is somewhat doubtful. It does not agree with my count and therefore I intend to repeat the cytological investigation of this species before publishing the number. It is uncertain which plant is meant by the horticultural "*Dimorphotheca Barberiae*" the number of which Pienaar determined as 2n=38—40. It may be a tetraploid form of *Osteospermum jucundum* or a garden hybrid with *O. jucundum* as one component.

In this paper chromosome numbers in three genera (*Castalis, Gibbaria* and *Chrysanthemoides*) and in the following 15 species are determined for the first time:

Dimorphotheca montana var. *hortensis*	2n=20	*Osteospermum jucundum*	2n=20
Castalis tragus	2n=20	— *oppositifolium*	2n=18
— *spectabilis*	2n=20	— *sinuatum*	2n=18
— *nudicaulis* s. str.	2n=20	— *clandestinum*	2n=16
Osteospermum muricatum	2n=18	— *hyoseroides*	2n=16
— *spinosum* var. *runcinatum*	2n=16	*Gibbaria ilicifolia*	2n=20
— *spinescens*	2n=36	*Chrysanthemoides monilifera* s. str.	2n=20
— *fruticosum*	2n=20		

Further, I have indicated approximately the chromosome number of a few species, viz. those with a high number and long chromosomes, for instance *Osteospermum monocephalum,* 2n about 36. It has not yet been possible to make an exact count of their chromosomes but next time slides are made another technique will be tried.

The basic numbers of *Dimorphotheca* have proved to be 9 and 10, and that of the type of this genus, *D. pluvialis,* is 9.

In the large genus *Osteospermum* the basic numbers certainly known are 8, 9 and 10. All three occur in the subgenus *Osteospermum* but only the two first-mentioned in the subgenus *Tripteris.* The type of *Osteospermum, O. spinosum,* has the basic number 8. This number also occurs in both species of sect. *Unifenestrata* of subgenus *Tripteris,* viz. *O. clandestinum* and *O. hyoseroides,* which from the morphological point of view are very different from *O. spinosum.* The section *Blaxium* which holds an isolated position in the subgenus *Osteospermum* has the basic number 10 which seems to be the most common number in the tribe. In sect. *Xenismia* (*O. muricatum*) and in sect. *Tripteris* (*O. oppositifolium* and *O. sinuatum*), which belong to different subgenera and are very different from each other, the basic number is the same (9). As mentioned above the basic number 12 given for *O. Vaillantii* does not agree with later counts and a new investigation has to be made.

The basic numbers of *Calendula* are 7, 8 and 9 (Darlington and Wylie 1955). It is surprising that two very closely allied taxa, *C. aegyptiaca* (2n=14) and *C. arvensis* (2n=36), investigated by Negodi, should have different basic numbers, the former 7, the latter 9. They are so similar to each other that *C. aegyptiaca* has often been classified as an infraspecific unit of *C. arvensis.* In the next paper of this series I intend to take up the problems of *Calendula.*

In many cases the chromosome number in closely allied species in the *Calenduleae* is the same, for instance in the species pairs *Dimorphotheca pluvialis—sinuata, Osteospermum oppositifolium—sinuatum,* and *Osteospermum clandestinum—hyoseroides.*

One might expect that the genera *Castalis, Chrysanthemoides* and *Gibbaria,* which differ a good deal from each other in their morphology, would also differ in their chromosome number, but that is not the case. The number has proved to be 2n=20 in all hitherto investigated taxa of the above mentioned genera. Moreover this number has also been found in about half the species of the tribe (except *Calendula*).

The investigations up to now show that the chromosome numbers are of secondary importance when classifying genera, sections, and species in the tribe *Calenduleae*.

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BOTANISKA NOTISER 1963 · VOL. 116 · FASC. 2 · LUND

Pyrola rotundifolia L. ssp. maritima (Ken.) Warb. i Sverige

AV ÖRJAN NILSSON

(Meddelande från Lunds Botaniska Museum, Nr 174)

I Norge, Sverige och Danmark har *Pyrola rotundifolia* L. sens. lat. en tämligen vid men något ojämn utbredning med luckor i de utpräglade slättområdena, i övre Norrlands skogsområde och i västra Norge. Tyngdpunkten för artens utbredning inom detta område ligger i Sverige i östra Svealand, där arten är allmän (Hultén 1950). I stort är *P. rotundifolia* cirkumpolär med de talrikaste förekomsterna i de mera kontinentala delarna av Ryssland och Asien. Dess europeiska sydgräns går genom Bulgarien, Jugoslavien, mellersta Italien och centrala Spanien. I de perifera delarna av detta utbredningsområde är arten uppsplittrad på ett flertal taxa, som tillmätts varierande systematisk rang. I Skandinavien förekommer utefter hela fjällkedjan ssp. *grandiflora* (Rad.) Fern., även uppfattad som art: *P. grandiflora* Radius (*P. norvegica* Knaben), med två underarter (Löve 1961). Den växer på torra fjällhedar och i björkskogens övre randpartier och är troligen något kalkkrävande. Den går i Nordnorge ned på ganska låga nivåer, medan den i övrigt tycks inskränkt till högfjällsområden.

Ssp. *rotundifolia* undviker i Västeuropa de utpräglat oceaniska områdena. I Norge saknas den sålunda helt på Vestlandet och i Danmark är den mycket ovanlig i västra Jylland. På öarna är den spridd men ingenstädes allmän. I Sverige är ssp. *rotundifolia* tämligen sällsynt i de sydvästra delarna. Det kan exempelvis nämnas, att den i norra Halland är mycket sällsynt och saknas helt inom stora områden, framförallt i kustbygden. Samma tendens, att undvika de kustnära områdena, kan iakttagas i England och Frankrike.

I de västeuropeiska kustområdena ersätts ssp. *rotundifolia* av en morfologiskt och ekologiskt avvikande form, som urskilts som ssp. *mari-*

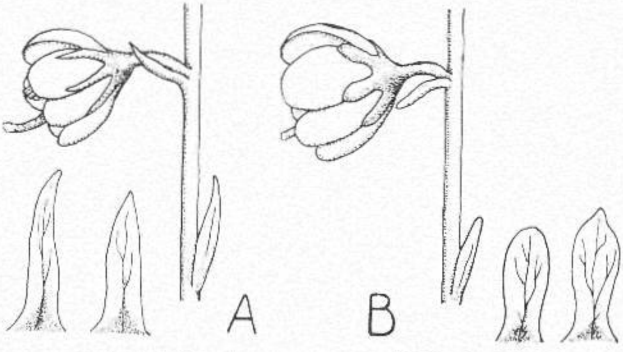

Fig. 1. Blommor och foderflikar hos ssp. *rotundifolia* A och ssp. *maritima* B. — Flowers and calyx-lobes of ssp. *rotundifolia* A and ssp. *maritima* B.

tima. Den blev beskriven som *P. maritima* av Kenyon 1846 från västra England. I Flora of The British Isles 1952 är den upptagen som ssp. *maritima* (Ken.) E. F. Warburg. Vidare har den beskrivits som var. *arenaria* av Koch 1837 från de östfrisiska öarna. I Flora og Fauna 1961 gör A. Hansen och A. Pedersen nykombinationen ssp. *arenaria*, men då den äldsta kombinationen i denna rang är ssp. *maritima*, är detta namn det giltiga.

Morfologiskt är ssp. *rotundifolia* och ssp. *maritima* tämligen distinkta i ett flertal karaktärer och lätta att särskilja:

ssp. *rotundifolia*

15—35 cm. Blad med kort nedlöpande, ± oval skiva. Stängel med 3—6 fjällika högblad, de övre lansettlika, tillspetsade. Blomskaft 4—8 mm, blommor 10—13 mm, foderflikar 3—6 mm, utdraget triangulära, c:a 3 ggr så långa som breda. Stift 7—8 mm, kraftigt böjt, ± rött.

ssp. *maritima* (Ken.) Warb. 1952

6—20 cm. Blad tätare ställda, med föga nedlöpande, vid basen ofta inskuren, nästan cirkelrund, något tjockare skiva. Stängel med 2—4 högblad, de övre avlångt ovala, kort spetsade. Blomskaft 4—5 mm, blommor 12—15 mm, få, foderflikar 2—4 mm, ovalt tunglika—spatelformade, trubbiga el. mycket kortspetsade, c:a 2 ggr så långa som breda. Stift 5—6 mm, svagt böjt—rakt, vitt—ljust rosa.

Från Danmark är ssp. *maritima* känd utefter jylländska västkusten på ett flertal lokaler från Skagen i norr ned mot tyska gränsen. I Jylland finns även några få inlandslokaler. Den är dessutom funnen på nordligaste Fyn och norra Själland. Ssp. *maritima* är i Norge endast anträffad på en lokal på Jären (A. Hansen och A. Pedersen 1961).

Under inventeringsarbete i norra Halland fann förf. 1958 ssp. *maritima* i Ölmevalla sn., nära Bråtevikens badplats på Hästholmen. Den växer på en låg strandvall en halv meter över havsytan, c:a 10 m från strandlinjen. Endast ett tiotal individ har observerats. Det skall anmärkas, att den brukar blomma mycket sparsamt och sporadiskt. 1958 påträffades tre blommande plantor, 1959—61 inga och 1962 en enda. Den uteblivna eller sparsamma blomningen en följd av år kan tänkas tyda på, att ssp. *maritima* här är vid eller nära sin nordgräns och saknar de ideala förutsättningarna för blomning och vidare spridning.

Sommaren 1962 insamlades av N. Englesson en *P. rotundifolia* - form vid ett mindre kärr nära Stångbymosse N om Lund. Vid kontrollbestämning visade sig även denna överensstämma med ssp. *maritima*. Denna lokal är i motsats till den halländska rik, och över en c:a 10 m^2 stor yta blommade ett 100-tal exemplar (muntlig uppgift). Den avviker också i det avseendet, att den ligger något mer än en mil från kusten.

Dessa båda fynd gav mig anledning att förmoda, att ssp. *maritima* blivit insamlad tidigare. Men en genomgång av *P. rotundifolia* - materialet från herbarierna i Lund och Göteborg gav negativt resultat. Det verkar dock sannolikt, att ssp. *maritima,* med hänsyn till de talrika fynden i Danmark, bör kunna anträffas på ytterligare några platser i de sydliga västkustlandskapen.

Utanför Sydskandinavien är ssp. *maritima* känd från tyska nordsjökusten, Nederländerna, Belgien och nordvästra Frankrike samt från några enstaka lokaler i västra England (Clapham et al. 1952). Var. *arenaria* (=ssp. *maritima* ?) är också uppgiven från östra Quebec och Nova Scotia (Hultén 1958).

Genom en i vissa drag skild ekologi avviker ssp. *maritima* från nominalunderarten. Medan ssp. *rotundifolia* huvudsakligen växer på fuktiga ställen i skogar, på ängsmarker, i kanten av kärr och på sjöstränder, växer ssp. *maritima* på torrare platser, »hvor man udmærket godt uden frygt for indtrængende væde kan sætte sig ned og nyde skønheden» (A. Hansen och A. Pedersen 1961). I Danmark anges den förekomma i lägre partier mellan sanddyner och klitter och i artrika ängar på sandigt underlag, aldrig på torv såsom ssp. *rotundifolia*. Vanligast ingår den i en *Salix arenaria - Holcus lanatus* - association med arter som *Potentilla erecta, Vicia cracca, Gentianella campestris* och *Empetrum nigrum* som allmänt ledsagande element. Från platser i närheten har angivits arter som *Epipactis palustris* och *Salix hastata*. Från lokaler i mer omedelbar anslutning till stranden upptas *Juncus balticus, Poa irrigata, Parnassia palustris* och *Centaurium vulgare* som följeväxter (se äv. Warming 1907, p. 339). Från England uppges ssp. *maritima* uppträda på liknande lokaler.

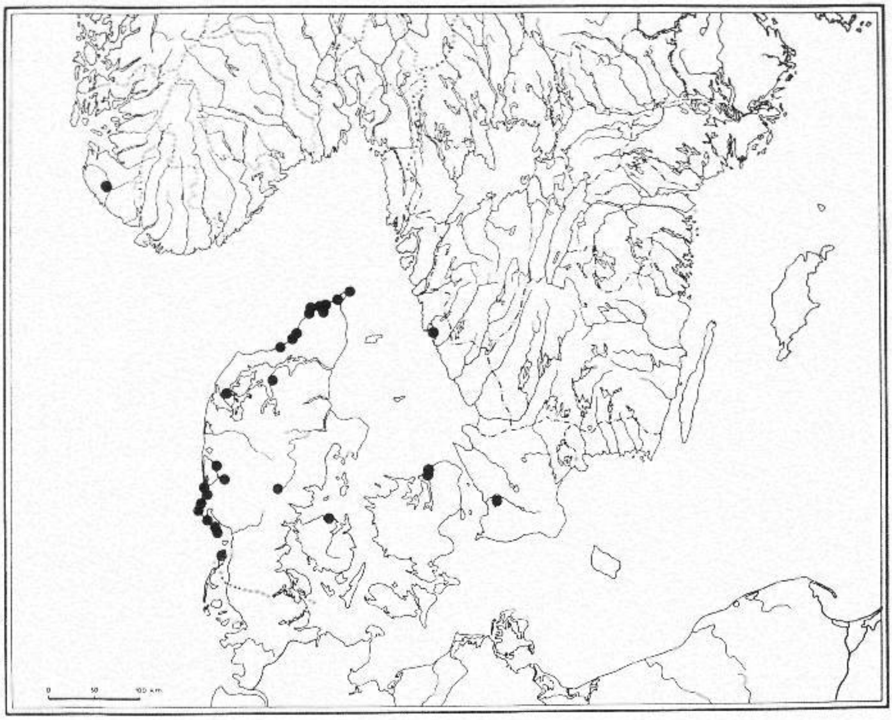

Fig. 2. Utbredningen av *Pyrola rotundifolia* ssp. *maritima* i Sydskandinavien. — The distribution of *P. rotundifolia* ssp. *maritima* in southern Scandinavia.

I Halland växer ssp. *maritima* så nära stranden, att ett flertal havsstrandväxter ingår i den mosaikartade vegetationen. Underlaget utgörs av en blandning av sand, grus och sten. Man kan säga att lokalen är torr, men grundvattnets övre gräns ligger normalt ganska nära markytan. Av följeväxterna skall nämnas *Salix arenaria, Juniperus, Calluna, Empetrum nigrum, Festuca ovina, F. arenaria, Anthoxanthum odoratum, Carex pilulifera, Potentilla erecta, Silene vulgaris* ssp. *maritima, Fragaria vesca, Lotus corniculatus* samt enstaka exemplar av *Glechoma hederacea, Fragaria viridis, Carlina vulgaris, Cochlearia danica, Centaurium vulgare, Armeria maritima, Plantago maritima, Cerastium semidecandrum* och *Viola tricolor*. Det skall påpekas, att lokalen vid extrema tillfällen under vår- och höststormarna delvis överspolas med saltvatten. Tångrester och dylikt har blivit funna där upprepade gånger. Jämförd med ssp. *rotundifolia* har det visat sig, att ssp. *maritima* i Halland blommar en till två veckor senare. Jämförelsen är gjord mellan denna strandlokal och en lokal för ssp. *rotundifolia* i Gällinge sn. c:a en mil in i landet. En jämförelse, som när det gäller de flesta andra växter, brukar ge uttryck för ett rakt motsatt förhållande.

Beträffande den skånska lokalen, som förf. ej besökt, kan endast sägas, att ssp. *maritima* växer fuktigare men fortfarande på ett sandigt underlag. Det har vidare meddelats, att *Phragmites, Epipactis palustris, Parnassia palustris, Agrostis stolonifera* och *Salix hastata* växer på platsen, av vilka vissa, som nämnts, förekommer i samband med några av de jylländska lokalerna. Parentetiskt skall nämnas, att ett flertal i vårt land på havsstränder normalt förekommande växter tidigare blivit funna i Stångbymosse.

Slutligen skall det påpekas, att det är diskutabelt, vilken systematisk rang man skall ge vad som här kallats ssp. *maritima*. Den avviker från ssp. *rotundifolia* i en rad distinkta morfologiska karaktärer, genom sin skilda ekologi och genom ett till största delen skilt utbredningsområde. Några påvisbara mellanformer är ej kända för förf. Det finns sålunda flera skäl att behandla den som art, då med namnet *P. maritima* Kenyon 1846, men detta kan knappast slutgiltigt avgöras utan ytterligare undersökningar.

Summary

Pyrola rotundifolia L. ssp. maritima (Ken.) Warb. 1952 found in SW Sweden.

In this paper I have given a brief report on the discovery of two localities of *P. rotundifolia* L. ssp. *maritima* (Ken.) Warb. 1952 from the southwestern part of Sweden. This subsp. is not known from Sweden before.

1. Sweden, prov. Halland, Ölmevalla, Bråteviken on the Hästholmen peninsula. 1958. leg. Ö. Nilsson.

2. Sweden, prov. Skåne, 6 km N of Lund, near the Stångbymosse. 1962. leg. N. Englesson.

The locality Ölmevalla in Halland is situated only 10 m from the seashore, and is under a strong influence from the sea. The locality in Skåne is almost free from such an influence and is situated more than 10 km from the coast. In Halland there were only found a few individuals but in Skåne there were more than one hundred. Ssp. *maritima* in Halland which I have observed since 1958 is flowering one or two weeks later than ssp. *rotundifolia* in the same part of the province.

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Kromosomtal och morfologi hos skånsk Anthericum

Av Sven-Olov Strandhede

(Meddelande från Lunds Botaniska Museum, Nr 175)

Inom ramen för arbetet med Skånes Flora har författaren av professor H. Weimarck tilldelats uppgiften att studera kromosomtalsförhållandena inom den skånska populationen av *Anthericum*.

Anthericum ramosum L. och *A. liliago* L. förekommer på sandiga gräshedar flerstädes i östra och sydöstra Skåne. Dessutom förekommer på några lokaler, såsom i Degeberga, Vä och Skepparslöv, en tredje typ, som redan i slutet av 1800-talet uppmärksammas av bl.a. Hjalmar Nilsson och som av Johan Erikson (1903) beskrives såsom hybriden mellan *A. ramosum* och *liliago*.

Vissa tvivel har ibland anförts beträffande denna tredje typs hybridogena ursprung. Som ett hinder för hybridens uppkomst har föräldraarternas olika blomningstid anförts. För att åskådliggöra detta förhållande skall här relateras blomningstiderna år 1960 för det undersökningsmaterial, som då odlades i Botaniska trädgården i Lund.

Den 23 juni 1960:
A. ramosum har ej börjat blomma.
A. liliago har blommat slut, med endast enstaka toppblommor ännu blommande.
»Hybriden» befinner sig mitt i sin blomning.

Den 7 juli 1960:
A. ramosum har just börjat blomma.
A. liliago har helt avslutat sin blomning.
»Hybriden» befinner sig i slutet av sin blomning.

Den 14 juli 1960:
A. ramosum blommar som bäst.
A. liliago, fröna har börjat antaga svart färg.
»Hybriden» befinner sig i slutet av sin blomning.

Denna skillnad i blomningstid hos arterna är emellertid ej större än att man i naturen ibland påträffar såväl *A. ramosum* som *A. liliago* blommande samtidigt och i omedelbar närhet av varandra. Något definitivt hinder för hybridbildning föreligger således ej i detta hänseende.

Kromosomtal

De tre typerna av *Anthericum* insamlades från skilda lokaler och kromosomtalsbestämdes. Fixeringar av rotspetsar gjordes i Svalövs modifikation av Navashin-Karpechenkos fixering efter cirka 18 timmars förvaring i en temperatur av $+2°$ C. Färgning skedde i kristallviolett efter snittning i seriemikrotom; snittjocklek: 16 μ. Prepareringsmetoden gav goda, lättolkade plattor av rotmitoser.

Totalt gjordes cirka 175 säkra bestämningar av 25 olika plantor. Kromosomtalsbestämningarna gav för

A. ramosum från Degeberga och Ravlunda	$2n=30$	(fig. 1 A);
A. liliago från Degeberga och Vä	$2n=60$	(fig. 1 B);
A. ramosum × *liliago* från Degeberga, Vä och Skepparslöv	$2n=45$	(fig. 1 C);
D:o från Degeberga (en klon)	$2n=44$	(fig. 1 D);

Resultatet är något överraskande jämfört med tidigare publicerade kromosomtal. Stenar (1928) har i samband med embryologiska undersökningar på material från Botaniska trädgården i Uppsala studerat meiosmetafaser av *A. ramosum*. Resultatet angives som $X=16$.

Några år senare gör även Elvers (1932) ett embryologiskt arbete över *Anthericum* på material från Bergianska trädgården, vilket ursprungligen insamlats i Skåne. Tyvärr gör de tunna snitten (10 μ) det ofta nödvändigt att kombinera flera på varandra följande snitt för att få en fullständig platta av meiosmetafasen. I meiosmetafas I angiver Elvers för *A. ramosum* $n=16$, för *A. liliago* $n=32$ samt för hybriden angives med viss reservation $16_{\text{II}}+16_{\text{I}}$.

För att om möjligt verifiera dessa äldre bestämningar tillskrevs Bergianska trädgården och levande material med ursprungsbeteckningen »Skåne, spont.» erhölls. Även detta material hade emellertid $2n=30$ resp. 60 och 45.

Det föreligger alltid en viss risk för felbestämning, då ett kromosomtal bestämmes i första meiosmetafasen. Ej sällan inträffar, att kromosomkonfigurationer misstolkas i detta stadium eller att metafasen övergått i en begynnande anafas med åtföljande separation av homologa kromosomer. Av de squash-preparat av meiosstadier som gjorts i sam-

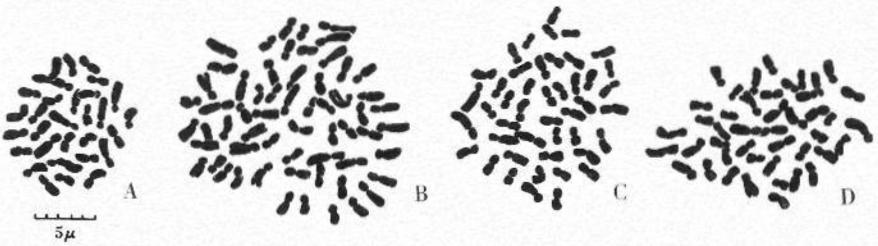

Fig. 1. Mitosmetafaser av *Anthericum*. A: *A. ramosum*, 2n=30; B: *A. liliago*, 2n=60. C—D: *A. ramosum×liliago*, C: 2n=45, D: 2n=44.

band med föreliggande undersökning, har sålunda inga säkra kromosomtal erhållits. Studiet av rotmitoser har därför visat sig lämpligare.

Utanför Skandinavien har kromosomtalsbestämningar gjorts i Ungern på spontant material av Polya (1950) och av Baksay (1956), som får 2n=32 resp. n=16 för *A. ramosum*. Samma kromosomtal återfinnes i Index Seminum från Jardin botanique, Strasbourg (Gagnieu et all. 1954, 1955, 1956). Författaren har ej undersökt material från Ungern resp. Strasbourg men föreliggande kromosomtalsuppgifter gör en sådan undersökning lockande ur såväl cytologisk som taxonomisk synpunkt.

Utöver dessa kromosomtal förekommer ytterligare ett par intressanta uppgifter. Sålunda rapporterar Bowden (1945) för *A. liliago* 2n=30 samt Fernandes (1950) 2n=32. Dessa tal överensstämmer mer med kromosomtalet för skånsk *A. ramosum* (2n=30) än skånsk *A. liliago* (2n=60). Tyvärr uppvisar de bägge sistnämnda författarnas figurer alltför många sönderskurna kromosomer, för att en mera ingående analys skall kunna göras med hjälp av dessa.

Triploid eller hybrid?

Kromosomtalet 2n=45 kan tolkas på två sätt. Antingen är dessa plantor triploida individ av A. *ramosum* eller också hybrider mellan *A. ramosum* och *liliago*. Att en kollekt har 2n=44 kan anses ligga inom ramen för vad som är att vänta i dylika situationer. Samtliga kollekter med 2n=44 och 45 har starkt störd pollenutveckling. Procenten morfologiskt gott pollen varierar från cirka 10 % i vissa kollekter till cirka 50 % i andra. Någon fruktsättning kommer ej till stånd. Strax efter blomningen lossnar fruktämne och blomrester i blomskaftets led. Denna sterilitet [1] bör teoretiskt utmärka såväl triploiden som hybriden. För att

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[1] Elvers (1932) angiver att han använt hybridpollen för lyckade återkorsningar mot såväl *A. ramosum* som *A. liliago*.

få svar på frågeställningen måste därför jämförande morfologiska undersökningar företagas.

Morfologi

A. ramosum utmärkes bl.a. av att blomställningen är grenig i motsats till *A. liliago*. För studerade kollekter av *A. ramosum* varierar medeltalet för antalet sidogrenar i blomställningen från 1,7 till 3,8. Hos *A. liliago* är blomställningen oftast helt ogrenad eller uppvisar i vissa kollekter en eller två sidogrenar. Kollekter med intermediärt kromosomtal har i medeltal 1,0—2,5 grenar per blomställning.

I blomställningar av *A. ramosum* har hos ett flertal plantor iakttagits, hur i vecket av grenar av första ordningen utbildas en andra skottgeneration. Denna nya skottgeneration utbildas främst i nedre delen av blomställningen, antingen i form av flerblommiga grenar eller enstaka blommor, och är fästad något lateralt innanför första skottgenerationen.

De enskilda blommornas stödblad avtager kontinuerligt i storlek från basen av blomställningen och uppåt. Dock har en morfologisk artskillnad iakttagits på stödblad från motsvarande delar och höjd på blomställningar från de olika enheterna. *A. ramosum* har stödblad av samma form på såväl huvudaxel som biaxlar (fig. 2 A och B). Vidare saknar stödbladen hyalin kant. *A. liliago* har på huvudaxeln långspetsade stödblad, medan biaxlar har avrundade och kortspetsade (fig. 2 C och D). Vidare är stödbladen hyalina från ytterkanten ända in mot sidonerverna.

Även i detta avseende intar kollekterna med $2n=44$ och 45 en intermediär ställning såväl beträffande form som hyalinitet (fig. 2 E—G). Som visas i figur 2 G, har hos vissa plantor påträffats en antydan till flikighet hos stödbladen.

Blomdelarnas storlek och utformning ger distinkta artskillnader mellan *A. ramosum* och *A. liliago*. Kalken är hos bägge arterna uppbyggd av två tretaliga kransar. De enskilda kalkbladen inom varje krans är i det närmaste lika. Stora formskillnader föreligger dock mellan kransarna, då inre kransens blad är bredare än yttre kransens något mera pergamentartade kalkblad. Inre kalkbladens form framgår av figur 2 H—J. *A. ramosum* har mer eller mindre omvänt äggrunda inre kalkblad (fig. 2 H), medan *A. liliago* har avlånga (fig. 2 I). Även här intager

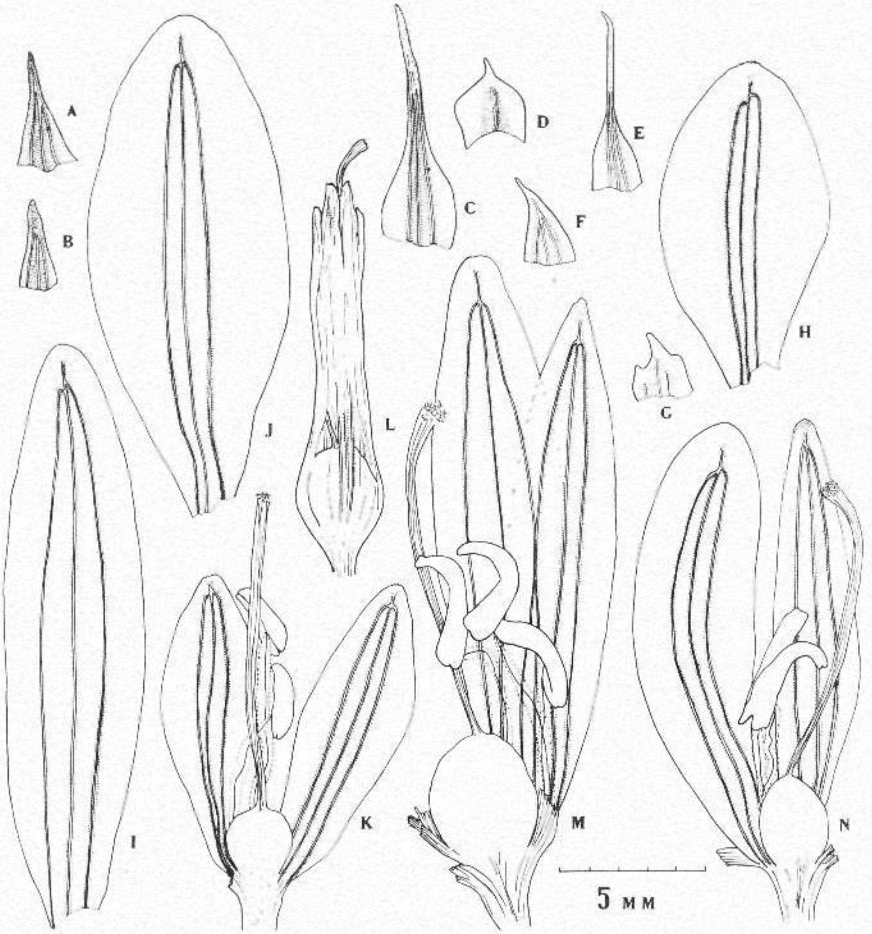

Fig. 2. A—G: Stödblad till blommor på motsvarande höjd i blomställningar av *Anthericum*, A—B: *A. ramosum*, A: från huvudaxeln, B: från en biaxel; C—D: *A. liliago*: C: från huvudaxeln, D: från en biaxel; E—G: *A. ramosum*×*liliago*, E: från huvudaxeln, F—G: från biaxlar; H—J: Inre kalkblad, H: *A. ramosum*; I: *A. liliago*; J: *A. ramosum*×*liliago*. K—N: Blommor i vilka stift och enstaka ståndare frilagts genom att andra delar delvis bortpreparerats, K: *A. ramosum*; L: *A. ramosum* strax efter blomningen; M: *A. liliago*; N: *A. ramosum*×*liliago*.

plantorna med 2n=44 och 45 en intermediär ställning (fig. 2 J), dock med vid variation från kollekt till kollekt.

Kalkbladens längd, mätt omedelbart efter det att kalken slagit samman efter blomningen, är för *A. ramosum* i medeltal 12 mm samt för *A. liliago* 21 mm. Motsvarande längd för den intermediära gruppen är

17 mm. Inom denna grupp är variationen mellan olika kollekter påtaglig och man kan finna plantor med cirka 14 mm långa kalkblad och andra med en längd av ända upp till 20 mm.

Stiftet hos *A. ramosum* (fig. 2 K) är längre än kalkbladen och från början nästan rakt men slutligen starkt krökt i toppen. Särskilt väl synes detta strax efter blomningen (fig. 2 L). Hos *A. liliago* är stiftet kortare än kalkbladen och jämnt bågböjt (fig. 2 M), liksom hos de cytologiskt intermediära kollekterna (fig. 2 N). Dock kan hos dessa senare påträffas blommor med nästan rakt stift. Emellertid tycks detta aldrig bli längre än kalkbladen.

Ståndarknapparna uppvisar klara storleksskillnader mellan *A. ramosum* (fig. 2 K), som har relativt korta knappar jämfört med *A. liliago* (fig. 3 C). De cytologiska intermediärerna (fig. 3 D) liknar även i denna karaktär mest *A. liliago.*

Några taxonomiskt användbara storleksskillnader mellan pollen från de två arterna förekommer ej, även om en viss storleksskillnad till *A. liliagos* favör kan iakttagas. Pollenet hos de cytologiska intermediärerna är som påpekats ofta deformerat och tomt. De fyllda pollenkornen varierar oerhört i storlek från abnormt små till den ungefärliga storleken hos normalt pollen.

Av denna kortfattade morfologiska genomgång framgår, att de cytologiskt intermediära plantorna ofta även morfologiskt är intermediära mellan de två arterna. Vidare kan konstateras, att vissa karaktärer såsom stiftets form och längd samt ståndarknapparnas storlek mest överensstämmer med *A. liliago.* Detta senare förhållande vore svårförklarat, om plantorna med kromosomtalet 2n=44 eller 45 skulle representera tripoid *A. ramosum.* Förhållandet styrker i stället åsikten, att intermediärerna är hybrider mellan *A. ramosum* och *A. liliago.*

På grund av *Anthericums* förmåga till vegetativ förökning med hjälp av jordstammar, kan rameter av enstaka plantor så småningom uppträda i stort antal på en lokal. Detta förklarar också varför man på hybridlokaler ofta i hög frekvens endast påträffar hybriden eller ibland tillsammans med endast den ena av föräldraarterna.

Summary

Chromosome numbers and morphology on Anthericum from Scania

1. Investigated material of *Anthericum* from different localities in Scania (Southern Sweden) have the following chromosome numbers: *A. ramosum* L. 2n=30 (fig. 1 A) and *A. liliago* L. 2n=60 (fig. 1 B).

2. The intermediate chromosome numbers 2n=45 and 44 (fig:s 1 C and 1 D) have been found in many plants from a few localities in the same area.

3. A morphologic analysis (fig. 2) of the cytologically intermediate plants has confirmed their hybrid origin (*A. ramosum*×*liliago*).

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BOTANISKA NOTISER 1963 · VOL. 116 · FASC. 2 · LUND

New Records of Scandinavian Mosses

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During the years 1958—62 we have collected mosses in various parts of Fennoscandia. This paper is a report on the most interesting of those so far identified. We have excluded many records of species of critical groups, such as the *Bryum erythrocarpum* complex, at present the subject of research, but we have added several records from herbarium sources. Records for which no collector's name is cited are our own.

Seligeria brevifolia (Lindb.) Lindb. Norway, Finnmark: limestone rocks on west side of Altafjord, about 8 km north of Kåfjord, 2.8.1958. New to Finnmark.

Desmatodon randii (Kennedy) Lazar. (*Entosthodon neoscoticus* M. S. Brown). Sweden, Skåne: Horsahallen, about 3 km south of Simrishamn, 20.2.1961; on the coast just south of Brantevik, Simris, 5.3 and 30.6.1961. In both localities it was growing with *Pottia heimii* among grass on moist sandy soil by the sea. New to Skåne, the only previous Scandinavian record being from Bohuslän: on fine sandy soil on side of ditch close to the sea on the island Sydkoster, 18.8.1927, C. Jensen and P. A. Larsson.

Desmatodon randii seems to be a rare plant thoughout its range. Outside Scandinavia it is known in Europe from Pommerania, Estonia, Latvia and Ukraine, and in North America from Nova Scotia, Maine, Iowa, Utah and Illinois. Most of these records are based on single localities. Some, including the type locality, are maritime and very similar to the Swedish habitats; but some are inland, including one from the shore of Lake Michigan (Flowers, 1930). Thus the plant is not an obligate halophyte. We have been unable to trace Flowers' report of a discovery of the species in Finland.

Barbula valida (Limpr.) Möll. Sweden, Öland: on soil in alvar, Albrunna, S. Möckleby, 20.7.1959, in very small quantity. New to Öland.

Tortella densa (Lor. & Mol.) Crundw. & Nyh. Norway, Oslo: on limestone, island of Malmöya, 26.5.1949, Per Störmer (as *T. tortuosa* fo. *curta* Alberts.). The second Norwegian locality, the only previously known one being from Nordland (Crundwell & Nyholm, 1962).

Tortella rigens Alberts. Estonia, Insel Ösel: alter Kalksteinbruch-Junipenestrift W vom Lodekrug, W von Arensburg, 21.7(=3.8.)1902, Joh. Mikutowicz, Bryotheca baltica, no. 415 a (as *T. tortuosa* var. *fragilifolia*). Previously known only from Sweden, from the areas reported by Albertson (1946): Öland, Gotland, Västergötland and two isolated island localities, one in Södermanland and one in Uppland. This new locality extends the range of the species by only about 200 km, but it is the first from outside Sweden, and it shows that *T. rigens* is present on both sides of the Baltic.

Weissia wimmeriana (Sendtn.) B., S. & G. Norway, Finnmark: on calcareous earthy bank at roadside, west side of Altafjord about 8 km north of Kåfjord, 2.8.1958. New to Finnmark.

Schistidium apocarpum (Hedw.) B. & S. var. *homodictyon* (Dix.) Crundw. & Nyh., *comb. nov.* (*Grimmia homodictyon* Dix., Rev. Bryol., 28, 12, 1901; *G. apocarpa* var. *homodictyon* (Dix.) Crundw., Trans. Brit. Bry. Soc., 2, 15, 1952). Sweden, Öland: on flat rock surface in limestone pavement, Möckelmossen, Stenåsa, 28.7.1959. New to Sweden, and not previously recorded from outside the British Isles, where it is known from only a few localities in Scotland and one in Westmorland. It is characterised by having dark brown hoary tufts, long spinulose hair-points to the leaves, the nerve not papillose at the back and the cells of the lamina incrassate and almost uniform throughout the leaf, sinuose to or nearly to the apex. In areolation, but not in other characters, it thus resembles *S. strictum*. It is found only on very highly calcareous rocks, nearly always on hard limestone. It is not a very striking variety, but its ecology and very restricted distribution show that it is worth maintaining.

Schistidium trichodon (Brid.) Poelt. Sweden, Jämtland: on limestone rock in felled spruce forest near R. Hårkan, Lit, 8.7.1958. Västmanland: on limestone rocks in mixed deciduous forest, Björkskogsnäs, Torrvarpen, 20.8. 1959. New to Västmanland. Previously known from only five Swedish localities (Poelt, 1953). In both these localities *S. boreale* Poelt, a more frequent species in Scandinavia than *S. trichodon*, was growing with it and remaining quite distinct from it. These two and *S. strictum* (Turn.) Mårt. have been treated by one of us (Nyholm, 1956) as synonyms of *S. apocarpum* var. *gracile* but by the other (Crundwell, 1959) as three good species.

Schistidium boreale Poelt. Sweden, Småland: Barkeryd, 1875, Scheutz. Dalsland: on stone by Damtjärnsbäcken, Regineberg, Bäcke, 1.7.1917, S. & G. Bergström; Tegen, Dalskog, 20.8.1929, S. Bergström. New to Småland and to Dalsland. The Småland locality is a southern extension of the range of this species which, apart from a single record from Novaya Zemlya, is known only from Scandinavia.

Schistidium atrofuscum (Schimp.) Limpr. Sweden, Öland: Resmo alvar, 3.7.1867, J. E. Zetterstedt; on rock surfaces, limestone pavement, Möckelmossen, Resmo, 28.7.1959; on rock surfaces, limestone pavement, and on stone wall (c. fr.), alvar south-east of the church, Vickleby, 27.7.1959; limestone rocks in alvar, Stora Alvaret, near Bårby, Mörbylånga, 23.8.1962. Gotland: on rock surfaces, limestone pavement, near Garde, Stenkyrka, 14.7.1960; limestone rocks, Östergarn, 19.7.1960; hällmark, Hejdeby hällar S om Marmorbrottet, Hejdeby, 29.3.1962, Bengt Pettersson. New to Sweden.

Probably common and generally distributed throughout the limestone areas of Öland and Gotland but hitherto overlooked because of its frequent sterility and because of the bewildering variety of *S. apocarpum* forms that grow with it. In all the localities it was present in quantity on flat fully exposed limestone rocks, associated with *S. apocarpum* forms, among which it is readily recognisable in the field by its compact, deep black tufts with obtuse or subobtuse leaves, muticous or with the hyaline point only microscopically visible.

S. atrofuscum is sometimes treated as a variety or subspecies of *S. apocarpum*, sometimes as a species. On Öland and Gotland it grows with *S. apocarpum*, sometimes in mixed tufts, but always without intermediates. The status of *S. atrofuscum* is discussed by Warburg (1957), with whom we agree in preferring to treat it as a species.

The only previous Scandinavian records are from two localities in Opland, Norway. Outside Scandinavia it is known from one locality in Scotland, from the Alps, the Tatra Mountains, the Balkans and Sierra Nevada (Spain) and from New Mexico, Tennessee and Arizona. It has also been reported from Palestine (Bilewsky and Nachmony, 1955) but this is an error, for a part of the gathering in question was sent by Miss Nachmony to one of us (A. C. C.) and is not *S. atrofuscum* but merely a muticous form of *S. apocarpum*.

Fontinalis hypnoides Hartm. Finland, Lapponia Kemensis: on rock in river near main road 43 km north-east of Rovaniemi, 8.8.1958. New to Finnish Lappland.

Rhynchostegiella compacta (C. Müll.) Loeske [*Amblystegium compactum* (C. Müll.) Aust.]. Sweden, Skåne: Kvassan, Kivik, 7.1946, Ivar Söderberg; Ålahaken, Tosterup, 1.6.1952, Elsa Nyholm; Tjuvelhamn, Hallands Väderö, 17.6.1954, Elsa Nyholm; Gislöshammar, Ö. Nöbbelöv, 3.8.1954, Elsa Nyholm; Brantevik, Simris, in several places along the coast, 20.2., 5.3. and 30.6.1961. New to Skåne.

All these localities are on moist sandy soil close to the sea. In nearly all the Scanish localities it grows mixed with a form of *Amblystegium serpens* which closely resembles it in the field. Outside Scandinavia it is chiefly a plant of limestone rocks.

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Botaniska Notiser 1963 · Vol. 116 · Fasc. 2 · Lund

Some Notes on Nothofagus from New Guinea and New Caledonia

By H. Hjelmqvist

(Meddelande från Lunds Botaniska Museum, Nr 176)

In the years 1952—1953 no less than 16 new species of *Nothofagus* were described by van Steenis from New Guinea, from where the genus was unknown before; the descriptions were mainly based on material collected by the Archbold expedition to New Guinea in 1938—1939. One more species was recognized by the same author in 1955. At about the same time, in 1953, Baumann-Bodenheim pointed out that the genus *Trisyngyne* of New Caledonia, which previously had been referred with hesitation to *Euphorbiaceae*, in fact belonged to *Fagaceae*, and described three new species collected by himself and his companions in 1950—1951; in addition the descriptions of the two previously known species were completed. These five species were in the following year transferred by van Steenis to *Nothofagus*, and to the same group as the species known from New Guinea.

Thus in recent times no less than 22 *Nothofagus* species have been recorded from New Guinea and New Caledonia, while previously 18 species in all were known from other territories — South America, Australia and New Zealand. The systematic position of the new species has been subject to different views. By van Steenis (1953) they are referred to the section *Calusparassus* (Hombr. & Jacq.) Krass., and there he lets them form the subsection *Bipartitae*. Baumann-Bodenheim (1953, and in v. Steenis, 1954), however, is of the opinion that the New Caledonian species and some of the New Guinea species should be referred to a genus of their own, for which the old name *Trisyngyne* is retained. Miss Langdon, who investigated the morphology of 4 or 5 species from New Guinea as early as 1947, before they had been described as species, was of the opinion that whereas in a combination of morphological characters they decidedly agree with *Nothofagus*, in some respects they show so great deviations from the typical pattern of the genus that they should form a special section. Similar opinions — that the group should be regarded as a subsection or section — have been expressed by Dadswell and Ingle (1954 and in Cookson and Pike, 1955) as well as by Cookson and Pike (1955) and Bailey (in Dadswell and Ingle, 1954).

The purpose of this study is not primarily to discuss the question whether the new species should form a new genus or not, but to bring them in relation to the groups previously known. In order to get an idea of the affinities of the group a survey must be made of its more important morphological characters, in comparison with those of other related groups.

Leaf structure

According to van Steenis (1953, p. 302, note) the New Guinean *Nothofagus* species can be immediately distinguished from other groups by means of a combination of vegetative characters: peltate stipules, distichous leaves with sulcate midrib and glandular lower surface, and the resinous colleters at the inner side of stipules and perular bracts. The leaves are further distinguished by being coriaceous, as a rule entire, emarginate in the apex, and by having revolute margins and a convolute bud position.

If these distinguishing features are regarded separately, however, transitions are often found from one group to another, making the limits more diffuse. Coriaceous leaves are found not only in the tropical species but also in the extratropical species of the section *Calusparassus*. Some of these, *N. Solandri* and *cliffortioides*, have also entire leaves; on the other hand, the leaves of two species from New Guinea, *N. Perryi* and *N. crenata*, are crenate in the upper part; the latter has also thinly coriaceous leaves, with a certain resemblance to *Fagus*. Peltate stipules, glandular on the inside, are found not only in the tropical group, but also for instance in *N. antarctica* of the other group. Further in the New Guinea group *N. cornuta* has not the sulcate midrib otherwise distinguishing the group, and a few species have not revolute, but ± flat leaf margins. Convolute leaf primordia are found in the extratropical *Calusparassus* species, and not only in the tropical group.

The leaf-anatomical investigations made by Langdon (l.c.) show a very sharp difference between for instance *Nothofagus Cunninghamii* and the New Guinean *N. Brassi* (p. 359, Fig. 18—19), the latter as well as two other investigated species having a several-layered hypodermal tissue with thickened cell walls; but another species from New Guinea (11335), which in other respects also is somewhat deviating, has according to the author no thick-walled cells except in the proximity of the nerves, as in for instance *N. Solandri* of the other group (p. 360).

Even if, as shown by these examples, there often is no sharp difference in special characters, it is nevertheless a matter of interest that the tropical group on the whole has a special combination of vegetative characters, distinguishing them from other species.

Wood anatomy

Of the wood anatomy an excellent study has been made by Dadswell and Ingle (1954). It has given the interesting result that in *Nothofagus* there are two strikingly different wood types, one of them represented by the New Guinean species — more recently (in Cookson and Pike, 1955, p. 197) the New Caledonian species have also been referred to it —, the other by the extratropical species. The only species that to some degree is intermediate is *N. Moorei* from the warmer parts of the Australian distribution area; it approaches the tropical type a little. Important differences between the two types are that growth rings are present in the extratropical group, but absent in the other, that wood parenchyma is very scarce in the former but abundant in the latter, that the vessels are dense and small in the former, 50—100(110) μ in average maximum diameter, and 420—880 μ in av. length, but sparse and large in the latter, 125—190 μ in average maximum diameter and 720—950 μ in av. length, and that tracheids are present in the former but absent from the latter. Some of these differences may, as pointed out by Bailey (in Dadswell and Ingle, 1954, p. 142), be due to the tropical-montane climatic conditions of the New Guinean and New Caledonian districts; for instance, the absence of growth rings. Other divergences must however be genetically founded, even if they possibly have arisen through selection in the course of time under tropical conditions. In certain respects the tropical group, as a matter of fact, agrees more with the genus *Fagus* than with the other *Nothofagus* species, as in the absence of tracheids and the length of the wood fibres, which in *Fagus* and the tropical *Nothofagus* reaches 1.48 mm but in the extratropical *Nothofagus* species averages 0.70—1.16 mm.

Female inflorescence and cupule

A comparison of the female inflorescence and the cupule of *Fagus* and the two *Nothofagus* groups shows the following distinguishing features.

Fagus: The cupule is generally 4-valvate and 2-flowered, without a central, primary flower but with two lateral flowers of first order, each of them surrounded by two cupular valves or lobes.

In cases of increase of the flower number in the cupule, which are not rare in *Fagus sylvatica,* the number of cupular lobes also increases, in a definite relation to the flowers: if there are *n* flowers, there are $n+2$ lobes. The same relation is found in cases of reduction of flower number: if only one side flower is present, which occurs in rare cases, there are only three cupule lobes. There is apparently no upper limit for the number of flowers and lobes; at least 9 flowers and 11 lobes may occur (Hjelmqvist, 1948, p. 85, 95). In its morphological nature the cupule corresponds to a branch system with dichotomous ramification: the flowers are terminal on the transformed branch generations and at the place of each flower the shoot divides into two.

Nothofagus, extratropical species: The cupule is generally 4-lobate with three flowers, one dimerous central flower and two trimerous lateral flowers of the first order, each surrounded by two cupule lobes.

If the number of side flowers is reduced, the number of cupular lobes also decreases. In *N. Solandri* and *cliffortioides* from New Zealand there is often only one side flower, and then the cupular lobes are only three; at the side where no side flower is present there is an undivided valve. In *N. pumilio* from S. America, moreover, only one flower is found in the dichasium (trimerous or with more than three carpels), and the cupule is bivalvate. Thus, in the 1- to 3-flowered cupules the relation side flowers/cupular lobes is the same as in *Fagus,* the lobes always being 2 more than the side flowers ($2+4$, $1+3$, or $0+2$).

When the number of side flowers is greater than 2, the conditions are however somewhat different. In a South American species, *N. Alessandri* Espinosa, the flower number is 3—7; as usual there is a flat, dimerous primary flower and two triangular, trimerous side flowers of the first order, but in addition there are often four side flowers of the second order, flattened and dimerous and placed opposite to the cupule valves, which here also are 4 in number (Espinosa, 1928; v. Steenis 1954, p. 267, Fig. 1 e). Thus an upper limit is here present: the number of cupule lobes is never greater than 4, and when the flower number surpasses 3, there is consequently no longer the relation $n/n+2$ between side flowers and cupular lobes.

Nothofagus, tropical species: Cupule always 2-lobate. Flowers in all New Caledonian and four New Guinean species 3 in the dichasium, all dimerous, flattened, with an oblique position in relation to the median plane, while in the remaining New Guinean species only one flower is present, the mid flower of the dichasium.

In the 3-flowered as well as in the 1-flowered cupules the number of cupule lobes is two; here thus no such relation between flower and valve number is found as is met with in *Fagus* and — to a certain limit — in the extratropical *Nothofagus* species. This fact may also be expressed so that the upper limit that in the latter group is determined by a valve number of 4, in this group instead is at a number of 2; the number of valves is never greater than 2, even if the flower number is so great that in other groups it would have caused an increase in the number of lobes.

A further peculiarity of the New Guinean species is that the cupule is ± absent in some species: *N. Carri, flaviramea, cornuta,* and *resinosa.* In *N. flaviramea* there is, however, a small, rounded, flattened appendage at either side of the fruit base, corresponding to the cupular valves (v. Steenis 1955, p. 281—282), and in *N. Carri* also at flowering time two small valves occur, without lamellae. The sole species where the cupule is totally lacking thus are *N. cornuta* and *N. resinosa*; the former, however, has at the flattened side of the female flower a prominent midrib that is prolonged upwards in a glandular appendage somewhat beneath the limb; whether this should be regarded as a perianth structure that occurs when the cupule is lacking, or as the last remnant of the reduced cupule, remains to be investigated. In *N. resinosa* the cupule is apparently totally absent; the cupular structure that van Steenis (1953, p. 356) in the description attributes to this species should according to a later addition (1955, p. 281) belong to *N. flaviramea*. The instances mentioned, as well as some other cases of weak cupule development, speak in favour of the view that there occurs in this group a lesser or greater degree of reduction of the cupule, as has been the opinion of various authors (Langdon, 1947; van Steenis, 1953), and that it is no primitive feature that the cupule is sometimes ± lacking.

Further contributions to the discussion about the origin and homologies of the cupule may be obtained from anatomical evidence. Investigations of the anatomy have already been made by Langdon (1947); some supplementary observations are added to them here.

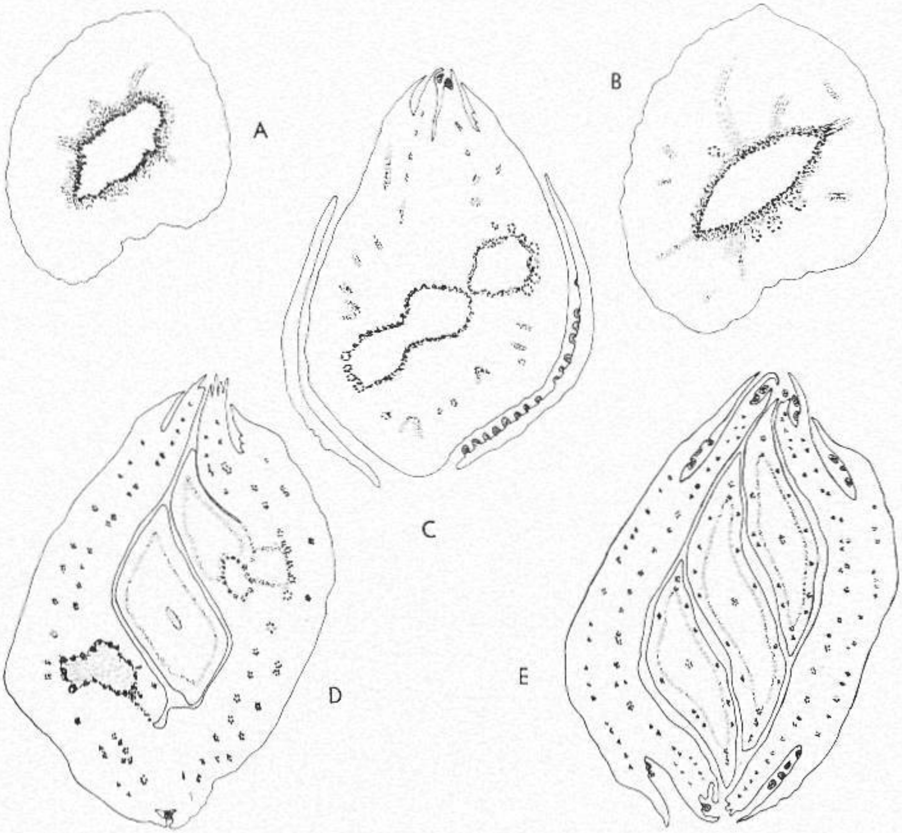

Fig. 1. *Nothofagus Starkenborghii*, successive transverse sections of female inflorescence, from the basal portion (A) towards the apex. — ×12.

Anatomy of female inflorescence

In the 3-flowered species of the tropical group, as *N. Starkenborghii* (Fig. 1, see also Langdon, Fig. 28—33, No. 11363, which probably refers to the same species) the vascular cylinder in the base of the cupule forms a strongly flattened strand, oblong-elliptical in cross section (Fig. 1 A, B), from which smaller strands branch off. At a higher level this flattened strand divides into three, which have the same oblique arrangement as the flowers (Fig. 1 C). The median one of these runs to the median or primary flower of the dichasium, the two others divide again into two branches, one of which proceeds to a side flower, the

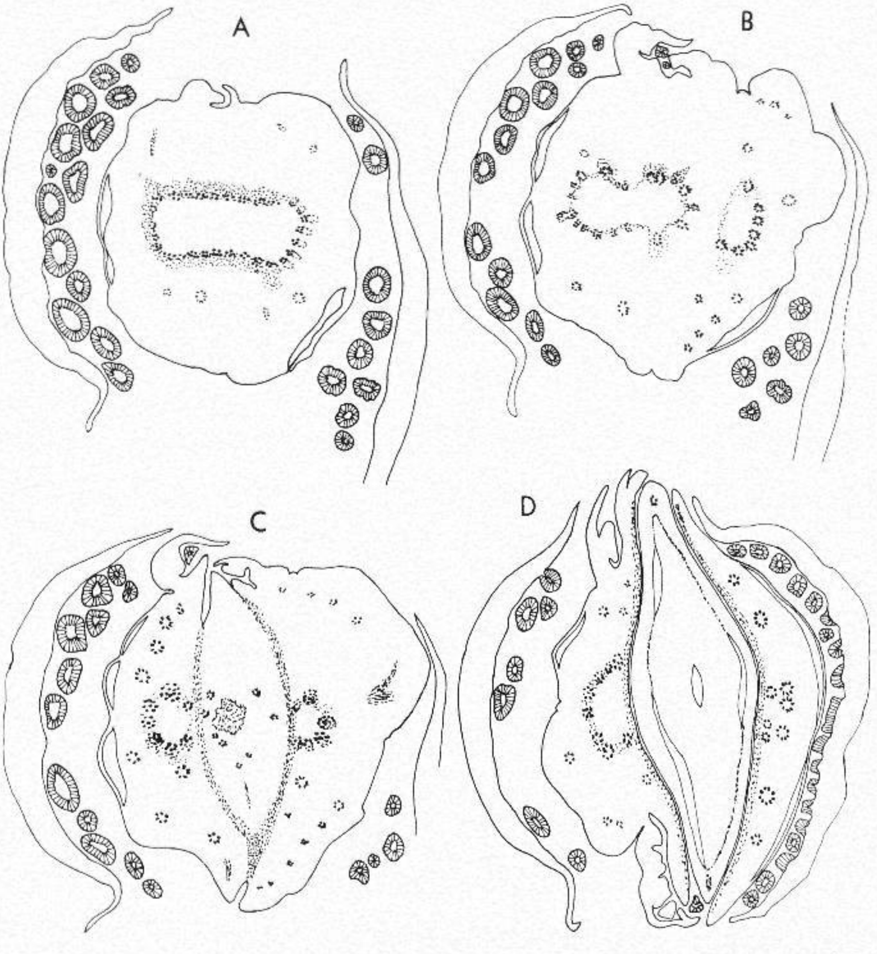

Fig. 2. *Nothofagus rubra,* transections of pistillate inflorescence in successive heights from the basal portion (A) and upwards. — ×25.

other to a cupular valve, where it joins the other vascular strands of the cupule (Fig. 1 D).

A comparison with the 1-flowered New Guinean species shows very great resemblances to the conditions just described. As shown by Fig. 2 (*N. rubra*) and Fig. 34—37 of Langdon (No. 11335=*N. crenata* Steen.) there is here also a flattened vascular strand that divides into three, arranged in a row. The orientation, however, is here not oblique, but transverse in relation to the supporting leaf. Each of these three main

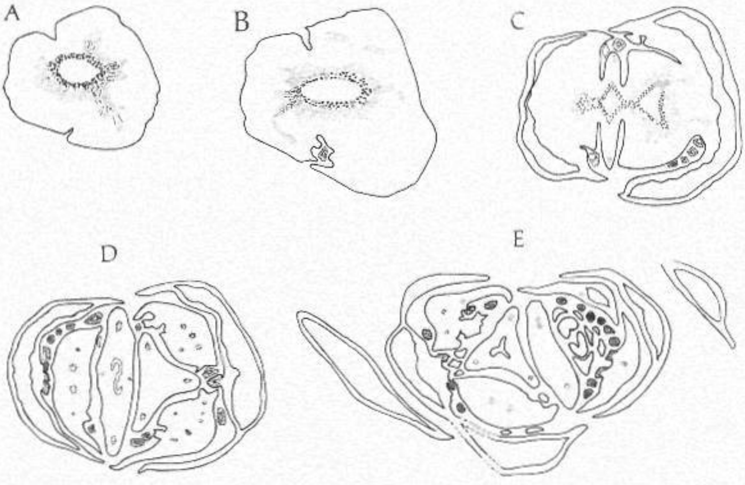

Fig. 3. *Nothofagus cliffortioides.* Female inflorescence with one side flower and three cupule valves in transverse section from basal to apical portion (A to D) and section through a 3-flowered inflorescence with dimerous pistil in one of the side flowers (E); in this case there are four cupule valves. — ×25.

branches is dissolved into circle of strands, where, at least in *N. rubra,* the structure is rather clearly collateral. The median one of these three vascular groups supplies the solitary flower, the two others proceed to the cupular valves. Since side flowers are lacking, the lateral main vascular branches here do not divide into two, but otherwise the conditions of the 1-flowered cupule are in good agreement with the 3-flowered dichasia and it may very well be assumed that this type has developed only by a reduction of the side flowers.

Passing on to the extratropical species, however, we meet a different picture of the course of the vascular strands (Fig. 3, *N. cliffortioides,* compared with Langdon, Fig. 20—27, *N. procera* and *antarctica*). In the base of the cupule (Fig. 3 A—B) the arrangement is about the same as in the former group: a vascular cylinder is present that is circular in cross section below but gradually becomes oblong in cross section higher up, while at the same time some branches are cut off to the cupule. This cylinder is divided into three main strands, the median of which supplies the central, primary flower. The two other strands at a certain height are triangular in cross section (Fig. 3 C, at the right), owing to the fact that from their outer part two branches diverge, representing tertiary axes and proceeding to the two cupular valves that are present

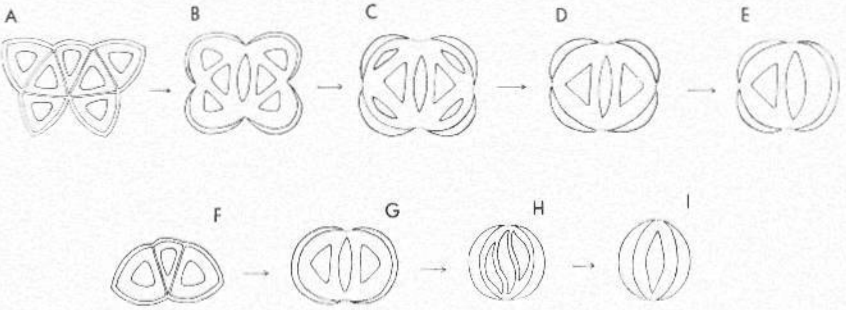

Fig. 4. Diagrams showing the probable derivation of the female inflorescence and cupule of *Nothofagus*. A and F dichasia of the type found in *Chrysolepis*; B and G hypothetical intermediary types (G possibly exceptionally occurring in the New Guinea species); C—E inflorescences of the extratropical *Nothofagus* species (C: *N. Alessandri*, D: the majority of species, E: *N. cliffortioides*, a common type). H—I dichasia of the tropical group, with 3 flowers and only the median flower, respectively.

at either side, while from the inner part a branch runs to the side flower. When, as often is the case in *N. cliffortioides*, one of the side flowers is lacking, the vascular strand at this side is greatly reduced (Fig. 3 C, at the left) and is diffusely resolved into elements that proceed into the cupular valve, now here undivided. The appearance here is thus different from that of the vascular circle found in the New Guinean species when the side flowers are absent.

These anatomical differences, together with the morphological organization, and especially the conditions in *N. Alessandri*, indicate that the cupule of the tropical group is not only a further development of that of the extratropical group through reduction, but that the two groups belong to different evolutionary lines. In the tropical species the development no doubt is derived from a 3-flowered dichasium where the cupule of the median flower has been reduced, while those of the two side flowers are present and are developed as two valves each surrounding a side flower (Fig. 4, below). The oblique orientation is probably a secondary phenomenon due to space factors, since in the 1-flowered cupules the orientation is not changed in this way (Fig. 2; B—C); possibly it is connected with the transition to dimery in the side flowers. — In the extratropical group there may occur in *N. Alessandri*, as mentioned, 7 flowers within the cupule, the 4 outer of which — side flowers of the second order — are placed opposite to the four valves of the cupule. The origin must on this account be assumed to be a 7-flowered cupule (Fig. 4, above), where the four valves correspond to the cupules of four side flowers of the second order, while the cupules of the median flower and of the two side flowers of the first order have been reduced; as always in the *Fagus* group the cupules are developed as a dichotomously branched shoot system. In general the side flowers of the second order are more or less reduced; even in *N. Alessandri* they are, if present at all, flattened and dimerous, and in other species they are almost always lacking. That the cupule of the extratropical and that of the tropical species is derived from a 7-flowered and a 3-flowered type, respectively, need not mean any great difference as to the point of origin, since both types often occur in the same species, for instance in *Chrysolepis chrysophylla*, but a development along two different evolutionary lines is no doubt a matter of importance.

In the genus *Fagus* the cupule is of a somewhat different origin, as it obviously has arisen from a type that in agreement with the newly described genus *Trigonobalanus* (Forman, 1962) has 2-cleft cupules; and the variation in flower and valve number indicates an origin from a dichasium with a varying, indefinite flower number.

Female flower

An important difference between the two *Nothofagus* groups is that the two side flowers in the 3-flowered dichasium in the extratropical group are trimerous, while in the tropical group they are flattened and dimerous. Transitions are, however, found: on the one hand the side flowers of the former group are sometimes dimerous (Fig. 3 E), on the other, according to Langdon (1947), the latter group may have trimerous side flowers; as this condition is not mentioned by van Steenis, it is apparently rare (not observed in the limited material of the present writer). With respect to the perianth there is no great difference: it is in both groups strongly reduced and adnate to the ovary; the perianth leaves between the wings are particularly reduced and in some New Guinean species are not discernible. — In the genus *Fagus* the perianth is better developed than in *Nothofagus*.

According to Poole (1952) the extratropical *Nothofagus* species have an ovule with only one integument, whereas other genera of *Fagaceae* have two integuments. The tropical species in this respect agree with the extratropical ones; here, too, there is only one integument, rather strongly developed. A development series may be followed from for instance the genus *Chrysolepis*, with two about equal integuments, to

Fagus, where the inner integument is reduced and thin (Hjelmqvist, 1957, Fig. 3 *a*) and finally to *Nothofagus*, with only one integument.

Male flower and inflorescence

The perianth of the staminate flower is in the tropical species cup- or bell-shaped, with a truncate or weakly lobate limb. This perianth type is found in all the species from New Guinea of which the male perianth is known (van Steenis, 1953) and occurs also in at least two species from New Caledonia (*N. Balansae* and *codonandra*, herbarium material). In comparison with the extratropical species this type must be held to be transformed and reduced. The most primitive type in the group is found in *Fagus*, with a deeply 6-lobate perianth.

Baumann-Bodenheim (1953) states, when characterizing the genus *Trisyngyne*, that the 3-flowered male dichasia are united in a loose raceme ("in racemum laxum unitis"); according to van Steenis (1954) his separation of the genus *Trisyngyne* from *Nothofagus* is founded on the male inflorescence type, in particular that it is branched and caducous. By van Steenis this character is held to be of minor importance; the New Guinea species according to him as a rule have persistent flowering twigs. Even if there is thus no pronounced deviation in the tropical group as to the male inflorescence, it is nevertheless of interest that we here obviously have a tendency to an inflorescence development of the compound catkin type.

Pollen

According to Cranwell (1939 and 1959, see also Cookson and Pike, 1955), who has investigated the pollen of the extratropical *Nothofagus* species, two different types may be distinguished among these: 1) The *fusca*-type, characterized by moderate size (< 40 μ in diameter), convex polar surfaces and vigorous, scabrate exine, with thickenings around the apertures, and sunken pore membranes. 2) The *Menziesii*-type, distinguished by bigger pollen grains (c. 40—60 μ in diameter at the equator), thin, strongly scabrate (spinulose) exine, and no or rudimentary apertures, but only "wide, furrow-like areas" where the pollen wall bursts. The outline is rather regularly rounded in both types.

The species from New Guinea and New Caledonia, the *Brassi*-type, cannot be fitted into either of these two groups, but form a third, unitary type (Cookson and Pike, 1955). They are distinguished by small—

mediocre pollen grains, which in polar view are polygonal with straight or somewhat concave borders and prolonged apertures. The exine is not thickened around the apertures, covered with a varying number of ± prominent spinules.

Cranwell (1959) expresses the opinion that the tropical group is intermediate between the two others; in comparison with the *fusca*-group it shows some reduction (the thickened borders of the apertures and the pore membranes are "reduced or lost"), and the *Menziesii*-type according to this author could derive its origin from the pollen type found for instance in the fossil *N. whenua* wich is close to *N. Bernhardi* from New Guinea.

According to palaeobotanical investigations, however (Couper, 1960), the *Brassi*-type is older than the two other types; in New Zealand it reaches back to the lower Senonian, while the *fusca*-type is not known before the upper Cretaceous, and in the greater part of the Tertiary (middle Eocene to end of Pliocene) the *Brassi*-type was abundant, the two others of secondary importance; not until the Quaternary period are they on the whole richly present. Is it then possible that the *Brassi*-type is the primary one and that the two others have developed as ramifications from it? It is scarcely probable on account of the fact that the *Brassi*-type as mentioned shows some reduction phenomena lacking in the *fusca*-type. Rather the *Brassi*-type must represent a line of development separated from the two others; it is close to the *fusca*-type but cannot derive its origin from it; they must have developed from a common origin, the development of the *Brassi*-type having included some reduction. In such a way the fact that the type is at the same time both primitive and somewhat reduced, may be explained.

Thus, a survey of some of the more important morphological features shows not only that there are pronounced differences between the tropical and extratropical *Nothofagus* species, but also that these differences can scarcely be explained through a development from the one group to the other. Several facts speak in favour of the view that the tropical group belongs to a special line of development, quite separate from the extratropical one. This of course implies that it should be of a higher systematic rank than has generally been assumed. I should be very grateful if Professor van Steenis, who has described the majority of species, would reconsider the systematic position of the group, with respect to the morphological results, especially the question whether it would not be most correct to regard it as a genus of its own.

One more thing of interest may finally be added. A striking fact is that in several characters the tropical *Nothofagus* species show features that are reminiscent of the order *Betulales* and the family *Betulaceae*. The dimerous female flowers, with their reduced perianth, and the flattened 2-winged fruits, resemble the conditions in *Betulaceae*; an agreement is also that as in this family there is only one integument. These similarities, however, certainly do not mean that there is any direct phylogenetic line from this group to the *Betulaceae*, but should, as well as, for instance, the resemblances that are found between some *Lithocarpus* species and *Juglandaceae* (Hjelmqvist, 1948, p. 62—63), most probably be regarded as parallel phenomena, which are natural in related groups.

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BOTANISKA NOTISER 1963 · VOL. 116 · FASC. 2 · LUND

An Account of the Use of Radiography for the Pictorial Reproduction and Study of Plants

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Introduction

In the course of morphological studies of plants the author of the following description was met repeatedly by the technical problem of how the most appropriate pictorial reproduction could be made. In this connection it can be stated that the current methods such as drawing (with or without mechanical help), photography with a lens camera, stereo-photography, contact-printing, etc., have their advantages and disadvantages. The disadvantages have often been due to the inconvenience, the limited means of application or, in some cases, the imperfect accuracy of the methods mentioned above.

It has become evident that *radiography* is a method which, in many respects, covers the demand for the most accurate and comprehensive reproduction of plants or plant details. This method cannot be regarded as new, and does not differ from its application in diagnostic medicine. However, the great possibilities of radiography in botany have until now been surprisingly little observed. Notes and small articles in photographic magazines were based merely on the aesthetic point of view. The same can be said about the beautifully illustrated notes by Albert D. Richards (1963). Scientifically, radiography has been practised only for seed testing in forest breeding (Simak, Gustafsson and Granström 1953 and 1956 and Metzner 1962).

The purpose of this article is to report on the technique of reproduction of plant material by means of radiography and to point out some possibilities of its application in morphology and anatomy. The notes are based on the author's experiences in the reproduction of a rather large number of ligneous plants.

General technique

The capacity of X-rays in penetrating different media is well known. This capacity decreases in proportion to the density of the medium, i.e. the varying absorptive powers of the structural elements on the X-rays. In photographing plants upon special film, i.e. X-ray film under certain conditions of time, voltage and strength of the electric current, the more dense organs of the plant (leaf-veins and other more or less ligneous parts of the vessel-system, the ovaries, stamens etc.) accordingly show a higher absorptive capacity on the X-rays than the other organs (the thinner parts of the lamina, petals etc.). This gives on the film an exact contrast picture of the plant organs, which is exceedingly rich in detail. Provided that the object and the film are located within the plane of focus and close together, there does not exist any problem as regards adjusting and depth of field in the conventional photographic sense. In using finegrain films, which permit very great enlargment of the negatives, even the smaller and otherwise scarcely observable parts of plant can be studied easily.

In radiographing leaves and flowers of different ligneous plants, some of which may illustrate the above account, the author has been using an X-ray apparatus of the type Dermamobil producing "soft", i.e. long-wave rays by current not exceeding 10 kV with a comparatively limited power of penetration. This is most suitable for the reproduction of the plant organs, which are generally thin. No, or only slight, contrast can be obtained by using "hard", i.e. short-wave, rays with a voltage exceeding 10 kV.

The focus used has been about 70 cm. Generally the author has been working with an X-ray film of normal gradation, which permits contact-printing as well as moderate enlarging (type Ilford Industrial CX). Sometimes finegrain film (type Kodak Crystallex), permitting a considerable degree of enlargment, was necessary. As a rule a voltage of 10 kV and a strength of current of 10 mA has been used, the time of exposure varying between 1 and 3 minutes. When radiographing extremely thin organs a softer degree of radiation was practised for which the time of exposure was prolonged accordingly. In some cases therefore voltage of 7 kV and a time varying between 3 and 15 minutes was adviceable. This was so especially when radiographing very small organs demanding a high degree of enlargment, and consequently the use of finegrain film.

Conclusion

Radiography is a diagnostic auxiliary in plant morphology and anatomy, of very great value for its capacity for absolutely accurate reproduction. Even very small and otherwise unvisible parts of plants are clearly reproduced, making dissection in many cases unnecessary.

The usefulness of radiography in herbarium work is obvious. Dried plants (even very old and brittle ones) are reproduced as easily as fresh material. They generally give the scientist negatives rich in detail. Contact-printing or partial enlargements will enable him to pick out certain essential details. Thus fragile or rare specimens of taxonomic units can be sent as radiograph-negatives in any special size.

The consequences of further development of this method are obvious. For instance the use of contrast media in order to bring out certain essential details in living or dried plants has not been satisfactorily investigated.

The author wishes to express his gratitude to professor Sven Roland Kjellberg, Roentgen Department 1, Sahlgrenska Sjukhuset, Göteborg, for valuable support in every respect.

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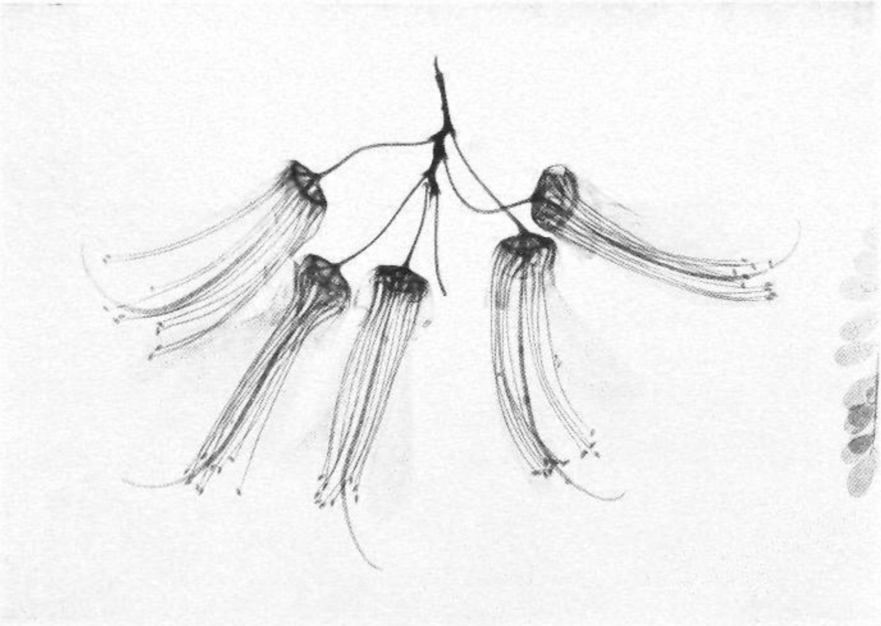
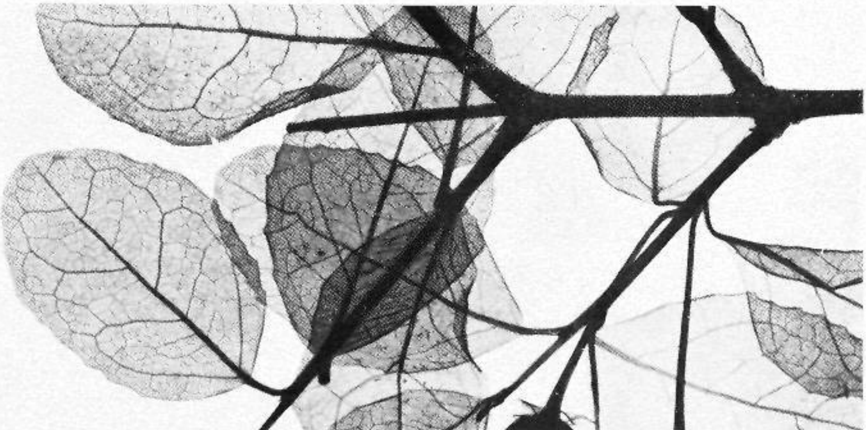
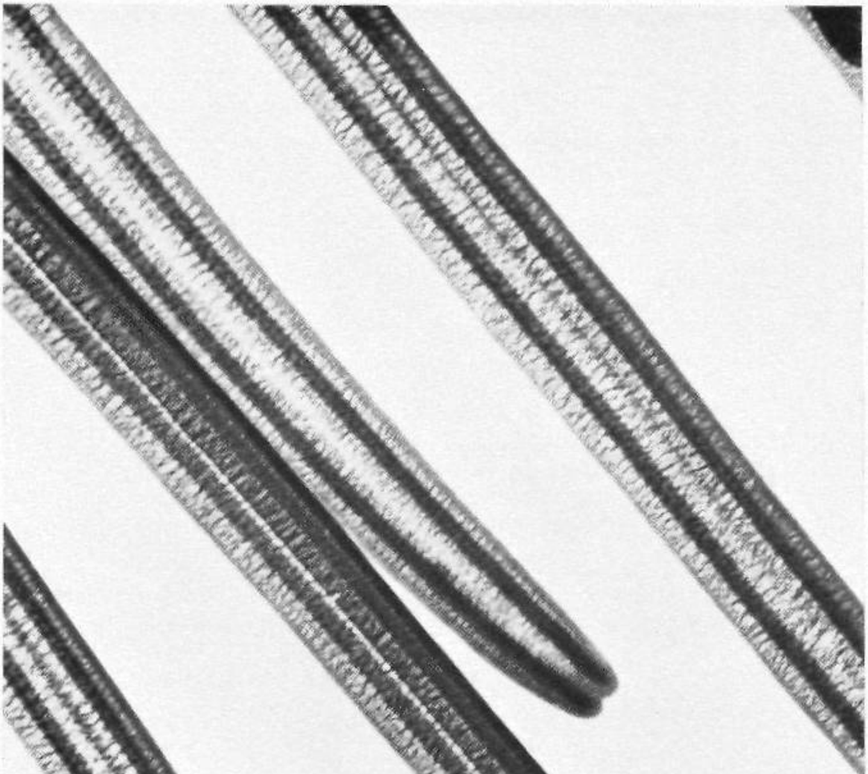




Pl. I a (above). *Sophora tetraptera*. $^3/_4$ nat. size. b (below) *Crinodendron dependens*. ×2. Film: Ilford Industrial CX. Voltage: 10 kV. Time of exposure: 1 minute. Herbarium specimens.

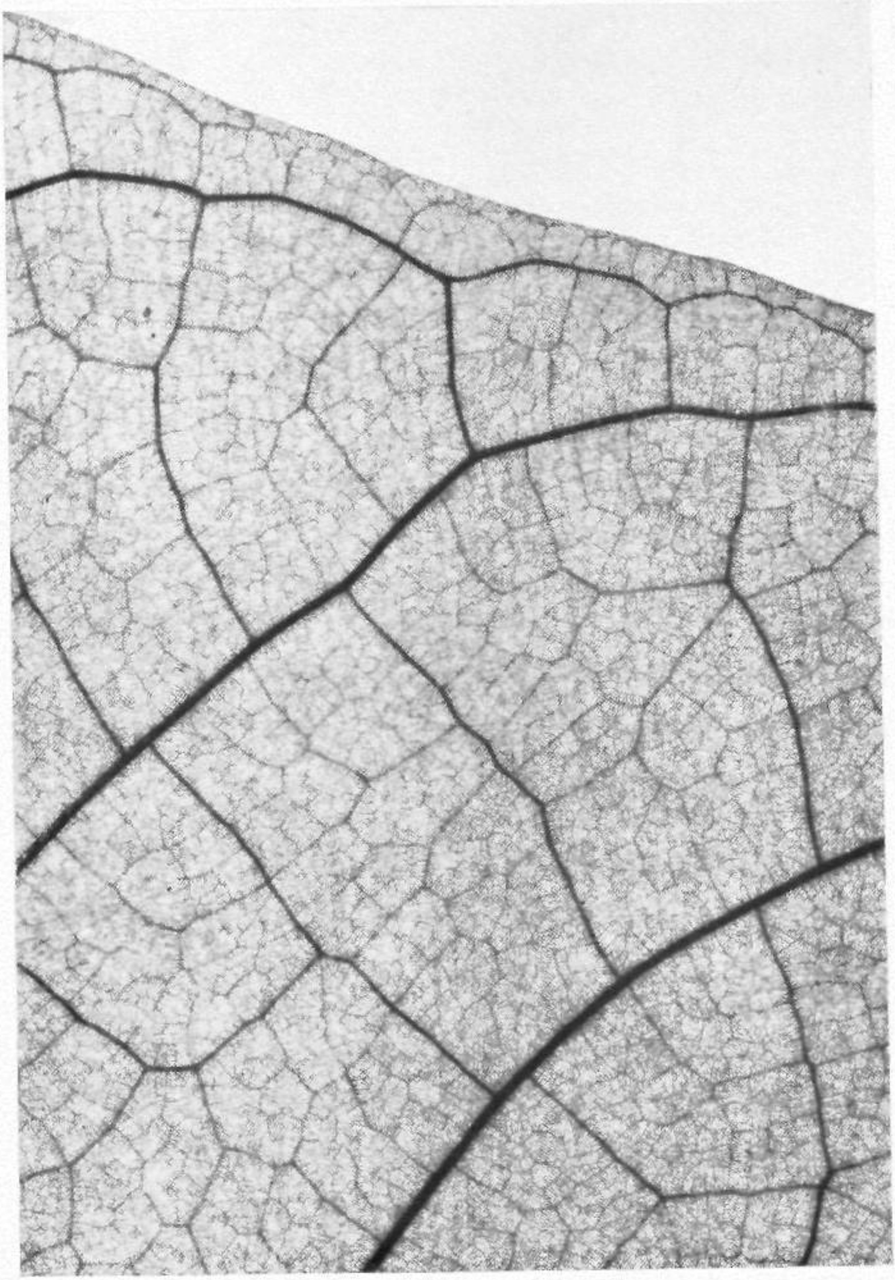
Pl. II. *Thujopsis dolabrata*. Film: Ilford Industrial CX; Enlargment: 5 ×. Voltage: 10 kV. Time of exposure: 1 minute. Fresh material.

Pl. III. *Ligustrum indicum.* Film: Ilford Industrial CX; Enlargment: 2 ×. Voltage: 10 kV. Time of exposure: 1 minute. Herbarium specimen.



Pl. IV. *Sciadopitys verticillata.* Film: Ilford Industrial CX; Enlargment: 5 ×. Voltage: 10 kV. Time of exposure: 3 minutes. Fresh leaves; note the clearly visible two vascular bundles and the connection between the two formerly separate leaves.

Pl. V. *Erythrina crista galli.* Film: Ilford Industrial CX; Enlargment: 2 ×. Voltage: 10 kV. Time of exposure: 1 minute. Herbarium specimen.



Pl. VI. *Theobroma cacao*. Film: Kodak Crystallex; Enlargment: 5 ×. Voltage 7 kV. Time of exposure: 6 minutes. Fresh leaf.

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Chromosome Numbers of Some Carex Species from Spain

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The genus *Carex* is one of the largest genera of amphimictic plants with its more than 2000 species distributed almost all over both hemispheres. It is almost paradoxical that it covers larger areas of cold and moist regions in the northlands than all other genera, though most of its species grow in different kinds of habitats of more southern lands. Only about 15 % of the species have so far been cytologically studied, most of them from boreal and arctic regions where the species number is low.

The present writers had an opportunity to collect cytological material of *Carex* from a more southern climate in 1962, in connection with studies of the cytotaxonomy of the Iberian flora. Altogether fourteen species of *Carex* were collected in two areas (Fig. 1), viz. the Cazorla Sierras of the province of Jaén (1), and the Albarracin Sierras of the provinces Cuenca and Teruel (2).

The fixations were made in the field in the Svalöv modification of Navashin's fixative (cf. Löve & Löve, 1954) and the preparations were made according to the paraffin method and stained in crystal violet with anilin. Voucher specimens were taken of the plants studied, and duplicates of these are being deposited in the herbaria of Liverpool and Lund under the collection numbers given below.

Carex Halleriana Asso

This is the only species of the section *Hallerianae*; it is a plant of dry grasslands or thin forests in calcareous regions. It is common in the mediterranean region but occurs also further north, up to southern Germany, Austria and Hungary. The chromosome number of plants from Casa el Foresta, Tragacete, area 2, collection number N433, was found to be 2n=54 (Fig. 2 C); this is the first report for this species.

Fig. 1. Map showing the two areas within which cytologically investigated material has been collected.

Carex asturica Boiss.

A representative of the section *Panicae*; it prefers alpine grasslands. This species is endemic in the Iberian Peninsula. Its chromosome number 2n=46 (Fig. 2 B) was counted on plants from Guadahornillos, area 1, (N103); it is a new report.

Carex pendula Huds.

This species, which belongs to the section *Maximae,* grows in damp woods and along shady streams from Denmark and the British Isles southwards to North Africa and eastwards to western Asia. Heilborn (1939) studied cultivated material of unknown origin and reported the chromosome number 2n=58, whereas Tanaka (1942 d, 1948) counted 2n=60 in plants grown from seeds originating from the Botanical Garden in Tábor in southern Czechoslovakia. Our specimens from a spontaneous population, from near Tranco close to the river Guadalquivir in area 1 (N217), were found to have 2n=58 chromosomes (Fig. 2 J).

Carex distans L.

This species of the section *Spirostachyae* grows scattered in marshes and in cracks of wet rocks mainly near the coast all over sub-Atlantic Europe from Scandinavia to the Mediterranean and the Azores and Madeira; it also reaches North Africa and western Asia. Our material from Vadillo, area 1, (N188) was found to have 2n=74 chromosomes,

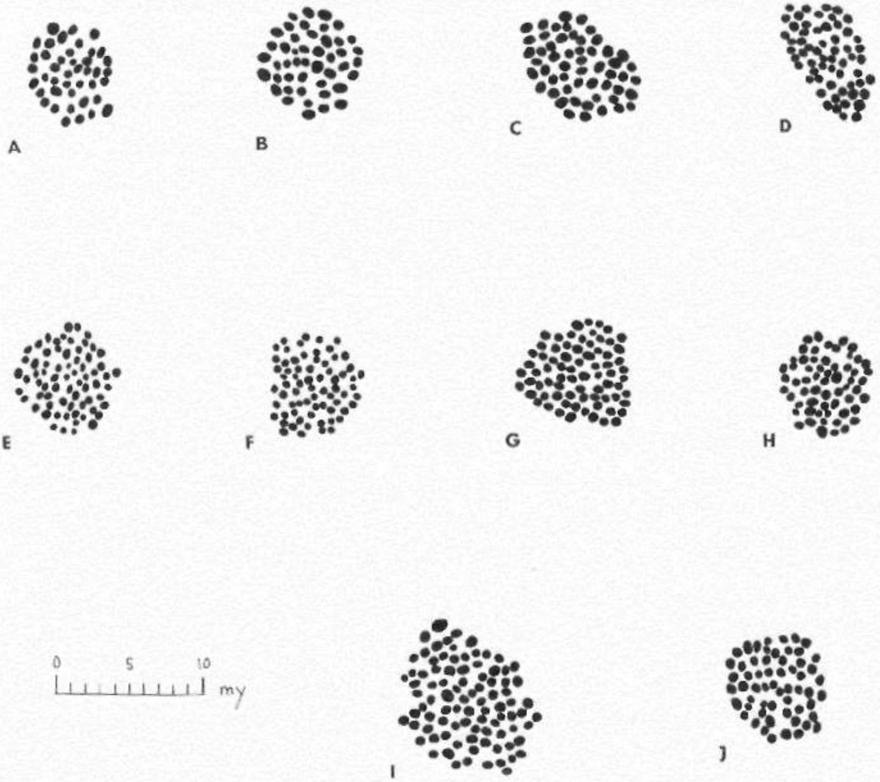

Fig. 2. Chromosome illustrations of A. *C. hispida* Willd. 2n=42; B. *C. asturica* Boiss. 2n=46; C. *C. Halleriana* Asso 2n=54; D. *C. lamprophysa* Sam. 2n=60; E. *C. Mairii* Coss. & Germ. 2n=68; F. *C. nevadensis* Boiss. & Reut. 2n=68; G. *C. distachya* Desf. 2n= 74; H. *C. divisa* Huds. 2n=60; I. *C. flacca* Schreb. 2n=90; J. *C. pendula* Huds. 2n=58.

or the same number as previously reported by Heilborn (1924) and Davies (1953, 1956 a, b) from Scandinavia, the British Isles and France.

Carex Mairii Coss. & Germ.

Another representative of the section *Spirostachyae*; it grows in wet meadows and slopes. This species is endemic in southwestern Europe, where it is rare in southern and western France and the Italian Riviera and scattered in Spain from the Pyrenees to the Sierra Nevada. Our material from Vadillo in area 1 (N140) was found to have 2n=68 chromosomes (Fig. 2 E), which is the same number as previously reported by Davies (1955) from Lumbreras in Spain.

Carex nevadensis Boiss. & Reut.

An endemic Iberian representative of the section *Spirostachyae,* mainly restricted to alpine regions in the Pyrenees and Sierra Nevada. Our material originated from San Felippe near Tragacete in area 2 (N440). Its chromosome number was found to be 2n=68 (Fig. 2 F), which is a new report.

Carex flacca Schreb.

A species of the section *Trachychlaenae* growing in dry calcareous grasslands, deep woods or bogs from Central Scandinavia, Iceland and the British Isles southwards to North Africa and eastwards to southern Siberia. Our material originated from 10 km south of Tragacete in area 2 (N460). Its chromosome number was found to be 2n=90 (Fig. 2 J), which is a higher number than the 2n=76 previously reported from Scandinavia by Heilborn (1924, 1932) and Tanaka (1942 d, 1948), Iceland by Löve & Löve (1956), and Britain by Davies (1956 a, b). Although our plants have a chromosome number differing from these reports, they doubtlessly belong to the typical variety and can not be referred to the taxon *C. cuspidata* Host, which is reported as a variety only of *C. flacca* by Kükenthal (1909) and others. It is a complex worthy of a closer investigation.

Carex hispida Willd.

A mediterranean species of the section *Trachychlaenae*; it grows in ditches and other wet places, especially near the coast. Our material was from Guadahornillos in area 1 (N87). Its chromosome number was found to be 2n=42 (Fig. 2 A); it has not been reported previously.

Carex divisa Huds.

A species belonging to the section *Divisae* and growing in moist often sandy places from Belgium and southern Britain, mainly near the shore, to the mediterranean region and North Africa eastwards to Crimea and the Himalayas; it is also reported from South Africa where it may be introduced. Our material originated from Vadillo in area 1 (N189). The chromosome number of our plants was found to be 2n=60 (Fig. 2 H). Tarnavschi (1948) reports 2n=14 from plants grown from seeds from Montpellier in France, but since the number counted by the present writers is closer to the numbers known from other species of the same section (cf. Löve & Löve, 1961), it is likely that the report by Tarnavschi has been based on some accidental mistake.

Carex divulsa Stokes

This species, which belongs to the section *Muehlenbergianae* and grows in pastures, open woods, hedge-banks etc., is common in southern Europe, North Africa and western Asia but rarer in western Europe though it is scattered throughout England and Wales and north to southern Scandinavia. The material studied by us originated from Nava de San Pedro in area 1 (N247), and Sierra Alta, Bronchales, in area 2 (N522). Its chromosome number was found to be 2n=58, or the same as previously reported by Tanaka (1942 b, 1948) from the Botanical Garden of Tábor, Rodrigues (1953) from Portugal and Davies (1956 a, b) from England.

Carex paniculata L.

A representative of the section *Paniculatae*; this species of wet and shady places on peaty soils, is distributed all over Europe except the far North and also in western Asia. Previous reports give the chromosome number 2n=60 (Tanaka 1942 b, 1948), 2n=62 (Tanaka 1948) and 2n=64 (Wulff 1939; Tanaka 1942 a; Löve & Löve 1944). Our specimens originated from 30 km SSE Tragacete in area 2 (N487). Their chromosome number was found to be 2n=60.

Carex lamprophysa Sam.

A representative of the section *Stenorhynchae* with preference for wet meadows on clayey soils and with a Central-West European and mediterranean distribution. The closely related *C. vulpina* L. also prefers similar habitats, whereas its distribution is more continental. A good comparison of these species has been made by Samuelsson (1922), Senay (1945), Kern and Reichgelt (1954) and Clapham, Tutin and Warburg (1962); we just would like to stress that the best separating character is the papillose perigynia of *C. vulpina* as contrasted to the smooth perigynia of *C. lamprophysa* (Fig. 3).

There has been some confusion as to the correct name for this species, since its oldest name, *C. nemorosa*, proposed by Rebentisch (1804), already had two previous homonyms. According to Janchen (1959) and many previous authors this is the plant described by Podpěra (1922) as *C. Otrubae*, but recent studies have shown that that plant actually is the hybrid *C. vulpina*×*contigua* as originally conceived by Podpěra (l.c.) (cf. Dostál, 1950; Jalas, 1958; Janchen, 1963). Therefore, the correct name of the species seems to be *C. lamprophysa* as described by

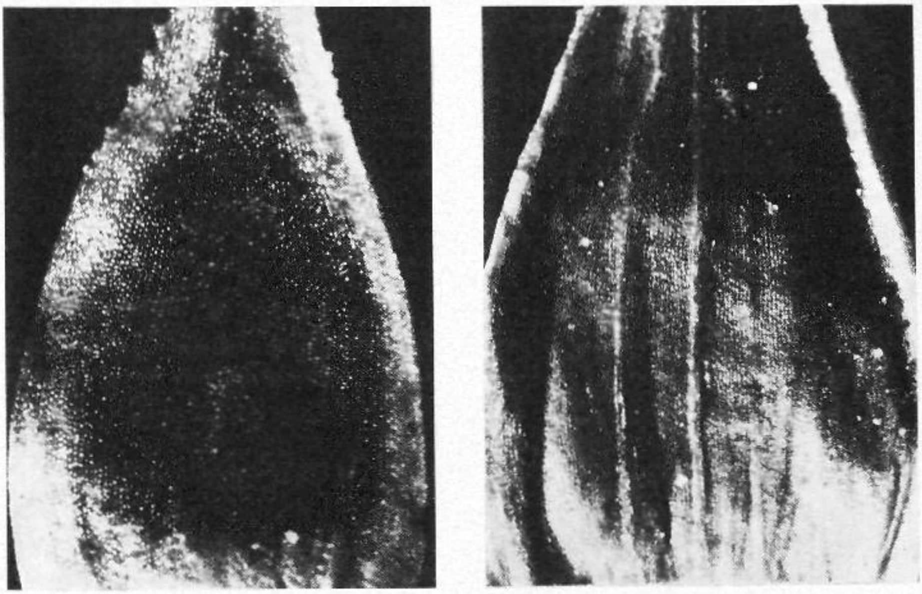

Fig. 3. Part of perigynia of *C. vulpina* L. (left) and *C. lamprophysa* Sam. (right).

Samuelsson (in Nordhagen, 1940). A later synonym is *C. subvulpina* (cf. Senay, 1945).

C. lamprophysa was reported from the Iberian peninsula by Samuelsson (1922), whereas Fernandes-Galiano and Heywood (1960) and others seem to include it under the name *C. vulpina*. According to Samuelsson (l.c.) the latter species in its strict sense is not represented from the Iberian peninsula in eight of the largest herbaria of Europe and the material available from this region in the herbarium in Lund also belongs only to the former species.

The two species here discussed are not only morphologically and geographically different, but also cytologically distinct, since *C. vulpina* s. str. has the chromosome number 2n=68 as reported by Heilborn (1922, 1924), whereas Tanaka (1942 b, 1948) reported 2n=60 for *C. lamprophysa*. Our material of the latter, originating from the neighbourhood of Tranco in area 1 (N220), also had 2n=60 chromosomes (Fig. 2 D).

Carex leporina L.

A species of the section *Ovales* usually distributed in acid soils throughout Europe except the far north and far south; it also occurs in North

Africa. Our specimens were from Sierra Alta, Bronchales in area 2 (N531). Their chromosome number was found to be 2n=64, which is the same number as reported by Tanaka (1942 c, 1948) and Davies (1956 a, b). Slightly higher numbers have been reported by Heilborn (1939) and Tanaka (1942 c, 1948) who found 2n=66, and by Wulff (1938) and Tanaka (1942 c, 1948), who counted 2n=68 chromosomes, but these seem to be more rare deviations of the kind sometimes observed in a few groups of the genus (cf. Tanaka 1948).

Carex distachya Desf.

A representative of the section *Schiedeanae* of the subgenus *Indocarex*; this species grows among rocks and stones along roads etc. and is strictly mediterranean in its distribution. Our material was collected at the lake near Tranco in area 1 (N 216). Its chromosome number was found to be 2n=74 (Fig. 2 G), which is the first report for the species.

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Summary

The following chromosome numbers are given for species of *Carex* from Spain:

Carex Halleriana Asso	2n=54	*Carex hispida* Willd.	2n=42
Carex asturica Boiss.	2n=46	*Carex divisa* Huds.	2n=60
Carex pendula Huds.	2n=58	*Carex divulsa* Stokes	2n=58
Carex distans L.	2n=74	*Carex paniculata* L.	2n=60
Carex Mairii Coss. & Germ.	2n=68	*Carex lamprophysa* Sam.	2n=60
Carex nevadensis Boiss. & Reut.	2n=68	*Carex leporina* L.	2n=64
Carex flacca Schreb.	2n=90	*Carex distachya* Desf.	2n=74

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Studies on Mire Vegetation in the Archaean Area of Southwestern Götaland (South Sweden)

III. On the Relation between Specific Conductivity and Concentrations of Ions in the Mire Water

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Introduction

As the specific conductivity of the water is easily measured even in the field it has often been used in order to estimate the total amount of ions in the water. Especially when combined with determination of pH it has proved to give information of great ecologic significance in the studies of mire vegetation. Cf., e.g., Kivinen 1935, Sjörs 1952, Gorham 1956 a, Gorham & Pearsall 1956, Pearsall 1956, Persson 1962, Malmer 1962 a and 1962 b. However, in interpreting the results of the measurements it is necessary to know the relation between the specific conductivity of the water and the concentration of major constituents found in the water at the ionic determinations.

The investigations have been performed in the Laboratory of Plant Ecology at the Institute of Systematic Botany of Lund University (head of the institute Professor H. Weimarck). Assistance as regards sampling has been given by Messrs. G. Ahrne, F. Andersson and M. Sonesson. Most of the laboratory work and the calculations have been carried out by Mrs. Mimmi Varga. Docent Åke Persson has critically read the manuscript.

Methods

The material treated in the present paper comprises mire water samples in which pH, specific conductivity and all the major constituents (Na, K, Mg, Ca, Cl, HCO_3^- and S) have been analyzed. Sampling has been performed in the open water on the surface of the mires in the whole investigated area in southwestern Götaland during the years 1955—1960 at all times of the year except when the mires are frozen. All the samples except two very deviating ones representing extremely rich fen vegetation have been included in this investigation.

The pH was determined electrometrically (glass electrode). The specific conductivity was determined at the same time as the pH by means of bright platinum electrodes (cell constant about 0.24). The reduced conductivity (abbrev. $\varkappa_{\text{red}}$) denotes the conductivity at 20°C multiplied by 10^6 when the conductivity due to the hydrogen ions, has been subtracted. The following values of the ionic conductivities have been used at the calculations concerning the specific conductivity: H^+ 325, Na^+ 45.1, K^+ 66.3, Mg^{2+} 96.2, Ca^{2+} 108, Cl^- 68.5, HCO_3^- 40.4 and SO_4^{2-} 145.

A thorough description of the investigated area and of the analytical methods including calculations of the errors are given in Malmer 1962 a pp. 9 ff. and pp. 186 ff. Some analyses are published there, too, (p. 303) and in Malmer 1962 b (Table A).

Results

When all the analyses are taken into account the measured reduced conductivity is lower than but proportional to the reduced conductivity calculated from the ionic determinations (Fig. 1). The difference is very variable. It is most evident at low ionic concentrations. In Central Sweden similar conditions have been demonstrated by Gorham (1952 p. 222) and they appear from calculations founded on analyses given by Sjörs (1948 p. 100). However, the same calculations on samples from the Lake District in England (Gorham 1956 b) and northern Scotland (Pearsall 1956) show agreement between measured and calculated conductivity in similar types of water.

When the pH is above 5 the measured reduced conductivity in the investigated mire waters is, on an average, only slightly lower than the calculated one (Fig. 2). These water samples are usually rather poor in humus and represent mainly spring and rich fen vegetation. The same relation is found in lake waters poor in humus in South Sweden (Malmer 1960, 1961). The differences between measured and calculated conductivity may be due to the fact that the ionic conductivities at infinite dilution are used at the calculations. As this condition is not realized the somewhat lower measured conductivity is easily explained. When pH is lower than 4.5 the measured reduced conductivity is considerably lower than the calculated one. In these waters rich in humus it can hardly be said to giv any reliable information about the total contents of ions. Most of these samples represent bog and poor fen

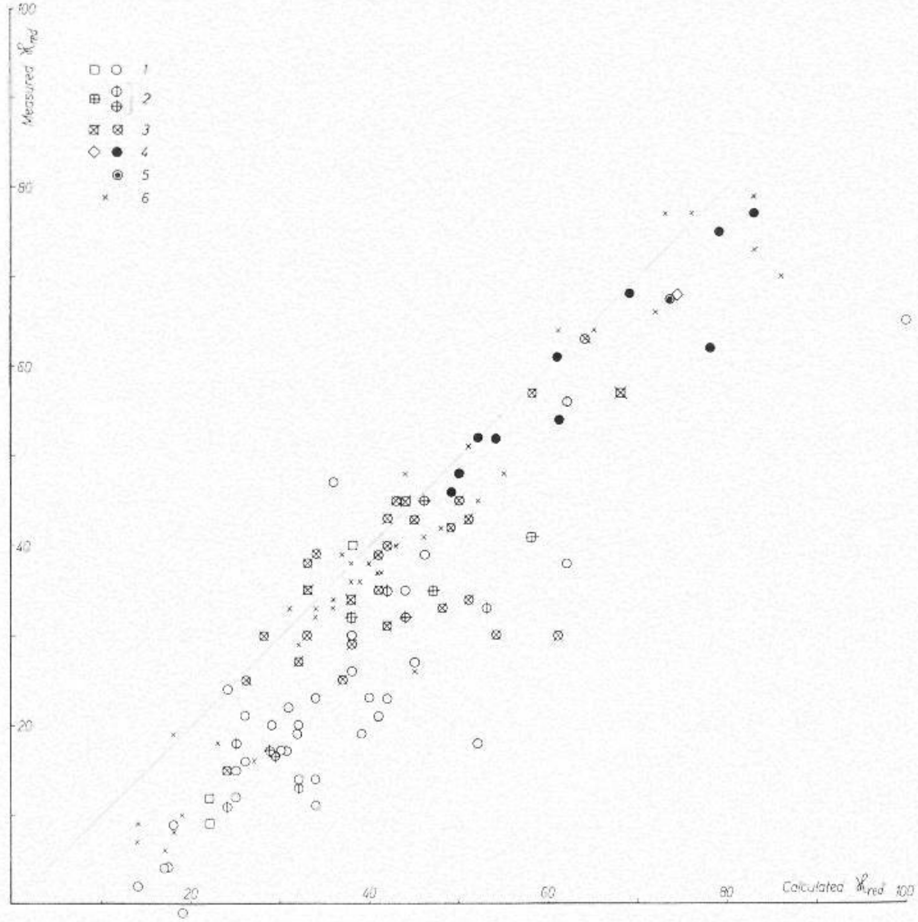

Fig. 1. The measured reduced conductivity (along the ordinata) in relation to the reduced conductivity calculated from the determinations of the major constituents (along the abscissa). -- Explanations. 1. Bog vegetation. 2. Poor fen vegetation without, e.g., *Menyanthes trifoliata, Utricularia* spp., *Carex lasiocarpa* and *Equisetum fluviatile*. 3. Poor fen vegetation with the mentioned species. 4. Moderately rich fen vegetation. 5. Extremely rich fen vegetation. 6. Samples published in Malmer 1962 b Tab. A. Circles denote samples representing mire expanse vegetation, squares wooded bog and mire margin fen vegetation as well as (when oblique) spring fen vegetation. (Terminology according to Malmer 1962 a.)

vegetation. The same conditions occur in similar types of lake water and surface water in mineral soil areas (Malmer opp.cc. and 1962 a p. 302).

In most of the samples the sum of cations (hydrogen ions + metallic cations) is higher than the sum of anions (Fig. 3). The difference may

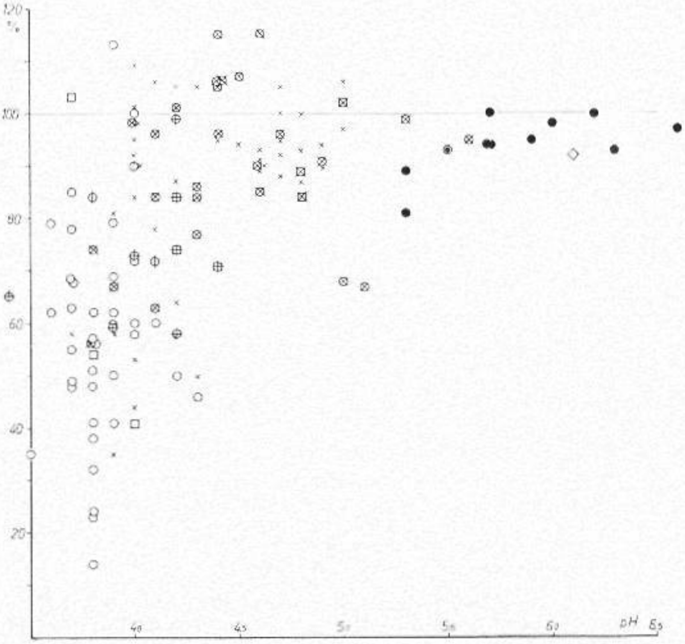

Fig. 2. The measured reduced conductivity in per cent of the calculated reduced conductivity (along the ordinata) in relation to the pH of the water (along the abscissa). — Further explanations in Fig. 1.

be estimated at about 0.15 meq/l on an average, but many times it amounts to twice this value. Only in samples representing rich fen or spring vegetation is there a fairly good agreement between the sum of cations and the sum of anions if the analytical errors are taken into account. In the investigated area equivalent amounts of cations and anions have been found in lake waters poor in humus but not always in acid surface water rich in humus from mineral soil areas (Malmer ll.cc.). Analyses of acid mire waters from Central Sweden published by Witting (1947) and Sjörs (1948) also indicate a great excess of cations over anions. However, on the British Islands Gorham (1956 b, 1958) and Pearsall (1956) have found equivalent proportions in similar types of water.

Discussion

The analytical results from southwestern Götaland treated above indicate considerable differences between acid waters rich in humus and less acid waters not too rich in humus. In the former case there is an

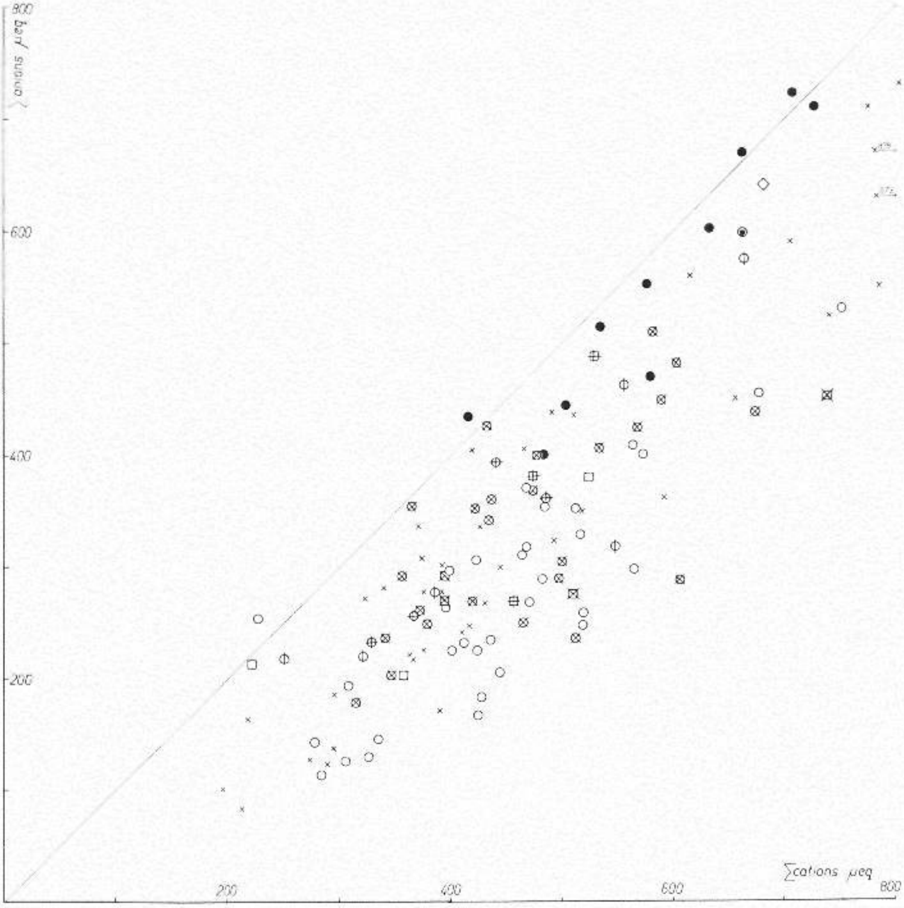

Fig. 3. The relation between the sum of anions (along the ordinata) and the sum of cations (hydrogen ions+metallic cations; along the abscissa). — Values in μeq/l. Further explanations in Fig. 1.

excess of cations and the calculated specific conductivity is higher than the measured one. In the latter case there are equivalent amounts of cations and anions as well as a fairly good agreement between calculated and measured values for the specific conductivity.

The lack of equivalence between cations and anions in the most acid waters rich in humus cannot be assigned to analytical errors, some of which have been discussed earlier (Malmer 1962 a p. 206). Duplicated determinations of pH show a standard deviation of ±7 % at the calculation of hydrogen ions as equivalents. It does not seem probable that there is a great error in the determination of pH due to a "suspension effect" of the humus colloids (Jenny et al. 1950). Only in a few of the most acid samples does the hydrogen ion concentration amount to as much as 0.15 meq/l. The results of the measurements of the specific conductivity make such an error very improbable, too.

The conditions discussed above seem to indicate that in waters rich in humus the ions are often distributed on two phases. All the anions (Cl^- and SO_4^{2-}) and the equivalent amounts of cations are dissolved in the water. The specific conductivity measured in the water seems to refer to this part of the ions which owing to the method used probably includes the hydrogen ions measured at the determination of pH. The remaining part of the cations is probably adsorbed on the filterable colloids in such a way that they do not affect the electric conductivity and do not have any corresponding anions. Among the metallic cations Ca^{2+} above all but also Mg^{2+} ought to be adsorbed on the colloids. Cf. the discussion in Malmer 1962 b pp. 35—36. A rough estimate indicates that the equivalent conductivity of the adsorbed ions may be somewhat less than 60. The sum of Ca^{2+} and Mg^{2+} usually amounts to about 0.08—0.15 meq/l. It is considerably lower only in the most dilute bog waters. In proportion to the contents of humus in the water (0.1—0.2 g/l) there may be about similar amounts of these two elements as in the peat (Malmer & Sjörs 1955, Malmer 1962 a and 1962 b).

At a pH above 5 it seems probable that many times only an unimportant part of the cations are adsorbed on the humus colloids. The excess of cations over $Cl^- + SO_4^{2-}$ is balanced by HCO_3^-. The pH of the water mainly depends on this equilibrium, too. In the more acid waters, where the excess of cations is adsorbed on the colloids, the pH is related to the distribution of the ions between the colloids and the water. The normal seasonal variation in pH seems to follow the redox conditions but not the variation in the concentration of metallic cations and anions (Malmer 1962 b p. 24). However, in southwestern Götaland extremely low figures for pH in bog water (3.4—3.5) have been measured in samples with unusually high concentrations of Cl^-. No determinations of SO_4^{2-} are available from such samples.

In the acid bog waters from the British Islands investigated by Gorham (1956 b, 1958) and Pearsall (1956) there are higher concentrations especially of anions than in southwestern Götaland (Malmer 1962 a p. 208). In that way equivalence between cations and anions as well as agreement between calculated and measured values of the specific conductivity is established. The pH is, however, the same in both areas.

Bog waters in Central Sweden have the same pH, too, but the excess of cations over anions is often greater than in South Sweden (Witting 1947, Sjörs 1948). It seems probable that sometimes nearly all metallic cations are adsorbed on the colloids in these waters. As the anions have a low equivalent conductivity compared with the hydrogen ions extremely low values and even negative ones may be found, when the reduced conductivity is calculated.

The discussion above indicates that the specific conductivity depends on the ions really dissolved in the water. In acid waters rich in humus there often seem to be, in addition, considerable amounts of metallic cations adsorbed on the colloids. The size and the chemical composition of this part varies both locally and regionally. Among other things it is related to the organic and inorganic constituents in the water as well as to the acid-base status. However, if these conditions are taken into account, measurements of the reduced conductivity in order to estimate the contents of ions will always yield easily obtainable information comparable with similar determinations in less acid waters poor in humus and of great importance in ecologic studies.

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Soil Moisture in Relation to Heath and Meadow Vegetation

I. Principles and methods

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(Meddelande från Lunds Botaniska Museum, Nr 178)

Introduction

In this paper we intend to present principles and methods which underlie the ecologic soil moisture studies carried out in connection with our investigations of Scanian heaths and meadows. In a following paper these methods will be exemplified by results from two soil profiles.

Soil moisture as habitat condition

In a paper by Sjörs (1954), i.a. soil moisture is treated and his ideas have guided our studies. Sjörs (op.c. p. 85; translated from Swedish) writes: "As direct ecologic condition (disregarding secondary effects, e.g. on acid-base status, other supply of electrolytes and aeration) the soil moisture can be characterized by the quantity of available water and the difficulty of plant taking it up. Excluding the effects of salts the soil moisture tension expresses this difficulty. These two properties are interrelated functions and their mutual relation is very different in different soils and must be determined in each case".

With this view in mind it is the actual available [1] water, its fluctuations and retention that must be recorded. Occasional or a few

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[1] In the following text available and unavailable always has the meaning of available to plant respectively unavailable to plant.

observations of these soil moisture conditions give incomplete information. Only when these determinations are made throughout the whole year their ecologic value will be satisfactory. Observations ought to be made during one or rather more years in order to estimate the effects of the duration and appearance of favourable and unfavourable periods. Periods with strong drying up or drowning may in several cases give rise to differentiation of vegetation. In case of too scattered observations it is possible that extreme conditions would be overlooked or overestimated.

The retention of soil moisture

The soil moisture is often classified as gravitational, capillary and hygroscopic water and water vapour (cf. Kramer 1949 p. 25—27, and the literature quoted there; Veihmeyer 1956 p. 64). These different classes of water cannot practically be delimited from each other. Therefore it is better to use a numerical expression like pF to describe the retention of water. Schofield (1935) defined pF as the common logarithm of the height in cm of a column of water corresponding to the free energy difference between free water and that held by soil, expressed as the pressure of the above mentioned column of water. Excluding the effects of salts, the retention of soil moisture expressed as energy (e.g., erg/g) equals numerically this retention expressed as pressure (e.g., cm water column). By determination of soil moisture at different levels of pressure the retention of soil moisture or soil moisture tension is recorded. The soil moisture tension is the pressure expressed in terms of the height in cm of a column of water or in atmospheres which must be applied to remove water at a given soil moisture content (Kramer 1949 p. 29).

Below some important limits referring to different levels of soil moisture tension are discussed.

Waterfilled (pF < 0) is the soil when the pore space is completely filled with water.

Maximal water capacity represents the water holding ability of a soil, and it is the water content which a layer (c. 1 cm) of fine earth can hold in equilibrium and just in touch with a water surface. Minimal water capacity or field capacity expresses the water holding ability of a soil in situ (cf. Veihmeyer & Hendrickson 1949 p. 75). Instead of field capacity a laboratorial and standardized water capacity is used (cf. S. Andersson 1955 p. 25). It is defined as the water content expressed in volume percentage held by a soil sample saturated by water in undisturbed stratification at drainage equilibrium. The drainage suction is determined by half the height of the soil sample (cf. S. Andersson & P. Wiklert 1960 p. 158). It differs from field capacity mostly by a lower drainage suction. Thus water capacity has pF 0.4 respectively 0.7 (according to the height of soil samples). The field capacity is assigned to a pF of 2.0—2.7. The use of this standardized water capacity has the advantage that samples from the whole profile can simultaneously be determined quickly and uniformly without any regard to their actual water contents. Compared to field capacity in situ the water capacity here applied will have a higher soil moisture contents (cf. S. Andersson 1955 p. 97; S. Andersson & P. Wiklert 1960 p. 156—163). This has also been proved by, i.a. Nääs (1957 p. 29) who found that the numerical value of the laboratorial water capacity of a sandy soil was three times that of field capacity in situ (cf. Volk 1931, 1937; Laatsch 1957 p. 167). Further, the field capacity in situ depends on, i.a., the level of subsoil water table , the influence of which is varying from time to time.

To get values corresponding to field capacity by determinations in laboratory one has to use some kind of suction technic (cf. S. Andersson & P. Wiklert 1960 p. 157; Gerth 1962) by which a high drainage suction (pF 2.0—2.5) is obtained.

Fifteen-atmosphere percentage (pF 4.2) is defined as the water contents expressed in volume percentage which are held by a soil sample saturated by water, in equilibrium with a pressure membrane at an excess pressure of fifteen atmospheres. These water contents can be compared to the permanent wilting percentage which has been shown by Richards & Weaver (1943). The permanent wilting percentage is usually defined as the water contents of soil where the ability of the plants to take up water ceases and a permanent wilting begins, i.e. the plant cannot recover though placed in air saturated with water vapour (cf. Wiklert 1958 and the literature quoted there). It is discussed whether the permanent wilting percentage can be regarded as a physical soil constant. Slatyer (1957, and cf. also the literature quoted there) emphasizes that it is the constitution of the plant itself, mostly its osmotic value, which determines the permanent wilting percentage. This osmotic value varies according to the age and environment of the plant. When comparing species from different, extreme biotopes, great differences in their osmotic value have been observed.

Dryness (pF 7) is reached by drying at 105°C of the soil samples. It is used as a basis of all calculations of soil moisture. Some water, however, can be held in soil samples rich in clay even at dryness (Ekström 1927).

Considering methods applied here waterfilled soil, water capacity, fifteen-atmosphere percentage and dryness are looked upon as constants characteristic of that horizon and the profile where they are determined.

The storage of soil moisture

The actual available water storage is part of the total storage of soil moisture which also includes the unavailable water (fig. 1). The upper limit of maximum total storage coincides with that of the maximum available storage. This limit is reached when a soil holds water capacity. Within the pore space also excess water may be found. This quantity is not included in the soil moisture storage though it may contribute to the water support of plants. The appearance of excess water in well drained soils is only ephemeral. In cases of long periods with excess water the air support will be impaired. The total storage of soil moisture includes the whole water contents down to dryness, but the lower limit of the available water is the fifteen-atmosphere percentage.

As mentioned these limits (water capacity and fifteen-atmosphere percentage) are soil physical constants (Veihmeyer & Hendrickson 1949, Kramer 1956, Scheffer & Schachtschabel 1956 p. 129, Walter 1960 p. 287). Consequently the maximum available and the maximum total storage of soil moisture are constants, characteristic of the profile studied. The unavailable water is practically unimportant to the water support of plants. Sometimes, however, it has a negative effect, i.e., when the upper layer has been dried out below the fifteen-atmosphere percentage. Under such circumstances an additional quantity of precipitation in the first place will supply the "dead water" before the available water will grow.

Like some other habitat conditions the soil moisture can be expressed in terms of quantity (storage) and intensity too (Sjörs 1956 p. 56, 1961 p. 6). As a consequence of the comparatively great and rapid turnover of the soil moisture, it is more the duration of the different levels of water storage than the storage itself that is of interest. In order to get

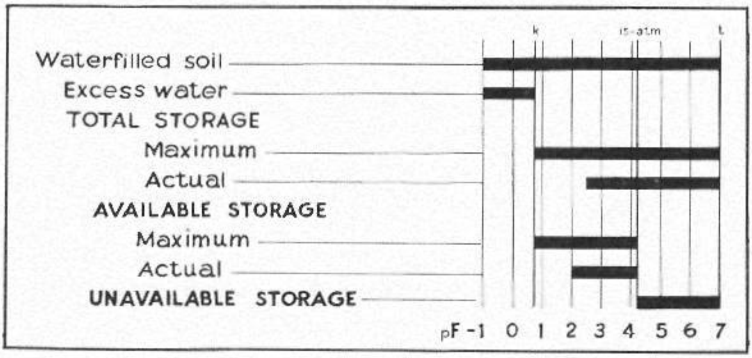

Fig. 1. Schematic survey of soil moisture storage in relation to soil moisture retention. Explanations: k = water capacity; 15-atm = fifteen-atmosphere percentage; t = dryness.

an ecologic characterization of soil moisture, a description of the intensity is desirable. This can be made by giving the retention of soil moisture, e.g., in terms of pF.

Some aspects of soil moisture determinations

Various methods have been elaborated to determine soil moisture. Two kinds may be distinguished, on the one hand direct methods involving weighing, drying and reweighing soil samples which gives the actual water contents in g; on the other hand indirect methods such as electrical resistance method, neutron meter method etc. (cf. Kelley et al. 1946, Diez 1963 and the literature quoted there). In the last-mentioned cases the values measured give only relative information of soil moisture. Generally a calibration is made by comparison to the common gravimetric method. This calibration makes it possible to calculate the water contents of the soil expressed as percentage of weight or volume.

When long periods of observation are wanted the gravimetric method may cause difficulties. Sampling within a limited area will gradually change the conditions of the soil. If an indirect method is used the deposition of apparatus in the soil will often disturb the natural conditions. Further, the calibration implies special problems. Processes of drying up cannot be calibrated in the same manner as processes of wetting. Reliable values are obtained only from a limited part of the calibration curve etc.

In previous investigations the soil moisture has mostly been described on basis of weight. The great differences in bulk density between a soil rich in humus and a pure mineral soil give incommensurable soil moisture values when these are expressed in terms of weight. Therefore it is more advantageous to calculate soil moisture in terms of volume. Further, it is desirable to be able to describe the structure (above all the distribution of different pore sizes) which has a great influence on the soil air and the soil moisture conditions (cf. Sekera 1931 p. 88, 1938 p. 286; Sjörs 1954 p. 86).

Methods

As basis of our soil studies we have applied much of the experimental method of soil physical investigations elaborated by Dr Sigvard Andersson, Professor at the Agricultural College of Sweden. The method is thoroughly described in a paper of 1955. By this method it is possible to compare the water turnover of different soil profiles in respect of precipitation, evaporation, transpiration and drainage. Here only the main features of the field and laboratory work will be presented. Shorter notes on determined units are added.

Field work. To get an exact volume of soil samples, sampling is made with cylinders of stainless steel with a cutting edge at the bottom. Cylinders of two different sizes have been used: 5 cm cylinders (height 50 mm; interior diameter 70 mm; volume 192.5 cm^3) and 10 cm cylinders (height 100 mm; interior diameter 70 mm; volume 385 cm^3). These cylinders are struck with a special apparatus which stears the cylinders perpendicularly into the ground. In this way cylinder samples are cut out from successively prepared levels of sampling, until the whole profile is represented with two samples from each level, down to the depth wanted. Where closer sampling is necessary due to structure and stratification 5 cm cylinders are used, otherwise 10 cm cylinders. From every sampling level also disturbed samples are gathered to be used at determinations of, i.a., fifteen-atmosphere percentage and pH.

The description of profile (cf. S. Andersson 1954, 1956) is made out of vertical and horizontal sections. The sections are taken in the pit after finishing cylinder sampling, by help of profile boxes of sheet-iron. The sections are photographed in black-and-white (Kodak Panatomic-X) and in colour (Kodachrome II). The morphological description is made on sections in actual condition using the Munsell Soil Color Charts (1954).

Laboratory work. Water capacity, w_k, is determined by placing the cylinder samples to water saturation in destilled water of two cm depth. After 1—3 days (when water saturation is observed) gravitational water is allowed to drain off during 24 hours. Then the samples are weighed (G_k).

Actual water storage, w_a. The cylinder samples brought out in the field are immediately weighed (G_a) in the laboratory in order to be able to calculate actual water storage.

To registrate the yearly variation of the actual water storage, samples (volume undefined) are gathered by an auger (Nääs 1958 p. 23; Nääs & Odentun 1958 p. 193—194). The auger consists of a steel tube (interior diameter 26 mm) on which special head edges can be screwed. It is driven into the ground with a sledge. Tubes of two different lengths have been used: 0.6 and 1.1 m. The obtained cores are immediately divided into pieces of 5 cm length, which are put into tins of aluminium with nearly airproof lids. The calculation of actual water storage into terms of volume is made using dry bulk density, γ_t.

Bulk density, γ, is the weight (G) of the volume unit of soil in undisturbed stratification (V).

Dry bulk density, γ_t, is defined as above, but is valid for samples dried at 105°C.

After water capacity, permeability (see p. 264) and moisture curve at drainage equilibrium (see p. 264) have been determined, cylinder samples are dried at 105°C. during 72 hours. After weighing (G_t) and grinding (if needed), samples are sieved and occurring roots, stones and gravel are weighed. From the remaining fine earth, samples to mechanical analysis, determinations of loss of ignition and bulk specific gravity are taken out.

Mechanical analysis has been performed as combined sedimentation- and pipette analysis according to Tamm (1934). The following particle size classes have been used:

Diameter		Class	Swedish term
>200	mm	Boulders	Block
200 — 60	,,	Stones	Större sten
60 — 20	,,		Mindre sten
20 — 6	,,	Gravel	Grovt grus
6 — 2	,,		Fint grus
		Fine earth:	Finjord:
2 — 0.6	,,	Sand	Grovsand
0.6 — 0.2	,,		Mellansand
0.2 — 0.06	,,	Fine sand	Grovmo
0.06 — 0.02	,,		Finmo
0.02 — 0.006	,,	Silt	Grovmjäla
0.006— 0.002	,,		Finmjäla
<0.002	,,	Clay	Ler

Loss of ignition has been determined in a muffle furnace at about 550°C.

Bulk specific gravity, s. Solid material volume has been determined by titration with 96 % alcohol (S. Andersson 1955 p. 26). Bulk specific gravity is used for calculating material volume and pore space.

Material volume, V_s, is the volume which the solid material occupies if it is packed in such a way that no hollow space occurs. V_s is generally expressed as percentage of volume referring to the undisturbed sample (V), and is symbolized by m.

Pore space, V_n, is the sum of all the pores or cavities in a certain volume (V), disregarding their contents of air and/or water. V_n is generally expressed in percentage of volume referring to the undisturbed sample, and is symbolized by n. It is called porosity, and is usually calculated as $n = 100 - m$.

Determination of pF has been made by drainage and by excess pressure technics.

In a suction bed (see S. Andersson & P. Wiklert 1960 p. 157) the cylinder samples saturated by water are drained at different levels of suction, until drainage equilibrium is reached. The suction bed consists of a double-bottomed box of stainless sheet with a lid. On the inner perforated bottom which is covered with a fine meshed nylon net and filter paper, a bed of (from the bottom) sand, fine sand and silt is placed. From the beginning the space between the two bottoms is filled with water, and even the bed is drowned. The cylinder samples (the bottom of which is exchanged for a nylon net) are then placed on the bed which may hold 20 cylinders. Through an outlet, where the water is allowed to drain over a perpendicularly movable overshot, the bed and the samples placed there can be drained at the drainage suction wanted.

Water contents of soil at higher pF (> 3) are determined in a pressure membrane apparatus (Richards 1941, 1949). In this, water saturated samples of fine earth (disturbed) placed in rubber rings (height 1 cm, diameter 5 cm) are subjected to desired excess pressure. In this way the soil moisture contents at, e.g. pF 4.2, the fifteen-atmosphere percentage ($w_{15\,\mathrm{atm}}$), have been determined. By calculation of the water contents into volume percentage, dry bulk density is used.

On the basis of these values obtained by direct determinations, the following units can be calculated: available water (w_u), unavailable water ($w_{15\,\mathrm{atm}}$) and actual deficit (w_{def}). The latter is the difference between water capacity and actual water storage.

Determination of permeability or k-value, i.e. determination of the rate of water percolation through a soil saturated by water. This has been made in order to elucidate the soil structure (S. Andersson 1955 p. 35). A permeameter with varied height pressure has been used. This is made of a tube of plexiglass (interior diameter 70 mm) connected to the top of the sampling cylinder with a coupling of rubber. During the determination the lower end of the sampling cylinder has been placed in a vat with destilled water. The tube is filled with destilled water and the height of this water column is recorded at suitable times (S. Andersson 1953). The following formula is applied to this permeameter:

$$k = 2.303 \cdot \frac{C}{t} \cdot \log \frac{h_0}{h_1} \text{ cm/hour}$$

$C = \frac{a \cdot l}{A}$ a = interior section area of tube
A = interior section area of sampling cylinder
l = height in cm of cylinder sample

For this permeameter a=A, therefore C=1.

l=5 or 10 according to the height of cylinder sample.

t=time in hours

h_0=first observed height of water column in cm

h_1=last observed height of water column in cm

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Studies in Sanguisorba officinalis L.

By Gertrud Nordborg

(Meddelande från Lunds Botaniska Museum, Nr 179)

Introduction

Sanguisorba officinalis L. (section *Eusanguisorba,* Cesati 1840) occurs in the temperate parts of Europe, Asia and America. The species does not have a continuous distribution but is split into a number of widely separated minor areas. It is regarded as circumpolar.

Distribution:

Europe: Northwards to Iceland, northern and western Ireland, the border between Scotland and England, the south of Scandinavia, Esthonia and the southern Kola Peninsula; in the European parts of the Soviet Union except the Ladoga-Ilmen region, from Karelen and the Dvina — the Petjora to the Black Sea, the Crimea, the Don and Volga; Central Europe, southwards to the Pyrenees, the northern Apennines, Montenegro in Jugoslavia and the Rhodope Mountains in Bulgaria.

Asia: In Siberia eastwards to Kamchatka and the Sea of Okhotsk; in Japan, Mongolia, China, Tibet and North Persia.

America: In Alaska from Bering Strait to Yukon; in the arctic parts of America east of the river Mackenzie; in the United States very rare, noticed from Maine and Minnesota; probably not native.

In Sweden *Sanguisorba officinalis* is found on Gotland and in a few localities in central Sweden (compare the chapter Distribution). In Norway it is fairly common from Bergen southwards along the coast and on the islands. Furthermore it is known from some isolated localities at Trondhjem and from Gjerpen at the northern part of the Oslofiord.

The study of *Sanguisorba officinalis* is based on spontaneous material, cultivated in the Botanical Garden, Lund, and on the writer's field observations in Scandinavia. The cultivated material from Scandinavia is rich enough to give a fairly detailed view of the situation there, while the samples from other parts of the distribution area are too few to give more than outlines.

Cultivation and Cytology

The material is rather sensitive to replanting as well as changes in temperature. Some examples will illustrate this. On two occasions plants have been sent here by air from Iceland. The first time they were placed at the beginning in a green-house, but they were soon affected by mildew blight and died in spite of syringing. The second time they were at once placed in the open air. Then most of them survived, flowered and set seeds (this is not the case on Iceland). Of the material from southern Europe the French samples have been least coldresistant. About 30 % of the plants have died during winter seasons. Quite opposite qualities are shown by *S. officinalis* from Norway and the Kola Peninsula, from where all plants are alive. A certain heterogeneity in the European material can thus be discovered, but it is scarcely large enough to allow any general conclusions.

For the determining of chromosome numbers root tips have been fixed in Navashin-Karpechenko and stained in crystal violet.

Numbers, earlier published:

2n=28. Nakajima 1936, Löve 1954 b, Nordborg 1958, Sokolovskaja and Strelkova 1960, Erdtman and Nordborg 1961.
2n=42. Polya 1950, Löve and Löve 1956 b.
2n=56. Nordborg 1958, Larsen 1959, Erdtman and Nordborg 1961.

The number 2n=42 has not been found in the author's material. Polya has reported it from Debrecen, Hungary, and Löve from Iceland, the latter with some hesitation, (personal communication), as the slides were not very good. The Hungarian and Icelandic plants which have been cultivated by the writer have 2n=56. Fig. 1.

Localities and chromosome numbers for the experimental material (first the Scandinavian and then the material from other countries in alphabetic order. Culture no:s in parenthesis):

Sweden. 2n=28. Gotland: Bäl, alvar (0704), Boge (0736), Bäl, Gane, alvar ground (1937), Hejnum, Pinus forest (8033), Othem, W of Klints, alvar pool (8035).

2n=56. Anga, meadow at church (0702), Alskog, park meadow (0773), Norrlanda, meadow at church (1933), Anga, meadow (1934), Kräklingbo, at church (1935), Gervide, Sjonhem (1936), Hartviksgård, Roma kloster (1938), 1 km S of the church of Anga (1939), Buttle, roadside SE of the church (8037),

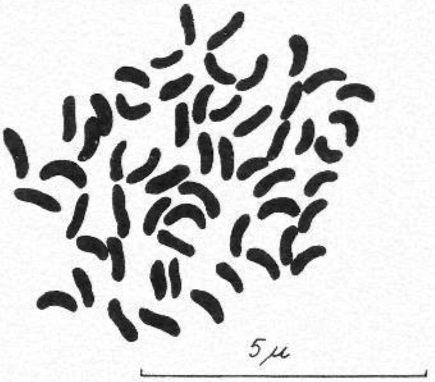

Fig. 1. Chromosomes in metaphase of *Sanguisorba officinalis*, 2n=56. Iceland (8043).

1.5 km N of Ala, dry meadow (8038). Östergötland: Degerön, Fridensborg (1997).

Norway. 2n=56. Hordaland: Sotra, Taelavåg, roadside (0784), Stora Sotra, Nipen (0785). Rogaland: Bua, N of Haugesund, meadow (0786), Lyngholmen, meadow (0787), Karmöy, Lilla Sund, Torvastad (0788), Karmöy, Eide, Kopervik (0789), Sandvesanden, sand beach (0790), Skudeneshavn, grass ground between rocks (0791), Madla, grassy plain (0792), Sola, dry gravel ground (0793), Revtangen-Klepp (0794), Jaeren, Varhaug (0795), Ogna, grass ground (0796), Egersund, Varberg, meadow (0797), Klungland near the church (0798). Vestagder: Flekkefjord, Tjörsvåg (0799), Feda (0757), Vanse (0758). Telemark: Skien, Gjerpen, at church (0759).

Austria. 2n=56. Donau, Mühlachen (1909), Obertalheim at the Agerknee (1915), Almtal, Kotmühle (8066).

Czecho-Slovakia. 2n=28. Čechy: Staňkov, meadow (1981), Chotěšov, meadow (1982), Praha (8107). Morava: near Brno (0618).

2n=56. Čechy: Merklin, meadow (1983), Gruhonice (1986). Morava: Mikulůvka (1984), Slovensko: Bratislava (8014).

England. 2n=28. Yorkshire, West Riding, Littondale (8045), Leeds (8133).

Esthonia. 2n=28. At the Kasari-river. (8041).

France. 2n=28. Les Landes, St Paul, 600 m W of Aurillac (1993), Les Landes, Aurillac (1994), Les Landes, Miecage (1995), Rochefort on the river Doubs (8008), Grenoble (8020), Cote-d'-Or, Messigny (8055), Collines de Ballbronn (8070), Cantal, Trizac (8146), Hautes Fagnes (8176), Jura, le lac de Bellefontaine (8238), Cote-d'Or, Moitron (8240), Doubs, Le Brey (8132).

2n=56. In the near of Grenoble, meadow (8087), Grenoble (8048).

Germany. 2n=28. Köln (0651), near Oldendorf (1924), Klagenfurt (1941).

2n=56. Tübingen (0649), Eberswalde (8105), Wuppertal (8124), Taunus (8135), Sachsen, Alt-Ottenhain (8046, 8136).

Holland. 2n=28. Near Wageningen, on the Rhine (1947), Meppel (8282), near Gramsbergen at the railway Zwolle Emmen (8283), on the river Waal, Nijmegen (8287).

Hungary. 2n=56. Mariabesnyö, near Budapest (8131), Jablunka, meadow (1985).

Iceland. 2n=56. Slope c:a 25 kilometres E of Reykjavik (1926), islet near Reykjavik (8043).

Italy. 2n=56. Savona, Acuabianca, Walle dell'Olba (8134), Udine (8116).

Japan. 2n=56. Peking (8047), ? (8024).

Poland. 2n=56. Lvov (8019).

Soviet Union. 2n=28. The Kola peninsula, Kandalaksja (1998), Vladivostok (8166), Komi, on the river Petjora (8186).

The lowest chromosome number hitherto published in *Sanguisorba* is 2n=28. The writer has however found 2n=14 in the American species *Sanguisorba annua* Nutt., which gives the basic chromosome number 7 for the genus. Therefore the cytotypes in *S. officinalis* has to be regarded as tetraploids and octoploids.

On Gotland there are both tetraploids and octoploids (fig. 2), in Norway only octoploids. From other countries the two cytotypes have been found only in Czecho-Slovakia, France, and Germany. In the writer's material there seems to be a slight tendency for the tetraploids to dominate in the western part of Central Europe, the octoploids in the eastern part. But the samples are rather few and possibly both levels exist at least in the central area of the species in Europe. Map of the European experimental material see fig. 3.

As will be seen in the following there are in some cases ecological differences between the tetraploids and the octoploids, but these differences are not characteristic of the whole area of the species. Nor are they morphologically well distinguished from each other in most characters.

Ecology

In *Svensk Botanik* 1807 Swartz remarked that *Sanguisorba officinalis* is not one of the common Swedish plants and has been observed only on Gotland in the parishes of Alskog and Östergarn. He also emphasized the fact that it occurs on limestone and moist soil, which increases the luxuriance of the plant.

In the main, this statement is still valid. Both chromosome types are strongly bound to limestone on Gotland. *S. officinalis* is now most common in the parishes of Norrlanda, Anga, Kräklingbo and Alskog.

The tetraploid is found only in a few localities in a rather limited area and never together with the octoploid. On the Bäl alvar *S. officinalis* (2n=28) has its richest occurrence on Gotland. The plant can be found

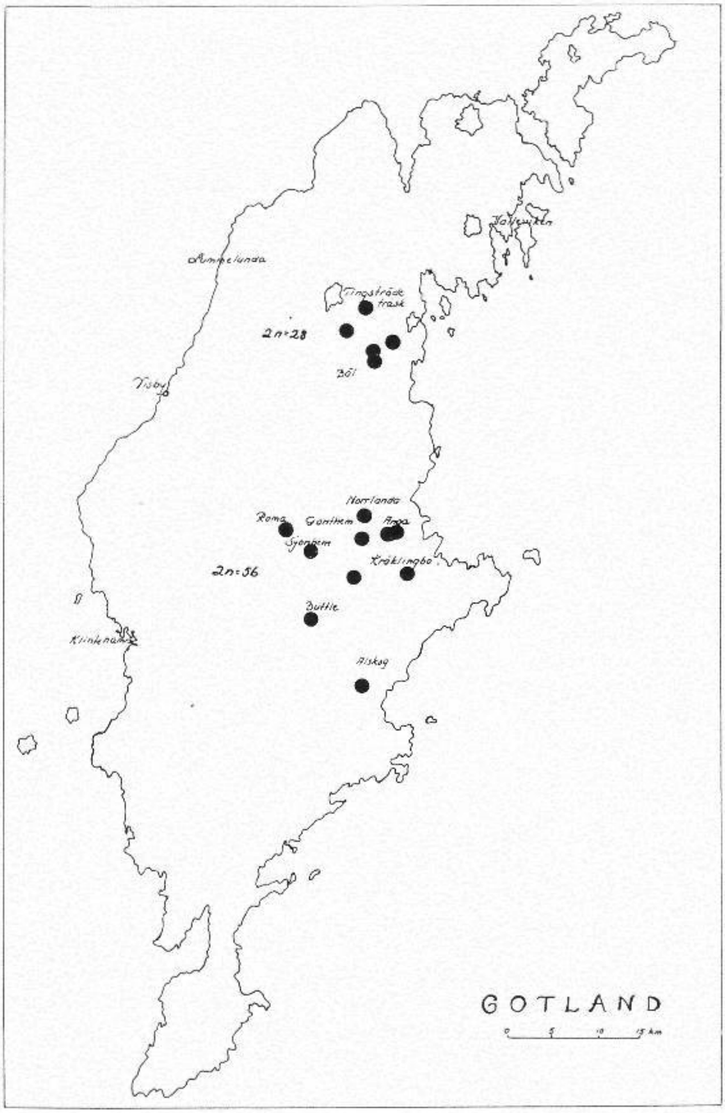

Fig. 2. *Sanguisorba officinalis* on Gotland. The dots represent sample localities of material in culture. The two cytotypes are well separated in distribution.

scattered in an area of several square kilometres. Possibly this distribution can be connected with that of the other tetraploids and thus all of them may belong to only one local population. The species occurs mostly on limestone heaths where the rock lies naked or is covered by a more

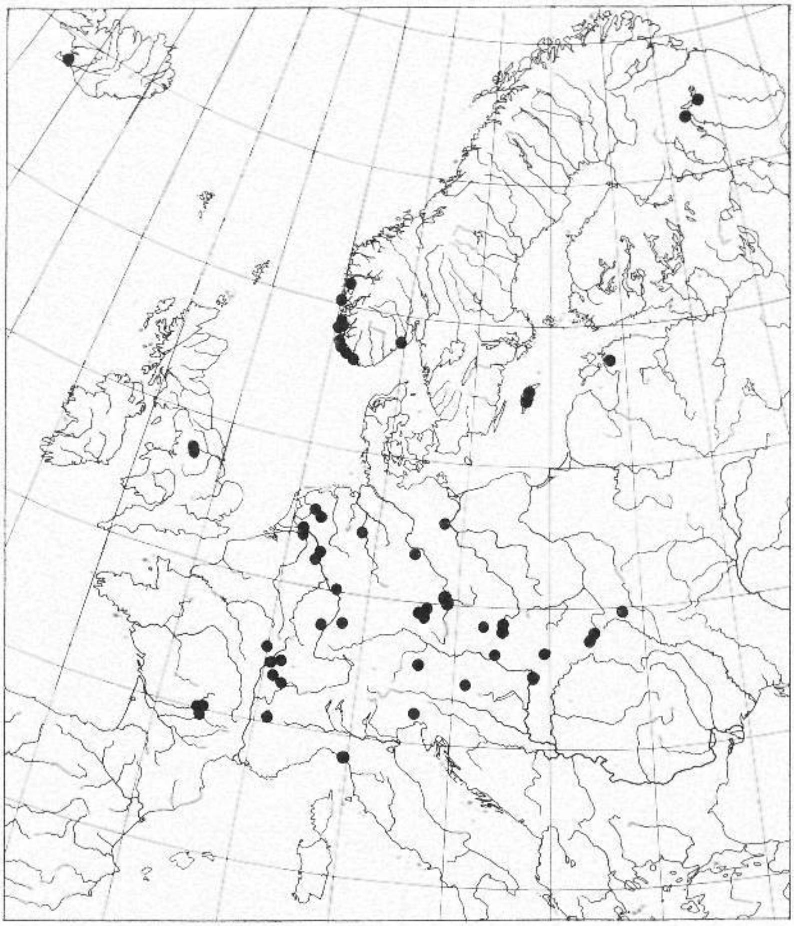

Fig. 3. The distribution of the European experimental material.

or less thin layer of soil. Only in a few cases there is a moraine layer thick enough for pine forest to grow, and Gotland probably is the only part of the world where *S. officinalis* can be found in a forest. But it may be observed that this is apparently due to the light-conditions, which are very favourable in this type of thin *Pinus*-forest. Similar conditions are noticed for other heliophilous species.

A careful analysis of the Bäl alvar has been made and combined with observations and notes from B. Pettersson's field studies on Gotland. The alvar declines slightly towards the east and southeast. It is a plateau of clayey limestone with small deposits of moraine, here and there covered by a rather thick layer of weathering material, which can be described as lake marl mixed with gravel.

Low pine-forest with *Juniperus*-bushes and isolated broad-leaf bushes, e.g. *Crataegus oxyacantha, Prunus spinosa, Rosa majalis, Rhamnus cathartica, R. frangula, Sorbus aucuparia, S. intermedia* and *Viburnum opulus* grow on the moraine hills. Also *Picea excelsa* of small size and *Taxus baccata* appear there. The field layer is dominated by grass and sedges: *Brachypodium silvaticum, Briza media, Calamagrostis varia, Carex digitata, C. flacca, C. panicea, Melica nutans* and *Sesleria caerulea.* Among other species are noticed *Anemone hepatica, Antennaria dioeca, Anthericum ramosum, Centaurea jacea, Filipendula vulgaris, Galium boreale, G. triandrum, G. verum, Globularia vulgaris, Hieracium pilosella, Inula salicina, Potentilla erecta, Solidago virgaurea, Succisa pratensis, Thymus serpyllum* and *Viola arenaria.* In the driest places occur even *Arctostaphylos uva-ursi* and *Vaccinium vitis-idaea.* The dominating moss is *Ctenidium molluscum* but on top of the moraine hills grow also *Dicranum polyserum, Hylocomium proliferum, Hypnum cupressiforme,* and *Rhytidiadelphus triquetrus.*

On the naked surfaces of clayey limestone the following species are particularly noteworthy: *Agrostis gigantea, Allium schoenoprasum, Carex flacca, Festuca ovina, F. rubra, Leontodon autumnalis,* and *Primula farinosa.* Examples on other components: *Calamagrostis varia, Carex oederi, Carlina vulgaris, Cirsium acaule, Daucus carota, Euphrasia stricta* ssp. *gotlandica, Linum catharticum, Molinia caerulea, Odontites verna, Ophioglossum vulgatum, Prunella vulgaris, Ranunculus acris, Sanguisorba officinalis, Succisa pratensis* and *Thymus serpyllum.* In this as well as in the above mentioned vegetation on moraine are many orchids: *Anacamptis pyramidalis, Dactylorchis cruenta, D. incarnata, D. spitzelii, Epipactis atrorubens* (most common), *E. palustris, Gymnadenia conopsea, G. odoratissima, Herminium monorchis, Platanthera bifolia, P. chlorantha.*

The vegetation is variable depending on the moisture conditions. From autumn to spring most of the area is highly wet, partially with water in open spots, in summer it is dried out except in extremely rainy periods. The humus formation is slight everywhere. Fig. 4 shows *S. officinalis* on the open spaces of the Bäl alvar. The picture is from the extremely dry summer of 1959. Drying damages had arisen in some places, but *Sanguisorba* was one of the few species which were resistant against the drought, and with its sanguine heads raised above the cracked alvar ground.

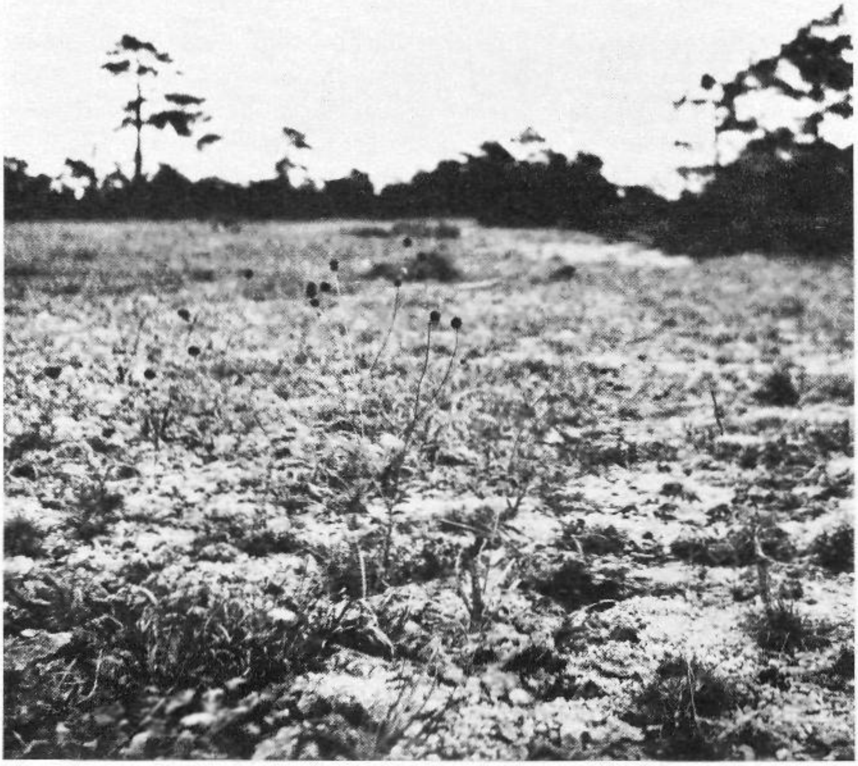

Fig. 4. *Sanguisorba officinalis* (2n=28) on the Bäl alvar, Gotland. See the text.

The northernmost tetraploid locality of Gotland is situated west of Klints in Othem. There *Sanguisorba* grows in an alvar pool, dominated by *Carex flacca* and *C. nigra*. Furthermore: *Carex panicea, Centaurea jacea, Dactylorchis cruenta, D. incarnata, Epipactis-species, Linum catharticum* and *Succisa pratensis*.

The octoploid (2n=56) seems to be the type discussed by Swartz. It is usually found in localities with a more uniform moisture and occurs especially in meadows. A typical 56-chromosome meadow form is represented in Alskog. Fig. 5. From an overgrowing park-meadow south of Alskog the following notes of habitat condition were made. *Sanguisorba* grows preferably in a depression on an open plain of the meadow, surrounded by *Quercus robur*. Other trees: *Malus silvestris, Populus tremula*, and *Picea excelsa*. The bush layer consists of *Corylus avellana*,

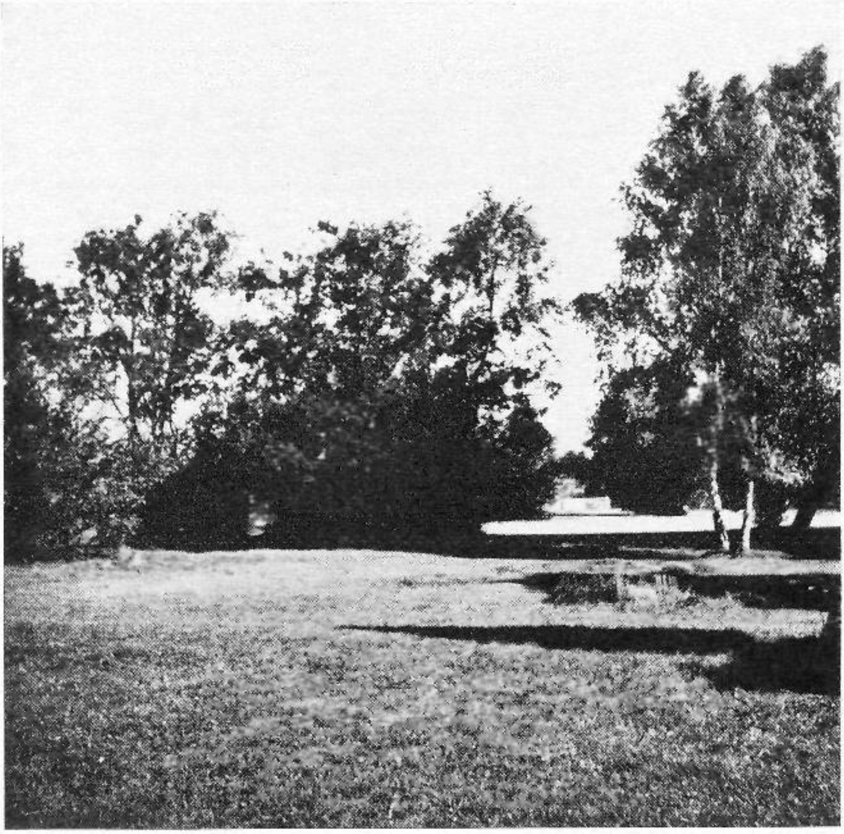

Fig. 5. Alskog, Gotland. Park meadow, a common biotope for *Sanguisorba officinalis* (2n=56).

Crataegus calycina, Juniperus communis, Prunus spinosa, Rhamnus cathartica, Rosa canina, Sorbus aucuparia, and *Viburnum opulus.* In the field layer *Carex tomentosa* dominates. Besides *Agrostis stolonifera, Anthoxanthum odoratum, Carex disticha, Deschampsia caespitosa, Festuca rubra, Filipendula ulmaria, F. vulgaris, Galium boreale, G. palustre, Lathyrus pratensis, Leontodon autumnalis, Molinia caerulea, Poa compressa, P. pratensis, Ranunculus acris, R. auricomus, R. flammula, R. repens, Salix repens, Scorzonera humilis, Sesleria caerulea, Succisa pratensis, Taraxacum suecicum, Trifolium repens* and *Viola canina.* The bottom layer is extremely poor with fragments of *Climacium dendroides* and a species of *Campylium.*

The depression, described above seems to be water-filled in winter. Near this place *Sanguisorba* forms a rich constituent in another, drier meadow type, which is still cultivated. The surrounding tree vegetation is preferably *Quercus robur* but also *Betula verrucosa, Fraxinus excelsior* and *Malus silvestris*. A thin bush layer with *Corylus avellana* and some *Juniperus*. The field layer can be described as an *Anthoxanthum odoratum - Festuca ovina - Rhytidiadelphus triquetrus* association with the following species: *Anemone nemorosa, Antennaria dioeca, Calluna vulgaris, Cerastium holosteoides, Filipendula vulgaris, Galium boreale, Helianthemum nummularium, Hieracium umbellatum, Listera ovata, Luzula multiflora, Lotus corniculatus, Orchis mascula, Platanthera bifolia, Potentilla erecta, Primula veris, Ranunculus acris, Rumex acetosa, Rhinanthus serotinus, Scorzonera humilis, Succisa pratensis* and *Veronica chamaedrys*. The bottom layer, which is luxuriant, is composed of *Hylocomium splendens, Rhytidiadelphus triquetrus,* and *R. squarrosus*.

In Norway *S. officinalis* has an atlantic occurrence (Faegri 1961). Its habitat condition agrees to a certain extant with the octoploids of Gotland. It is usually found on moist meadow ground, grass-slopes, and road-sides. An important difference is that the species is not bound to limestone in Norway. Typical associated species: *Anthoxanthum odoratum, Centaurea jacea, Dactylorchis maculata, Deschampsia caespitosa, Filipendula ulmaria, Hypericum perforatum, Lotus corniculatus, Polygonum viviparum, Ranunculus acris, Rumex acetosa*. But *S. officinalis* occurs in Norway in other biotopes too. It can, e.g., be a component in *Erica* heaths. And it has even been found c:a 50 m from the sea right in the sand together with *Thalictrum flavum, Geranium sanguineum,* and *Honckenya peploides*.

Also in other parts of Europe *S. officinalis* is mainly a plant belonging to somewhat moist meadow grounds. This applies to both chromosome types. Accordingly they cannot be separated ecologically — at least judging from examinations hitherto made — in the greater part of their extension.

Some examples of associated plants from localities in Central Europe will be pointed out. From Holland (prov. Overijssel, near Gramsbergen) are noticed: *Dactylis glomerata, Equisetum arvense, Filipendula ulmaria, Potentilla palustris, Veronica longifolia*. Germany (Sachsen, Alt-Ottenhain): *Molinia* meadow with among others *Carex panicea, Filipendula ulmaria* and *Serratula tinctoria*. France (Hautes Fagnes, 640 m): dominants as *Betonica officinalis, Geranium silvaticum, Rhinanthus* *minor* and *Senecio Fuchsii*. From another locality (Cote-d'Or, Moitron): in *Juncus subnodulosus* - community. Austria (Obertalheim, at the river Ager): in a meadow, entirely dominated by *Anthriscus silvestris*.

While *Sanguisorba officinalis* in Scandinavia is found only at a low level, never more than 100 m above the sea, it can in the rest of Europe be found from the sea level to mountains of 2000 meters' height.

Distribution

The unusual geographical distribution of *Sanguisorba officinalis* has been mentioned in the introduction. Some viewpoints on this, particularly as regards to the northern outposts with large distances from each other, will be drawn up.

The montaneous zone in Austria and Czecho-Slovakia locally can have an oceanic climate similar to the Norwegian. But Faegri does not regard *Sanguisorba* as a typical oceanic plant, as it is very eurytopic climatologically in Norway. Similarities between Norway and Gotland are on the other hand difficult to find. However, Hultén (1950) showed certain parallels in distribution, e.g. *Coronilla*. The agreements between Gotland, Esthonia and the Kola Peninsula are closer. Finally it can be called in question, whether all octoploids derive their origin from one single population.

The question has been raised, if *S. officinalis* is spontaneous on Gotland. Both of the "type"-localities described above prove this. Certainly the 56-chromosome-type grows on very culture-affected ground, roadsides, church meadows etc., but it is less probable that it has been introduced. The very few localities in central Sweden, however, are residues from that time when it was cultivated as a decorative and medical plant particularly in monastery gardens. Also the ecological background in Norway indicates its being spontaneous there. That *S. officinalis* nowadays is a component in natural plant-communities is not a real proof of its spontaneity, however.

Further and more obvious proof are furnished by fossil pollen. Swedish late-Glacial finds are recorded from Skåne (Magnusson 1962) and Blekinge (Berglund 1963). The pollen from Blekinge has with comparison of recent pollen been fixed to chromosome number type (compare the following chapter and Berglund: Late-quaternary records of *Sanguisorba officinalis* in south-eastern Sweden, published in this fascicle). It is shown there that the tetraploids as well as the octoploids of *S. officinalis* existed in Sweden during the late-Glacial period. These finds indicate that both of them have come to Sweden from the south.

From southern Norway Hafsten (1956) reports finds of pollen from the pre-Boreal and Atlantic period. He questioned whether *Sanguisorba* died out in the late-Glacial, when the forest invaded the country and reimmigrated later. Faegri, on the other hand, does not think that the forest was ever so dominating that there was no possibility for *Sanguisorba* to survive. It is reasonable to suppose that the species has had a continuous spreading since the late-Glacial period. A problem in the distribution is the few isolated finds. It is scarcely probable that the area of the species has been larger in any period of time, nor that immigration in a later period can serve as explanation for these finds. One of them, a sample from Gjerpen at the Oslo-fjord, has been studied. Neither cytologically nor morphologically does it differ from those of other collections.

In what way *Sanguisorba* has come to Norway is still a mystery. That it should be a relict, which survived the glacial period, is not likely, even if the Norwegian material is cold-resistant. Perhaps it can be assumed that it spread from the South in agreement with the species found on Gotland.

The spontaneity of *S. officinalis* ($2n=56$) on Iceland is proved through a find of a pollen grain from the Atlantic time (Berglund 1963).

Fossil pollen from the late-Glacial has, besides in Skåne and on Gotland, been found in Great Britain (Godwin), Holland (van der Hammen), Denmark (Iversen), and Poland (Koperowa).

What can be established with assurance is that *S. officinalis* has had a considerably larger geographical distribution than the present in a period when the competition was slight. But later it has not been able to retain its position — apparently owing to the advance of the forest.

Morphology

Datas given below are based on an experimental material of some hundreds of plants.

The root. The root is a thick tap-root more or less branched, up to 3 cm in diameter. It forces very deep down into the soil (roots of more than 2 m have been dug up). Above the root merges into a rhizome, which can be richly branched with a corresponding number of leaf rosettes. Up to 30 have been observed on the same plant. Any absolute differences between tetraploids and octoploids do not exist. In most cases, however, the octoploids have a strongly branched rhizome, the tetraploids on the other hand a slightly or not at all branched one.

The stem. The stem is at least in the lower part somewhat suffruticose, round or slightly polygonal, furrowed, glabrous or thinly hairy. From the main stem side-branches arise, which in adult specimens reach to about the same height as the central one. The result is that most of the heads are on the same level. This ramification, "capitula in corymbus", to use an extreme expression, gives the plant a characteristic appearance. In this respect there are no differences between the chromosome-types. The height of the plants is (30)—60—80—(110) cm. The tetraploid keeps within the scope of the middle values, while the octoploid covers the whole variation.

The leaf. Owing to short internodes most of the leaves are situated in a rosette at the base of the stem. They are pinnate with 3—8 pairs of leaflets. The cauline leaves of the stem are few, 0—5, the upper being smaller and having fewer leaflets than the lower. Differences in colour, earlier observed (Nordborg 1958) between tetraploids and octoploids on Gotland are only applicable to these populations. This confirms the hypothesis that all tetraploids of Gotland should have a common origin.

Comparative leaf-characters (the measurements were taken on the rosette leaves on leaflets next to the terminal leaflet. The figures represent minimum-, mean- and maximum-values).

	$2n=28$	$2n=56$
Form of the leaflet	rounded—ovate	rounded–pointed-ovate
Size of the leaflet	15—27—40 mm	10—32—58 mm
Numbers of teeth on half of the leaflet	8—11—15	10—12—17
Length of the petiole	0—5—12 mm	0—7—19 mm
Length of stomacells	52—62—77 μ	55—66—74 μ

The leaflets have a cordate base. The margins are more or less densely indented, deeply or shallowly or sometimes only notched. Each tooth in general has convex sides attenuated into a point. The octoploids are not seldom double-indented. At the base of the petioles — valid for both $2n=28$ and $2n=56$ — there may be a further pair of small leaflets, in literature often incorrectly called stipules. The size varies from small rudimentary leaflets to 1 cm long of the normal type. Variation of leaflets, see fig. 6.

Leaf anatomy. Photos of anatomical sections through leaf-stalks and the middle-vein of leaflets show the usual anatomical construction in the species. Fig. 7. The agreements between tetraploids and octoploids

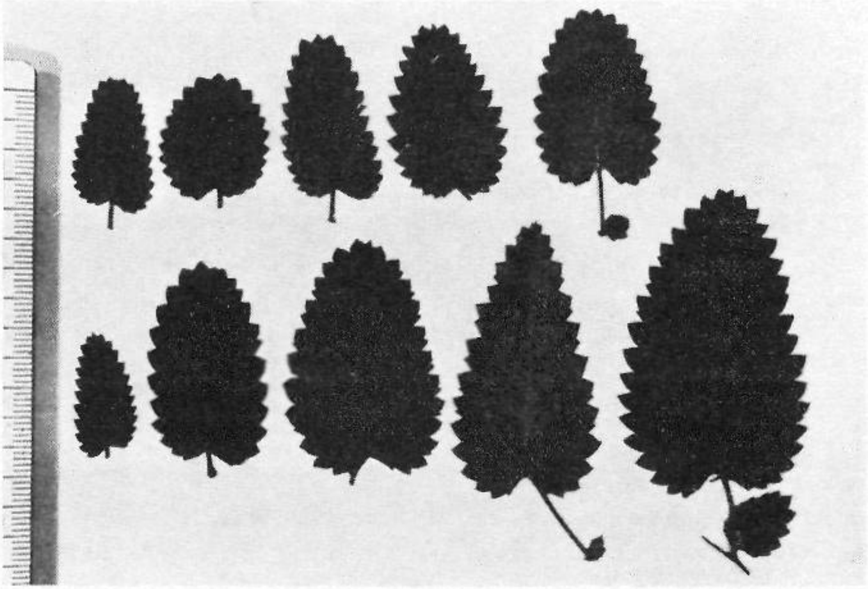

Fig. 6. Variation in leaflets. The upper row the tetraploid, the lower the octoploid. All leaflets are taken next to the terminal leaflet of a rosette leaf.

are great. Only a slight tendency towards differences in the formation of the epidermic cells can be traced. These are in the octoploid slightly more thickened, which will give the cells a rounder form, contrary to the more or less thin, angular cells of the tetraploid.

Length of stomata cells. In conditions as equal as possible the measurements of the stomata cells have been made. For this purpose the epidermis has been removed from the under-side of the uppermost leafpair on the first developed rosette-leaves. The mean value for the tetraploid is 62 μ, for the octoploid 66, but the minimum- and maximum-mean values, respectively, are 52, 77 and 55, 74 μ, which means that they overlap considerably. The length is extremely variable between different individuals of the same locality but also for one and the same plant. Not rarely the stomata cells of a leaf can be divided up into two different groups of size, one of which, the dominating one, represents the medium-size, while the other has values of the double size. As the stomata-length apparently has no importance as a taxonomic character, there is scarcely any need for publishing tables and diagram.

The flower. The flowers are collected in more or less oblong heads, 1—3 cm. Each flower has 4 sanguine to very dark red, calyx lobes.

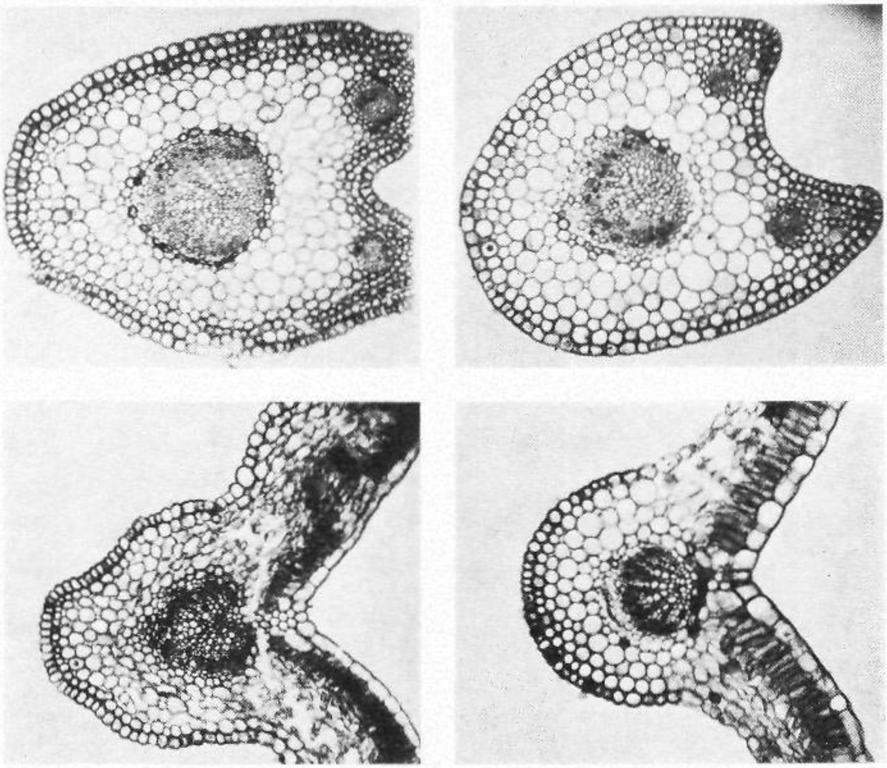

Fig. 7. Anatomical sections of leaf-stalks and the middle vein of leaflets. To the left the tetraploid (0704), to the right the octoploid (0792). A slight difference in the appearance of epidermic cells.

The basal part of the calyx is green, united to form a part of the receptacle, as the case is within the whole genus. The bracts of the flowers vary in length from very short, and blunt, not reaching outside the sepals, to long, usually pointed, up to the double length of the sepals. These differences do not always follow the different chromosome types, but long-pointed bracts are considerably more common in tetraploids. Petals are lacking.

The stamens are four in number with yellow anthers, sometimes red-striated, and red filaments, as long as or shorter than the sepals. Measurements of the length of the anthers show that significant differences exist between the two cytotypes. However, the values of some tetraploids are quite separated from others and accord well with most of the octoploids. On the other hand a few 56-chromosome collections from

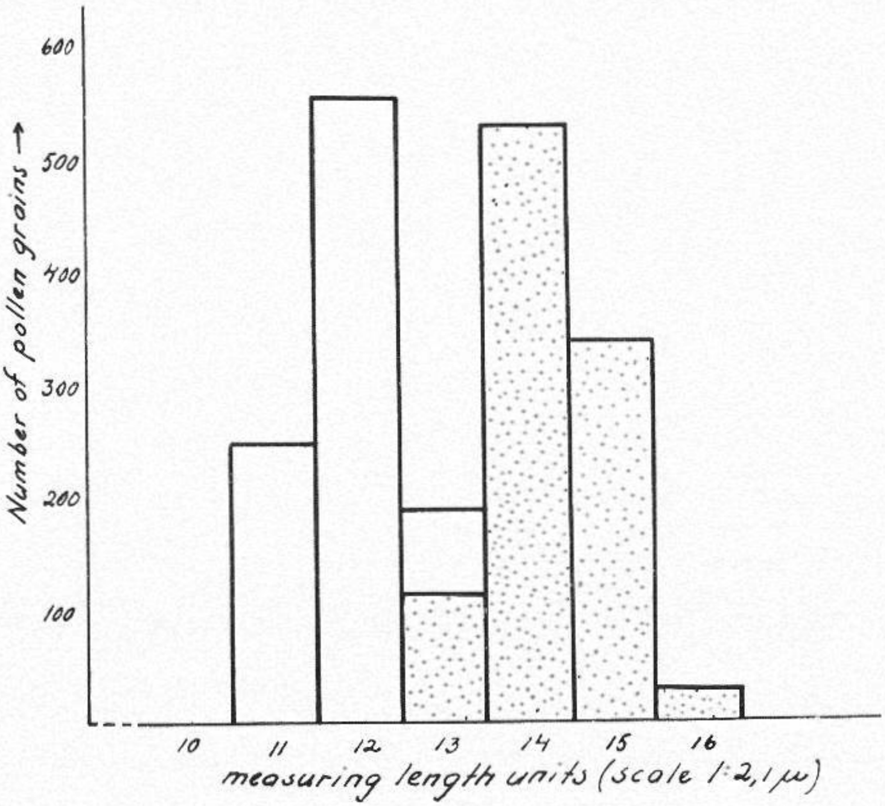

Fig. 8. Histogram showing the variation in size of pollen grains of tetraploid and ocotploid *S. officinalis*. □: the tetraploid, ▨: the octoploid. As seen the overlapping is small and the two cytotypes are rather well distinguished in pollen size.

Gotland have means, which coincide with the tetraploids. That is, in individual means a considerable overlapping exists, and the difference is of little value in the taxonomic treatment of the two chromosome types.

Pollen. The frequency of morphologically good pollen varies between 90 and 100 %. The size of the pollen grains is comparatively constant for the respective cytotype. The values from the tetraploid lie between 23 and 26 μ and from the octoploid between 28 and 31 μ. Means: 25 and 30 μ. The difference is large enough for using pollen measurement as a method for determining the level of chromosome number. 100 measurings were made from each head. The equatorial diameter of the pollen has been used as a measure of the size. Histogram, fig. 8.

Pollen samples from about ten localities have been given to Berglund (l.c.), who has prepared them according to the acetolysis method (Erdtman 1952) and examined them as a comparison to fossil finds. The results are published by Berglund in this number of Bot. Not. He has measured the polar axis of the pollen grains. These values, too, give record of the difference between the tetraploid and the octoploid.

Ikuse, 1954, described pollen of two types of *S. officinalis* from Japan, one of the size 18—19.5×19.5—21 μ, one 21—22×23—24 μ. Whether in this case tetraploids and octoploids have been investigated is uncertain, as the values are not in agreement with those published above. Perhaps the values reflect another method of measuring. She also points out some morphological differences. *S. officinalis* has in contrast to other known species of *Rosaceae* 6-colporate pollen. The openings, the apertures, are often placed in pairs. According to Ikuse more or less marked anastomoses between the apertures are observed on the larger type, which is not the case on the smaller one. In the writer's material the apertures are usually placed in pairs in both tetraploids and octoploids. Anastomoses on the other hand are rare, but have been observed in both chromosome types.

In microscope preparations made by the acetolysis method the following morphological differences are seen:

$2n=28$	$2n=56$
6-colporate, in single cases 3-colporate	6-colporate
marked constriction in the equatorial plain	without constriction
zonorate, with a thin, more or less distinct os	zonorate, with a broad os

Erdtman's nomenclature followed (Erdtman 1952). Photos of pollen from the tetraploid and the octoploid in Erdtman and Nordborg, 1961.

The pistil is composed of one carpel. At the base of the style is an annular nectarium. The stigma is very papillose. In the fruit (receptacle), also torus and the lower part of the sepals are joined. It has four narrow angles or wings. The surfaces between them are smooth.

Variation in fruit size. From every locality the maximal length and breadth of 20 fruits chosen at random have been measured. A statistical treatment of the material shows that no variation in fruit size actually exists between collections of 28- and 56-chromosome *S. officinalis*. In every case the variation within the one or the other chromosome group is greater than between them.

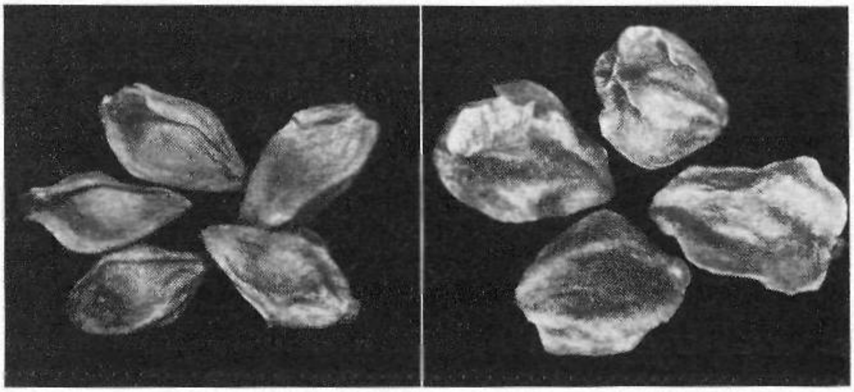

Fig. 9. The variation in fruits. To the left: 2n=28. Fruits more or less spoolshaped with narrow borders. To the right: 2n=56. Fruits somewhat triangular in shape, with developed wings. — These two types are not limited to the respective chromosome number.

	Min. means		Max. means		Means of the whole material	
	Tetra-ploid	Octo-ploid	Tetra-ploid	Octo-ploid	Tetra-ploid	Octo-ploid
Length	3.1	3.1	4.0	3.9	3.5	3.4
Breadth	2.1	2.2	2.4	2.5	2.2	2.3

The figures above give the lowest and the highest mean for length and breadth, which have been obtained for a plant but also the mean value for the whole material. The mean error is of the size ±0.05—0.08. As is seen the values completely cover each other. On the other hand the ratio between length and breadth varies rather much, similarly in the two cytotypes, however. The quotient length : breadth lies between 1.3 and 1.8 with 1.4—1.5 as the most usual values. This variation is due to the difference in breadth of the wings (angles). The form of the fruit, projected on one plane is spool-shaped to broadly triangular, the later type with broad wings at the base, upwards more and more narrowing. Fig. 9.

Embryology

Buds of different ages have been stained in Haidenhain's hämatoxylin. Fig. 10 a shows a longitudinal section through a flower of *S. officinalis*. The formation of nucellus follows the typical *Rosaceae*-pattern: several-

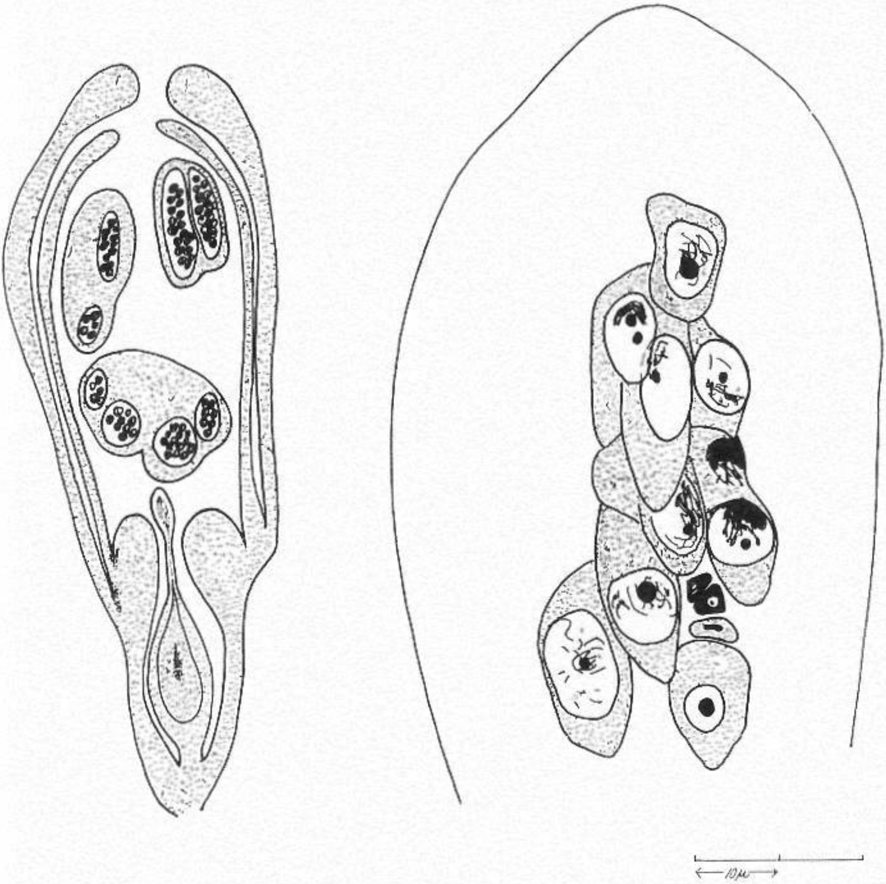

Fig. 10. a: longitudinal section through a flower of *S. officinalis*. b: a large number megaspore mother cells and one 1-nuclear embryo sac with degenerated macrospores.

layered epidermis, one to several layers of cover-cells, and innermost a multicellular archesporium.

Several cells in the archesporium are developed to megaspore mother cells, fig. 10 b. At first a central MMC is developed and then secondary up to 10. One of these, not always the central, however, undergoes meiosis, and an embryosac will be formed according to the normal type. The rest of the megaspore mother cells are reduced. In rare cases one or another of them may develop, but never longer than to a 2-nuclear embryo sac. — Any tendency to apospory has not been established.

Crossing experiments

A series of crossings has been performed to show if sterility barriers exist.

1) S. officinalis 2n=28 $\overset{\rightarrow}{\underset{\leftarrow}{\times}}$ S. officinalis 2n=56
2) S. officinalis 2n=28 $\overset{\rightarrow}{\underset{\leftarrow}{\times}}$ S. minor ssp. minor (=ssp. dictyocarpa) 2n=28
3) S. officinalis 2n=28 $\overset{\rightarrow}{\underset{\leftarrow}{\times}}$ S. minor ssp. muricata 2n=28
4) S. officinalis 2n=28 $\overset{\rightarrow}{\underset{\leftarrow}{\times}}$ S. minor ssp. verrucosa 2n=28
5) S. officinalis 2n=56 $\overset{\rightarrow}{\underset{\leftarrow}{\times}}$ S. minor ssp. muricata 2n=56

Result: 1) Fertility only with the tetraploid as ♂. Together 85 receptacles were developed, but only one germinated and this plant died already as a seedling. In the crossings 2) and 3) very few perfect seeds were received and only with *S. officinalis* as ♂. From these seeds 3 and 1 respectively have given plants. They have not yet been flowered. The leaves resemble those of the mother individual and it is rather probable that the plants are not hybrids but the result of apospory in *Sanguisorba minor* ssp. *minor* and ssp. *muricata*. The writer has found a tendency to facultative apospory in the *Sanguisorba minor* complex and the examination continues to investigate this closer. The crossings 4) and 5) have not given fruit-setting.

As is seen above *Sanguisorba officinalis* is genetically well separated from the *Sanguisorba minor* complex, but also between the tetraploid and the octoploid of the species there is a sterility barrier.

Taxonomy

Sanguisorba polygama Nyl. has been maintained as a distinct species, closely related to *S. officinalis*. It has by other authors been placed as a subspecies or a taxon of doubtful rank. Nylander (1843) reports it from Russian Lapland at the Lake Imandra, the river Neva and the village of Kandalax, at the White Sea, and in Karelen. From *S. officinalis* it differs through "spicis sanguineis, tubo calycis fructiferi marginato, squamis lineari-lanceolatis et colore totius plantae laetiori" (l.c.). With regard to morphological characters it occurs in the variation of tetraploid *S. officinalis*. For that reason *Sanguisorba polygama* is included in *Sanguisorba officinalis* by the present writer.

The studies of *Sanguisorba officinalis* have shown, that two cytotypes (tetraploid and octoploid) occur within the species. Besides a hexaploid has been recorded from Hungary. However, the author has not been able to verify this chromosome number in her material.

Crossings between the two cytotypes have been unsuccessful. Morphologically the two types can be distinguished by differences in the pollen grains. In other characters there is only a tendency, if it is even as much as that, to differences. Therefore it is, in spite of a sterility barrier, scarcely justified or at least not suitable to make a division into two species.

Consequently, in the opinion of the writer, *Sanguisorba officinalis* must remain as one species, if possible with the chromosome number following the name.

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BOTANISKA NOTISER 1963 · VOL. 116 · FASC. 2 · LUND

Late-Quaternary Records of Sanguisorba officinalis in South-Eastern Sweden

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Sanguisorba officinalis L. is differentiated into two chromosome number types (2n=28, 2n=56; Nordborg 1958, Erdtman and Nordborg 1961, Nordborg 1963). The best morphological differences between these two types are to be found in the pollen grains (Ikuse 1956, opp. citt., Erdtman, Berglund & Praglowski 1961 p. 53 f.). In this connection the size of the pollen grains has been most stressed.

New investigations of Gertrud Nordborg's material from north-western Europe, foremost from southern Norway and Gotland, have given the following results (embedding medium glycerine jelly).

2n=28 (tetraploid). 10 pollen grains from 8 collects. Polar axis 23—29 μ. MV 26 μ. 2n=56 (octoploid). 10 pollen grains from 8 collects. Polar axis 31—36 μ. MV 33 μ. Also in other characters the pollen grains of the two types are different, which easily can be seen in a comparison ocular. Both types have 6-colporate pollen grains but sometimes the grains of the tetraploid type are 3-colporate. The grains of the latter type have a narrow, complicated equatorial colpus constriction, in the octoploid one this is not the case. Both types have zonorate pollen but the os is more distinct in the octoploid one because its zonal os is wider (about 4 μ at colpi) than in the tetraploid one (about 2 μ) (cf. Pl. I in Erdtman & Nordborg 1961).

Numerous finds of pollen grains from *Sanguisorba officinalis* have been made in Late-glacial layers in north-western Europe (British Isles, Holland, Germany, Poland, Denmark, Sweden, Norway). In the British Isles these records are also verified by finds of fruits (Godwin 1956, p. 118). But, as far as I know, different chromosome number types have not hitherto been identified with certainty (cf. Averdieck & Döbling 1959 and Erdtman & Nordborg 1961).

In pollen-analytical studies of the Late-quaternary history in south-eastern Sweden (prov. Blekinge) some finds of *Sanguisorba officinalis* have been made. It seems to be possible to refer them to definite chromosome number types.

Hallarums mosse, 16 km E of Karlskrona. Sample number 356 (62). One pollen grain of *S. officinalis* 2n=28. Size 25×22 μ. Layer from the beginning of the transition stage between the Younger Dryas and the Pre-boreal time. Photo Figs. 1—4.

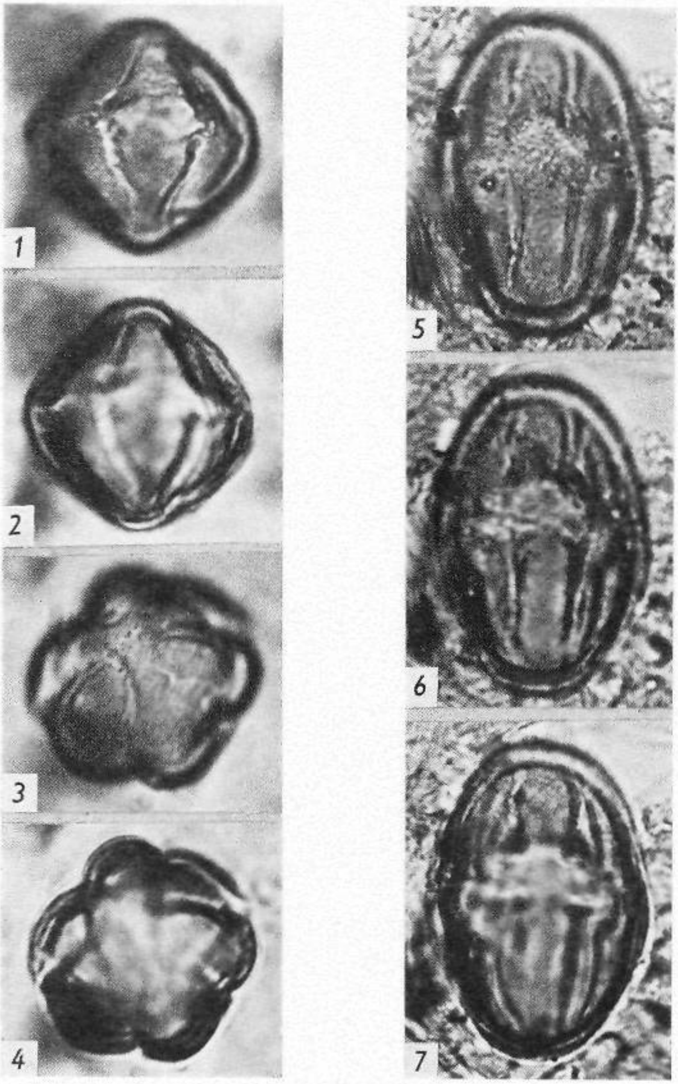
Store mosse, 10 km NNE of Ronneby. Sample number 411 (61). One pollen grain of *S. officinalis* 2n=56. Size 33×23 μ. Layer from the transition stage between the Younger Dryas and the Pre-boreal time. Photo Figs. 5—7.

Lösensjön, 12 km NE of Karlskrona. Sample number 381 (59). One pollen grain of *S. officinalis* 2n=28. Size 23×20 μ. Layer from the transition stage between the Younger Dryas and the Pre-boreal time. — Sample number 380 (59). One pollen grain of *S. officinalis* 2n=56. Size 32×26 μ. Layer from the Pre-boreal time. — Sample number 366 (59). One pollen grain of *S. officinalis* 2n=28. Size 27×24 μ. Layer from the Early Boreal time.

Färsksjön, 17 km E of Karlskrona. Sample number 51 (56). One pollen grain of *S. officinalis* 2n=28. Size 29×22 μ. Layer from the Late Boreal time.

The finds have been made in sediments (clay gyttja, algae gyttja, fine detritus gyttja) with no secondary (rebedded) pollen. Glycerine has been used as embedding medium. By measuring other pollen grains it is stated that the grains are not swollen.

The three Late-glacial finds originate from the transition between the Younger Dryas and the Pre-boreal period, a stage described comprehensively by Iversen (1954). During this time the vegetation can be characterized in the following way. There occurred a tree vegetation (c. 40 percent of the total pollen sum) with *Betula, Pinus* and more seldom *Populus, Sorbus* and *Prunus padus,* a shrub vegetation (10—30 percent) with *Juniperus* (dominating), *Salix* and *Hippophaë,* dwarf-shrub vegetation (5—10 percent) with *Betula nana* and *Empetrum,* and a herb and graminid vegetation (20—40 percent) with *Artemisia, Atriplex-Chenopodium, Rumex acetosella* coll., *Dryas octopetala, Saxifraga aizoides* and *S. oppositifolia, Ephedra, Helianthemum* cf. *oelandicum, Filipendula* cf. *ulmaria, Urtica, Sanguisorba minor* etc. Characteristic for the transition stage is the rich occurrence of the thermophilous plants (the three last-mentioned) and *Juniperus.* As a whole it was a mosaic vegetation with forests in places with favourable climate and open areas with shrubs and tundralike vegetation. It was a short stage with non-arctic climate but delayed forest development. For this reason there were still good existence possibilities for plants demanding much light, plants of unstable soil etc. Among these heliophytes we find arctic-subarctic species as well as species with southern distribution.



Figs. 1—7. Fossil pollen grains of *Sanguisorba officinalis* (1200 ×).

Figs. 1—4. *S. officinalis* $2n=28$. Hallarums mosse. Figs. 1, 2. Equatorial view; high focus and optical section. Figs. 3, 4. Polar view; high focus and optical section.

Figs. 5—7. *S. officinalis* $2n=56$. Store mosse. Equatorial view; high focus, low focus and optical section.

To the last-mentioned group the two types of *Sanguisorba officinalis* may be included (cf. ecological data in Nordborg 1963).

The recent distribution of *Sanguisorba officinalis* is rather unique. The species occurs in widely separate areas in northern Europe (op. cit.). The numerous fossil finds show that *S. officinalis* was common and had a wide distribution during Late-glacial time. During the Post-glacial time a disjunction has taken place (Godwin 1956 p. 118). — According to the investigations in Blekinge it seems probable that the tetraploid as well as the octoploid type occurred in southern Sweden during Late-glacial time. Later on their distribution has been restricted to Gotland.

Additional Note

During the printing following new finds of *Sanguisorba officinalis* have been made.

From the locality of Färsksjön (se above) several pollen grains of the two chromosome number types have been found in layer from the Sub-boreal time.

At an investigation of peat from a bog in Hornafjörður, SE Iceland, collected by prof. Carl H. Lindroth (Institute of Entomology, Lund), one pollen grain of *S. officinalis* $2n=56$ (size 32×29 μ) has been found. The layer has been dated to the Atlantic time (c. 4000 B.C.), which indicates that the recent Icelandic population of *S. officinalis* is spontaneous (cf. Nordborg 1963).

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BOTANISKA NOTISER 1963 · VOL. 116 · FASC. 2 · LUND

Några sörmländska svampfynd

AV ERIK JULIN

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Föreliggande uppsats utgör en sammanställning av fynd av några intressantare storsvampar, som under de tre sista åren gjorts huvudsakligen i trakterna kring Nyköping. Fynden gälla discomyceten *Sarcoscypha coccinea* och gastromyceterna *Rhizopogon roseolus, Bovistella paludosa, Geastrum quadrifidum, G. pectinatum, G. rufescens, G. fimbriatum, Dictyophora duplicata* och *Phallus impudicus*.

Insamlade svampprov förvaras i Uppsala universitets Botaniska museum, där professor J. A. Nannfeldt lämnat hjälp med bestämningarna. Mossprov från Bärstakärret ha bestämts, resp. konfirmerats av fil. lic. Bengt M. P. Larsson och docent O. Mårtensson, Uppsala, samt av med. o. fil. dr S. Arnell, Stockholm, och från Sandstugukärret av lektor E. von Krusenstjerna, Djursholm, professor G. E. Du Rietz, Uppsala, och dr Arnell. Bestämningen av *Chara contraria* har konfirmerats av fil. mag. Svante Pekkari, Uppsala. *Carices* av *Fulvella*-gruppen ha bestämts av fil. dr L. Fagerström, Helsingfors. Vattenanalyser med avseende på pH och specifik ledningsförmåga ha utförts av professor H. Sjörs, preparator S. Eriksson och fil. lic. T. Ingmar på Växtbiologiska och Limnologiska institutionerna, Uppsala. Till alla dessa personer och institutioner riktar jag ett varmt tack.

Sarcoscypha coccinea (Fr.) Lambotte

Denna vackra och tämligen stora skålsvamp påträffades första gången i Södermanland av fru Ingrid Eriksson, Stigtomta, under en av mig ledd exkursion den 6 maj 1961 på Linudden, 5 km VSV om Nyköpings centrum. Den växte på multnande lövträdskvistar i ett par rishögar i östra utkanten av Linuddens naturparks västra parti. Huvudparten av fruktkropparna befunno sig dolda i högarnas inre. Vegetationen på fyndorten utgöres av fuktig och skuggig asp-hassel-skog nära havet.

Arten är en vintersvamp, som hos oss normalt visar sig vid snösmältningstid, men vid fyndtillfället befann den sig ännu i full utveckling av fruktkroppar. Den största av dessa mätte i friskt tillstånd 60 mm i diameter. Den 24 maj sågs blott få friska apothecier men många i mer eller mindre långt framskridet vissningsstadium.

Följande år anträffades *Sarcoscypha coccinea* på en likartad lokal norr om Nyköpingsfjärden.

Sörmländska lokaler:

S:t Nicolai: Linudden 6. V. 1961 Ingrid Eriksson, 24. V. 1961 Erik Julin, 12. V. 1962 Birger Pettersson. Svärta: Labro, hassellund 2 km SSO om Sjösa gård, på döda kvistar på marken 24. IV. 1962 Larseric Eldenäs.

Rhizopogon roseolus (Corda) Th. Fr.

Den 29. IX. 1961 påträffades i ett kärr vid stranden av sjön Yngaren SV om Bärsta Kronogård i Stigtomta sn, c. 16 km VNV om Nyköping fyra fruktkroppar av en tryffelartad svamp. Den först observerade fruktkroppen stack upp ur den ett par cm höga *Drepanocladus revolvens* - bård, vilken utgjorde randen av en låg tuva. De tre andra doldes av mossan och upptäcktes först, då jag trevade med handen på *Drepanocladus*-mattan. Svampfruktkropparna mätte i friskt tillstånd 49×36×32, 44×37×30, 43×32×27 och 32×21×21 mm. Den minsta (yngsta) hade guldgult peridium och grågrön gleba. De tre större voro utvändigt mörkt gulbruna och inuti mörkbruna. Två av dessa hade oregelbundna hål på peridiet, och innehållet höll på att flyta sönder till en mörkbrun vätska, som till konsistensen liknade en simmig sås med karaktäristisk syrlig (ej lökartad) lukt. Denna visade sig under mikroskopet innehålla talrika brett elliptiska, nästan färglösa sporer. Gleban var hos de yngre exemplaren kamrad, och peridiet bekläddes hos samtliga glest av bruna myceliesträngar. I samma kärr hittades, likaledes i *Drepanocladus revolvens* - matta, ungefär 25 m från den första fyndpunkten följande höst en enda mjuk och söndersprucken men ännu ej helt upplöst fruktkropp. Jag tvekar icke att trots den egendomliga biotopen hänföra fruktkropparna till ovanstående gastromycet.

Kärret vid Bärsta ligger helt på den landvinning, som uppkom, då Yngarens vattenyta under förra hälften av 1860-talet sänktes. I det gamla strandhaket upprinna flera källor, vilka före sjöns sänkning måste ha vällt fram på sjöbottnen. Nu ge de upphov till slingrande rännilar över den nästan plana, av sand bestående landvinningsmarken och ha på i runt tal hundra år danat denna till ett kärr. Detta utgöres av en mot sjöstranden relativt öppen yta av ett par

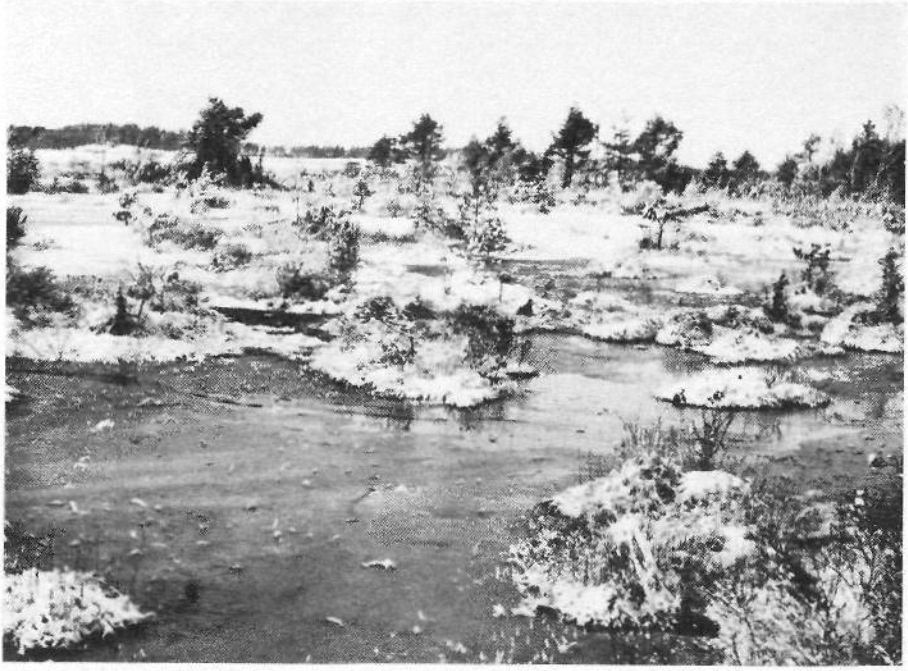

Fig. 1. *Rhizopogon*-kärret vid Bärsta, Stigtomta sn, Södermanland. Mellan fondens låga skogsrand och den största tallen t.v. skymtar Yngarens sjöyta. Vattenprov A är taget i det mitt på bilden synliga, öppna källdroget något tiotal m närmare sjön (t.v. utanför bilden). — Foto Birger Pettersson 30. XI. 1962.

hundra meters diameter, som mot land och i söder begränsas av alskog. Över denna öppna kärryta höja sig glest större och mindre, rätt flacka tuvor med kärrmossor i de låga kanterna och skogsmossor i centrum, om detta är tillräckligt högt. Bland de förra märkas *Philonotis calcarea, Drepanocladus revolvens, Bryum pseudotriquetrum, Calliergon giganteum, Fissidens adianthoides* och *Paludella squarrosa* samt levermossorna *Pellia endiviifolia, Preissia quadrata, Riccardia pinguis* och *Marchantia polymorpha*. På gammal kospillning uppträder *Splachnum vasculosum*. Tuvornas kärlväxter äro bl.a. *Myrica gale*, småvuxna individ av tall, en, glasbjörk, klibbal, rönn och *Rhamnus frangula*. Framträdande element äro *Salix repens, Trichophorum alpinum, Primula farinosa, Festuca ovina, Carex panicea, C. dioeca, C. pulicaris, C. Oederi* ssp. *euoederi, C. lepidocarpa, C. hostiana* och *Eriophorum latifolium*. Mindre talrikt uppträda *Carex capillaris, C. lepidocarpa*×*Oederi* ssp. *euoederi, Equisetum variegatum, Briza media, Sagina nodosa, Linum catharticum, Hieracium lepidulum* (det. E. Almquist), *Galium uliginosum, Potentilla erecta, Hieracium auricula, Molinia coerulea, Sieglingia decumbens, Parnassia palustris, Peucedanum palustre, Pinguicula vulgaris, Platanthera bifolia, Carex rostrata* och *C. elata*.

De tuvorna till arealen vida överstigande plana ytorna mellan dem äro täckta av någon till några cm djupt vatten. De genomdragas av de något djupare rännilarna från källorna mot sjön. Dessa kärrytor ha en ganska fast sandbotten. Gyttjebildningen har hittills varit så obetydlig, att bottnen alltjämt huvudsakligen har sandens färg. Den glesa vegetationens dominerande kärlväxter äro *Eleocharis pauciflora*, *Utricularia intermedia*, *Equisetum palustre* och *Utricularia minor* i nu nämnd ordning. Små, delvis prostrata skott av *Phragmites* förekomma glest jämte *Triglochin palustre*. Bland mossorna spelar *Scorpidium scorpioides* den största rollen. *Chara contraria*, delvis starkt kalkinkrusterad, har här sin enda hittills kända sörmländska lokal. De talrika algskyarna innehålla *Spirogyra*- och *Zygnema*-arter.

Vid besök i kärret 21. IX. 1962 iakttogs i den tidigare *Rhizopogon*-förande *Drepanocladus revolvens* - mattan och även i många andra tuvkanter i närheten av denna en riklig förekomst av c. 5 cm tjocka, tämligen fasta, *Nostoc*-geléliknande klumpar. Professor H. Skuja, Uppsala, som beredvilligt undersökt ett prov av en sådan geléklump, fann däri flera blågrönalger, *Lyngbya* (flera arter), *Aphanothece Castagnei*, *Oscillatoria* (enstaka trådar) samt åtskilliga diatomaceer.

Ovanstående redogörelse för Bärstakärrets artbestånd hänför detta till rikkärrens kategori. Med hänsyn bl.a. till förekomsten av *Carex lepidocarpa*, *C. elata* och rikedomen av *Eleocharis pauciflora* jämte flera exklusiva mossor bör det närmast betecknas som ett extremrikkärr. Det förefaller sannolikt, att källvattnet kommer från ett skalgruslager, som emellertid ej lokaliserats.

Tre vattenprov (betecknade A—C), tagna 30. 11. 1962 från tre olika källdrog i kärret, analyserades med nedanstående resultat.

	pH	$\varkappa_{20^\circ} \cdot 10^6$
A	7,4	295
B	7,9	255
C	7,5	287

Värdena på såväl pH som specifik ledningsförmåga kunna sägas vara normala för extremrikkärr.

Rhizopogon roseolus är en i Sverige rätt allmänt förekommande art, som är känd från de flesta landskap. Den uppträder på relativt torra lokaler, »företrädesvis i barrskogar, men äfven på trädlös mark, på något öppna, med lågt gräs bevuxna ställen (t.ex. vid skogsvägar o.s.v., aldrig i täta skogen) eller under mossa, helst på sandjord» (Fries 1909, s. 283). Varken i litteraturen eller i Uppsalamuseets rikhaltiga herbariematerial har jag kunnat finna en enda uppgift om förekomst i kärr eller över huvud taget på fuktiga lokaler. Uppträdandet av *Rhizopogon roseolus* i Bärstakärret innebär sålunda en för denna art helt ny biotop, som visar, att dess ekologiska amplitud är vidare, än man tidigare vetat.

Sörmländsk kärrlokal:

Stigtomta: Bärsta, kärr vid Yngarens strand 29. IX. 1961 och 6. X. 1962 Erik Julin.

Bovistella paludosa (Lév.) Lloyd

Den 24 oktober 1962 fann jag i Sandstugukärret mellan Sandstugan och Israelsberg i Svärta sn ungefär 5 km österut från Nyköpings centrum fyra fruktkroppar av ovannämnda art. Egentligen hade svampen hittats redan föregående höst. Tjänsteman Evert Rådström, Nyköping, meddelade mig nämligen, att han då sett små röksvampar ute i kärret. Visserligen kunde det knappast vara fråga om något annat än *Bovistella paludosa*, men utan belägg vågade jag inte gå i god för uppgiften. Vid ett gemensamt besök i kärret 19. X. 1962 utpekade Rådström det område, där han året innan sett röksvamparna. Vi kunde emellertid inte finna någon fruktkropp. Först vid ovan nämnda senare besök hittades sådana.

Sandstugukärret är ett ungefär 400×600 m stort extremrikkärr av backkärrtyp beläget mellan Sjösafjärden och vägen (stigen) Sand—Sandstugan—Israelsberg. Det sluttar ganska kraftigt mot väster. I den nordöstra kanten upprinna flera källor, vilkas vatten sannolikt passerar ett skalgruslager. I ett grustag 500 m öster om kärret är detta synligt. Det innehåller bl.a. *Litorina*-skal och är sålunda av marint ursprung. Kärrets kärlväxtflora är för sörmländska förhållanden ovanligt rik med bl.a. tolv orkidéarter, riklig *Carex lepidocarpa* och andra kalkbundna arter. Även mossfloran är den för extremrikkärren typiska.

Bovistella paludosa förekom på en c. 75×75 m stor, öppen, sluttande kärryta 100 m rakt väster om Sandstugans bostadshus, här benämnd *Bovistella*-kärret. I öster gränsar detta till kärrkantens alskog, i övrigt till andra kärrtyper. Centralt genom *Bovistella*-kärret slingrar ett källdrog västerut från alskogskanten i öster. Ett prov av dess vatten, taget 2. XI. 1962, visade pH 6.8 och $\varkappa_{20^\circ} \cdot 10^6$ 338.

Bovistella-kärret är ett lågstarrkärr. Dess bottenskikt utgöres av låga mosstuvor, växlande med plana mossmattor. Följande arter förekomma:

Aulacomnium palustre
Bryum pseudotriquetrum
Calliergonella cuspidata
Campylium stellatum
Cratoneurum commutatum
Drepanocladus intermedius
D. revolvens
Fissidens adianthoides
Mnium seligeri
Paludella squarrosa
Philonotis calcarea
Pseudoscleropodium purum
Scorpidium scorpioides
Sphagnum warnstorfianum
Tomentypnum nitens
Calypogeia Meylanii
Cephalozia bicuspidata
C. media

Fig. 2. *Bovistella*-biotopen i Sandstugukärret, Svärta sn, Södermanland. — Foto Birger Pettersson 16. XI. 1962.

C. pleniceps
Chiloscyphus pallescens
Plagiochila asplenioides
Riccardia latifrons
R. pinguis.

Bland fältskiktsarterna i *Bovistella*-kärret märkas:

Briza media
Carex dioeca
C. echinata
C. hostiana
C. hostiana×*lepidocarpa*
C. lasiocarpa
C. lepidocarpa
Dactylorchis incarnata
D. Traunsteineri
Eleocharis pauciflora
Epipactis palustris
Eriophorum latifolium
Liparis Loeselii
Ophrys insectifera
Pinguicula vulgaris
Potentilla erecta
Primula farinosa
Sesleria coerulea ssp. *uliginosa*
Succisa pratensis
Triglochin palustre

Det första svenska fyndet av *Bovistella paludosa* gjordes så sent som 1907 (Fries 1923, s. 155) i Uppland. Först 1936 kom nästa fynd, i Torne Lappmark (Sandberg 1940, s. 74 ff.). Sedan har arten påvisats i det ena landskapet efter det andra: Jämtland 1939, Västergötland 1940 (Sandberg l.c., s. 76), Dalarna 1946 (Sjörs 1948, s. 128 o. tab. L), Skåne 1948 (Andersson 1950, s. 77), Småland 1956 (Fridén 1959, s. 247), Östergötland 1956 (Fridén 1961, s. 244), Närke och Västmanland 1961 (Hakelier 1961, s. 621).

Det har hävdats, att »förekomsten av *Bovistella paludosa* är korrelerad med en alldeles speciell artkonstellation i bottenskiktet, i det att den är intimt knuten till de mossmattor, som domineras av *Cratoneurum*-arter, *Drepanocladus intermedius* och *Campylium stellatum*» (Andersson 1950, s. 75). Senare svenska litteraturuppgifter om *Bovistellas* följearter ge emellertid vid handen, att någon intimare korrelation mellan denna svamp och *Cratoneurum*-arter ej existerar. Däremot har korrelationen mellan *Bovistella* och de båda andra mossarterna bekräftats. Ett något svagare samband synes också finnas mellan svampen och mossorna *Bryum pseudotriquetrum*, *Calliergon giganteum* och *Tomentypnum nitens*. Dessa mossor äro emellertid alla vanliga rikkärrarter, som ingalunda äro inskränkta till extremrikkärren, till vilka *Bovistella paludosa*, så vitt vi för närvarande veta, är bunden. Man skulle kunna uttrycka förhållandet så, att *Bovistella paludosa* visserligen i regel växer tillsammans med de ovan nämnda mossarterna, men att dessa ej visa någon speciell sociologisk affinitet till svampen, vilken ekologiskt är tydligt kräsnare än mossorna i fråga.

Bovistella paludosas närmaste grannar bland mossorna voro i Sandstugukärret *Drepanocladus intermedius* (3 fruktkroppar) och *Bryum pseudotriquetrum* (1 fruktkropp).

Sörmländsk lokal:

Svärta: Sandstugukärret 24. X. 1962 Erik Julin.

Geastrum quadrifidum Pers.

Nya sörmländska lokaler:

Helgona: granskog 1600 m OSO om Rosenkälla, ett femtiotal dels färska, dels gamla fruktkroppar på barrsockeln kring större gran i glest *Oxalis*-bestånd 20. IX. 1960 Erik Julin. Svärta: sydexponerad bergbrant med kalkvegetation 700 m SO om Ödesby, några äldre fruktkroppar under gran i glest *Oxalis*-bestånd 17. V. 1961 Britta Lindelöf; ca. 50 m från platsen för ovanstående fynd bland gles *Oxalis* och *Poa nemoralis* under gran 22 äldre och yngre fruktkroppar, de unga med blågrådaggigt, de äldre med brunt endoperidium 5. X. 1962 Erik Julin; berg 200 m öster om Uddebystugan 1961 Birger Pettersson. Tunaberg: Pilthyttan, två gamla fruktkroppar 8. IV. 1962 Staffan Karlsson.

Geastrum pectinatum Pers.

Ny sörmländsk lokal:

Halla: Sund, några årets fruktkroppar i *Oxalis*-granskog på urbergskalk nära stranden av sjön Yngaren (tillsammans med *G. rufescens*, se nedan) 3. X. 1960 Erik Julin.

Geastrum rufescens (Pers.) Fr.

Ny sörmländsk lokal:

Halla: Sund, några årets fruktkroppar i *Oxalis*-granskog på urbergskalk nära stranden av sjön Yngaren (tillsammans med *G. pectinatum*, se ovan) 3. X. 1960 Erik Julin.

Geastrum fimbriatum Fr.

Sörmländska lokaler (arten ny för landskapet):

Svärta: Skälkulla, sydsluttningen av den kalkvegetationsklädda höjden norr om gården på naken barrmatta under granar en färsk, en fjolårs fruktkropp 9. IX. 1962, sex färska fruktkroppar 28. IX. 1962 Erik Julin, tio m därifrån på ett *Rhytidiadelphus triquetrus* - klätt block en årets och tre sannolikt äldre fruktkroppar 14. X. 1962 Erik Julin och Evert Rådström. Trosa landssocken: bergig udde i Östersjön c. 800 m SSV om Stensunds folkhögskola tre färska fruktkroppar på barrsockel invid granstam i gran-tall-alskog 6.—10. IX. 1962 Grette Armfelt-Hansell.

Dictyophora duplicata (Bosc.) Ed. Fisch.

Mellan Glasberget och Hallbosjön, 700 m norr om Väsby gård i Halla sn 20 km VNV om Nyköping, påträffade jag den 19 aug. 1962 några fullbildade fruktkroppar och »häxägg» av *Dictyophora duplicata*. De växte på ett c. 50 kvadratmeter stort område i övre delen av det brant sluttande strandhak, som före 1860-talets sjösänkning utgjorde Hallbosjöns strand.

Vegetationen på platsen består av alskog med insprängd gran och björk. I det mycket glesa fältskiktet dominerar *Oxalis*. Mossor saknas. Den något leriga mullmarken är starkt påverkad av tramp av betesdjur. En mycket frekventerad kostig leder rakt igenom området.

Svampen upptäcktes genom lukten, som är väl så stark och kvalitativt densamma som hos *Phallus impudicus*. Lukten utgår från gleban. Sedan denna flutit bort, luktar svampen ytterst svagt. Häxägget luktar ej.

Såväl de fullbildade fruktkropparna som häxäggen uppträdde oftast parvis. Ett par av vardera slaget grävdes upp. Det visade sig därvid, att de båda fruktkropparna i paret utgingo från var sin gren av samma rotlika mycelsträng. Vid ett senare besök, den 15 sept., visade sig fruktkropparna blott en och en. De utgjordes nu av två äldre, liggande och åtta häxägg. Den 21 sept. fanns på platsen en fullt utvecklad fruktkropp, en annan, hos vilken receptaklet just sprängt peridiet och var på väg att skjuta i höjden, samt några ägg. Ett av dessa visade den koniska form, det erhåller strax före sprängningen. Två dagar senare hade denna fruktkropp redan kollaberat och låg nu på marken.

Dictyophora duplicata, som hör hemma i Nordamerika, anträffades första gången i Europa 1915, vid Paderborn i Westfalen. Sedermera ha tillkommit många nya tyska lokaler, alla belägna väster om Oder, samt enstaka fynd i Österrike, Frankrike och Danmark (Michael & Hennig 1960, s. 260). Som ny i Sverige upptäcktes arten 1948 i bokskog i Röddinge och Tolånga i Skåne (Andersson 1950, s. 72). Ett nytt fynd gjordes 1950 vid Fölsvik i Värmland. Svampen växte där »i ett skuggigt strandbuskage, bestående av huvudsakligen al, björk och gran» (Höjer 1951, s. 532). Väsbylokalen, den fjärde svenska, är tydligen av samma slag som den värmländska.

Det har ansetts, att *Dictyophora duplicata* kommit till Tyskland med amerikanska trädplantor. Andersson (l.c.) accepterar denna teori och tillämpar den på de skånska lokalerna, dit svampen enligt honom sannolikt införts med granfrö från mellersta Tyskland.

På den sörmländska lokalen har någon sådd eller plantering av skogsträd emellertid icke ägt rum efter 1919 och sannolikt ej heller tidigare. Det ser därför ut, som om man skulle få lov att tillgripa en annan förklaring till artens uppträdande här. Därvid synes mig insektspridning i första hand böra komma i betraktande. Redan på fyndplatsen iakttogs talrika flugor på svamparnas gleba. Två hemförda häxägg, placerade på min balkong (tredje våningen i en central del av Nyköpings stad), drogo, när de utvecklade sig, dit mängder av as- och spyflugor samt ett individ av as-skalbaggen *Silpha thoracica*.

En supponerad spridning med asinsekter skulle, ehuru kanske ej alldeles obligat, förutsätta ett något tätare lokalbestånd än det f.n. kända svenska. *Dictyophora* kan i vårt land knappast antas vara mycket förbisedd. Men med hänsyn till den relativt korta tid — blott några timmar — under vilken svampen genom indusiets styvhet är lätt att även på något avstånd skilja från *Phallus impudicus*, kan möjligheten av att den någon gång har blivit förväxlad med denna enligt min mening ej

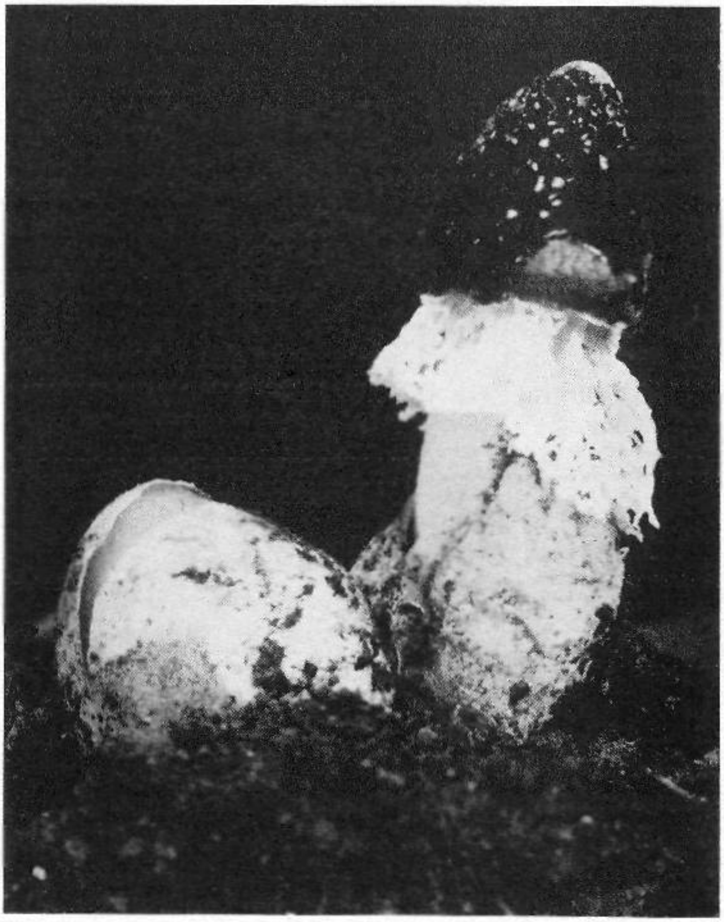

Fig. 3. *Dictyophora duplicata.* T.v. ett »häxägg» med uppsprucket peridium; i sprickan skymtar den ännu fasta, ljusa gleban. T.h. en nästan fullt utvecklad fruktkropp med bortflytande gleba och styvt indusium.

alldeles uteslutas. Sedan slöjan förlorat sin styvhet, krymper den både omkretsmässigt och på längden. Den kommer därvid att hänga tätt intill receptaklet och är ofta synlig blott någon eller ett par cm under hattkanten. Dess genom krympningen förminskade hål likna receptaklets porer, och bestämningen fordrar nu en närgången inspektion. Härtill kommer, som redan antytts, fruktkropparnas efemära uppträdande. Man måste ha stor tur för att träffa på en fruktkropp i full utveckling med styv, krinolinliknande slöja.

I förhoppning om att flera lokaler möjligen skulle kunna uppdagas i Nyköpingstrakten, vände jag mig till ortstidningen Södermanlands Nyheter med begäran om publicering. Tidningen införde också på framträdande plats en bild av svampen med åtföljande redogörelse för fyndet. Den sålunda erhållna tidningsreklamen medförde visserligen flera meddelanden om iakttagelser av liknande svampar, men i alla kontrollerbara fall gällde det *Phallus impudicus*. Dessa lokaler återfinnas nedan. Trots misslyckandet tror jag ändå, att det kunde vara mödan värt att underkasta äldre (och nya) *Phallus*-lokaler en kontrollundersökning med *Dictyophora* i tankarna.

Den nakna hatten visar en detalj, som är olika utbildad hos *Dictyophora duplicata* och *Phallus impudicus*, och som av mig tillgänglig litteratur att döma ej tidigare synes ha beaktats. Sedan gleban runnit bort, framträder hattens underliggande ljusa innerskikt. Detta har en gropig ytstruktur, ej olik cellerna i en honungskaka. Hos *Phallus impudicus* äro dessa gropar mot hattens spets långa och smala (längden ofta 3—4 gånger bredden), mot hattkanten rundade. Hos *Dictyophora duplicata* äro groparna mera likformiga över hattens hela yta (mot hattspetsen ungefär dubbelt så långa som breda). Gropväggarnas fria ytterkanter äro hos *Phallus impudicus* jämnare än hos *Dictyophora duplicata*.

Sörmländsk lokal:

Halla: Väsby, i alstrandskog vid Hallbosjön 700 m norr om gården 19. och 20. VIII, 15., 21. och 23. IX. 1962 Erik Julin.

Phallus impudicus (L.) Pers.

Nya sörmländska lokaler:

Bälinge: Hånö, Larsro, fuktig alskog 20. VIII. 1962 Hans Möller, på samma lokal 19 fruktkroppar i olika utvecklingsstadier inom en yta av 10 kvm 16. IX. 1962. Helgona: blandskogsklädd bergkulle vid Nyköpingsfjärden mellan Brandholmen och Tjuvholmen, ett femtiotal fruktkroppar 8. X. 1960 Erik Julin. Nykyrka: Sandstugan hösten 1962 Erik Andersson. Oxelösund: Jogersö, vid sophög i alskog 200 m från östra stranden 2. X. 1962 Christer Sundqvist.

Summary

Some finds of fungi in the Swedish province of Södermanland

Sarcoscypha coccinea, *Bovistella paludosa*, *Geastrum fimbriatum*, and *Dictyophora duplicata* are reported as new to Södermanland. For *Rhizopogon roseolus*, *Geastrum quadrifidum*, *G. pectinatum*, *G. rufescens*, and *Phallus impudicus* new localities are given.

Rhizopogon roseolus, a common species, known from most Swedish provinces, always on ± dry localities, was here found in a new type of habitat, an extremely rich fen, where it grows among *Drepanocladus revolvens*. The water has a high pH, lying between 7.4 and 7.9, and its electric conductivity ranges from 255 to 295. This habitat indicates that the species has a wider ecological amplitude, than we up to now knew.

Bovistella paludosa, a rare species, because its habitats — extremely rich fens — are rare, is up to now found in the provinces of Skåne, Småland, Östergötland, Västergötland, Närke, Västmanland, Uppland, Dalarna, Jämtland, and Torne Lappmark.

Dictyophora duplicata, previously known from the Swedish provinces Skåne and Värmland only, was in Södermanland found under circumstances, which seem to exclude an immigration by means of tree plants or seeds. A theory of spread through insects is instead discussed.

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Botaniska Notiser 1963 · Vol. 116 · Fasc. 2 · Lund

Vegetation på ön Senoren

III. Havsstrandvegetationen

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Bidrag till Blekinges Flora, Nr 3
(Meddelande från Lunds Botaniska Museum, Nr 180)

Denna uppsats är en direkt fortsättning av Berglund 1962 och 1963 a. Där behandlades Senorens vegetationshistoria jämte översiktligt öns geologi, topografi, klimat m.m. respektive landvegetation.

Metodik

Strandvegetationen har undersökts med hjälp av bandprofiler av växlande bredd, $^1/_3$—1 m. Täckningsgraden har angivits i enlighet med Hult-Sernander-Du Rietz's 5-gradiga skala. Bandprofilerna åskådliggöres grafiskt. Staplarnas höjd är proportionell mot täckningsklassens mittvärde (Malmer 1962 ss. 48 ff.). Referensvärdet för avvägningskurvorna är medelvattenytan i Karlskrona handelshamn.

På strandängarna har markprover tagits i anslutning till bandprofilerna. 30 g av den naturfriska torven (humuslagrets övre del) har extraherats med 250 ml vatten. Extraktets pH, specifika ledningsförmåga, natrium- och kloridhalt har bestämts. I tre vattenprover från havet har samma bestämningar utförts. Analyserna har gjorts enligt Malmer (1960 ss. 80 ff.). Värdena för ledningsförmågan, omräknade till 20°C och multiplicerade med 10^6, betecknas $\varkappa_{\text{red}}$. Natrium- och kloridvärdena avser mmol/l extrakt, resp. liter havsvatten. Analysvärdena för humuslagret gäller ej för den outspädda markvätskan men de är dock inbördes jämförbara.

Nomenklaturen för kärlväxterna följer Hylander (1955) och för mossorna Jensen (1939). *Poa pratensis* har behandlats kollektivt. I allmänhet är det ssp. *irrigata*, som förekommer på strandängarna. *Plantago major* åsyftar ssp. *intermedia*.

Vid beskrivningen av havsstrandvegetationen indelas stranden enligt Du Rietz 1950 (jfr schema hos Gillner 1960 s. 24); sublitoral, hydrolitoral (vattenstrand) skild från föregående genom lågvattenlinjen, geolito-

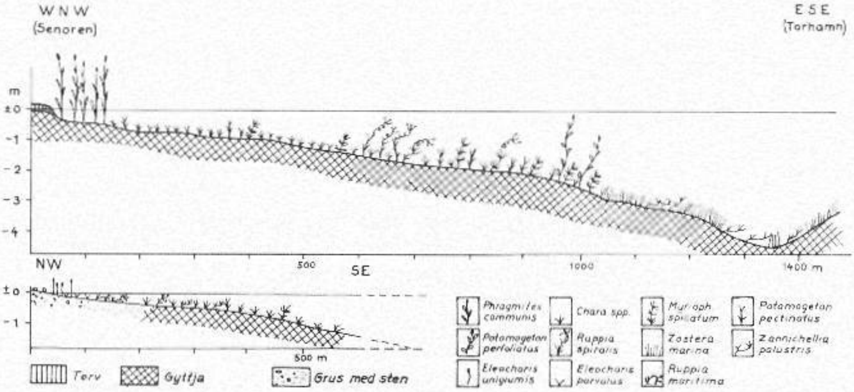

Fig. 1. Schematiska vegetationsprofiler visande vegetationen inom det sublitorala och hydrolitorala bältet i sundet mellan Senoren och Torhamnshalvön. Profilerna är karakteristiska för mindre exponerade kuster i blekingeskärgården. — Schematic transects showing the vegetation of the sublitoral and hydrolitoral belt in the strait between Senoren and Torhamn Peninsula. The profiles are characteristic of less exposed coasts in the archipelago of Blekinge. Explanations: Torv=peat, Gyttja=gyttja, Grus med sten=gravel with stones.

ral (landstrand) skild från föregående genom medelvattenlinjen samt epilitoral skild från föregående genom högvattenlinjen. Vegetationen inom geo- och epilitoral beskrives nedan under tre olika strandtyper, strandängar, moränstränder och klippstränder.

Sublitoral vegetation

(För djupförhållanden, se Berglund 1962 fig. 2; vegetationsprofiler fig. 1). Översiktligt har de sublitorala växtsamhällena i Blekinge beskrivits tidigare (Berglund 1963 b). Fanerogamvegetationen är inskränkt till mjukbottnarna. Under 2,5 m dominerar enartssamhällen med *Zostera marina* eller *Zannichellia palustris*. Mellan 1,5 och 2,5 m är ett *Ruppia spiralis* - *Potamogeton pectinatus* - samhälle med *Myriophyllum spicatum* och *Zannichellia palustris* jämte enstaka exemplar av *Potamogeton perfoliatus*, *Ranunculus baudotii*, characéer samt reducerade former av *Fucus vesiculosus* utbildat. Det är ett samhälle, där dominanterna ofta växlar. Inom det sublitorala bältets övre del i grunda vikar och fjärdar med skyddat läge dominerar characévegetation. I de mera exponerade delarna av området är erosionsfläckar betydligt vanligare. Även ett samhälle med lösliggande *Fucus vesiculosus* har där större utbredning.

Fig. 2. Vy över betad strandäng (bandprofil fig. 3). Till vänster synes täta bestånd av *Phragmites communis* och *Scirpus tabernaemontani*, därinnanför en tuvig zon med *Eleocharis uniglumis* - *Agrostis stolonifera* - samhälle varpå följer ett *Juncus gerardi* - samhälle. — View of a grazed shore meadow (profile figure 3). To the left dense stands of *Phragmites* and *Scirpus*, in the middle a hummocky zone with an *Eleocharis* - *Agrostis* community and to the right a *Juncus* community. — Östernäs. Aug. 1953.

Hydrolitoral vegetation

Vattenstranden förmedlar övergången mellan havets växtsamhällen och landstrandens. Vid exponerade stränder dominerar antingen alger (*Fucus*, *Enteromorpha*), *Ruppia maritima*, *Eleocharis parvulus* eller *Eleocharis uniglumis*. Vid skyddade stränder (med mera finkorniga sediment) bildar *Phragmites communis*, *Scirpus maritimus* eller *Scirpus tabernaemontani* täta bestånd.

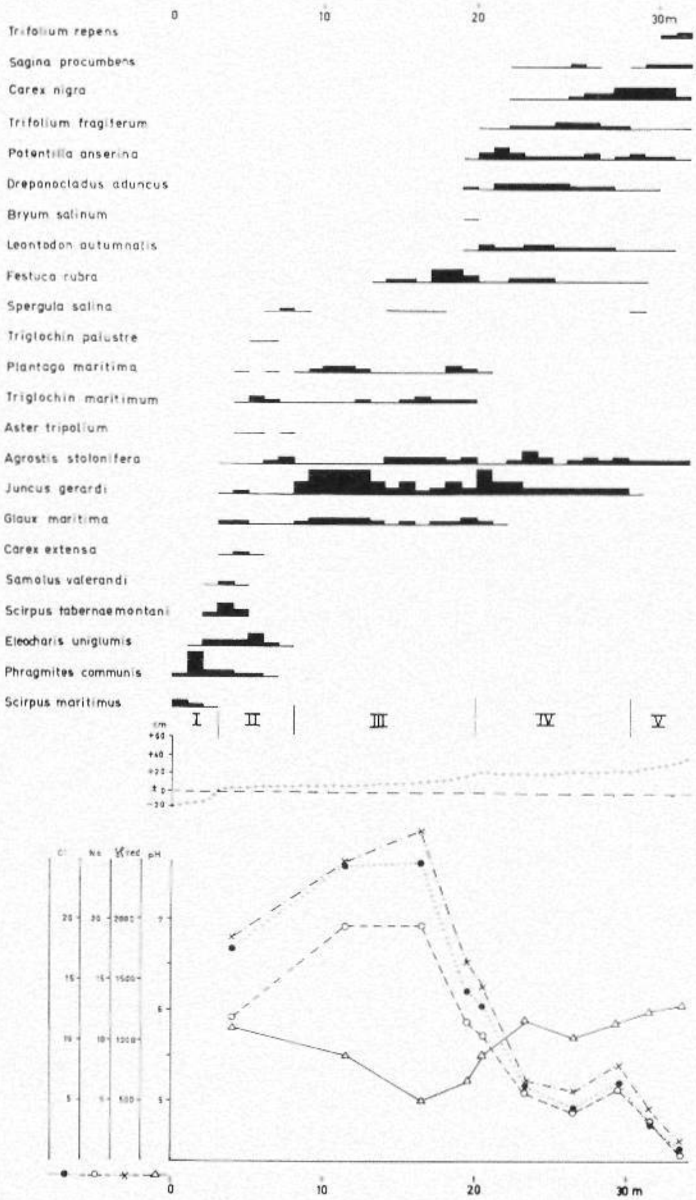

Fig. 3. Bandprofil från en strandäng 200 m SSE östligaste gården i Östernäs. Rutstorlek 1×1 m². Siffrorna I—V betecknar i stort sett hydrolitoral, geolitoral (undre, mellersta, övre) resp. epilitoral. Samma beteckningar återfinnes i övriga bandprofiler. I anslutning till vegetationsprofilen en avvägningskurva samt därunder ett diagram med resultaten av de markkemiska undersökningarna. Till skillnad från övriga

Strandängar

(Signatur 16 på Pl. I, Berglund 1963 a; bandprofiler fig. 3, 4, 6, 7; foto fig. 2, 5). De förekommande strandängarna är små och i allmänhet belägna i vikar med skyddat läge (fig. 2—6). Endast vid udden Röaskär i västligaste delen av Torp förekommer mera exponerade strandängar (fig. 7). På skären och holmarna utanför Senoren finns också dylik vegetation ehuru fragmentarisk. — Strandängarna var förr slåttermarker, numera är de uteslutande betesmarker.

Vid de skyddade strandängarna följer på vattenstrandens vass- och sävruggar ett *Eleocharis uniglumis-Agrostis stolonifera*-samhälle. Detta är en av kreaturstramp och uppfrysning tuvig zon med bl.a. *Samolus valerandi* och *Carex extensa*. Den bildar en övergång till *Juncus gerardi*-samhället, som intar större delen av landstranden. Ibland uppträder några andra arter som dominanter vid sidan av *J. gerardi*, exempelvis *Blysmus rufus, Odontites litoralis, Centaurium vulgare, Festuca rubra* eller något högre upp *Leontodon autumnalis* och *Potentilla anserina*. Den senare uppträder rikligt, där tång har anrikats. Andra arter som tillhör detta samhälle är *Plantago coronopus, Spergula salina, Carex distans* och *Bryum salinum*. — Redan i geolitoralens övre del kan sötvattentillförseln orsaka en markant förändring av vegetationen. Detta märks tydligast genom att *Carex nigra, C. panicea* och *Juncus articulatus* kommer in i *Juncus gerardi*-samhället. Andra viktiga arter är *Armeria maritima, Potentilla anserina, Trifolium fragiferum, Festuca rubra, Eriophorum angustifolium* och *Drepanocladus aduncus*.

Ett *Carex nigra*-samhälle är utbildat i epilitoralens nedre del (*C. nigra* dominerar fullständigt). Det avlöses i allmänhet av ängsvegetation, exempelvis ett *Molinia coerulea-Sieglingia decumbens*-samhälle med *Centaurea jacea, Hydrocotyle vulgaris, Ophioglossum vulgatum, Selinum carvifolia, Tetragonolobus maritimus, Vicia cracca, Agrostis tenuis, Anthoxanthum odoratum* och *Briza media*. Slut-

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undersökta strandängar har denna synnerligen svag lutning. Här förekommer också erosionsfläckar. Topografin gynnar således en saltanrikning. — Belt transect from a shore meadow 200 m SSE of the easternmost farm in Österäs. Size of squares 1×1 m². The figures I—V indicate approximately hydrolitoral, geolitoral (lower, middle, upper) and epilitoral. Below the vegetational profile a levelling curve and a diagram of the soil chemical investigations. — 23 VII 1958.

Tillägg till de fem översta rutorna (In addition to the five uppermost squares): *Atriplex patula, Plantago major, Juncus articulatus, J. bufonius, Poa pratensis.*

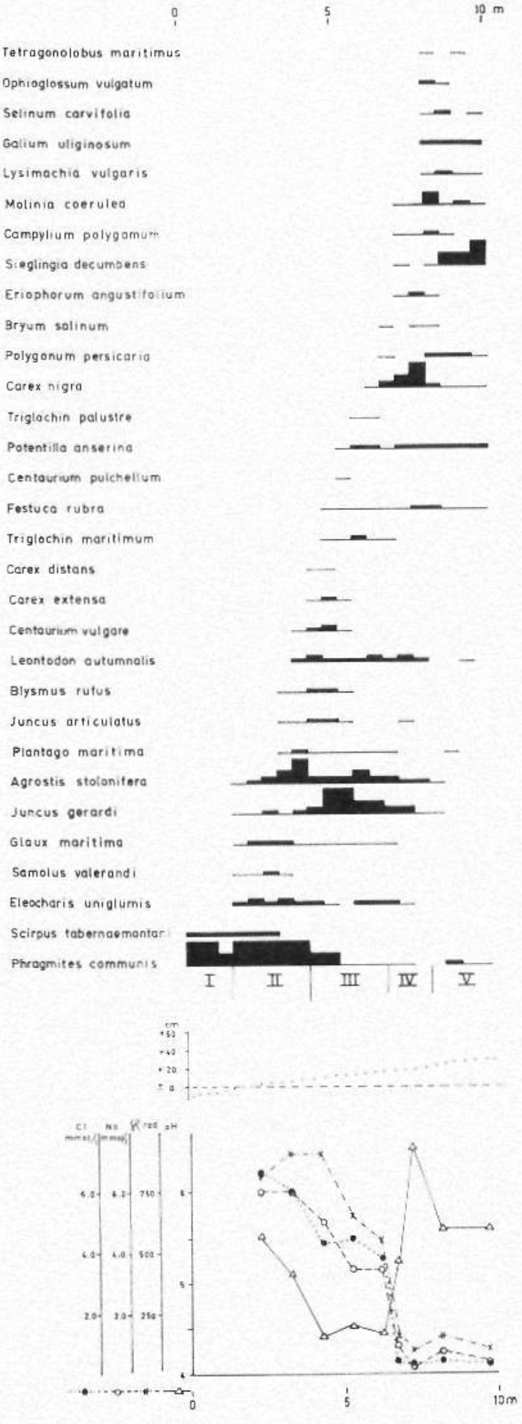

Fig. 4. Bandprofil från en mindre hårt betad strandäng 600 m ENE östligaste gården i Österäs. Rutstorlek 1×1 m². — Belt transect from a less intensively grazed shore meadow 600 m ENE easternmost farm in Österäs. Size of squares 1×1 m². — 24 VII 1958.

Tillägg till de fyra översta rutorna (In addition to the four uppermost squares): *Agrostis tenuis, Anthoxanthum odoratum, Briza media, Carex panicea, Elytrigia repens, Festuca ovina, Holcus lanatus, Hydrocotyle vulgaris, Lotus corniculatus, Lycopus europaeus, Nardus stricta, Poa pratensis, Potentilla erecta, Prunella vulgaris, Ranunculus acris, Rhytidiadelphus squarrosus, Sagina nodosa, Trifolium pratense, T. repens. Vicia cracca, Viola canina.*

Fig. 5. Strandäng med högvuxen ängsvegetation, *Calamagrostis epigeios* - *Calystegia sepium* - samhälle (bandprofil fig. 6). — Shore with tall herb meadow vegetation, *Calamagrostis* - *Calystegia* community (profile figure 6). — Västernäs. Aug. 1953.

ligen kommer ett *Alnus glutinosa*-samhälle, numera dock synnerligen fragmentariskt, före den helt terrestra skogsvegetationen.

En avvikande strandängsvegetation är den, som ställvis förekommer i en ofta endast c:a 10 m bred bård innanför hydrolitoralens vassvegetation (fig. 5, 6). Den förekommer vid skyddade stränder, där gödslingen är relativt stark (jfr utbredningen för *Calystegia* fig. 9). Hela geolitoralen är utbildad som ett frodigt, örtrikt *Calamagrostis epigeios*-*Calystegia sepium*-samhälle med bl.a. *Allium scorodoprasum, Lysimachia vulgaris, Lythrum salicaria, Ophioglossum vulgatum, Selinum carvifolia, Sonchus arvensis* och *Elytrigia repens*. Epilitoralens vegetation är ett ängssamhälle med bl.a. *Anthriscus silvestris, Festuca arundinacea* och *Phalaris arundinacea*. Hela strandvege-

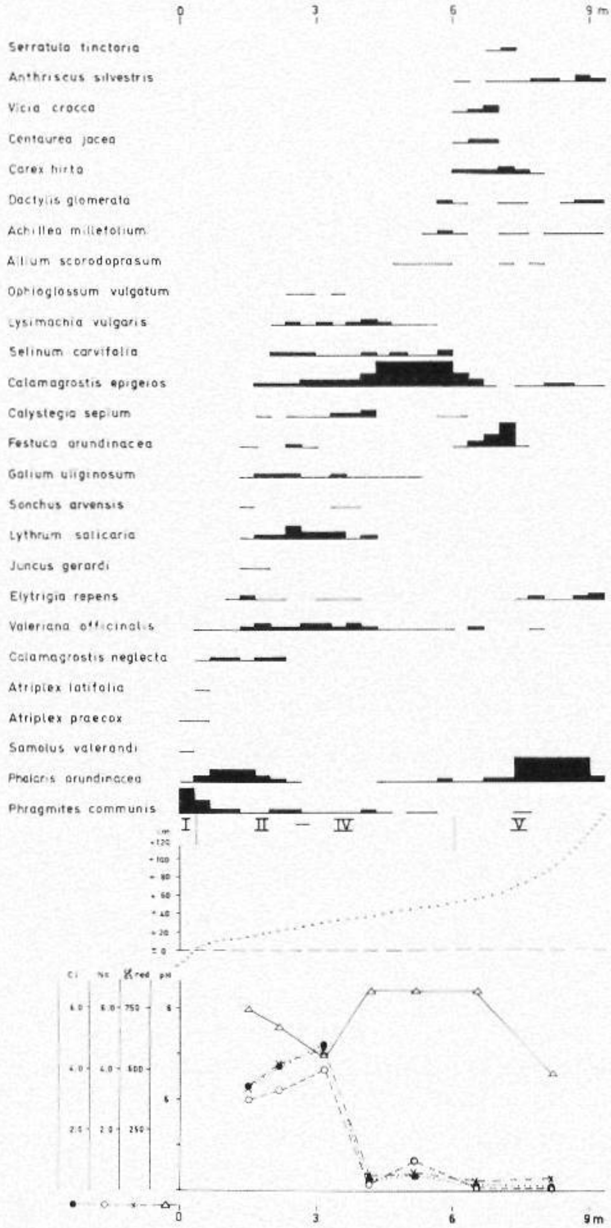

Fig. 6. Bandprofil från en strand med högörtängsartad vegetation, *Calamagrostis epigeios* - *Calystegia sepium* - samhälle, omedelbart nordväst om bron till fastlandet. Rutstorlek $^1/_3 \times ^1/_3$ m². — Belt transect from a shore, where the vegetation has the

tationen har karaktär av högörtäng. Denna är fortfarande föremål för slåtter.

De exponerade strandängarna skiljer sig i vissa avseenden väsentligt från de ovan beskrivna. Hydrolitoralen har ett glest *Eleocharis uniglumis* - samhälle i stället för slutna vassruggar. Inom geolitoralen har *Blysmus rufus* - och *Potentilla anserina* - dominerade samhällen större utbredning. I geolitoralens övre del finns en tångvall med *Elytrigia repens* - vegetation med *Atriplex latifolia, A. litoralis, Galeopsis bifida, Potentilla reptans* och *Ranunculus repens*. Den epilitorala vegetationen är bäst utbildad på de små skären i väster, exempelvis St. Kyrkoskär, där den utgöres av ett *Arrhenatherum elatior* - samhälle eller *Prunus spinosa* - snår med bl.a. rikligt av *Scutellaria hastifolia* (jfr denna arts utbredning, fig. 10). Dessa båda samhällen har sin närmaste motsvarighet i den yttre skärgården.

Havsvattnets salthalt är vid blekingekusten c:a 7 ‰. Analys av tre vattenprover från Senorens stränder har givit följande resultat:

	pH	$\varkappa_{red}$	Na mmol/l	Cl mmol/l
Torps södra del	6,7	2980	125	112
Östernäs östra del	6,8	3100	90	116
W Möcklöbron, Västernäs	6,8	3410	85	109

Resultaten av de markkemiska undersökningarna framlägges i diagram i anslutning till bandprofilerna. De visar, att kurvorna för specifika ledningsförmågan, natrium och klorid löper parallellt. Från medelvattenlinjen stiger de mer eller mindre tydligt inemot geolitoralen, vilket tyder på en saltanrikning på åtminstone vissa av strandängarna (jfr fig. 3). På en bestämd nivå i övre geolitoralen sjunker emellertid dessa värden mycket plötsligt, stundom bildas dock två »knän» på kurvorna. I epilitoralen är värdena mycket låga. Den kraftiga minskningen av elektrolythalten, främst NaCl, torde ha sin förklaring i att på denna nivå möter fastmarkens grundvatten (jfr Gillner 1960). I vegetationsprofilen motsvaras förändringen av att *Juncus gerardi* - samhället avlöses av *Carex nigra* - samhället.

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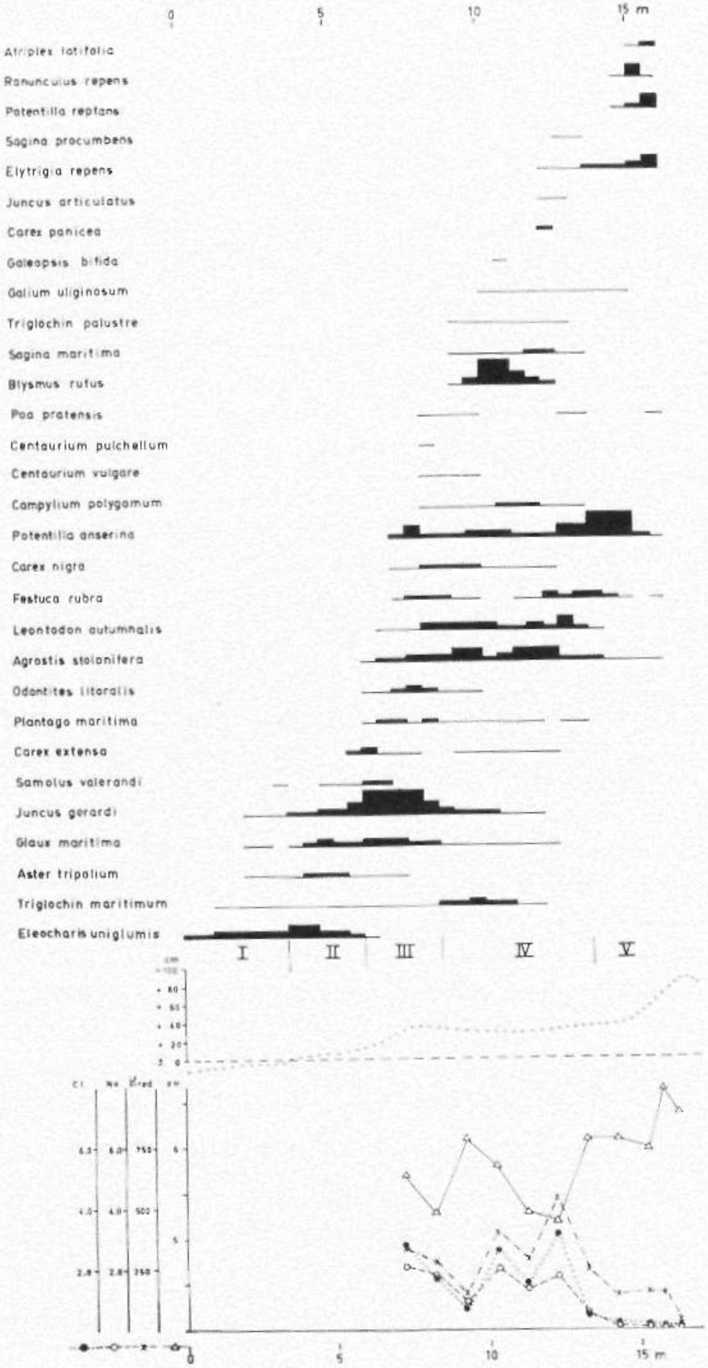
character of a tall herb meadow situated immediately northwest of the bridge to the mainland. Size of squares $^1/_3 \times {}^1/_3$ m^2. — 24 VII 1958.

Tillägg till de åtta översta rutorna (In addition to the eight uppermost squares): *Agrostis tenuis, Avena pubescens, Deschampsia flexuosa, Festuca rubra, Galium verum, Linaria vulgaris, Poa pratensis, Ranunculus acris, Rumex acetosa, R. domesticus, Scrophularia nodosa.*


0
5
10
15 m
Atriplex latifolia
Ranunculus repens
Potentilla reptans
Sagina procumbens
Elytrigia repens
Juncus articulatus
Carex panicea
Galeopsis bifida
Galium uliginosum
Triglochin palustre
Sagina maritima
Blysmus rufus
Poa pratensis
Centaurium pulchellum
Centaurium vulgare
Campylium polygamum
Potentilla anserina
Carex nigra
Festuca rubra
Leontodon autumnalis
Agrostis stolonifera
Odontites litoralis
Plantago maritima
Carex extensa
Samolus valerandi
Juncus gerardi
Glaux maritima
Aster tripolium
Triglochin maritimum
Eleocharis uniglumis
I
II
III
IV
V
cm
+100
+80
+60
+40
+20
± 0
Cl
Na
Ered
pH
6.2
6.0
750
6
4.0
4.0
500
2.8
2.8
250
5
0
5
10
15 m

pH-kurvan har emellertid ett något oväntat förlopp. Värdena är alltid höga vid medelvattenlinjen, men de sjunker sedan, så att kurvan har ett tydligt minimum, där övriga kurvor visar sitt tydliga maximum för att sedan åter stiga till värden, som i övre geolitoral och epilitoral i allmänhet är något högre än ute vid vattenlinjen. De låga pH-värdena i geolitoralen kan möjligen förklaras av att vissa delar av detta bälte är en oxidationszon. Reducerande svavelföreningar i kontakt med luften oxideras. Analyserna visar också, att syra-bas-status i övre delen av geolitoralen samt i epilitoralen är gynnsam, pH ligger omkring 6. Inom denna del av stranden är i allmänhet en rik ängsvegetation utbildad med arter, som annars förekommer i kalktrakters fuktängar, t.ex. *Ophioglossum vulgatum, Scutellaria hastifolia* och *Tetragonolobus maritimus* (jfr karta fig. 8).

Vegetationsundersökningarna visar, att det finns två särskilt viktiga gränser i strandängsvegetationen, gränsen mellan hydro- och geolitoralens växtsamhällen samt gränsen mellan geo- och epilitoralens samhällen. Den förra motsvarar medelvattenlinjen, den senare den linje, som skiljer havsvattenpåverkad mark från övervägande sötvattenspåverkad mark.

I en tabell har jämförelse gjorts mellan västkustens och ostkustens strandängsvegetation (Dahlbeck 1945, Gillner 1960 resp. Sterner 1933). Gillners schema (op. cit. s. 92) har varit utgångspunkt för denna jämförelse. De blekingska strandängarna i skyddat läge med större sötvattenspåverkan motsvarar nära västkustens *Scirpus maritimus-Alnus glutinosa*-zonering och vegetationen kan benämnas på samma sätt. Den har nästan exakt samma utformning i Kalmarsunds innersta och mellersta skärgård. De mera exponerade stränderna med mindre sötvattensinflytande, som ju dock är fåtaliga inom Senorenområdet, har en *Eleocharis uniglumis-Prunus spinosa*-zonering motsvarande västkustens *Salicornia strictissima - Rosa, Crataegus, Prunus spinosa* - zonering. Dessa skiljer sig i väsentliga delar från varandra, i synnerhet gäller detta undre geolitoralens växtsamhällen. *Salicornia* spp., *Puccinellia maritima, P. distans* och *Artemisia mari-*

Fig. 7. Bandprofil från en exponerad strandäng, udden Röaskär i västligaste delen av Torp. Rutstorlek 1×1 m^2. Avvägningskurvans krön markerar tydliga tångvallar. — Belt transect from an exposed shore meadow, the point of Röaskär in the westernmost part of Torp. Size of squares 1×1 m^2. The tops of the levelling curve are caused by banks of sea wrack. — 29 VII 1958.

Tillägg till de fyra översta rutorna (In addition to the four uppermost squares): *Atriplex litoralis, Centaurea jacea, Trifolium repens, Viola canina.*

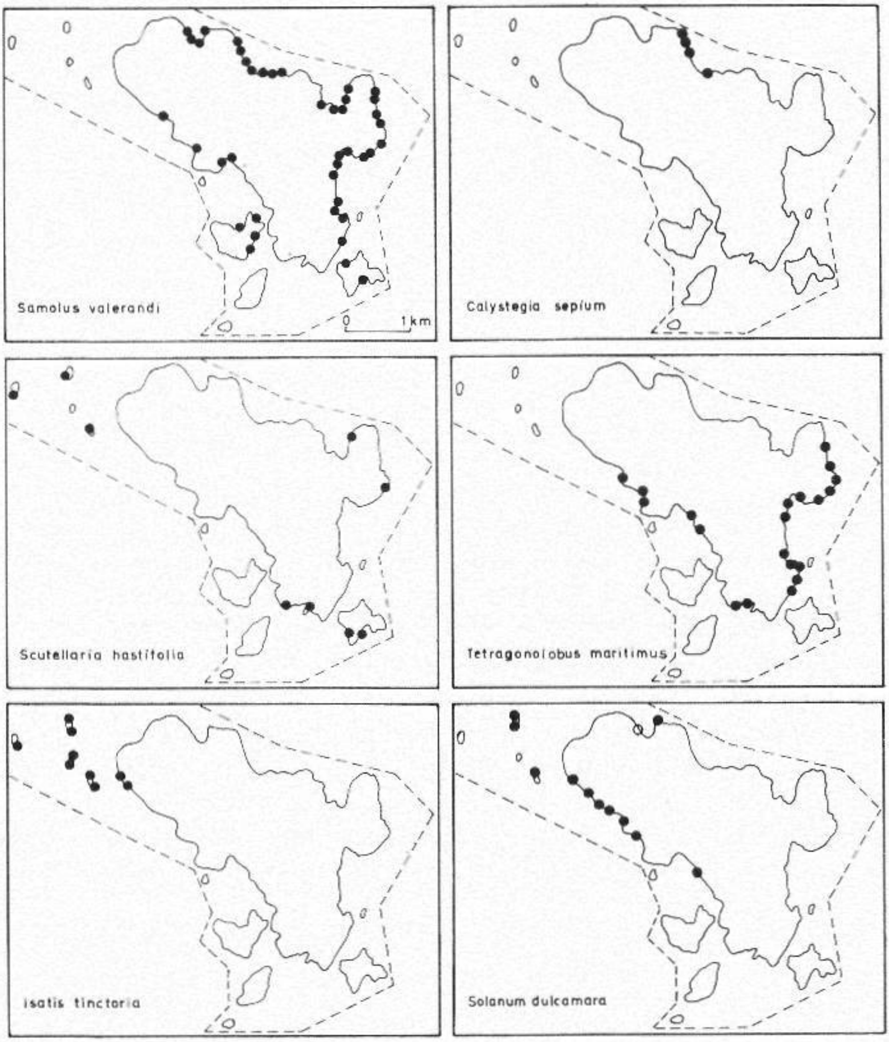


Fig. 8. Utbredningen av några strandväxter. *Samolus* och *Calystegia* är knutna till de skyddade stränderna i norr och öster. *Scutellaria* och *Tetragonolobus* till de något mera exponerade strändernas ängsvegetation i övre geolitoral och epilitoral. *Isatis* och *Solanum* till de mest exponerade moränstränderna i väster. — Distribution of some shore plants. *Samolus* and *Calystegia* are restricted to the less exposed shores in the north and east, *Scutellaria* and *Tetragonolobus* to the meadow vegetation in upper geolitoral and epilitoral of more exposed shores and *Isatis* and *Solanum* to the most exposed moraine shores in the west.

tima är sällsyntheter i den blekingska floran (jfr Holmgren 1942). Däremot finns flera likheter inom epilitoralen. Kalmarsunds *Phalaris arundinacea - Prunus spinosa* - zonering i yttre skärgåden överensstämmer däremot till allra största delen med den blekingska zoneringen. Västkustens *Salicornia europaea - Carex panicea, Sieglingia decumbens - Empetrum nigrum* - zonering förekommer i Blekinge men är synnerligen sällsynt. Öresunds strandängsvegetation överensstämmer till största delen med den egentliga västkustens. Först inne i Östersjön ersätts *Salicornia*-samhällen av *Scirpus uniglumis* - samhällen och *Puccinellia maritima* - samhällen av *Agrostis stolonifera* - samhällen.

De tånggödslade samhällena i övre geolitoralen visar flera gemensamma drag från västkusten till ostkusten. Dock saknas ett par samhällen i Blekinge och vid Kalmarsund. Den örtrika *Calamagrostis epigeios - Calystegia sepium* - ängen har en intressant motsvarighet i det av Gillner (op. cit. s. 90) beskrivna *Calystegium sepii maritimum,* tidigare av Nordhagen beskrivet från södra Norge. Detta växtsamhälle innehåller ett stort antal sydliga arter.

Moränstränder

(Fig. 10, 11). Dessa har den största utbredningen av alla strandtyper. De har en helt annan karaktär än västkustens blockstränder (Gillner 1959). Sten- och grusfraktionerna dominerar, men samtidigt förekommer också en hel del ler. Detta gör att vegetationen blir en modifierad strandängstyp med sammanträngda zoner på grund av strandens större lutning. Bandprofilen representerar en moränstrand med skyddat läge. Hydrolitoralvegetationen avviker ej från strandängar, geolitoralens vegetation kan benämnas *Agrostis stolonifera* - samhälle eller stundom *Juncus gerardi* - samhälle. Här är vegetationen gles med åtskilliga helt kala ytor. I geolitoralens övre del samt i epilitoralen finns ofta en *Hydrocotyle*-bård som tecken på sötvattenspåverkan. I den grusiga jorden uppträder bl.a. *Anagallis arvensis, Centaurium pulchellum, Sagina maritima,* mera sällan *Gypsophila muralis* samt på sydligaste delen av Senoren *Myosotis laxa* ssp. *baltica. Isatis tinctoria* och *Solanum dulcamara* (karta, fig. 8) är helt knutna till de exponerade moränstränderna. I epilitoralen är ofta en *Alnus glutinosa* - strandskog utbildad. En sällsynt art, som stundom påträffas invid de första albuskarna är *Scutellaria hastifolia.*

		Västkusten	Sydöstra Blekinge	Kalmarsund
Sub-litoral		*Zostera marina* - ass.	Dito	Dito ?
		Ruppia spiralis - *Zostera nana* - ass.	*Ruppia spiralis* - *Potamogeton pectinatus* - smh.	Dito ?
Hydro-litoral		*Ruppia maritima* - ass.	Dito	Dito ?
		Eleocharetum parvulae	Dito	Dito ?
		Scirpetum maritimi	Dito	× { Dito *Phalaris arundinacea* - smh.
		× *Salicornietum strictissimae*	× *Eleocharis uniglumis* - smh.	
Geolitoral	undre	*Eleocharis uniglumis* - *Agrostis stolonifera* - smh.	Dito	Dito
		× *Puccinellietum maritimae*	× *Eleocharis uniglumis* - *Agrostis stolonifera* - smh.	—
		× *Puccinellia distans*	—	—
	mellersta	*Juncetum Gerardi*	Dito	Dito
		× *Artemisietum maritimae*	—	—
		× *Sagineto maritimae* - *Cochlearietum danicae*	— (Klipp- och moränstr.)	—
	övre	*Caricetum rectae*	*Juncus gerardi* - *Potentilla anserina* - *Leontodon autumnalis* - smh. *Juncus gerardi* - *Carex nigra* - smh. el. *Hydrocotyle*-smh.	*Festuca rubra* - äng
Tånggödslad geolitoral		*Tripleurospermeto maritimi* - *Atriplicetum litoralis*	— (Yttre skärgården)	?
		× *Elytrigietum repentis maritimum*	× Dito	Dito
		Calystegietum sepii maritimum	*Calamagrostis epigeios* - *Calystegia sepium* - smh.	?
		Catabrosa aquatica - *Stellaria crassifolia* - smh.	—	—
Epilitoral		× *Lolieto* - *Cynosuretum* × *Festuceto commutatae* - *Cynosuretum*	× *Arrhenatherum elatior* - smh.	Dito
		Caltha palustris - smh.	Dito	Dito ?
		Carex nigra - smh.	Dito *Hydrocotyle*-smh.	Dito Dito
		× *Sieglingia decumbens* - *Carex panicea* - smh.	*Molinia coerulea* - *Sieglingia decumbens* - smh.	Dito *Festuca ovina* - äng *Avena pubescens* - äng
		Alneta glutinosae	Dito	Dito
		× *Rosa, Crataegus, Prunus spinosa* - snår	× *Prunus spinosa* - snår	Dito

Fig. 9

Fig. 10. Blockstrand med skyddat läge (bandprofil fig. 11). Till vänster hydrolitoralens förhållandevis glesa vegetation av *Phragmites communis* och *Scirpus maritimus*, till höger en *Alnus glutinosa* - bård, varpå följer det epilitorala bältets ekskogsvegetation. — Scheltered boulder shore (belt transect figure 11). To the left *Phragmites* and *Scirpus maritimus* belonging to the hydrolitoral belt, to the right an *Alnus glutinosa* border and an oak forest vegetation belonging to the epilitoral belt. — Österngäs. Aug. 1953.

Fig. 9. Översikt av strandängarnas växtsamhällen i södra Sverige. — markerar att samhället ifråga ej förekommer inom området. × markerar, att samhället i fråga förekommer på mera exponerade lokaler med mindre sötvattenspåverkan. — Survey of the plant communities on the shore meadows in southern Sweden. — indicates that the community is not found in the area. × indicates that the community occurs on more exposed localities with less fresh-water influence.

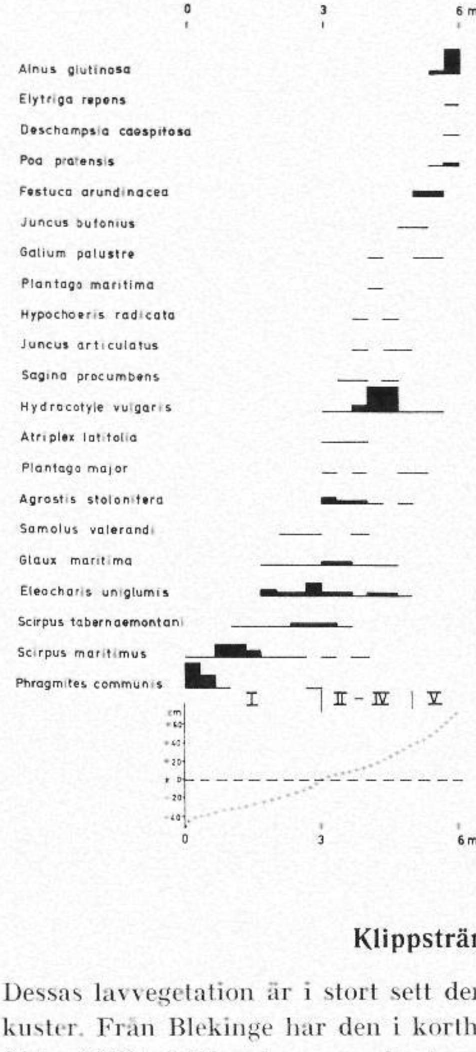


Fig. 11. Bandprofil från en blockstrand med skyddat läge, 400 m S östligaste gården i Österäs. Rutstorlek $^1/_3 \times {}^1/_3$ m². — Belt transect from a less exposed boulder shore 400 m S of the easternmost farm in Östernäs. Size of squares $^1/_3 \times {}^1/_3$ m². — 23 VII 1958.

Klippstränder

Dessas lavvegetation är i stort sett densamma som vid andra östersjökuster. Från Blekinge har den i korthet beskrivits av G. E. och G. Du Rietz (1925). I klippskrevorna förekommer en artfattig fanerogamvegetation: i nedre delen *Aster tripolium, Plantago maritima, P. coronopus, Puccinellia retroflexa* samt något högre upp *Armeria maritima, Cochlearia danica, Sagina maritima, Viola tricolor* och *Festuca rubra*. På de mera exponerade hällarna i väster, exempelvis Annaskär, där gödsling av tång och fågelspillning är större, tillkommer *Allium schoenoprasum, Atriplex latifolia, A. litoralis, Sedum acre, S. telephium, Senecio viscosus, Spergula vernalis* och *Tripleurospermum maritimum*. Där växer också gärna rikligt med *Cynanchum vincetoxicum*. I Torhamns yttre skärgård tillkommer på liknande lokaler bl.a. *Melandrium viscosum*. Till väsentliga delar överensstämmer strandklippornas vegetation med västkustens, men vissa skillnader finns också, exempelvis avsaknaden av *Silene maritima* (Gillner 1959).

Summary

Vegetation of the Island of Senoren

III. The Shore Vegetation

This paper is a continuation of Berglund 1962 and 1963 a, where the vegetational history and the land vegetation have been treated respectively.

The shore vegetation has been studied by belt transects. In connection with these soil samples have been collected from the humus layer. Thirty grams of the fresh peat have been extracted with 250 ml water. The pH, specific conductivity, sodium- and chloride concentration of the extract were determined according to Malmer (1960 pp. 88 ff.).

The shore is subdivided according to Du Rietz (1950, cf. scheme in Gillner 1960 p. 24). The communities of the shore meadows including the sublitoral and hydrolitoral vegetation are summarized in figure 9. They are also compared with corresponding communities of the Swedish West Coast (Gillner op. cit., Dahlbeck 1945) and with the communities of the Swedish East Coast (Sterner 1933). The more sheltered and fresh water influenced shore meadows of Blekinge correspond to the *Scirpus maritimus* - *Alnus glutinosa* - zonation of the West Coast. They are also of much the same type as on the East Coast. The more exposed and less fresh water influenced shore meadows of Blekinge correspond to the *Salicornia strictissima* - *Rosa, Crataegus, Prunus spinosa* - zonation of the West Coast but there are many important differences. On the other hand corresponding vegetation on the East Coast is very like that in Blekinge.

The diagrams of the soil chemical analysis show that the curves for specific conductivity, sodium and chloride run parallel to each other. In the geolitoral belt there is a high salt concentration but in the uppermost part of this belt the curves fall suddenly. Probably this is caused by the confluent fresh water from the epilitoral belt. In the vegetation this corresponds to the beginning of the *Carex nigra* - community. The pH-values are high in the lower part of the geolitoral belt, low in the middle of the this belt (probably caused by oxidation processes) and high in the uppermost part of the geolitoral belt and in the epilitoral belt. The acid-base status is consequently very good in the upper parts of the shore meadows. Here is also a rich meadow vegetation with among other species *Ophioglossum vulgatum, Scutellaria hastifolia* and *Tetragonolobus maritimus* (map figure 8).

The vegetation of the moraine shores (figures 10, 11) and the rock shores is briefly described.

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Studies in the Aegean Flora

V. Iberis arbuscula sp. nov.

By HANS RUNEMARK

(Meddelande från Lunds Botaniska Museum, Nr 181)

In 1958 during an investigation of the island of Ikaria a perennial, fruticose member of *Iberis* was discovered. The plant cannot be referred to any east-Mediterranean species, but is apparently related to *Iberis gibraltarica* L., a rare chasmophyte in the area surrounding the Strait of Gibraltar.

The newly detected *Iberis* species is probably an obligate chasmophyte. It has been found on a single precipice in the central part of Ikaria (it has in vain been looked for in other parts of Ikaria and on the neighbouring island of Samos). The locality is a south-exposed, c. 200 m high precipice of hard limestone with a horizontal extension of c. 2 km. It is situated between 600 and 800 m above sea level and faces the sea. Among other chasmophytes occurring together with the *Iberis* species may be mentioned *Linum gyaricum* Vierh., *Cephalaria sieberi* Szabo, *Coronilla emeroides* Boiss & Spr., *Cheiranthus cheiri* L., *Chamaepeuce alpini* Jaub. & Spach., *Brassica cretica* Lam., and *Carum multiflorum* (S. & S.) Boiss.

The *Iberis* species is a contribution to the exclusive group of Aegean chasmophytes with west-Mediterranean affinities. Other species belonging to this group are *Asperula tournefortii* Sieb., *Cephalaria sieberi* Szabo, *Scabiosa cretica* L., *Senecio bicolor* (Willd.) Tod., *Dianthus arboreus* L., and *Anthyllis aegaea* Turr.

Iberis arbuscula sp. nov.

Orig. coll. Greece. Ikaria, 2—3 km N of "Praya P:t" c. 700 m s.m. Runemark and Snogerup 18.6 1958 (R. & S. 11481); holotype in LD, isotype in E.

Diagnosis. *Iberidi gibraltaricae* L. similis, sed differt siliculis obovatis, lobis alarum rotundatis et sinu anguste lineari.

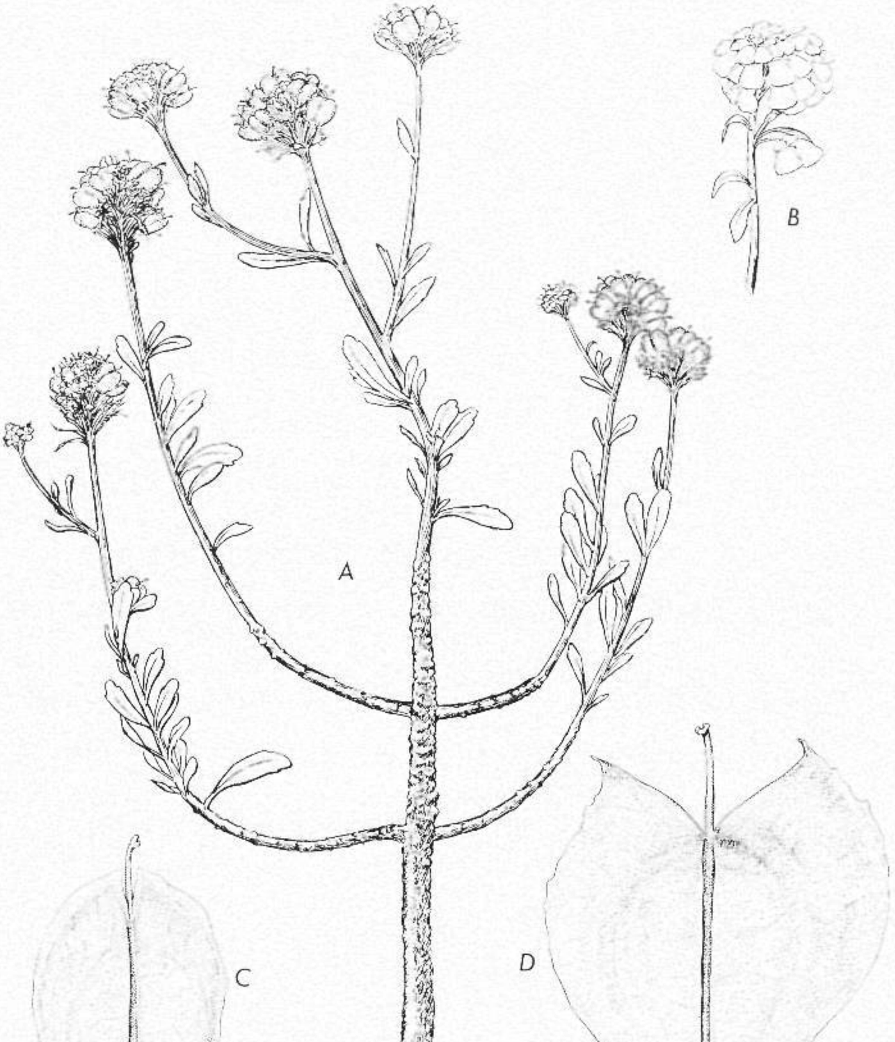

Fig. 1. *Iberis arbuscula* sp. nov. (except. fig. 1 D). — A. Holotypus (×2/3) — B. Inflorescence; cultivated material (×2/3) — C. Silicula (×4) — D. Silicula of *I. gibraltarica* L.; Gibraltar 1887 Reverchon, herb. LD (×4).

Description. Perennial shrub 20—50 cm high. Basal parts ligneous, 5—10 mm in diam. Flowering branches herbaceous, foliate. Leaves 1—3 cm, glabrous, ± leathery, spathulate to narrowly obovate, narrowing into a stalklike base, sparsely denticulate towards the apex. Inflorescence contracted, oblong to rounded, of 20—70 flowers. Flowers faintly pinkish to almost white, marginal ones to 15 mm in diam., the external petals 3—4 times as long as the internal ones. Sepals c. 6 mm ovate, greenish with white margins and a pinkish spot at the apex. Siliculae slightly obovate (8—10 mm long, 6—7 mm broad), wings 2—3 mm, dorsally rounded, the notch between the wings very narrow. Style c. 3—4 mm. Seeds not winged, 3—3.5 mm. Chromosome number 2n=14; chromosomes relatively large, one pair with distinct satellites.

The description is founded on preserved material from the type locality, except for the flowers which are described on living material cultivated in the Botanical Garden, Lund.

Cultivated material has been used for the cytologic investigation. The chromosomes have been studied in somatic plates in roots using the paraffin method (fixation in Navashin-Karpeschenko, staining in crystal-violet).

Affinities. On vegetative characters and in flowering state *I. arbuscula* can hardly be distinguished from *I. gibraltarica* L. (cf. e.g. the figure of that species in Curtis's Bot. Mag. plate 124). The two species also have the same chromosome number, 2n=14 (cf. Manton 1932). However, there are great differences between them in the shape of the siliculae (fig. 1 c, d).

Other perennial, fruticose members of *Iberis*, as *I. sempervirens* L. and *I. semperflorens* L., are easily distinguished from *I. arbuscula* in habit, in the shape of siliculae, and in having entire leaves. They too have different chromosome numbers (2n=22 and 2n=16 ?).

Summary

The new species *Iberis arbuscula* Run. is described. It is a perennial, fruticose chasmophyte found on the island of Ikaria in the Aegean Sea. The new species is apparently related to *Iberis gibraltarica* L., a chasmophyte in the area surrounding the Strait of Gibraltar. The chromosome number for *I. arbuscula* is 2n=14.

Reference

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BOTANISKA NOTISER 1963 · VOL. 116 · FASC. 2 · LUND

Något om de skånska Cochlearia-arterna

AV BÖRJE LÖVKVIST

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(With an English Summary)

Släktet *Cochlearia* representeras i Skåne av *C. danica* L. och av typer inom *C. officinalis* - komplexet. Värdet av dessa typer har varit föremål för synnerligen divergerande uppfattningar och floraförfattare har behandlat komplexet på skiftande sätt, medan däremot *C. danica* har ansetts som bättre avgränsad. Släktet, och då framförallt *C. officinalis* - komplexet, är föremål för ingående undersökningar på flera håll i världen. Några resultat, som nåtts på skånskt material, kommer att redovisas nedan.

Cochlearia danica L.

Såvitt jag kan finna är denna art tämligen enhetlig i Skåne. Vissa storleksskillnader är iakttagna, men dessa kan i stort sett betraktas som modifikativa. Ett undantag utgör en dvärgform, som uppträder här och var på den skånska västkusten, framförallt i sydväst. Egna experimentella undersökningar, som bevisar, att det här rör sig om en genetiskt fixerad dvärgform, saknas. På engelskt material har Crane & Gairdner (1923) visat, att dylika dvärgformer, genetiskt fixerade, kan uppkomma även efter artificiell självpollinering.

Kromosomtalsundersökningar av plantor från den skånska västkusten visar, att *C. danica* har $2n=42$. Detta tal har tidigare rapporterats t.ex. av Crane & Gairdner (1923). I deras arbete påpekas också att arten uppvisar ett intressant kromosomgarnityr med 14 långa kromosomer, 14 medellånga och 14 korta. Samma storleksskillnader kan iakttagas i Skånematerialet.

Cochlearia officinalis-komplexet.

Linné beskrev *C. officinalis* redan i Species Plantarum 1753. I Systema Naturae (10. ed. 1759) nämnde han för första gången *C. anglica*, som anses stå nära *C. officinalis*, och är inrymd i vad ovan kallas *C. officinalis* - komplexet. Sett ur skånsk synpunkt torde de största variationerna och den större mångformigheten föreligga inom *C. anglica* (Fig. 1 b och c), medan *C. officinalis* (Fig. 1 a) i egentlig bemärkelse är tämligen enhetlig.

Undersökningar över kromosomtalen hos plantor av den egentliga *C. officinalis* har gjorts av Crane & Gairdner (1923), som fann 2n=28. Kromosomerna var alla av ungefär samma storlek till skillnad mot förhållandet hos *C. danica*. I det undersökta materialet från Skåne har 2n=24 visat sig vara det vanligaste talet. På några lokaler förekommer dock andra tal, 2n=25, 26, 27, 28, 29. Det verkar dock som det vore naturligast att betrakta 2n=24 som det för arten egentliga talet, men extra kromosomer kan förekomma. Att extra kromosomer tillförts genom hybridisering torde inte vara helt uteslutet. Korsningsexperiment utförda av Crane & Gairdner (l.c.) visar att detta är möjligt. På Kullaberg förekommer dock en typ som synes ha 2n=28 fixerat, utan att det rör sig om extra kromosomer, men kommande undersökningar får visa, vad denna typ är värd.

C. anglica - delen av komplexet är, som ovan påpekats, mångformig. Kromosomtalsundersökningarna visar, att flera tal förekommer, 2n=36, 48, 60, samt åtskilliga andra mellan 48 och 60. En tydlig skillnad tycks finnas mellan förhållandena i östra och västra Skåne, medan inga egentliga undersökningar ännu föreligger över sydkustmaterial. *C. anglica* är ur morfologisk synpunkt tämligen enhetlig på östkusten och endast ett kromosomtal är känt, nämligen 2n=36. I västra Skåne är förhållandena helt annorlunda. Där finner man synnerligen växlande tal, medan 2n=36 synes vara sällsynt inom de områden till vilka undersökningarna hittills koncentrerats. Inom dessa är plantor med talen 2n=48 och 60 att betrakta som tillhörande rena populationer på octoploid och decaploid nivå, baserat på grundtalet 6. I bestånd som ur morfologisk synpunkt är enhetliga eller har liten variation förekommer endast ett kromosomtal antingen 48 eller 60. I bestånd med stor variation varierar också kromosomtalen, och en hybridisering mellan plantor med 2n=48 och 60 har ägt rum. Inga sterilitetsbarriärer mellan dessa typer synes förefinnas, och uppkomna primärhybrider är fertila med full frösättning, trots att kromosomuppsättningen innehåller ett udda antal satser

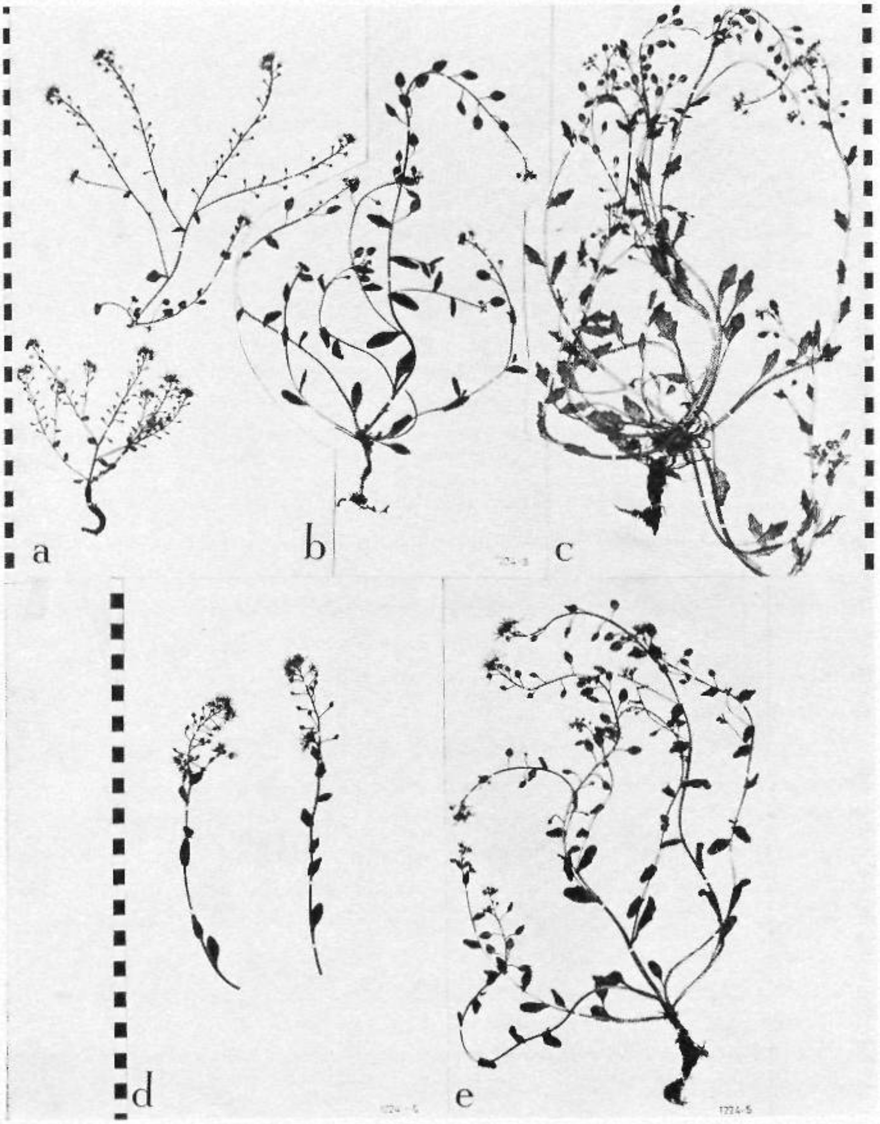

Fig. 1. a. *Cochlearia officinalis* L. s. str. $2n=24$. b. *C. anglica* L. $2n=48$. c. *C. anglica* L. $2n=60$. d. *C. anglica*×*C. officinalis*. Planta med $2n=54$. Om uppkomst se text. e. *C. anglica* $2n=54$, hybrid mellan plantor motsvarande b och c.

om 6 kromosomer. Härigenom ger primärhybriderna dels avkomma sinsemellan och dels efter återkorsning med någon av ursprungstyperna. På en lokal med stor morfologisk variation har en noggrann undersökning visat att flertalet plantor har kromosomtal mellan 54 och 60. En primärhybrid (Fig. 1 e) mellan de två kromosomtalstyperna, 48 och 60, bör få kromosomtalet 54, då könscellerna hos föräldrarna har 24 resp. 30 kromosomer. Vid en primärhybrids återkorsning med en 60-kromosomig typ kommer talen bevisligen att ligga var som helst mellan 54 och 60.

Bland plantorna med 2n=54 fanns en, som morfologiskt avvek från övriga med samma tal (Fig. 1 d). Det torde vara nödvändigt med en förklaring, hur en sådan planta kan ha uppkommit. Det framgår av Fig. 1 e och d, att den senare plantan, trots samma kromosomtal som den förra, har klara drag av 24-kromosomig *C. officinalis*. Det är väl bekant, att s.k. oreducerade könsceller kan uppkomma, d.v.s. könsceller med samma kromosomtal som de vegetativa cellerna. Sker detta på honsidan, kommer det att efter befruktning bildas en triploid planta efter en diploid moderplanta, och en hexaploid efter en tetraploid. Sker bildningen på hansidan, är chansen för att cellen skall få fungera ganska liten, men den finns dock. För att denna avvikande planta, som alltså morfologiskt har klara drag av *C. officinalis*, skall få kromosomtalet 2n=54, måste en oreducerad hanlig könscell med 24 (i stället för det normala 12) ha sammansmält med en reducerad honlig från en *C. anglica* med 2n=60. Även om förklaringen är något långsökt, torde den i detta fallet vara den enda verkligt tänkbara.

Hybridisering emellan andra kromosomtalstyper inom komplexet är kända från andra geografiska områden (Lövkvist 1963).

Några ekologiska anmärkningar

C. danica. Denna art växer ibland vid själva havsstranden, men vanligare ett stycke därifrån. I SV Skåne förekommer den gärna i anslutning till upphöjningar inom havsstrandängar. Den tycks undvika områden med hög salthalt, vilket påpekats också av Dahlbeck (1945). Inom andra delar av Skånes kuster förekommer den gärna på mer eller mindre stenigt underlag, men visar sig också vid sandiga havsstränder.

C. officinalis. Denna art förekommer rikligast inom NV Skånes klippstränder men kan mera tillfälligt slå till för något eller några år längre söderut längs västkusten, vanligen då på steniga stränder.

C. anglica. Typerna inom denna art växer på strandängar av skilda typer, men också på steniga stränder. En annan miljö, där man finner dem, är i anslutning till tångvallar o.d. Förekomsterna i NÖ Skåne är i anslutning till den låga stranden, framförallt där en viss sandhalt är för handen. Undersökningar över de olika kromosomtalstypernas ekologi har ännu inte hunnit göras i någon större utsträckning.

Taxonomiska anmärkningar

Det torde inte vara helt slutgiltigt att den ovan gjorda uppdelningen av *Cochlearia*-arterna i *C. danica* och *C. officinalis* - komplexet är den riktiga. Likheterna mellan *C. officinalis* s. str. och *C. danica* är så stora, att dessa arter eventuellt kan tänkas stå varandra närmre än de två som ovan inryms i *C. officinalis* - komplexet. Kromosomtalen i ett sådant material som detta kan tillmätas betydelse först efter synnerligen ingående undersökningar.

English Summary

Notes on the Cochlearia species of Skåne

The genus *Cochlearia* is in Skåne represented by *C. danica* and types within the *C. officinalis* complex.

C. danica has 2n=42 and is morphologically uniform, with a dwarf type as the only exception.

In the complex, *C. officinalis* s. str. has 2n=24, but plants with extra chromosomes (2n=25—29) occur. They may have developed after hybridizations, but this is not proved. — *C. anglica* is polymorphous with the investigated types having 2n=36, 48, and 60. In Skåne hybrid swarms between types with 2n=48 and 60 are met with.

Among the primary hybrids with 2n=54 one deviating plant was found, the probabe origin of which was from a normally reduced female gamete of a *C. anglica* plant with 2n=60 and an unreduced male gamete from *C. officinalis* s. str. with 2n=24.

Citerad litteratur

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BOTANISKA NOTISER 1963 · VOL. 116 · FASC. 2 · LUND

Nils Lilja och Skånes Flora

AV AXEL TÖRJE

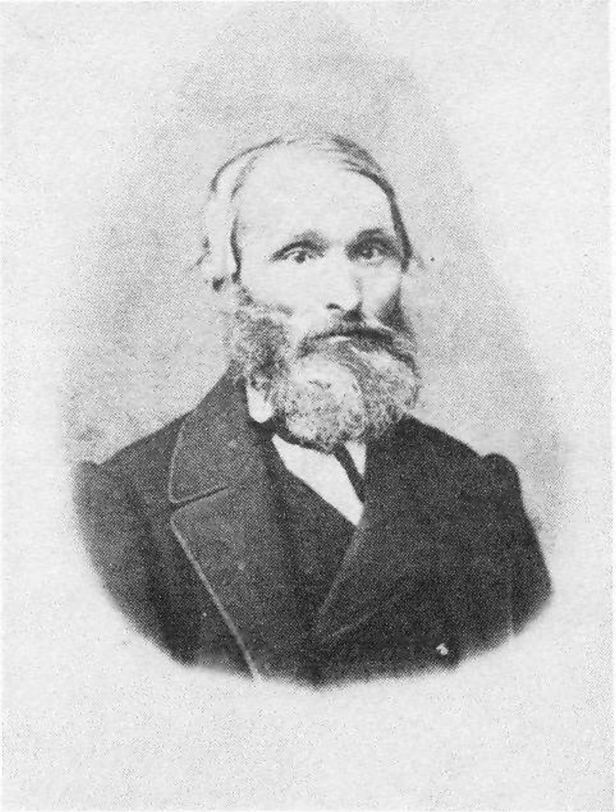
Botaniska Trädgården, Lund

Nils Lilja var en orolig natur, som sysslade med mångahanda ting, ofta med föga framgång. Här skall endast behandlas hans sysslande med växter, i synnerhet de skånska. Men först några biografiska uppgifter.

Nils Lilja var född i Blinkarp 1808 d. 17 okt., gick i Malmö skola 1824—1828 och blev student i Lund 1829, där han ämnade studera till präst. Sjukdom, han var tidvis nästan blind, hindrade honom att fullfölja detta; han försökte försörja sig som skriftställare, idkade frö- och blomsterhandel och hade ett kommissionskontor. År 1843 blev han klockare i Billinge, men vantrivdes och försökte upprepade gånger skaffa sig en annan tjänst. Häri hade han dock ingen framgång, men han var ofta och under långa perioder ledig från klockarebefattningen. Han dog 1870 d. 19 dec.

Liljas håg för växternas värld väcktes tidigt. Det var hans fader som ledde honom in på den vägen. Denne hade utan någon som helst hjälp börjat syssla med naturen och synnerligast med växterna. Senare när sonen börjat skolan i Malmö och fått någon undervisning i naturvetenskap blev det han som kunde underlätta och fördjupa sin faders och sina egna strävanden i den riktningen. Säkert har de båda offrat mycken tid och möda på att utforska vad som växte i markerna både nära och längre ifrån deras hem, som fram till 1825 var Blinkarp och därefter i några år Ramstorp, ett litet hemman underlydande Trolleholm. Detta kommer till synes längre fram i tiden.

Några närmare uppgifter om Liljas botaniska studier under skoltiden i Malmö och under de första studentåren i Lund finns inte på annat sätt än att han visade sig vara väl förtrogen med floran i och kring dessa båda städer. Visserligen kallar han C. A. Agardh och Elias Fries för sina lärare, men någon examen för dem avlade han ej och ej



Nils Lilja.

heller för någon annan. Det ser ut som om han mest studerade på egen hand och utan annat syfte än att tillfredsställa sitt eget intresse.

År 1835 började Elias Fries, då professor i Uppsala, utgiva Flora Scanica. På Lilja synes detta ha verkat så, att hans eget sysslande med Skånes växter tog en fastare och mera bestämd form.

På hösten 1836 skriver Lilja till Fries och erbjuder sig att lämna växtgeografiska tillägg till floran. Han säger sig själv ha tänkt att utarbeta en flora över Skåne, men var likväl benägen att såsom en tacksamhetsgärd åt Fries lämna dessa uppgifter, som han annars varit ensam om. Han tillägger: »Jag är öfvertygad om, att ingen botanist i Skåne för närvarande har mera reda på skånska vextställen än jag». Han kommer också med förslag att Fries måtte hos Vetenskaps Akademien utverka resestipendium åt honom, på det att han än mera skulle kunna utöka sina kunskaper om den skånska floran. Det gällde i synnerhet de sydliga kusttrakterna och de nordligare delarna av landskapet som var föga utforskade. Lilja vill också att Fries skaffar honom en förläggare till floran.

Hur Fries ställde sig till allt detta är inte känt. Troligen har svaret varit en besvikelse för Lilja, ty han tillgriper nu en annan åtgärd. På nyåret 1837 förekommer i Aftonbladet en längre insändare, skriven av Lilja, vari Fries' flora blir föremål för en närgången granskning.

Inledningsvis prisar han Fries, kallar honom ett »botaniskt snille», som Norden kunde vara stolt över att äga, så mycket mer som den botaniska vetenskapen först härifrån räknar sitt egentliga ursprung.

Om floran däremot har Lilja mycket att anmärka. Det s.k. naturliga systemet som Fries använde var inte alls passande för en landskapsflora, då en sådan inte kunde lämna någon helhetsbild av systemet. En sådan flora var ju, menar Lilja, framför allt avsedd för nybörjare och det gives få sådana som mäktar studera denna vetenskap efter ett naturligt system. I detta avseende var det gamla Linnéanska både lättfattligt och ändamålsenligt.

Lilja har också en del att säga om hur Fries begränsar arterna, vad som skall kallas varietet o.s.v. Mest att anmärka har han dock beträffande växtlokalerna, som han finner vara mycket ofullständigt anförda. Han räknar upp en mängd dels nya, dels gamla och dels sådana där vissa arter var ovissa eller helt försvunna. Dessa växtlokaler och ännu dubbelt flera säger han sig kunna tillägga, ty även han hade en Skåne-flora under arbete och hade en längre tid varit verksam med att skaffa sig noggranna uppgifter om växtställen. Dock ville han inte försöka tävla med Fries utan endast, då vi på modersmålet saknar en Skåne-flora, utgiva en sådan, som »jemte noggranna diagnoser och vextställen, upptager vexternas medicinska och ekonomiska nytta d.v.s. förenar nöjet med nyttan».

Någon dag senare, i Aftonbladet 17/1 1837, skriver Fries, att någon polemik med Lilja kan det inte bli tal om, men om denne tagit del av Flora Scanica i sin helhet hade hans insändare varit tämligen överflödig. Då jag icke hade rum för någon barlast, fortsätter Fries, uteslöt jag hundradetals av mig själv välkända växtlokaler och anförde endast de väsentligare och viktigare. — En av de arter som Lilja omnämnde var *Primula elatior* och om den säger Fries »hade jag icke tillfälle att speciellt anföra hvarje hage eller buske den vexer uti».

»Att jag icke upptagit åtskilligt som Hr Lilja saknar, har i synnerhet tvenne skäl; det ena att jag afhandlar åtskilligt i andra arbeten; det andra uti en vana, som mången annan torde finna besynnerlig, att icke skrifva öfver något som jag ej undersökt eller förstår bedöma . . .». Han säger också att han inte tänkt sig, att hans »Specialflora» kunde vara av intresse för en större allmänhet och för den skull inte låtit annonsera densamma. Till sist heter det: »Som jag dessutom står i förbindelse hos Hr Lilja för mycken artighet både på vers och prosa, sedan han började sina botaniska studier: så får jag heligt försäkra, att ingen högre än jag kan glädja sig åt Hr Liljas hastiga framsteg; att ingen villigare än jag skall erkänna värdet af Hr Liljas upptäckter, när han lyckas göra några sådana och att jag af hjertat önskar att dess högtsträfvande ande i den milda blomsterverlden måtte finna ro».

Finna ro eller söka ro var nu något som inte alls passade Lilja. Tvärtom, fann han av Fries' genmäle, trots dess bitande innehåll, ytterligare belägg för, att en Skåne-flora, sådan han tänkt sig den, hade en mission att fylla.

Liljas Skånes Flora förelåg färdig och utgiven på C. W. K. Gleerups förlag redan 1838. (Samma år fyllde Lilja 30 år.) Floran är tillägnad Hans Kungl. Höghet Josef Frans Oscar, Sveriges och Norges Kronprins och kansler för Lunds universitet. Inför honom redovisar Lilja sitt verk, som kunnat utkomma endast tack vare den godhet som Kronprinsen visat honom. (Lilja hade under åren 1834—1838 åtnjutit ett årligt understöd ur Kronprinsens privata handkassa.)

Företalet är vidlyftigt. Han vill tillkännagiva, att han »icke ex professo är botanist». Därmed menar han, att han icke på statens bekostnad haft tillfälle att förvärva sig någon vidsträckt erfarenhet inom naturens område och att arbetet ej gör anspråk på någon sträng och kritisk vetenskaplighet, utan är blott att betrakta som ett försök att giva den ostuderade en populär växtbeskrivning och en hjälpreda vid botaniska excursioner. Vidare har arbetet ej tillkommit av skrivbegär eller för att därmed göra någon ekonomisk vinst, utan endast därför att han sedan barndomen sysslat med växter och att detta under hans fleråriga sjukdom varit hans enda tillflykt och tröst. — Detta låter betydligt mera dämpat än insändaren i Aftonbladet.

Floran upptager mer än tusen arter, numrerade i löpande följd och även försedda med de nummer som förekommer i Fries' flora. De båda frororna upptager samma växter men vänder sig till olika publik: Fries' till den lärda världen, Liljas till en större allmänhet. Den senare följer därför, som förut nämnts, det Linnéanska systemet med de beteckningar som höra dit, men är för övrigt helt på svenska.

Med så olika utgångspunkter låter de båda arbetena sig knappast jämföras med varandra, även om det skulle ligga nära till hands att vilja göra så. Lilja är mångordig och berättande. I synnerhet gäller detta växtlokalerna, som noggrannt uppräknas både för allmänna och mindre vanliga arter. Många av platserna synes Lilja ha själv besökt. Särskilt ofta nämnes trakterna kring Blinkarp (Liljas barndomshem) och Ramstorp (dit föräldrarna flyttade 1825). Florans egentliga värde ligger väl i dessa lokalangivelser.

Lilja har också nedlagt förtjänst genom att anföra svenska och skånska växtnamn. Särskilt de senare varav han nämner närmare hundratalet, som tydligen var i bruk då, men som numera ofta är bortglömda.

Något mera påtagligt erkännande för sin flora synes Lilja inte ha fått och ej heller fick han någon officiell uppmuntran som kunde ha stimulerat honom att fortsätta på den inslagna vägen.

Han fortsätter emellertid. I Botaniska Notiser, 1839, redogör han för några växtlokaler som han inte kände till när floran gavs ut. Det samma gör han i flera nummer av Tidning för trädgårdsskötsel och allmän växtkultur, som Lilja gav ut under åren 1840—1848. Så heter det i nov. 1841: »Vänner af Skånes flora underrättas härmed, att den hos oss sällsynta *Epipogium Gmelinii* är i somras funnen i temlig mängd vid Lindved och växande på en skogsudde som utskjuter i Börringesjön . . .». I aug. 1842 heter det: »*Orobanche elatior* förekommer i stor mängd i åkrarna och vid vägen ända från Råå till Säbyholm».

Sedan Lilja år 1843 flyttat till Billinge, där han blivit klockare, synes han tämligen snart ha företagit en omfattande inventering av floran både i Billinge och Röstånga och trakterna däremellan. Resultatet har han publicerat i Botaniska Notiser, 1846, i en avhandling på 14 sidor upptagande betydligt mer än femhundra arter. Han har således på detta begränsade område antecknat ungefär hälften av Skånes då kända arter. Såsom växtlokal nämnes i flera fall Billinge N:r 7, som är klockaregården.

Upprepade gånger var Lilja under längre eller kortare tid ledig från sin klockaretjänst och verkade då som tidningsman och hann med att vara redaktör för tre olika tidningar i Malmö. Sin vana trogen skrev han om skånska växter även här. 1866 var han redaktör för Malmö Handels- och Sjöfarts-Tidning. Det var på våren och han började med notiser om vårväxter men övergick i en serie artiklar som upptog stort utrymme i tidningen. Anledningen var att Hartmans flora kommit ut i en ny upplaga, den nionde. Vad som i den sades om Skånes växter fann

Lilja vara oriktigt, vilseledande. Detta var så mycket mera beklagligt som floran användes i undervisningen. Lilja redogör i sina artiklar för drygt två hundra skånska växters förekomst. Han hoppas att härtill skall tagas hänsyn när floran nästa gång kommer ut i ny upplaga.

Samma år (1866) utkom en ny skånsk flora, skriven av F. W. C. Areschoug, då adjunkt vid Lunds universitet. Han nämner flera personer som lämnat honom lokaluppgifter, men Liljas namn förekommer kanske inte mer än en gång och då följt av frågetecken. Det synes dock, att Areschoug till icke ringa del hämtat sina lokalangivelser från Lilja. Särskilt gäller detta sådana ortsangivelser som Ramstorp, Rökaholm, Gryttinge, Hjortaröd och andra, vilka genom Lilja blivit bekanta i de skånska frororna.

Tydligt är också att Areschougs flora inte lämnat Lilja någon ro. Själv hade han så gott som ständigt samlat material till en ny upplaga av sin flora. Han vänder sig genom brev eller på annat sätt — även genom uppmaningar i tidningar — till olika personer för att få nya uppgifter om växtförekomster och för att få de gamla kontrollerade. En av dem som han på detta sätt var i livlig förbindelse med var en ung botanikstuderande, Alfred Falck. I Lunds universitets bibliotek förvaras 13 långa brev som Lilja under åren 1866—1869 skrivit till Falck. I dem diskuteras en stor del av de skånska växternas förekomst m.m. — Tyvärr synes Falcks svar på breven inte vara bevarade. Det visar sig emellertid att Lilja i flera avseenden har en annan uppfattning än den som förekommer i Areschougs flora. Han ger sig också in på rent växtsystematiska frågor, vill ställa upp nya både släkten och arter och göra omflyttningar bland de gamla. Detta och mycket annat kommer tillsynes i florans nya upplaga, som var under tryckning i tre år. Den långa tiden berodde till en del på att Lilja gjorde ideliga ändringar.

Slutligen på våren 1870 kommer Skånes Flora, innefattande Skånes vilda och odlade växter ut i sin utökade och förbättrade upplaga. Tryckt i Stockholm och utgiven på L. J. Hiertas förlag därstädes.

I förordet lämnar Lilja följande bekännelse: »Från mina skånska skogars djup öfverlemnar jag härmed mitt testamente till min sköna älskade fäderneprovins, Sveriges rika, fruktbara och herrliga blomsterland, som utgjorde min barndoms förtjusning, min ungdoms käraste tillflykt och der jag äfven i ålderdomen haft min bästa och min ljufvaste sysselsättning».

Den nya upplagan skiljer sig väsentligt från den förra. Så har alla växterna givits svenska namn följda av det latinska som är satt inom parentes. Lilja menade, att i en svensk lärobok i växtkunskap hade de svenska namnen större betydelse än de latinska, vilka senare dock icke kunde undvaras. Det var Fries som inspirerat honom därtill. Lilja har måst nybilda en mängd namn. En del är endast överföringar eller översättningar från latin eller annat språk. Några ha fortlevt, andra icke.

Lokaluppgifterna har åtskilligt förändrats, nya har tillkommit, andra har strukits. Växter som i den förra upplagan ansågs vara ovanliga är nu i flera fall allmänna. Andra som redan tidigare förekom sparsamt är nu än mera sällsynta eller kanske helt borta.

Som titeln anger innehöll floran odlade växter också. I första upplagan fanns ett litet tillägg upptagande några kulturväxter. Detta utbyggde han vidare till en Flora öfver Sveriges odlade vexter, som utkom redan 1839 och följdes året därpå av Första supplementet, allt tryckt i Stockholm. Den fick emellertid en mycket besk kritik i »Eos, Litterär Tidning», 1840. Men redan 1842 var Lilja färdig med en ny bok i samma ämne, nämligen Handbok i de odlade vexternas flora och deras kultur. Ett stort upplagt verk varav inte stort mer än början — två häften på sammanlagt 276 sidor — utkom. Det första blev obarmhärtigt nedgjort i »Frey, Tidskrift för vetenskap och konst», 1842, av signaturen »J. A.». — Troligen Nils Johan Andersson, botanist och sedermera professor vid Bergianska trädgården.

Efter dessa båda misslyckanden dröjde det nära 25 år innan Lilja kom med någon liknande handbok, dock begränsad till Svenska Foder- och Sädesväxter, utgiven 1867.

I den nya upplagan av Skånes flora fick Lilja utlopp för sitt vetande om odlade växter, framför allt trädgårdsväxterna. Ett sammandrag av det väsentliga av vad han tidigare skrivit i detta ämne, kompletterat med 30 års erfarenhet, kommer här till synes.

Förut är nämnt att Lilja försökte sig som växtsystematiker. Därvid hade han dock ringa eller ingen framgång alls. Viljan var nog god, alltför god, men hans livliga fantasi förde honom ut på vägar som han inte behärskade. Det började och skedde i synnerhet i ovannämnda floran över odlade växter.

På 1820-talet infördes från Kina till England en ny växt, som fick namnet *Primula sinensis*. Den visade sig vara odlingsvärd och kom även till vårt land. När Lilja skulle beskriva den för sin flora, fann han att den inte var någon riktig *Primula*-art utan skilde sig från detta släkte i flera avseenden. Han ansåg det berättigat att på dessa olikheter ställa upp ett nytt släkte som han gav namnet *Oscaria* med arten *O. sinensis* (och en annan art). Direkt uttalat är det inte, men tydligt är att Lilja på detta sätt ville hedra sin välgörare Kronprins Oscar. Han blev dock ensam om sitt nya släkte, *Oscaria* nämnes endast som synonym. Släktet som sådant har Lilja kvar ännu 1870 i Skånes flora, men nu har han ändrat namnet till *Primulopsis*.

Betydligt mera invecklat blev ett annat av Liljas namngivningsförsök. Det gällde ett par blomsterväxter, som förts i odling under namnet *Calandrinia*. Av beskrivning på hur detta släkte skulle se ut, drog Lilja den slutsatsen att de inte alls kunde höra till *Calandrinia*, utan måste vara ett par helt andra, ej förut beskrivna och namngivna arter, som Lilja nu utan några större betänkligheter döpte till *Tegneria*. Strax efter ändrar han namnet till *Rhodopsis*. Därmed blev det värre, detta namn var redan upptaget på annat håll. Han försöker ytterligare med ett annat namn innan han återgår till *Tegneria* med den motiveringen, att en i hela Europa så ryktbar skald som Tegnér förtjänade ett namn i blomstervärlden. — Dessförinnan hade Lilja brevväxlat med Tegnér. Lilja hade tänkt att ge ut en kalender och önskade bidrag från Tegnér. Denne synes ha svarat undvikande och menat att väl ingen numera frågar efter vad han skriver. Lilja svarar att Tegnérs namn visst inte var urmodigt och själv hade han bidragit till att hedra det genom att »benämna ett nytt släkte av några bland de vackraste Sydamerikanska växter för *Tegnéria*; ett släkte som förtjänar detta namn». (Skriver Lilja julafton 1839.)

Ytterligare ett par släkten lanserar Lilja i sin flora. Dessa och de föregående giver han förutom den svenska även en latinsk beskrivning. Sådan förekommer i floran, i Botaniska Notiser, 1839, och i den tyska tidskriften »Linnaea».

Som redan nämnts blev Liljas flora över odlade växter kritiserad i den litterära tidskriften »Eos». Kritiken var signerad »T» (vem som dolde sig bakom den framgår inte) och gällde framför allt Liljas växtsystematiska äventyrligheter.

Av Liljas sätt att bestämma nya släkten, heter det, kan man med all rätt påstå, att han mera skådar naturen med poetens öga än med naturforskarens. Har man inte något bättre att komma med, gör man klokt i att avstå från detta nyhetsbegär. Önskligt vore att Lilja ville inhämta vad Linné anfört i dessa stycken, ty ur dem kan hämtas »många gyllne lärdomar, som det icke höfves någon svensk botanist (åtminstone hvarje, som vill uppträda såsom nyskapande författare) att vara okunnig om».

Bland mycket annat skulle han då icke, även om han åtnjutit nåd av någon högt uppsatt person eller av sympati för en berömd skald, brutit mot hundraårig hävd och uppkallat växtsläkten efter personer som inte alls haft med botanik eller naturvetenskap över huvud att göra.

Det var väl detta som föranledde Lilja att avstå från Tegneria, vilket namn han dock återtog sedan han funnit att den tyske skalden Schiller fått ett växtsläkte (Schilleria) uppkallat efter sig.

Man skulle kunna tro att Lilja efter den nedslående kritiken, varav vi endast berört en del, skulle vara mera återhållsam. Men sådant var inte hans kynne, kritik hade föga verkan på honom.

Lilja idkade även fröhandel och sålde under några år dessutom plantskolealster. I sin trädgårdstidning lät han trycka katalog över vad han hade att sälja och i den fick hans »namnfantasi» fritt utlopp utan att möta motstånd.

Detta och mycket annat kommer till synes i hans stora flora 1870. Några egentligen nya släkten att beskriva har han visserligen inte, men han möblerar om så mycket mera bland de gamla. Delar och bryter ut nya släkten. Av *Bromus* får han ut *Bromopsis,* av *Malva Malvaria* o.s.v. Han försöker också återuppliva förlinnéanska släkten såsom *Nummularia,* vilket han skiljer från *Lysimachia.* På ungefär samma sätt går han fram bland arterna. Räknar man med alla släkten och arter som han velat omdöpa blir det ett betydande antal. Men någon framgång hade han inte. I något äldre botaniska samlingsverk förekommer hans »namn» som synonymer, annars inte. Endast i ett fall har hans namngivning haft bestående värde, nämligen *Godetia amoena.* Dock hänger detta samman med om *Godetia* skall bilda ett eget släkte eller höra till *Oenothera.*

Allt detta bör emellertid inte förringa florans egentliga syfte och värde. Den kommer väl alltid att bli en källa att (med urskillning) ösa ur när man vill veta något om skånska växter i gången tid — det lär ju hända än i dag att när floristen i Skåne går ut att söka någon rar ört, rådfrågar han först »Lilja».

Själv fäste Lilja stora förhoppningar till sin flora, som han trodde skulle omfattas med allmänt intresse och bliva något av en folkbok. Det är med en viss stolthet han skriver till Fries (25/1 1870): »Jag tror att det blir den fullständigaste provinsflora i verlden».

Men hur mottogs den? Tyvärr liksom förra gången tämligen ljumt. I Aftonbladet kommer en anmälan vari man gör utdrag ur förordet och säger, att boken är i hög grad ägnad att sprida örtkunskapen till en vidare krets än som hittills varit och därmed göra den till ett föremål för folkundervisningen. — Men Aftonbladet stod ju nära Hiertas förlag.

I ett par skånska tidningar förekommer korta notiser. Snällposten hade en sådan, men efter några dagar (30/6 1870) kom en längre och mycket berömmande recension skriven av N. P. Osberg, en av Liljas vänner från Lundatiden, han kallade sig nu privatlärare och var bosatt i Malmö. Osberg ville hoppas att denna flora icke skulle vara sista alstret av Liljas nit för en vetenskap, »hvars studium han hela sitt lif med så mycken värma omfattat och med så mycken framgång odlat».

Den ekonomiska vinsten för Lilja var det också klent beställt med. I brev till sin vän redaktör F. Borg i Hälsingborg beklagar han sig och skriver: »Skam af Hierta att icke gifva mig ett öre för hela detta dryga arbete, som kostat mig mycken möda. Han är millionär och för en god saks befrämjande äro några hundra rdr ju för honom en spottstyver».

Lilja skördade nu som förr varken guld eller ära, men han hade den tilfredsställelsen att se sitt livsverk i tryck. Han dog ju snart därefter.

På Billinge kyrkogård är till Liljas minne rest en gravvård, tillkommen genom insamling bland vänner. Han hade trots allt många sådana.

Anmärkningar

Den nämnda insändaren, som var införd i Aftonbladet 1837 d. 4 och 7 januari och av Lilja daterad nov. 1836, är veterligen första gången Lilja publicerar något om skånska växter. Vad han här anför om växtlokaler kommer igen i floran 1838. På samma sätt är det med vad han skriver i Malmö Handels- och Sjöfartstidning 1866 (april—maj), det upprepas i floran 1870.

Vid utarbetandet av denna uppsats har, såsom framgår, materialet hämtats från tidningar och tidskrifter, från Liljas skrifter och icke minst från hans brev. Lilja var en flitig brevskrivare. Närmare 300 brev — säkert flera — finnes bevarade och förvaras i olika bibliotek och arkiv. De flesta avhandlar dock helt andra ting än botanik. Tyvärr är alla de brev han själv fått mottaga icke bevarade.

BOTANISKA NOTISER 1963 · VOL. 116 · FASC. 2 · LUND

Smärre uppsatser och meddelanden

Ett par förbisedda växtuppgifter från Sandhammarområdet

Arbetet med den nya skånska floran, som så framgångsrikt förts fram mot en avslutning under professor H. Weimarcks ledning, har givit en rad nya intressanta fynd av mera sällsynta växter inom det skånska området.

Det är ju kanske icke så märkvärdigt att en eller annan art på detta sätt tidigare kunnat gömma sig undan en mindre rationell inventering men det är kanske mera märkligt att en del äldre lokaluppgifter för växter med mycket begränsad spridning i Skåne i våra dagar skulle kunna letas fram ur tidigare botaniska tryck.

Jag har ansett det värt att här påminna om ett par sådana arter, som omnämnas i Bengt Fried. Cronbergs gradualavhandling »Oeconomisk beskrifning öfver Mälarne uti Skåne», vilken i februari 1762 ventilerades i Lund under professor Clas B. Trozelii överinseende.

Denna lilla skrift redogör i 20 paragrafer för hushållningen på de s.k. Mälarne i Sandhammar-området och uppehåller sig därvid huvudsakligen vid skogsplanteringarna på de omfattande flygsandsmarkerna. Skriften innehåller emellertid också några allmänna iakttagelser över Mälarnas vegetation och därvid var det speciellt § 14—16 som tilldrogo sig mitt intresse.

I § 14 säges sålunda »På sank-jord och där tufwor warit fandt man några stånd af Sqwattran, ledum». Notisen är såtillvida intressant som den icke synes ha uppmärksammats i någon av de senare, detaljerade skånska växtförteckningar eller lokalfloror, i vilka *Ledum* omnämnts. Den sydligaste på senare tid nämnda och kända lokalen för *Ledum* torde väl vara den i sanka betesmarker på Bertilstorps ägor i Andrarums socken, vilken lokal jag tidigare flera gånger besökt med Ture Hulthén som ciceron. *Ledum*-lokalen vid Sandhammaren har legat flera mil längre åt söder.

Men Cronbergs dissertation bjuder på ytterligare en överraskning i uppgiften i § 16 där han närmare beskriver Mälarnas torvmossar: »På desse Torfmåsar växte icke något för Boskapen synnerligen godt och dugeligit grässlag; utan endast ett som af gemene Man kallas Tak eller Ag, Schoenus, hwilket årligen af sin rot upwäxer till 2 a 3 alnars högd. Brukas här å orten, i brist af annat hö, till kreaturens föda om wintren. . . . Ölänningen, . . . betjenar sig jämwäl af detta grässlag til tak-täkning». Enligt föregående skulle detta ha hört till Hagesta by. Ingenstädes i senare litteratur har denna uppgift citerats och lokalen är i nutiden bortglömd. *Cladium* har, efter vad jag kunnat finna, anträffats inom Silvåkra, Ivetofta, Kiaby och Arrie samt även uppe i Osby socken i nordligaste Skåne.

Även om dessa båda förekomster falla naturligt in med resp. arters utbredningsområde så synes det mig likväl vara värt uppmärksamhet då båda representera de sydligaste fyndorterna för dessa arter i vårt land. Märkligare är egentligen att det fortfarande är möjligt att i äldre botanisk litteratur finna lokaluppgifter för sällsynta växter, vilka uppgifter helt tappats bort under floristikens guldålder.

BERTIL LINDQUIST (†)

Några Orobanche-notiser

År 1939 gjorde undertecknad i Botaniska Notiser en förteckning över de *Orobanche*-arter som iakttagits mer eller mindre spontant växande i Lunds botaniska trädgård. Flertalet av dessa — samtliga på fritt land förekommande arter, som med säkerhet kunnat konstateras — har återkommit under senare tid, flera av dem så gott som varje år, andra under kortare perioder eller enstaka år. En ny art har också tillkommit, nämligen *O. minor* Sutt. som under åren 1944, 1952, 1955 och 1957 antecknats som parasit på *Trifolium repens*, såväl på *Trifolium*-gruppen som ute i gräsmattan. Vidare har för åtskilliga av de iakttagna arterna noterats en del värdväxter som förut varit okända eller ovanliga för arten i fråga. De redovisas i det följande.

O. lucorum. Denna art, som sedan gammalt förekommit på *Berberis* i trädgården — nu mera sparsamt än förr — och som även regelbundet brukat växa på olika *Thalictrum*-arter, iakttogs år 1951 på *Aquilegia vulgaris*. År 1955 förekom den i stor utsträckning på denna värdväxt: bland *A. vulgaris* i pomacékvarteret räknades ej mindre än 67 blommande stjälkar av *O. lucorum*, och ett tiotal förekom dessutom på *Aquilegia* i den systematiska avdelningen. År 1951 förekom samma *Orobanche*-art även på *Dicentra formosa* och 1956 på *Tellima grandiflora*. Ingen av dessa värdväxter är känd av Beck, som i sin monografi i Das Pflanzenreich (1930) endast anför *Berberis* och *Rubus* som säkert kända sådana.

O. Hederae. En *Orobanche* iakttogs på *Aralia*-gruppen sent på hösten 1939, när gruppen röjdes av. Den växte intill *A. chinensis* och har parasiterat på denna eller någon annan *Aralia*-art. Troligen var det *O. Hederae*; materialet var dock ej lämpligt för en säker bestämning. — I en trädgård i Botaniska trädgårdens närhet, Tunavägen 4, upptäcktes i sept. 1958 (av I. Värendh) en *Orobanche*, som visade sig vara *O. Hederae*. Den växte ett par meter från en vägg med murgröna; tydligen hade den spritt sig hit från Botaniska trädgården, där den regelbundet brukar växa på *Hedera*.

O. ramosa växte i äldre tid ofta på hampa, som odlades på försöksfältet med bl.a. graminéer; år 1939 kom den också upp på samma värdväxt, men i gagnväxtavdelningen. 1951 anträffade akademiträdgårdsmästare A. Törje en *Orobanche* på *Macleaya cordata*, som odlades på det nämnda försöksfältet, nära den plats där hampa tidigare odlats och *Orobanche ramosa* förekommit. Det visade sig också, att det var fråga om denna art, vilken tidigare aldrig iakttagits på *Macleaya* eller över huvud någon papaveracé, om den också enligt Beck (a.a.) kan förekomma på växter av åtskilliga olika familjer. Den återkom år 1953 på samma värdväxt.

O. crenata har brukat uppträda på olika ärtväxter (*Lathyrus*- och *Vicia*-arter) men växte hösten 1943 även på *Tropaeolum majus*, där den utvecklades kraftigt, samt på *Satureja hortensis*, där den dock visade en helt svag utveckling. Den förekom också år 1943 i en kruka med *Pelargonium zonale*. Detta gav anledning till omprövning av det exemplar av *Orobanche*, som en gång insamlats av Hj. Nilsson på *Pelargonium* men ej tidigare kunnat säkert bestämmas. Det överensstämmer på det hela taget med *O. crenata*, men har avsevärt mindre blommor. Det måste därför tillhöra *O. crenata* var. *silvestris* Beck, vilken utmärkes genom små blommor och vanligen parasiterar på *Pelargonium*. Svårigheten vid bestämningen beror på att varieteten i blomstorleken, vilken användes som en gruppkaraktär, avviker från gruppen *Speciosae* och överensstämmer med *Minores*.

O. minor. Utom på *Trifolium repens* har denna art en gång förekommit som parasit på en i kruka odlad *Campanula*, *C. garganica*. Enligt Beck är arten tidigare iakttagen på en annan *Campanula*, *C. Poscharskyana*.

I samband med de anförda *Orobanche*-arterna kan även ett par *Cuscuta*-arter omnämnas. Den i trädgården i stor utsträckning förekommande *C. europaea*, som tidigare mest angripit olika Compositae, har också parasiterat på skilda labiater, bl.a. *Hyssopus officinalis* och *Stachys silvatica*; ett bestånd av den senare arten dödades helt av parasiten.

Cuscuta lupuliformis såddes någon gång på 1940-talet och förvildade sig sedan och angrep *Rubus illecebrosus* och *Syringa reflexa*; på den senare växte den till 1,65 meters höjd. — Samma art har f.ö. enligt en insamling av K. E. Flinck år 1961 förekommit till synes fullt spontan i Stockholm, Kungsträdgården, där den också parasiterade på en syrén; eljest brukar arten ofta förekomma på *Salix*.

H. HJELMQVIST

Summary

A number of new or rare host plants for some *Orobanche* species were observed in the Botanical Garden of Lund, viz. *Aquilegia vulgaris*, *Dicentra formosa*, and *Tellima grandiflora* for *O. lucorum*, *Macleaya cordata* for *O. ramosa*, *Tropaeolum majus* and *Satureja hortensis* for *O. crenata*, and *Campanula garganica* for *O. minor*.

Litteratur

S. ARNELL: Hepaticae of South Africa. Published by Grant-in-Aid for Scientifical Publications from the Swedish Natural Science Research Council and distributed by the council. 411 p., 190 figs. Printed by Kungl. Boktryckeriet P. A. Norstedt & Söner. Stockholm 1963. Price: SCR. 60: —.

"Hereby another new world is opened up to the South African student. For 150 years specimens collected haphazardly have been sent to Europe, named and published by experts there in many languages and in many books and pamphlets, then the types were locked away as in a fireproof safe, inaccessible to the South African public except by a long pilgrimage to many shrines, . . ." That is the beginning of the preface of Sim's South African bryophyte flora of 1926. It was the first hepatic flora of any southern hemisphere region.

Sim's flora deals with no less than 671 bryophytes, 180 of them hepatics, 6 Sphagna and 485 mosses. All of them are figured though the quality of some of these is not too good. It is in many ways an impressing work by a man living isolated not the least scientifically and also made in his free hours after his professional work as a forestry officer. As regards the mosses Sim was helped rather much by the British bryologist Dixon, one of the most excellent specialists we ever have had. Unfortunately Sim had no contact with any hepaticologist and the result has been that his treatment of the hepatics is inferior to his treatment of the mosses. For example: no less than 11 species which are restricted to the northern hemisphere are included in his flora and some of them are said to be common. It is true that several are more or less related to South African species but not all of them. Nevertheless Sim has contributed considerably in furthering our knowledge of South African hepatics by bringing together a hepatic herbarium which contains his own rich collections from various parts of the region as well as contributions from several other collectors.

This herbarium of Sim, kept in the National Herbarium, Pretoria, has been an important basis for later work by Arnell, who has revised it thoroughly. During a South African spring (Sept.—Nov. 1951) Arnell also made very extensive collections of bryophytes, concentrating upon the hepatics. For all he collected in the Cape Peninsula and adjacent regions, in the Knysna region of the Cape Colony some 400 Km East of Cape Town, in the Montague region West of Knysna, in the Pretoria region and at the Victoria Falls. In a large number of publications he has dealt with the results not only from his study of his own material but also of that received from other collectors such as Dr. B. J. Cholnoky, Dr. E. Esterhuyzen, Mr. S. Garside, and Dr. E. A. Schelpe.

Then he has included published works on South African hepatics which came after Sim. These are few but nevertheless important and include thorough monographic work by the South African hepaticologists S. Garside and J. F. Duthie on *Riccia* (subgen. *Ricciella*) and *Oxymitra* (4 resp. one new species) and by the British bryologist G. Wigglesworth on *Riella* (two new species). Much use has also been made of monographs and other publications on tropical African hepatics by Dr. E. W. Jones, Oxford, and Dr. C. Vanden Berghen, Brussels.

Dr. Arnell is better qualified for this flora work than any other recent hepaticologist: he is not only one of the leading men in the field with a worldwide experience but also the only one to have studied the South African hepatic flora in the field. He has also thoroughly studied regions of Southern hemisphere of utmost importance for the understanding of the South African flora. These include South America, Tristan da Cunha, Australia and New Zealand.

South Africa in the sense it is given here includes as well as the Union of South Africa also S.W. Africa, Bechuanaland, South Rhodesia and Portuguese East Africa. As regards Bechuanaland we know practically nothing and for Portuguese East Africa we know a little more but the material collected there refers almost entirely to the region close to the boundary with South Rhodesia.

Arnell's flora deals with 92 genera and 289 species, a considerable increase compared with the 58 genera and 180 species given by Sim. Also included are some species which might be expected to occur in the region. All species are fully described and figured in a most valuable and detailed way and adequate examination schemes given. With a master's hand the author has been able to penetrate the jungle of synonyms, where we i.a. meet with a *Clasmatocolea,* which has been brought under 11 different genera and has been endowed with no less than 21 different species names.

The largest genera are *Riccia* (34 species, 19 of them *Eu-Riccia,* and 15 *Ricciella.* Only North Africa seems to have a chance to compete with South Africa in this respect), *Frullania* (18), *Plagiochila* (15), *Cephaloziella* (12), and *Metzgeria* and *Riccardia* (10 each).

As regards the authors of the species it may be of some interest to note that Thunberg was the first one to describe a South African hepatic: *Pallavicinia podophylla* (Thunberg, as *Jungermannia*) Nees & Montagne, with a wide distribution in South Africa, in the mountains of Central Africa, in Abyssinia, and also in the southern parts of South America and Tristan da Cunha. About 50 % of the species were described in the nineteenth century before Stephani, who himself contributed with 78 species. Sim stands for 21 and Arnell for 33 new species.

For non-bryologists the phytogeographical aspects are the most interesting and therefore I will concentrate upon them. For this purpose I have used the generally very valuable accounts of the total area of the different species given by Arnell. Before that, however, it is necessary to warn the reader to review the phytogeographical data critically. We know far less about the distribution of the hepatics than of the flowering plants. Though the mosses are generally better known than the hepatics it is only recently that the famous specialist on African mosses the late Mr. R. Potier de la Varde (1958) reported the monotypic moss genus *Oedipodiella* (fam. *Gigaspermaceae*), supposed to be a good endemic of South Africa, for the extreme N.E. of Spain represented there by an undescribed variety of the South African species.

Beginning with the higher units I note that there is no hepatic family endemic to South Africa or even for Africa. As regards genera until recently only one endemic African hepatic genus was known, namely the monotypic genus *Sprucella* with a wide distribution in West Africa. Some few genera have in our time been supposed to be endemic in South Africa but none have stood up to a more thorough criticism. As regards the genus *Simia* S. Arnell 1962 (fam. *Cephaloziellaceae*) described as *Cephalozia atroviridis* Sim and widely distributed in tropical and subtropical Africa I use the occasion to note that the author has told me that it is quite possible that this genus is not an African endemic but also represented outside the continent.

According to Phillips (1926) the flora of the Union of South Africa already then contained 1,500 genera of flowering plants and of these no fewer than 488 were endemic, giving a proportion of about 30 %, a figure quite different from what we find for hepatics (and also the mosses). It may be added that several endemic South African families are represented among the flowering plants.

As regards the distribution of the species I have tried to make a phytogeographical arrangement of them and I begin with a table giving their distribution more roughly:

Table 1

Hepatic species (total number 289) known from South Africa.

Endemics of Africa	218	species	75.4 %
„ „ Southern Africa[1]	139	„	48.1 „
„ „ Cape Province	62	„	21.4 „
„ „ Cape Proper (sensu Marloth)	45	„	15.6 „

As regards the African species not restricted to South Africa there are species rather widely distributed all over the continent with exception of the Mediterranean region. More frequently they are either restricted to West Africa, this constitutes a large group, or they belong to an Afro-montane element with its centre in the African mountains, this also is a large group. Also, it is of interest to mention that similar to the flowering plants there are comparatively few elements that are common to South Africa and to Madagascar and the Mascarenian Islands.

That the species endemism is so high is not too surprising when we consider the fact that the flora of flowering plants in South Africa is so extremely rich not only in species but also in endemics. At least half the flowering plants in Cape Proper are endemic there.

It is of considerable interest to study the distribution outside South Africa of the 71 species which are not restricted to Africa. In table 2, following, in applicable parts, Weimarck (1941) in his thorough study of the phytogeographical groups within the Cape flora I have tried to group them.

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[1] Including S.W. Africa, Bechuanaland, Southern Rhodesia and Portuguese East Africa (Mozambique); only few species known from these areas.

Table 2

Phytogeographical groups of species (71) not solely restricted to Africa.

Subcosmopolitan (subtropical-tropical)	19 sp.
Subantarctic	15 ,,
South African — South American (except subantarctic part)	12 ,,
Hyperoceanic-bicentric, South African and North Atlantic	10 sp.
North-hemisphere temperate	6 ,,
Mediterranean-oceanic	3 ,,
Unspecified	6 ,,

Of rather great interest is the subantarctic group. With reference to the flowering plants we have well known phytogeographical contacts between South Africa and the Subantarctic region but it is then the question of families or sometimes genera which are common to both regions, not as here of species. The distribution of the five *Jamesoniella* species found in South Africa is interesting: *J. Rehmannii* St. is endemic there and known only from the Knysna forest in Cape Province, *J. colorata* (Lehm.) Spr. has a wide distribution in South America as well as in the Antarctic and Subantarctic Islands, in Tristan da Cunha, in Tasmania and in some localities in the Cape Province, *J. oenops* (L. & G.) St. occurs in southernmost South America and in one locality each in the Cape Province and Natal, and finally *J. paludosa* St. is known from southernmost South America and, between 5,000—5,500 ft., on the mountain Fonteintjiesberg in the Cape Province.

Of the 15 species referred to this group five have a circumpolar distribution in the southern hemisphere, 9 are restricted to South America and Africa and only one, *Psiloclada clandestina* Mitt., is not found in South America: South Africa, New Zealand, Tasmania, New Guinea and Amboina.

It is also worth while to say some words about the small genus *Adelanthus*. Two of its three South African species belong to the group under discussion: *Adelanthus unciformis* Tayl. & Hook. is one of the most common hepatics in southernmost South America but is also found in other parts of the continent. In Africa we have it in the Cape Province, in Madagascar, in Mauritius, and in Ruwenzori. It has also been found in Ireland. In 1903 one of the most sensational hepatic finds in Europe was made when *Adelanthus unciformis* was found on the island Achill off the west coast of Ireland. Since then it has been found in two more Irish localities.

The second species, *A. sphalerus* (Hook. & Tayl.) St., closely related to *unciformis*, is confined to southernmost South America and the Table Mountain of the Cape Peninsula.

The Table Mountain, where the species of this group are particularly concentrated and often occur in large quantities, is also the only locality in Africa for a third *Adelanthus* species namely *A. decipiens* (Hook.) Mitt. Apart from this the distribution is: Western Ireland, most hyperoceanic parts of Great Britain, Bretagne, and the Azores.

The species of this group are, as regards Africa, generally confined to South Africa and here often only occur in the Cape Province.

The hyperoceanic-bicentric, South African and North Atlantic group is of quite special interest because there seems not to be any correspondance with regards to the flowering plants. Most of the species are confined in South Africa to the Cape Proper. As regards their distribution in the northern hemisphere most of them are restricted to the most hyperoceanic parts of

Europe (often in Macaronesia, rarely only there) and in few cases also in the most oceanic parts of Eastern North America. One species, *Adelanthus decipiens,* has been mentioned already, but other examples are as follows: *Drepanolejeunea hamatifolia* (Hook.) Schiffn.: most hyperoceanic parts of Great Britain, France and the Iberic Peninsula, Cape Province, Natal, Transvaal, Portuguese East Africa, *Lophocolea fragrans* (Moris & D.N.) G., L. & N.: Western Europe, Macaronesia, and, as var. *capensis* S. Arnell: Cape Peninsula (Southern Apostels), *Lejeunea Ecklonii* Ldbg.: the Canaries, Cape Verde Islands, Cape Province, Natal, Transvaal. Another *Lejeunea* species may also be mentioned: Arnell notes *L. Wilmsii* St. from several localities in South Africa and one in Angola but remarks that it is probably identical with *L. Holtii* Spr. from Ireland, westernmost Spain and Macaronesia.

A true Mediterranean element hardly exists in South Africa, the very few species to be considered are better characterized as Mediterranean-oceanic. When the Mediterranean type is more pronounced the species seem to be, as regards their occurrence in South Africa, restricted to Southwest Africa, I note *Riccia canescens* St.: Algeria, Russia (deserts north of Kasp. Sea), the Canaries, SW. Africa, several localities, *Athalamia Spathysii* (Ldbg.) Hattori (*Clevea Spathysii* (Ldbg.) K.M.); the Mediterranean area, the Canaries, SW. Africa: Windhoek.

Finally there are some species which are hard to place phytogeographically. I mention *Gymnomitrium laceratum* (St.) Horikawa: alpine species rather isolated in the genus (even brought under a genus of its own) and with a scattered distribution: Ruwenzori: Mt. Elgon 3,000—4,000 m s.m., South Africa: the Cape Province (Ceres Mansieberg), Natal, in two localities at respectively 8,000 and 9,000 ft., Japan, and, in a few scattered localities, North and South America, *Riccia* (*Ricciella*) *Perssonii* S. A. Khan: East Pakistan (Dakka), Southwest Africa (Okavango region, Omatako), *R.* (*Ricciella*) *plana* Tayl.: South Africa, Australia, South America (Uruguay), and — more surprising — South Europe, *Riella affinis* Howe & Underwood: South Africa (Cape Province, near Grahamstown), the Canaries (Gran Canaria), North America (California) and India (Benares) on one locality each.

HERMAN PERSSON

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DONALD N. MCVEAN & DEREK A. RATCLIFFE: Plant Communities of the Scottish Highlands. — Monographs of the Nature Concervancy I. London 1962. 445 sid.+12 sid. planscher+2 utvikskartor. Pris £ 3 15 s. 16 d.

Vegetationen på de Brittiska öarna erbjuder många intressanta möjligheter till jämförelser med nordiska förhållanden. Detta gäller inte blott många av våra växtsamhällen med sydvästlig eller sydlig prägel utan även fjällvegetationen. Sedan början av detta sekel har Tansleys »The British Islands and Their Vegetation», vilken utkommit i många upplagor, varit det kanske viktigaste standardverket för forskare, som velat skaffa sig en bild av vegetationen inom detta område. Liksom i flertalet specialundersökningar spelar de systematiska växtsociologiska beskrivningarna av vegetationen en underordnad roll i detta arbete. Därigenom skiljer sig denna monografi på ett markerat sätt från flertalet av dem, som behandlar områden på Europas fastland.

Det föreliggande arbetet om Skottlands vegetation avviker på många punkter avsevärt från tidigare brittisk tradition. I fråga om metodiken följer författarna i stort sett de principer, som sedan länge varit allmänt vedertagna i Skandinavien och Centraleuropa. De har sålunda genomgående strävat efter att ge en systematisk prägel åt sin beskrivning av vegetationen inom området. I tre uppsatser av M. E. D. Poore i Journal of Ecology 43 (1955) har de för författarna grundläggande synpunkterna på dessa problem ingående diskuterats. Som vegetationsenhet har de ofta använt det av honom föreslagna begreppet »nodum». Därmed betecknas en växtsociologisk enhet, vilken utvalts som »referenspunkt» i en vegetation, vars variation är i stort sett kontinuerlig. Enhetens sociologiska rang har ej närmare definierats. Endast i de fall vegetationsanalyserna tyder på att ett nodum har tillräcklig grad av homogenitet och distinkt karaktär har det betecknats som en association av mera konventionell karaktär. Genom lämplig namngivning har erhållits anknytning till sådana tidigare beskrivna enheter, vilka vunnit allmänt burskap.

Inalles har närmare ett åttiotal associationer och noda urskilts. Därtill kommer en del allmänna beskrivningar av mera speciell vegetation, t.ex. på klippor. Arbetet ger en fullständig och fyllig bild av den skottska vegetationen med undantag för de mera kulturpåverkade typerna. Dock behandlas ej havsstrands- och sjövegetation. Till den rent beskrivande texten har även fogats ett rikhaltigt material av vegetationsanalyser. Med stöd av skisser och vegetationsprofiler behandlas också de olika växtsamhällenas lokala fördelning i terrängen, något som ofta försummas i andra liknande arbeten. I beskrivningarna av vegetationen göres ofta jämförelser med förhållandena inom andra områden, särskilt Norge. Även ett sammanfattande kapitel ägnas helt åt detta och att inordna de olika enheterna i konventionella ordningar och förband. Varje läsare med botanisk fälterfarenhet kan med utgångspunkt från det presenterade materialet utan svårighet komplettera dessa jämförelser.

Även om huvuduppgiften för författarna har varit att åstadkomma en ren vegetationsbeskrivning, har de även ägnat stor uppmärksamhet åt olika ståndortsförhållanden. Inte bara klimatet utan även exempelvis snötäcke och olika markförhållanden behandlas ingående. Vegetationsbeskrivningarna kompletteras bl.a. med ett stort antal bestämningar av pH, Na, K, Ca och P i mark- och vattenprover. Denna del av undersökningarna har möjliggjort sammanställandet av listor angivande indikatorväxter för olika marktyper inom området. Också i dessa fall erbjuder resultaten goda möjligheter till detaljerade jämförelser med nordiska förhållanden.

Genom denna allsidiga monografi får man en klar bild av hur skiftande vegetationen är i Skottland. Inte bara de stora nivåskillnaderna inom området utan också de växlande markförhållandena och olikheter ifråga om oceanitit bidrar till den starka differentieringen av vegetationen inom omådet. I ett antal diagram anges de olika vegetationsenheternas vertikala utbredning inom olika områden. I flertalet fall har deras utbredning inom undersökningsområdet även angivits på kartor. Därigenom får läsaren allsidigt belyst områdets regionala differentiering.

Det framgår av kartmaterialet hur obetydlig utbredning skog har i våra dagars Skottland beroende på avverkning och bete. Med utgångspunkt från till synes naturliga förekomster av skog och utbredningen av olika växtsamhällen har författarna sökt rekonstruera ek-, tall- och björkskogens samt den alpina kalvegetationens utbredning i Skottland under nuvarande klimatbetingelser innan den stora skogskövlingen satte in. Enligt författarnas mening kan inte någon enhetlig och enkel klimatiskt betingad zonering av skogsvegetationen påvisas eftersom skogsträdens fördelning även påverkas av markförhållandena och regionala särdrag. Låglandsområden i söder har sålunda dominerats av ekskogar, i nordost av tallskogar med inslag av ek och i nordväst av björkskogar. Ek- och tallskogarna har på högre nivå avlösts av en subalpin björkskogsvegetation (i vissa fall med inslag av hassel!). Ur regional synpunkt visar dessa och andra liknande drag i vegetationen enligt författarnas mening att de skotska högländerna i växtgeografiskt avseende närmast anknyter till Nordvästeuropa och då särskilt Norge. Det är enligt deras mening främst den större oceaniteten, en större variation i fråga om temperaturförhållandena samt en mycket intensivare kulturpåverkan, som betingar avvikelserna i Skottlands vegetation.

NILS MALMER

HENNING WEIMARCK: Skånes Flora. — Bokförlaget Corona AB. Lund. Malmö 1963. 24+720 sidor. Pris inb. 45:—.

Den efterlängtade nya Skåne-floran har nu blivit en i allo glädjande verklighet. Den 7 april 1963 låg den med vacker backsippefärgbild på bokomslaget lockande, digra volymen första gången i de skånska bokhandelsfönstren.

Sedan den senaste Skåne-floran, 2:dra upplagan av F. W. C. Areschougs Skånes Flora, 1881 utkom, har den skånska floran undergått betydande förändringar. Naturlandskapet har i väsentliga delar blivit ett annat under de senast gångna 82 åren. Kulturens landvinningar ha gått hårt fram och i mångt och mycket omdanat den skånska landskapsbilden. Ett flertal växtarter har härvid helt försvunnit. Vi behöva här blott erinra om några av den forna Skåne-florans sannskyldiga prydnader, sådana som Kullabergs jordviva (*Primula vulgaris*), torvmossarnas myrbräcka (*Saxifraga hirculus*) och Immelns sjönöt (*Trapa natans*). Några år 1881 som sällsynta betecknade arter ha av kulturen gynnats i sin fortsatta utbredning och under de senaste decennierna blivit allt allmännare, så exempelvis vårkorsörten (*Senecio* *vernalis*) och kanadabinkan (*Erigeron canadense*); den nu allmänna gatkamomillen (*Matricaria matricarioides*) anges av Areschoug 1881 allenast från Lund och Broby — det äldsta skånska ex. i Lunds bot. mus. är från Lund 1880. Om allt detta få vi i den nya Skåne-floran värdefulla upplysningar.

Antalet i 1963 års Skåne-flora nytillkomna arter är förvånansvärt stort. Förutom talrika nya adventivväxter möter här ett 30-tal först under senare tid som medborgare i den spontana skånska floran konstaterade arter. Som exempel på dylika förtjäna här i första hand nämnas sådana arter som *Equisetum telmateja*, *Iris spuria*, *Juncus maritimus* och *stygius*, *Luzula sylvatica*, *Schoenus nigricans*, *Carex obtusata*, *Betula nana*, *Beta maritima*, *Ranunculus fluitans*, *Rorippa microphylla*, *Cnidium dubium*, *Scutellaria minor*, *Cirsium rivulare* — numera utgången? —; några av dessa nya för Sverige! Senare tids forskning har vid ingående analys av de gamla kollektivarterna i flera fall uppdelat dessa i olika arter, varigenom artantalet i våra floror över huvud taget utökats. »*Alchemilla vulgaris*»-arterna och de båda *Gentianella*-arterna *baltica* och *uliginosa* äro välkända exempel härpå. Upptagandet i den nya Skåne-floran av de under senare tid i allt större omfattning inom landskapet uppmärksammade adventivväxterna vid kvarnar och fabriker etc. måste hälsas med den allra största tillfredsställelse. De svenska botanisterna i gemen ha här fått en förut saknad möjlighet att i en svensk flora närmare lära känna våra mången gång högintressanta nya adventivförvärv. Exempelvis av gräs ha över 80 adventivarter upptagits i den nya Skåne-floran.

Som en särskilt beaktansvärd förtjänst är också att nämna upptagandet i den nya floran av i de angränsande svenska landskapen och i Danmark men ej — ännu — i Skåne förekommande 126 arter. Som i Skåne vildväxande eller naturaliserade kärlväxter upptagas nu 1.204 och av adventiver 601; av hybrider ha dessutom 321 kunnat registreras inom landskapet.

De olika arternas formväxling har i regel väl uppmärksammats i resp. artbeskrivningar. Efter de vedertagna latinska formnamnen söker man dock oftast förgäves. De relat. få i Lunds botaniska förenings senaste »Förteckning över Nordens växter» 1955 upptagna varieteterna och formerna borde författaren ha namngivit, då de ingå i Skåne-floran, främst i de fall, då dessa äro särskilt uppmärksammade just i Skåne. Sammanförandet av samtliga *Rubi corylifolii* i en art, *R. corylifolius* Sm., i en så omfattande flora som den nu föreliggande nya Skåne-floran, synes mindre välbetänkt. Så i ögonen fallande *Rubus*-former som exempelvis *R. gothicus*, *R. Lagerbergii*, *R. pruinosus* och *R. Wahlbergii* hade varit väl förtjänta av ett särskilt omnämnande. Så även den som underart av *Rubus idaeus* uppställda formen *anomalus* Arrh., vilken karakteristiska form ägnats en särskild uppsats av Ernst Nilsson i Botaniska Notiser 1927.

Det är ett i högsta grad berömvärt arbete, författaren framlagt i sin nya Skåne-flora. Många års ingående studier av den högintressanta skånska kärlväxtfloran ha här givit till resultat en av våra förnämligaste landskapsfloror. För den utomordentliga typografiska utstyrseln förtjäna Bokförlaget Corona och Förlagshuset Nordens Boktryckeri en särskild eloge.

NILS SYLVÉN

BOTANISKA NOTISER 1963 · VOL. 116 · FASC. 2 · LUND

Notiser

Botanikprofessuren i Århus. Laborator Axel Nygren, Uppsala, som utnämnts till professor i botanik vid Århus universitet från den 1 april 1963, har meddelat naturvetenskapliga fakulteten vid universitetet, att han avsäger sig befattningen i fråga.

Lantbrukshögskolan. Till laborator i växtfysiologi vid lantbrukshögskolan har utnämnts docent N. G. Stenlid.

Doktorsdisputationer. Vid Lunds universitet har under vårterminen 1963 följande doktorsavhandlingar ventilerats: D. 27 april »Studies on the effects of translocated herbicids on aspen and pea with particular regard to the responses of the roots» av L. Eliasson; d. 2 maj »Mesokratische Angiospermen im Känozoikum Eurasiens» av H. Tralau; d. 21 maj »Relations between earliness of spring wheat varieties and some properties in connexion with their germination and seedling growth» av Kerstin Lexander. Vid Uppsala universitet försvarades den 20 maj avhandlingen »Comparative studies in plant water relations» av P. G. Jarvis och vid Stockholms universitet den 21 maj avhandlingen »Studies on the germination in seeds of Scots pine» av B. Nyman.

Forskningsanslag. Från Lars Hiertas Minne har i april 1963 utdelats 800 kr. till doc. M. Fries, Uppsala, för pollenanalytisk undersökning på Åland och i Uppland; 3.000 kr. till fil. mag. P. E. Lindgren, Uppsala, för undersökning av havsalgvegetationen i Göteborgs skärgård; 2.300 kr. till fil. dr E. Teiling, Lund, för en monografi över släktet *Staurodesmus*. — Fysiografiska sällskapet i Lund har utdelat bl.a. 1.300 kr. till fil. lic. R. Dahlgren för fortsatt arbete på en monografi över släktet *Aspalathus*; 800 kr. till fil. kand. E. Helmer för fortsatt undersökning av kolhydratmetabolismen under celltillväxt och celldelning; 300 kr. till fil. kand. Ö. Nilsson för en undersökning rörande planterade barrskogar i centrala Skåne; 1.500 kr till fil. lic. S. Snogerup för undersökning av polymorfismen hos spontan *Cheiranthus cheiri* och 1.000 kr. till fil. lic. S. O. Strandhede för undersökning av extraskandinaviskt material av släktet *Eleocharis*. Dessutom har 1.200 kr. tilldelats kommissionen Skånes flora och 1.100 kr. sektionen Blekinges flora, för inventeringsarbeten. Ur sällskapets Nilsson-Ehle-fond har utdelats bl.a. 1.800 kr. till fil. kand. G. Ising för framställning av cytologiska preparat; 2.000 kr till prof. H. Lamprecht för genetiska studier av bl.a. ärter, bönor och *Chrysanthemum*, samt 1.600 kr. till fil. kand. G. Persson för fortsatta studier över finstrukturen i muterade segment hos korn. — Från Anna och Svante Murbecks minnesfond har fil. mag. E. Kjellqvist erhållit ett anslag om 1.500 kr. för studier och insamlingar av *Festuca rubra* i England, Skottland och på Färöarna samt fil. mag. Karin Olsson 1.000 kr. för att i Holland, Belgien och Frankrike insamla material av huvudsakligen *Lathyrus pratensis*. Fil. lic. R. Dahlgren har ur C. F. O. Nordstedts fond erhållit 475 kr. för studier av släktet *Aspalathus* i herbarierna i London och Paris.