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Studies in the Aegean Flora

VII. Chromosome Morphology in the Nigella arvensis Complex

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Introduction

The genus *Nigella* belongs to the tribe *Helleborae* of the family *Ranunculaceae*. Together with the closely related monotypic genus *Komaroffia* it holds a relatively isolated position within the tribe (cf. LEVITSKY 1931, GREGORY 1941). The genus contains about 25 species, all of which are annual and distributed mainly in the Mediterranean area. Most of them are comparatively distinctly delimited and easily identifiable entities, but the complex of forms grouped around *N. arvensis* L. exhibits extensive regional and local differentiation, making taxonomic subdivision extremely difficult. RECHINGER (1943) lists 7 Aegean species in the *Nigella arvensis* complex, but MEIKLE (1954) argues that they should probably all be united into a single species with a number of infraspecific taxa. Nomenclatural and taxonomic problems in the complex will be discussed elsewhere, and the working names used in this paper should thus to some extent be regarded as provisional. A definite opinion on the taxonomic subdivision is not, however, essential for the present investigation.

HOCQUETTE (1922) gives a chromosome number of $2n=12$ for *N. sativa* L., *N. arvensis* L. and *N. nigellastrum* Willd. This observation has been confirmed by a number of workers (LANGLET 1927, LEVITSKY 1931, GREGORY 1941, PEREIRA 1942, DELAY 1947, KURITA 1956, 1957 and 1959, BHATTACHARJYA 1958, et al.). All the species investigated are diploid with $2n=12$ and their karyotypes are very similar. KURITA (1957) did not find differences in chromosome morphology between the quite distantly related species *N. sativa* L. and *N. ciliaris* DC., despite using a modern squash technique. PEREIRA (1942) noticed, however, that some species have two pairs of satellite chromosomes, while others have three or four pairs. BHATTACHARJYA (1958) also found slight differences in chromosome morphology between *N. sativa* L. and *N. damascena* L. Several workers have noted that the karyotype of *Nigella* is pronouncedly "asymmetric" (STEBBINS 1950) with five pairs of more or less metacentric chromosomes and one pair of telocentric to subtelocentric ones. The latter pair is noteworthy as this type of chromosome is very rare among plants (cf. STEBBINS 1950). The basic number x=6 is unknown in other genera of the tribe *Helleborae*. The closely related genus *Komaroffia* has the basic number x=7 and three pairs of subtelocentric chromosomes (PEREIRA 1942).

Material and Methods

The present investigation is based mainly upon material raised from seeds collected by Mr. R. v. BOTHMER and the author in the summer of 1964. Part of the material was collected by Dr. H. RUNEMARK, Dr. S. SNOGERUP and Mr. B. NORDENSTAM between 1958 and 1964. The plants were cultivated in the greenhouses of the Botanical Garden, Lund, during the winter of 1964—65. The values given below for the time from sowing to flowering should only be mutually compared as in nature development is much faster. A total of about 520 individuals from 54 populations were examined for chromosome number, all of them having 2n=12. In the sense of RECHINGER (1943) the material represents *N. aristata* S. & S. (42 collections), *N. degenii* Vierh. (10 collections), *N. cretica* Mill. (one collection) and *N. fumariaefolia* Kotschy (one collection). Fig. 1 shows the distribution of the material investigated (in several cases a single point represents more than one collection). With respect to external morphology, *N. aristata* is a very variable species, whereas *N. degenii*, which is endemic to the Cyclades, seems to be more homogeneous. Within *N. aristata* five populations from different islands were selected for a particularly careful cytological examination. Measurements of the chromosomes were made from camera lucida drawings (× 4770) and arm index values as well as relative length values were calculated. The arm index was defined as the ratio of the long arm to the short arm. In the case of satellite chromosomes the length of the satellite was included in the length of the arm to which it was attached, but the gap between the arm and the satellite was excluded as its extension may vary considerably. The relative length value of an individual chromosome is given as a percentage of the total length of the haploid complement. As there is considerable variation in the degree of chromosome contraction between different metaphase plates, absolute length values cannot be used. Table 1 gives the arm indices and the relative length values for the chromosomes of *N. fumariaefolia*, *N. degenii* and *N. cretica*. Table 2 gives the arm index values for the chromosomes in five populations of *N. aristata* as well as t values (with conventional signs for statistical significance) obtained by comparing homologous chromosomes from

Table 1. Relative length and arm index values of the chromosomes of N. fumariaefolia, N. degenii and N. cretica

Relative length

Chromosome No.

Species	1	2	3	4	5	6
N. fum.	18.48 ± 0.18	18.64 ± 0.20	17.60 ± 0.19	18.69 ± 0.14	17.65 ± 0.14	9.01 ± 0.22
N. deg.	19.71 ± 0.21	19.43 ± 0.17	17.14 ± 0.18	16.58 ± 0.13	16.00 ± 0.15	11.14 ± 0.19
N. cret.	18.90 ± 0.16	18.98 ± 0.20	19.73 ± 0.22	16.58 ± 0.17	15.57 ± 0.18	10.22 ± 0.23

Arm index

Chromosome No.

Species	1	2	3	4	5	6
N. fum.	1.15 ± 0.03	1.26 ± 0.03	1.08 ± 0.02	1.23 ± 0.03	1.05 ± 0.02	15—20
N. deg.	1.05 ± 0.02	1.13 ± 0.02	1.21 ± 0.03	1.06 ± 0.02	1.03 ± 0.01	15—20
N. cret.	1.21 ± 0.02	1.12 ± 0.03	1.25 ± 0.03	1.07 ± 0.02	1.04 ± 0.01	15—20

Table 2. Arm index values (long arm/short arm ratio) of the chromosomes in five populations of N. aristata and t values obtained by comparing the different populations

Population	Chromosome No. 1	2	3	4	5	6
AD	1.19 ± 0.03	1.18 ± 0.03	1.15 ± 0.02	1.06 ± 0.02	1.02 ± 0.01	15—20
BE	1.44 ± 0.02	1.08 ± 0.02	1.19 ± 0.02	1.11 ± 0.02	1.04 ± 0.01	15—20
BK	1.09 ± 0.03	1.06 ± 0.02	1.12 ± 0.03	1.07 ± 0.02	1.03 ± 0.02	15—20
BU	1.23 ± 0.02	1.05 ± 0.01	1.21 ± 0.02	1.07 ± 0.01	1.03 ± 0.01	15—20
BB	1.45 ± 0.03	1.13 ± 0.01	1.20 ± 0.02	1.13 ± 0.02	1.06 ± 0.01	15—20
t (AD/BE)	6.92***	2.77*	1.41	—	—	—
t (AD/BK)	2.36*	3.32**	0.83	—	—	—
t (AD/BU)	1.11	5.81***	2.12*	—	—	—
t (AD/BB)	5.46***	1.58	1.77	—	—	—
t (BE/BK)	9.75***	0.71	1.94	—	—	—
t (BE/BU)	7.42***	1.34	0.71	—	—	—
t (BE/BB)	0.28	2.24*	0.35	—	—	—
t (BK/BU)	3.88**	0.45	2.50*	—	—	—
t (BK/BB)	6.74***	3.13**	2.22*	—	—	—
t (BU/BB)	6.09***	5.66***	0.35	—	—	—

the different populations. Table 3 gives the corresponding values for relative chromosome length. The figures represent mean values from 10 measurements.

The low chromosome number and the large size of the chromosomes make *Nigella* favourable for cytological investigation. The squash technique described by ÖSTERGREN & HENEEN (1962) was used with the following modifications:

1. Before fixation the roots were pretreated for 3—4 hours with a 1.7 mM solution of 8-hydroxy-quinoline at 10°C. ÖSTERGREN & HENEEN recommend 2 mM solution (for *Agropyron*) and 1 mM (for *Secale*) at 15°C. With *Nigella* the somewhat lower temperature prevents tendencies for stickiness although, on the other hand, too low a temperature causes overcontraction of the chromosomes.

Table 3. Relative length values of the chromosomes in five populations of N. aristata and t values obtained by comparing the different populations

Population	Chromosome No.					
	1	2	3	4	5	6
AD	18.33±0.13	19.37±0.22	17.54±0.18	17.48±0.19	17.34±0.20	9.95±0.19
BE	18.46±0.17	17.19±0.17	16.95±0.16	19.37±0.18	16.47±0.11	11.13±0.26
BK	17.76±0.19	17.76±0.22	17.26±0.13	18.24±0.19	18.32±0.15	10.20±0.20
BU	19.03±0.16	18.68±0.09	17.28±0.12	16.69±0.11	17.34±0.13	11.09±0.09
BB	17.17±0.14	18.55±0.11	17.50±0.17	18.05±0.13	18.12±0.13	10.60±0.10
t (AD/BE)	0.78	7.84***	2.44*	—	—	3.68**
t (AD/BK)	2.37*	5.42***	1.26	—	—	0.91
t (AD/BU)	3.40**	2.90*	1.20	—	—	5.42***
t (AD/BB)	6.07***	3.33**	0.16	—	—	3.03**
t (BE/BK)	2.75*	1.83	1.50	—	—	2.84*
t (BE/BU)	2.44*	7.75***	1.60	—	—	0.15
t (BE/BB)	5.86***	6.72***	2.36*	—	—	1.90
t (BK/BU)	5.11***	3.87**	0.11	—	—	4.06***
t (BK/BB)	2.50*	3.29**	1.12	—	—	1.79
t (BU/BB)	8.75***	0.92	1.06	—	—	3.64**

2. Carnoy (3 parts acetic acid: 1 part absolute alcohol) was used instead of the special fixative recommended by Östergren & Heneen. The latter fluid did not give satisfactory results with *Nigella* roots as it was difficult to obtain well stained and flattened preparations. Furthermore, the roots can only be left in this fixative for a few days without a deleterious effect. Using the simple Carnoy fixative the objects may be preserved in well stoppered vials at —15°C for at least a few months without damage. The chromosomes were well stained by means of the Feulgen reaction, exhibiting smooth outlines and bringing out morphological landmarks distinctly.

After staining the roots were placed in a 5 % pectinase solution for 2—6 hours (depending on the quality of the pectinase) and squashed in 45—50 % acetic acid using a dissolvable cover slip of Astralon plastic. The preparations were sealed by means of a rubber frame, the plastic cover slip was dissolved in acetone, and the preparations were mounted in Permount, using an ordinary cover slip of glass, as described by Östergren & Heneen.

Results

Nigella fumariaefolia Kotschy

Crete: Cape Sitia, poorly developed garigue on hard limestone. 7.6.1964. (Code designation AB).

N. fumariaefolia is a comparatively rare species, known from a few localities on Cyprus, Rhodes and easternmost Crete. The single collection obtained in nature was heavily modified by extreme drought, the plants being only a few cm high. Only dry capsules were obtained.

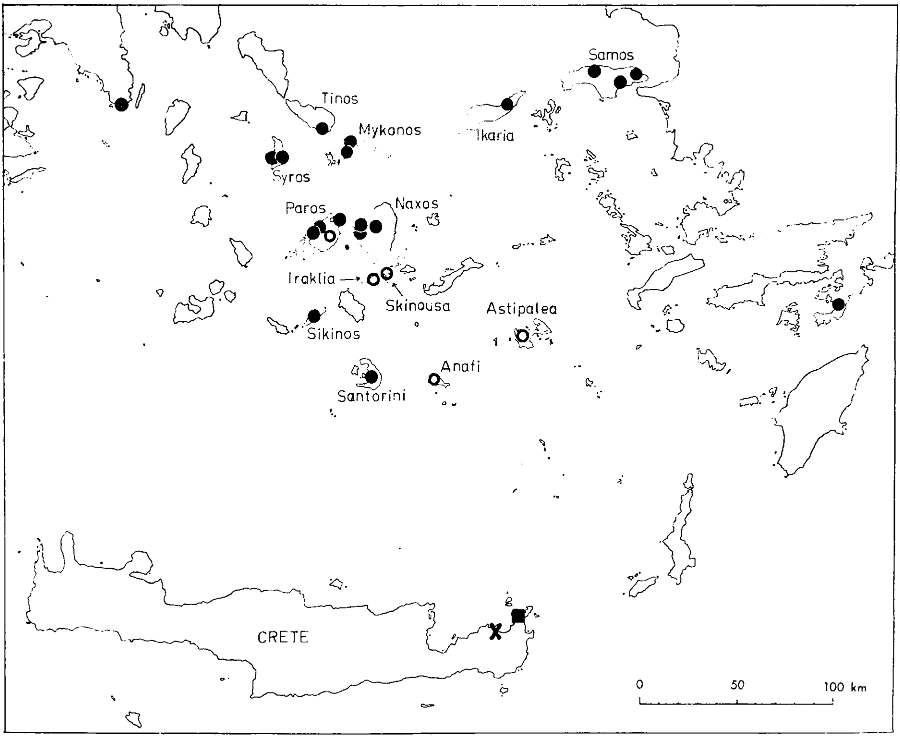

Fig. 1. Distribution of the material examined for chromosome number. Solid circles= *N. aristata*. Open circles=*N. degenii*. Square=*N. fumariaefolia*. Cross=*N. cretica*.

On cultivation about 20 cm high, sparsely branched, with bright green, about 2 mm broad leaves. Flowers 12—15 mm in diameter, almost always with five white, obtuse, somewhat down-bent petals. Nectaries small, pointed, scarlet. Anthers dark violet. Follicles united for $^1/_5$—$^1/_3$ of their length, bending outwards at a right angle to the long axis as the fruit ripens. Time from sowing to flowering 130—150 days.

Compared to the other species investigated *N. fumariaefolia* shows a higher frequency of root tip cells undergoing division. Thanks to good morphological differentiation of the chromosomes, all six pairs can be identified with certainty (see fig. 2). The chromosomes have been numbered as follows:

Chromosome 1. Arm index 1.15±0.03. Relative length 18.48±0.18. The short arm has a marked secondary constriction, dividing it in the proportions of about 1 : 2. Near the end of the short arm a faint

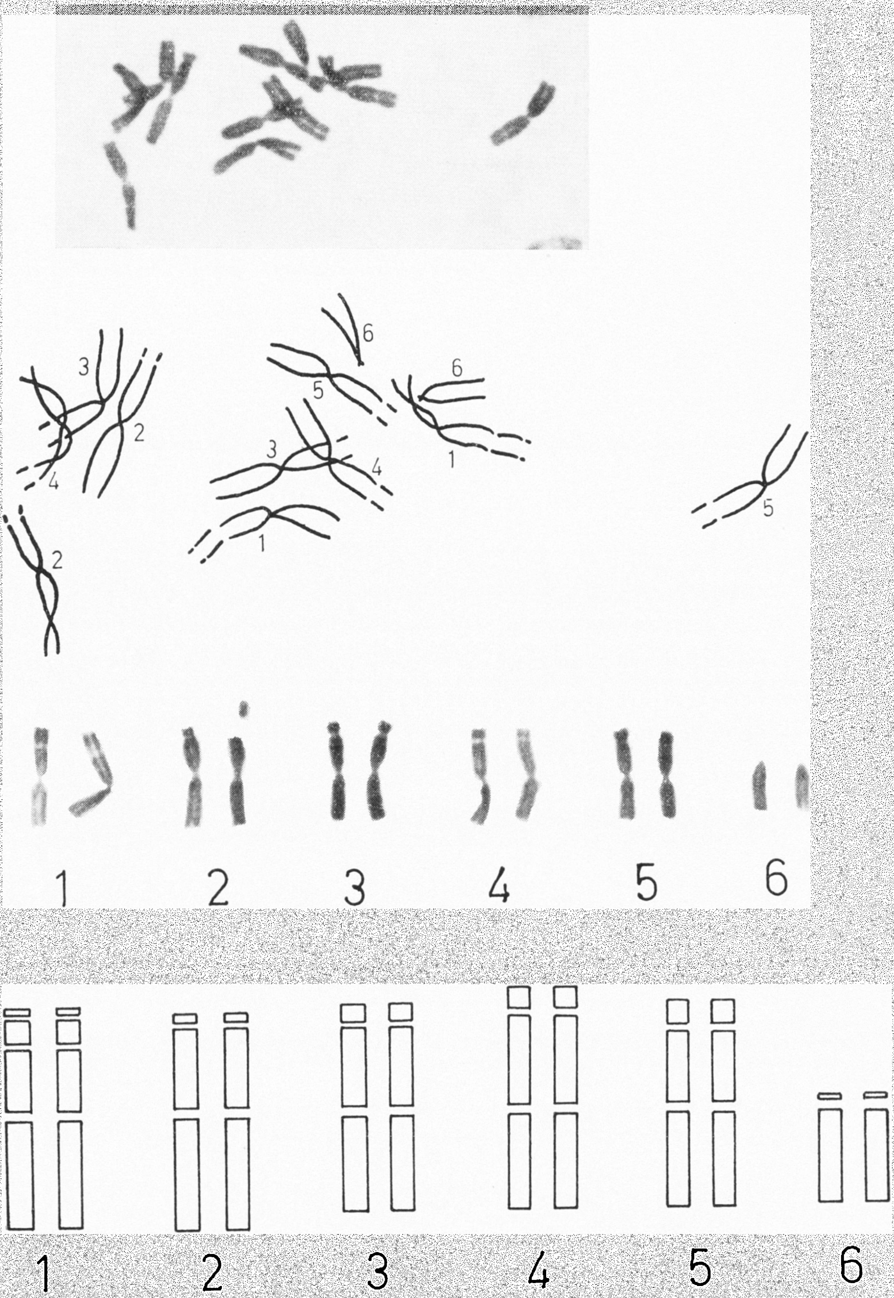

Fig. 2. The chromosomes of *N. fumariaefolia*. From the top: Photo of a metaphase plate (×2850). Diagrammatic drawing of the same plate (×4770). The chromosomes arranged as karyotype. Diagrammatic drawing of the karyotype (idiogram).

secondary constriction is sometimes visible, making the satellite double. In one case a structure like half-chromatids was obvious in the satellite region, the satellite being split into a four-stranded formation.

Chromosome 2. Arm index 1.26 ± 0.03. Relative length 18.64 ± 0.20. The short arm has a small satellite, occupying about one sixth of its length.

Chromosome 3. Arm index 1.08 ± 0.02. Relative length 17.60 ± 0.19. The somewhat shorter arm has a satellite, occupying $^1/_4$—$^1/_5$ of its length.

Chromosome 4. Arm index 1.23 ± 0.03. Relative length 18.69 ± 0.14. Similar to chromosome 2, but with a bigger satellite, situated on the long arm.

Chromosome 5. Arm index 1.05 ± 0.02. Relative length 17.65 ± 0.14. Similar to chromosome 3, but with a somewhat bigger satellite.

Chromosome 6. Almost telocentric, the short arm being minute. Arm index 15—20. Relative length 9.01 ± 0.22. Sometimes a faint secondary constriction appears near the end of the long arm.

Thus the variation in relative chromosome length is rather small, viz., between 17.60 and 18.69, except for the subtelocentric chromosome 6. It is not possible to homologize the individual chromosomes Nos. 1—5 with those of the other species investigated. Cytological data support the opinion that *N. fumariaefolia* is quite distinct from the other species investigated.

Nigella degenii Vierh.

Cyclades, Iraklia: Venetico. 9.6. 1960. (Code designation CE, coll. no. R. & N. 15530.)

N. degenii is endemic to the Cyclades. In nature it flowers in May (earlier than *N. aristata* and somewhat earlier than *N. fumariaefolia*). Some variation is found with respect to external morphology, viz., plant height, degree of branching and angles between the branches, but no significant chromosome morphological differences were found between different populations. However, less material of *N. degenii* was studied than of *N. aristata.*

On cultivation 35—45 cm high, erect, rather slender, sparsely branched. Leaves with few lobes, about 2 mm broad, more or less withered at the time of flowering. Flowers 9—13 mm in diameter, with white, shortly stalked, bluntly pointed petals. Nectaries small, white, with a light green cross-band. Anthers light brown. Follicles united to the middle of their length, their free part at an angle of about 135° to the long axis of the fruit.

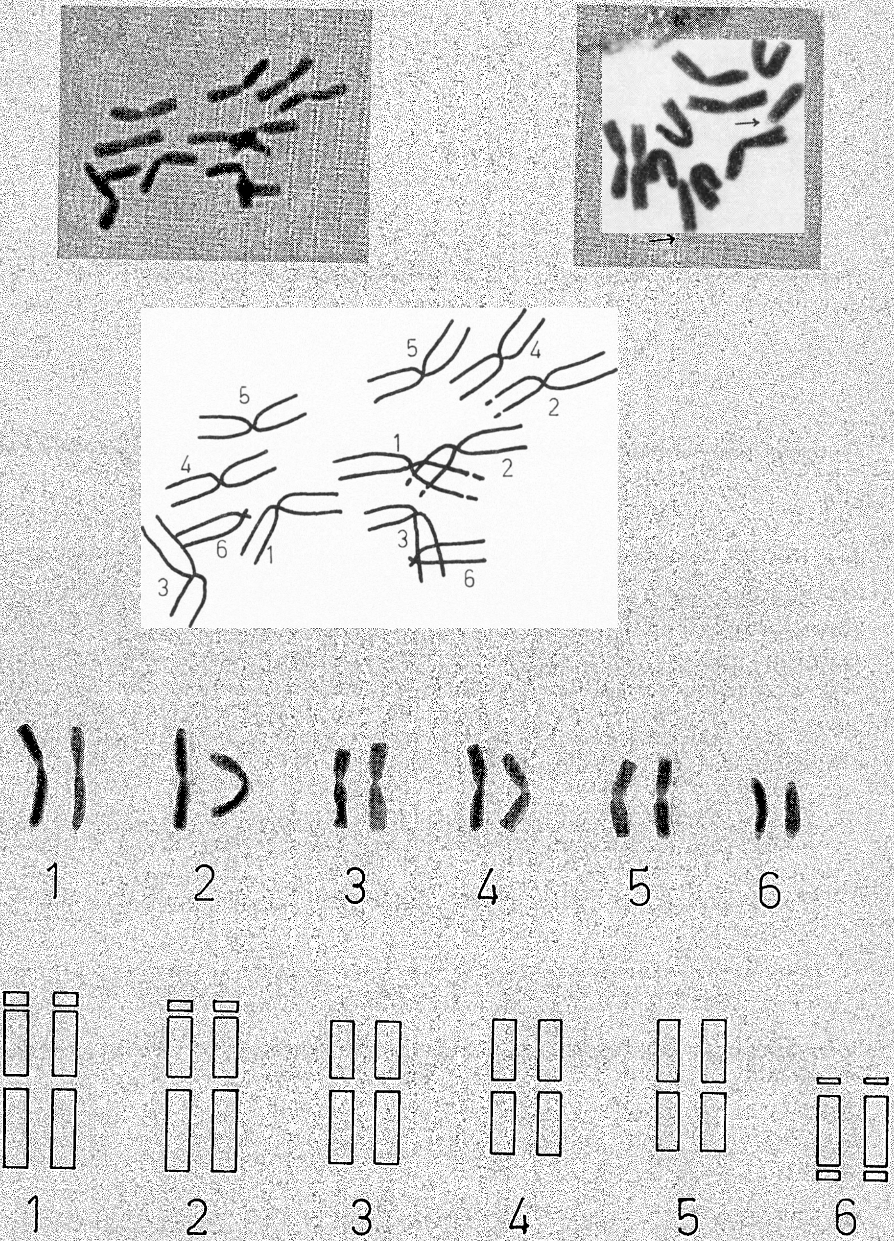

Fig. 3. The chromosomes of *N. degenii.* From the top: Photo of two metaphase plates (×2850). In the plate to the right the satellites attached to chromosomes Nos. 6 are indicated by arrows. Diagrammatic drawing of the plate to the left (×4770). The chromosomes arranged as karyotype. Diagrammatic drawing of the karyotype (idiogram).

The chromosomes of *N. degenii* are frequently more heavily contracted than those of the other species investigated. Two pairs of satellite chromosomes are present (see fig. 3).

Chromosome 1. Arm index 1.05 ± 0.02. Relative length 19.71 ± 0.21. The short arm has a satellite occupying about one fifth of its length.

Chromosome 2. Arm index 1.13 ± 0.02. Relative length 19.43 ± 0.17. The short arm has a small satellite.

Chromosome 3. Arm index 1.21 ± 0.03. Relative length 17.14 ± 0.18. Secondary constrictions do not occur. Distinguished from chromosomes Nos. 4 and 5 by a higher arm index value.

Chromosome 4. Arm index 1.06 ± 0.02. Relative length 16.58 ± 0.13.

Chromosome 5. Arm index 1.03 ± 0.01. Relative length 16.00 ± 0.15. Very similar to chromosome 4. Some uncertainty is inherent in the identification of chromosomes Nos. 4 and 5. Of the four chromosomes remaining after the identification of Nos. 1, 2, 3 and 6, the two with the highest arm index have been called No. 4. Thus chromosomes Nos. 4 and 5 are not identified in the same sense as the others (cf. *N. cretica* and *N. aristata* below).

Chromosome 6. Arm index 15—20. Relative length 11.14 ± 0.19. A secondary constriction occurs near the end of the short arm, giving the chromosome the appearance of a short rod with a knob attached to each end. This constriction is more conspicuous than that occasionally present in chromosome 6 of *N. fumariaefolia, N. cretica* and *N. aristata* (see above and below).

One or more satellites may sometimes have fused with their respective chromosome arms, the secondary constrictions being invisible. This is particularly true in the case of heavily contracted metaphase plates, which are often found in *N. degenii*. Best results are obtained by studying premetaphase stages, where the chromosomes are not yet fully contracted. The karyotype of *N. degenii* is similar to that of *N. cretica* and *N. aristata* (see below).

Nigella cretica Mill.

Crete: Cape Sidero, very dry garigue on hard limestone. 6.6. 1964. (Code designation AC).

The plants obtained from nature were heavily modified dwarfs. Only dry capsules were obtained.

On cultivation 20—30 cm high, slender, basally branched 2—5 times. Leaves small, with few lobes, more or less withered at the time of flowering, about

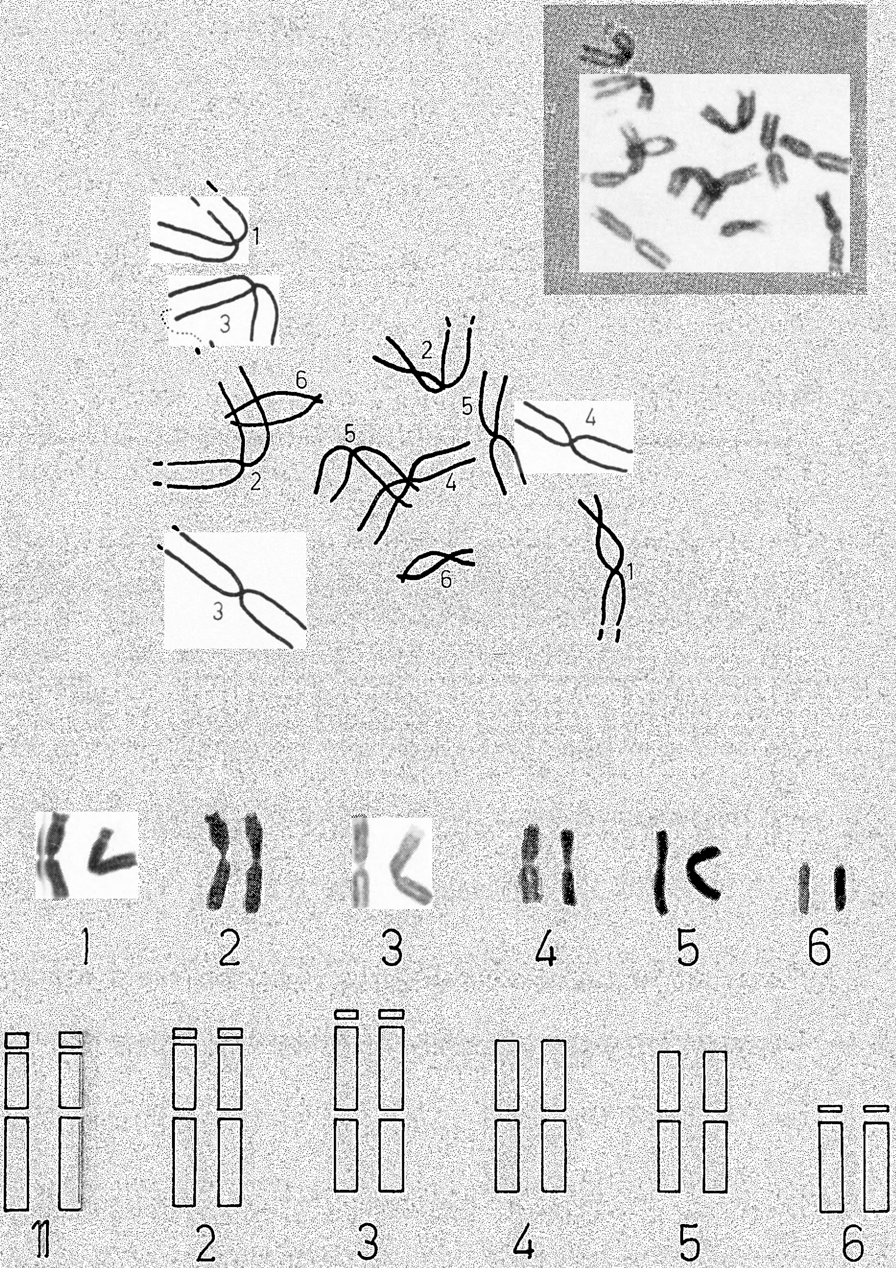

Fig. 4. The chromosomes of *N. cretica*. From the top: Photo of a metaphase plate (×2850). Diagrammatic drawing of the same plate (×4770). The chromosomes arranged as karyotype. Diagrammatic drawing of the karyotype (idiogram).

2 mm broad. Flowers about 10 mm in diameter with white, shortly stalked, relatively pointed petals. Upper flowers with five carpels and petals, the lower ones often with three to four. Nectaries as in *N. degenii*. Anthers brown. Follicles transversely rugose, united almost to the middle of their length, their free part bending outwards at an angle of about 120° to the long axis of the fruit. Develops from sowing to flowering in 95—100 days.

N. cretica is similar to *N. degenii*. Crossing experiments, the results of which are not yet available, are expected to clarify the taxonomic relationships. In the present paper *N. cretica* is kept as a working name. *N. cretica* may be distinguished cytologically from the other species investigated, for example, by the presence of three pairs of satellites (see fig. 4).

Chromosome 1. Arm index 1.21 ± 0.02. Relative length 18.90 ± 0.16. The short arm has a rather large satellite, occupying $^1/_4$—$^1/_5$ of its length.

Chromosome 2. Arm index 1.12 ± 0.03. Relative length 18.98 ± 0.20. The short arm has a small satellite.

Chromosome 3. Arm index 1.25 ± 0.03. Relative length 19.73 ± 0.22. The long arm has a very small satellite.

Chromosome 4. Arm index 1.07 ± 0.02. Relative length 16.58 ± 0.17. No secondary constrictions have been found.

Chromosome 5. Arm index 1.04 ± 0.01. Relative length 15.57 ± 0.18. Very similar to chromosome 4, but somewhat shorter. However, as in *N. degenii*, chromosomes Nos. 4 and 5 cannot be identified with certainty. They have been defined in the same way as in *N. degenii*.

Chromosome 6. Arm index 15—20. Relative length 10.22 ± 0.23. Sometimes a faint secondary constriction is visible near the end of the long arm.

Except for the extra pair of satellites, *N. cretica* is thus similar to *N. degenii* in its cytology (and also to *N. aristata*; see below). The chromosomes are, however, frequently less heavily contracted than those of *N. degenii*.

Nigella aristata S. & S.

More material of *N. aristata* was available than of the other species investigated. Five populations from different islands were selected for a particularly careful cytological examination. In fig. 5 the mean relative length values of the long and short arms of chromosomes Nos. 1, 2, 3 and 6 in the five populations are represented diagrammatically. *N. aristata* is similar to *N. degenii* in its cytology, but considerable

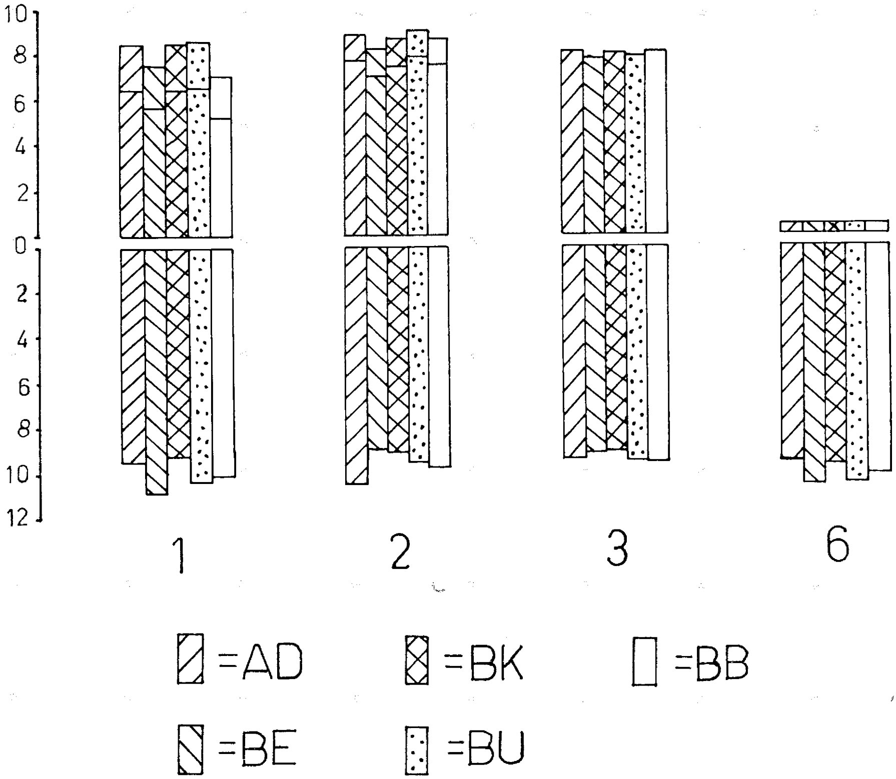

Fig. 5. Diagrammatic representation of chromosomes Nos. 1, 2, 3 and 6 in five populations of *N. aristata*. Scale in relative length units. Further explanation in the text.

variation is found between different populations (see below). Fig. 6 shows the variation in arm index of a single chromosome (No. 1) in 27 populations. The lowest arm index values represent mainly populations from the island of Syros and the highest ones populations from Mykonos and Ikaria.

1. Population AD.

Cyclades, Naxos: The chapel N of Ozia. 4.8. 1958.

Only seeds were obtained.

On cultivation about 40 cm high, erect, rather slender, sparsely branched. Leaves slender, with few, gradually pointed, 1—2 mm broad lobes, those at the base soon withering. All floral parts bigger than those of the other

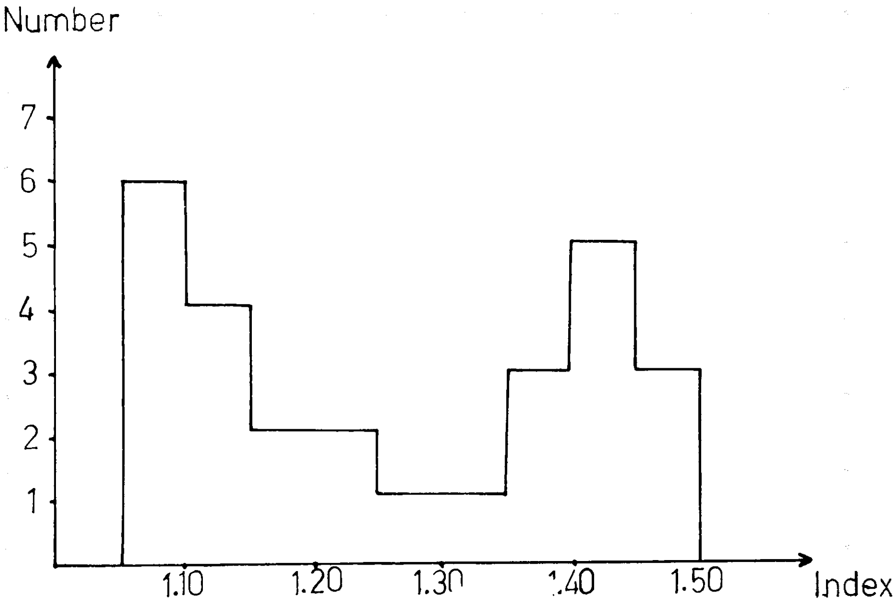

Fig. 6. Arm index values for chromosome 1 in 27 populations of *N. aristata*. Further explanation in the text.

species investigated. Flowers about 20 mm in diameter with white to greenish, stalked, broad, bluntly pointed petals. Nectaries light blue-violet at the base, light green with a brown, central cross-band in the middle, and above this darker green. Anthers light blue-violet. Follicles united to the middle of their length, their free part being of uniform slenderness, obliquely directed upwards.

One individual cultivated in the spring of 1964 proved to be structurally heterozygous in the satellite region of chromosome 2, one satellite being bigger than the homologous one. Population AD is the progeny obtained by enforced self-fertilization of this single divergent individual. Among 12 individuals produced after isolation of a single flower the different chromosome types were distributed as follows (A=big satellite; a=small satellite):

Chromosome structure	AA	Aa	aa	uncertain
Number	2	6	2	2

Although the material was rather limited, the distribution does not differ from the expected 1 : 2 : 1-segregation (cf. fig. 7). In two indi-

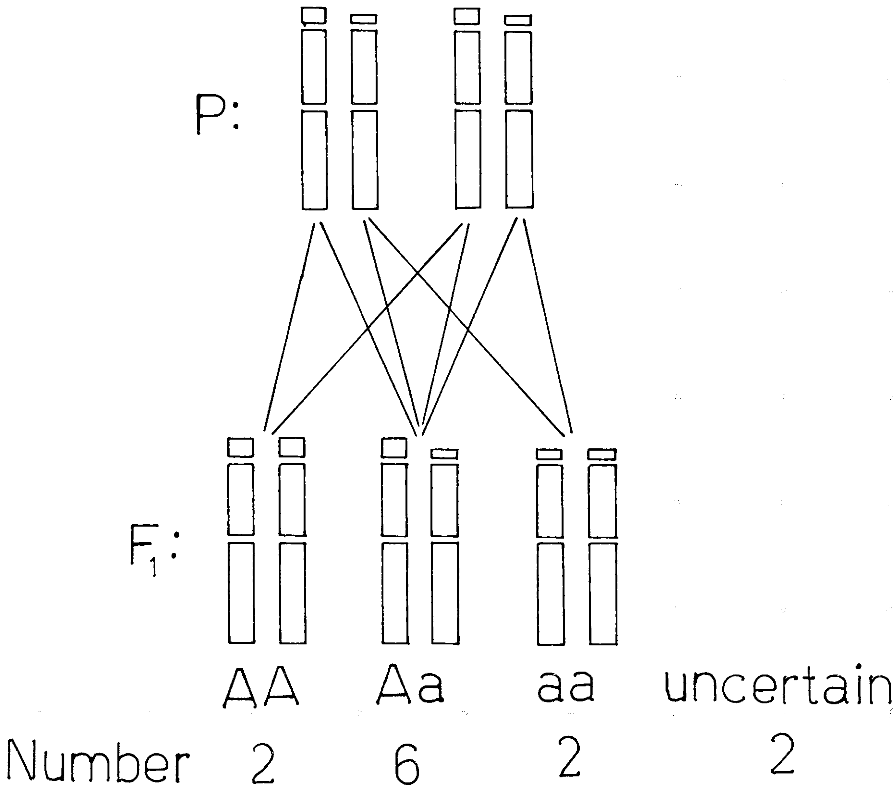

Fig. 7. Recombination of different chromosome types in F_1 after enforced self-fertilization of one individual of *N. aristata* structurally heterozygous in the satellite region of chromosome 2.

viduals it was not possible to identify the structure of chromosome 2 because the preparations were indistinct.

It is noteworthy that individuals with two small satellites (aa) differ morphologically from individuals with the constitution AA or Aa. Individuals of the AA- or Aa-type start flowering about 160 days after sowing, while the development of aa-individuals is more retarded (see fig. 8). No conspicuous differences have been observed between AA- and Aa-individuals. Probably the a-type of chromosome 2 suffers from a deficiency in the satellite region, which causes considerable delay of development in the homozygote.[1]

The karyotype of *N. aristata* is closely similar to that of *N. degenii*. Two pairs of satellites are present.

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[1] The aa-individuals started flowering about 250 days after sowing. The flowers were normal in shape, but rather small.

Fig. 8. Four individuals of *N. aristata* (population AD; Naxos) about 160 days after sowing. From the left: Two individuals of the aa-type. One individual of the Aa-type. One individual of the AA-type. Further explanation in the text.

Chromosome 1. Arm index 1.19 ± 0.03. Relative length 18.33 ± 0.13. The short arm has a rather big satellite, occupying $^1/_4$—$^1/_5$ of its length.

Chromosome 2. Arm index 1.18 ± 0.03. Relative length 19.37 ± 0.22 (both values calculated for the A-type). The short arm has a satellite, occupying about one sixth of its length. In the deficient chromosome type the satellite is only little more than half as big.

Chromosome 3. Arm index 1.15 ± 0.02. Relative length 17.54 ± 0.18.

Chromosome 4. Arm index 1.06 ± 0.02. Relative length 17.48 ± 0.19.

Chromosome 5. Arm index 1.02 ± 0.01. Relative length 17.34 ± 0.20. Very similar to chromosome 4. As chromosomes Nos. 4 and 5 are almost impossible to distinguish in most cases, they have been excluded in the calculation of t values obtained by comparing different populations of *N. aristata*. They have been defined in the same way as in *N. degenii* and *N. cretica*.

Chromosome 6. Arm index 15—20. Relative length 9.95 ± 0.19. As in *N. fumariaefolia* and *N. cretica* a faint secondary constriction sometimes appears near the end of the long arm. This is also true of the other *N. aristata* populations cited below.

It may be noted that in the metaphase plate shown in fig. 9 the subtelocentric chromosomes Nos. 6 lie in close proximity to each other. This has been observed to be a constant tendency in all *Nigella* material investigated, although it is frequently disturbed as a consequence of the squash technique. As may be seen from the chromosome plates drawn by, for example, GREGORY (1941) and PEREIRA (1942), other authors have noticed the same phenomenon, although they have not commented on it. Presumably rather weak, but specific, attraction forces are acting, the nature and origin of which still remain obscure.

2. *Population BE.*

Cyclades, Mykonos: Path about 3 km NE of the town. 4.7. 1964 (coll. no. B. & St. 21790).

On cultivation 30—40 cm high, suberect, slender, sparsely branched. Leaves rather short, with few lobes, about 2 mm broad. Flowers 15—20 mm in diameter, with white, long-stalked, rather obtuse petals, greenish towards the tip. Nectaries blue-violet at the base, with a light central cross-band; above this brown-violet. Anthers red-violet. Follicles as in population AD, but somewhat smaller.

Chromosome 1. Arm index 1.44 ± 0.02. Relative length 18.46 ± 0.17. The short arm has a reatively big satellite. The arm index value is remarkably high. Four populations from Mykonos have been studied with special regard to the structure of chromosome 1, and all of them have arm indices between 1.40 and 1.50. The differences between, for example, populations BE and AD or between BE and BK (see below) are highly significant.

Chromosome 2. Arm index 1.08±0.02. Relative length 17.19±0.17. The short arm has a small satellite. Chromosome 2 is quite variable. Highly significant differences are found in several cases between different populations (see table 2 and 3).

Chromosome 3. Arm index 1.19±0.02. Relative length 16.95±0.16. This chromosome is somewhat shorter than the homologous ones in the other populations investigated, but, on the whole, chromosome 3 is less variable than chromosomes Nos. 1 and 2. The variation in arm index between the five populations is rather small, viz., between 1.12 and 1.21.

Chromosome 4. Arm index 1.11±0.02. Relative length 19.37±0.18. This chromosome is unusually long and has a comparatively high arm index.

Chromosome 5. Arm index 1.04±0.01. Relative length 16.47±0.11. In this case it is possible to distinguish chromosomes Nos. 4 and 5 satisfactorily.

Chromosome 6. Arm index 15—20. Relative length 11.13±0.26. In this case and, to a lesser extent in the others, the relative length value of chromosome 6 varies considerably within a single population. The mean values vary between 9.95 and 11.13. As in the other cases, it is not possible to calculate arm indices accurately because of the minuteness of the short arm.

Thus the Mykonos type is cytologically principally characterized by the high arm index of chromosome 1, rather short chromosomes 2, 3 and 5, and an unusually long chromosome 4, which is possible to distinguish from No. 5 (see fig. 10).

3. *Population BK.*

Cyclades, Syros: Roadsides W of Foinikia. 19.6.1964 (coll. no. S. 21135).

On cultivation 30—40 cm high, suberect, richly branched from the base. Leaves with numerous lobes, about 1 mm broad, rather withered at the time of flowering. Flowers about 20 mm in diameter, bluish white. Petals long-stalked, more or less squared, shortly pointed. Nectaries blue at the base, with a brown central cross-band; above this yellowish green. Anthers blue to blue-violet. Follicles similar to population AD, but their free part somewhat longer and slenderer.

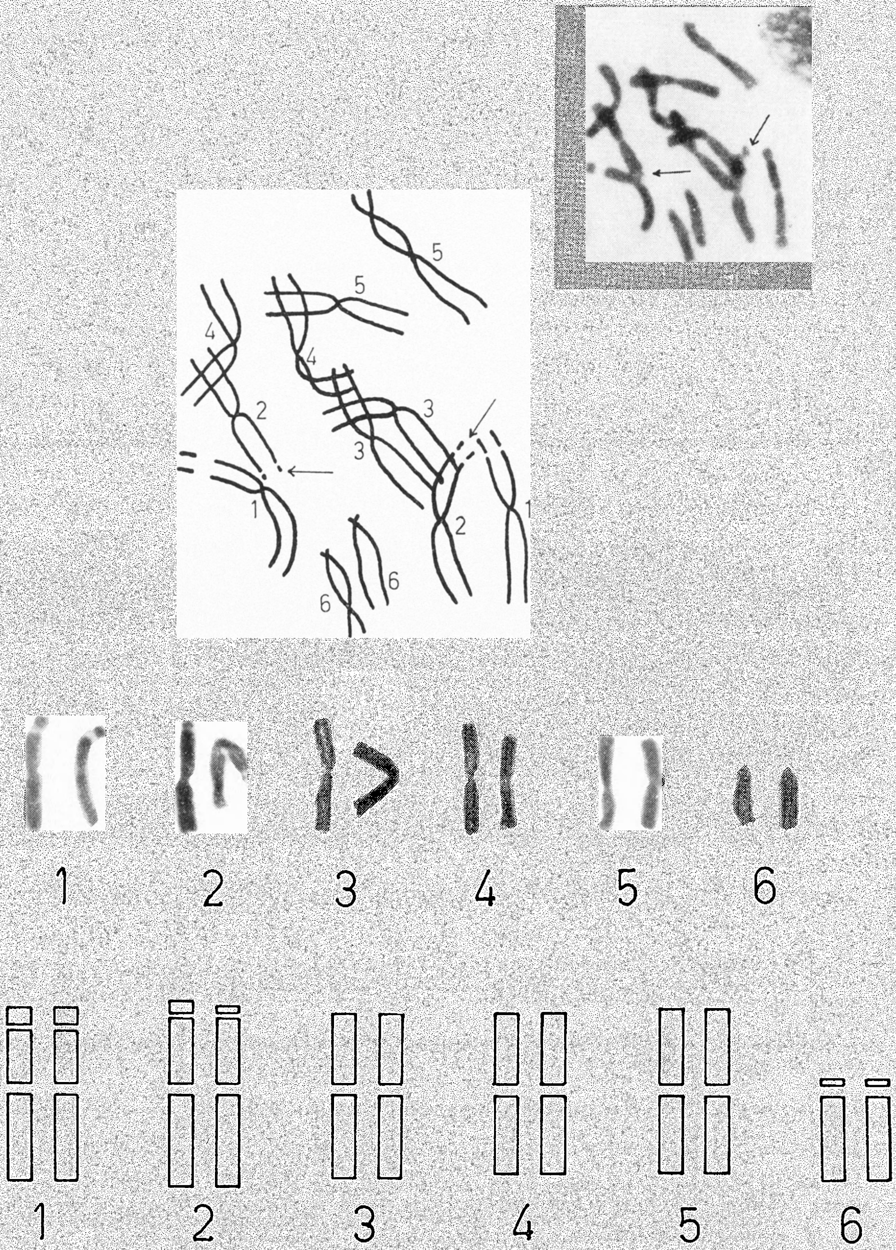

Fig. 9. The chromosomes of *N. aristata* (population AD; Naxos; structurally heterozygous individual). From the top: Photo of a metaphase plate (×2850). Diagrammatic drawing of the same plate (×4770). The chromosomes arranged as karyotype. Diagrammatic drawing of the karyotype (idiogram). Note the satellites attached to chromosome 2 (indicated by arrows).

Chromosome 1. Arm index 1.09±0.03. Relative length 17.76±0.19. The short arm has a rather big satellite. The arm index value is among the lowest ones found in the whole *aristata* material. Six populations from Syros have been checked with respect to the structure of chromosome 1, and all of them have been found to have indices around 1.10.

Chromosome 2. Arm index 1.06±0.02. Relative length 17.76±0.22. The somewhat shorter arm has a small satellite. The chromosome is comparatively short with a low arm index. Significant differences from population AD are found in both respects.

Chromosome 3. Arm index 1.12±0.03. Relative length 17.26±0.13. This chromosome is fairly constant throughout the *aristata* material investigated. Highly significant differences are found neither with respect to arm index nor to relative length when population BK is compared with any of the other four populations.

Chromosome 4. Arm index 1.07±0.02. Relative length 18.24±0.19.

Chromosome 5. Arm index 1.03±0.02. Relative length 18.32±0.15.

Chromosomes Nos. 4 and 5 are very difficult to distinguish. They have been defined in the same way as chromosomes Nos. 4 and 5 in *N. degenii*. However, as may be seen from the close similarity both in arm index and relative length, this "identification" is by no means unassailable.

Chromosome 6. Arm index 15—20. Relative length 10.20±0.20. This chromosome is slightly shorter than the homologous one from population BE (weak significance).

Population BK is characterized mainly by the low arm index of chromosome 1 and a rather short chromosome 2 with almost equal arms. The other four chromosomes have values which scarcely discriminate them from the homologous ones in the other populations investigated (see fig. 11).

4. *Population BU.*

Cyclades, Santorini: Roadsides 1 km SE Thira. 2.7. 1964 (coll. no. S. 21204).

On cultivation 70—80 cm high, erect, almost unbranched. Leaves 2 mm broad, with numerous, pointed lobes, rather freshly green at the time of flowering. Flowers 30—35 mm in diameter, with large, broad, bluish white petals. Nectaries dark blue at the base, with a faint brown-violet central cross-band; above this impurely green. Follicles as in population AD, but bigger, like all parts of the flowers. Time from sowing to flowering 210—230 days (150—180 days for the other *aristata* populations).

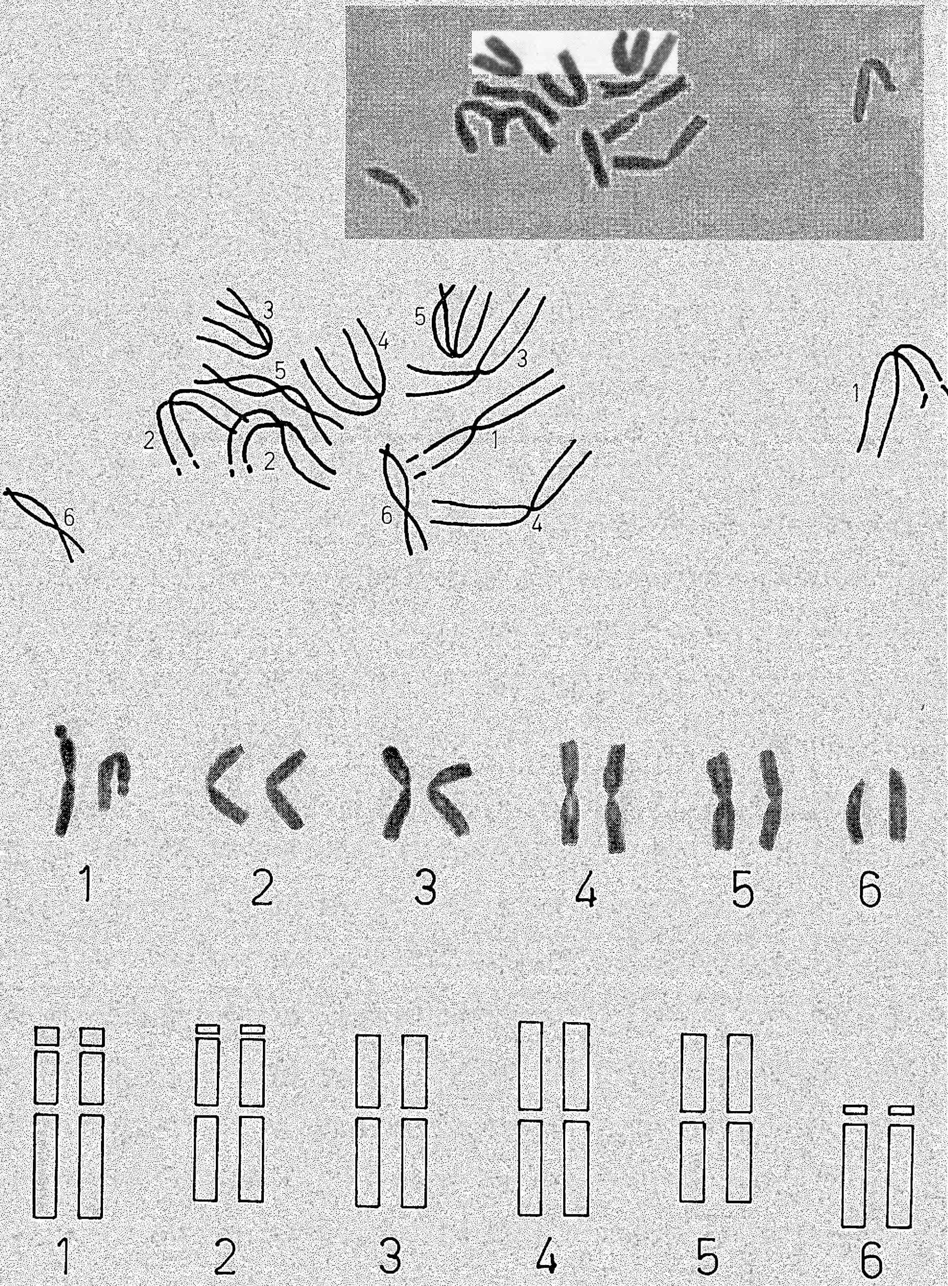

Fig. 10.

Chromosome 1. Arm index 1.23 ± 0.02. Relative length 19.03 ± 0.16. This chromosome is exceptionally long, but intermediate with respect to arm index.

Chromosome 2. Arm index 1.05 ± 0.01. Relative length 18.68 ± 0.09. The arm index value is fairly low. The chromosome is significantly shorter than the homologous one from population AD, but longer than those from populations BE and BK.

Chromosome 3. Arm index 1.21 ± 0.02. Relative length 17.28 ± 0.12. The arm index is the highest one found in the *aristata* material, although the variation is rather small. The relative length value is intermediate.

Chromosome 4. Arm index 1.07 ± 0.01. Relative length 16.69 ± 0.11.

Chromosome 5. Arm index 1.03 ± 0.01. Relative length 17.34 ± 0.13. With regard to chromosomes Nos. 4 and 5, the facts stated for population BK also hold for population BU.

Chromosome 6. Arm index 15—20. Relative length 11.09 ± 0.09. This chromosome is significantly longer than the homologous ones from populations AD and BK.

Population BU is strikingly different from all the other *aristata* collections available with respect to external morphology, but cytologically intermediate in most respects. Some chromosome morphological peculiarities are found, for example, chromosomes Nos. 1 and 6 are unusually long and chromosome 2 has a rather low arm index. On the whole, however, there seems to be no obvious correlation between the degree of gross morphological and chromosome morphological differences between any two populations.

5. *Population BB.*

Eastern Islands, Ikaria: 3 km NNW Ag. Kirikos. 10.7. 1964 (coll. no. B. & St. 21819).

On cultivation 15—25 cm high, more or less decumbent, richly branched from the base, with a dense leaf rosette. Leaves 1—2 mm broad, dark green, rosulate leaves broadest towards the apex. Flowers 12—18 mm in diameter, white. Nectaries rather small, greenish white, with one prominent and one or two faint blue cross-bands. Follicles small, with relatively few, flat seeds.

Fig. 10. The chromosomes of *N. aristata* (population BE; Mykonos). From the top: Photo of a metaphase plate (×2850). Diagrammatic drawing of the same plate (×4770). The chromosomes arranged as karyotype. Diagrammatic drawing of the karyotype (idiogram).

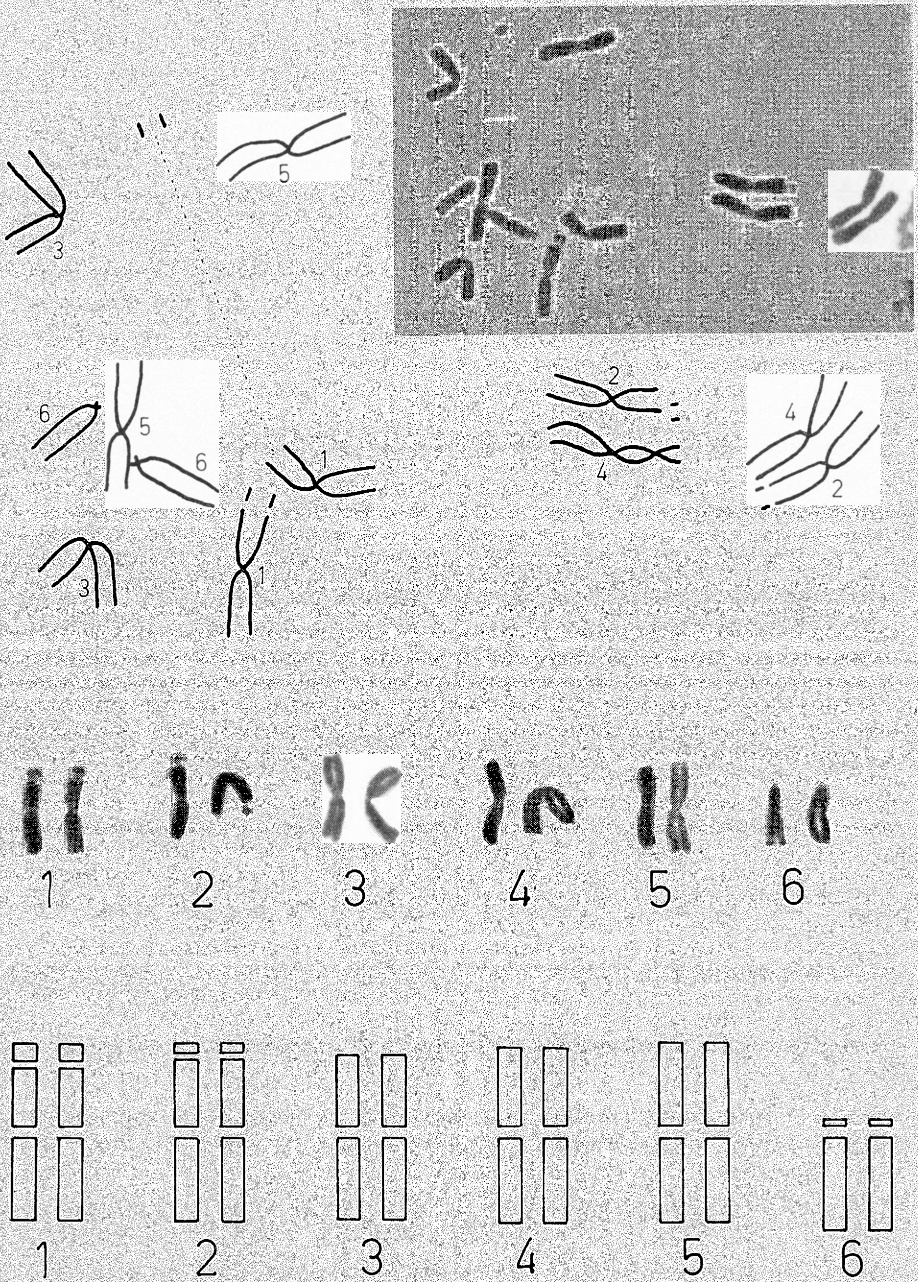

Fig. 11.

Population BB differs very markedly from all the other *aristata* material studied, and should possibly be referred to a taxon of its own. Extensive hybridization experiments, the results of which are not yet available, are likely to give the answer to this question.

Chromosome 1. Arm index 1.45 ± 0.03. Relative length 17.17 ± 0.14. This chromosome is unusually short. With respect to arm index it is closely similar to the homologous one from population BE.

Chromosome 2. Arm index 1.13 ± 0.01. Relative length 18.55 ± 0.11. With respect to arm index this chromosome is intermediate between population AD on the one hand and populations BE, BK and BU on the other. It is significantly shorter than the homologous one from population AD, but longer than the ones from populations BE and BK.

Chromosome 3. Arm index 1.20 ± 0.02. Relative length 17.50 ± 0.17. The arm index is slightly higher than that of the homologous chromosomes from populations BE and BK. The chromosome is somewhat longer than the one from population BE.

Chromosome 4. Arm index 1.13 ± 0.02. Relative length 18.05 ± 0.13. The arm index is unusually high, and comparable to that found for chromosome 4 in population BE.

Chromosome 5. Arm index 1.06 ± 0.01. Relative length 18.12 ± 0.13. In this case, as in population BE, it is possible to distinguish chromosomes Nos. 4 and 5 with certainty.

Chromosome 6. Arm index 15—20. Relative length 10.60 ± 0.10. This chromosome is intermediate in length.

Population BB is characterized by a short chromosome 1 with a high arm index and by the possibility of discriminating between chromosomes Nos. 4 and 5. It is cytologically closely similar to population BE from Mykonos, although quite outstanding from a morphological point of view.

Discussion

All four species investigated manifest good seed setting after self-fertilization enforced by isolation. In the few cases where a second generation was available for study, no indication of deleterious inbreeding effects were observed. Thus it is highly probable that no genetically

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Fig. 11. The chromosomes of *N. aristata* (population BK; Syros). From the top: Photo of a metaphase plate (×2850). Diagrammatic drawing of the same plate (×4770). The chromosomes arranged as karyotype. Diagrammatic drawing of the karyotype (idiogram).

controlled self-incompatibility mechanism is acting, and that the *Nigella arvensis* group is mainly self-fertilized. This statement is strengthened by the fact that most populations obtained from seeds collected in nature were strikingly homogeneous. In a few cases, however, variation in floral characters (colour of anthers and nectaries) was observed within a single collection of *N. aristata.* For example, among 18 individuals from population BK, the cytology of which is described above, 15 had rather light flowers with light blue as the dominant colour of anthers and nectaries, whereas the remaining three had dark violet anthers and much darker nectaries. In this case, as well as in a few others, the original material must have been heterozygous, indicating that outcrossing had occurred. In the cultivated material, a large number of artificial crosses have been made, both between different species and between different populations within a single species, and in most cases mature seeds have developed. WAISEL (1959), working with ecotypic differentiation in *N. arvensis,* found forms intermediate between sspp. *divaricata* and *tuberculata* near to the Mediterranean coast of Israel. These intermediates were supposed to be of hybrid origin, and artificial crosses between sspp. *divaricata* and *tuberculata* gave fertile, intermediate F_1 hybrids.

The facts and findings listed above exclude the possibility that the *N. arvensis* group consists of obligate self-fertilizers. Different *N. aristata* collections from the same island (e.g., 6 collections from Syros, 4 from Mykonos, 4 from Naxos) exhibit close morphological and cytological similarity. Thus cross-fertilization is likely to occur frequently enough to prevent permanent isolation of sub-populations on one and the same island. In fact there probably exists a theoretical possibility of gene exchange in all directions. On the other hand, populations of *N. aristata* from different Aegean islands are in most cases effectively isolated and have often developed into morphologically very dissimilar types. As the variation in climatic and edaphic conditions is insignificant, the differentiation can only to a very limited extent be explained by the action of selective forces.

In the chasmophytic genus *Cheiranthus,* SNOGERUP (unpublished) found great morphological variation and partial sterility in crosses between populations from different Aegean islands. In this case the differentiation is likely to be largely due to random changes of gene frequencies because of the very limited population size (the so-called genetic drift or Sewall Wright effect).

In favourable years, at least, *Nigella* does not occur in small populations, and the above argument cannot be directly applied to it. However, according to RUNEMARK (personal communication), the size of the populations may vary considerably from year to year, as a consequence of the time when severe summer drought sets in. Under such circumstances, random changes of gene frequencies and frequencies of structurally different chromosome types may occur when the populations are at their minimal size. CLAUSEN (1951) gives a marked example of this kind of evolutionary mechanism for the North American genus *Layia*.

Parallel to the variation in external morphology, obvious chromosome morphological variation was observed, which probably reflects structural differences. HENEEN & RUNEMARK (1962) found similar differences in the satellite chromosomes of *Elymus Rechingeri* between populations from different Aegean islands. These authors also found cases closely parallel to the one reported above for population AD of *N. aristata*, with unequal satellites on two homologous chromosomes.

In the opinion of the present author, the arm index is a more significant chromosome morphological character than the relative length value. Now and then metaphase plates are found in which some chromosomes have either contracted less than the others, or been artificially stretchened as a consequence of the squash technique, but differences in the degree of contraction between the arms of a single chromosome are less likely to occur.

Partial or absolute sterility in crosses between or within species may be due to chromosome structural differences, i.e., lack of homology between the combined genomes. When F_1 hybrids become available, their chromosome morphology, meiosis and pollen fertility will be studied in detail in order to determine the effect of the combination of genomes which are probably structurally different.

Acknowledgements

The author wishes to express his thanks to Dr. H. RUNEMARK, who suggested the study, and to other members of the "Aegean team" from the Institute of Systematic Botany, Lund, who are mentioned in the text. The English text was checked by Mr. ANTHONY M. CARTER. The field work was supported by grants from the Swedish Natural Science Research Council.

Summary

The chromosome morphology of four Aegean species of the genus *Nigella*, viz., *N. fumariaefolia* Kotschy, *N. degenii* Vierh., *N. cretica* Mill., and *N. aris-*

tata S. & S. was investigated. All four species have the diploid chromosome number 2n=12 and their karyotypes are similar. Five pairs of metacentric to submetacentric chromosomes and one pair of almost telocentric ones occur. However, differences were found between the species, for example, with respect to the number and position of secondary constrictions.

N. fumariaefolia is cytologically distinct from the other species investigated, because of the high number of secondary constrictions. All six chromosome pairs can be identified.

N. degenii frequently exhibits heavily contracted metaphase plates. Two pairs of satellites occur, as well as a secondary constriction in the small, subtelocentric chromosome.

N. cretica is morphologically closely similar to *N. degenii*, but cytologically somewhat different. Three pairs of satellites occur.

N. aristata is very variable both with respect to external morphology and chromosome morphology. The karyotype is similar to that of *N. degenii*, but morphologically the two species are quite distinct. Five populations of *N. aristata* from different Aegean islands were selected for a particularly careful cytological examination. Significant differences were found in several cases. The progeny obtained by enforced self-fertilization of one individual structurally heterozygous in the satellite region of chromosome 2 was studied. The different satellite types were distributed according to the expected 1 : 2 : 1 ratio.

The four species investigated are apparently normally self-fertilizers, but in several cases artificial crosses have resulted in good seed setting. Populations from different Aegean islands are in most cases effectively isolated. Random changes of gene frequencies and frequencies of structurally different chromosome types due to fluctuation in population size have probably played an important role in the morphological and cytological differentiation of *N. aristata*.

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Floral Anatomy of Zephyranthes carinata Herb. with Special Reference to Gynoecium

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Introduction

Previous work on the Floral Morphology of some species of *Amaryllidaceae* with special reference to its gynoecium has been only meagre (NEWMAN 1928; JOSHI & PANTULU 1941; CHATURVEDI 1945). The present work is an attempt at a proper elucidation of the exact morphological relationship between the gynoecium and floral whorls in *Zephyranthes carinata* Herb. on the basis of floral anatomy.

Material and Method

Flower buds of *Zephyranthes carinata* Herb. at different stages of development were collected in the Botanic Garden of the Annamalai University campus and were fixed in F.A.A. Microtome sections of the flower buds were taken (thickness 10—12 μ) and stained with Delafield haematoxylin.

Observations

The flower stalk has a continuous ring of 12 vascular bundles (Fig. 1 a). Six of these bundles are larger and alternate with six smaller bundles. These bundles branch and anastomose without any regularity only to reorganize at the base of the inferior ovary (Fig. 1 b). The ovary is trilocular. At the base of the ovary within the ovary wall are six large bundles forming the outer ring of vascular strands and are situated outside the three locules. Out of the six bundles, three bundles are opposite the loculi and hence in the position of the dorsal bundles of the carpels (Fig. 1 c). The other three bundles are opposite the septum, parietal in position (Fig. 1 c). On the inner margins of the carpels there are six bundles forming an inner ring (Fig. 1 c). These bundles represent the fused product of the carpellary laterals and the ventral bundles and constitute the placental supply. A short distance higher up, all the six bundles of the outer ring divide and each bundle gives rise to two lateral traces (Fig. 1 d, e). These vascular traces represent the perianth laterals. Each locule of the ovary has two ovules. Although the ovules are very close to the placentae almost throughout their length, their actual attachment is only to their upper ends. The placentation, of course, is to be regarded as axile. Near the top of the ovary but before the loculi have ended, all the six placental strands, after supplying the ovules, divide into two strands each (Fig. 1 f) and disappear at the sterile neck region of the ovary. After the closing up of loculi, the bundle standing opposite to each locule divides into an outer perianth midrib bundle and an inner stamen-carpellary midrib bundle (Fig. 1 f, g). Almost at the same level, the stamen-carpellary dorsal strand divides into an inner dorsal strand (carpellary) and an outer staminal strand. The carpellary dorsals enter the style. Again at this level only, all the three bundles standing opposite to the septum divide to form an outer perianth midrib and an inner staminal strand. A short distance above, the style separates out from the perianth-stamen tube (Fig. 1 g). The style is hollow with three stylar canals. These canals lie in the positions of the ovarian locules. It is interesting to note that from the middle of the ovary, the carpels have maintained their individuality by not fusing with each other completely (Fig. 1 d). The perianth-stamen tube contains an inner ring of six bundles representing the staminal supply and an outer ring of eighteen bundles which constitute the perianth supply (Fig. 1 h). All the perianth bundles are of equal size and shape. The perianth midrib can be distinguished only by its position and not by its shape or size.

Discussion

There are two main views regarding the origin of the inferior ovary or perigynous flower. According to the first view, the calyx tube is receptacular in origin and it is formed through the invagination or involution of the receptacle around the gynoecium. According to the second view, the inferior ovary is appendicular in nature, i.e., it is formed through adhesion or cohesion of floral parts.

In *Polianthes tuberosa* and in *Eucharis amazonica,* the vascular

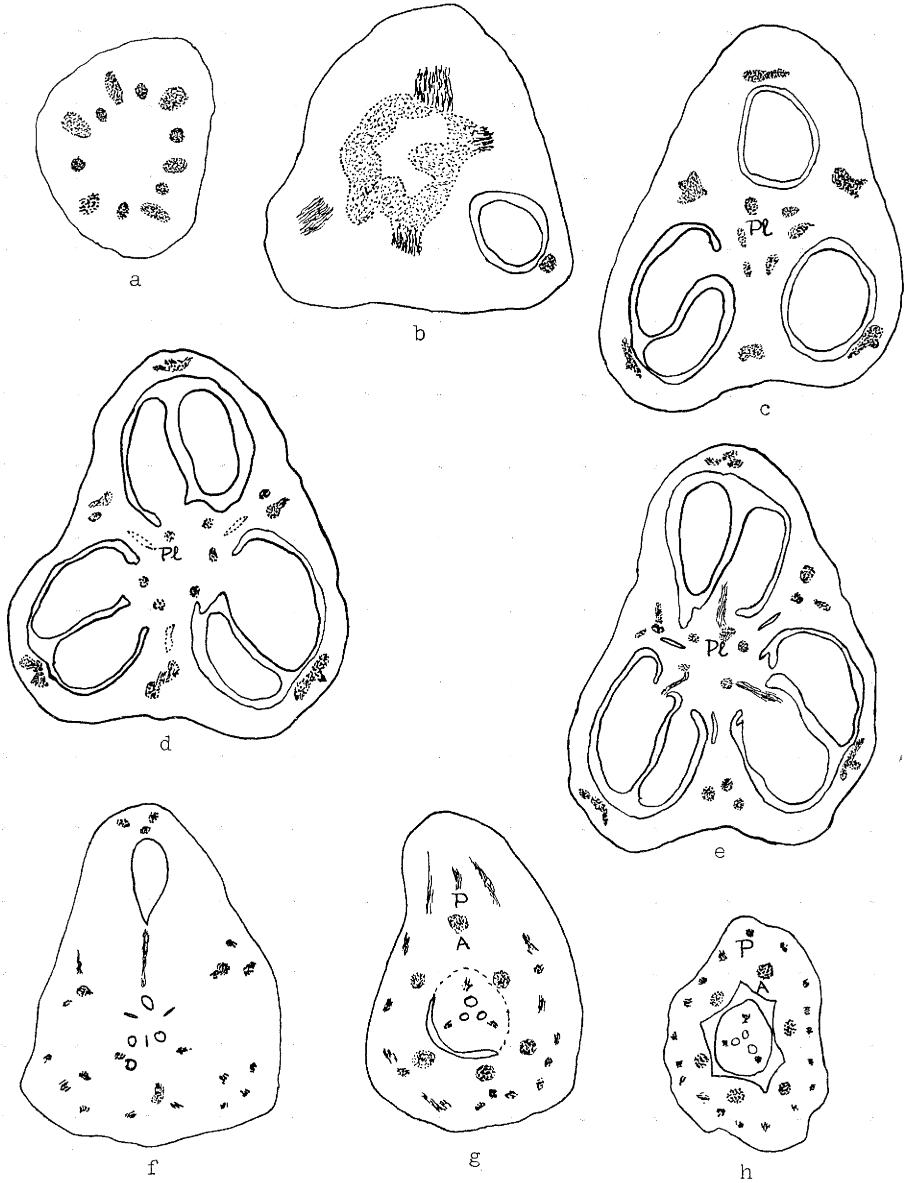

Fig. 1. a: Stele of the pedicel. — b: Vascular strands have fused at the base of the ovary. — c: Showing the three loculi, the ovarian wall with six bundles, and the six placental strands. — d, e: Showing the branching of all the vascular strands and the independent nature of the carpels. — f, g: Showing the sterile region of the ovary, the separation of the style, and the branching of the perianth staminal strands. — h: Showing the perianth tube with eighteen perianth traces and six staminal traces. — (All ×10.) — Abbreviations: P=Perianth bundle; Pl=Placental bundle; A=Staminal bundle; D=Dorsal bundle of the carpel.

bundles for the various floral parts have been shown to separate out from the stele of the receptacle below the ovary. It has been indicated further, that in the wall of the inferior ovary the bundles of the outer and the inner whorls of perianth leaves, stamens and carpels are present quite distinct from one another (JOSHI & PANTULI 1941, CHATURVEDI 1945). This appears to be the simplest type of anatomical organization of an inferior ovary, although the family *Amaryllidaceae* itself might not be a primitive one. This type illustrates clearly the origin of the inferior ovary by an adnation of the outer floral parts with the wall of the ovary without involving fusions of vascular bundles of different whorls. In the next stage, one can imagine a fusion for varying distances in the ovary wall of the traces on the same radius but belonging to different floral whorls, which condition is clearly exhibited by *Zephyranthes*. In *Zephyranthes* the perianth midribs have fused with the staminal bundles lying on the same radii. The dorsal bundles of the three carpels have fused with the perianth stamen traces which are nearest to them and also lie on the same radii.

In *Amaryllidaceae* one can expect a variety in the origin and behaviour of the bundles of the ovary wall. In *Polianthes tuberosa* and *Eucharis amazonica* the vascular bundles for different floral parts separate at the very base of the ovary and they maintain their individuality throughout. In *Zephyranthes*, on the other hand, the vascular bundles lying on the same radii fuse with each other. In *Viburnum* of *Caprifoliaceae,* WILKINSON (1948) observed a fusion of the dorsal traces of the carpels with the peripheral bundles and a separation from them only in the upper part of the ovary.

In *Begonia* (GAUTHIER 1950) and in *Hillebrandia* (GAUTHIER 1959) the dorsal bundles of the carpels are fused with the sepal traces. In *Drosera cystiflora*, HALL (1949) found a fusion of sepal midribs with staminal traces and of petal traces with sepal lateral traces. In fact, in many families with inferior ovaries such adnations are common and *Zephyranthes* appears to be no exception.

Summary and Conclusion

The inferior ovary in *Zephyranthes* is best explained under the appendicular theory as due to an extreme adnation of the outer floral parts with the ovary, involving also extensive fusions of the vascular bundles of different floral whorls. Thus the type of inferior ovary seen in *Zephyranthes* appears to be more advanced than that of e.g. *Polianthes tuberosa* and *Eucharis amazonica.*

Acknowledgement

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Halesia cf. carolina L. (Styracaceae) im oberen Pliozän von Weilerswist in Westdeutschland

Von HANS TRALAU

Naturhistoriska Riksmuseet, Stockholm 50

Einleitung

Die Gattung *Halesia* kommt gegenwärtig mit 3 Arten im atlantischen Nordamerika und mit einer Art in SO-China vor. Im Mitteleuropäischen Tertiär ist die Gattung bis jetzt zweimal durch das Vorkommen von flügellosen Steinkernen bekannt geworden. Die als *Camptotheca crassa* von REID & REID (1915) beschriebenen Reste aus dem Pliozän von Swalmen in Holland wurden von KIRCHHEIMER (1943) zu *Halesia* geführt. Gleichzeitig beschreibt der gleiche Verfasser flügellose Steinkerne aus dem Oligozän von Spremberg bei Kausche in Deutschland und fasst diese Vorkommen mit denen von Holland unter dem Namen *Halesia crassa* zusammen. Die Gattung ist ebenfalls fossil in Nordamerikas Miozän durch den Abdruck einer Frucht bekannt geworden, die BROWN (1946) mit der nordamerikanischen *Halesia diptera* vergleicht. Das hier mitzuteilende Vorkommen stammt aus dem oberen Pliozän von Weilerswist, woraus kürzlich das fossile Vorkommen von *Trapella* beschrieben wurde (TRALAU 1964). Es handelt sich um eine Süsswasserablagerung, in der sich die Reste sowohl der Seevegetation, z.B. *Trapella, Euryale,* als auch die eingewehten Teile der Ufervegetation, z.B. *Halesia, Alnus, Nyssa* u.s.w. befinden. Der hier gefundene *Halesia*-Rest ist eine mit den Flügeln erhaltene Frucht, die von der rezenten *Halesia carolina* L. nicht zu unterscheiden ist, wohl aber von den übrigen Arten der Gattung.

Das rezente Vorkommen

Halesia carolina unterscheidet sich von *H. monticola* durch bedeutend geringere Länge der Früchte. Die von *H. carolina* sind 2,5—3,5 cm lang

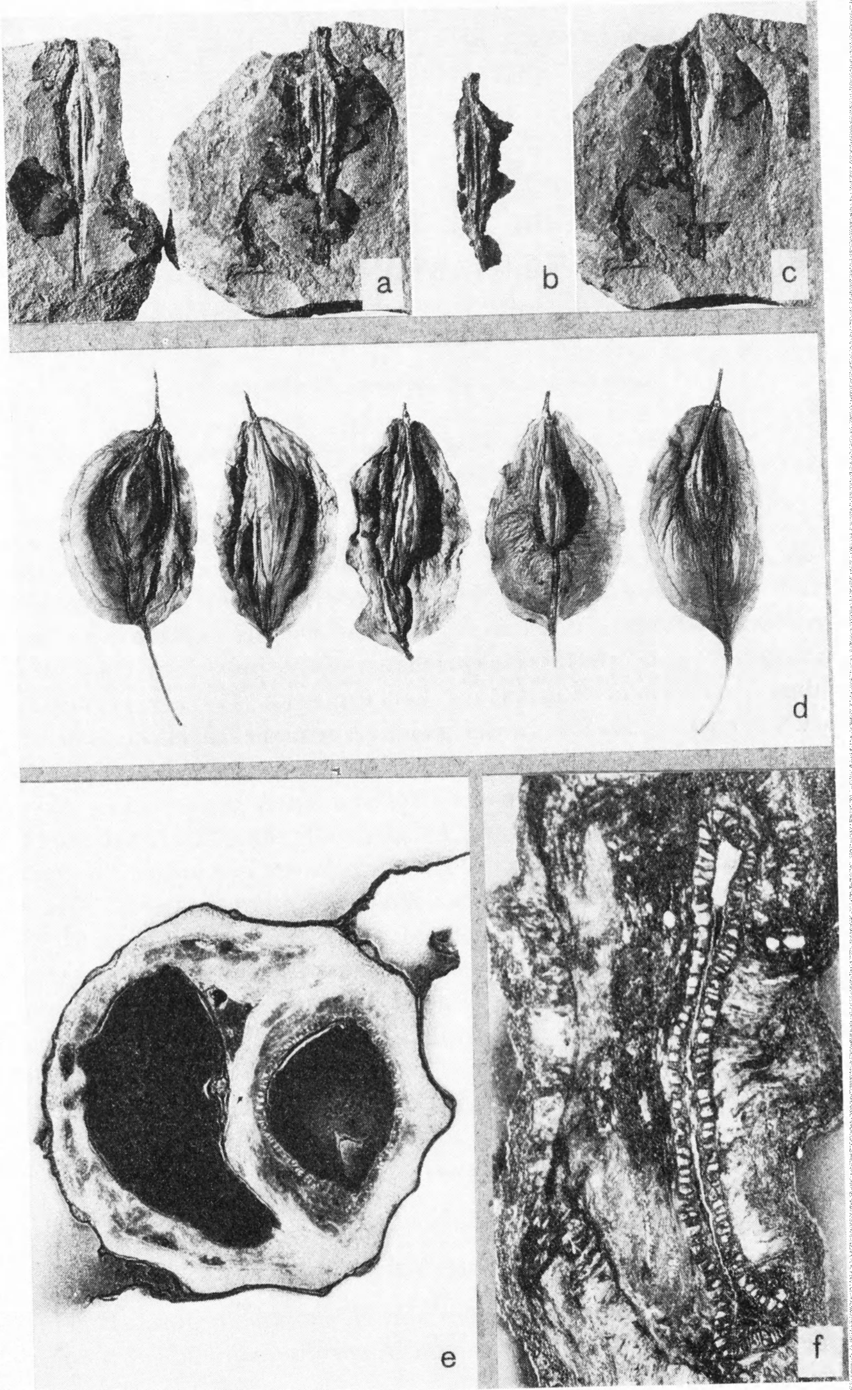
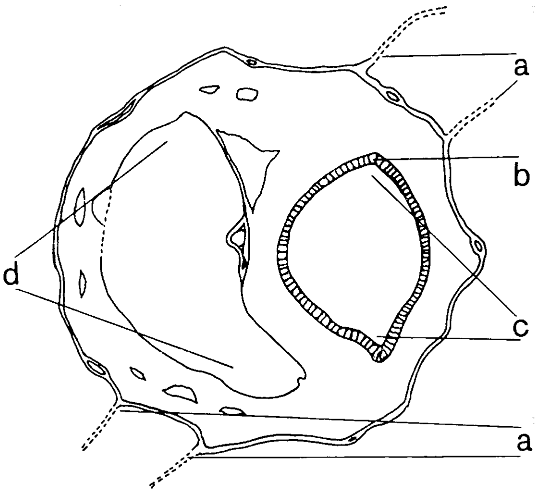


Fig. 1.



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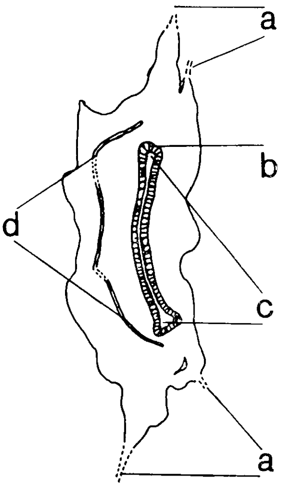

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Fig. 2. Querschnitt durch den rezenten Steinkern von *Halesia carolina*. a=Flügelansätze, b=Samenschale des fertilen Faches, c=fertiles Fach, d=steriles Fach. 10: 1.

Fig. 3. Querschnitt durch den fossilen Steinkern von *Halesia*. a=Flügelansätze, b=Samenschale des fertilen Faches, c=fertiles Fach, d=steriles Fach (oder Fächer). 10: 1.

und die von *H. monticola* im Durchschnitt 1 cm länger. Von *H. diptera* unterscheidet sich *H. carolina* durch vier Flügel (Fig. 1 e und 2 a). Ein deutlicher Nerv verläuft ± parallel den Flügelrand entlang. *H. diptera* hat hingegen nur zwei Flügel. Die Steinkerne von *H. carolina* sind 0,2 bis 0,5 cm breit und 1,0 bis 2,5 cm lang und haben an der Spitze verholzte Reste des Griffels. Die Steinkerne sind in der Regel in der oberen Hälfte der Flügelfrucht gelegen (Fig. 1 d). Die Frucht enthält meistens ein fertiles Fach und ein bis drei sterile Fächer. Bis zu vier fertile Fächer können vorkommen. Die sterilen Fächer enthalten

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Fig. 1. a: Abdruck der fossilen *Halesia*-Frucht mit dem Steinkern in der einen Hälfte (rechts). — b: isolierter Steinkern mit ausstehenden Exokarpresten. — c: Abdruck nach Entfernung des Steinkerns. 1: 1. — d: rezente Früchte von *Halesia carolina* L. (Riksmuseets bot. avd., Stockholm 50: A. Ruth No. 6812, Knoxville, Tennessee, U.S.A.). 1: 1. — e: Querschnitt durch den Steinkern einer rezenten *Halesia carolina* L. (von Fig. 1 d). 10: 1. — f: Querschnitt durch den fossilen Steinkern der *Halesia*. 30: 1.

Fig. 4. Die rezente Verbreitung von *Halesia carolina* L. (▨) und das pliozäne Vorkommen von *Halesia* cf. *carolina* (◓).

Reste abortierter Embryonen. Das fertile Fach (Fig. 1 e und Fig. 2 c) ist von einer Schicht breiter, fast viereckiger Zellen umgeben. Sie haben eine Höhe von 40—80 μ und eine Breite von 30—80 μ (Fig. 1 e und Fig. 2 b). Diese „Samenschicht" hat ihren Ursprung im Integument und ist daher als Samenschale zu betrachten.

Das fossile Vorkommen

Diagnose: Geflügelte Frucht. Ohne Stengel und den verholzten Griffel 3,1 cm lang und ± 2 cm breit. Der zentralplazierte, längliche Steinkern im oberen $^{2}/_{3}$ der umgebenden Flügel. Steinkern längsgefurcht, zusammengepresst auf ± 1,5 mm, enthält Fächer, von denen eines fertil und eines (zwei oder drei) steril ist.

Beschreibung: Die dünnen, verkohlten Flügel sind zum grossen Teil zerstört und Epidermis hat sich nicht preparieren lassen. Dagegen ist ein deutlich zum Flügelrand ± parallel verlaufender Nerv sowohl im inkohlten Material als auch im Abdruck des Tons zu sehen. Die verholzten Reste der Griffels sind nicht bewahrt. Der Steinkern hat zwischen 8 und 10 Längsrippen, die teilweise ganz von den apikalen zu den basalen Teilen des Steinkerns laufen. Im Querschnitt (Fig. 1 f und 2 b) zeigt der Steinkern deutlich die Samenschale des fertilen Faches. Die Zellen dieser Schicht zeigen die gleichen Grössenverhältnisse wie die der rezenten Exemplare. Die Höhe variiert zwischen 40 und 80 μ und die Breite zwischen 30 und 80 μ. Eine an diese Zellen sich nach aussen anschliessende Faserschicht (Fig. 1 f) lässt sich auf Grund der Fossilisation nur undeutlich erkennen. Die Anzahl der sterilen Fächer ist ungesichert. Eine deutliche Faltungsebene lässt sich erkennen (Fig. 1 f und Fig. 3 d). Ob diese Faltungsebene aber durchgehend ist und also ein steriles Fach repräsentiert oder unterbrochen ist und daher zwei oder drei sterile Fächer anzeigt, lässt sich wiederum auf Grund destruktiver Vorgänge bei der Einkohlung nicht nachweisen.

Die hier gezeigten morphologischen und anatomischen Merkmale des Fossils machen es wahrscheinlich, dass dieses mit der rezenten nordamerikanischen Art *H. carolina* identisch ist. Da aber die übrigen Merkmale der fossilen Population von Weilerswist, d.h. Blüten, Blätter u.s.w., unbekannt sind, soll das aktuelle Fossil nur als *Halesia* cf. *carolina* bezeichnet werden. Zur Frage der artlichen Zusammengehörigkeit dieses Fossils mit den anderen fossilen Vorkommen der Gattung kann nicht Stellung genommen werden, da bei diesen die Form und Anzahl der Flügel unbekannt sind. Bei den Vorkommen vom Pliozän von Swalmen ist sogar die Anatomie unbeschrieben.

Das hier publizierte Fossil wurde auf einer im Mai 1964 vorgenommenen Reise nach Weilerswist vom Verfasser gesammelt. Mittel für diese Reise wurden von dem Direktor der Paläobotanischen Abt., Naturhistorisches Reichsmuseum, Professor Olof H. Selling aus Fonden der Abteilung zur Verfügung gestellt, wofür ich an dieser Stelle meinen verbindlichen Dank sage.

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Pollen Morphological Studies in Indian Urticales

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Introduction

The plants contained in the order *Urticales* (ENGLER & PRANTL, cit. LAWRENCE 1958), are classified in three families, namely *Ulmaceae, Moraceae* and *Urticaceae.* However, BENTHAM & HOOKER (1880—1883) had recognized only one family, *Urticaceae,* comprising all the above mentioned taxa. HUTCHINSON (1926), and RENDLE (1952) separated the genus *Cannabis* into a separate family, *Cannabinaceae.*

Several investigators have studied the pollen grains of the families of *Urticales,* of whom may be mentioned, WODEHOUSE (1935), SELLING (1947), and ERDTMAN (1952). The present study covers 28 species of Indian members of the orders.

Material and Method

Polliniferous material has been procured from dry plant specimens deposited in the herbaria of the National Botanic Gardens, Lucknow, and the Botanical Survey of India, Poona. Pollen preparations have been made by the acetolysis method (ERDTMAN 1952). The relevant data and slides are deposited in the Palynology Laboratory of the National Botanic Gardens, Lucknow. However, a few sporomorphs are unacetolysed. Terminology used in pollen descriptions is in accordance with NAIR (1964, 1965).

Observations

Ulmaceae

Holoptelea Planch.

H. integrifolia Planch. (Sl. 3744;[1] Acetolysed). Fig. 1: Grains 4-zonoporate. Spheroidal, size 27 μ (range 26—31 μ). Pore tenuimarginate,

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[1] Slide number.

slightly wavy. Pore diameter 2.2 μ. Exine thickness 1.1 μ, being membraneous in some grains. Endine very thin. Ectine surface rugulate (Ulmoid, cf. ERDTMAN 1952).

Trema Lour.

T. orientalis Blume (Sl. 4197; Acetolysed). Fig. 2: Grains 2-porate, spheroidal, size 19.1 μ (range 18.88—21.2 μ). Pore annulate, diameter 1.5 μ. Exine thickness 1.1 μ. Endine very thin. Ectine surface faintly granulose.

Moraceae

Artocarpus Forst.

A. altilis (Parkinson) Fosberg (Presented by T. M. VARGHESE; Sl. 4594; Acetolysed). Fig. 3: Grains 2-porate. Longest axis 20.5 μ (range 18.88—23.6 μ). Pores operculate in some grains, diameter 2.2 μ. Exine thickness 1.5 μ, surface with a faint LO-pattern.

A. lakoocha Roxb. (Presented by T. M. VARGHESE; Sl. 4592; Acetolysed). Fig. 4: Grains (3—)4(—5)-zonoporate. A few abnormally parasyncolpate grains also occur. Pore diameter 1.1 μ. Exine thickness 2.2 μ, being thinner towards pore margins. Ectine thicker than endine, tegillate. Ectine surface granulose, granules being sparse.

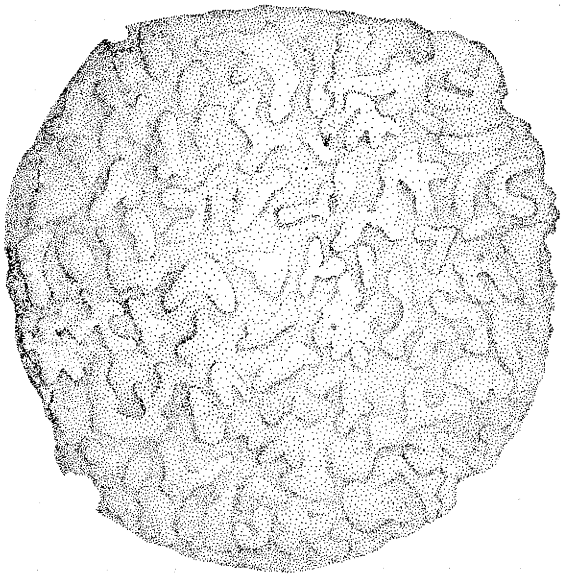
A. odoratissima Blanko (Presented by T. M. VARGHESE; Sl. 4593; Acetolysed). Fig. 5: Grains (2—)3(—4)-zonoporate. Few grains trichotomocolpate. Longest axis 17.4 μ (range 16.5—18.8 μ). Even after acetolysis, protoplasm is symmetrically contracted in each grain. Pore diameter 1.1 μ. Exine thickness 1.1 μ. Exine surface minutely spinulose, spinules almost reduced to granules.

Broussonetia L'Herit.

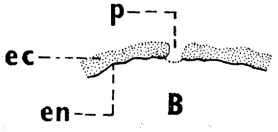
B. papyrifera Vent. (Fresh; Sl. 3652; Unacetolysed). Fig. 6: Grains 2-zonoporate (Pororate?). Longest axis 11.7 μ (range 9.9—13.2 μ). Pore diameter 2 μ. Exine very thin, surface pattern obscure (probably faintly granulose).

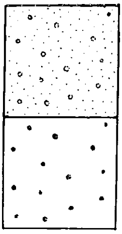
Cannabis (Tourn.) Linn.

C. sativa Linn. (Sl. 2023; Acetolysed). Fig. 7: Grains 3-zonoporate, spheroidal. Diameter 22.4 μ (range 21.2—23.6 μ). Pore annulate, diameter 2.2 μ. Exine very thin, membraneous. Exine surface faintly granulose.



1 A





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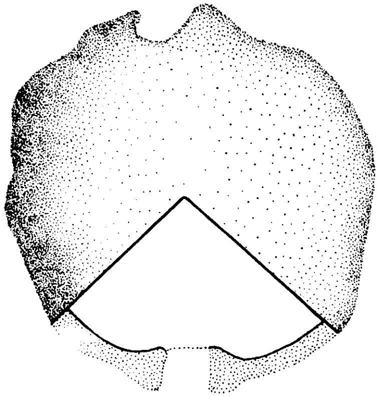

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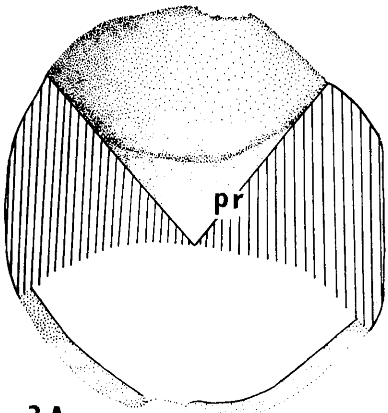


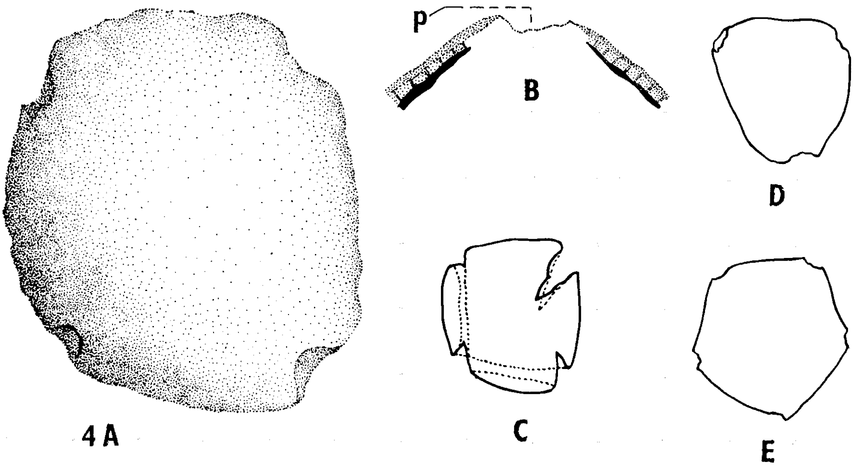
3 A

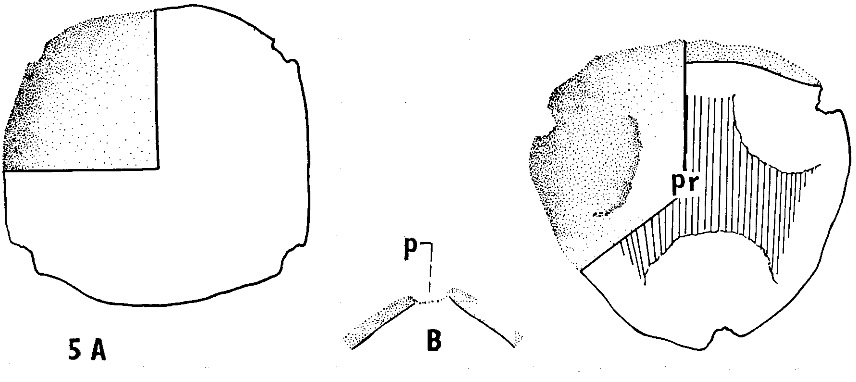
Figs. 1—10. Pollen grains of *Urticales.* — a. annulus, ec. ectine, en. endine, p. pore, pr. protoplasm, t. trichotomous aperture.

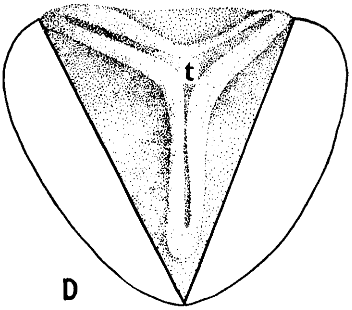
Fig. 1. *Holoptelea integrifolia:* A. Polar view (×2475); B. Exine strata with a pore (×2475).

Fig. 2. *Trema orientalis:* Grain showing surface and exine strata (×2475).

Fig. 3. *Artocarpus altilis:* A. Grain showing contracted protoplasm and exine strata (×2475); B. LO-pattern (×2475).







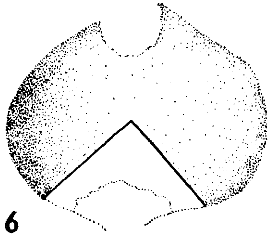
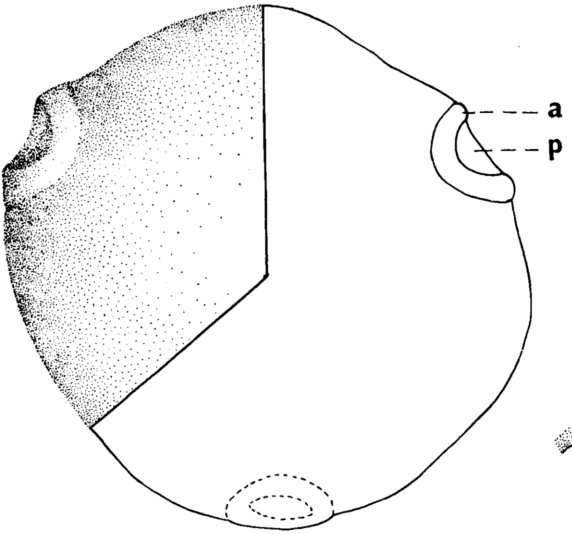


Fig. 4. *A. lakoocha:* A. Polar view (×2475); B. Exine strata with a pore (×2475); C. Abnormally 4-parasyncolpate grain (×1125); D. 3-porate grain (×1125); E. 5-porate grain (×1125).

Fig. 5. *A. odoratissima:* A. 4-porate grain (×2475); B. Exine strata (×2475); C. 3-porate grain (×2475); D. Trichotomocolpate grain (×2475).

Fig. 6. *Broussonetia papyrifera:* Grain showing surface and the thin exine (×2475).



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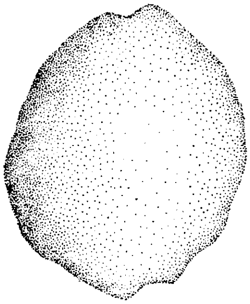

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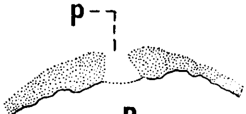

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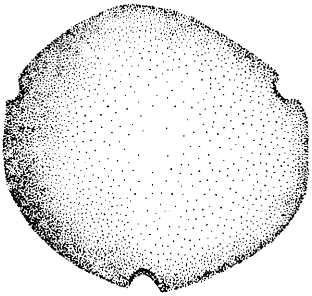

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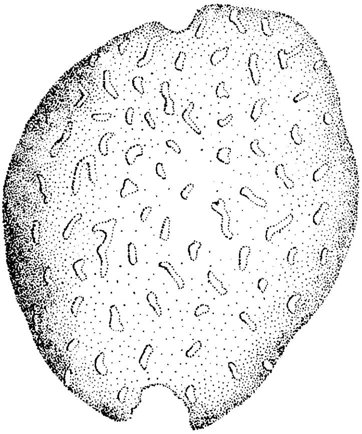

10 A

Fig. 7. *Cannabis sativa:* Polar view (×2475).
Fig. 8. *Ficus tomentosa:* Surface view (×2475).
Fig. 9. *Boehmeria nivea:* Polar view (×2475).
Fig. 10. *Pilea umbrosa:* A. Surface view (×2475); B. Exine strata (×2475).

Chamabainia Wight

C. cuspidata Wight (Sl. 3634; Acetolysed): Grains shrunken, aperture indiscernible, longest axis 10.7 μ (range 9.9—12.1 μ). Exine very thin. Exine surface pattern obscure.

Elatostema Forst.

E. surculosum Wight (Sl. 3637; Acetolysed): Grains 3-zonoporate.

Longest axis 9 μ (range 7.7—9.9 μ). Pore diameter 1.1 μ. Exine very thin, membraneous. Exine surface with a faint LO-pattern.

Ficus Tourn. ex Linn.

F. hispida Linn. (Sl. 3647; Acetolysed): Grains 2-porate. Longest axis 15.7 μ (range 14.3—17.6 μ). Pore diameter 2.2 μ. Exine very thin, membraneous. Exine surface psilate.

F. tomentosa Roxb. ex Willd. (Sl. 3640; Acetolysed). Fig. 8: Grains 2(—3)-porate. Longest axis 15.7 μ (range 13.2—19.8 μ). Pore diameter 2.2 μ. Exine very thin. Exine surface with a faint LO-pattern.

Laportea Gaudich.

L. crenulata Gaudich. (Sl. 4583; Acetolysed): Grains 3-zonoporate. Longest axis 17 μ (range 15.4—18.7 μ). Pores faint. Exine very thin, surface pattern obscure.

Maoutia Wedd.

M. puya Wedd. (Sl. 2025; Acetolysed): Grains 2-porate. Longest axis 16.5 μ (range 14.3—18.7 μ). Pores slightly annulate, diameter 1.1 μ. Exine very thin, surface faintly granulose.

Morus (Tourn.) Linn.

M. alba Linn. (Sl. 243; Acetolysed): Grains 2(—3)-porate. Longest × shortest axes 18.26×15.4 μ (range 16.5—20.9×15.4 μ). Pore diameter 2.2 μ. Exine very thin, surface with a faint LO-pattern.

M. laevigata Wall. (Sl. 4657; Acetolysed): Grains 2-porate. Longest axis 15.29 μ (range 13.2—17.6 μ). Pore diameter 1.5 μ. Exine very thin, surface with a faint LO-pattern.

M. nigra Linn. (Sl. 4657; Acetolysed): Grains 4-zonoporate. Longest axis 31.4 μ (range 28—33 μ). Pore diameter 5.5 μ. Exine very thin, surface with a faint LO-pattern.

Streblus Lour.

S. asper Lour. (Sl. 4196; Acetolysed): Grains 3-zonoporate. Most of the grains are shrunken. Longest axis 17 μ (range 14.2—18.8 μ). Pore diameter 2.2 μ. Exine very thin, surface faintly granulose.

Urticaceae

Boehmeria Jacq.

B. malabarica Wedd. (Sl. 4588; Acetolysed): Grains 3-zonoporate, pro-

late. Size 16.8×12.4 μ (range 15.4—19.8×11—14.3 μ). Pore diameter 2.2 μ. Exine very thin, surface psilate (faint LO).
B. platyphylla D. Don (Sl. 4577; Acetolysed): Grains 3-zonoporate, spheroidal, size 15.3 μ (range 11—18.7 μ). Pores very faintly marked. Exine very thin, membraneous. Exine surface with a faint LO-pattern.
B. nivea Gaudich. (Sl. 2019; Acetolysed). Fig. 9: Grains 3-zonoporate. Longest × shortest axes 17×11.1 μ (range 14.3—20.9×8.8—13.2 μ). Pores faintly marked. Exine very thin, surface faintly granulose.

Debregeasia Gaudich.

D. hypoleuca Wedd. (Sl. 3635; Acetolysed): Grains (2—)3-zonoporate. Most grains are shrunken. Longest axis 19.3 μ (range 16.5—21.2 μ). Pore diameter 2.2—3.3 μ; being apparently operculate in some grains. Exine very thin, surface with a faint LO-pattern.
D. velutina Gaudich. (Sl. 2024; Acetolysed): Grains 3-zonoporate. Longest axis 17.7 μ (range 16.5—19.8 μ). Pores ill defined, diameter about 2 μ. Exine very thin, surface with a faint LO-pattern.

Pilea Lindl.

P. scripta Wedd. (Sl. 3737; Acetolysed): Grains 3-zonoporate. Longest axis 16.5 μ (range 14.3—18.7 μ). Pore diameter 2.2 μ. Exine very thin, surface with a faint LO-pattern.
P. umbrosa Wedd. (Sl. 3738; Acetolysed): Fig. 10: Grains 2-porate, longest axis 20 μ (range 18.88—23.6 μ). Pores ill defined. Exine thickness 1.65 μ, being thinner in some crumpled grains. Ectine thicker than endine, surface granulose-rugulate.

Pouzolzia Gaudich.

P. hirta Hassk. (Sl. 3735; Acetolysed): Grains 3-zonoporate. Longest axis 13.5 μ (range 12.1—15.4 μ). Pores faintly demarcated, diameter 2 μ. Exine very thin, surface with a faint LO-pattern.
P. indica Gaudich. (Sl. 4587; Acetolysed): Grains 3-zonoporate. Longest axis 13 μ (range 11—15.4 μ). Pore diameter 1 μ. Exine very thin, surface with an obscure pattern.
P. pentandra Benn. (Sl. 3733; Acetolysed): Grains 3-zonoporate. Longest axis 15.8 μ (range 14.3—17.6 μ). Pore diameter 2 μ. Exine very thin, surface with a faint LO-pattern.

Urtica (Tourn.) Linn.

U. parviflora Roxb. (Sl. 3726; Acetolysed): Grains 3-zonoporate. Longest axis 17.1 μ (range 15.4—20.9 μ). Pores ill marked, diameter 1.5 μ. Exine very thin, surface pattern obscure.

Discussion

Pollen grains are 2-porate (pores feebly annulate) or 4-zonoporate in *Ulmaceae;* usually 2—3—4-zonoporate, rarely 5-zonoporate, trichotomocolpate, and abnormally parasyncolpate in *Moraceae,* and 2—3-porate in *Urticaceae*. Pores are sometimes annulate or operculate. Exine is thick, i.e., "resistant" to acetolysis, or thin and membraneous, i.e., "nonresistant" to acetolysis. In resistant exine, columella is hardly noticeable (probably fused, becoming homogeneous), except in a few species.

Variations in the apertures are common in several species of *Moraceae,* grains being 2—3—4-zonoporate in the same species, and most pronounced in *Artocarpus* spp. In *A. lakoocha,* 3—5-zonoporate grains occur along with the normal 4-zonoporate ones, apart from a few abnormally parasyncolpate grains. Similarly, in *A. odoratissima,* 2—4-zonoporate and rarely trichotomocolpate pollen grains occur along with the common 3-zonoporate pollen types. It is interesting to note, that among the *Moraceae,* all the three species of *Artocarpus,* studied here, possess "resistant" exine. The endine is thin in *A. altilis* and *A. odoratissima,* and thick in *A. lakoocha.* Variations in apertural types are also observed in *Morus alba* and *Ficus tomentosa.* It may be noted that all plants having the apertural variations in their pollen, are cultivated (except *Ficus tomentosa*).

Among the members of *Moraceae, Cannabis sativa* appears to be palynologically different from other species, by the presence of prominently annulate pores, which might provide an additional support to separate the genus into a family *Cannabinaceae,* as done by RENDLE (1952), and HUTCHINSON (1926). Similarly, members of *Ulmaceae* are characterized by the "Ulmoid" (ruguloid) exine pattern (ERDTMAN 1952). Within the family, grains are 2-porate and faintly granulose in *Trema orientalis,* and 4-zonoporate with a ruguloid pattern in *Holoptelea integrifolia.* Exine is "resistant" in both species. Within the *Urticaceae,* grains are either 2-porate (e.g., *Broussonetia papyrifera, Maoutia puya,* and *Pilea umbrosa*), or 3-zonoporate (e.g., *Boehmeria, Debregeasia*). In *Chamabainia cuspidata,* apertures are not discernible as all the grains are shrunken.

The porate condition in pollen is considered to be an advanced character (WODEHOUSE 1936) over the colpate type. *Urticaceae* is composed of plants with porate pollen (pores 2—5 in number). According to HUTCHINSON (1926), the *Urticales* are phylogenetically related to *Fagales* which is composed of the taxa possessing both 3-porate (e.g., *Betulaceae*), and 3-colpate (e.g., *Fagaceae*) pollen grains. ERDTMAN (1952) noted palynological similarities between the *Ulmaceae* and the *Betulaceae.* Pollen grains do not offer any evidence to support the view, based on vascular supply to the ovule, that the *Urticales* are not a natural order (BECHTEL 1921). If it is considered that the 3-colpate types are primitive, the evolution of the *Urticales* may be traced from the *Ranales* (3-colpate) through the *Fagaceae.* The alliance of the families of *Urticales* with *Malvales* (BESSEY 1915), or their inclusion in the *Terebinthales* (HALLIER 1912) does not find support from pollen morphology.

The "resistant" exine is prevalent in the *Ulmaceae.* In the *Moraceae,* most species have "non-resistant" exine. However, the exine is thick in species of *Artocarpus* (*Moraceae*) of which, one shows clearly marked columellae. The "resistant" exine should be considered a primitive character, as this exine character tends to give more protection to the germ plasm. In such an event, *Ulmaceae* appear to be primitive, and the *Moraceae* and *Urticaceae* are advanced within the *Urticales.* BECHTEL (1921) noted that the *Urticaceae* are higher than the *Moraceae,* which in turn are more advanced than the *Ulmaceae.*

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Nye bidrag til Bornholms flora

Af ALFRED HANSEN, ARNE LARSEN og ANFRED PEDERSEN

Bornholm har forståeligt nok altid haft en særlig tiltrækning for florister og botanisk interesserede, der to gange har oplevet at se artsfortegnelser for øen publiceret, nemlig N. H. BERGSTEDT's flora fra 1883 (Bot. Tids. 13) og ARNE LARSEN's flora fra 1956 (Bot. Tids. 52).

Siden 1956 er der gjort en hel del nye og interessante fund, dels af arter, der er nye for Bornholm og Erteholmene, dels af arter, der kun kendes fra få fund. Hertil kommer, at Bot. Museum i 1963 fra Herlufsholm Kostskole modtog et omfattende herbarium, samlet af apoteker J. BAAGØE (1838—1905), der inden sin død skænkede det til Herlufsholm. BAAGØE opholdt sig på Bornholm i årene 1859—1865, og en meget stor del af hans herbarium består af indsamlinger fra disse år. Selv om alle hans fund angives at have været stillet til rådighed for BERGSTEDT, da denne i sin tid udarbejdede sin flora, indeholder herbariet — ud over hidtil ukendte fund — en del beviseksemplarer for ældre angivelser af bornholmske plantefund, om hvis pålidelighed der hidtil har hersket tvivl. Endvidere er der i 1964 tilgået museet en samling planter, samlet af afdøde lektor, dr. phil. P. GELTING, mest fra Erteholmene og med adskillige for disse øer nye arter. Endelig bringes en del fund gjort af afdøde SV. ANDERSEN og hentet dels fra et utrykt manuskript »Et tillæg til Bornholms karplanteflora» (1950) og dels fra hans samling af notater (samlet og renskrevet af fhv. lærer S. M. RASMUSSEN, opbevares ligesom manuskriptet på Bot. Museum). SV. ANDERSEN's fund stammer fra årene 1928—1948.

Floraen på den 12 ha store ø Græsholm har særlig interesse, fordi øen er videnskabeligt fuglereservat (siden 1935, fredet i 1926). Den første floraliste stammer fra skoledirektør SOFUS FRANCK, der i 1902 og 1903 besøgte øen. I P. GELTING's herbarium fra 1937 repræsenteres øens flora af 35 arter, medens vores floraliste stammer fra et besøg

15/8 1964. De to floralister fra 1902—03 og 1964 er meget forskellige; til brug for sammenligning bringes oversigten over øens flora for sig.

Efterfølgende liste fremtræder som et supplement til Arne Larsen: Bornholms flora (1956), hvorfor artsangivelserne er placeret i samme familierækkefølge som i denne. For flere arter og slægter bringes der en ny taxonomi. De nye fund, der omtales i en ekskursionsberetning i Bot. Tids. *54*: 80 ff., 1958, er medtaget her. En tak skal bringes til prof. Vald. M. Mikkelsen for oplysninger om plantefund og til prof. R. Spärck for velvillig tilladelse til besøg på Græsholmen.

Følgende forkortelser er anvendt:

SA. = Sv. Andersen
JB. = J. Baagøe
NB. = N. B. Bergstedt
G. = P. Gelting
H. = Alfred Hansen
J. = Th. Jensen
L. = Arne Larsen
M. = Vald. M. Mikkelsen
P. = Anfred Pedersen
W. = K. Wiinstedt
Ø. = Hans Øllgaard

En * foran et artsnavn eller lavere enhed betyder, at nævnte plante er ny for Bornholm (distr. 47) og ikke medtaget hos Arne Larsen 1956.

Pteridophyta

Lycopodiaceae:

Lycopodium clavatum, Strandmarken v. Dueodde 1963 (K. Lind).

Ophioglossaceae:

Botrychium lunaria, Storefos i Rø (Bot. For. eksk. 1957), Christiansø: Mange ekspl. på en lille plet mell. klipperne udan f. muren v. Næsset (L.).

Polypodiaceae:

Asplenium septentrionale, Hammerens Stenbrud 1962 (Ø.).
— *trichomanes,* v. stien s. f. Vang 1960 (P.).
**Athyrium filix-femina* var. *imbricata* Lange (= var. *bornholmiensis* A. Lange), Kleven på vejen mell. Rønne og Allinge v. Spellingemosen (under Splitgårds jorder) i begyndelsen af 1880'erne, Erichsen leg. (Senere indplantet i Bot. Have). Også samlet 1890 af K. Jespersen.
Dryopteris thelypteris, Bastemose 1962 (Ø.).
Polystichum lobatum, Christiansø 1893 (H. Eilstrup, sml. C. Christensen, Bot. Tids. *24,* 372, 1902).

Equisetaceae:

Equisetum arvense, Christiansø 1937 (G.).
— *hiemale,* Mølledalen v. Hammershus 1958, Rutsker Højlyng (begge L.).
— *pratense,* Torpe Bakker ø. f. Hasle (M.), Christiansø 1960 (P.).

Gymnospermae

**Taxus baccata,* selvsået v. Hammershus (M.).

Monocotyledones

Gramineae:

**Agrostis canina* ssp. *montana* (*A. canina* var. *arida*), Christiansø 1964 (H. & P.).

Alopecurus myosuroides, Rønne Havn 1962 (Ø.) og 1964 (H.).

Arrhenatherum pratense (*Avena p.*), Christiansø 1961 (P.).

**Bromus inermis,* ruderat v. Rønne Sydhavn 1964 (H.).

*— *mollis* var. *leiostachys,* Christiansø 1961, Boderne 1963 (begge P.). Næppe sj., jvf. W., Bot. Tids. *55:* 45, 1959.

— *ramosus,* Dronteskov i Vestermarie, Randkleve (SA.).

Dactylis aschersoniana, Dronteskov i Vestermarie, skov. Olskirke, Storedal v. Sandkås, Jomfrubjerget, Christianshøj, v. f. Åremyre (alle SA.), Kobbeå og Sandflugtsskoven v. Villa Nova (Bot. For. eksk. 1957), Louisenlund 1958 (P.).

Festuca polesica, spredt i klitterne fra ca. 2 km n. f. Dueodde til ca. 5 km v. f. Dueodde (SA.).

— *trachyphylla,* Galløkken, Hammeren, langs banen v. Balka (SA.).

Hordelymus europaeus (*Hordeum e.*), Kobbeå n. f. Stavehøl (M.) skov v. parkeringspladsen i Stavehøl i Østerlars 1958 (L.).

**Hordeum jubatum,* ruderat v. Rønne Havn 1960 (L.).

*— *secalinum* (*H. pratense*), NB. anfører: »Skibsbroen v. Rønne (J.). Denne angivelse beror på en forveksling m. følgende, d.v.s. *H. murinum* (H. HJORTH).» — I BAAGØE's herb. ligger et ekspl. af *H. secalinum* m. påskriften: »Langs strandkysten i nærheden af Rønne Havn mell. *H. murinum* (J.) leg. 1856.» Planten har muligvis været indslæbt og er ikke siden genfundet.

Lolium strictum, som hos L. er angivet af H. DAHL fra Grisby, må formentlig udgå, da den formentlig er identisk m. *L. multiflorum* ssp. *gaudinii.*

Melica uniflora, Christiansø 1961 (P.).

Panicum miliaceum, optrådte i have i Rønne allerede i 1860, ifølge BAAGØE's herb., Melsted og sø. f. Kobbeå's udløb v. et hønseri (SA.), Hasle 1964 (H. & P.).

Phalaris canariensis, Svaneke (SA.), gammelt sandstensbrud i Snogebæk 1958 (B.).

Phleum arenarium, ø. f. Boderne (SA.).

— *phleoides,* skrænt s. f. Blanch's Hotel (SA.).

Poa bulbosa, Frederiksø 1960 (P.), første fund fra Erteholmene; på klipper og langs stier s. f. Svaneke 1958 (L.), i mængde på strandklint v. Boderne 1962 (L.), første fund uden for granitområdet.

— *chaixii,* Fuglesangsrenden (SA.).

— *pratensis* ssp. *angustifolia,* Almindingen, Lilleborg, Bølshavn, Christiansø (P.), sandsynligvis t. alm. på Bornholm.

*— — ssp. *irrigata,* Rantzau's Bastion på Christiansø 1937 (G.), i 1964 bemærket adskillige steder på Bornholm og næppe sj. på øen.

Puccinellia maritima, et fund fra Røsted v. f. Gudhjem samlet af H. i 1958 (oprindelig henført til *P. distans*) blev publiceret i Fl. og Fauna 65: 93, 1959 som *P. maritima.* En fornyet undersøgelse af materialet bekræfter dog den oprindelige bestemmelse til *P. distans.* Udover en angivelse af WARMING i »Strandvegetationen» (p. 15, 1906) fra Malkværn n. f. Neksø (uden bevismateriale) samt en angivelse af NEUMAN, Bot. Notiser 1896, p. 92 af et fund (1 ekspl.) fra stranden ikke langt fra Neksø (=Malkværn?) kendes således indtil videre ingen sikre fund af denne art på Bornholm. Ved besøg ved Malkværn i juni og aug. 1964 blev kun fundet *P. retroflexa* (sparsom).

— *retroflexa,* stranden v. Melsted 1964 (H. & P.), Listed Havn 1962 (P.).
Setaria glauca, ruderat v. Rønne Sydhavn 1964 (H.).
*— *italica,* roemark ø. f. Robbedale (SA.).
*— *viridis* var. *major,* Rønne Havn, Neksø (SA.).
Vulpia myurus, ruderat v. Svaneke Havn 1964 (P.).

Cyperaceae:

Carex appropinquata, Gammelmose og Duedalsvandet i Almindingen (SA.).
— *contigua,* Christiansø 1964 (H. & P.).
— *elongata,* Gamleborg, Kohullet, Langemose, Pykkekullekær og Duedalsvandet i Almindingen (SA.).
— *hirta,* Christiansø 1937 (G.).
Carex hostiana, Bøgebjerg i Østerlars 1961 (L.).
— *nigra* var. *recta* (*C. caespitosa*), Ølene 1964 (H.).
— *otrubae,* Præstedammen på Christiansø 1937 (G.).
— *vulpina,* Sdr. Muregaard ø. f. Rutsker 1962 (M.), på Sydbornholm v. Risebæks udløb (Bot. For. eksk. 1957).
Eriophorum latifolium, i Bodilsker, Ølene (SA.).
Scirpus fluitans, Ølene i nord og Pykkekullekær (SA.), Ellesmyr i Paradisbakkerne 1960 (L.).

Typhaceae:

Sparganium minimum, rockpool v. Bølshavn 1961 (L.).
Typha angustifolia, Torneværket i Knudsker 1958 (L.).

Lemnaceae:

Lemna gibba, Skovgårdsløkken i Knudsker (Bot. For. eksk. 1957).

Araceae:

Arum maculatum ssp. *danicum,* Christiansø (P.), sandsynligvis indplantet,

Potamogetonaceae:

Groenlandia densa (*Potamogeton d.*), en angivelse af denne art fra Hammersøen hos J. LANGE 1888 (meddelt af V. HENNINGSEN) og gengivet hos HYLANDER 1953 betvivles meget stærkt. Intet herbarieekspl. foreligger, og Bornholm ligger ikke inden for artens naturlige udbredelseområde.
Potamogeton panormitanus, St. Myregaard i Knudsker 1958 (L.) og 1962 (Ø.).
— *pectinatus,* Graamyr v. Gudhjem 1964 (J. PEDERSEN).
— *pusillus,* vandhul i randen af plantage nø. f. Boderne 1957 (TH. SØRENSEN), publiceret af W. som *P. friesii* i Bot. Tids. *54*: 178, 1958; endv. Øleaa v. Slusegaard 1964 (H. & P.).
Zannichellia palustris var. *major,* rockpool v. Listed 1962 (P.).

Zostera. Slægten er ved Bornholms kyster formentlig kun repræsenteret ved *Z. marina.* Et ekspl. i BAAGØE's herb. samlet af J. 1856 v. Gudhjem og benævnt *Z. minor* virker ikke overbevisende, og ekspl. af såkaldt *Z. hornemanniana* fra Øleaa 1901 og Rønne 1901, begge samlet af L. KOLD. ROSENVINGE, er formentlig identiske med *Z. marina,* som specielt i Østersøen optræder i meget smalbladede former, som ikke tillægges nogen systematisk værdi. Nævnte herbarieekspl. er uden frugter, som er de eneste sikre kendetegn til adskillelse af *Zostera*-arterne, jvf. HYLANDER 1953.

Juncaceae:

Juncus conglomeratus×*inflexus,* Risebæk 1957 (L. INGERSLEV, 1958).
— *effusus*×*inflexus,* Ginesminde 1957 (L. INGERSLEV, 1958).

Liliaceae:

Allium carinatum, 2 ekspl. i BAAGØE's herb.: Rabækkegård v. Rønne 1858 (HAMANN) og Rønne 1860.
— *schoenoprasum.* Det første Bornholmsfund menes sædvanligvis at stamme fra 1937: Kystklipper s. f. Svaneke Fyr (M. SKYTTE CHRISTIANSEN). BAAGØE's herb. rummer imidlertid et ekspl. fra Bornholm fra 1859, dog uden nærmere findestedsangivelse. Ekspl. tilhører utvivlsomt »den baltiske kysttype».
Lilium martagon, naturaliseret i Svaneke Sydskov v. Hullehavn 1963 (P.).
Ornithogalum nutans, Melsted (SA.).

Convallariaceae:

Asparagus officinalis, Madsegrav v. Arnager 1962 (Ø.), mon spontan?
Polygonatum odoratum, gravhøj v. St. Bakkegaard i Aaker, Ekkodalen (SA.).

Orchidaceae:

**Dactylorchis incarnata* var. *subextensa* Hartm., Læså 1924 (M. P. CHRISTIANSEN), Ølene 1937 (W.) og 1964 (H.), Svaneke 1964 (H.).
— *maculata* angives hos L. 1956 coll. alm. på Bornholm. Den omfatter på øen formentlig følgende taxonomiske enheder:
D. maculata ssp. *maculata* (engformen), 2 fund i herb.
D. fuchsii, næppe sj., 8 fund i herb.
(*D. maculata* ssp. *ericetorum,* surbundsformen, er ikke med noget herbariebevis kendt fra øen).
*— *majalis* var. *pinguis,* Saltuna Strand, v. Sdr. Aasedam og eng v. Aaremyr (SA.).
— *sambucina,* talrig i både rød- og gulblomstrede ekspl. v. Lillegaard i Bodilsker 1962, 1964 (J. HØRBERG).
— *traunsteineri,* opretholdelsen af denne art for Bornholms vedkommende er næppe holdbar. Den svenske botaniker N. HYLANDER vil henføre de bornholmske ekspl. til ovenstående *D. incarnata* var. *subextensa.*
Goodyera repens, arten er på Bornholm ud over Sandflugtsskoven v. Rønne og Loftgårdsskoven v. Boderne kendt fra Dueodde, første fund 1933, nu ret hyppig her.

Dicotyledones

Salicaceae:

Populus nigra var. *italica,* v. Præstedammen på Christiansø cult. 1937 (G.).
Salix pentandra, Ølene 1960 (L.).

Cannabaceae:

Humulus lupulus, Ypnasted 1959 (L.).

Polygonaceae:

**Polygonum bistorta,* naturaliseret i Robbedale-Skoven v. Rønne 1963 (J. CHR. NIELSEN).
— *convolvulus,* Christiansø 1937 (G.).
— *cuspidatum,* forv. v. Onsbæk, Hammersholm og Rømersdal (SA.), v. kysten nær Svaneke 1962 (P.), v. Neksø og Snogebæk 1964 (H.) og vejkanter v. Robbedale, Hasle, i Pedersker og i Østermarie 1964 (H. & P.).
— *dumetorum,* Ekkodalen (SA.).
— *lapathifolium,* i kartoffelhaver på Christiansø 1937 (G.).
— *minus,* Kroggårdsløkken i Knudsker (Bot. For. eksk. 1957).
*— *persicaria* var. *incanum,* Dueodde 1962 (P.), bækudløb v. Balka Strand 1964 (H. & P.).
*— *sachalinense,* forv. i stor mængde v. vejkant s. f. Hammersøen nær Hammersholm 1964 og v. vejkant v. f. Sandvig 1964 (H. & P.).
Rumex domesticus, Ormebækkens udløb (SA.).
— *hydrolapathum,* stranden v. Tyrevig på Christiansø 1937 (G.) og Christiansø 1963 (P.).
— *thyrsiflorus,* Christiansø 1964 (P.).

Caryophyllaceae:

Cerastium glutinosum, n. f. Svaneke 1961 (P.), Christiansø 1961 (P.).
Honkenya peploides, Christiansø 1961 (P.).
Lychnis flos-cuculi, Tyrevig på Christiansø 1937 (G.).
Melandrium album, Frederiksø 1937 (G.).
— *noctiflorum* (*Silene n.*), Møllegaard i Klemensker 1959, Randkleve i mængde 1960, Allinge i mængde 1963 (L.), grusgrav v. Østervang, Allinge 1962 (M.), ruderat v. Rønne Sydhavn (H.) og have i Svaneke 1964 (H. & P.).
*— *rubrum* var. *crassifolium,* her i landet kun kendt fra Nordbornholms klippekyst fra Jons Kapel over Hammeren til Helligdomsklipperne ved Rø.
— *album*×*rubrum,* mark i Ibsker 1962 (Ø.).
Sagina ciliata, v. fyret på Christiansø 1937 (G.).
Scleranthus polycarpos, Christiansø 1958 (P.).
Silene armeria, BAAGØE's herb.: Seiersgaard i Knutsker 1859, dyrket?
Spergula vernalis, nye fund på Nordbornholm: Lyngbakker v. Grønnedal mell. Allinge og Sandkås 1958, Borrelyng v. Vang og Smedens Lyng (M.), i mængde på klippeknude v. Blaaholtsgaard i Olsker 1960 (L.).
Stellaria alsine, Paradisbakkerne 1960 (L.).
— *pallida,* Christiansø 1937 (G.) og 1961 (P.).

Portulacaceae:

**Claytonia perfoliata,* ukrudt på Rønne Kirkegård 1964 (L.). Planten spredes her i landet utvivlsomt med stauder og buske fra planteskoler.

Montia fontana (*M. lamprosperma*), næppe særlig sj., Bot. Museum har 11 fund.

**Portulaca oleracea,* v. havnen og i haver i Gudhjem 1933, i haver i Melsted, i haver i Boderne 1948 (SA.), Rønne Kirkegård 1959 (L.).

Amaranthaceae:

Amaranthus albus, hønseri i Østerlars (SA.).

— *retroflexus,* grusgrav s. f. Svaneke 1964 (H. & P.).

Chenopodiaceae:

Atriplex calotheca, er ikke med herbariebevis fundet på Bornholm, angivelserne må bero på fejlbestemmelser af *A. deltoidea*-former.

— *deltoidea* (*A. hastata* hos L. 1956), alm. v. kysterne, kaolinbruddet v. Rabekkeværket 1964 (P.). Andre arter hørende til *A. hastata*-gruppen er ikke kendt fra Bornholm.

— *glabriuscula,* ud over de hos L. 1956 angivne fund desuden kendt fra Bæle, Helligpeder, Ginesminde, Vang, Hammeren, Salene Bugt, Svaneke, Neksø og Christiansø, alle 1964 (H. & P.). På flere af de angivne steder er den en hyppig plante.

— *hortensis,* ruderat i Allinge Havn 1964 (H. & P.).

**Chenopodium album* ssp. *virgatum,* Rønne 1957 (L. INGERSLEV).

— *hybridum,* i blomsterbed foran toldbygningen i Rønne Havn 1964 (H.).

*— *schraderianum* (*Ch. foetidum*), BAAGØE's herb.: Smedehaven i Bodilsker, u. årst. (NB.).

**Salsola kali* var. *polysarca* (den glatte var.), stranden v. Arnager 1959 (K. DAMSHOLT), Balka Strand og Dueodde 1964 (H. & P.).

Ranunculaceae:

**Anemone hepatica* f. *rosea* Neum., Tornegaards Skov v. Salene 1964 (G. FUNCH ANDERSEN).

— *nemorosa,* Christiansø 1961 (P.), sandsynligvis udplantet.

— *ranunculoides,* Christiansø 1963 (P.), sandsynligvis udplantet.

Aquilegia vulgaris, forv. i ret stor mængde i Dynddal og Paradisbakkerne 1960 (L.), tilsyneladende spontan mell. strandklipperne s. f. Svaneke 1964 (P.).

**Caltha palustris* var. *radicans,* bækkløft v. Jons Kapel, mell. hotellet og stranden, ret fåtallig på kilderig bund sammen med hovedarten 1948 (SA.).

Clematis vitalba, forv. i stor mængde på strandklipper v. Svaneke Nordhavn 1964 (H. & P.) og Neksø havneplads 1964 (L.).

Myosurus minimus, v. fyret på Christiansø 1937 (G.).

Ranunculus sardous, Neksø Havn, Hundsemyre, Lisegaard i Paradisbakkerne og grusgrav s. f. Svaneke 1964 (H.).

**Thalictrum aquilegiifolium,* forv. på stranden n. f. Gudhjem 1961 (O. EGEDE JENSEN).

Ceratophyllaceae:

Ceratophyllum demersum, Rønne 1859 (JB.).

Papaveraceae:

**Meconopsis cambrica,* forv. v. Svaneke 1961 (O. EGEDE JENSEN).
Papaver somniferum, forv. på Frederiksø 1937 (G.).

Fumariaceae:

**Corydalis pumila* var. *latiloba,* strandkrat n. f. Randkleve 1938 og stengærder v. Vang 1948 (SA.). NB. 1883 nævner fl. fund og tilføjer: Ikke sj.
**Fumaria capreolata,* ukrudt i stenhøj v. hotel Halleklippen, Neksø 1956 (L.).
*— *muralis,* haveukrudt i Svaneke 1954 (L. INGERSLEV).

Cruciferae:

**Arabis alpina,* forv. på Christiansø 1963 (K. FREDERIKSEN).
Barbarea intermedia, Kalbygaard 1957 (P.), Frederiks Stenbrud v. Neksø 1957 (P.), Sømarken, Sandvig 1948 og Frennegaards Strand 1943 (SA.).
— *stricta,* s.f. Svaneke Fyr 1964 (H.).
Brassica juncea, Svaneke (SA.).
Camelina (revideret).
Med herbariebeviser er følgende arter kendt fra Bornholm:
C. alyssum, 7 fund i herb. fra årene 1847—1890.
— *macrocarpa* (*C. alyssum* ssp. *macrocarpa*), 3 fund i herb. fra årene 1848—69.
— *microcarpa,* mark v. Sose Odde 1955, v. Almindingen St. 1955 og 4 km nv. f. Aakirkeby 1955 (alle P.).
Øvrige angivelser af arter af denne slægt er uden herbariebeviser højst usikre.
**Cardamine flexuosa,* Sdr. Borgdal i Rø Plantage 1958 (P. NØRGAARD).
— *hirsuta,* Bolsterbjergs have 1958 (L.).
— *pratensis* ssp. *palustris* (incl. var. *dentata* hos L. 1956), Vallensgaards Mose 1962 (P.); Bot. Museum har fund fra Almindingen 1862 (A. BENZON) og Strandmarken v. f. Dueodde 1936 (SA.).
Coronopus squamatus, ret alm. på gårdspladser over hele øen (L.).
Crambe maritima, Frederiksø 1961 (P.), Ypnasted 1963 (P.), Saltuna og Frennemark (SA.).
Dentaria bulbifera, Christiansø 1963 (P.), sandsynligvis indplantet.
Diplotaxis tenuifolia, Rønne Havn 1929 (SA.), stadig i 1964 (L.).
**Eruca sativa,* sandstensbrud ø. f. Snogebæk 1958 (L.).
**Iberis umbellata,* forv. på Christiansø 1865 (JB.).
Isatis tinctoria, Lange Skanse s. f. Neksø i en 400 m lang og 4 m bred, meget tæt bevoksning som en tæt sennepsmark 1961 (L.), 1 ekspl. v. Balka Strand 1964 (H.), Ginesminde 1964 (H. & P.), første fund v. vestkysten.
Lepidium heterophyllum, mark v. Neksø 1943 (J. OLSEN).
Neslia paniculata, i mængde og i kæmpeekspl. v. Blemme Mølle (L.).
Rorippa silvestris, ukrudt på Rønne Kirkegaard 1961 (L.).
Sinapis arvensis, Christiansø 1937 (G.).
Sisymbrium loeselii, ruderat v. Dueodde Fyr 1962 (P.).
— *orientale,* Gudhjem Havn 1962 (P.).

Thlaspi arvense, alm. haveukrudt på Christiansø 1937 (G.) og 1960 (P.).
Turritis glabra, i mængde langs vejen v. »Vandmøllen» n. f. Rønne 1963 (L.).

Violaceae:

Viola palustris, Segen 1959, planten er blevet sj. på Bornholm (L.); fl. steder i Almindingen (P.).

Cistaceae:

Helianthemum chamaecistus ssp. *hirsutum* (*H. nummularium* ssp. *ovatum*), Almegaard i Knudsker, Helligpeder samt iagttaget i 1960 i Nordskoven v. Rønne v. Sorthat Huse (L.).
— — ssp. *chamaecistus* (*H. nummularium, H. vulgare*) kendes kun med 2 fund: Lilleborg 1960 (L.) og bakke n. f. Hammershus 1962 (Ø.).

Hypericaceae:

Hypericum humifusum, Vasegård i Åker (L.), Ø. Sømarkshuse (Bot. For. eksk. 1957).

Oxalidaceae:

Oxalis stricta, have på Christiansø 1937 (G.).

Geraniaceae:

Geranium columbinum, fyrmesterens have på Christiansø 1937 (G.).

Balsaminaceae:

**Impatiens parviflora,* i A. P. JENSEN's Arboret, Dynddalen (sydskrænt v. Dynddalåen) 1957, udsået af arboretejeren; i mængde v. skovvej s. f. Segen skovfogedhus i Almindingen 1960, efter skovfoged NIELSEN's udsagn optrådte den første gang ved hans hus i 1948 (L.). Sidstnævnte sted har planten bredt sig yderligere i 1964 (H. & P.).
*— *glandulifera,* forv. v. Klippeløkkens Granitbrud 1964 (P.).

Euphorbiaceae:

Euphorbia cyparissias, Gudhjem (SA.).
— *dulcis,* Rønne, ukrudt i haven ved Dams Hotel (SA.).
Mercuralis annua, Tejn (S. M. RASMUSSEN).

Callitrichaceae:

Callitriche stagnalis er med herbariebevis kun kendt fra Borregård.

Aceraceae:

**Acer circinnatum,* forv. i Blykobbe Plantage (Bot. For. eksk. 1957).
— *campestre,* et enkelt gammelt, forkrøblet ekspl. i strandkrat ca. 1/2 km n. f. Vang, spontan? (L.).

Aquifoliaceae:

Ilex aquifolium, Stamperegårdsskoven i Ø. Marie 1959 (L.), 2 ekspl. i skovudkant v. Lobbæk 1962 (Ø.).

Crassulaceae:

Sedum album, v. strandstien mell. Sandkaas og Allinge, i sand mell. klipperne nær højeste vandstand ca. 400 m fra bebyggelse 1962 (D. LAURIDSEN).

*— *anglicum*, 4 findesteder på Christiansø 1961 og 1962, G. TURESSON 1963, som anser planten for at være kommet til øen med trækfugle fra plantens svenske, norske el. engelske forekomster. I Bot. Museum ligger den indsamlet fra øen i 1960 af H. ØDUM og i 1964 (H. & P.). GILLNER 1964 har påvist, at den er udplantet mell. 1910 og 1930 af den svenske maler O. HULLGREN, hentet i Cornwall og Bretagne. Jvf. TURESSON 1964. Planten indgår helt i naturlige plantesamfund.

*— *dasyphyllum*, forv. på Christiansø 1865 (JB.), fandtes endnu 1937 (G.).

*— *sexangulare*, Christiansø 1962 (P.), muligvis spontan.

— *spurium*, forv. v. stranden v. Melsted 1961 (L.).

Saxifragaceae:

Parnassia palustris, baneterræn v. Aakirkeby 1955 (E. VESTERAGER), Bølshavn i strandeng 1958 (L.).

Ribesiaceae:

Ribes nigrum, Lindesdal på Hammeren, Storedal v. Sandkås og Juelsgårde Skov i Bodilsker (SA.).

Pomaceae:

**Crataegus coccinea*, plantet på Hammershusklippen 1960 (M.).

*— *monogyna*, Christiansø 1937 (G.) og 1963 (P.).

**Malus prunifolia*, forv. i Gudhjem Plantage 1930 (C. GUDMANN).

Sorbus aria, kan i dag karakteriseres som t. sj. på Bornholm, idet den kun kendes fra Helligdomsklipperne 1961, hotel Finnedalen 1961, Stevelen i Rø 1961 (L.); M. angiver den fra Hammeren og Jons Kapel.

— *hybrida*, Sandflugtsskoven 1962 (L.), et godt og vel mandshøjt individ med 2 næsten lige tykke stammer. Stedets skovfoged har oplyst, at træet ikkeer plantet, hvorfor man må regne med, at det er spontant indvandret.

**Cotoneaster horizontalis*, forv. nær Ferskesø v. Neksø 1964 (H.).

— *melanocarpa*, mange særligt veludviklede, indtil 2 m høje individer v. kysten n. f. Vang 1961 (L.).

*— *simonsii* (art fra Syd-Asien), stranden v. hotel Finnedalen 1928 (C. O. PLENGE) i *Rubus*-bevoksning i birkeskov n. f. Finnedalen 1948 (SA.).

*— *tomentosa*, (art fra SØ. Europa og V. Asien), forv. v. Hammershus 1860 og 1888 (JB.) og (R. T. HOFF); også iagttaget forv. i det øvrige land.

**Amelanchier spicata*, forv. v. Gudhjem 1946 (L. INGERSLEV) og v. Svaneke Fyr 1964 (H.).

Rosaceae:

Alchemilla (revideret):

A. acutiloba, Spidslappet Løvefod, t. alm. i nord.

— *filicaulis*, Trådstænglet L., t. sj., kendt med 5 herbarieekspl. fra øen: V. og ø. f. Ols Kirke 1919, Tejn 1919 (alle A. LANGE), Jons Kapel 1924 (L.) og Louisenlund i Vestermarie 1959 (K. LARSEN).

— *glabra,* Glat L., alm. *f. *miripila,* Fævogten v. Rønne 1859 (R. T. HOFF).
— *glaucescens,* Flöjlshåret L., alm.
— *gracilis* (*A. micans*), Glanshåret L., t. alm. i nord.
— *monticola* (*A. pastoralis*), Grå L., t. alm. i Almindingen og i nord. Der kan næppe være tvivl om, at den er spontan på Bornholm.
— *subcrenata,* Bølgebladet L., sj. og kun kendt med 3 herbariebeviser: Gudhjem 1931 (A. LANGE), Svaneke 1943 (L.) og v. f. Østermarie 19? (L. INGERSLEV).
— *vestita,* må stryges fra den bornholmske flora, da den ikke er kendt med noget herbariebevis.
— *xanthochlora,* Gulgrøn L., hyppig i Almindingen og i nord.
Aphanes microcarpa, Svaneke 1953 (L.), s. f. Melsted og s. f. Neksø 1964 (H. & P.).
Fragaria ananassa (*F. grandiflora*), Christiansø 1963 (P.).
— *viridis,* Kongens Have på Christiansø 1937 (G.).

Potentilla (revideret):

**P. anglica*×*erecta* (×*P. suberecta*), Kanegård i Knudsker 1861 (JB.).
— *arenaria,* der regnes nu med følg. sikre fund: Lindholmsbakkerne i Rø 1850 (TH. SCHIØTZ) og 1878 (JB.), Rispebjerg 1867 (NB.), Gudhjem 1887 (H. KIÆRSKOU), skrænter v. Kobbeåen i Østerlarsker 1869 (NB.), Frennemark v. Svaneke 1938 (SA.) og 1943 (W.), skrænter n. f. Bobbeåens udløb 1887 (J. LANGE) og 1920 (W.).
— *subarenaria* (*P. arenaria*×*tabernaemontani*), se L. 1956.
*— *subargentea* (*P. arenaria*×*impolita*). Botanisk Museum har 24 ark af denne plante indsamlet i årene 1854—1948 på Hammershusklippens sydskrænter, Hammersholm og fra sydsiden af Hammerknuden (P. 1964), Hammershus og Hammerknuden 1955 (L.).
*— *collina* ssp. *leucopolitana,* går ind i stedet f. *P. collina ssp. wiemanniana* (L. 1956), der ikke er kendt fra Bornholm (P. 1964).
*— *argentea* coll., tetraploid type morfologisk set svarende til de af A. MÜNTZING fra Blekinge dyrkede tetraploider: Klinten s. f. Aakirkeby 1960 (P.), Hammershus (Aarhus-herb.).
— — ssp. *argentea,* diploid, t. alm.
— — ssp. *demissa,* diploid, t. alm.
— *impolita* ssp. *impolita,* pentaploid, hexaploid, alm. Flere konstante typer kendes.
*— — ssp. *decora,* i herb. kendt fra Hasle, Hammershus, Rø, Gudhjem, s. f. Melsted, Saltuna, Frennegård v. Svaneke, Neksø, Soldatergården og Christiansø.
— *canescens,* fundet på Christiansø 1860 og 1876 (JB. og NB.), fandtes dér endnu i 1961 (P.).

Rosa (revideret):

R. canina ssp. *canina,* alm., Christiansø (P.).
— — ssp. *dumetorum,* t. alm.

— *dumalis* ssp. *coriifolia,* alm., Christiansø (P.).

— — ssp. *dumalis* (*R. glauca* hos L. 1956), alm., Christiansø (P.).

*— — ssp. *subcanina,* ialt 7 fund, også Christiansø 1963 (P.).

*— — *subcollina,* ialt 4 fund.

— *elliptica* ssp. *inodora,* er med herbariebevis kun kendt fra Ypnasted 1868 (P. NIELSEN). NB. angiver ca. 8 fund og J. LANGE 1888 3 fund.

— *majalis* (*R. pendulina* hos L. 1956 er ikke synonym f. *R. majalis*). Signaturen hos HULTÉN 1950 angiver, at han anser den for at være spontan på Bornholm. Muligheden for, at den er oprindelig på moselokaliteter på øen, er stor, og nye fund har derfor interesse. De af L. angivne fund fra Hammershus og Onsbæk findes ikke på Bot. Museum. Ved Norske Dam blev den forgæves eftersøgt i 1964.

— *obtusifolia,* t. alm.: Ypnasted, Rø, Snogebæk, Teglkås, Helvedesbakker, Randkleve, Gudhjem, alle Bot. Museum, endv. Almindingen, Kroggårdsløkken, n. f. Neksø og Christiansø (P.). HERRING angiver den som alm. i sin bog »Danske roser» 1934.

— *rugosa,* ud over angivelser hos L. 1956 følgende nye fund: Stranden v. Kobbeå's udløb (SA.), Hammeren, Ypnasted, s. f. Svaneke, Sose Odde, v. f. Arnager og Christiansø, alle 1962—63 (P.), Slusegaard 1964 (H. & P.).

— *rubiginosa,* hh.

— *rubrifolia,* forv. v. Hammersøen og v. Onsbækkens udløb 1916.

*— *tomentosa* ssp. *sherardi,* alm., Christiansø; ssp. *tomentosa* ap. Herring er ikke kendt fra Bornholm.

— *villosa* ssp. *villosa* (*R. pomifera*), forv. fra dyrkning, Christiansø 1962 (P.).

— — ssp. *mollis,* t. alm., Christiansø.

*— *virginiana* (*R. lucida*), forv. v. Hammershus 1876 (NB.) og 1890 (O. GELERT).

**Rubus idaeus* var. *maritimus,* kysten mell. Tejn og Allinge 1885 (O. GELERT). Hidtil eneste kendte fund af denne plante i Danmark.

— *laciniatus,* forv. i Blemmelyng 1962 (L.).

*— *parviflorus,* Mølledalen v. Hammershus 1960 (M.).

Sanguisorba minor ssp. *minor* (*Poterium sanguisorba* ssp. *dictyocarpum* hos L. 1956), samtlige fund på Bornholm synes at tilhøre f. *virescens* Nordb., der muligvis repræsenterer den indigene race i Danmark.

— — ssp. *muricata,* v. Allinge vandværk 1938 (M.).

**Spiraea alba,* Hammershus, pl. (JB), Havbakker v. Rønne 1860 (JB.), forv. i Nordskoven v. Rønne 1935 (S. DAL-PEDERSEN) og 1963 (K. LIND) samt naturaliseret over et stort areal i klitterne v. Sommerodde v. f. Dueodde 1964 (H.).

— *salicifolia,* en kløft i klitterne mod havet i Sandflugten n. f. Rønne 1859 (J.B).

Amygdalaceae:

**Prunus mahaleb,* forv. på Hammershusklippen 1960 (M.).

*— *serotinus,* forv. v. Hammershus 1959 (K. DAMSHOLT) og v. Snogebæk 1964 (H.).

Papilionaceae:

**Cicer arietinum,* gade i Gudhjem 1912 (H. MØLLER), indsl.

**Cytisus nigricans,* forv. i krat på klipperne v. Gudhjem 1931 (M. LANGE).
**Genista tinctoria* ssp. *elatior,* forv. i Galløkken v. Rønne 1926 (M. WEITZE).
**Lathyrus sativus,* klipper v. villa Fredebo s. f. Aarsdale 1936 (O. HAMMER PEDERSEN), indsl.
Lotus tenuis, utvivlsomt spontan v. landeveje, skovveje og på græspladser i Almindingen, f.eks. v. Aaremyre, fl. st. i Fuglesangsrenden, Segen (1948), desuden Brudesengen i Vestermarie (1938), Vallensgaards Mose og fl. st. i Ølenes østl. del, repræsenterende den hos os sædvanlige strandform og ikke kulturformen (SA.).
Medicago falcata, mell. Risebæk og Læså (Bot. For. eksk. 1957).
Medicago falcata×*sativa,* fra Hammerhavnen over Sandvig hen mod Allinge (SA.).
Vicia angustifolia var. *bobartii,* Stampen, Arnager, Hammershusskrænterne, Hammeren, Olsker, s. f. Allinge, Balka og omegn, Dueodde, Frennemark, vistnok øens almindeligste *Vicia* (SA.) — dens f. *lutescens* Sv. And., der hidtil kun har været kendt fra Stampen, er også noteret på Christiansø 1960 (P.).
*— *lathyroides* var. *cirrhata,* Boderne (Bot. For. eksk. 1957).
— *pseudocracca* ssp. *varia* (*V. villosa* ssp. *dasycarpa, V. dasycarpa*), sandmark v. Stampen (SA.).

Oenotheraceae:

Circaea intermedia, i den udtørrede Øleaa v. Slusegaard 1964 (H. & P.).
Epilobium adnatum (*E. tetragonum*), grusgrave v. Listed og s. f. Svaneke 1962 og 1964 (P.); Christiansø 1964 (H. & P.), Rønne Havn, Balka Strand, Snogebæk, Frennegaard, Storedal v. Sandkaas, Segen i Almindingen (SA.).
— *hirsutum,* Christiansø 1937 (G.).
*— *lamyi,* Ormebækken v. Rønne 1860 (JB.), endv. angivet mell. Hammershus og Allinge af WINKELMANN (Deut. Bot. Monatschr. *17:* 36, 1899).
— *montanum,* Christiansø 1964 (P.).
— *obscurum,* Rønne, Ølene, Egeby, Ekkodalen, Fuglesangsrenden, Lilleborg, Aaremyr, Langemose ø. f. Kohullet, Christianshøj, Jomfrubjerget (SA.).
— *palustre*×*parviflorum,* grusgrav v. Snogebæk 1964 (H.).
*— *parviflorum* var. *brevifolium,* en karakteristisk var., som træffes på fugtig sandbund, især i grusgrave; grusgrav v. Snogebæk 1964 (H.), Bølshavn 1959 (K. LARSEN).

Haloragidaceae:

Myriophyllum alterniflorum, Christiansø 1963 (H. RIIS).
— *verticillatum,* vandhul v. Hammeren 1859 (JB.).

Cornaceae:

Cornus suecica, arten er kun fundet en gang på Bornholm, nemlig af J. W. HORNEMANN i 1817. Fundet har hidtil ikke været repræsenteret ved noget kendt herbarieekspl., men et sådant befandt sig i BAAGØE's herb., dog uden nærmere findestedsangivelse.

Umbelliferae:

Aegopodium podagraria, Christiansø 1961 (P.).

Archangelica litoralis, n. f. Bølshavn, n. f. Aarsdale, Aarsdale, Hundsemyre (SA.), Bæle Strand, n. f. Hasle 1960 (L.) og 1964 (H. & P.), vel identisk m. findestedet v. Helligpeder (Bot. For. eksk. 1957), sidstnævnte repræsenterer første fund på vestkysten.

Bupleurum tenuissimum, Allinge 1960 (L.), 1 stort ekspl. på opfyldt areal v. Neksø Sydhavn 1964 (H.).

Cicuta virosa, i grøft i gammel grusgrav v. Snogebæk 1964 (H.).

Eryngium maritimum, Boderne 1963 (M).

Falcaria vulgaris, n. f. Pedersker St., Kæmpemøllen i Poulsker (SA.).

Heracleum mantegazzianum, forv. v. Præstedammen på Christiansø allerede 1937 (G.), Neksø (SA.), s. f. Bølshavn, Nyker, Sorthat 1964 (H. & P.).

*— *speciosum* (*H. pubescens*), forv. på Christiansø 1964 (H. & P.).

— *sphondylium* ssp. *sphondylium,* s. f. Hasle, s. f. Blanchs Hotel, Bodilsker, Christianshøj, Aaremyr (SA.). — *var. *elegans,* Helligdommen i Rø 1860 (JB.), Rø 1919 (J. LASSEN), Hammerhavnen 1958 (H.).

Levisticum officinale, forv. v. Allinge 1860 (HJORTH).

Myrrhis odorata, Allinge, Tejn, Bølshavn (SA.).

Petroselinum crispum, Rønne Sydhavn, Gudhjem (SA.), blomstrende individer forv. i mængde på Frederiksø 1964 (P.).

Scandix pecten-veneris, Frennemark (SA.).

Selinum carvifolia, skov sv. f. Ny Kirke 1859 (JB.), ø. f. Loftgaardsskoven i Vestermarie 1916 (H. MØLLER).

Pyrolaceae:

Pyrola media, Gamleborg-området og ø. f. Jomfrubjerget i Almindingen (SA.).

Ericaceae:

Calluna vulgaris, Christiansø 1962 (P.).

Erica tetralix, Frydenlund v. Rønne 1859 (JB.); m. sj., L har kun 2 fund fra 1900-tallet, er ikke set siden 1940 og må formodentlig anses som forsvundet fra øen.

Empetraceae:

Empetrum nigrum, Allinge og s. f. Gudhjem (SA.).

Vacciniaceae:

Vaccinium uliginosum, 1 ekspl. fra Almindingen 1863 (JB.).

Primulaceae:

Centunculus minimus, Hammershus 1860 (JB.).

Primula farinosa, 57 ekspl. talt v. Sdr. Aasedam 1962 (Ø.), pletvis talrig v. klippekysten mell. Neksø og Aarsdale 1964 (J. HØRBERG).

Plumbaginaceae:

Armeria maritima, grusgrav v. Baggaard i Nyker 1959, første fund i indlandet i vor tid (L.), sml. NB. 1883.

Convolvulaceae:

Calystegia pulchra (*Convolvulus silvestris*), forv. på klipper v. Gudhjem 1953 (K. LARSEN), Snogebæk 1962 (P.), Ypnasted 1963 (L.), ruderat v. Rønne Sydhavn, Svaneke Havn og Bæle Strand 1964 (H. & P.).

*— *sepium* ssp. *baltica* (*Convolvulus sepium* var. *americana*), strandvold v. Store Fos i Rø 1918 (C. H. OSTENFELD).
— *sepium* ssp. *sepium,* Erteholmene 1937 (G.).

Cuscutaceae:

**Cuscuta australis,* indslæbt i gartneri i Gudhjem snyltende på Asters 1957 (L.).
— *epithymum* ssp. *epithymum,* Madsegrav ø. f. Arnager 1958 (L.).

Solanaceae:

**Datura stramonium* f. *tatula,* 1 ekspl. på mark v. Staalesgaard i Nyker 1959 (L.).
Hyoscyamus niger, Klippeløkken 1962 (P.), ø. f. Hasle 1964 (H. & P.).
Physalis alkekengi, forv. v. Ormebækkens udløb sø. f. Rønne 1964 (H. & P.).
**Solanum dulcamara* var. *marinum,* Neksø Havn, Balka Strand, Allinge (SA.), Dueodde 1961 og Ypnasted 1963 (P.).
*— — — — f. *aurantiibaccatum,* stranden s. f. Allinge 1939 (H. NILAUS JENSEN).
— *nigrum* var. *chlorocarpum,* Fynegaard, mark v. f. Ormebæk, Boderne (SA.).
*— *nitidibaccatum,* Rønne Sydhavn 1946 (L.), hos L. 1956 henført til *S. luteum.*

Scrophulariaceae:

Cymbalaria muralis (*Linaria cymbalaria*), forv. i have på Christiansø 1937 (G.), v. Ferske Sø v. Neksø 1964 (H.), v. havnekajerne i Allinge, Svaneke og på Christiansø 1964 (H. & P.), endv. forv. på kirkegaardsmur i Aakirkeby 1964 (J. HØRBERG).
Digitalis purpurea, Bølshavn (SA.).

Euphrasia (revideret):

E. curta, t. alm.
*— *curta×vernalis* ssp. *brevifolia* (×*E. murbeckii*), Almindingen 1890 (O. GELERT), Hammershus 1901 (E. WARMING).
— *micrantha,* t. alm.
*— *micrantha×stricta* (×*E. gratiosa*), Rønne 1866 (J. HENRIKSEN), s. f. Neksø 1964 (H. & P.).
*— *rostkoviana* ssp. *montana,* Kjøllergaard i Bodilsker 1867 (NB.), Lilleborg 1890 (O. GELERT), ny f. Danmark. Begge i Bot. Mus. herb.
— *stricta* ssp. *stricta,* hist og her.
— *vernalis* ssp. *brevipila,* alm.
— — ssp. *vernalis* (*E. tenuis*), Hundsemyre 1901 (O. PAULSEN).
**Linaria maroccana,* Sandvig 1937 (K. GRAM s. n. *L. versicolor*).
*— *repens,* klipper v. Gudhjem 1946 (L. INGERSLEV).
Melampyrum cristatum, Kirkebogaarddalen i Olsker 1959 (L.).
Misopates orontium (*Antirrhinum o.*), haver på Christiansø 1937 (G.), Rønne 1962 (P.).
**Odontites verna* ssp. *rothmaleri,* Malkværn 1964 (H. & P.).
Rhinanthus minor coll. findes hist og her, underarterne *ssp. *elatior* og *ssp. *minor* er kendt.

— *serotinus* coll., angivet som alm. på Bornholm, kun *ssp. *vernalis* og *ssp. *apterus* er kendt ved herbariebeviser.
Veronica aquatica (V. *comosa, V. catenata*), Ølene 1961 (M.).
— *persica,* haveukrudt på Christiansø 1937 (G.).
— *polita,* marker v. Jons Kapel og v. Randkleve (P.).
— *scutellata,* dammen bag fyret på Christiansø 1937 (G.).
*— *spicata* var. *latifolia,* Jons Kapel, Hammershusklippen, Langemyre i Åker (NB.), Vang 1901 (O. MØLLER), Kleven i Klemensker 1861 (R. T. HOFF) og 1918 (E. HANSEN).
— *triphylla,* Madsegrav 1958 og Aarsdale 1958 (P.).
Verbascum speciosum, Listed 1964 (H. & P), Bølshavn 1964 (L.).

Lentibulariaceae:

Utricularia minor, Ølene 1959 (L.).

Plantaginaceae:

**Plantago lanceolata*-form fra Hammershusklippen 1960, 1962 (P.), lav, stærkt håret, *dubia*-lignende, men mere bredbladet og kortakset; særlig race fra Hammershusklippen?
— *major* ssp. *intermedia,* Christiansø 1937 (G.), alm. i strandengene på Nordkysten (P.).
— *media,* indslæbt på græsplæne v. hotel Helligdommen (L.), vejkant v. Aasedammene i Almindingen (SA.).

Boraginaceae:

Lithospermum officinale, Ginesminde i Rutsker 1961 (L.).
Lycopsis arvensis, Frederiksø 1937 (G.).

Symphytum (revideret):

S. asperum, Ru Kulsukker, kun kendt m. herbariebeviser fra Rønne 1922 (L.) og Gudhjem 1964 (P.).
— *officinale,* Læge-Kulsukker, kun kendt m. herbariebeviser fra Hammersøen 1959 (L.) og v. Øleaa n. f. Pilemølle 1964 (H.).
— *uplandicum* (*S. peregrinum, S. asperum*×*officinale*), Alm. Kulsukker, hist og her, f.eks. Rønne Havn 1922 (L.), v. Præstedammen på Christiansø 1937 (G.), Bølshavn 1959 (K. LARSEN), Snogebæk, n. f. Neksø, s. f. Bølshavn, n. f. Listed, Rispebjerg, Trekanten, Rønne, Svaneke, alle st. v. vejkanter 1964 (H. & P.).

Labiatae:

Galeopsis bifida, Tyrevig på Christiansø 1937 (G.). Sandsynligvis alm. på Bornholm.
— *tetrahit,* Bot. Museum har ingen herbarieekspl. af denne art fra Bornholm, hvor den formentlig er sj.
**Lamium amplexicaule* var. *clandestina,* Pythuset (SA.).
Mentha gentilis, Rønne Havn og Sydhavn, vejkant v. Vang, grøftekant ved gård i Balka (SA.).
— *spicata,* Ormebækkens udløb og Helligpeder 1964 (H. & P.).
Salvia pratensis, n. f. Aabygård i Nyker 1920 (H. MØLLER), opført hos L. 1956 som *S. verbenaca,* der ikke er fundet i Danmark.

— *verticillata,* forv. på bastionen v. præstegården på Christiansø 1937 (G.), Grisby 1958 (L.).

Stachys arvensis, Blemmelyng 1958, Almindingen 1958 og Skørrebro i Aaker 1963 (L.).

— *palustris,* Christiansø 1964 (P.).

— *silvatica,* oven for Hestehuset på Christiansø samt i granplantning v. præstegården 1937 (G.).

Thymus pulegioides, angivelserne fra Bornholm: Skrænter v. Blanchs Hotel, mell. Risebæk og Lilleaa, Arnagerskrænterne og Bodilsker betvivles indtil videre, da ingen herbariebeviser foreligger. Ved Risebæk samledes i 1964 kun *Th. serpyllum.*

Oleaceae:

Ligustrum vulgare, forv. v. Møllevig s. f. Hammershus, s. f. Blanchs Hotel, Lindesdal på Hammeren og v. stien sø. f. Gudhjem (SA.).

Rubiaceae:

Galium aparine var. *marinum,* Christiansø 1964 (P.).

— *mollugo,* Splitsgård i Klemensker 1961 (M.).

— *mollugo* var. *angustifolium,* Christiansø 1923 (L.).

— *mollugo*×*verum,* alm. på Christiansø 1937 (G.).

*— *saxatile,* brandlinie i lyngbevoksning nær Aasedam i Almindingen 1961 (L.). Første sikre fund på Bornholm, hvorfra den tidl. med tvivl har været angivet (planteliste af LIEBMAN på Bot. Museum).

Valerianaceae:

Valerianella dentata, marker v. Dueodde Fyr (SA.).

Compositae:

Ambrosia artemisifolia, ruderat v. Rønne Sydhavn 1964 (H.).

Anaphalis margaritacea, forv. på Christiansø 1865 (JB.) og udplantet i flyvesandet v. Dueodde 1865 (JB.), ikke set i dette årh.

**Arctium minus*×*nemorosum,* v. Hotel Hammersø (SA.).

*— *nemorosum*×*tomentosum,* stranden mell. Vang og Finnedalen (Bot. For. eksk. 1957).

**Artemisia vulgaris* var. *coarctata,* Bodilsker 1850 (TH. SCHIØTZ), Christiansø 1962 strandklipper v. Listed og s. f. Svaneke, Frederiks Stenbrud v. Neksø 1964 (H. & P.), sandsynligvis hyppig v. klippekysten, men v. mellemformer forbundet m. hovedformen.

**Aster novi-belgii,* forv. v. Rønne Sydhavn 1964 (H.).

**Chrysanthemum macrophyllum,* forv. på strandskrænt v. Salene 1947 (Bot. Tids. *48*: 333, 1949). *C. maximum,* der er omtalt som forv. v. kysten mell. Risebæk og Læsaa (Bot. For. eksk. 1957), er formentlig identisk m. *C. macrophyllum.*

*— *vulgare* var. *crispum,* forv. på Frederiksø 1962 (P.).

Centaurea nigra, vejkant v. jernbanen v. f. Robbedale 1964 (H. & P.).

**Cirsium arvense* var. *horridum,* v. vejen mell. Svaneke og Almindingen 1886 (E. ROSTRUP), Svaneke, Bølshavn (P.).

*— — var. *integrifolium,* ruderat v. Rønne Sydhavn 1964 (H.).

— *oleraceum,* småskove v. f. Kjøllergaard i Bodilsker, Frennemark (SA.).

*— *vulgare* var. *hypoleucum,* skoven v. Salene Bugt 1962 (P.).

Crepis setosa, de bornholmske fund af denne art omtales hos L. 1956 som tvivlsomme. Bot. Museum har imidlertid 6 sikre indsamlinger, alle fra »Kløvermark, Fævogten v. Rønne» 1866.

Doronicum pardalianches, Bølshavn 1947 (H. P. Kristensen).

Echinops sphaerocephalus, Allinge Havn og vejkant ø. f. Stamperegård i Østermarie 1964 (H. & P.).

**Erigeron acre* var. *strictus,* klinter v. Risegård 1964 (H. & P.).

— *canadensis,* s. f. Snogebæk 1964 (H. & P.).

Filago minima, Christiansø 1937 (G.).

Galinsoga ciliata, haveukrudt i Svaneke 1964 (H. & P.).

— *parviflora,* haveukrudt i Sandvig 1963 (K. Lind), ruderat v. Rønne Havn 1964 (H.).

**Hieracium cymosum,* skrænter i Døvredal i Bodilsker (Bot. Tids. 5: 48, 1867).

— *pilosella,* Rantzau's Bastion på Christiansø 1937 (G.).

*— *umbellatum* var. *eurobalticum,* Dueodde, Boderne, v. Aasedam (L. Ingerslev).

*— *virgultorum,* skovvej nær Ølene 1964 (J. Hørberg). Bot. Museum har et herbarieekspl. samlet af NB. i Smedehaven i Bodilsker, men arket bærer påskriften »Indplantet».

Hypochoeris glabra, Sømarken og Stampen (SA.), Rønne Sydhavn 1962 (L.) og 1964 (H.).

Inula helenium, vejkant v. Sejersgård i Ibsker 1964 (H. & P.).

Lactuca muralis, den røde lysbundsform er kendt fra fl. steder på Bornholms klippekyster, således n. f. Gudhjem Havn 1964 (H.).

*— *sativa,* ruderat v. Rønne Sydhavn 1964 (H.).

— *serriola,* forv. v. stranden v. Boderne 1963 (K. Damsholt).

Petasites hybridus. Der kendes nu 4 fund fra Bornholm: 1. Ved landevejen ø. f. Listed 1957; bevoksningen her stammer fra en nærliggende have, hvortil den er kommet fra Bolsterbjerg Planteskole i Almindingen (L.). 2. Grøftekant nær Lyngholt i Klemensker 1960; det vides ikke, hvorfra denne bevoksning stammer, men antagelig har den samme oprindelse som foregående (L.). 3. Krat mell. Bækkegård og Kodalhuse i Ibsker, tæt uden for en ejendom, der ligger ved en vej, som fortsætter ind i Paradisbakkerne som »Linds Vej», 1963 (L.). 4. Mell. sten i strandengsvegetation s. f. Helligpeder 1964 (H. & P.). — Sandsynligvis er planten på Bornholm i alle tilfælde udkommet fra haver i nyere tid (L.).

**Senecio aquaticus* ssp. *barbareifolius,* Vallensgårds Mose 1962 (J. Hørberg). Indsamlet på øen allerede i 1938 u. nærmere findestedsangivelse (A. Vesterdal). Ssp. *barbareifolius* er østdansk i sin hjemlige udbredelse, og det bornholmske fund knytter forbindelse mell. plantens forekomst i Nordtyskland-Polen og Skåne.

— *silvaticus,* Christiansø 1937 (G.).

— *viscosus,* stenbrud s. f. Segen Skovfogedhus 1964 (H. & P.).

**Sonchus arvensis* ssp. *uliginosus,* Christiansø 1883 (NB.).

— *asper* ssp. *inermis,* vejkant v. Rabekkeværket 1964 (P.).

*— *palustris,* er ikke omtalt hos L. 1956. Den angives fundet i Hundsemyre 1872 (NB., Bot. Tids. *5*: 293).

**Taraxacum euryphyllum,* Krogsgårdsløkken (Bot. For. eksk. 1957, M. P. CHRISTIANSEN det.).

*— *hybridum,* Rø Plantage (Bot. For. eksk. 1957, M. P. CHRISTIANSEN det.).

*— *sublaeticolor,* Christiansø 1961 (P.), (M. P. CHRISTIANSEN det.).

**Telekia speciosa,* forv. v. lejrplads, Sletten pr. Gudhjem 1953 (K. LARSEN).

Tragopogon pratensis ssp. *minor,* mell. Nylars og Åkirkeby, Galløkken, Ugleenge, Bodilsker, mell. Melsted og Ypnasted, eng v. Åremyre (SA.).

Tripleurospermum maritimum (*Matricaria* m. coll.).

ssp. *ambiguum* var. *boreale,* Arktisk Strandkamille. Varieteten er muligvis kun kendt fra Kullen i Skåne, Nordbornholms klipper (Jons Kapel, Vang, klipperne mell. Vang og Hammershus, Hammeren, Rø) samt fra Christiansø.

ssp. *salinum,* Alm. Strandkamille, har ikke hidtil været kendt fra Bornholm med noget herbariebevis. NB. 1883 angiver den som alm. på sandstrand og i klipperifter ved havet. SA. angiver den i sine noter fra Saltuna, Rø, Svaneke, Balka Strand og Snogebæk. Med sikkerhed fundet 1964 v. Rønne Havn, Hasle, Listed, Balka Strand og Slusegaard (H. & P.).

Græsholmen

Ialt kendes der nu 118 arter fra Græsholmen, men kun 6 arter er fælles i nedenstående lister fra de 3 foretagne undersøgelser: *Agrostis stolonifera, Carex otrubae, Elytrigia repens, Holcus lanatus, Leontodon autumnalis* og *Poa annua.* De fleste fælles arter findes i listerne fra 1937 og 1964 (20). Af de 56 arter fra FRANCK's floraliste er de 16 (mærket *) fra ferskvandsprægede fugtigbundslokaliteter, der næsten ikke findes på øen i dag. Af de 15 arter, der er fælles for listerne fra 1902—03 og 1964, er over halvdelen fra strandlokaliteter. I 1902—03 var øen næppe i lige så høj grad som nu præget af fuglenes tilstedeværelse, men efter fredningen er især siden 1940 antallet af ynglende sølvmåger steget betydeligt (fra 300 par til ca. 2500 par i 1955), og plantevæksten kan have ændret sig i forbindelse hermed. Skal fuglenes indflydelse på floraens sammensætning vurderes, bør man se bort fra strandplanterne (mærket ^{o}), hvorfor 20 arter af de i 1964 fundne 63 arter kan udelades i bedømmelsen. Nitrofilt begunstigede er nogle få, meget udbredte og kraftigt voksende græsser som *Avena elatior, Calamagrostis epigeios, Baldingera arundinacea, Hordeum murinum, Holcus lanatus og Dactylis glomerata.* Bortset fra de to sidstnævnte er disse græsser indvandret til øen efter 1903, og *Holcus lanatus,* der i dag er ret dominerende, spillede næppe dengang nogen større rolle i vegetationen. Nyindvandret er også den klart nitrofile *Tripleurospermum maritimum* ssp. *ambiguum* var. *boreale.* Iøvrigt skal følgende planter hørende til det nitrofile element nævnes, alle kendt fra undersøgelserne i 1937 eller 1964: *Erodium cicutarium, Festuca rubra, Galeopsis bifida, Poa annua, Puccinellia distans, Rumex crispus, Sedum acre, Galium aparine, Senecio silvaticus, Stellaria media* og *pallida* samt *Urtica dioica.* En række arter med frugter, der har endozoisk spredning, kan tænkes at være kommet til øen med mågeekskrementer, således *Sambucus nigra, Prunus spinosa, Rubus plicatus, Rosa obtusifolia* samt *Crataegus monogyna* og *oxyacantha.* I tilknytning hertil kan nævnes indvandringen af en række *Polygonum*-arter, *Chenopodium album, Fragaria vesca* (1902—03) samt *Stellaria media* og *pallida,* medens forekomsten af *Juncus*-arter og *Galium aparine* kan hidrøre fra epizoisk spredning. Menneskets færden spores måske kun i forekomsten af *Matricaria matricarioides.*

Artsliste

	S. Franck 1902—03	P. Gelting 1937	A. Hansen & A. Pedersen 1964
Agrostis gigantea	—	+	—
°— *stolonifera*	+	+	+
**Alopecurus geniculatus*	+	—	+
Anthemis arvensis	+	—	—
Anthoxanthum odoratum	+	—	—
Anthriscus silvestris	—	—	+ få ekspl.
Artemisia vulgaris	—	—	+
°*Aster tripolium*	+	—	+
Athyrium filix-femina	—	—	+ få ekspl.
°*Atriplex deltoidea*	—	—	+
°— *glabriuscula*	—	—	+
°— *litoralis*	—	—	+
Avena elatior	—	+	+ alm.
Baldingera arundinacea	—	+	+ alm.
**Briza media*	+	—	—
**Brunella vulgaris*	+	—	—
Calamagrostis epigeios	—	—	+ alm.
**Callitriche* sp.	+	—	—
Capsella bursa-pastoris	+	—	—
°*Carex distans*	+	—	—
°— *extensa*	—	+	—
— *flacca*	—	+	—
*— *nigra*	+	+	—
°— *otrubae*	+	+	+
Chamenerion angustifolium	—	—	+
Chenopodium album	—	—	+ få ekspl.
**Cicuta virosa*	+	—	—
°*Cochlearia danica*	—	+	+
°— *officinalis*	—	+	—
Crataegus monogyna	—	+	+
— *oxyacantha*	—	—	+
**Cynosurus cristatus*	+	—	—
Dactylis glomerata	+	—	+ alm.
Deschampsia caespitosa	+	—	—
— *flexuosa*	+	—	—
Dryopteris dilatata	—	—	+ få ekspl.
**Eleocharis palustris*	+	+	—
°*Elytrigia repens*	+	+	+
Erodium cicutarium	—	—	+ få ekspl.
°*Festuca arundinacea*	—	+	+
— *pratensis*	+	+	—
— *rubra*	—	+	+
Fragaria vesca	+	—	—
Galeopsis bifida	—	+	—

	S. Franck 1902—03	P. Gelting 1937	A. Hansen & A. Pedersen 1964
Galium aparine	+	—	+
— *boreale*	+	—	—
*— *uliginosum*	+	—	—
— *verum*	+	—	+
°*Glaux maritima*	+	—	+
Holcus lanatus	+	+	+
Hordeum murinum	—	+	+ alm.
°*Hydrocotyle vulgaris*	+	—	—
**Juncus articulatus*	+	—	—
— *bufonius*	+	—	—
— *conglomeratus*	+	—	—
— *effusus*	—	—	+
— *glaucus*	+	—	—
°— *gerardii*	—	+	+
Juniperus communis	+	—	—
Lemna minor	+	—	—
°*Leontodon autumnalis*	+	+	+
Lolium multiflorum	—	+	—
— *perenne*	+	—	+ få ekspl.
Lotus corniculatus	+	—	—
*— *uliginosus*	+	—	—
Matricaria matricarioides	—	—	+ få ekspl.
Medicago lupulina	+	—	+ få ekspl.
°*Phragmites communis*	—	—	+
°*Plantago coronopus*	+	—	—
°— *major* ssp. *intermedia*	—	—	+
°— *maritima*	+	—	+
Poa annua	+	+	+
— *pratensis*	—	+	+
— *trivialis*	+	+	—
Polygonum heterophyllum	—	+	+
*— *hydropiper*	+	—	—
— *lapathifolium*	—	—	+ få ekspl.
— *neglectum*	—	—	+ få ekspl.
— *persicaria*	—	—	+ få ekspl.
Potentilla argentea	+	—	—
*— *palustris*	+	—	—
Prunus spinosa	—	—	+
°*Puccinellia distans*	—	+	+
°— *retroflexa*	—	—	+
Ranunculus acer	+	—	—
*— *flammula*	+	—	—
*— *repens*	+	—	—
Rosa canina	+	—	—
— *obtusifolia*	—	—	+
Rubus plicatus	—	—	+
Rumex acetosa	—	—	+
— *acetosella*	—	+	+
— *crispus*	—	—	+
— *thyrsiflorus*	—	—	+
°*Sagina maritima*	—	+	—
Salix repens	+	—	—
Sambucus nigra	—	—	+ alm.
°*Scirpus maritimus*	—	—	+
Sedum acre	—	+	—
Senecio silvaticus	—	—	+

	S. Franck 1902—03	P. Gelting 1937	A. Hansen & A. Pedersen 1964
Spergularia rubra	—	+	+
°— *salina*	—	+	+
Stellaria media	—	+	+
— *pallida*	—	+	—
°*Trifolium fragiferum*	+	—	—
*— *repens*	+	—	—
°*Triglochin maritimum*	—	—	+
Tripleurospermum maritimum ssp. *ambiguum* var. *boreale*	—	—	+ alm.
Typha latifolia	—	—	+
Urtica dioica	—	—	+
Vicia cracca	+	+	—
— *tetrasperma*	+	—	—
°*Zostera marina*	+	—	—
Antal arter	56	35	63

Botanikeren F. Diderichsen (1814—1887), som var overskibslæge i den danske flåde i 1849 og 1854, besøgte Græsholmen i juni—juli 1849 og har efterladt sig nogle få indsamlede planter, således *Athyrium filix-femina, Polystichum lobatum, Luzula campestris* og *Aster tripolium.* Endvidere er *Plantago major* ssp. *intermedia* samlet på øen af J. Baagøe allerede i 1860, og endelig kendes følgende 2 fund fra øen: *Rubus griffithianus* (1931, N. Petersen) og *Beta vulgaris* ssp. *vulgaris* (1948, B. Fredskild).

Ny floristisk litteratur om Bornholm

(tillæg til Bot. Tids. **52:** 311—312, 1956)

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Bemerkungen zur Gliederung der Gattung Trisetum Pers.

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Die Gattung *Trisetum* Pers. umfasst, in dieser Auffassung, nur ausdauernde Arten, am öftesten solche mit grossen Ährchen, gewöhnlich mit ± lockeren Ährchenrispen und ausdrucksvoll behaarten Ährchenspindeln. Die einjährigen Arten mit kleinen Ährchen, mit oft auffallend zusammengezogenen Ährchenrispen und oft nur zerstreut behaarten oder stacheligen Ährchenspindeln werden in die Gattung *Trisetaria* Forsk. eingereiht. Der Unterschied zwischen beiden Gattungen liegt auch in ihrer Verbreitung. Das Vorkommen der Arten der Gattung *Trisetaria* ist vor allem an das Mediterrangebiet gebunden und nur wenige Arten wachsen ausserhalb dieses Gebietes. Die Arten der Gattung *Trisetum* sind, ausser dem Mediterrangebiet, auch in der gemässigten und kalten Zone der nördlichen Halbkugel häufig verbreitet, u.zw. sowohl in der Alten als auch in der Neuen Welt. Nur einige Arten reichen bis auf die südliche Halbkugel, inbesondere in montane Gebiete. Bei den, hauptsächlich in montanen bis hochmontanen Lagen vorkommenden Arten der Gattung *Trisetum,* ist ausserdem noch eine grosse Tendenz zu einem Endemismus vorhanden. So z.B. *Trisetum glaciale* Boiss., *T. antoni-josephii* F. Q. et Muñ. Med. (Sierra Nevada); *T. gracile* (Mor.) Parl. (Sardinien); *T. burnoufii* Req. (Korsika); *T. baregense* Laf. et Miég. (Pyrenäen); *T. fuscum* (Kit.) R. et S., *T. macrotrichum* Hackel (Karpaten); *T. alpestre* (Host) Pal.-Beauv. (Mitteleuropa); *T. velutinum* Boiss., *T. hispidum* Lge. (Spanien) usw.

Das wichtigste Unterscheidungsmerkmal zwischen den Gattungen *Trisetum* und *Trisetaria* ist schliesslich das Dauern der Pflanzen. Dieses Merkmal hat im gegebenen Falle einen hohen taxonomischen Wert. Die übrigen angeführten Merkmale und einige weitere kann man nur für die Charakteristik der Gattung benützen. Trotzdem weist aber der Komplex dieser Merkmale eine ganz abweichende Entwicklungstendenz innerhalb beider Gattungen auf.

In der botanischen Literatur, auch in der derzeitigen, werden die beiden angeführten Gattungen, trotz ihrer ganz abweichenden Entwicklungstendenz oft in eine umfangreiche Gattung zusammengefasst und zwar entweder unter der Bezeichnung *Trisetum* Pers. oder *Trisetaria* Forsk. (cf. z.B. PAUNERO 1950; MAIRE 1953). Als selbständige Gattungen werden sie in der neueren botanischen Literatur z.B. von HOLUB (1958) gewertet, der eine Übersicht der Entwicklungsbeziehungen zwischen den einzelnen Gattungen der Tribus *Aveneae* anführt. Die Art *Trisetum myrianthum* (Bert.) Parl. ist in die selbständige Gattung *Parvotrisetum* Chrtek abgetrennt.

In dieser Arbeit untersuchte ich vor allem die europäischen Arten der Gattung *Trisetum,* von denen ich mangels Materials nur die griechische Art *T. laconicum* Boiss. et Orph. und die serbische Art *T. rufescens* (Panč.) Adam. nicht werten konnte; die letztere hat aber vom taxonomischen Gesichtspunkt auf Grund der Literatur bisher einen unklaren Wert.

Die amerikanischen und auch die asiatischen Arten habe ich nur orientierungshalber studiert. Im ganzen kann man sagen, dass man die meisten morphologischen Typen u.zw. im Bau der Blätter, der Epidermis der Blattspreiten, der Endodermiszellen des Wurzelquerschnittes u.ä. bei den europäischen Arten findet. Die asiatischen und amerikanischen Arten sind viel einheitlicher und zeigen keine so reiche Skala der morphologischen Typen.

Im weiteren führe ich eine kurze Übersicht der Einteilung der Gattung *Trisetum* in niedrigere taxonomische Einheiten an. Die Gattung *Trisetum* (enger aufgefasst) wurde von ASCHERSON & GRAEBNER (1899) in zwei selbständige Sektionen geteilt: *Eu-Trisetum* Asch. et Gr. mit *T. flavescens*-Komplex und *Trisetaera* Asch. et Gr. mit *T. spicatum* (L.) Richt. HERMANN (1956) vertritt eine sehr breite Auffassung der Gattung *Trisetum* (er bezieht auch die Gattung *Ventenata* ein). Er teilt die Gattung in vier Untergattungen (wahrscheinlich, die taxonomische Kategorie ist hier nicht klar bezeichnet) und zwar *Ventenata* (mit der Art *Ventenata dubia*), *Rostraria* (einjährige Arten, die zur Gattung *Trisetaria* gehören), *Argentaria* (mit den Arten *T. distichophyllum* und *T. argenteum*) und *Trisetum* (mit ausdauernden Arten). Beachtenswert an dieser Teilung ist die Abtrennung der Arten *T. distichophyllum* und *T. argenteum* von den übrigen Arten der Gattung *Trisetum.* Die Abtrennung führte der Autor hauptsächlich auf Grund der Gestaltung der Blattspreiten durch. Bei der Gruppe *Argentaria* sind die Blätter nach HERMANN „gefalzt“, bei *Trisetum* „gerollt“. CHRTEK & JIRÁSEK (1963) teilten die hochmontanen mediterranen Arten *T. gracile, T. glaciale* und *T. antoni-josephii,* in die selbständige Sektion *Gracilia* Chrtek et Jirásek ein.

Wertung der Variabilität einiger Merkmale des äusseren und inneren Baues der Pflanzen

Ein gründlicheres Studium zeigt aber, dass einige der angeführten Gruppen sehr heterogen sind und ihr Umfang eine Revision erfordert. Bei der Wertung der verwandtschaftlichen Beziehungen ging ich vor allem von den folgenden Merkmalen aus: Gestaltung der Blattspreiten der Innovationsblätter, Verteilung des Sklerenchymgewebes der Blattspreiten (am Querschnitt), Bau der Epidermiszellen auf der abaxialen Blattspreitenseite, Bau der Endodermiszellen am Wurzelquerschnitt, Behaarung der Vorspelzenkiele, Länge des Blatthäutchens, Stellung der Blätter an Halmen und sterilen Trieben, Behaarung der Ährchenspindel und Charakter der Ährchenrispe. Diesen Merkmalen wurden in einigen Fällen weitere zugefügt, die sich für eine nähere Klärung der verwandtschaftlichen Beziehungen bestimmter Artengruppen eignen. Auch die Verbreitung der einzelnen Arten wurde in Betracht gezogen.

1. Gestaltung der Blattspreiten der Innovationsblätter. Ein sehr wichtiges Merkmal ist die Vernation der Innovationsblätter in der Knospe. Innerhalb der Gattung kann man zwei Typen unterscheiden: Blattspreite geschlossen, d.h. zusammengerollte Knospenanlage (vernatio convoluta) und Blattspreite zusammengefaltet, d.h. zusammengelegte Knospenanlage (vernatio conduplicata). Der erste Typ ist der häufigste (Abb. 1), sehr typisch z. B. bei den Arten *T. flavescens, T. alpestre, T. sibiricum, T. macrotrichum, T. rigidum, T. fuscum, T. spicatum, T. baregense* usw. Den zweiten Typ findet man z.B. bei den Arten *T. glaciale, T. distichophyllum, T. argenteum, T. gracile* (Abb. 2). Bei *T. gracile* bildet die Gestaltung der Blattspreiten manchmal einen gewissen Übergang zwischen den beiden angeführten Typen (Abb. 2, Fig. 4). Das Merkmal der Gestaltung der Blattspreite kann man aber zur Unterscheidung einiger Artengruppen sehr gut verwenden; es sind dies hauptsächlich die bereits angeführten Arten mit geschlossener Blattspreite. Auf Grund dieses Merkmales teilte z. B. HERMANN (1956) die Arten *T. distichophyllum* und *T. argenteum* in eine selbständige Gruppe ein.

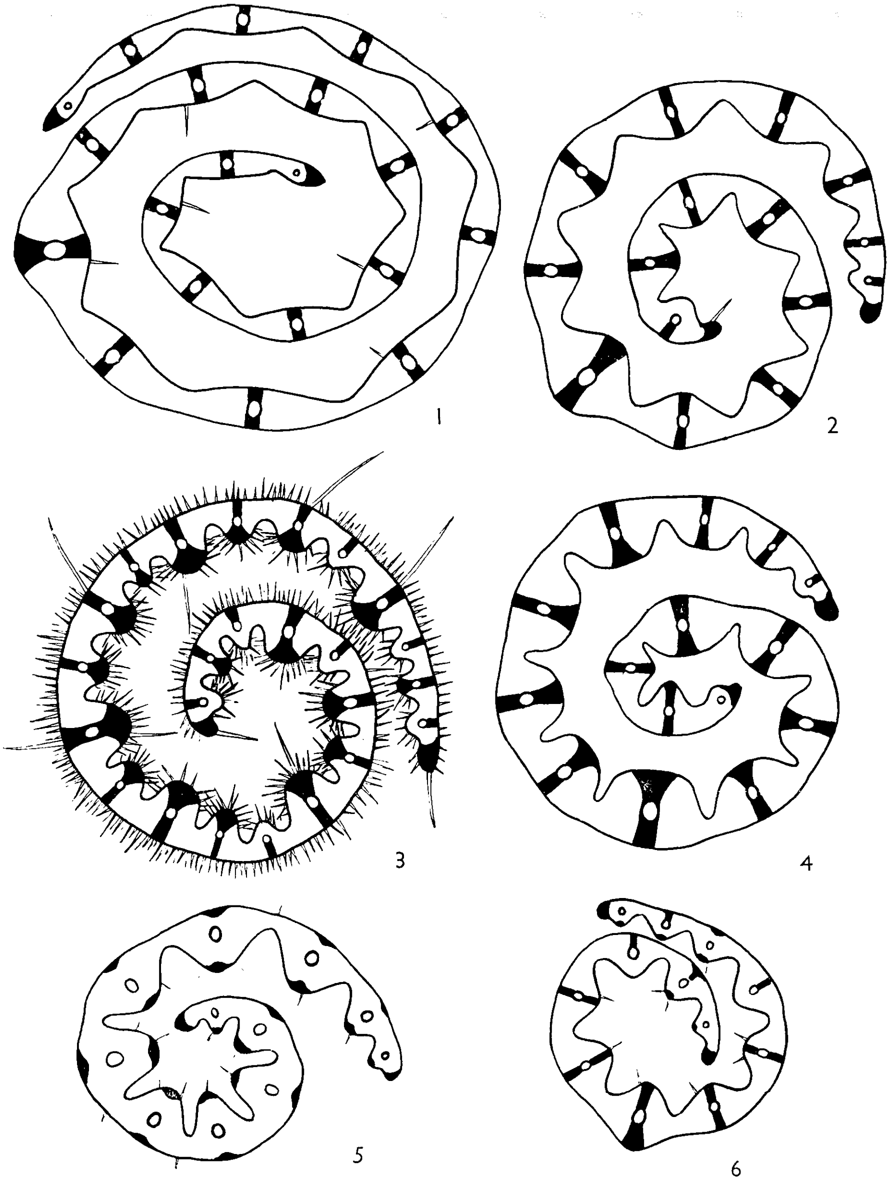


Abb. 1. Schematische Veranschaulichung der Gestaltung der Blattspreiten der Innovationsblätter: 1. *Trisetum macrotrichum,* 2. *T. fuscum,* 3. *T. hispidum,* 4. *T. rigidum,* 5. *T. spicatum,* 6. *T. agrostideum.*

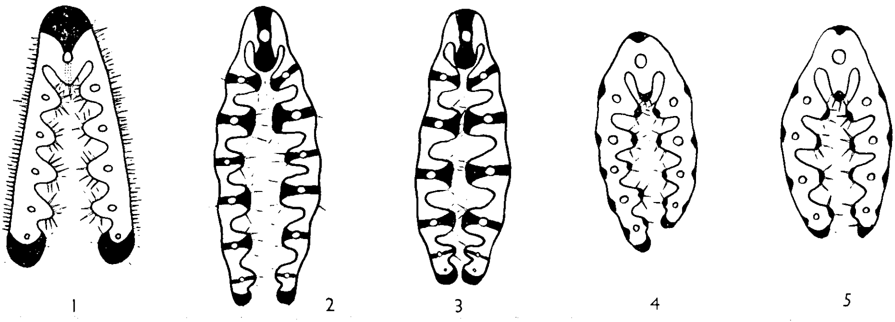


Abb. 2. Schematische Veranschaulichung der Gestaltung der Blattspreiten der Innovationsblätter: 1. *Trisetum glaciale,* 2. *T. distichophyllum,* 3. *T. argenteum,* 4–5. *T. gracile.*

2. Verteilung des Sklerenchymgewebes der Blattspreiten der Innovationsblätter (am Querschnitt). Bei den europäischen Arten kann man drei Typen unterscheiden.

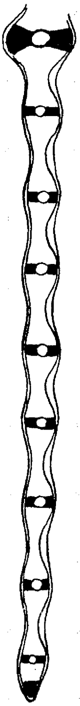
a) Das Sklerenchym ist auf den Kielteil und Blattränder beschränkt (Abb. 3, Fig. 8). Auf der abaxialen Blattspreitenseite reicht das Sklerenchym bis an die Scheide des Gefässbündels, auf der adaxialen Blattspreite findet man gegenüber diesem zentralen Gefässbündel öfters einen schmalen Streifen mit langgezogenen Zellen, mit etwas verdickten Wänden. Das Sklerenchym an den Blatträndern ist mächtig entwickelt.

Diesen Typ findet man nur bei den Arten *T. glaciale* und *T. antoni-josephii.*

b) Das Sklerenchym bildet gegenüber den Gefässbündeln kleine Inselchen u.zw. sowohl auf der abaxialen als auch auf der adaxialen Blattspreitenseite, reicht aber nicht bis zu den Scheiden der Gefässbündel (es reicht nur ausnahmsweise an die Scheiden der Gefässbündel). Das Sklerenchymgewebe gegenüber den Gefässbündeln fehlt aber oft, insbesondere bei den Bündeln einer höheren Ordnung, oder es ist nur auf einige Zellen beschränkt. Schliesslich ist das Sklerenchymgewebe auch an den Blatträndern (Abb. 3, Fig. 5—7).

Diesen Typ findet man z.B. bei *T. gracile* und *T. spicatum.* Diese Arten haben zwar den ähnlichen Typ der Verteilung des Sklerenchymgewebes, zwischen ihnen bestehen aber auf Grund anderer Merkmale

Abb. 3. Schematische Veranschaulichung der Verteilung des Sklerenchymgewebes am Blattspreitenquerschnitt: 1. *Trisetum fuscum,* 2. *T. distichophyllum,* 3. *T. rigidum,* 4. *T. velutinum,* 5–6. *T. spicatum,* 7. *T. gracile,* 8. *T. glaciale,* 9–10. *T. agrostideum.*



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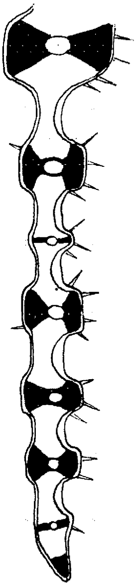

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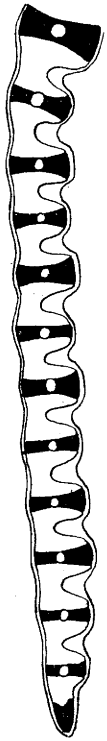

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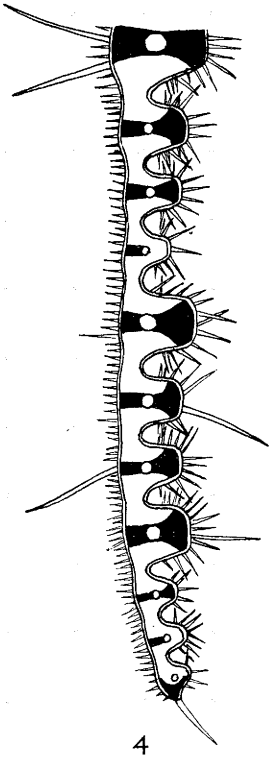

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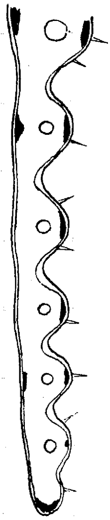

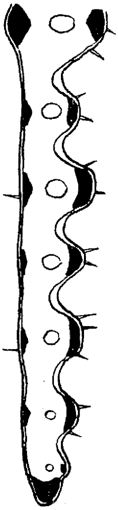

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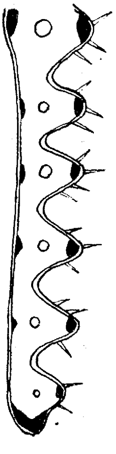

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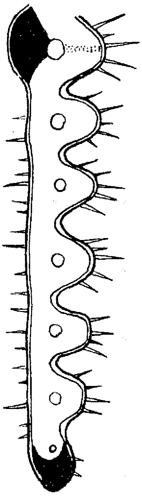

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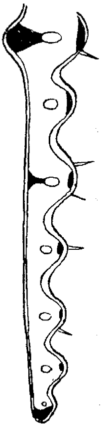

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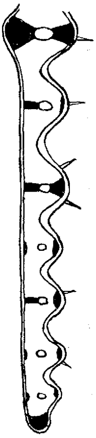

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keine rechten verwandschaftlichen Beziehungen. Bei der Art *T. spicatum* ist die Variabilität der Mächtigkeit des Sklerenchymgewebes besonders gross. In einigen Fällen ist das Sklerenchym nur auf einige Zellen über den Gefässbündeln unter der Epidermis beschränkt, oder es fehlt sogar bei den Gefässbündeln der höheren Ordnung des Sklerenchyms ganz. Manchmal reicht das Sklerenchym bis an die Scheide des Gefässbündels.

c) Der letzte meist verbreitete Typ der Verteilung des Sklerenchymgewebes ist der folgende. Das Sklerenchymgewebe erreicht zumindest bei den Gefässbündeln der I. und II. Ordnung die Scheide der Gefässbündel und zwar sowohl von der abaxialen als auch von der adaxialen Seite der Blattspreite (Abb. 3, Fig. 1—4, 9—10). Nur bei den Gefässbündeln höherer Ordnung erreicht das Sklerenchymgewebe die Scheide der Gefässbündel manchmal nur von der abaxialen Seite, oder es ist nur auf die Zellengruppe unter der Epidermis begrenzt. Vereinzelt kann das Sklerenchym fehlen. Das Sklerenchymgewebe ist auch an den Blatträndern.

Diesen Typ der Verteilung des Sklerenchymgewebes findet man bei den meisten europäischen Arten. Die typischeste Ausbildungsform findet man z.B. bei den Arten *T. velutinum, T. hispidum, T. distichophyllum, T. argenteum, T. flavescens, T. fuscum, T. rigidum, T. sibiricum, T. alpestre;* etwas weniger ausdrucksvoll z.B. bei den Arten *T. baregense* und *T. agrostideum.* Bei der letztgenannten Art ist das Sklerenchym bei den Gefässbündeln der höheren Ordnung manchmal sehr schwach entwickelt oder es fehlt ganz. Die angegebene Verteilungsform des Sklerenchyms kennzeichnet die um die Art *T. distichophyllum* und weiter um die Arten *T. flavescens, T. fuscum, T. rigidum* und *T. hispidum* konzentrierten Gruppen. Dieser Übersicht kann man entnehmen, dass zwischen dem b) und c) Typ Übergangsformen bestehen, besonders aber bei *T. agrostideum.*

3. Bau der Epidermiszellen auf der abaxialen Blattspreitenseite bei Flächenansicht. Bei der überwiegenden Mehrheit der Arten ist der Epidermistyp ± gleich. Die Epidermis setzt sich aus langen und kurzen Zellen zusammen, die untereinander ± unregelmässig abwechseln. Die langen Zellen haben gewöhnlich die Form langgezogener Sechsecke oder Rechtecke. Die Wände sind gerade (Abb. 4, Fig. 1—7). Die kurzen Zellen sind entweder ± quadratisch oder schmal rechteckig und den langen Zellen gegenüber quergestellt. Die kurzen Zellen enden am öftesten in einen kleinen Stachel oder in ein Haar. Diesen Typ findet man z.B. bei den Artengruppen *T. flavescens, T. distichophyllum, T. spicatum, T. agrostideum, T. rigidum, T. fuscum;* doch manchmal können die kurzen

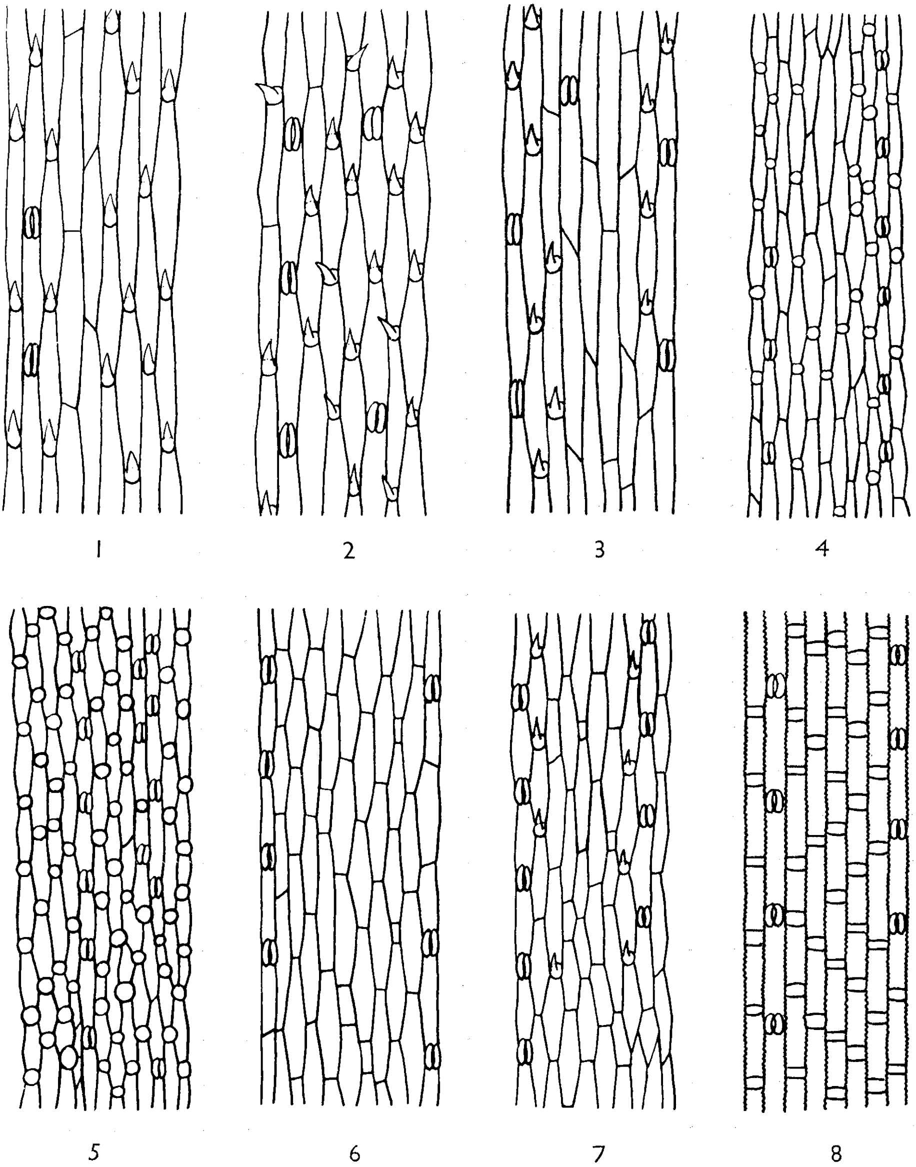

Abb. 4. Schematische Veranschaulichung des Baues der Epidermiszellen auf der abaxialen Blattspreitenseite: 1. *Trisetum fuscum,* 2. *T. distichophyllum,* 3. *T. spicatum,* 4–5. *T. glaciale* (Haare nicht eingezeichnet), 6–7. *T. gracile,* 8. *T. velutinum.*

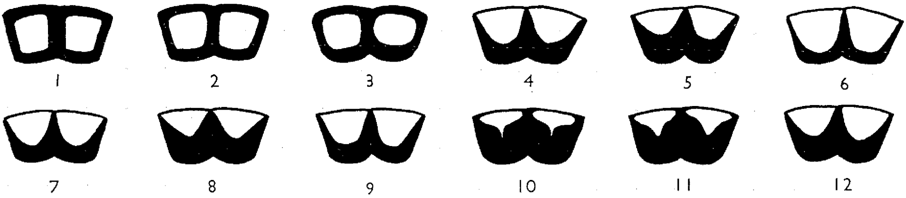

Abb. 5. Schematische Veranschaulichung des Baues der Endodermiszellen am Wurzelquerschnitt: 1–3. *Trisetum gracile,* 4–5. *T. glaciale,* 6–7. *T. flavescens,* 8–9. *T. argenteum,* 10–12. *T. velutinum.*

Zellen fehlen oder sie sind nur vereinzelt vorhanden. Bei wenigen Arten besteht zwar die Epidermis aus langen und kurzen Zellen (auch aus ± quadratisch und schmal rechteckigen), jedoch sind die Wände der langen Zellen, am öftesten aus auffallend langgezogenen Rechtecken, gewellt, so z.B. bei zwei nahe verwandten spanischen Arten *T. velutinum* und *T. hispidum* (Abb. 4, Fig. 8).

Einen etwas abweichenden Bau der Epidermiszellen findet man oft bei der Art *T. glaciale,* wo die langen Zellen, im Hinblick zu anderen Arten, oft verhältnismässig kurz und die kurzen Zellen meistens ringformig und oft auffallend gross sind. Manchmal wechseln kurze und lange Zellen regelmässig ab (Abb. 4, Fig. 5).

4. Bau der Endodermiszellen am Wurzelquerschnitt. Bei fast allen studierten Arten sind die Zellen am Wurzelquerschnitt in Form des Buchstabens C, bzw. U typisch verdickt, d.h., dass die innere Tangentialseite viel mehr verdickt ist als die äussere, wobei die Radialseiten in der Richtung von der Mitte zum Rande der Wurzel sich allmählich verschmälern. Durch das Wort Verdickung in Form des Buchstabens U oder C soll angedeutet werden, dass es sich um Zellen handelt, die in radialer (Form des Buchstabens U) oder i tangentialer Richtung (Form des Buchstabens C) langgezogen sind (Abb. 5, Fig. 4—12). Bei einigen Arten, insbesondere bei *T. velutinum* und *T. hispidum* ist die innere Tangentialseite der Endodermiszellen auffallend verdickt.

Nur bei der Art *T. gracile* findet man einen abweichenden Verdickungstyp u.zw. in Form des Buchstabens O, d.h., dass die Endodermiszellen rundum ± gleichmässig verdickt sind (Abb. 5, Fig. 1—3). Gewöhnlich sind die Wände an der inneren Tangentialseite etwas dicker als an der äusseren.

Der Typ der Verdickung der Endodermiszellen ist ein sehr wichtiges

Merkmal, das sehr oft bestimmte Beziehungen zwischen den einzelnen Arten aufzeigt. Insbesondere innerhalb der Tribus *Aveneae* erweist es sich vorderhand, dass man diesem Merkmal einen bedeutenden taxonomischen Wert beimessen muss.

5. Behaarung der Vorspelzenkiele. Alle studierten Arten, ausser der Art *T. fuscum,* haben am Kielrande kurze nach vorne gerichtete Zähnchen, manchmal sind sie kaum kennbar. Etwas verlängerte Zähnchen findet man bei *T. alpestre,* wo sie manchmal noch auffallend dicht sind. Nur bei *T. fuscum* findet man auf den Kielen ausser verlängerten Zähnchen oft Haare. Durch dieses Merkmal unterscheidet sich *T. fuscum* deutlich von allen anderen Arten.

6. Länge des Blatthäutchens. Bei den meisten Arten ist das Blatthäutchen kurz, ± abgestutzt, oft mit einer Reihe verlängerter Randzellen endigend. Bei der Art *T. fuscum* ist aber das Blatthäutchen auffallend verlängert.

7. Behaarung der Ährchenspindel. Die Ährchenspindeln sind immer behaart. Die meisten Arten (*T. spicatum, T. flavescens, T. agrostideum, T. baregense* uzw.) haben aber kurze Haare, so dass sie bei einer flüchtigen Beobachtung des Ährchens nicht merklich sind. Auffallend verlängerte Haare der Spindeln haben die Arten der Artengruppe *T. rigidum.* Die Haare sind schon beim ersten Blick gut sichtbar. Bei den Arten *T. distichophyllum* und *T. argenteum* liegt die Länge der Haare an den Spindeln in der Mitte zwischen der Haarlänge der beiden Artengruppe von *T. flavescens* und *T. rigidum.* Die Länge der Haare auf den Spindeln ist ein wichtiges taxonomisches Merkmal, welches die geschlossenen Artengruppen von *T. rigidum* und *T. distichophyllum* gut kennzeichnet.

8. Stellung der Blätter an den Halmen und sterilen Trieben. Bei einigen Arten, insbesondere an den sterilen Trieben sind die Blätter auffallend zweireihig angeordnet, sodass Formen wie „kleine Leitern“ entstehen. Die sehr typisch ausgebildete Form dieser Zweireihigkeit findet man bei den Arten *T. distichophyllum* und *T. argenteum;* weiter auch, doch nicht so typisch, in der Artengruppe von *T. rigidum,* teilweise auch bei *T. hispidum.* Ähnlich wie das vorherige Merkmal kennzeichnet auch dieses gewisse Artengruppen, die auf Grund anderer Merkmale sehr nahe verwandt sind.

9. Charakter der Ährchenrispe. Bei den meisten Arten ist die Ährchenrispe ± locker, mit deutlich gestielten Ärchen. Durch den Charakter der Ährchenrispe unterscheidet sich die Art *T. spicatum,* die eine zusammengezogene Ährchenrispe hat. Eine zusammengezogene Ährchenrispe findet man auch bei *T. velutinum.*

Aus dieser Übersicht kann man ersehen, dass man bei der Aufteilung der Gattung *Trisetum* viele Merkmale verwenden kann, denen besonders innerhalb der Familie *Poaceae* eine grosse taxonomische Wichtigkeit zukommt. Als wichtigstes Merkmal zur Teilung der Gattung *Trisetum* in niedrigere Einheiten erachte ich die Gestaltung der Blattspreiten der Innovationsblätter, die Verteilung des Sklerenchymgewebes auf dem Blattspreitenquerschnitt und den Bau der Endodermiszellen am Wurzelquerschnitt. Diese durch einige weitere ergänzten Merkmale bieten die Möglichkeit, die Gattung *Trisetum* in 4 Gruppen zu teilen.

Die artenreichste und am meisten verbreitetste Gruppe ist durch die geschlossene Blattspreite eindeutig gekennzeichnet. Hierher gehören die Arten aus dem Bereiche von *T. flavescens, T. rigidum, T. fuscum, T. spicatum, T. velutinum.* Die weiteren Gruppen sind viel weniger artenreich und auch weniger verbreitet. Es ist dies z.B. die Gruppe mit den Arten *T. distichophyllum* und *T. argenteum,* gekennzeichnet durch eine zusammengefaltete Blattspreite, mit einem am Blattspreitenquerschnitt auffallend reich entwickeltem Sklerenchym. Die Endodermiszellen haben am Querschnitt die Form des Buchstabens C oder U. Diese Gruppe ist auf die Alpen, das Jura-Gebirge und die Gebirge der Balkanhalbinsel (westlicher Teil) beschränkt. Weiter ist es die Gruppe mit den Arten *T. glaciale* und *T. antoni-josephii,* die in der Sierra Nevada wachsen. Ihre Blattspreiten sind zusammengefaltet, das Sklerenchym ist nur auf den Kielteil und auf die Blattränder beschränkt. Die Endodermiszellen haben am Wurzelquerschnitt die Form des Buchstabens C oder U. Die letzte Gruppe ist durch *T. gracile,* die einzige endemische Art Sardiniens repräsentiert. Die Gestaltung der Blattspreiten ist zusammengefaltet oder zusammengefaltet mit einer Neigung zur geschlossenen Blattspreite. Das Sklerenchym am Blattspreitenquerschnitt ist unter der Epidermis über den einzelnen Gefässbündeln inselartig verteilt. Die Endodermiszellen haben am Wurzelquerschnitt die Form des Buchstabens O.

Die angeführten Gruppen betrachte ich wegen einer ganzen Reihe von wichtigen Merkmalen als sehr gute Untergattungen, die ich wie folgt bezeichne: *Trisetum, Distichotrisetum, Glaciotrisetum* und *Graciliotrisetum.* Die Untergattung *Trisetum* kann man noch in einige weitere Gruppen vom Werte einer Sektion unterteilen. Zur Charakterisierung der Sektionen wurden als Hauptmerkmale vor allem verwendet: die Verteilung des Sklerenchymgewebes und die Grösse der Gelenkzellen auf dem Blattspreitenquerschnitt, der Bau der Epidermiszellen auf der abaxialen Blattspreitenseite, die Behaarung der Ährchenspindeln, die Länge des Blatthäutchens, die Behaarung der Vorspelzenkiele, die Stellung der Blätter an den Halmen und sterilen Trieben und der Charakter der Ährchenrispe. Auf Grund dieser Merkmale kann man die Untergattung *Trisetum* in folgende 5 Sektionen teilen: *Trisetum, Trisetaera, Rigida, Hispanica* und *Carpatica.*

Die systematische Gliederung der Gattung *Trisetum* Pers.

Subgenus *Trisetum*

Vernatio convoluta; sclerenchyma in parte laminarum abaxiali adaxialique in trabeculis singulis nervos attingens (nonnumquam ad nervos superiorum ordinum non perveniens), vel sclerenchyma in parte laminarum abaxiali adaxialique nervis adversum ad eos non pervenit (aut sclerenchyma praecipue apud nervos superiorum ordinum deest) et etiam in marginibus laminarum instructum; membrana cellularum endodermidis radicium (sectio transversalis) crassa, cellulae formam litterae U aut C imitantes.

Sectio *Trisetum*

Panicula ± effusa; sclerenchyma in parte laminarum abaxiali adaxialique in trabeculis singulis nervos attingens, solum apud nervos superiorum ordinum ad eos non pervenit; epidermidis cellulae in parte laminarum foliorum abaxiali longae cum membranis rectis; ligula brevis; cellulae bulliformes perspicuae.

Typus sectionis: *Trisetum flavescens* (L.) Pal.-Beauv.

Es ist die am meisten verbreitete Sektion; hierher gehören die Arten *T. flavescens* (L.) Pal.-Beauv., *T. alpestre* (Host) Pal.-Beauv., *T. sibiricum* Rupr., *T. agrostideum* Fr., *T. baregense* Laf. et Miége. Bemerkenswert ist die Art *T. agrostideum,* die durch den Charakter der Verteilung des Sklerenchyms am Blattspreitenquerschnitt manchmal an die Art *T. spicatum* erinnert.

Sectio *Trisetaera* Asch. et Gr.

Panicula ± contracta; sclerenchyma in parte laminarum abaxiali adaxialique in trabeculis singulis nervis adversum (sed apud nervos superiorum ordinum deest), sed nervos non attingens (singulariter nervos attingens); epidermidis cellulae in parte laminarum foliorum abaxiali longae cum membranis rectis; ligula brevis; cellulae bulliformes perspicuae.

Typus sectionis: *Trisetum spicatum* (L.) Richt.

Hierher gehört nur die Art *T. spicatum* (L.) Richt. s.l., die in ihrem Areal viele bedeutende Typen bildet, die oft als selbständige Arten gewertet werden. Verbreitung des *Trisetum spicatum*-Komplexes (sec. HULTÉN 1959): Gebirge Europas (seine Absenz in den Karpaten und auf dem Balkan ist beachtenswert), Asiens, Amerikas und Australiens und im ganzen arktischen Teil der nördlichen Halbkugel.

Sectio *Rigida* sect. nova

Sclerenchyma in parte laminarum abaxiali adaxialique in trabeculis singulis nervos attingens (nonnumquam ad nervos superiorum ordinum non perveniens); epidermidis cellulae in parte laminarum foliorum abaxiali longae cum membranis rectis; ligula ± brevis; cellulae bulliformes perspicuissimae; pili spicularum rhachillae prolongati; folia innovatiorum culmorumque ± distincte disticha.

Typus sectionis: *Trisetum rigidum* (M.B.) R. et S.

Hierher gehören die Arten *T. rigidum* (M.B.) R. et S.-Komplexes (cf. SEREDIN 1961) und *T. macrotrichum* Hackel. In Europa sind die Arten dieser Sektion auf der Halbinsel Krim und im Kaukasus und weiter in den benachbarten Gebirgen verbreitet, am weitesten gegen Westen bis in die Karpaten.

Sectio *Hispanica* sect. nova

Sclerenchyma in parte laminarum abaxiali adaxialique in trabeculis singulis nervos attingens; epidermidis cellulae in parte laminarum foliorum abaxiali longae cum membranis undatis; ligula paulo prolongata; cellulae bulliformes inconspicuae; folia conspecte hirsuta.

Typus sectionis: *Trisetum velutinum* Boiss.

In diese Sektion gehören nur zwei, in Spanien verbreiteten Arten: *T. velutinum* Boiss. und *T. hispidum* Lge.

Sectio *Carpatica* sect. nova

Sclerenchyma in parte laminarum abaxiali adaxialique in trabeculis singulis nervos attingens (nonnumquam ad nervos superiorum ordinum non perveniens); epidermidis cellulae in parte laminarum abaxiali longae cum membranis rectis; ligula prolongata; cellulae bulliformes perspicuae, in palearum carinis nonnumquam etiam denticuli prolongati usque pili.

Typus sectionis: *Trisetum fuscum* (Kit.) R. et S.

In die letztere Sektion gehört nur die Art *T. fuscum* (Kit.) R. et S., die in den Karpaten wächst.

Beachtenswert wird wahrscheinlich auch die Stellung der Art *T. burnoufii* Req. aus Korsika sein, die sich von einigen verwandten Arten durch eine Reihe von Merkmalen unterscheidet; es ist nicht ausgeschlossen, dass sie zu einer selbständigen Sektion gehören wird; sie hat bestimmte Beziehungen zur Sektion *Hispanica*.

Subgenus *Distichotrisetum* subgen. novum

Syn.: *Trisetum Argentaria* Hermann, Flora v. Nord.- und Mitteleuropa, p. 120.

Vernatio conduplicata; sclerenchyma in parte laminarum abaxiali adaxialique in trabeculis singulis nervos attingens et etiam in marginibus laminarum instructum; membrana cellularum endodermidis radicium (sectio transversalis) crassa, cellulae formam litterae U aut C imitantes; epidermidis cellulae in parte laminarum foliorum abaxiali longae cum membranis rectis; pili spicularum rhachillae satis prolongati; folia innovatiorum culmorumque conspecte disticha.
Typus subgeneris: *Trisetum distichophyllum* (Vill.) Pal.-Beauv.

In diese Untergattung gehören nur zwei Arten, *T. distichophyllum* (Vill.) Pal.-Beauv. (incl. *T. albanicum* Jáv.) und *T. argenteum* (Willd.) R. et S.; sie sind in den Alpen, im Jura und in den Gebirgen der Balkanhalbinsel verbreitet. Ihr Vorkommen in den Pyrenäen und besonders in den Karpaten ist zweifelhaft.

Subgenus *Glaciotrisetum* subgen. novum

Vernatio conduplicata; sclerenchyma in carina in parte laminarum abaxiali in trabeculo singulo ad nervum attingens et etiam in marginibus instructum; membrana cellularum endodermidis radicium (sectio transversalis) crassa, cellulae litterae U aut C imitantes; epidermidis cellulae in parte laminarum foliorum abaxiali longae cum membranis rectis; folia brevia, rigida.
Typus subgeneris: *Trisetum glaciale* Boiss.

In diese Untergattung gehören nur in der Sierra Nevada wachsenden Arten *T. glaciale* Boiss. und *T. antoni-josephii* F. Q et Muñ. Med.

Subgenus *Graciliotrisetum* subgen. novum

Trisetum sectio *Gracilia* Chrtek et Jirásek, Webbia 17:574, 1963, p.p.

Vernatio conduplicata usque inconspicue convoluta; sclerenchyma in parte laminarum abaxiali adaxialique in trabeculis singulis nervis adversum (nervos non attingens) et etiam in marginibus laminarum instructum; membrana cellularum endodermidis radicium (sectio transversalis) crassa, cellulae formam litterae O imitantes; epidermidis cellulae in parte laminarum foliorum abaxiali longae cum membranis rectis; folia brevia, rigida.
Typus subgeneris: *Trisetum gracile* (Mor.) Parl.

In diese Untergattung gehört nur die einzige in Sardinien endemische Art, *T. gracile* (Mor.) Parl.

Zusammenfassung

Die Gattung *Trisetum* wird auf Grund einiger morphologischer und anatomischer Merkmale in 4 Untergattungen geteilt und zwar: *Trisetum, Distichotrisetum, Glaciotrisetum* und *Graciliotrisetum.* Die Untergattung *Trisetum* weiter in 5 Sektionen und zwar: *Trisetum, Trisetaera, Rigida, Hispanica* und *Carpatica.* Die einzelnen Untergattungen und Sektionen sind auch durch ihre Verbreitung charakterisiert.

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Släktet Mentha i det nordiska floraområdet

AV NILS HYLANDER

Då arbetet på min Nordisk kärlväxtflora för mer än 20 år sedan sattes i gång, var avsikten närmast att med detta verk ge en modern flora av ungefär samma typ som 11. upplagan av HARTMANS Handbok fastän omfattande ett betydligt större geografiskt område; den tänktes publicerad i ett enda band eller möjligen två, som dock skulle utkomma med kort mellanrum. För att så fort som möjligt kunna meddela ett par prov på hur utformningen var tänkt, utförde jag, när beslutet om utgivningen fattats, ett par avsnitt, omfattande några släkten, som jag då hade aktuella, bl.a. *Mentha*. Sedan emellertid floran under hand kommit att anta en avsevärt förändrad karaktär och visat sig komma att bli betydligt större än från början avsetts, blevo dessa redan färdigställda (t.o.m. i form av ett provtryck utförda) avsnitt liggande opublicerade; genom forskningens fortskridande förlorade också en del av dem sin aktualitet. I fråga om släktet *Mentha* sökte jag emellertid tid efter annan att föra framställningen up to date; sålunda ha resultaten av HÅRDs arbete om *M. aquatica* och *M. aquatica* × *arvensis*, A. HANSENs upptäckt av *M. aquatica* × *longifolia* i Danmark och MARKLUNDs studier över de östfennoskandiska formerna av *M.* × *gentilis* och *M.* × *dalmatica* arbetats in, liksom jag också så vitt möjligt tagit del av till museerna nyinkommet material. I november 1964 gjorde jag också ett besök i Oslo, speciellt för att studera det norska *Mentha*-materialet i därvarande botaniska museum, vilket jag också kunde genomgå och bestämma. Då det synes mycket osäkert när (eller överhuvud om) jag skall få tillfälle att i floran nå fram till en så högtstående grupp som labiaterna, har det synts mig motiverat att i en särskild uppsats publicera framställningen av de nordiska myntorna, så som den nu föreligger, i hopp om att den skall kunna vara till nytta för Nordens floristen och stimulera till fortsatt forskning i denna förvisso långt ifrån utredda, intrikata grupp. Uppställningen följer så noga som varit möjligt den i första delen av Nordisk kärlväxtflora (och i den snart föreliggande andra) brukade. Tecknet * markerar som där förvildade men nu naturaliserade taxa.

Mentha L. 1753.

Fleråriga örter med hela blad; foder tvåläppigt el. (oftast) nästan radiärt, femtandat; krona vanl. ± violett (rödviolett—nästan blå), endast otydl. tvåläppig, de tre nedre flikarna sinsemellan lika, hela, ung. jämnhöga med den ngt bredare, nästan platta, vanl. urnupna överläppen; stånd. åtskilda, med parallella knapprum (blr ofta ♀); delfrukter kala, rundade—äggrunda.

A. Foder tydl. tvåläppigt (de båda övre tänderna tydl. bredare än de nedre), i svalget tätt långhårigt; bladskivor svagt sågade—nästan helbräddade, vanl. ej > 2 cm långa .... **pulegium** 1.

AA. Foder nästan radiärt (alla tänder nästan likformiga), i svalget kalt el. glest korthårigt; bladskivor vanl. större

B. Blomkransarna bilda ett (åtm. upptill) smhängande, toppställt ax med förkrympta högblad (endast hos × *piperita* det nedersta stödbladsparet väl utvecklat)

C. Foderpip utanpå kal; bladskivor på båda sidor gröna, kala el. endast på nerverna glest håriga

D. Foderpip kort klocklik med svaga o. glesa nerver; blad oskaftade .... **spicata** 8.

DD. Foderpip nästan cylindrisk, starkt tätnervig; blad skaftade × **piperita** 5.

CC. Foderpip utanpå hårig; bladskivor undertill grå- el. vitludna

D. Foderpip mkt kort, rundat klocklik; bladskivor starkt rynkiga, naggade, ± rundat ovala, i spetsen brett avrundade **rotundifolia** 11.

DD. Foderpip mer utdraget klocklik; bladskivor ej tydl. rynkiga, ± vasst sågade, med tydlig spets

E. En del hår greniga .... × **villosa** 10.

EE. Alla hår enkla, långt utdragna i en vass, mkt fin spets **longifolia** 9.

BB. Blr antingen bildande en toppställd huvudlik ställn. (ev. under denna en enda, ofta upplöst blomkrans) el. ordn. i kransar i vecken av vanliga mlnblad o. vanl. alla (mera sällan endast de nedre) tydl. åtskilda

C. I stj:s topp en huvudlik, ± klotrund ställn., därunder inga blr el. en enda, ofta upplöst blomkrans i vecken av mlnblad; foder långt (c. 3,7—4 mm) med nästan cylindrisk, kraftigt tätnervig pip o. nästan syllika tänder .... **aquatica** 4.

CC. Blr i ± talr., åtskilda kransar, alla el. flert. med stora, mlnbladsartade stödblad (de översta stundom med ± reducerade stödblad o. ngt axlikt närmade)

D. Foder klocklikt med svaga nerver, dess tänder ± brett triangulära, nästan alltid trubbiga; fruktsättn. god **arvensis** 2.

DD. Fodrets pip klocklik—trattlik el. nästan cylindrisk med åtm. 5 kraftigt markerade nerver; fodertänder spetsiga; blr vanl. ♀ el. könlösa; frukt mkt sällan utvecklad

E. Foder 3,5—4 mm långt; foderpip smalt klocklik—nästan cylindrisk med 10(—13) tättliggande, mkt kraftiga nerver; fodertänder smalt—syllikt triangulära × **verticillata** 3.

EE. Foder c. 2—3 (sällan, hos *gentilis* nm. *submascula*, intill 3,5) mm långt, dess pip med 5 kraftiga nerver o. mln dem vanl. 5 svagare
F. Bladskivor under gröna, gleshåriga × **gentilis** 6.
FF. Bladskivor under starkt gråludna × **dalmatica** 7.

I. Subg. **Pulegium** (Mill.) Briq. 1891 (*Pulegium* Mill. 1768 pro gen.): Foder tydl. tvåläppigt, i svalget med en tott av vita hår.

1. **M. pulegium** L. 1753 (*Pulegium vulgare* Mill. 1768). — Polejmynta (N, D: poleimynte; F: puolan minttu).

Stj. från långa jordstammar upprätta el. ± uppstigande, vid basen med ovanjordiska, rikbladiga utlöpare; nedre stj.blad kort el. otydl. skaftade, deras skiva sällan > 2 cm lång, ovalt lansettlik, nedtill kilformigt avsmalnande, svagt naggsågad—nästan helbräddad, kal el. svagt korthårig, med endast 1—3 par sidonerver; blomkransarnas stödblad ngt mindre med ± rundad skiva, de översta ofta ± förkrympta; blomkransar talr., långt åtskilda, mkt rikblommiga; foderpip ± smalt klocklik—trattlik, med täta o. kraftiga, i tänderna utlöpande nerver, ± tätt korthårig; fodertänder spetsiga, de nedre nästan syllika, de övre smalt triangulära med udd; krona med smala flikar, även den övre i spetsen hel, avrundad; nötter äggrunda, släta. Lukt kraftig, behaglig, ngt syrlig. — Krom. 2n=20, 40. — HS, ES.

Utöver den ovan beskr. typrasen (även kallad var. *communis* Bth. 1832—36) har inom omr. även som adv. anträffats den starkt håriga var. **villosa** Bth. ap. DC. 1848.

Typrasen fordom off. o. odl. i apoteks- o. herrgårdsträdg. i **D** o. s. **S**; en gång (c. 1800) funnen i **D** (Fyn: Korselitze) till synes spont. men säkerligen tillf. förv., i modern tid funnen adv., mestadels helt tillf., på rud.mark i **S** (Gbg från 1930-t. flerst., på några lok. flera år i följd), **D** (Kbhvn) o. **F** (Nyl Drumsö vid Hfors); var. **villosa** **S** Göteborg tillf. — [Arten inhemsk i s. o. mell. Eur., v. As., n. Afr., Etiop., därutanför flerst. odl. som kryddväxt o. för utvinning av olja (polejolja); typrasen mest i mell. Eur., var. *villosa* i s. Span., n. Afr. samt odl. i Tyskl., Engl. o. NAm.]

II. Subg. **Menthastrum** (Coss. & Germ. 1845 pro sect.) Briq. 1891: Foder nästan radiärt (alla fodertänder ung. lika breda), i svalget kalt(—glest korthårigt).

A. Sect. **Verticillatae** L. 1763: Alla blomkransar åtskilda, i vecken av mlnblad; krona utanpå o. i svalget hårig; blad skaftade.

2. **M. arvensis** L. 1753. — Åkermynta (N: åkermynte; D: agermynte; F: peltominttu).

Utlöpare underjordiska; stj. vanl. 10—40 cm hög, täml. vek, ofta grenig; bladskivor mkt växl. till form, hårighet o. serratur, brett lansettlika—äggrunda, oftast täml. grunt o. trubbigt sågade; foder kort (vanl.

c. 3 mm långt), dess pip ± öppet klocklik, ± tätt hårig, med fem svaga (på pressat material knappt framträdande) nerver, dess tänder täml. brett triangulära (ung. lika långa som breda el. ngt bredare), ngt trubbiga (sällan med kort spets); blr ⚥ el. ♀; fruktsättning rikl.; nötter avlånga, släta (under lupp finstrimmiga). Lukt hos vissa ff. angenäm (melissartad), hos andra frän. — Krom. 2n=*12, 60—62, 72,* 54, 64, c. 90, 92. — HS—H.

Även inom omr. ytterligt mångformig, men någon rationell systematisering av de olika typerna låter sig, åtm. f.n., ej gmföra. N-ut synas emellertid lång- o. smalbladiga typer överväga o. vara de eg. inhemska.

Stränder, fuktig skogsmark etc. samt allehanda (helst fuktig) kulturjord: åkrar, diken, beteshagar; mkt hemerofil o. ofta besvärligt ogräs. — **K.** HULT. 1950, nr 1518. — **S** Götal. o. Sveal. allm.; Norrl. i kustprov. till Nb Pajala, (ännu i Mpd t. allm.), i inl.prov. till LyL sälls. o. nästan endast på (sjö- o.) flodstränder, mkt sällan nående upp i subalp. reg.; PL Arvidsjaur: Glommersträsks stn (adv.), möjl. även Arjeplog. — **N** N-ut till NTrd Nærøy, i s. del. allm.; Nrd tillf. — **D** hela landet allm. — **FR** nästan alla prov. (till Lk, Lp, Lm), i de s. o. mell. del. (till 64° n. br.) ± allm. — [Nästan hela Eur. (mot NV till Orkn., i medit.omr. endast som ± sälls. ogräs), Madeira, Kauk., n. As. (mot S till Him.); natural. i NAm. — Den närst. *M. canadensis* L. som typisk inhemsk i NAm., i ± avvikande ff. (även smfattade som *M. haplocalyx* Briq. 1889) i ö. As.]

B. Sect. **Capitatae** × sect. **Verticillatae.**

3. **M.** × **verticillata** L. 1759 (pro sp.;=*M. aquatica* × *arvensis*; *M. sativa* L. 1763). — Kransmynta.

Utlöpare vanl. underjordiska; stj. vanl. hög o. grov som hos nr 4 men ofta rikt långgrenig (även i nedre delen); blomst.typ mkt växl. från »subcapitat», d.v.s. med översta stödbladen förkrympta o. en—flera kransar saml. till en huvud- el. axlik ställn. (men då alltid med flera ± skilda kransar under topphuvudet), till »verticillat»: med alla blomkransar åtskilda, i vecken av mlnblad; från nr 2 alltid skild gm det långa ribbnerviga fodret, som liknar det hos nr 4 men ofta är ngt kortare o. har mot basen bredare tänder; blr oftast ♀; frukt ej sedd av förf. — Krom. 2n=c. *96*, c. *120*, 26. — HS—H.

Ytterst mångformig hybr., i **S** vanligare än *M. aquatica* o. förekommande långt utanför dennas omr. Gm sin mkt rika veg. förökning o. den lätthet, med vilken utlöparbitar spridas o. rota sig, kan hybr. bilda rika enhetliga bestånd o. vissa kloner stundom uppträda som lokalraser; en sådan är den i Ög Ombergs-tr. uppträdande s.k. *M. gothica* Neum. 1901.

Växeställen ung. som för *M. aquatica*; förr odl. som kryddväxt (åtm. i Sm). — **K.** HÅRD 1955, s. 9 (**S**, med lf.). — **S** ± spridd i alla prov. (även Dls o.

Vrm) till Dlr o. Upl (här mest vid kusten o. i skärg.; då i regel hybr. med *aq.* var. *litoralis*); enst. fynd i Gstr, Hls (*lit.*-hybr.) o. Ång. — **N** i kusttr. från Oslofjorden till Hrd Fana o. Fjell; SoFj Gudvangen i Sogn (*subarvensis*-f.). — **D** uppg. från de flesta distr. men mindre allm. än nr 4. — **F** Al sälls. (även *lit.*-hybr.: *M. litoralis* f. *interrupta* Lindb. fil. ap. Hjelt 1919—23); St Luvia (*lit.*-hybr.).

C. Sect. **Capitatae** L. 1763: Stj. avslutad med en ± halvklotformig, tätt huvudlik (sällan ngt förlängd o. nedtill ± avbruten) blomst. med förkrympta stödblad, därnedanför ofta en ensam (ej sällan upplöst) blomkrans i vecken av vanliga mlnblad; krona utanpå o. inuti hårig; blad skaftade.

4. **M. aquatica** L. 1753 (*M. aq.* A. *capitata* Fr. 1828). — Vattenmynta (Fs: hästmynta; N: vassmynte; D: vandmynte; F: vesiminttu; Fär: hestamynta).

Utlöpare talr., mkt långa o. långledade, småbladiga, vanl. ovanjordiska (stundom nedsänkta i vattnet o. då med ± förkrympta o. bleka blad); stj. grov o. stadig, intill 80 cm hög, ogrenad el. upptill med täml. korta, ofta blombärande grenar; blomskaft täthåriga; foder långt (vanl. 3,7—4 mm), oftast ± purpurbrunt anlupet, dess pip (smalt klocklik—) nästan cylindrisk, tätt strävhårig—nästan kal, tätt ribbig av 10 ung. jämnstarka, grova nerver, dess tänder mkt spetsiga, (triang.) syllika (mera sällan triangulära med syllikt hopdragen överdel); krona stor (vanl. 6—6,5 mm lång) med täml. smala (± äggrunt avlånga) flikar; blr nästan alltid ⚥; nötter rundat ovala, ngt knottriga. — Krom. 2n= c. *96*, 36. — HS—S.

Till storlek, hårighet o. bladform ytterst växl., stundom svår att avgränsa från *aquatica* × *arvensis*. En täml. utpräglad ras är

var. **litoralis** (Hartm.) C. A. West. 1863 (*M. aq.* ssp. *lit.* Hartm. 1846; *M. lit.* (Hartm.) Neum. 1901): stj. nästan fullst. kal, ogrenad el. fågrenig; bladskivor undertill på nerverna ± gleshåriga, f.ö. (nästan) kala, smalt—täml. brett äggrunda med rundad—nästan tvär bas o. täml. tät men grund o. trubbig sågning; foder mkt kort gleshårigt. — Krom. 2n=. . .

Kärr, stränder, bäckar, diken, helst i kalk- o. kusttr.; var. **litoralis** endast på havsstränder. — **K.** HULT. 1950, nr 1517; HÅRD 1955, s. 6 (**S**, med lf.). — **S** (exkl. var. *litoralis*) Gtl, Öl o. Sk ± allm.; n. Hl—Bh spridd (nästan endast vid kusten); Bl:s kusttr. flerst.; s. Klm o. Vg sälls.; Dls (alltjämt?) Ör o. Dalskog; Ög Ö. Ryd o. Vreta kloster; Srm Nyköping; Upl Lidingö o. Möja (Ramsmoraö). — **N** sälls. i kusttr. från Oslofjorden till AuAgd Hövåg o. från Rog

Modla till Hrd Stord. — **D** allm. — **F** (exkl. var. *lit.*) Al sälls.; Ab Hirvensalo vid Åbo (trol. förv.); Nyl Lappvik. — **Fär** sälls.: Strömö, Vågö. — var. **litoralis**. **S** Klm Loftahammar-tr.; Ög vid Bråviken; Srm Torö (enl. HÅRD även Tunaberg o. Bälinge); Upl särsk. Sthms skärg. o. n. kusten (här rikl.); Gstr Gävle skärg. flerst.; Hls Skog o. Ljusne. — **F** Al sälls.; St Eurajoki o. Luvia. — [Eur. (åt NÖ utom vårt omr. till Ösel, Estl., Ingermanl.), v. As. (till v. Sib. o. n. Pers.), n. Afr., Kap; natural. på Madeira, i NAm., SAm. (även Juan Fernandez) o. Austr. — var. *litoralis* ej känd utom omr.]

M. aquatica × **arvensis** — se ovan nr 3.

M. aquatica × **arvensis** × **spicata** (=*M. aquatica* × *gentilis;* M. × smithiana R. A. Grah. 1949; »*M. rubra*» s. Sm. et auct. mult. poster. — non Mill. 1768, nec Huds. 1778).

Hit synas höra några ex. från Gtl (Visby o. Lummelunda), avvikande från *M.* × *gentilis* nm. *verticillata* gm mer förlängd, starkt mångribbig foderpip; huvudskottets övre blomkransar starkt närmade varandra, med helt små, helbräddade stödblad.

M. aquatica × **longifolia** (M. × dumetorum Schult. 1809 pro sp.; *M. hirta* Willd. 1809; *M. pubescens* Willd. 1809).

I blomst. o. bladtyp ± intermediär; fodertänder mera triangulära än hos *M. longifolia,* foderpip kortare o. mindre ribbig än hos *M. aquatica.* — Bladskivor hos de föreliggande nord. ex. som unga (liksom de unga skottaxlarna) tätt gråludna, som äldre glesare håriga (mest på nerverna), även de övre tydl. skaftade, de nedre avlångt äggrunda o. med antydan till dubbelsågning, de övre brett—hjärtlikt äggrunda; blr ♀.

Sälls. bland stamarterna. — **D** Jl (distr. 21) N om Stjære Söskov nära Tåstrup Sö; möjl. hör hit även ett av WIINST. som *aquatica* × *longifolia* bestämt ex. från distr. 13 vid Glenstrup Sö med ytterst snarlik bladform men till synes helt *longifolia*-lik blomst.- o. fodertyp.

[**M. aquatica** × **rotundifolia** (M. × maximilianea F. W. Schultz 1854).

Uppgiven från **D** Brnh Ormbækken vid Rönne; beläggen synas mig för outvecklade för säker bestämning men torde vara *M. aquatica.*]

D. Sect. **Spicatae** × sect. **Capitatae.**

5. **M.** × **piperita** L. 1753, em. Huds. 1762 (=*M. aquatica* × *spicata*). — Pepparmynta (N: peppermynte; D: pebermynte; F: piparminttu).

Utlöpare talr., huvudsakl. ovanjordiska, småbladiga; stj. nästan kal, vanl. purpurbrunt anlupen, ofta täml. rikgrenig (de översta grenarna axbärande); bladskivor äggrunt lansettlika el. på de nedre bladen ± avlånga, med tydligt (vanl. 6—8 mm långt) skaft, sågade med låga men vassa o. långa tänder (stundom med antydan till dubbelsågning), på u.sid:s nerver glest enkelhåriga, f.ö. kala, på ö.sid. mörkgröna, undertill ngt blekare; blomkransar saml. i ett vanl. c. 4—6 cm långt o. c. 1,5 cm brett, upptill tätt, nedtill avbrutet ax i stj.toppen, de nedersta kransarna ofta ± tydl. upplösta i ± skaftade delknippen, den nederstas (el. de två nederstas) stödblad ofta ± mlnbladslika; foderpip nästan cylindrisk, ribbig av de täta, starka nerverna, vanl. mörkt purpurbrun, starkt hartsprickig, kal; fodertänder syllikt triangulära, ± glest styvhåriga; krona 4—4,5 mm lång; blr ♀; frukt 0. Lukt frisk (»pepparmynt»). — Krom. $2n=36$ (»var. *officinalis*»), 72 (»var. *vulgaris*»), 86. — HS, ES.

Off. **S** (drog torkade blad: Folium menthae piperitae), **N**, **D** o. därför odl. (stundom även som kryddväxt) men sälls.; någon gång ngt förv. (**S** Gtl Ganthem, Vg Stenstorp). Beskrivningen passar till den typ. formen, även kallad nm. *vulgaris* Sole 1798 (pro var.; *M. pip.* subsp. *eupiperita* Briq. var. *officinalis* Sole f. *rubescens* Camus), den enda inom omr. förek. (o. off.) rasen; urspr. uppkommen i Engl. på 1600-t., sedan förökad på veg. väg (»black mint»).

Till hybr.kombinationen *M. aquatica* × *spicata* hör sannol. följ., om *M. spicata* var. *crispa* erinrande, åtm. förr i **S** o. **D** som med.växt odl. krusbladiga form:

M. crispa L. 1753, s. Lge 1886—88 (*M. piperita* γ *crispa* (L.) Koch 1837), grå krusmynta, skild från *M. piperita* gm undertill starkare håriga, ngt gråaktiga, hjärtlikt rundade, nästan parallellnerviga, veckiga, i kanten oregelbundet inskuret smalsågade o. krusiga bladskivor på mkt kort, långhårigt skaft samt tätare, endast c. 3 cm långt ax o. mkt korthåriga fodertänder. — Jämte *M. spicata* var. *crispa* förr off. som krusmynta. Kulturform av okänd härstamning, enl. Lge l.c. i **D** (Sj) ofta odl. i gamla trädg. o. därifrån förv.; nuvarande status obekant.

E. Sect. **Spicatae** × sect. **Verticillatae.**

6. ***M.** × **gentilis** L. 1753 (pro sp.), s. coll. Hyl. 1941 (=*M. arvensis* × *spicata*). — Ädelmynta (N, D: engmynte; F: — se nedan).

Utlöpare underjordiska (sällan någon enst. ovan jord), ofta grova; bladskivor ovan täml. tätt håriga—(nästan) kala men alltid med mittnerven (särsk. mot basen) korthårig med delvis glandulösa hår; blomkransar åtskilda i mlnbladens veck, sällan de övre ngt närmade med ngt reducerade stödblad; foder c. 2,5—3 (hos nm. *submascula* ända till 3,5) mm långt, dess pip kal el. ± tätt hårig, klocklik med avrundad bas el. nästan trattlik, med 5 grova, i tänderna utlöpande nerver o. mln dem 5(—7) svagare; fodertänder åtm. i kanten ± tätt styvhåriga, ± smalt

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Fig. 1. a. *Mentha arvensis* ♀. Skåne, Sireköpinge: Kläsinge 1903 N. Alvthin. — b. D:o. Dalarna, Stora Skedvi 29/7 1902 G. Samuelsson. — c. *M. aquatica* × *arvensis*. Skåne, Vitaby 7/9 1902 Fr. E. Ahlfvengren. — d. D:o. Skåne, Bårslöv 21/8 1901 O. J. Hasslow. — e. *M. gentilis* nm. *anderssoniana*. Dalarna, Falun aug. 1916 E. Hellström. — f. *M. gent.* nm. *Arrhenii*. Stockholm, Djurgården: Oakhill 27/8 1926 T. Vestergren. — g. *M. gent.* nm. *verticillata*. Östergötland, Linköping 30/8 1919 Hj. Holm. — h. D:o. Skåne, Brunnby: Krapperup s.a. N. Gyllenstierna. — i. *M. gent.* nm. *submascula*. Gotland, Alva: kornåker vid stationen 18/8 1929 E. Th. Fries. — j. *M. gent.* nm. *subspicata*. Skåne, Svalöv: Holgerstorp 23/8 1921 N. Sylvén. — k. *M. gent.* nm. *parviflora*. Finland. Nyland, Kyrkslätt: Österby, Nygård H. Lindberg (Pl. Finl. Exs. 879). — × $6\,^1/_3$. (Från Hyl. 1941).

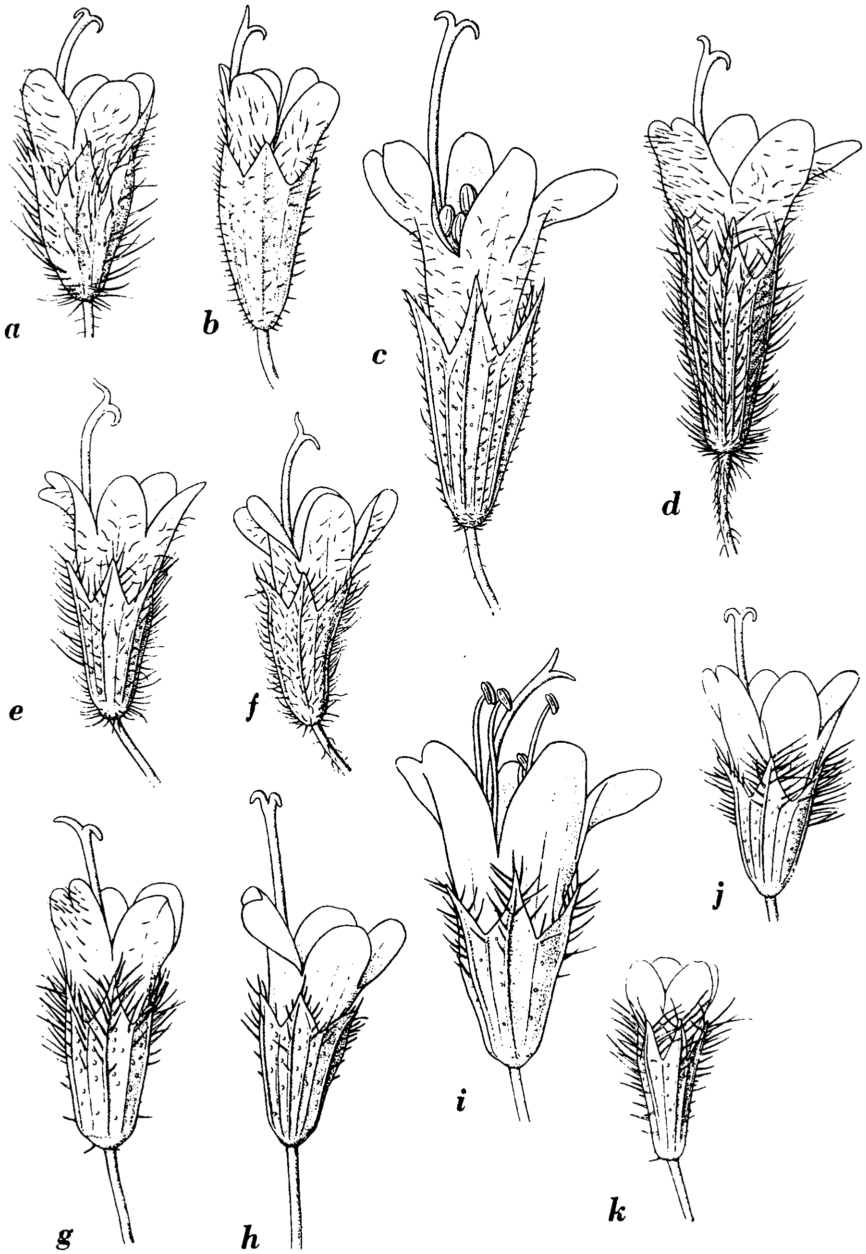

Fig. 1.

triangulära, ± spetsiga (tydligast på unga blr); blr oftast ♀; fruktsättning nästan alltid 0. — ES, H.

M. × *gentilis,* som här fattas i sma vida mening som hos Hyl. 1941, där avgränsningen närmare motiveras, utgör av allt att döma ett från *M. arvensis* ×*spicata* härst. formkomplex, vars inom omr. funna ff., att döma av herb.-materialet, till allra största delen kunna fördelas på följ., här som nothomorfer (nm.) upptagna men kanske ej helt likvärdiga taxa (jfr nedan under nm. *verticillata* o. nm. *subspicata*). Dessa ha ordnats på ett sätt, som i möjligaste mån motsvarar den här använda artföljden, d.v.s. begynnande med de mest *arvensis*-lika ff. o. avslutat med de ± *spicata*-lika, nm. *subspicata* o. nm. *parviflora.* De båda sistn. äro hos oss utan tvivel, i den mån de förek. vilda, rester av en ännu i sen tid bestyrkt odling som doftväxter; nm. *parviflora* har över huvud endast sällan lyckats sprida sig utanför tomtgränserna. Även nm. *verticillata* torde vara en sådan kulturrelikt, fastän den i långt högre grad emanciperats o. i stor utsträckning uppträder som åkerogräs o. även neofyt. De tre ± *arvensis*-lika ff.: nm. *anderssoniana,* nm. *hirtella* o. nm. *Arrhenii* äro endast kända som ogräs, o. det kan väl ej uteslutas, att de (el. någon av dem) uppkommit inom vårt omr. efter återkorsning av en odl. (o. förv.) *gentilis*-form, närmast då nm. *verticillata,* med *M. arvensis.* På förekomsten av sådan återkorsning tyda måhända de i herb. föreliggande ströex., som — fastän hörande till *gentilis* — ej kunna hänföras till någon av de nedanst. formerna o. vilka ej synas ha vunnit en sådan utbredning som dessa. Cytol. undersökningar kunna här kanske bringa klarhet liksom i fråga om de redan urskilda nothomorfernas inbördes förhållande o. genesis.

a. Blr ♀ med ur kronan utskjutande stift men inneslutna, förkrympta st.knappar; foderpip klocklik, även vid basen ± tätt långhårig; krona i svalget med talr. långa hår.

nm. **anderssoniana** (H. Br.) Hyl. 1941 (pro var.; *M. and.* H. Br. 1890; *M. dalmatica* var. *and.* (H. Br.) Briq. 1896; [*M. gent.* var. *vermlandica* Hyl. in sched. et ex Hult. 1950, n. nud.;] »*M. Arrhenii*» s. auct. suec. quoad pl. suec. — non s. orig.; »*M. aquatica* × *austriaca* (f. *verticillata*)» et »*M. agrestis* × *aquatica*» s. Neum. 1901; »*M. agrestis* Sole» s. Neum. 1901 — non s. orig.).

Stj. nedom den blombärande regionen vanl. med (stundom sent utväxande), slutl. i regel starkt förlängda, ± bågigt uppstigande grenar, nedtill glest, upptill (särsk. i blomreg.) tätt hårig av ± nedåtriktade hår; bladskivor från rundad (på kraftiga ex. stundom vid själva bladskaftsfästet ngt killik) bas ± utdraget äggrunda med ngt utdragen, helbräddad, täml. spetsig toppdel, ovan täml. tätt o. långt håriga, under på nerverna ± tätt långhåriga, f.ö. ± gleshåriga; bladskivans tänder långa men låga, med rak el. vanl. ngt insvängd rygg o. utsvängd, vass spets; blomkransar talr., åtskilda, vanl. täml. täta o. starkt grå av de täthåriga fodren; blomskaft kala el. med ngt enst. hår; krona c. 4,5 mm lång, utanpå (särsk. på överläppen) vanl. rikhårig. — Krom. 2n=...

Trädg.land, åkrar (i sht potatis-), diken. — **K.** Hyl. 1941, s. 12 (med lf.). — **S** Sm Växjö- o. Nässjö-tr.; s. Ög Kisa; Gbg, Bh, Dls, Vg, Vrm o. Dlr ± spridd o. ofta rikl.; v. Nrk Nysund. — [Ej känd utanför **S**.]

nm. **hirtella** Markl. [ex Hyl. 1955, n. nud., et] 1963 (pro var.; »*M. Arrhenii*» s. auct. finl. p.p. et s. Lindb. fil. 1906 p.p. sed non quoad typum).

Intar en mlnställn. mln nm. *anderssoniana* o. nm. *Arrhenii,* från den förra skild gm ej så tydl. utdragna bladskivor med trubbigare, mindre utsvängda tänder, från den senare skild gm de ngt starkare håriga, vid basen ± rundade, ej nedlöpande, ± äggrunda bladskivorna med tätare o. mera framåtriktade tänder, mera lång- o. täthårigt foder o. större (c. 5 mm lång), mörkare blåviolett krona samt längre utskjutande, tydl. violett stift; blomskaft kala el. med ngt enst. hår; lukt (enl. Marklund) behagligare än hos nm. *Arrhenii,* ngt pepparmyntsartad. — Krom. 2n=. . .

Växeställen som för nm. *anderssoniana.* — **K.** Marklund 1963, s. 6 (med lf.). — **F** ö. Ab Pusula, Lojo o. Vihti; Nyl spridd (kring Hfors ± allm.); Ka Karhula o. Aspö (=Haapasaari); St Hämeenkyrö; Ta Teisko o. Tammerfors. — [Ej känd utanför **F**.]

nm. **Arrhenii** (Lindb. fil.) Hyl. 1941 (pro var.; *M. Arrh.* Lindb. fil. 1906, quoad coll. typ.: Pl. Finl. Exs. n:o 880). — (F: Suomen minttu.)

Habituellt o. i fråga om bladskivornas tandning mkt lik nm. *verticillata,* från de båda föreg. nm. skild gm att bladskivornas bas är ± kil-likt utdragen, så att bladskaften (i sht på skuggex.) bli ngt vingade; blomskaft tätt håriga; krona ljusviolett (på skuggex. stundom nästan vit); stift blekt. — Krom. 2n=. . .

Växeställen som för nm. *anderssoniana.* — **K.** Marklund 1963, s. 7 (med lf. för **F**); Hyl. 1941, s. 12 (**S**, med lf.). — **S** endast känd från Sthms-tr., trol. i sen tid (1800-t.?) ink. från **F**; ej sedd efter 1930-t. — **F** s. Ab—Ik spridd (särsk. i kusttr.); St Tyrvis; Ta Luhanka o. Heinola; Sa o. Sb sälls.; Tb Jyväskylä. — [Ej känd utanför vårt omr.]

b. Blr ♀ liksom hos a (el., hos nm. *submascula,* ⚥ med utskjutande stånd.) men foderpip vid basen kal; krona inuti med helt korta (± pigglika) hår el. kal.

nm. **verticillata** F. Aresch. 1866 (ut [var.] β; *M. gent.* var. *agardhiana* Lge 1883; *M. ag.* Fr. 1842 — non s. orig. Fr. 1819; *M. gent.* β *lincopensis* Neum. 1901; *M. arvensis* δ *subgentilis* A. Blytt 1874).

Stj. vanl. 30—50 cm hög, oftast rikgrenig, nedtill (nästan) kal, upptill med ± (ofta mkt) gles hårighet av helt korta, ± nedåtböjda hår, vanl. i hela sin längd ± starkt purpuranlupen; bladskivor vanl. föga håriga, äggrunda—äggrunt elliptiska, täml. trubbiga med jämn sågning av täml. låga, trubbiga tänder med ngt kullrig rygg o. vanl. ngt inböjd spets (endast på de övre stödbladen stundom med ngt konkav rygg o. utåtböjd spets), alla likformiga o. mot toppen endast föga avtagande i storlek, åtm. de nedre tydl. skaftade; blomkransar långt åtskilda, täml. glesa (stundom ± upplösta); blomskaft kala (utom hos vissa norska ex.); fodertänder vanl. rikt styvhåriga; krona c. 4,5 mm lång, utanpå kal el. ngt hårig, i svalget med korta hår ung. i jämnhöjd med st.knapparna. — Krom. 2n=. . .

Vissa gotländska (o. öländska) ex. med sma foderhårighet avvika gm ngt spetsigare fodertänder, ngt större krona samt glesare men vassare o. mer utsvängda bladtänder o. närma sig därigenom nm. *submascula*; möjl. representera de en egen ras. Även *verticillata*-materialet från **S**:s fastl. o. **N** visar emellertid en större variation, åtm. i fråga om fodrets (särsk. fodertändernas) form o. hårighet, än övr. här upptagna nm. o. kan möjl. — i motsats till vad som synes vara fallet med dessa (möjl. med undantag av den föga kända nm. *submascula*) representera mer än en klon, fast en uppdelning därav på tydl. skilda grupper ej varit mig möjlig; först jämförande odling av olika provenienser kan avgöra i vad mån skillnaderna äro av modifikativ natur o. om ärftliga olikheter finnas — ev. också i krom.talet — vilka kunna tillåta en vidare uppdelning. — Några snarlika gotl. ex. med nästan cylindriskt klocklik, tätnervig foderpip synas vara *aquatica* × *gentilis* (se ovan efter *M. aquatica*).

Åkrar, trädg.land, stundom vid bäckar o.d. — **K**. HYL. 1941, s. 14 (**S**, med lf.). — **S** känd från Götal:s samtl. prov. utom Dls (särsk. Sk o. Ög, sälls. i Vg); Nrk, Srm sälls. — **N** (lf. HYL. 1941) spridd i kustprov. från Akh till NTrd Frosta; Nrd Bodö. — **D** Sj flerst.; Brnh Rönne. — [Ej med säkerhet känd utom vårt omr.]

nm. **submascula** (Neum.) Hyl. 1965 (*M. gent.* var. *agardhiana* f. *subm.* Neum. ap. K. Joh. 1910; *M. gent.* var. *verticillata* f. *subm.* (Neum.) Hyl. 1941).

Från omr:s övr. *gentilis*-ff. skild gm utskjutande stånd. o. större blr (krona c. 5,5 mm lång). — Habituellt närmast lik nm. *verticillata* men stödbladsskivor ngt smalare o. spetsigare med ngt rakare o. mer utstående tänder. — Krom. 2n=. . .

Åkrar etc. — **S** Gtl flerst.

nm. **subspicata** F. Aresch. 1866 (ut [var.] α; *M. comatula* (Briq.) Neum. 1901; *M. gent.* var. *com.* Briq. 1896). — Skånsk ädelmynta.

Stj. (30—)50—100 cm hög, i övre delen med (ofta talr.) smån. starkt förlängda, ngt utstående, (nästan) raka fert. grenar, glest el. (på solex.) ej sällan täml. tätt klädd med täml. korta, ± nedåtböjda hår, ofta starkt rödanlupen; blad kortskaftade (de nedersta ofta, liksom åtm. de övre stödbladen, nästan oskaftade); nedre o. mell. stj.bladens skivor ± avlångt elliptiska, med låga men långa o. vassa tänder, mot den avsmalnande — nästan rundade basen helbräddade o. med ngt utdraget, tydl. spetsat ändparti; stödblad med glesare tandning o. tydligare spets, i sht på solex. till större delen (men särsk. de översta) tydl. reducerade o. på var sida med endast 1—2 tänder el. helbräddade; blomkransar mkt talr., gm högbladens reduktion nästan bildande ett avbrutet ax, mkt täta o. starkt grå av fodertändernas täta hårighet; fodertänder vasst tillspetsade; krona utanpå o. i svalget kal, c. 4 mm lång, mera rödaktig än hos övr. nm. — Krom. 2n=. . .

Mkt lik nm. *subspicata* i bladen men med både absolut o. i förhållande till fodertänderna tydl. längre, brett vaslik fodertyp, mindre håriga fodertänder, glesare blomkransar o. större, mindre röd krona är en typ, som samlats i Gbg Landvetter (i potatisland; jfr H. FRIES 1945, s. 366, not). I sin tur mkt lik sistn. men med nästan fullst. kalt (på tänderna helt svagt hårigt) foder är en av R. OHLSÉN samlad f. från Vg Alingsås-tr. (Västerled i Rödene samt därifrån inflyttad i Alingsås). Även på Al (Vårdö) är en snarlik f. funnen (se MARKLUND 1963), från nm. *subspicata* skild gm mera håriga, mindre utdragna bladskivor.

Täppor, tomter, vägkanter etc. — K. HYL. 1941, s. 13 (**S**, med lf.). — **S** från äldre tid endast sv. Sk o. här spridd, i sen tid plant. o. kvarst. i nö. Sk Kviinge; Gbg Hinsholmen i V. Frölunda. — **D** Jl Åbenrå; Sj sälls. — [Uppg. för Harz o. Thüringen men osäker.]

c. Blr könlösa med stånd. o. pist. helt reducerade; krona mkt liten, nästan radiär, utanpå o. inuti helt kal.

nm. **parviflora** Hartm. 1846 (ut [var.] β; *M. gent.* var. *Friesii* Briq. 1894; *M. gent.* δ *baltica* Neum. 1901; *M. gent.* L. s. str. Fr. 1828 etc.). — Småblommig ädelmynta (F: jalominttu).

Från de föreg. skild gm de ytterst små, helt könlösa blrna o. nästan trattlik, gleshårig — nästan kal foderpip. — Stj. vanl. 40—70 cm hög, ofta starkt rödanlupen o. i sht i övre delen ofta täml. starkt hårig av korta, ± nedåtriktade hår, med mkt lång fert. region, nedom denna förr el. senare med vanl. talr., slutl. långa, bågigt uppåtböjda fert. grenar; bladskivor ovan täml. tätt korthåriga; nedre stj.bladsskivor ± brett elliptiska med ± kilformig bas, de övre ± äggrunt lansettlika—brett äggrunda; bladtänder mkt vassa, med insvängd—nästan rak rygg

o. ± utstående spets, på de nedre bladen täta o. ofta grova, på de övre stödbladen få (ofta endast 2—4 på var sida) o. låga men mkt spetsiga; blomkransar mkt talr., de övre ofta med ± reducerade stödblad, alla långt åtskilda, mkt täta, starkt grå av fodertändernas täta hår; krona endast c. 3,5 mm lång, blekt (röd)violett. — Krom. 2n=. . .

Allt material jag sett av nm. *parviflora* har haft blr av ovan beskriven typ med helt förkrympt pistill. Nyligen har emellertid MARKLUND från **F** omtalat några ex., där stiftet i vissa blr är väl utvecklat o. utskjutande men som enl. hans mening ej på ngt sätt i övr. avvika från nm. *parviflora* o. därför av honom räknas till denna.

Trädg.täppor, tomter, kvarst. efter odl. men numera sälls. o. ej längre avsiktligt odl.; någon gång sek. på rud.mark, åkrar el. landsvägskanter. — **K.** HYL. 1941, s. 13 (**S**, med lf.); MARKLUND 1963, s. 12 (**F**; d:o). — **S** belagd från c. 40 lok. (delvis mkt gamla fynd) på Öl. o. i Klm, Sm, Hl, Gbg, Bh, Vg, Ög, Nrk, Srm, Upl, Vsm, Gstr o. Hls. — **N** endast sedd från Vestf Eian o. AuAgd Lyngör. — **F** spridd på Al o. i fastl:s v. prov., mot NV till Oa Vasa-tr., mot NÖ till Sb Pielavesi o. Heinävesi, i SÖ blott till Nyl Borgå. — [Ej känd utom omr.]

[*M.* × *gentilis* i talr. ff. spridd i större delen av Europa, som spont. väl uppkommen flerst. inom omr. för *M. spicata.*]

7. ***M.** × **dalmatica** Tausch 1828, s. ampl. Briq. 1896 (=*M. arvensis* × *longifolia*; *M.* × *Kerneri* Topiz 1915, n. illeg.).

Till blad- o. blomst.typ närmast motsv. *M.* × *gentilis* men skild gm de undertill starkt gråluddiga bladskivorna o. den starkare hårigheten hos stj:s övre del; foder täthårigt på både pip o. tänder.

Den inom omr. förekommande representanten för denna, utom vårt omr. mkt mångformiga, med *M.* × *gentilis* analoga formserie synes, att döma av materialets enhetlighet, utgöra en enda klon, vilken — så länge den ej med säkerhet kan identifieras med någon från trakter utanför vårt omr. beskriven f. — i klarhetens intresse må ges ett särskilt namn:

nm. **fennica** Hyl. 1965: stj. vanl. 45—75 cm hög, stadig, tätbladig; stj. o. grenar åtm. som unga tätt långhåriga; bladskivor kortskaftade, de nedre ± brett (äggrunt) ovala o. nästan trubbiga, de övr. äggrunda, kortspetsade, med talr., långa men låga, i en vass spets utsvängda tänder; övre stödblad täml. starkt reducerade o. de mkt täta blomkransarna därigm i viss mån tenderande att bilda en avbrutet axlik ställn.; blomskaft håriga; blr ♀ med utskjutande stift o. förkrympta stånd. (med i pipöppn. ofta skymtande knappar); foder c. 2,5—3 mm långt; krona blekt violett, c. 4,5(—5) mm lång. — Krom. 2n=. . . — ES, H.

Täppor vid gårdar o. torp, fordom odl., sedan kvarst. men mkt sällan spridd utanför tomterna. — **K.** MARKLUND 1963, s. 13. — sö. **F** spridd (särsk. i Sb o. Kb) från Ka o. Ik upp till Sb Nilsiä o. Kb Pielisjärvi (här talr. lok., se lf. hos

Sonck 1964, s. 166, o. **k.** 91), mot NV till Tb Hankasalmi o. Sb Suonenjoki (Viipero). — [*M.* × *dalmatica* spridd i mell. o. ö. Eur.; nm. *fennica* ej fastställd utanför **F.**]

F. Sect. **Spicatae** L. 1763: Blomkransar i vecken av små högbladsartade stödblad o. bildande ett långsträckt ax i stj:s topp; krona inuti kal; mlnbladsskivor med bred bas, oskaftade (sällan helt kort skaftade).

8. ***M. spicata** L. 1753, em. L. [Nathhorst] 1756 (*M. spic.* α *viridis* L. 1753; *M. vir.* L. 1763). — Grönmynta (N: grönmynte; D: grön mynte; F: vihreä minttu).

Utlöpare underjordiska, fjälliga; stj. 40—100 cm hög, nästan kal el. ± rikl. klädd med raka, långt tillspetsade, nedåtriktade hår, oftast purpurbrunt anlupen; stj.bladsskivor oskaftade, från ± hjärtlik—brett avrundad bas jämbrett lansettlika—avlånga, ovan kala o. mörkgröna, under ngt blekare gröna (el. ofta ngt purpurbrunt anlupna) o. kala el. på nerverna med glesa raka enkelhår, spetsiga, ± vasst sågade; ax som helt utvuxet vanl. 5—10 cm långt, c. 1 cm brett, som ungt med utdragen smal topp, i regel med tydl. åtskilda kransar (den nedersta ofta ngt avlägsnad o. ej sällan med ngt förstorade stödblad); foderpip klocklik med 10 täml. svaga nerver, åtm. vid basen (liksom blomskaftet) kal; fodertänder syllikt triangulära; krona 4 mm lång, violett, kal; nötter fint punkterade. Lukt stark, ofta »oljig». — Krom. 2n=*36, 48,* 84. — HS—H.

Täml. mångformig; även inom omr. äro flera (även i lukten) olika typer funna. En anmärkningsvärd kulturf. är var. **crispa** (Bth.) Mansf. 1959 (*M. viridis* var. *crispa* Bth. 1832—36; *M. spic.* var. *crispata* (Schrad.) Sch. & Th. 1914; *M. crispata* Schrad. 1808 et ex Willd. 1809), vanlig krusmynta: bladskivor ± hjärtlikt triangulära—triang. äggrunda, liksom veckade mln de ± parallellt förlöpande huvudnerverna, i kanten krusiga, ± inskuret vasssågade. Fordom off. (**S**: Folium menthae crispae).

Rud.mark, vägkanter, gårdar etc., i sen tid förv. el adv. men numera flerst. stationär i s. **S** o. **D**; någon gång alltjämt odl. som kryddväxt. — **K.** Hult. 1950, nr 1521. — **S** Öl, Sk:s slättbygd o. Bl t. sälls., f.ö. som ± konst. på enst. lok. upp till Vg o. Ög, längre N-ut funnen ± tillf. på rud.mark i Sthmstr. o. Mpd (Timrå, barlast). — **N** tillf. adv. (Oslo-tr., Skåtöy vid Kragerö, Bergen). — **D** t. sälls.; känd från Jl (flert. distr.), Fyn, Ærö, Lang, Loll, Flst, Sj (alla distr.) o. Brnh. — var. **crispa** åtm. förr stundom odl. som med.växt o. någon gång förv. el. adv. (**S** Visby, Srm Villa Plania i Nacka). — [Inhemsk el. arkeofyt i s. o. mell. Eur.; var. *crispa* endast känd i kultur.]

9. **M. longifolia** (L.) L. [Nathhorst] 1756 (*M. spicata* β *long.* L. 1753; *M. sylvestris* L. 1763). — Gråmynta (N: gråmynte; D: grå mynte; F: harmaa minttu).

Utlöpare underjordiska, fjälliga; stj. 40—100 cm hög, åtm. upptill ± tätt besatt med långa, mångcelliga, enkla, i en vass spets smån. avsmalnande, raka el. föga krusiga hår, i de översta bladens veck vanl. med korta, axbärande grenar; stj.bladsskivor oskaftade (sällan mkt kortskaftade), ovan gröna—gråludna, under ± tätt (grå- el.) vitludna, jämbrett lansettlika el. ± brett avlånga (el. äggrunda), ngt spetsiga, sågade, med vanl. långa, täml. låga, ± vassa o. i spetsen ofta ngt utböjda tänder; ax vanl. ngt bredare, tätare o. mera kortspetsat än hos nr 8; foder 3 mm långt, liksom blomskaftet ± tätt korthårigt, dess pip klocklik med 10 svaga nerver, dess tänder spetsiga, ± syllika; krona 4 mm lång, ljust rödviolett, utanpå hårig; nötter ung. som hos nr 8. — Krom. 2n=*24,* 18, 48. — ES.

Ytterligt mångformig art, även inom omr. med flera ± distinkta ff. Vanlig i **S** är en ♀-typ med brett(—äggrunt) avlånga, vassågade, undertill täml. löst gråulliga bladskivor: var. **latissima** Hartm. 1846; till denna höra flert. svenska fynd från mera naturl. lok. (Öl, Sk, Vg, Ög).

Fuktig mark (särsk. vid åar o. bäckdrag), vid gårdar, rud.mark etc., särsk. i kalktr., ofta till synes inhemsk men möjl. alltid från början förv.; numera dock knappast odl. inom omr. — K. HULT. 1950, nr 1519. — **S** fullt natural. (el. inhemsk) på Gtl o. Öl, i Sk, Vg, Ög o. Vsm (Ramsberg); dessutom åtsk. lok. på rud.mark upp till Upl samt (åtm. förr) Hls Hudiksvalls-tr. — **D** nästan hela landet, till synes inhemsk (0: Als, Ærö, Mön, Samsö, Anholt, Læsö). — [Utom omr. i s. o. mell. Eur. (i V upp till Storbrit. men här möjl. ej inhemsk), v. o. mell. As., n. Afr. (även Etiop. o. Egypten), s. Afr.]

10. **M.** × **villosa** Huds. 1778 (pro sp.), s. ampl. Janchen (=*M. longifolia* × *rotundifolia* et *M. rotundifolia* × *spicata*; *M. niliaca* s. ampl. Briq. 1891 — an s. orig. Jacq. 1776?; n. dub.).

Mångformig, ster. hybr., habituellt ± pendlande mln nr 9 o. 11; bladskivor undertill ± tätt vitludna, stundom täml. tydl. nätnerviga, på ö.sid. gröna—gråa men ej tydl. rynkiga; stj. med ± tät o. krusig hårbeklädnad. — De inom omr. funna ff. likna i högsta grad *M. longifolia* men kunna igenkännas som *rotundifolia*-hybr. på stj:s beklädnad av krusiga, täml. jämntjocka o. i enst. fall greniga hår. — Krom. 2n=24, 56.

Adv. på rud.mark. — **S** Lund, Sölvesborg, Mölndal, Östersund; säkerligen ej uppkommen på fyndplatsen utan ink. i form av utlöparbitar. — [Som inhemsk känd från s. o. mell. Eur., i V upp till Skottl.]

11. ***M. rotundifolia** (L.) Huds. 1762 (*M. spicata* γ *rot.* L. 1753). — Rundmynta (N: rundmynte; D: rundbladet mynte; F: pyöreälehtinen minttu).

Vitt kringkrypande med dels underjordiska, fjälliga, dels ovanjordiska, småbladiga utlöpare; stj. 25—60 cm hög, tätt vitullig av krusiga, mångcelliga, täml. jämntjocka, ± greniga hår, med axbärande grenar i de översta bladvecken; mlnbladsskivor oskaftade, rundat ovala med brett hjärtlik, omfattande bas, rundtrubbiga, svagt naggsågade, ovan gröna o. (nästan) kala, starkt rynkiga, undertill nätlikt tätnerviga o. (grå- el.) vitludna; ax täta, smala (vanl. 3×1 cm); foder korthårigt, med klocklik—halvklotformig, otydl. nervig pip o. korta, ngt spetsiga, ± (syllikt—)smalt triangulära tänder; krona mkt liten, vit, ofta ♀; nötter släta. Lukt kraftig, obehaglig. — Krom. 2n=*24*, 18, 54. — ES, H.

Odl. (mest förr o. nästan blott i omr:s sydl. delar) o. gärna länge kvarst. på el. kring odl.platsen, i Sk o. **D** flerst. tydl. förv. på ± långt avstånd från bebyggelse (på renar, banvallar etc.) o. i en del fall natural. på ± naturliga lok. (ängar, alkärrs- o. bäckkanter etc.) men säkerl. ingenst. inhemsk; förr stundom adv. med barlast. — K. HULT. 1950, nr 1520. — **S** Sk som ± förv. o. delvis neofytisk flerst. i S, V o. SÖ; f.ö. uppg. el./o. belagd från enst. lok. upp till Jmt, i flert. fall säkerligen odl. el. i någon mån förv., någon gång kanske (Gävle 1893) ink. med barlast. — **N** förr tillf. adv. på barlast: Östf Kråkeröy vid Fredrikstad, Oslo, Kristiansund. — **D** som förv.: Brnh flerst. (nära Rönne sedan länge natural. på fuktig mark), f.ö. känd från några lok. på s. Fyn, Ærö o. s. Sj (Stevns, Kbhvn). — **F** tillf. adv. Nyl Drumsö vid Hfors (o. Ab Kimito?). — [Inhemsk i s. o. mell. Eur. o. n. Afr.]

Appendix

Mentha × gentilis L. nm. **submascula** (Neum.) Hyl., n. comb. (*M. gentilis* var. *agardhiana* f. *submascula* Neuman ap. K. Johansson in Bot. Not. 1910, p. 220; *M. gentilis* var. *verticillata* f. *submascula* (Neum.) Hyl. in Acta Phytogeogr. Suec. XIV, p. 44).

Mentha × dalmatica Tausch nm. **fennica** Hyl., n. nm. (= *M. dalmatica* s. Marklund 1963 quoad pl. fenn.): caulis plerumque 45—75 cm altus, firmus, densefoliatus, una cum ramis saltem juventute dense et longe pilosus; laminae foliorum brevipetiolatae, inferiores ± late (ovate) ovales et subobtusae, ceterae ovatae, breviter acutatae, dentibus numerosis, longis, arcuatim elongatis argute sed sat leviter serratae; bracteae superiores sat reductae, verticillis florum densissimis sic quasi spicam interruptam formantibus; pedunculi pilosi; flores ♀, stylo exserto, staminibus reductis (antheris non raro in fauce corollae visibilibus); calyx c. 2,5—3 mm longus; corolla pallide violacea, c. 4,5(—5) mm longa.

Habitat in cultis in provinciis naturalibus Karelia austr. et ladog., Isthmo karel., Savonia austr. et bor. et Karelia bor. Fennoscandiae orientalis (vide MARKLUND 1963, p. 13 et 15); olim odoris causa culta. — Typus in H (prov. Karelia bor.: Värtsilä, in pago, leg. H. ROIVAINEN 9. VIII. 1937; vide tab. 5 in MARKLUND 1963).

Summary

The genus Mentha in the Scandinavian flora

The genus *Mentha* is represented in the Scandinavian flora by two undoubtedly indigenous, polymorphic species, *M. arvensis* L. and *M. aquatica* L. The former is not known from the northernmost parts of the Scandinavian peninsula, Iceland and the Faeroes but is otherwise common in most districts, both in natural habitats and as a weed. The main type of *M. aquatica* is common in Denmark and occurs in the coast districts of Norway north to Hordaland; in Sweden it is common in the provinces of Gotland, Öland and Skåne and has more scattered occurrences, mainly along the coast, up to Dalsland and Stockholm. It also occurs in Finland (Åland, Nyland) and the Faeroes. A glabrous seashore race, var. *litoralis* (Hartm.) C. A. West., grows in the Swedish east coast from north Kalmar district up to Hälsingland and also in SW Finland: Åland and Satakunta. The hybrid *M. aquatica* × *arvensis* (*M.* × *verticillata* L.) is known in Sweden up to Dalarna and Ångermanland, from most districts of Denmark and the coast districts of Norway up to Hordaland (one locality also in Sogn); it is also known from Åland and Satakunta in Finland. The Swedish distribution of this extremely variable hybrid thus extends further north than that of *M. aquatica,* and even in their common area it often occurs independently of the parents. It was formerly grown as an odoriferous plant in the province of Småland.

In the same way, forms of the polymorphic hybrid *M.* × *gentilis* L., i.e. *M. arvensis* × *spicata,* have long been grown in Sweden, namely nm. *subspicata* F. Aresch. (also known from Denmark) and nm. *parviflora* Hartm. (also in south Finland and Norway); they are now rare as relicts from cultivation near old habitations. Other forms of this hybrid are nowadays mainly or exclusively weeds (esp. in potato fields): nm. *anderssoniana* (H. Br.) Hyl. (in Sweden), nm. *Arrhenii* (Lindb. fil.) Hyl. (in south Finland and a few places in east Sweden) and nm. *hirtella* Markl. (in Finland), all of which remind of *M. arvensis* by their calyx being hairy even at the base. This is glabrous in nm. *subspicata* and in nm. *verticillata* F. Aresch., which is widespread in south Sweden and also occurs in Denmark and the coast districts of Norway; it grows mainly as a weed but sometimes as a neophyte along rivulets etc. In nm. *parviflora* the flowers are very small and totally asexual, in the other nothomorphs mentioned the flowers are female. The nm. *submascula* (Neum.) Hyl., known only from Gotland, deviates by bisexual flowers. From this province there are also two collections which seem to be *M.* × *smithiana* R. E. Grah., i.e. *M. aquatica* × *arvensis* × *spicata.*

The other parent species of *M.* × *gentilis, M. spicata* L., is nowadays naturalized in many parts of Denmark and south Sweden (up to Västergötland and Östergötland) and has been found as a casual further north in Sweden (Stock-

holm, Medelpad) and Norway but is certainly everywhere an escape from former cultivation; it occurs as "wild" mainly in ruderal places, along roads etc. On the other hand, *M. longifolia* L., which also may be found in such localities, grows in Denmark and south Sweden, esp. in lime districts, seemingly indigenous in damp places, such as borders of streams and rivulets — in Sweden mainly as var. *latissima* Hartm., a broad-leaved ♀ form. In Denmark a spontaneous hybrid with *M. aquatica* has been found. The hybrid *M. arvensis* × *longifolia, M.* × *dalmatica* Tausch, is known from numerous localities in SE Finland in form of one clone, nm. *fennica* Hyl., which was grown in the same way as *M.* × *gentilis* and now remains near habitations. The third species of the *Spicatae* group, *M. rotundifolia* (L.) Huds., has been found as a casual (partly introduced with ballast) in Sweden, Norway and Finland but occurs as an escape from earlier cultivation and partly naturalized in moist places in Denmark and Skåne, the southermost province of Sweden. Its hybrid with *M. longifolia* has been found in a few places in Sweden as casually introduced.

The subgenus *Pulegium* is only represented by casual occurrences of *M. pulegium* L., which has been found near Copenhagen and Helsingfors (Helsinki) and in several years near Göteborg (Gothenburg). It was formerly officinal and sometimes grown for medicinal purposes like *M.* × *piperita* L. and *M. spicata* var. *crispa* (Bth.) Mansf., which have also been found rarely as escapes in ruderal places in Sweden.

For further information on the *M. gentilis* and *dalmatica* complexes see HYLANDER 1941 and MARKLUND 1963, on *M. aquatica* and *M. aquatica* × *arvensis* HÅRD 1955.

Litteratur

Arbeten som endast anföras i de nomenklatoriska avsnitten, äro ej upptagna i nedanstående förteckning; de återfinnas med få undantag hos HYL. 1941 o. 1945.

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Chromosome Studies in Eleocharis, Subser. Palustres

IV. A Possible Case of an Extra, Reductional Division Giving Rise to Hemi-haploid Pollen Nuclei

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I. Introduction

1. Normal Meiosis and Pollen Development

It may be appropriate as an introduction to recapitulate the principal features of meiosis (cf. STRANDHEDE 1965 a) and pollen mitosis (cf. STRANDHEDE 1965 b) in *Eleocharis.*

The first meiotic division is, from a cytological viewpoint equational. The metaphasic associations pass quite regularly to the poles. The second division is cytologically reductional, and it is here that irregularities become observable if present. After a short interphase, one tetrad nucleus passes into first pollen mitosis, while the other three tetrad nuclei degenerate. The resulting pseudomonad thus has three abortive nuclei and one viable nucleus. At the time of first pollen mitosis, cell membranes may be observed between the tetrad nuclei.

The generative nucleus of the pollen grain undergoes yet another division before shedding, the second pollen division, and a normal pollen grain thus has a total of six nuclei: three degenerate tetrad nuclei, which often almost disappear, one large, but often diffuse, vegetative nucleus, and two small, lens-shaped, sperm nuclei.

2. Material and Methods

The plant discussed below belongs to *Eleocharis palustris* (L.) R. & S. ssp. *palustris* (cf. STRANDHEDE 1960) and was collected in Morastrand, Dalarna, Sweden, in a shallow pool beside the road near Grophus (plant no. 069901). The somatic chromosome number is 2n=16 (4 L+12 M-S) and thus quite normal. The 16 chromosome taxa within *Palustres* seem to be tetraploid, being secondarily obtained from the basic number X=5 by chromosome fusions (cf. STRANDHEDE 1965 c).

Squash preparations were made in 1958 of immature anthers of the plant discussed. These reveal strange irregularities in the pollen formation in that year, which have not, however, been observed in preparations made later. Although it has thus been impossible to complete the observations, a report on the conditions observed, which seem to be rather unique, should be of some theoretical interest.

The cytological technique used has previously been presented (STRANDHEDE 1965 a, b, c). Young spikes are fixed in a Carnoy solution (3: 1), and the anthers are then squashed and stained in acetocarmine.

II. Observations

1. Deviating Pollen Formation

In addition to conditions which fall within the variation in the common, cytological appearance of *Palustres,* a quite deviating type of pollen grain is frequently observed in preparations from this plant. According to meiotic principles, there should be 4 tetrad nuclei at interphase after the second meiotic division, but many pollen grains of this plant have 8 nuclei at this stage (fig. 1 a). The density and structure vary between the nuclei.

One of the "octad" nuclei usually passes into a mitosis with 4 chromosomes (fig. 1 b), viz., half the normal number of n=8. 3 or 5 chromosomes may rarely be observed in metaphases of this division (cf. figs. 1 d and e). During the mitosis, seven nuclei normally remain undivided, most commonly gathering in the proximal (apical) part of the pollen grain (figs. 1 b, d, e, and f).

Single pollen grains have only 6 observable resting nuclei during the mitosis, but this number is not quite definite, as two adjacent nuclei may possibly be mistaken of only one (cf. fig. 1 f). Mitosis may, however, occasionally take place contemporarily in two of the "octad" nuclei (cf. figs. 1 a and c), in which case the number of undivided nuclei is actually six.

No other chromosome numbers have been found in this type of deviating pollen apart from those mentioned. The anaphase (fig. 1 f) is

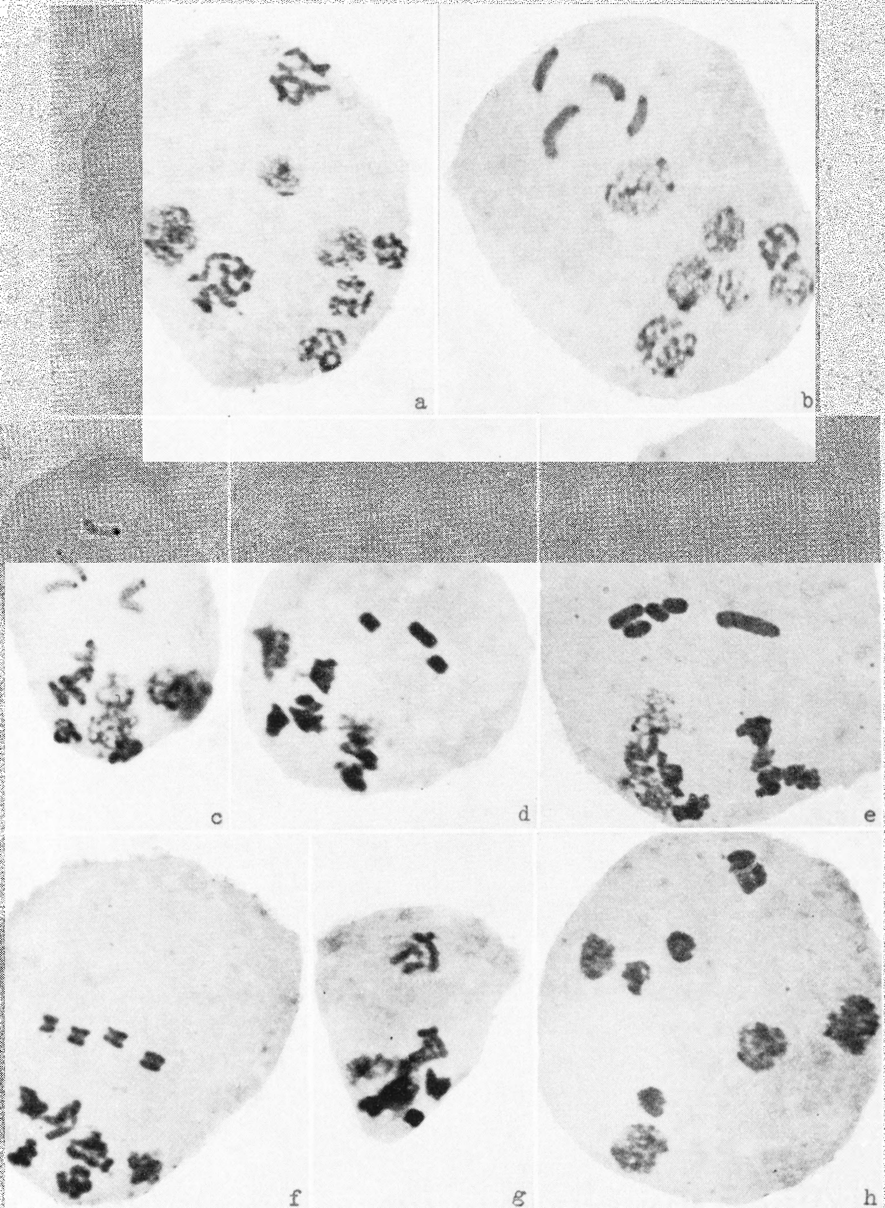

Fig. 1. Hemi-haploid pollen grains. — *a*: An "octad" with two nuclei in beginning first pollen mitosis. — *b*—*e*: First pollen metaphase. — *b*: 4 metaphasic chromosomes (1 L + 3 M-S), the common hemi-haploid number, and seven degenerating nuclei. — *c*: Two "octad" nuclei developed into metaphase. — *d*—*e*: The rarely occurring chromosome numbers 3, respectively 5 at metaphase. — *f*: First pollen anaphase. — *g*: First pollen telophase. — *h*: Interphase between first and second pollen mitosis with 9 nuclei extremely dispersed in the whole pollen grain. (× c. 850)

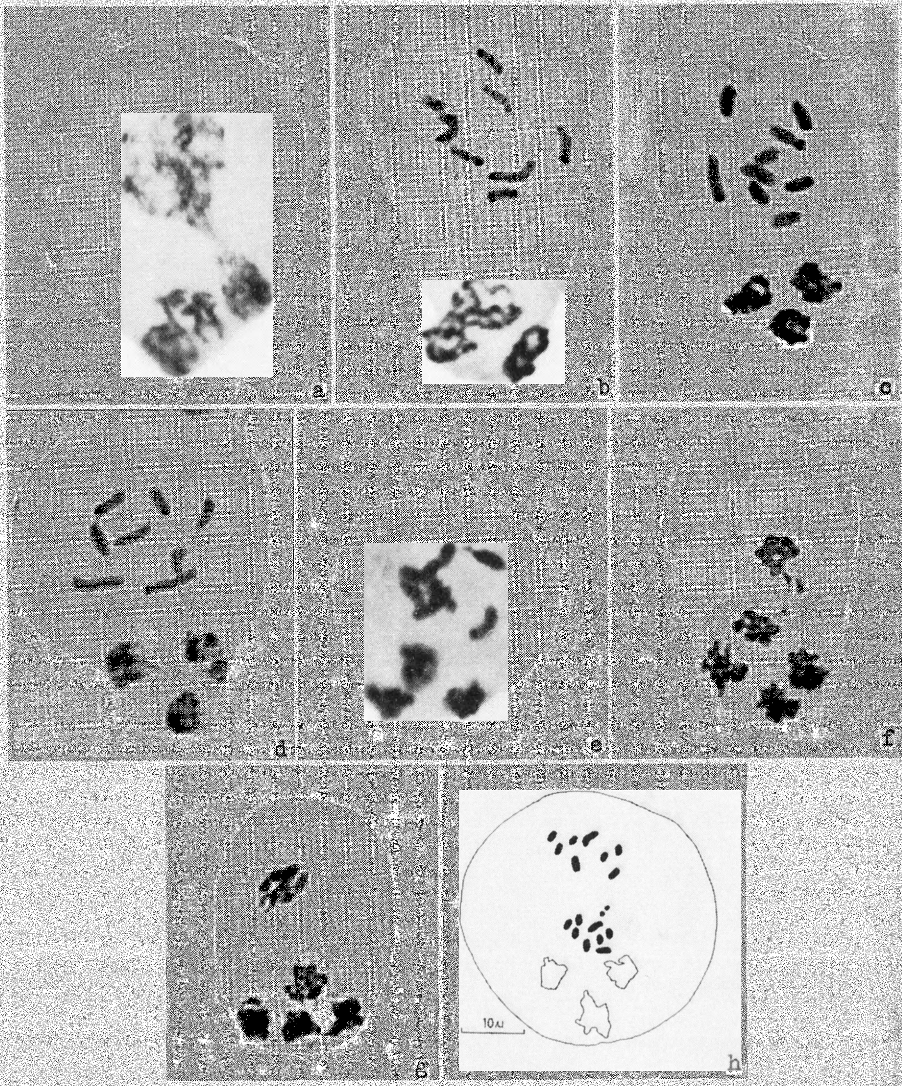

Fig. 2. *a*: Interphase with a dumb-bell formed nucleus after irregular second meiotic division. — *b*—*e*: First pollen metaphases. — *b*: n=8; *c*: n=9. — *d*—*e*: Chromatic extensions and connections because of stickiness. — *f*—*h*: Mitotic irregularities during first pollen telophase (fig. *h* is drawing). (×c. 850)

regular, and the 4 chromosomes pass to the poles (fig. 1 g). Pollen grains of this type have 9 nuclei after this mitosis (fig. 1 h).

In one of the preparations from 1958, many aborting pollen grains are present. Other pollen preparations have been made from the same plant but not until two years after the squash preparations discussed. The pollen was quite normal at that time, and no deviating pollen mitoses were observed.

2. A Few Notable Observations on Normal Pollen Grains of the Plant

Meiosis was unfortunately unavailable for direct study, but the results of meiotic irregularities are obvious in many tetrads. In some cases, meiosis seems to be so disorientated that the second division fails completely. A dumb-bell formed restitution nucleus is shown in fig. 2 a as an example. Quite normal tetrads are also noted in the preparations, and many first pollen mitoses are quite normal with $n=8$ (fig. 2 b). A few pollen mitoses with one or a few supernumerary chromosomes are also observed (fig. 2 c). Fragments occur in single pollen mitoses, and a somewhat sticky appearance is observed in a few metaphases (figs. 2 d and e).

The anaphase passes regularly in most cases but, in a very few mitoses, fragments lag during anaphase and telophase (figs. 2 f, g and h).

III. Discussion

1. Deviating Pollen Formation

The results of meiotic irregularities are obvious within the preparations though meiosis has not been available for direct study in this plant. The dumb-bell shaped restitution nucleus in fig. 2 a shows one result of severe meiotic irregularities during the second division. Such meiotic irregularities seem not, however, to be responsible for the occurrence of 8 nuclei at the tetrad stage observed in several pollen mother cells. The "octad" is probably produced by an additional division of the tetrad.

The occurrence of 8 nuclei at the interphase after the tetrad stage is reminiscent of a phenomenon described by JOHNSSON (1944) in the diploid species *Alopecurus myosuroides* ($n=7$). He calls it polymitosis in accordance with BEADLE who had previously described similar behaviour in maize. In *Alopecurus* the meiosis is normal, but after an exceedingly short resting stage the chromosomes are reorganized into a metaphasic plate. No pairing or longitudinal division occurs, but the chromosomes separate at random during anaphase. The result is an octad in which the nuclei have 1—7 chromosomes with a mode at 3—4 chromosomes. Whether this extra division is to be regarded as a premature pollen mitosis after an abnormally shortened resting stage, or as a double meiosis, is a matter for discussion. It is of interest that RESENDE has advanced the opinion that chromonemata do not divide during the second meiotic division (ref. in RESENDE 1956). In that case, an additional second meiotic division in diploids could perhaps give rise to chromosome numbers like those found in *Alopecurus*.

It is a well-known fact that three of the four tetrad nuclei become abortive in *Eleocharis* and other genera of *Cyperaceae*. These nuclei are usually found in the proximal part of the pollen grains. The additional division of the tetrad, resulting in 8 nuclei in the plant under observation, may rarely give rise to a tendency for mitosis in two nuclei (figs. 1 a and c), and the six undivided nuclei may seem to correspond directly to the three degenerating nuclei of the normal tetrad. As previously pointed out (STRANDHEDE 1965 b), however, a complete mitosis has never been observed in the abortive, proximal nuclei of *E. palustris*. These nuclei may reach a stage simulating metaphase during pollen mitosis but do not divide. It thus seems most improbable that the "octad" is produced by a simple mitosis of the tetrad nuclei. Very special conditions seem to be prevailing during the additional division of the tetrad nuclei, as such "octad" nuclei which pass into the subsequent mitotic metaphase stage have half the haploid, or "hemihaploid", chromosome number of 4. A mitotic division of the tetrad nuclei would not lead to such an additional reduction of the chromosome number.

Seven of the "octad" nuclei usually behave quite similarly to the three abortive tetrad nuclei of the normal pollen grains. They normally gather in the proximal part of the pollen grains. Less frequently, they are dispersed as in fig. 1 h, but the same thing may also occur in the pollen grains of quite regular and normal plants. One "octad" nucleus passes into a mitosis that in all details corresponds to a first pollen mitosis (cf. figs. 1 and 2). It is also notable that, sporadically, a second "octad" nucleus passes into a metaphase (fig. 1 c) as if, at the "octad" stage, a certain after-effect remains in two (daughter?) nuclei of the special physiological conditions, which normally cause one of the tetrad nuclei to undergo first pollen mitosis.

There are similarities between the cases reported in *Alopecurus* and *Eleocharis*, but there are also important differences. In *Eleocharis*, the "octad" stage is the earliest stage observed, and no nuclei have been seen in which the chromosome number is extremely small or high as in *Alopecurus*. The normal condition is that 4 chromosomes are found, seldom 5 or 3. No chromosome numbers between n=5 and n=8, or below n=3 have been observed. The rarely occurring mitoses with n=3 or n=5 may probably be explained by a restricted affinity between the chromosomes of the tetrad nuclei (cf. below), but this fluctuation is also a parallel to the normal conditions in ssp. *palustris,* where single subnumerary and supernumerary chromosomes occur sporadically at first pollen mitosis of otherwise quite regular plants. One of the 4 chromosomes is often long (L), the other 3 chromosomes are shorter (M-S), and the hemi-haploid karyotype (1 L+3 M-S) (fig. 16) is similar to half the normal karyotype of *E. palustris* ssp. *palustris* (2 L+6 M-S) (cf. STRANDHEDE 1965 c).

As previously discussed (STRANDHEDE 1965 c), the chromosome number 2n=16 may be regarded as tetraploid. As no multivalents are normally found at the meiotic metaphase, no signs of autopolyploidy remain. It seems, however, conceivable that the 8 chromosomes of haplophase should be able to pair with each other, giving the extra division found in the plant discussed the character of an additional reduction division, during which the two basal genomes of the haplophase of the stabilized tetraploid cytotype segregate. Such haploid pairing may be possible between the basal genomes of old polyploids because of a residual homology which is normally hidden because of the differential homology between the recent, differentiated genomes of the diploidized polyploid. A residual homology between the two genomes on which the recent haplophase of *E. palustris* ssp. *palustris* is based may explain the regularity of the hemi-haploid chromosome number found. In *Alopecurus*, on the other hand, no such regularity occurs, but all chromosome numbers between n=1 and n=7 are found (JOHNSSON 1944). This may perhaps be explained by a lack of residual homology because the basic number of *Alopecurus* coincides with the chromosome number of the haplophase (X=n=7).

From a cytological viewpoint, the second meiotic divison in plants with localized centromeres is mitotic, or equational. In *Eleocharis,* however, the second meiotic division is reductional, while the first division is equational (STRANDHEDE 1965 a). These pecularities may be another reason for the differences observed between *Alopecurus* and the plant of *Eleocharis* under discussion. In *Eleocharis* homologues are paired until the second meiotic division during which they segregate. If this division is repeated for certain, unknown, exceptional reasons, a new pairing may occur because of the residual homology discussed above.

Still another condition is observed in *Eleocharis* which may facilitate such additional pairing in a stage where no pairing normally occurs. It is the notable tendency for somatic pairing observed (cf. STRANDHEDE 1965 c).

After the hemi-haploid mitosis discussed, corresponding to first pollen mitosis of normal pollen grains, the deviating pollen grains have 9 nuclei: seven of them correspond to the normal three, degenerate nuclei, and of the other two nuclei, one is the generative nucleus and the other one the vegetative nucleus of the hemi-haploid pollen grain. Normal pollen grains have 5 nuclei at this stage (cf. STRANDHEDE 1965 b).

MARTENS (1939) has reported supernumerary nuclei in pollen grains of *Carex picta*. These pollen grains have two vegetative nuclei, two generative nuclei, and they germinate with two tubes. This type of twin pollen grain does not seem to have any similarity to the present case of *Eleocharis*.

Pollen grains that have only half the normal genome should be lethal, which is probably the case as many empty pollen grains have been observed in the preparations made in 1958. Two years later, however, the pollen grains of the plant were quite normal and morphologically well developed. A probable explanation is that the aberrant spike from which the preparations were made in 1958 was quite unique. All later attempts to complete the observations discussed here have proved fruitless.

2. Normal Pollen Formation in the Plant Discussed

The cytological behaviour of the plant discussed is heterogeneous. Cytologically normal as well as deviating pollen mother cells are found within one and the same anther. A treatise on the normal, cytological conditions within *E. palustris* ssp. *palustris* has recently been published (STRANDHEDE 1965 c). These conditions will not be discussed again here, but a few notable observations in this plant will be mentioned though they are obviously independent of the curious hemi-haploid pollen mitoses discussed.

The first observation deserving comment is the sticky appearance of several chromosomes at first pollen mitosis. The sticky appearance of the chromosomes of *Eleocharis* and other genera with "diffuse" centromeres has been observed by several cytologists (cf. STRANDHEDE 1965 c). Under certain circumstances, as in figs. 2 d and 2 e, this stickiness may be similar in appearance to small satellites. Satellites have not been found with any certainty by the author, but TANAKA (1942), HÅKANSSON (1954), BERNARDINI (1959), and others have reported satellites in *Palustres.*

Another observation is the sporadic occurrence of fragments that have a tendency to lag during anaphase of first pollen mitosis. Such lagging may have several causes. One may be a persisting stickiness of the kind just discussed. Another possibility is the occurrence of difficulties during the longitudinal division of such mitotic fragments. Very rarely, similar mitotic irregularities have been observed both in first pollen mitoses and in root mitoses when small fragments occur in otherwise normal samples of *Palustres.* One explanation, supported by observations on other strains within *Palustres,* is that the centromeric activity is restricted in small fragments. The observations support the idea that the centromeric activity is not quite uniform along the whole chromosomes but restricted to special points or parts along the chromosomes (cf. STRANDHEDE 1965 a, c).

IV. Conclusions

As no stages prior to the "octad" stage were available for study, the conclusions drawn must be hypothetical in several respects, and no definite explanation of the cytological phenomenon of plant 069901 can be given. A possible explanation is the occurrence of an additional division during meiosis with reductional effect, resulting in an octad instead of the normal tetrad and a hemi-haploid chromosome number at first pollen mitosis.

As mentioned above, JOHNSSON has described a similar case in *Alopecurus myosuroides,* but hemi-haploid chromosome numbers do not occur as regularly in that genus as in *Eleocharis.* In spite of this, it seems possible to explain that case and the present one in *Eleocharis* in the same way. The strong variation in chromosome number of the "octad" nuclei of *Alopecurus* is possibly caused by lack of homology between the chromosomes of the haplophase, viz., the chromosome number of the haplophase is the same as the basic number (n=X). The pronounced regular hemi-haploid chromosome numbers found in the *Eleocharis* plant, on the other hand, may be a result of a residual homology causing pairing between the two basic genomes found in the haplophase of the old tetraploid taxon *E. palustris* ssp. *palustris* with

$2n=16$ (cf. STRANDHEDE 1965 c), viz., $n=2X$. The regularity during this additional division in *Eleocharis* is probably supported by the normal course of cytological post-reduction during meiosis and perhaps also by the tendency for somatic pairing observed.

Though less probable in the present case, pairing should also be possible because of a partial, haploid homology between chromosomes as a result of certain chromosomal mutations such as reduplications of homologous segments (DARLINGTON 1937). If such a sectional meiotic pairing is established it may also be continued between non-homologous sections as shown in meiotic prophases of structural hybrids of maize (MCCLINTOCK 1933).

Summary

The aim of the paper is to demonstrate and discuss the occurrence of pollen grains with an "octad" instead of a tetrad stage in a plant of *Eleocharis palustris* ssp. *palustris* in 1958. The first pollen mitosis has half the haploid (hemihaploid) chromosome number and, instead of three abortive tetrad nuclei, these deviating pollen grains have seven degenerating nuclei during first pollen mitosis.

The author suggests that an abnormal meiotic course, consisting of three divisions, two of which are reductional, may result in the conditions observed. The 8 chromosomes of the normal haplophase seem to be capable of pairing with each other because of a residual homology between the two basal genomes which are included in the recent normal haplophase.

(Stickiness of chromosomes and irregular anaphasic movements of small mitotic fragments are briefly discussed.)

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Physiological and Genetical Effects on Seed of Soft X-rays Used for Radiography

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Introduction

For determining seed quality by radiography, the material is exposed to soft x-rays. The dose given is small, but in cases where the seed is to be used for further experiments, it is important to know, if the irradiation has produced any physiological or genetical effects. The results of other radiation studies can only be of limited importance here, as the effects of irradiation vary with a number of factors, e.g., radiation quality, moisture content of seed, degree of seed ripeness, temperature, etc. (cf. GUSTAFSSON & SIMAK 1958). The present investigation was undertaken to study the effect of soft x-rays with the same equipment and under the same conditions as are usually used by us for seed radiography.

Material

Three samples, one each of Scots pine (*Pinus silvestris* L.), Norway spruce (*Picea abies* L.) and celery (*Apium graveolens* L.), were used for the experiment. The details of the samples are given in table 1.

For the present study it was necessary to use fresh and homogeneous material. This was obtained in the case of pine and spruce by radiographying freshly collected samples and selecting only such seed, as had fully developed embryo and endosperm (cf. fig. 1 b, class IV A, GUSTAFSSON & SIMAK 1956). For celery, no similar classification of embryo types with the help of x-ray radiography is available. However, it is possible by this method to distinguish between empty and filled seed (cf. fig. 1 a). The empty seed was mostly shrivelled and, consequently, the latter was removed from the sample by microscopical examination and only the rest was used for the experiment.

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Table 1

Species	Locality	Latitude	Altitude in metres	Year of collection
Pinus silvestris	Södermanland	59° 3′	55	1964
Picea abies	Småland	57° 32′	260	1964
Apium graveolens	Commercial sample obtained from State Seed Testing Station, Solna			1964

Methods

Seed was irradiated with soft x-rays from the same equipment as used for radiography (KAMRA 1964). The conditions of exposure were: kV=14, mA=10, focus=25 cm, and time=3, 6, 12, 24, 48, 96, 400 and 800 seconds. (These values also include the exposure of 3 seconds used for taking radiographs in order to select the material.) After irradiation, the seed was put for germination immediately. As control non-irradiated seed (O) was used. In order to make this series comparable with the material selected radiographically in the irradiated series, empty and insect-damaged seed was removed from the control samples of pine and spruce by macroscopical examination as far as possible. Moreover, at the end of the germination period, all ungerminated seed was dissected out and examined. In this way, the exact number of filled seed was determined. This procedure was, naturally, unnecessary in the case of celery, as here the shrivelled (empty) seed had already been removed from the entire sample.

The dose rate of the x-ray apparatus used was determined by Mr. AHNSTRÖM of the Biochemical Institute of the University of Stockholm, with the method of ionisation chambers specially constructed for measuring low-kilovolt radiation. The measurement showed the x-ray dose to be of the order of 1,95 R per second (±7 %).

Water content of the samples was determined at the time of irradiation by drying seed for 16 hours at 105°C and it gave the following values:

Pine=4.8 %. Spruce=4.6 %. Celery=5.3 %

Physiological effects of irradiation: The physiological effects were studied on the germination percentage and the germination rate of the different series. The germinated seeds were counted every day beginning with the 4th day. For pine and spruce a seed was considered as germinated, when the length of the root was equal to the length of the seed itself; in celery, when the length of the root was three times that of the seed.

Germination test was performed on JACOBSEN apparatus under the following conditions:

(a) For pine and spruce:
Temperature=20°C constant.
Light=1000 Lux (continuous).
Number of seeds germinated=4×50.
Period of germination=30 days.

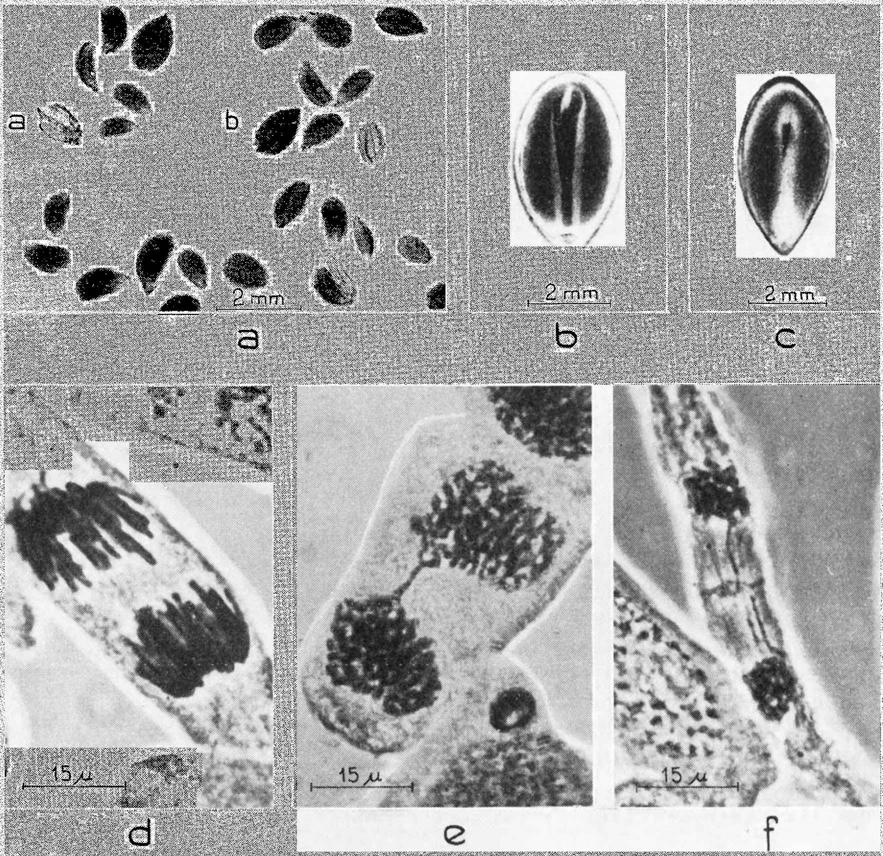

Fig. 1. a: X-ray radiograph of celery seed. (a. empty. b. filled seed.) — b: Fully developed seed (class IV A). — c: Seed with incompletely developed embryo. (Seed types b. and c. are valid both for pine and spruce.) — d: Normal cell division in pine. — e: Note simple bridge and micronucleus in pine. — f: Chromosome bridge in spruce.

(b) For celery:

Pretreatment = Germination substratum moistened with 0.2 % KNO_3.
Temperature = Alternate, 20°C for 16 hours, 30°C for 8 hours.
Light = 1000 Lux (given for 8 hours when temperature was 30°C).
Number of seeds germinated = 4 × 50.
Period of germination = 21 days.

Genetical effects of irradiation: Cytological investigations on the root tips of seedlings were undertaken in order to study the genetical effects. The cytological analysis was carried out in all the three species on such seedlings in which the length of the root was almost equal to that of the seed and which grew on the day when the germination culminated. The material was fixed in CARNOY's solution (3 parts of absolute alcohol and 1 part of acetic acid) and hydrolysed in equal parts of absolute alcohol and conc. hydrochloric acid. Squashing was done in 2 % orcein. Anaphase and telophase were investigated in order to find out, if bridges and in connection with them any fragments existed. Even the micronuclei in the telophase and interphase were looked for.

Results

(i) Physiological effects of irradiation with soft x-rays

(a) Germination percentage:

The irradiation had no effect on the final percentage of germination in all the three species, as will be seen from the following table.

Table 2

Period of irradiation in seconds	R-Dose 1.95 R/sec (± 7 %)	Germination percentage		
		Picea abies after 30 days	*Pinus silvestris* after 30 days	*Apium graveolens* after 21 days
0	0	99	100	75
3	5.8	99	99	74
6	11.7	99	100	80
12	23.4	100	100	71
24	46.8	100	100	72
48	93.6	100	100	74
96	187.2	99	100	78
400	780.0	99	99	80
800	1560.0	100	100	72

(b) Rate of germination:

The curves for the rate of germination of the irradiated series of each species were very close, so that the differences were not easy to make out. In view of this, three characteristic points were chosen from the germination curves in order to get an idea of the germination rate. These points were as follows:

1) The day on which the germination in the control series culminated. It was the 7th day for spruce and celery, and the 5th day for pine.
2) Three days after the culmination of germination (10th and 8th day respectively).
3) The 21st day.

Spruce: As will be seen from the curve for the 7th day (fig. 2), short periods of irradiation (3—24 seconds) showed a stimulative effect; the difference between the germination value of the control and that

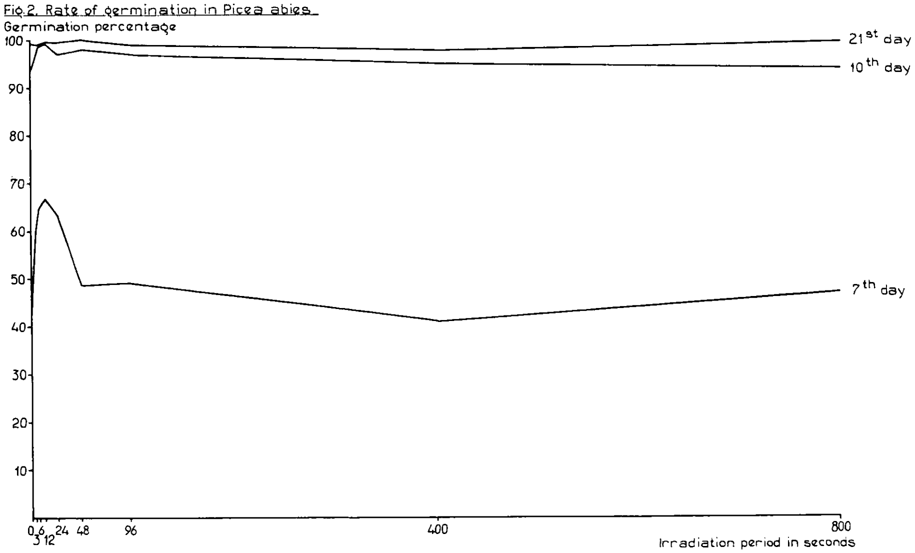

Fig. 2.

of the series with 12 seconds of irradiation being more than 20 % (maximum stimulation). After this, the curve falls, at first very rapidly up to 48 seconds of irradiation and later very slowly. The low value of germination for 400 seconds of irradiation is to be considered insignificant, because of the large variation among the replicates of 400 seconds series. Even with the longest irradiation period (800 seconds), the germination percentage was about the same as that of the control.

Already three days later (10th day), the stimulative and delaying effects had disappeared. After 21 days, the germination percentages in all the series practically reached the maximum.

Pine: The curve for the 5th day (fig. 3) shows a constant fall in germination with increasing time of irradiation except for a weak favourable effect after 3 seconds of exposure. The value of germination in the case of 800 seconds of irradiation is about 45 % less than that of the control. The curves for 8 and 21 days do not show any stimulation or delay in germination.

Celery: This species has a very irregular germination with large variations among replicates (cf. fig. 4). No clear differences in the germination rates of the various series are shown by the curves for 7, 10 and 21 days.

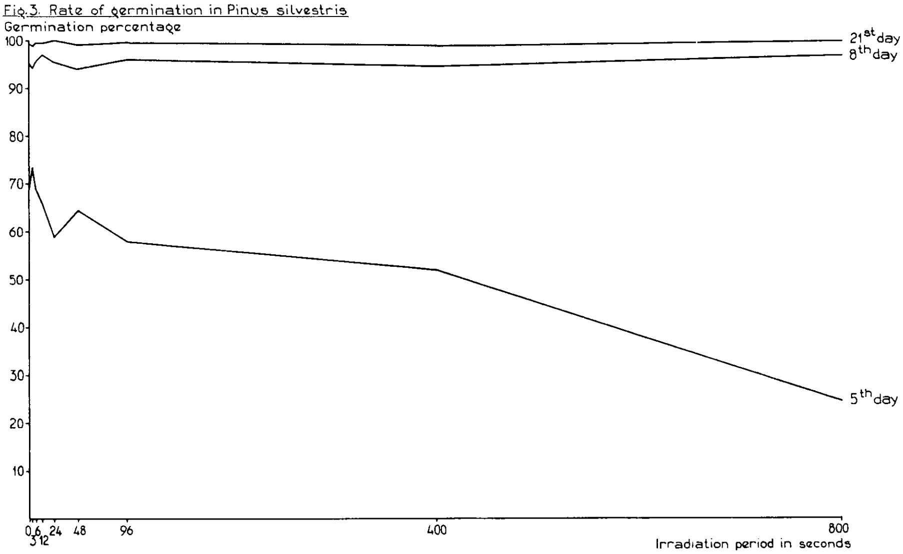
Fig.3. Rate of germination in Pinus silvestris
Germination percentage
100
90
80
70
60
50
40
30
20
10
0
3
6
12
24
48
96
400
800
Irradiation period in seconds
21st day
8th day
5th day

Fig. 3.

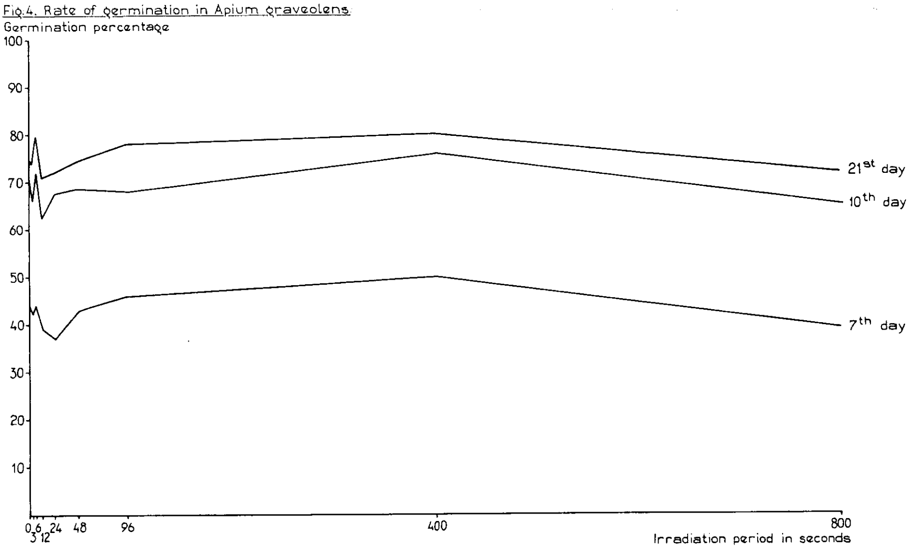
Fig.4. Rate of germination in Apium graveolens
Germination percentage
100
90
80
70
60
50
40
30
20
10
0
3
6
12
24
48
96
400
800
Irradiation period in seconds
21st day
10th day
7th day

Fig. 4.

(ii) Genetical effects of irradiation with soft x-rays

Cytological analyses showed different results for the three species. Investigations were carried out on 10 seeds of each irradiation series and on an average 30 plates/seed were studied. The results (fig. 5) show that in spruce and pine disturbances in cell division occur already with short irradiation periods. In spruce even the presence of a spontaneous chromosome aberration (one bridge in one seed out of 30 plates analysed) was observed. In celery, there was no irregularity in cell-division noticeable even with the longest period of irradiation.

Discussion

From the forestry plants pine and spruce were selected as the experimental material in view of the fact that their seed has been extensively studied by x-ray radiography. Celery was chosen as a representative of the agricultural plants.

The commonly used time of exposure for the radiography of several species of seed is about 2—3 seconds, depending upon such factors as the structure of the seed, type of film, the adjustments of the x-ray machine, etc. The adjustment of the machine in our usual work is at kV=14, mA=10 and focus=25 cm. An exposure of 2—3 seconds under these conditions corresponds to a dose of 3.90 to 5.85 R (±7 %). However, in the present investigation such a long exposure time as 800 seconds (=1560 R) was used, in order to have a very safe margin for the judgement of the effects of x-rays on the radiographed seed.

No effect on germination percentage was observed in all the three species even with the longest irradiation period (800 seconds). This would mean that the commonly used exposure time for radiography (2—3 seconds) can be increased at least a hundred times without damaging the germination value of the investigated seed.

The rate of germination did not show any distinct delay in spruce and celery. In the case of pine, a delay in the rate of germination was observed clearly on the 5th day with 800 seconds of irradiation. Already 3 days later this effect practically disappeared. However, from these results it should not be generalized that pine seed is more sensitive than that of spruce. Earlier investigations pointed out that there can be differences in the radiation sensitivity between populations of a species (OHBA & SIMAK 1961) and among the individuals of a population (SIMAK et al. 1961). Moreover, the pine seed collected during 1964

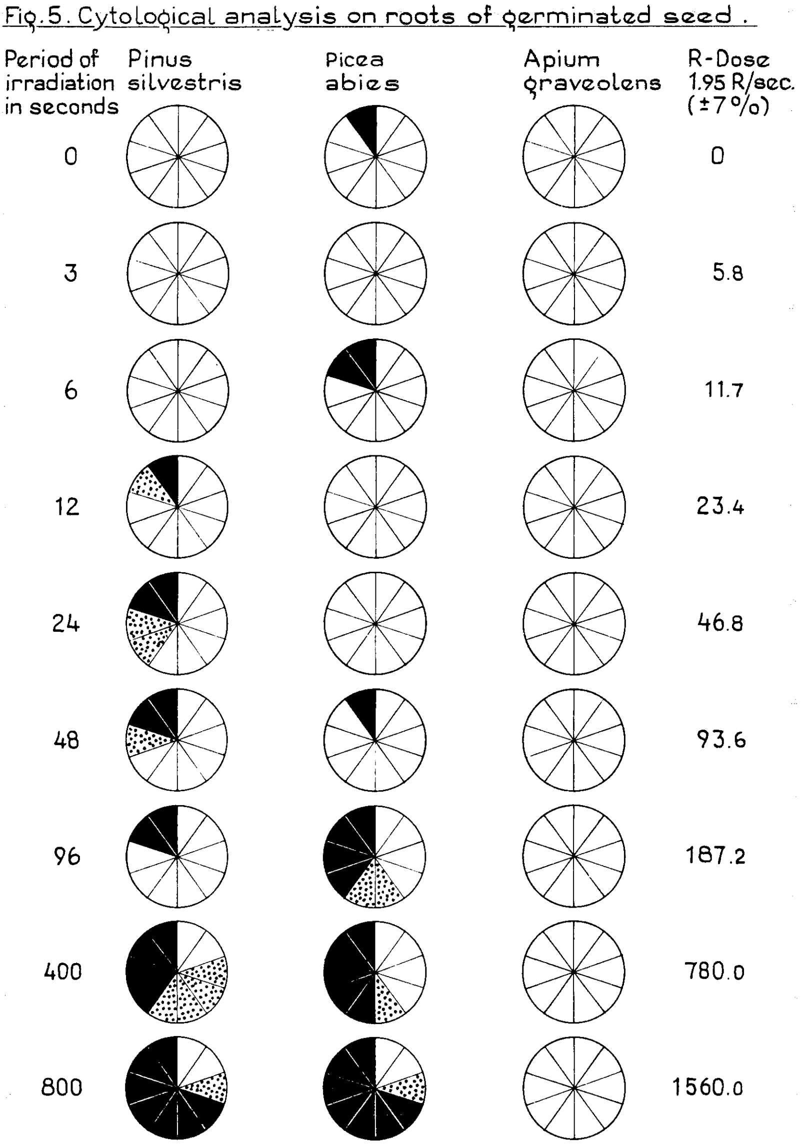

Fig. 5. Each section in the circle represents one analysed seed.
White: Seed with normal cell division only.
Dark: Seed with at least one abnormal cell division (chromosome bridge).
Dotted: Seed with normal cell division but with micro-nuclei.

was in general of poor anatomical and physiological development and its radiation sensitivity can be variable.

The purpose of the present investigation was to determine, if short periods of irradiation in the range of those used for radiography have any physiological or genetical effects on seed. For spruce the rate of germination seems to be stimulated with short irradiation up to 12 seconds as is shown by the 7 days curve in fig. 2. It increases continuously from 45 % for the control to 67 % for 12 seconds of irradiation.

The germination value of the control in the case of pine is perhaps lower than could be expected. This is due to the fact that the selection of filled seed in the control sample could not be carried out radiographically for apparent reasons. In view of the poor seed quality in the year of collection, it is probable that some of the seed is filled but the embryo is not fully developed (cf. fig. 1 c). Such seed grows more slowly than that of class IV A. The eventual presence of this incompletely developed seed in the control sample would explain the delay in the germination rate.

Before discussing the results of the cytological investigation, it is necessary to mention an important point about the technique used. The chromosome aberrations should be studied at a specified germination stage. In the present investigation only such seedlings were analysed in which the length of the root was almost equal to that of the seed itself and which grew on the day when the germination culminated in each species. As is well-known the highest frequency of chromosome aberrations occurs just after the cell divisions in the germinating seed start. Later the repair of the radiation damage begins (cf. SOBELS 1963, MERGEN & STRØM JOHANSEN 1964) and after some days of germination the chromosome aberrations may be partially or completely eliminated, which is indicated by the high frequency of micro-nuclei in the cells (cf. fig. 1 e). In view of this, the results given in fig. 5 may be considered as relative for the different series of each species and not as absolute.

The genetical effect of soft x-ray irradiation expressed itself in the frequency of chromosome aberrations. These were, however, of a type with simple bridges (cf. fig. 1 e). In pine the first abnormal cell division was observed after 12 seconds of irradiation, in spruce after 6 seconds and in celery not all. Of special interest are the results of spruce. It is true that the first chromosome aberration was detected with 6 seconds of irradiation, but in the following two series (12 and 24 seconds), none was noted. The real continuous increase in the frequency of aberrations begins with 48 seconds (cf. fig. 5). The presence of chromosome bridges in two seeds of the 6 seconds series could perhaps be related with the spontaneous chromosome mutation observed in the control.

The differences in the radiation sensitivity of pine and spruce on one hand and celery on the other, which did not show any aberrations, agree with the fact that the conifers in general are more sensitive than the angiosperms. This can be due to the bigger nuclear volume in the conifers (cf. GUSTAFSSON & SIMAK 1958).

Summary and conclusions

The present investigation was undertaken to study the effects of soft x-rays used for radiography of seed. As experimental material seed of *Pinus silvestris, Picea abies* and *Apium graveolens* was used. Although the usual time of exposure for seed radiography is about 2—3 seconds, the study was conducted with 3, 6, 12, 24, 48, 96, 400 and 800 seconds, in order to have a safe margin for the judgement of the effects of irradiation. The seed was irradiated with the same x-ray equipment and under the same conditions of exposure, as are usually used by us for radiography.

It was observed that: (i) Even the longest period of irradiation had no effect on the percentage of germination in all the three species. The germination values were determined after 30 days for pine and spruce and after 21 days for celery seed.

(ii) There was a weak tendency towards the stimulation of germination rate with short periods of irradiation in *Picea* and a delay in it with long exposure in *Pinus,* but no effect on germination rate was observable in *Apium.*

(iii) Already relatively short irradiation produced chromosome aberrations in the mitotic cell divisions of pine and spruce. No chromosome mutation was observed in celery even with the longest exposure.

From the results summarized above, it can be concluded that short exposure to soft x-rays used for seed radiography does not damage the seed as far as germination rate and germination percentage are concerned. The same seed can, hence, be utilized for other studies as well, which is not possible in the case of seed treated with tetrazolium or other methods for determining seed quality.

Genetical damage in the form of chromosome aberrations can arise in seed already with relatively short periods of irradiation. It is, therefore, important to keep this point in view in the genetical experiments. Of course, the degree of damage will vary with the species and the conditions used.

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BOTANISKA NOTISER 1965 · VOL. 118 · FASC. 2 · LUND

Smärre uppsatser och meddelanden

Om en ny inlandslokal för Myosotis baltica Sam.

Denna art påträffades i början av aug. 1964 nära sjön Vikern mellan Råskog och Bengtstorp i Vikers s:n, Nora bergslag, Västmanland. Arten finns inte tidigare uppgiven för vare sig detta landskap eller de båda närliggande, Värmland och Närke.

Myosotis baltica betecknas av HULTÉN (1950) som en för Norden endemisk strandväxt, vars utbredning endast är fragmentariskt känd. För närvarande är arten blott känd från ett fåtal inlandslokaler, de flesta i östra Norge.

På dess ståndort i Viker förekommer arten rikligt på ett några tiotal m^2 stort område i fuktig, lerig, söndertrampad betesmark, samt mindre starkväxande på några närliggande åkrar, som övergivits sedan de försumpats genom att vattenståndet i sjön Vikern genom reglering höjts. Fältskiktet på dessa åkrar saknas mestadels, och bottenskiktet utgöres av en tät matta av mossan *Climacium dendroides*.

Om *Myosotis baltica* sedan gammalt har hemortsrätt i Vikers flora är det svårt att uttala sig om. Men förekomsten är så riklig, att den inte kan betraktas som tillfällig.

Möjligen kan man i analogi med t.ex. vissa *Potamogeton*-arter, som förekommer i bräckt vatten men också i inlandet i sjöar i kalktrakter, anta att samma gäller för en strandväxt som *Myosotis baltica,* då Vikers-lokalen är belägen på urkalkområdet i nämnda socken och lokalen är klart kalkgynnad.

Citerad litteratur

HULTÉN, E. 1950. Atlas över växternas utbredning i Norden. Stockholm.

PER ERIK PERSSON

Veronica praecox All. på Stora Karlsö

Denne sjældne *Veronica*-art er i Norden kun kendt fra Gotland (HYLANDER 1941 i SBT 35, PETTERSSON i Acta Phytogeogr. Suec. 40), Öland (ALBERTSON 1944 i BN, STERNER 1944 i BN), samt med et par fund fra marker i Skåne (MERKER 1959 i BN 112) og på Sjælland (Bot. Tids. 59, s. 78). PETTERSSON fremhæver, at forekomsten på Gotland temmelig sikkert er synantrop og næppe indigen, en opfattelse, der ikke ganske deles af HYLANDER og for Ölands vedkommende af ALBERTSON og STERNER. I maj 1965 fandt jeg den i ret stor mængde på Stora Karlsö, dels på sydskrænterne af Marmorberget SV for grotten Lilla Förvar, dels på skrænterne ved Lerberget og ned mot Suderslätt. Den voksede her på åben bund med et tyndt muldlag over kalken, iblandet kalkgrus og i selskab med *Sedum album, Sedum acre, Cladonia* sp. og annuelle arter som *Hornungia petraea, Cerastium pumilum, Saxifraga tridactylites, Lithospermum arvense* var. *coerulescens, Draba muralis, Erophila verna, Scleranthus polycarpos* og *Myosotis stricta.* Der har næppe været marker på Stora Karlsö i historisk tid, og der er for mig ingen tvivl om, at man i modsætning til, hvad der er tilfældet for Danmarks vedkommende, kan medregne arten til Sveriges indigene flora. Iøvrigt refereres *Veronica praecox* af PETTERSSON som fundet en gang tidligere på Stora Karlsö.

ANFRED PEDERSEN

BOTANISKA NOTISER 1965 · VOL. 118 · FASC. 2 · LUND

Litteratur

T. T. KOZLOWSKI: Water metabolism in plants. — Harper & Row, New York, 1964. xx+227 sidor.

Titeln på denna bok är något förbryllande. Med metabolism brukar man mena ämnesomsättning, men någon sådan behandlas inte i denna bok. Dessutom är det svårt och ganska ointressant att i metaboliskt sammanhang enbart behandla vatten.

Boken behandlar växterna i deras relation till vatten. I de olika kapitlen diskuteras vattenbalans, osmotiska förhållanden i celler och vävnader, växternas vattenupptagning, vattentransport och avgivande av vatten, samt inverkan av vattendeficit på växterna.

Boken är mycket ojämnt skriven. Många problem behandlas rapsodiskt och litteraturhänvisningarna sker mest till egna och kollegers arbeten. Som exempel kan nämnas påståendet att först i och med KRAMERS och CRAFTS et al. 1949 utgivna monografier problemet angående växternas förhållande till vatten började undersökas på bred front. Inte ett ord nämns om sådana forskare som MAXIMOV, SEYBOLD och WALTER!

En onödig bok, som inte ger den presentation och översikt av teorierna och problemen man kunde ha rätt att vänta sig.

STIG OLOF FALK

M. J. PURVIS, D. C. COLLIER & D. WALLS: Laboratory techniques in botany. — Butterworths & Co. Ltd, London, 1964. viii+371 sidor. Pris 57 s. 6 d.

Det är naturligtvis omöjligt att i en så liten bok utförligt behandla den laboratorieteknik som användes inom botaniken. Det måste med nödvändighet bli korta presentationer av de vanligaste metoderna och den apparatur som fordras för dessa.

Boken innehåller kapitel om allmän laboratorieapparatur (vågar, centrifuger, mikroskop etc.) och allmän laboratoriemetodik (Warburgmetodik, kromatografi, destillationsteknik), anatomisk och histologisk teknik (fixering, inbäddning, snittning, färgning etc.), mikrobiologisk laboratoriemetodik, växtfysiologiska undersökningsmetoder, skötsel av växthus och akvarier m.m. Varje kapitel avslutas med hänvisningar till litteratur där metoderna beskrives mera utförligt.

Framställningen är klar men kortfattad. Författarna som är tekniker behärskar inte alltid de biologiska resonemangen, men det kan man ju bortse från i en bok som denna. Litteraturhänvisningarna är inte särskilt up to date.

Boken kan kanske rekommenderas till sådana personer som snabbt vill lära känna huvuddragen av de vanligaste metoderna som botanister använder.

STIG OLOF FALK

C. P. WHITTINGHAM: The chemistry of plant processes. — Methuen & Co. Ltd, London, 1964. 209 sidor. Pris 25 s.

Professor WHITTINGHAM, professor i botanik vid Queen Mary College i London, ger i sin bok en översikt av valda kapitel inom växtfysiologin, som antingen är speciellt aktuella ur forskningssynpunkt eller som intresserat honom personligen. Boken avser alltså inte att vara en fullständig lärobok i växtfysiologi, utan förutsätter elementära kunskaper i ämnet hos läsaren.

Boken inleds med en historik av den experimentella botanikens utveckling. Därefter behandlas cellens struktur och metabolism. Kapitlet om jäsning och andning innehåller många fakta men saknar en klar och överskådlig framställning, vilket gör att det blir mycket tungläst. Fotosyntesen (prof. WHITTINGHAMS specialområde) däremot behandlas i ett välskrivet kapitel. Mörkerreaktionerna i fotosyntesen kan numera anses så gott som klarlagda genom bl.a. CALVINS och hans medarbetares undersökningar medan de fotokemiska reaktionerna bjuder forskningen på många olösta gåtor.

Boken avslutas med några kapitel om »växtprocesser», där sådana saker som osmotiska förhållanden, transport av vatten och lösta ämnen samt tillväxt behandlas. Dessa kapitel är inte av samma klass som de tidigare och faller väl egentligen utanför den ram som bokens titel låter antyda.

WHITTINGHAMS bok kan rekommenderas för den som vill sätta sig in i några av de aktuella forskningsområdena inom växtfysiologin.

STIG OLOF FALK

HUTCHINSON, JOHN: The Genera of Flowering Plants. Dicotyledones. Vol. I. — Oxford, Clarendon Press, 1964. Price 126 s.

This work is to be regarded as an up-to-date Genera plantarum. It follows the same system as that used by the same author in his well-known “Families of Flowering Plants”, the second edition of which was printed as late as 1959. The work is admirable in several ways. The task of writing such a work is gigantic, and the fact that it has been done by a single person makes it the more impressive.

The descriptions of the families and genera are based on those in BENTHAM and HOOKER’s Genera plantarum but are written in English, not in Latin. They are often abbreviated in relation to those in the latter work and also modified from observations in the Kew herbarium and from diagnoses in modern floras or monographs. The leading principles in the work and in the arrangement of the groups have been the same as those presented in the “Families of Flowering Plants”, and they are briefly summarized in the introduction. Emphasis is placed on those characters which should be regarded as "primitive" in relation to others. The basic ideas are that once united organs seldom separate into their constituents again, that organs once lost seldom return, that zygomorphic flowers seldom become actinomorphic, etc. An uncritical or unrestricted acceptance of them all might shackle systematical work, although most of them are probably sound. The division of the dicotyledons into fundamentally woody and fundamentally herbaceous ones, characteristic of HUTCHINSON's arrangement of the orders in his "Families", is followed also here.

Seven orders are treated in this first volume: *Magnoliales, Laurales, Dilleniales, Coriariales, Rosales,* and *Leguminales,* the last two of which comprise the greater part of the volume. Keys are given to the families, tribes and genera. The synonyms of each genus are enumerated, and the approximate number of species and the distribution in large are given. Important literature on the larger genera is also cited. The diagnoses, written in smaller style, are concise and in most of the cases checked they have been found to be accurate.

Working in a nomenclatural centre the author has been able to give rich information on generic synonyms, which will be of great help in future taxonomic work. However, the synonymy should be carefully re-examined before accepted. This is obvious in *Aspalathus,* for example. The most recent publications on this genus have naturally not been consulted by HUTCHINSON. Of the cited synonymous genera *Acropodium* Desv. and *Lapasathus* C. Presl were based on *Lotononis* species, and *Nefrakis* Raf. on the species now called *Brya ebenus.* Also *Semetor* Raf. does not belong to the synonyms of *Aspalathus.* (See DAHLGREN 1963 B.) Also orthographic or typographic variants of previous genera are sometimes cited among the synonyms without indication of the original author or of the status. Such details show that there is sometimes need for further investigations and controle. Even such a modern work as the present one is not — and could not possibly be — definite.

The number of species given for each genus is usually up to date, but sometimes the numbers in major monographs or certain standard works have been accepted without consideration of later contributions. An example is *Cliffortia,* where the number of species (c. 80) in WEIMARCK's monograph of 1934 has been accepted, although WEIMARCK's further contributions have rised the number to about 113.

A detail is worth mentioning in connection with the otherwise distinct and usually adequate terminology. In the rose-hips the achenes are considered to be "included in the berry-like calyx-tube". It is doubtless not *only* the calyx tube that takes part in the fleshy part of the hips, on the edge of which the (free parts of the) sepals, petals, and stamens are situated. The terms "hypanthium" and "receptacle" may be more adequate, although especially the latter is usually considered to represent only the variously enlarged end of the flower axis. The truth in this case may be that the receptacle cups correspond to a combination of the flower axis and part of the perianth and stamens.

The difficulties in deciding the size and circumscription of many genera have been great. A middle course between "splitting" and "lumping" has been the aim. Different opinions are natural in many cases. The rank is sometimes of great importance in principle, in other cases of less importance. Practical reasons only may sometimes be decisive in the choice of rank. The genus rank in some cases seems too high. According to Mrs. G. NORDBORG (oral communication), this is the case in part of the *Poterieae* (*Rosaceae*), where otherwise the conception of the groups of species agrees in the main features with the conclusions reached by her, which are based on morphological as well as experimental studies. In the key to the genera of this tribe it seems impossible, however, to identify *Poteridium*. In the description the flowers are (correctly) said to be bisexual, but one of the conditions for arriving at *Poteridium* in the key is that the flowers are considered "monoecious or polygamous".

My own special interest is part of the *Papilionaceae*. In this family HUTCHINSON lowers the level of the tribus rank more than one step in relation to other works. It is instructive to compare the treatment with that of the same group (by G. K. SCHULZE-MENZ) in the 12th edition of ENGLER's "Syllabus der Pflanzenfamilien", Berlin-Dahlem 1964. In this work subfam. *Faboideae* (corresponding to *Papilionaceae*) is divided into 10 tribes, a division which agrees rather closely with that in BENTHAM and HOOKER's Genera plantarum as well as that in TAUBERT's treatment in ENGLER's "Die natürlichen Pflanzenfamilien". HUTCHINSON distinguishes 50 tribes. It is regrettable — and must be confusing for students — that in two almost contemporary important and general treatments of such an important plant group the authors have so different concepts of rank. Which is the more appropriate concept is difficult to tell, but 50 tribes are hardly convenient to survey.

I find it difficult to accept especially one of the tribes distinguished by HUTCHINSON, *Borbonieae*. The genera of this tribe are usually treated among those which constitute the tribe *Lotononideae* in HUTCHINSON's work. The difference between these two tribes: "*leaves primitively simple, stipules and stipels absent*" for *Borbonieae*, "leaves *digitately* 3-foliolate or rarely 1-foliolate, sometimes sessile; stipules present or absent" for *Lotononideae* (italics in cited parts by HUTCHINSON). In *Borbonieae*, typified by *Borbonia*, are assembled the genera *Borbonia, Rafnia,* and *Euchlora*. Certain *Borbonia* species actually show such a great resemblance to some species of *Aspalathus* that I have incorporated *Borbonia* in *Aspalathus* (cf. DAHLGREN 1963 A). The simple leaves of *Borbonia* in this case doubtless correspond to the terminal (middle) leaflets of the trifoliolate sessile leaves in most *Aspalathus* species. A similar reduction in leaflet number occurs also in other groups within *Aspalathus* and also in other genera, e.g. *Lebeckia* (where the leaves are petiolate, however). Certain forms of the monotypic genus *Euchlora* have trifoliolate or trilobate leaves, occasionally with stipules (cf. DAHLGREN 1964). My recent study on *Euchlora* cannot be, and that on *Borbonia* has probably not been, known to HUTCHINSON. They are mentioned here only to show how hazardous it may be to classify leaves as "primitively" or secondarily simple without performing a thorough study.

The present remarks may indicate that a work of this general type has its value more in the rich contents of material for further investigations than in being a final presentation in short of all the genera of higher plants. When completed, "The Genera of Flowering Plants" will represent an indispensible handbook in botanical institutes and herbaria and it will be of great help in future scientific work. It gives a representative picture of how the angiospermous genera are usually conceived to-day, and its useful descriptions and most of the synonymy will probably stand the time. A long-felt need will be filled, and the work will certainly become basic in systematic research.

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ROLF DAHLGREN

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