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Cytotaxonomical Studies in the Arctic Alaskan Flora

The Genus Festuca

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Introduction

In the summers of 1960 and 1961 the author had the opportunity of collecting botanical material on the Arctic Slope of Alaska. The main task of these two trips, which were led by Dr. W. C. Steere, New York, was to make studies of the bryophyteflora. Also, when time allowed, material for cytotaxonomical studies of certain critical species-groups of phanerogams was collected. The first results of these studies were published in Holmen (1962). The field-work was carried out at the Arctic Research Laboratory, Barrow, the director of which, Dr. Max. C. Brewer provided excellent working-facilities during the stay. Financial support was granted by the Arctic Institute of North America and by Carlsbergfondet, Copenhagen.

The material of Festuca was collected for comparison with the Greenland representatives, which the author has studied for several years; a special study has been made of the *F. brachyphylla* species group, which contrary to *F. ovina* s. lat. has very short anthers.

In their recent flora of Arctic Alaska Wiggins and Thomas (1962) enumerate the following species of *Festuca*: *F. altaica, F. brachyphylla* (incl. ssp. *saximontana* (Rydb.) Hultén), *F. baffinensis,* and *F. rubra* (incl. var. *lanuginosa* Mert.). To this list may now be added *F. vivipara* and *F. ovina*. The first has already been reported from Arctic Alaska by Johnson and Viereck (1962), the latter, which is new to the flora, being represented by a new subspecies, in addition to a forma of this subspecies.

Chromosome numbers of the species

The chromosome numbers of the species studied are given in Table I. Except for those of *F. ovina* ssp. *alaskana* and *F. vivipara* none of the chromosome numbers represent new records, but they are the first counts from Arctic Alaska. Two of them, however, *F. brachyphylla* and *F. altaica,* have been studied by Bowden (1960) from southern Alaska.

The present cytological material consists of roots tips fixed in the field. The fixative used was Navashin-Karpeshenko, in which the RT's could be stored until later embedding in paraffinwax. The chromosomes were stained using the Feulgen method.

Table I.

No.	Species	Locality	Date	2n
851	F. brachyphylla	Lake Peters	26/VII 1960	42
860	F. ,,	Barrow	2/VII 1960	42
863	F. ,,	Cape Sabine	15/VII 1960	42
893	F. ,,	Barter Island	5/VII 1961	42
896	F. ,,	Meade River	7/VIII 1961	42
939	F. ,,	Liberator Lake	20/VII 1961	42
858	F. baffinensis	Lake Peters	25/VII 1960	28
862	F. ,,	Driftwood Creek	8/VII 1960	28
865	F. ,,	Cape Sabine	15/VII 1960	28
869	F. ,,	Lake Peters	26/VII 1960	28
892	F. ,,	Meade River	7/VIII 1961	28
875	F. vivipara	Cape Sabine	15/VII 1960	c 63
877	F. ,,	Lake Peters	26/VII 1960	c 63
898	F. ,,	Liberator Lake	21/VII 1961	c 63
868	F. ovina ssp. alaskana	Lake Peters	26/VII 1960	14
895	F. ,, ,, ,,	Old John Lake	13/VII 1961	14
899	F. ,, ,, ,,	Liberator Lake	21/VII 1961	14
901	F. ,, ,, ,,	Lake Peters	7/VII 1961	14
866	F. ,, ,, ,, f. pallida	Cape Sabine	15/VII 1960	14
897	F. ,, ,, ,, ,, ,,	Feniak Lake	30/VII 1961	14
900	F. ,, ,, ,, ,, ,,	Liberator Lake	21/VII 1961	14
861	F. rubra	Driftwood Creek	10/VII 1960	42
870	F. altaica	Lake Peters	26/VII 1960	28

Notes on the species

Below are all species discussed. In "List of specimens" are enumerated all specimens which were collected in 1960 and 1961. Those marked with "F" were studied cytologically. Some of the numbers were collected together with Dr. O. Mårtensson, Uppsala, Sweden. Herbarium specimens with the same numbers are kept at Universitetets Botaniske Museum, Copenhagen (C.).

Festuca brachyphylla Schultes

List of specimens: Barrow 1960 (F. 860, 60-1493); Barter Island 1961 (F. 893); Meade River, Atkasuk 1961 (F. 896, 61-1585); Cape Sabine, Pitmegea River 1960 (F. 863, F. 864, 60-1492); Liberator Lake 1961 (61-1795); Driftwood Creek, Utokok River 1960 (60-1496); Umiat 1960 (60-1495); Lake Peters, Brooks Range, 1960 (F. 851, 60-1494); Feniak Lake, Noatak River Drainage 1961 (61-1100, 61-1391).

This species, which seems common throughout the Arctic, was first described by R. Brown (1823) from Melville Island under the name of *F. brevifolia* (Typus in British Museum). This name was, however, previously used for another taxon by Muhlenberg and was then changed by Schultes in Roemer & Schultes (1827) to *F. brachyphylla* simply by a translation of the epithet from Latin to Greek.

True *F. brachyphylla* has the chromosome number 2n=42. This has been determined by Bowden (1960) on material from Kenai Peninsula in Alaska, from Southamtpon Island, Chesterfield Inlet, Baffin Island, and two localities in northern Quebec, all in Canada. In Greenland this number (2n=42) has been found in material from a number of places. Holmen (1952) reports it from Zackenberg and Ella Island in NE Greenland, Jørgensen, Sørensen and Westergaard (1958) from Wollaston Forland and Clavering Island, NE Greenland, and B.W. 1 in South Greenland. In W. Greenland I have ascertained this number on material from Umanak Fjord, Godhavn, Egedesminde, Sdr. Strømfjord, Godthåb, and several other localities. Including the counts from Arctic Alaska (see Table I) we can state that this species — as to the chromosome number — is quite constant within its arctic range.

The species has, however, also been reported from numerous localities in the alpine parts of the Rocky Mountains. During a stay at the University of Colorado in 1960, Dr. W. A. Weber showed me some of the Colorado localities for the species, and I had the opportunity to determine that the species there is tetraploid having 2n=28. This material is therefore worthy of taxonomic rank, probably at the subspecies level.

F. brachyphylla is the most abundant species of the genus in Arctic Alaska. Wiggins & Thomas (1962) also give a very long list of localities for the species. At the end of this list are two localities for *F. saximon-*

tana Rydb. (sub nom. *F. brachyphylla* ssp. *saximontana* (Rydb.) Hult.). As this species actually has areas in common with *F. brachyphylla,* I have borrowed the type of *F. saximontana* from the New York Herbarium to compare with my *F. brachyphylla* material from Alaska. *F. saximontana* Rydb. differs from *F. brachyphylla* in two very important features: it has long anthers, and the sclerenchymatic tissue of the leaves is strongly developed (see Fig. 1). Furthermore it is a robust species. I think it is impossible to include it as a subspecies of *F. brachyphylla,* as done by Hultén (1942). To me it seems more closely related to *F. trachyphylla.*

Festuca baffinensis N. Polun.

List of specimens: Meade River, Atkasuk 1961 (F. 892); Cape Sabine, Pitmegea River 1960 (F. 865); Liberator Lake 1961 (61-1794); Driftwood Creek, Utokok River 1960 (F. 862); Lake Peters, Brooks Range 1960 (F. 858, F. 869, 60-1497, 60-1498, 60-1499).

F. baffinensis seems to be the most distinct of all Festuca-species with short anthers. Since the original description by Polunin (1940) it has been reported from a large number of localities. In the New World it is present in the Rocky Mts. south to Colorado (Weber, 1961), and in the Arctic it has continuous distribution from Alaska in the West across Canada to Northeast Greenland in the East, preferring areas with calcareous soil. Further to the east in the Arctic area it is known from Svalbard (Jørgensen, Sørensen & Westergaard, 1958) and also from Novaya Zembla. Four years ago I had opportunity to go through the Festuca collections at Naturhistoriska Riksmuseet, Stockholm. I found that *F. baffinensis* was represented from seven different localities on Svalbard, and furthermore a single specimen labelled: "Nov. Zembla, Belushii Bay" leg. Ekstam, 1905, which was also this species. It therefore seems likely that *F. baffinensis* has a circumpolar distribution.

The chromosome number is now known from a number of places in Greenland (Cp. Holmen 1952; Jørgensen, Sørensen & Westergaard 1958), Canada (Cp. Bowden 1960), and Alaska (see Table I), and all counts show $2n=28$. The Colorado population also has this number (Cp. Holmen in Weber 1961).

Festuca vivipara (L.) Sm. s. lat.

List of specimens: Cape Sabine, Pitmegea River (F. 875); Liberator Lake (F. 898); Lake Peters, Brooks Range (F. 877); Feniak Lake, Noatak River Drainage (61-1390).

Festuca vivipara (L.) Sm., in the sense of most authors, is a complex, probably consisting of a number of species and hybrids. Nothing has yet been shown about the taxonomic status of the different races, and different taxa have not been described within this complex, although most authors are aware of the occurrence of different chromosome-races which are restricted to certain areas.

The typical race of *Festuca vivipara* undoubtedly includes the taxon common in the Scandinavian mountains, in Iceland, and South Greenland. It is a vigorous plant with puberulent paleas.

The chromosome-number of this taxon ($2n=28$) has been reported from all the three areas mentioned above (Löve & Löve, 1961). In other parts of the Arctic where populations of viviparous Festuca occur, e.g. in Northeast Greenland and in Alaska, plants with higher chromosome numbers are found. They differ considerably from the tetraploid species in morphology, but they often seem more closely related to *F. brachyphylla* or *F. baffinensis* in these areas.

There has been no investigation or clarification of the origin of these forms, but some considerations have been presented by Löve & Löve (1956), in whose opinion they may be hybrids. It is possible that the chromosome numbers of these viviparous Festucas could be explained in this way.

As appears from Table I $2n=63$ is the most likely chromosome number for the plants from the three localities where I collected cytological material of viviparous Festuca in Alaska. If this has originated from species to be found in the area today the only simple way would be to assume that the unreduced egg of *F. brachyphylla* ($2n=42$) had been fertilized by normal pollen of the same species ($n=21$). This would give a new generation with $2n=63$, but it is difficult to visualise how normal meiosis could take place. As yet, however, there is no evidence for or against the hypothesis.

In their recent account of *Festuca vivipara* in Alaska Johnsen & Viereck (1962) are convinced that their material should be referred to the same taxon as that in Scandinavia. A further study of this whole problem therefore seems to be worthwhile.

Festuca ovina L.

List of specimens (ssp. alaskana): Liberator Lake 1961 (F. 899); Lake Peters, Brooks Range 1960 (F. 868), 1961 (F. 901); Old John Lake 1961 (F. 895).

ssp. *alaskana* f. *pallida*: Cape Sabine, Pitmegea River 1960 (F. 866); Liberator Lake 1961 (F. 900), Lake Peters 1960 (60-1501); Feniak Lake, Noatak River Drainage (F. 897, 61-1401).

True *Festuca ovina* seems not to have been previously found in the American Arctic (Greenland incl.). All the representatives of the group hitherto collected have proved to bear short anthers and must therefore be referred to *F. brachyphylla*, *F. baffinensis* or others.

The present material, which was collected on dry windblown habitats such as ridges and hill-summits, consists of rather vigorous, densely caespitose specimens with straight and almost filiform leaves. The culms are slender and scabrous. The panicle is open during anthesis, with spreading branches, a phenomenon which I have never observed in *F. brachyphylla.* The spikelets are also open during anthesis and this, with the large anthers (more than 2 mm, usually 2.7 mm, long), makes the species easily recognized in the field and shows its close relationship to true *F. ovina.*

A very large number of varieties, subspecies and microspecies of *F. ovina* have been described, especially from alpine areas. Besides having long anthers, most of them are characteristically diploid (2n= 14, cp. Brandberg 1947) as is the material studied from Alaska.

St-Yves (1925) has shown that one of the most important taxonomic characters in Festuca is to be found by study of transverse sections of the leaves which in the different taxa show a characteristic distribution of sclerenchymatic tissue; the spikelets, however, do not usually provide good taxonomic characters in *F. ovina.*

In an attempt to determine whether *F. ovina* from Alaska is identical with any of the many microspecies already described, comparisons have been made with a number of these.

F. ovina L. s.str., *F. supina* Schur., *F. halleri* All., *F. rupicaprina* (Hack.) Kern., *F. valesiaca* Schleich., and *F. alpina* Suter have been studied. Of these, only *F. supina* seems to have been reported from the Arctic. According to the Russian floras it has frequently been found along the arctic coasts of Russia and Siberia. However, both *F. supina* and *F. ovina* s.str. are distinctly different from the Alaskan species in having a strong sclerenchymatic band just beneath the epidermis of the abaxial side of the leaf blade. This band is absent in the Alaskan material (see Fig. 1).

The only species which was found, in this respect, to be similar to the Alaskan one was *F. alpina,* which in other characters differs from the Alaskan specimens in being much more slender and less hairy, and also in having shorter anthers. Further *F. alpina* seems to be limited to a small area in the European Alps. As the Alaskan material definitely seems isolated from its closely related taxa, I think it deserves the rank of subspecies, and I propose here:

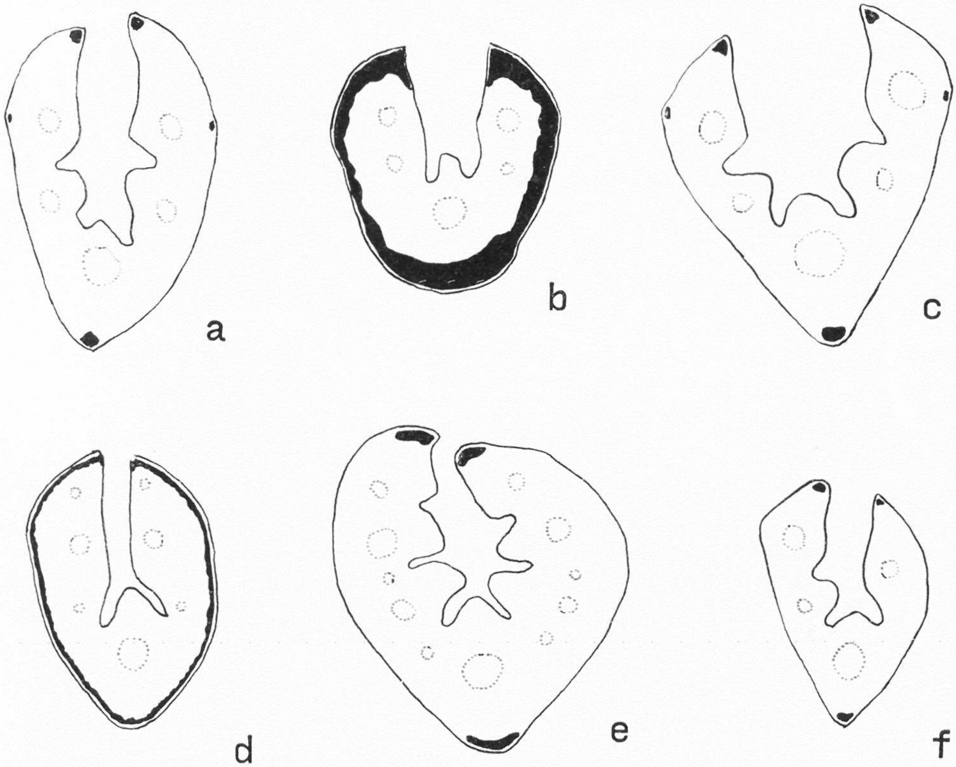

Fig. 1. Cross-sections of leaves of *Festuca*-species. Sclerenchymatic tissue is black. a. *F. brachyphylla*, NE Greenland. b. *F. saximontana*, Banff, Alberta (Type). c. *F. baffinensis*, Arctic Alaska. d. *F. ovina* ssp. *ovina*, Denmark. e. *F. ovina* ssp. *alaskana*, Arctic Alaska (Type). f. *F. alpina*, European Alps. — Magnification 60×.

Festuca ovina L. subsp. *alaskana* subsp. n.

A subsp. *ovina* differt foliis solum juxta margines et ad nervum medianum sclerenchymate firmatis, non ut in illa strato sclerenchymatico subepidermatico continuo in pagina inferiore (exteriore) armatis.

A *Festuca alpina* Suter, quacum illam notam communem habet, staminibus differt ut in subsp. *ovina* 2.5—3 mm longis.

Typus: Alaska: Brooks Range, Lake Peters (69°20′ lat. bor., 145° long. occ.) altit. 900 m K.H. no 901. 7. Jul. 1961. In some places a form was collected, which morphologically completely matches ssp. *alaskana*, but with the whole plant having a yellowish-green colour; it is never tinged with reddish or purple on the stem and spikelets as is the common form.

This pale form is called:

F. ovina L. ssp. *alaskana* K. Holmen forma *pallida* f.n.: a forma *alaskana* differt colore pallide viridi purpureo nusquam affecto.

Fig. 2. *Festuca ovina* L. ssp. *alaskana* K. Holmen. Type-specimen.

Typus: Alaska: Cape Sabine (68°53′ lat. bor., 164°35′ long. occ.) KH no. 866. 14.—16. Jul. 1960.

Festuca rubra L.

List of specimens: Meade River, Atkasuk 1961 (61-1556); Cape Sabine, Pitmegea River 1960 (60-1491); Driftwood Creek, Utokok River 1960 (F. 861, 60-1490); Umiat 1960 (60-1489)); Lake Peters, Brooks Range 1960 (60-1488); Feniak Lake, Noatak River Drainage 1961 (61-1104, 61-1126, 61-1392).

Although this species has not been included in my studies, it is mentioned here as I have determined the chromosome number of vigorous and caespitose specimen from Driftwood Creek, Utokok River. The count showed the usual number for this species, 2n=42, which is known from a large number of localities throughout its range.

Festuca altaica Trin.

List of specimens: Driftwood Creek, Utokok River 1960 (61-1485); Liberator Lake 1961 (61-1698); Lake Peters, Brooks Range 1960 (F. 870, 60-1486, 60-1487) 1961 (61-1001); Old John Lake 1961 (61-1299); Feniak Lake, Noatak River Drainage 1961 (61-1396).

My material from Lake Peters in the Brooks Range has the same number (2n=28) as reported by Sokolovskaja & Strelkova (1940) from Altai, by Bowden (1960) from Alaska and Western Canada, and by Sokolovskaja (1963) from Kamtchatka.

Key to the Arctic Alaskan species of *Festuca*

A. Panicle with open branches which are 5—8 cm long. Spikelets 10—15 mm long *F. altaica*
A. Panicle spike-like, with the branches less than 3 cm long. Spikelets rarely exceeding 10 mm
B. Spikelets viviparous .... *F. vivipara*
B. Spikelets not viviparous
C. Anthers very small (0.5—1 mm)
D. Culms glabrous .... *F. brachyphylla*
D. Upper part of culms densely puberulent .... *F. baffinensis*
C. Anthers usually 2 mm or more
E. Plants densely caespitose. Leaves filiform.
Lemmas glabrous or minutely scaberulous.
F. Spikelets more or less purple .... *F. ovina* ssp. *alaskana*
F. Whole plants yellowish-green, without any violet or reddish *F. ovina* ssp. *alaskana* f. *pallida*
E. Plants loosely caespitose, often with rhizomes. Leaves more or less flat.
Lemmas puberulent or pilose .... *F. rubra* coll.

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The Genus Trapella Oliver in the Tertiary of Europe

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I. Introduction

The present day East Asiatic angiospermous element of the Cainozoic flora of Europe has often been assumed the most important and dominating one as regards plant genera now absent from Europe. The dicotyledonous genera present in the Tertiary and Lower Quaternary flora of Europe, but living representants now confined to Asia, have been treated recently in a monograph by Tralau (1963). The history of the investigation of the Asiatic plants in Europe during the Cainozoic period is outlined briefly in the paper cited above, and detailed information can be obtained there. The discovery of the genus *Trapella* from Pliocene deposits in Europe is a further contribution to our knowledge of the Asiatic component in Europe during that time.

II. The Genus *Trapella* Oliver

a. The recent species

The genus *Trapella*, containing two aquatic species of Eastern Asia, has been described by Oliver (1888—89) and monographed later by Glück (1940).

The following living species are recognized: 1. *T. antennifera* (Léveillé) Glück, 2. *T. sinensis* Oliver (*T. sinensis* var. *infundibuliformis* Glück included).

The chief specific characters of the two species in question is that

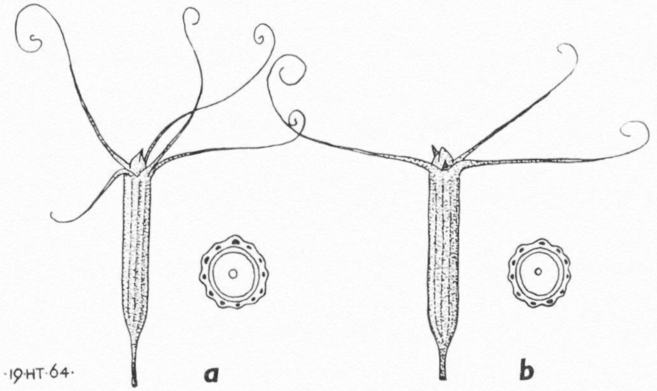

Fig. 1. a: fruit of *Trapella antennifera* with cross section to the right; b) fruit of *T. sinensis* with cross section to the right.

the fruit of *T. antennifera* has five flagella-like appendages,[1] about 2.0—3.0 cm long (see fig. 1 a), called antennae by Glück (1940), that arise from the apex of the fruit. They are situated hypopetally and alternate with the sepals. *T. sinensis* also has five appendages of which three are as long as *T. antennifera* but two remain short (see fig. 1 b). Two of the long flagellae originate from the upper carpel and are thus laterally adaxial. The third long flagella is medial-abaxial and thus originates from the lower carpel. The fruits are often provided with longitudinal wings of different shape. According to Glück's observations winged fruits are much more frequent in *T. antennifera* than in *T. sinensis* and are said to be much more extensively developed than those of the other species. Cleistogamic fruits always lack those longitudinal wings.

b. The fossil species of Europe

Trapella weylandi (Thomson & Grebe) Tralau nov. stat. (Syn.: *Dulichium weylandi* Thomson & Grebe).

Type: Figured in Grebe 1955, pl. XXXIV, f. 14. The original specimen in Thomson's collection is lost .

Lectotype: Paläobotanische Sammlung des Amtes für Bodenforschung, Krefeld, Germany: from the Pliocene (Reuverian) of Swisterberg/Weilerswist in Western Germany.

Ill.: Grebe 1955, pl. XXXIV, f. 14.

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[1] Miki (1961) declared that these flagella-like appendages are bracts. Though situated immediately beneath the persisting, conically contracted calyx the flagellae actually are not bracts but belong to the fruit.

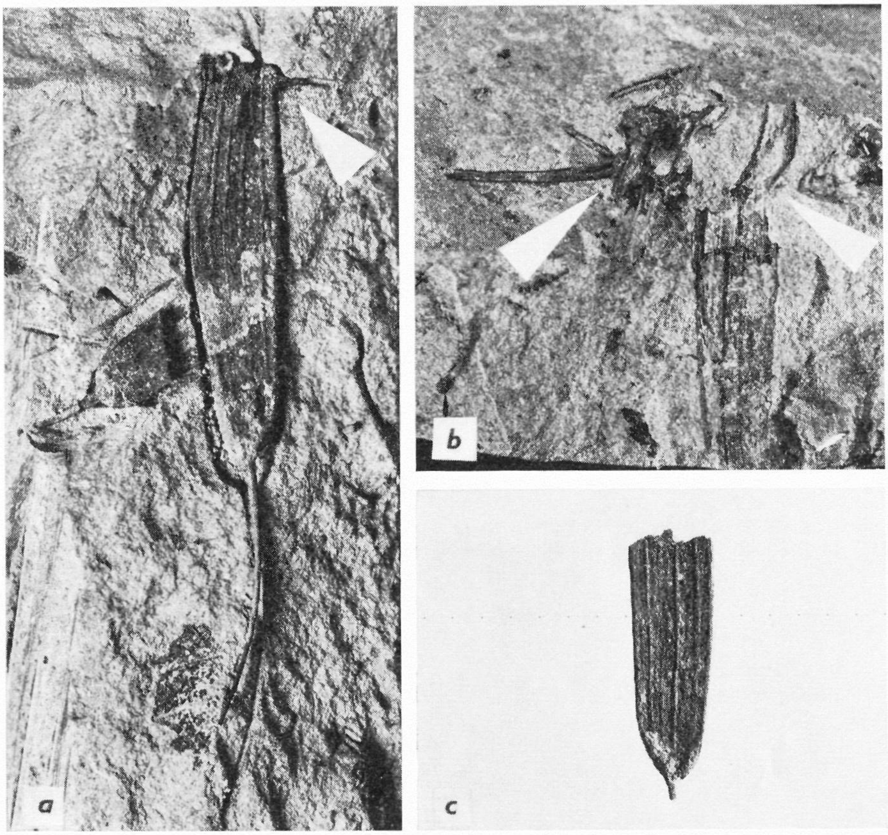

Fig. 2. *Trapella weylandi* (Thomson & Grebe) Tralau from the Pliocene (Reuverian) of Swisterberg/Weilerswist, Germany. Coll.: Thomson & Grebe.

a: Full-sized fruit with basal part of the flagella-like appendage to the right. 5×.
b: Apices of full-sized fruits with flagellae. 5×.
c: Basal part of a full-sized fruit. 5×.

Photo: K. E. Samuelsson.

Diagnosis: Fruit cylindric with linear ribs running parallel abapically. Appending flagellae often right angled to the upper apex. Basal part of the fruit truncated. Stalk slender.

Description: Fruit 10.0 mm long and 2 mm broad, with four or five (eventually six) ribs running from top to base. Flagella-like appendages attached to the apex. Number of flagellae unknown, but at least three. Stalk slender and about 8.0 mm long according to the impression in the specimen of fig. 2 a.

The genus *Trapella* has not been recognized previously in the fossil state in Europe and the present specimens have been referred to the

Fig. 3. The recent and fossil distribution of the genus *Trapella* (The recent occurrences: ● = *T. sinenses,* ⊙ = *T. antennifera*; the fossil occurrences outside the present range: ◒ = Miocene, ◓ = Pliocene).

genus *Dulichium* (Thomson and Grebe in Grebe 1955). There are, however, records of fossil *Trapella* from Asia. In Japan it has been found by Miki (1938, 1941, 1961) from Quaternary (Holocene) and Upper Tertiary, e.g. Pliocene, deposits. Miki proposed four "fossil species". In Siberia the genus has been found in Miocene sites by Dorofeef (1963 a & b) and he named them *T. cf. sinensis* even though these specimens lack the flagellae.

All these Asiatic fossils, however, are identical with the European ones described here. They also obviously arose from cleistogamic flowers as longitudinal wings cannot be observed in these specimens.

Pollen resembling those of *Trapella* have been found by the present author in samples from the Pliocene of Swisterberg/Weilerswist. The pollen morphological characters of *Trapella* pollen are, however, not convincing. Therefore this determination remains tentative.

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Cotoneaster splendens, a New Species from Western China

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Among the rich material of *Cotoneaster* that has been collected by Dr. Harry Smith of Upsala during his journeys in the Western China 1922—1934 there is a taxon with a closed low distichous habit and a very rich development of bright orange, large berries. This taxon was after cultivation by the collector claimed to be one of the very best Cotoneasters for gardens hitherto known. This opinion about the horticultural value has been confirmed. In 1950 an "Award of Merit" was given by the Royal Horticultural Society (Journ. R. Hort. Soc. p. 489, 1950; Koch. Gartenwelt p. 336, 1955) to *Cotoneaster*×*Sabrina* hort., a supposed hybrid between *C. horizontalis* and *C. pannosus,* which was said to have arisen in a garden in Somerset, England. The name of *Sabrina* means Bristol-Kanal. This garden type is, however, no doubt identical to Harry Smith's collection No. 12925, which has been cultivated for more than 25 years in botanical gardens in Scandinavia, among others in Gothenburg, Copenhagen, Lund, Stockholm (Berganium) and Upsala. On several occasions seed has been distributed. It is an apomictic species, which will be described below as a new one.

Cotoneaster, sectio ***Orthopetalum*** Koehne in Deutsch. Dendrol. 1893, p. 224, series **Franchetioideae** Flinck et Hylmö in Bot. Not. 1962, p. 383.

Cotoneaster splendens Flinck et Hylmö sp. apom. nova, Fig. 1 et Fig. 3.

Syn.: *C.*×*sabrina* Hadden ex Krüssmann in Laubgehölze ed. 2, p. 117, 1951 pro hybrida *C. horizontalis*×*C. pannosus,* nom. nud.; Klotz in Wiss. Z. Univ. Halle, Math.-Nat. VI, 16 p. 971, 1957, nom. nud.

Ex affinitate *C. Dielsiani* Pritzel, a quo distat: frutice minus alto, foliis latioribus, tenuioribus, pilosis, nervis modice impressis, pedicellis brevibus, baccis majoribus nitenter aurantiacorubris.

Frutex 1(—2) m. altus; rami subarcuati, partim subdecumbentes, ramuli juniores distichi, dense albo-fulvescenter strigillosi, annotini pilosi, cortice rubro-fusco vel cinerascente-fusco.

Folia decidua, late ovata, elliptico-ovata vel suborbicularia, apice acuta, basi obtusa, 13—22 vulgo 16—18 mm. longa et 13—15 mm. lata, supra in statu vivo modice nitentia, viridia, permanenter pilosa, subtus albo- vel albo-flavescenti-pilosa vel -tomentosa, nervis paginae superioris modice impressis; petioli 2—3 mm. longi, strigillosi; stipulae membranaceae, subulatae, 2—3 mm. longae, rubro-violaceae.

Cymae parvae, plerumque 3-florae (2—7), in ramulis lateralibus 3—6(—15 mm. longis, vulgo 5-foliatis insidentes; pedicelli 1—2 mm. longi; bracteae subulatae, virides—viridi-violaceae, strigosae, c. 2 mm. longae.

Flores erecti c. 8 mm. longi, c. 5 mm. diamentientes, receptaculo calycis albo vel alboflavescenter piloso vel -strigoso, c. 4,5 mm. crasso; lobi calycis erecti, strigosi, deltoidei, acutati vel acuminati, c. 2 mm. longi et 2,5 mm. lati, 0,5 mm. late membranaceo-marginati, membrana glabra, rubro-fusca, marginaliter albo-flavescenter tomentosa. Petala erecta, valde incurvata, fere orbicularia, late brevi-unguiculata, marginem versus laete, ceterum intense rosea, c. 4 mm. longa et aequilata, apice suberosa. Stamina c. 16(13—20) filamentis inter se aequalibus, late subulatis, apice incurvatis rubris, thecis laete flavidis aetate brunnescentibus.

Fructus obovoideus, 9—11 mm. longus et 8—10 mm. crassus, splendide aurantiaco-ruber, apice applanatus, pilosus vel glaber; calycis lobi strigosi, centrum tegentes. Pyrenae 4(3—5).

West China: Sikang, Kangting (Tachienlu) distr., Cheto valley towards Kangting, ca 2900 m., frutex ad 2 m. altus. 22.10.1934, H. Smith 12925 (holotype in herb. Upsala). Rumichango distr., inter Maoniu et Tjedji, 3200 m., 30.9.1934. H. Smith 12578.

Cotoneaster splendens Flinck et Hylmö (figures 1 and 3) is related to *C. Dielsianus* Pritzel but differs in lower shrub height, thinner broad ovate—elliptical to suborbicular leaves with lightly impressed nerves and in bright orange fruits.

An ascending to subdecumbent shrub 1(—2) m. high with arching to divaricate shoots distichously branched. *Leaves* deciduous, broad ovate or elliptical—ovate to suborbicular, apex acute, base obtuse. Upper side slightly lustrous, bright green, remaining pilose; below white—yellowish white pilose to tomentose.

Inflorescences with usually 3 (2—7) erect flowers on 3—6 mm. long spurs. *Calyx* tube ca 4.5 mm. in diameter with erect deltoid acute or acuminate lobes. *Petals* erect, incurved, orbicular with a short, broad

Figure 1. *Cotoneaster splendens* Flinck et Hylmö. Holotype in herbarium of Upsala. Harry Smith No. 12925, Sikang, Kangting (Tachienlu) district Oct. 22, 1934.

claw, and somewhat irregularly dentate, pink—red with rose margins. Stamens about 16.

Fruits obovoid, 9—11 mm. long and 8—10 mm. broad, with top flattened, as young pilose. Lobes strigose, covering the centre. The colour of the fruits are bright orange and according to the Wilson Colour Chart (International Horticultural Colour Chart), capsicum red (Capicinus No. 715) or Dutch vermilion (Ruber vermicularis hollandicus No. 717). Pyrenes mostly 4.

C. Dielsianus was described in 1900 as collected by B. von Rosthorn in Szechwan (No. 492 Nanch'uan P'aomuwan) and is now commonly in cultivation. It grows upright and is cultivated in southern Scandinavia 2—3 m. high. The leaves of *C. Dielsianus* are thicker, almost subcoriaceous and with more deeply impressed nerves than *C. splendens*. The upper sides of the leaves of *C. Dielsianus* are soon becoming glabrous. Calyx lobes are acuminate, drawn out to long *mucro*. The hairiness of *C. Dielsianus* is softer white than *C. splendens'* strigose yellowish white. The inflorescences are also more often flowering with 5—7 flowers on more drawn-out spurs. The fruits of *C. Dielsianus* will not be as large as those of *C. splendens* and are considerably more lustreless, darker scarlet (Blood red No. 820 to currant red No. 8211 Wilson Colour Chart).

With regard to other taxa closely related to *C. splendens* we can mention that we have had the opportunity of studying the holotype of *C. Dielsianus* forma *major* Rehder et Wilson in Sargent, Pl. Wilson. 1: 166, 1912, (Wilson No. 1288 of Hort. Veitch [A]). This specimen consists of a shoot with well-developed, large leaves but with only a few fruits. We have not succeeded in identifying other herbarium material of cultivated bushes with this forma, and therefore we must wait for the present with the classification of this taxon. The forma probably represents a microspecies. Although there is in the Botanical Gardens of Gothenburg a bush, about 4 m. high, "*C. applanatus,* Berlin 1924" which is strikingly like *C. Dielsianus* f. *major,* the question of whether *C. Dielsianus* f. *major* is a synonym of *C. applanatus* Veitch has to be further investigated. *C. applanatus* is by many authors supposed to be a synonym of *C. Dielsianus.*

Further, we have received photos and a single leaf of *C. Dielsianus* var. *globosus* Hurusawa in Acta Phytotax. Geobot., 13, p. 233, 1943, through the courtesy of the Herbarium of the University of Tokyo. In spite of the fact that this specimen is a poor, late taken branch with one single berry and 10 shed leaves we feel quite convinced that this is not

Figure 2. *Cotoneaster elegans* (Rehder et Wilson) Flinck et Hylmö. Type specimen in herbarium of Arnold Arboretum. E. H. Wilson No. 1287, Western Szechwan, July 1908 and October 1908. We regard October 1908 (left) as the holotype.

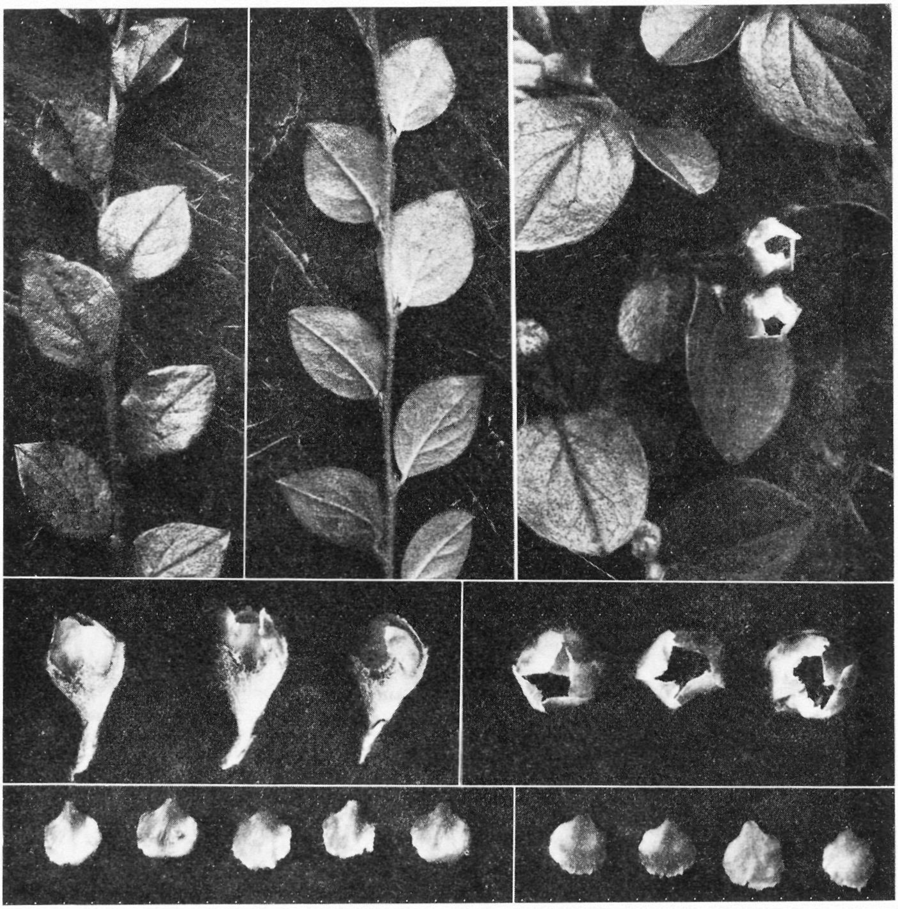

Figure 3. *Cotoneaster splendens* Flinck et Hylmö. From plant No. 9414 cultivated in Bjuv, Scania, Sweden. Photo July 1, 1961.

a relative of *C. Dielsianus* but a taxon within the series of *Melanocarpae*. The locality, northern China, prov. Chatar (=Hopeh), Kalgar, also indicates a relationship to more northern species than *C. Dielsianus*.

As we have already discussed *C. splendens* is cultivated under the name of *C.×sabrinus*, and under this name Krüssmann 1951 and 1962, Koch 1955 and Klotz 1957 have mentioned it. The figure (Krüssmann 1962, Tafel 120 g) clearly shows that it is the same taxon that we describe here. We have also a herbarium specimen of *C.×sabrinus*, "said to be *C. horizontalis×pannosus*", Loc.: Somerset (England), West

Porlock, 27.9.1950; comm. N. G. Hadden (UPS), which confirms the identity with *C. splendens*. We must, however, object to the proposed relationship with *C. pannosus* Franchet, which is a species closely related to *C. lacteus* W. W. Smith, from Sect. *Chaenopetalum* Koehne with for this section typically spreading, white petals and with the flowers bursting into blossom simultaneously in the corymbs. *C. pannosus* has coriaceous leaves with a specific waxy, glossy upper side of an unmistakable character. Probably *C. pannosus* has been mixed up with *C. Franchetii*, a not uncommon mistake in cultivation. It seems more reasonable to liken it to *C. horizontalis* Decaisne. The habit of *C. splendens* has some resemblance to the large-leaved variety of *C. horizontalis* (var. *robustus* hort.), but the likeness is very superficial. *C. horizontalis* belongs to the series of *Adpressae* Hurusawa, characterized among others by one- or few-flowered inflorescences, 10(—12) stamina and 2—3 pyrenes and sparse pilose or glabrous leaves, calyx and calyx receptaculum.

In our cultivation trials *C. splendens* breeds true at seeding. The material comprises about 200 plants without proved variation during 4 generations, and therefore the species must be looked upon as apomictic. The information that *C.×sabrinus* should have arisen in a garden in England therefore seems to be unlikely. It is obviously a progeny from H. Smith's collection No. 12925 from Szechwan, from which seeds have been distributed from the Botanical Garden of Upsala since 1945 and earlier from Mr. Magnus Johnsson from the Bränningestrand Nursery, Sweden.

With regard to what is mentioned above, other reported garden hybrids ought to be examined, and then especially *C.×Crispii* Exell and *C.×newryensis* T. Smith. Perhaps one day also these can be proved to be apomictic species which have been found by an industrious collector in China's so difficultly accessible mountains. We have seeding of *C.× Crispii* and it seems to breed true.

Against the description of *C.×sabrinus* by Klotz (1957) we wish to raise the following objection. It is described by Klotz to be half-evergreen but *C. splendens* loses its leaves in Scandinavia as early as October. The leaves are not leathery but are relatively weak and can possibly be described as subcoriaceous. They are not either naked above but are on the contrary persistent pilose. Cymes is by Klotz said to be 4—15 flowered, but we found most commonly 3 and as a maximum and only very seldom 9 flowers. Pyrenes are not 2 but usually 4, sometimes 3, seldom 5.

Cotoneaster splendens grows like *C. Dielsianus* and *C. elegans* in Szechwan. In herbaria and in cultivation we know some more apomictic microspecies from the same area, and they are no doubt related to the above-mentioned species. They represent a group within the series of *Franchetioideae,* which differs from the type-species of the series, *C. Franchetii* Bois and its closest allies through thinner and less leathery leaves and through earlier flowering and defoliation. *C. splendens* flowers in southern Scandinavia at about the 20th of June, which is about one week earlier than *C. Dielsianus* and 2—3 weeks earlier than *C. Franchetii.*

C. Franchetii like *C. amoenus* Wilson, *C. Wardii* W. W. Smith and *C. Sternianus* (Turrill) Boom comes from the province of Yünnan or from Upper Burma and has half leathery winter green or half winter green leaves. Also of this southern species within the series of *Franchetioideae* there are several microspecies in cultivation, which await description. Some of these have a high horticultural value. We have had the opportunity of studying the type specimens for all these four species. Much of what we saw cultivated under the name of *C. Wardii* has been shown to belong to *C. Sternianus,* so even plants from seeds distributed by the author of *C. Wardii.* The holotype of *C. Wardii* comes from a flowering bush; the propagating material of the species must therefore have been collected on another occasion and have reached us in other ways. What we have received from several English and German nurseries under *C. hybridus* "Gloire de Versailles" Hesse (Koch 1955, Krüssmann 1962) has turned out to be *C. Wardii,* which species is a graceful spreading shrub with acuminate calyx lobes, often drawn out to a long mucro.

The leaves of *C. cinerascens* (Rehder) Flinck et Hylmö are thinner and less leathery but are shed although relatively late. The place of origin has not earlier been quite fixed. The species is described from cultivated material, which was supposed to come from Schneider's collects in Yünnan or S. W. Szechwan. We have recently in herbaria identified two collections of *C. cinerascens,* namely Schneider 3131 (K) Yünnan, in dumetis infra glaciem inoquam prope Lichiang, fr. sanguineae, 10 Sept., 1914, 3.500 m., and Wilson 995 (AA, K, BM) w. Szechwan, Tachien-lu, 8—9.000 ft; 6—10 ft., fruits bright red, Sept., 1908. In the Botanical Gardens of Dublin there is also cultivated material, marked Wilson 995 and others with locality information Tengyueh (Yünnan), which we have identified as *C. cinerascens.*

Cotoneaster splendens is like *C. Dielsianus* and *C. elegans* relatively hardy and stands in southern Scandinavia winters with as low temperatures as — 20°C to — 22°C. At even lower temperatures these species will freeze back. However, the more winter-green species within the species group around *C. Franchetii* are injured already at considerably higher temperatures and are therefore very difficult to cultivate in Scandinavia.

We are indebted to Dr. Harry Smith, Upsala, for willingly placing his great experience and rich herbarium material at our disposal. He has also translated the diagnose into Latin, and he has proposed the species name of *splendens*. Further we owe thanks to Mr. Magnus Johnsson, Gothenburg, who through opening his nursery has saved much of Smith's Chinese material to richen the gardens now and in the future by disposing part of his nursery for this material.

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Notes on the Ecology of Tolypella glomerata (Desv.) Leonh.

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Several Charophytes show an irregular occurrence, especially some small therophytic species, and as a consequence their distribution is incompletely known, as well as their ecology. One of these species, *Tolypella glomerata* (Desv.) Leonh., had since 1873 not been collected in Sweden, when the author found it growing in a small shallow pool in a limestone pavement area on Fårö, North Gotland, in winter 1961. Afterwards the species disappeared from this locality and has been repeatedly sought after in vain during 1961—1963. It did not reappear until autumn 1963.

A pronounced periodicity seems to exist in the Charophyte vegetation of the shallow depressions which are characteristic of flat limestone areas on the island of Gotland and which are called "vät" (plur. "vätar") in the native language. This irregular periodicity is caused by the varying weather conditions during different years, and depends mainly on the amount of precipitation. The shallow Charophyte pools normally dry up in summer, and the carpets of mainly *Chara* spp. of which *Ch. aspera* is a characteristic species generally grow up again during the later part of the summer or autumn and hibernate. During extremely dry summers the main part of the charophyte vegetation indefinitely disappears in such habitats.

The extremely dry year of 1959 (see Table 2) was followed by a very wet year, in which the depressions in the limestone pavement areas were already filled with water in July. The Charophyte vegetation of the "vätar" and even of the pools in the fens had disappeared but came back to some extent in autumn 1960, however, only as thinly dispersed patches or single specimens, especially at the margins of the pools and

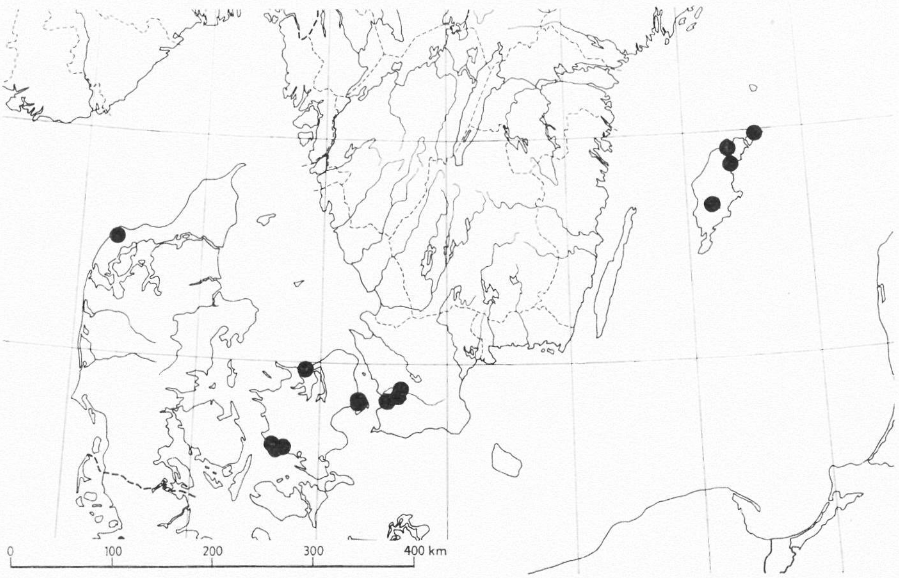

Fig. 1. Entire distribution of *Tolypella glomerata* (Desv.) Leonh. in Denmark (according to Olsen 1944) and Sweden. The northernmost locality is situated on Fårö, North Gotland.

fens. Among the first species to reappear was *Tolypella glomerata,* no other species being collected in the above-mentioned locality in early spring 1961.

Tolypella glomerata in Sweden

Tolypella glomerata is nearly related to *T. nidifica* Leonh. but differs in several characters, especially smaller oospores (Groves & Bullock-Webster 1920 p. 140). *T. nidifica* is widely distributed in brackish water along the coasts of the Baltic and also grows according to Hasslow (1931 p. 93) in fresh water. However Luther (1951 p. 322) does not agree: "Die Art dürfte wenigstens in Nordeuropa nicht in völlig süssem Wasser angetroffen sein". *T. glomerata* is mainly found in fresh water but occurs also in brackish water (Groves & Bullock-Webster 1920 p. 137, cf. Olsen 1944 p. 70).

From West Scania four *Tolypella glomerata* localities are known, all situated within a very limited area in the neighbourhood of Malmö and Lund (Hasslow 1931 p. 94) and discovered between 1863 and 1873.

It may be assumed that the species later became extinct in these ancient localities.

On Gotland four localities, too, have been discovered (see Hasslow l.c.): Lojsta, small hollows by the road. G. Eisen, June 1865; Othem, Slite, May and June 1864, P. T. Cleve; Hangvar, Snäckers, "in fossis", L. J. Wahlstedt, 7th July 1871; Fårö, Broskogs (SE. of Norrsund), shallow depression in a limestone pavement area, sheep-pasture, Bengt Pettersson, 28th Febr. 1961 (with ripe oospores), 6th Oct. 1963 (with antheridia and oogonia), 12th Jan. 1964 (with ripening oospores), depth of water in Oct. ca. 18 cm, in Jan. 20 cm (under 6 cm ice).

From Denmark Olsen (1944 p. 69—70) reports ten localities for *Tolypella glomerata,* most of which were found about 1940. The species grows at a depth of 0—3.75 m, for the most part in quite shallow water. One habitat (Olsen l.c. p. 34 and 72) is said to dry up every summer and not to be filled with water until about the beginning of October. The habitat conditions of the other localities are not sufficiently known.

Sometimes plants are found which seem to be summer annuals (cf. Hasslow 1931 p. 94: "f. *annua*", Olsen l.c. p. 72). The specimens collected by Wahlstedt on Gotland, Hangvar, Snäckers, in July 1871, are evidently of this kind. As a rule germination takes place late in the summer or autumn, and the plants hibernate. Olsen (l.c.) found plants at the end of December in one locality, where no traces of the species could be seen in April the following year.

Although different views prevail about its tolerance towards ice, it is obvious that *Tolypella glomerata* can endure being frozen in winter and still survive (cf. Wahlstedt 1864 p. 33). Olsen (l.c.) observed on one occasion that the young plants disappeared sometime between December and April, and suggests that they had been suffocated by the cover of snow.

Vegetation and properties of the water in the recently found locality for Tolypella glomerata, Gotland, Fårö

When *Tolypella glomerata* was found in Febr. 1961, the species was mistaken for heavily encrusted *Chara globularis* Thuill. (syn. *Ch. fragilis* Desv.), and no complete list of the accompanying flora was made. The only species noted were *Littorella uniflora, Ranunculus trichophyllus* and *Veronica scutellata* together with species of *Spirogyra* and *Zygnema,* which were found when *Tolypella* was determined on collected material.

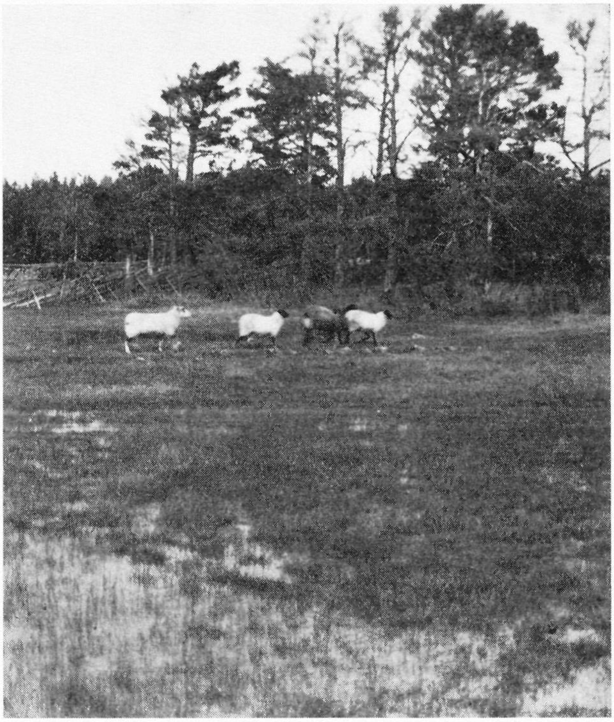

Fig. 2. A habitat for *Tolypella glomerata*: shallow depression ("vät") in limestone pavement area, drying up in summer. The sheep keep away from the inundated ground and follow a low ridge across the water. Gotland, Fårö, Broskogs, Oct. 6th, 1963.

On Aug. 10th, 1962, the vegetation where *Tolypella* was found was examined more closely. The bottom was dry, and no *Charophyta* were visible. Of the vascular plants present *Agrostis stolonifera* and *Juncus articulatus* predominated. In addition, the following species grew on the bottom of the small depression: *Carex oederi, C. flacca, Galium palustre, Gentianella uliginosa, Inula britannica, Leontodon autumnalis, Myosurus minimus, Ranunculus flammula, Sagina nodosa, Teucrium scordium,* and *Veronica scutellata.* Of bryophytes were noted: *Bryum* cf. *bimum, Calliergon turgescens, Campylium helodes, C. stellatum, Dicranella varia, Drepanocladus sendtneri, Fissidens adianthoides, Hymenostylium recurvirostre, Riccia canaliculata,* and *Trichostomum crispulum.* Among the cyanophyta *Scytonema myochrous* predominated.

Vegetation of this character is not normally wholly inundated in winter and may be looked upon as semi-terrestrial. The water level is, however, regularly rising to the surface of the ground, and often, at extremely high water, somewhat higher.

In this part of the depression the species was apparently abundant in the early spring of 1961. In the autumn of 1963 it did not occur here at all but was found in great quantities in a somewhat deeper part which is regularly covered with water every winter.

The bottom of the deeper part of the pool was looser and consisted of highly calcareous mud. The vegetation was not so rich in vascular plants here. On Jan. 12th 1964 the following species were noted in a small area: *Galium palustre, Littorella uniflora, Ranunculus trichophyllus,* and *Veronica scutellata.* Among Bryophytes only *Bryum neodamense, Drepanocladus lycopodioides,* and *Riccia duplex* were present. The only Charophytes besides *Tolypella* were young specimens of *Chara contraria.* A thick carpet of *Schizothrix* sp. together with many other Cyanophytes covered the surface of the mud.

The habitat seems to be completely dependent upon the influence of sheep (Fig. 2) which graze and trample down the vegetation during dry periods, stirring up the thin sediments. Without their activities the vegetation would change, and tall-growing helophytes might invade at least the deeper part of the depression (cf. Bengt Pettersson 1958 p. 267, Fig. 124).

A sample of water from the habitat, collected in winter, has been analysed (Table 1).

Table 1. Some chemical data of the water from the Tolypella glomerata habitat, Fårö, Gotland; collected from a shallow depression in flat limestone area of grazingland for sheep, 12th Jan., 1964. Analysis by Sigvard Åhrberg, Institute of Limnology, Uppsala.

pH	$\varkappa_{20} \cdot 10^6$	mg/l						
		HCO_3	SO_4	Cl	Ca	Mg	Na	K
7,88	425	271	21,3	9,7	92,4	0,78	9,9	0,85

Compared with analyses which the author has published earlier from Gotland (Bengt Pettersson 1958 p. 50), the water of this *Tolypella glomerata* habitat has a very high value of specific conductivity which is only comparable with the strongest auxotrophiated lake water. This may partly be due to the dunging of the area by the grazing sheep. Furthermore, the water contains rather large amounts of SO_4 and Na. The figures for Cl, K, and Mg are relatively low. The water is consequently characteristic for the habitat when compared with other investigated kinds of water on Gotland.

The irregular occurrence of Tolypella glomerata and the weather conditions

The labels on the earlier collected material of *Tolypella glomerata* in Gotland enable the determination of when the oospores had germinated. A closer examination of the weather conditions about a century ago has revealed some interesting results. Unfortunately, Visby was the only meteorological station in Gotland at that time, and has to be taken as representative of two localities a distance of 30—40 km away. According to Hamberg (1911 p. 112), 1862 was a very dry year with a total amount of rainfall of only 366 mm, fairly evenly distributed throughout the year. In 1863 the rainfall was more normal, but it is worth mentioning that July and September were moist (96 and 74 mm, respectively). October and November were unusually mild that year; the temperature did not fall below zero in Visby at any occasion. 1864 had a very high precipitation in August, 137 mm, and October was mild.

These conditions are rather similar to the weather that prevailed about the time when the more recent finds of *Tolypella glomerata* were made in Gotland. 1959 was an extremely dry year (Fårö 369 mm) which was followed by a very wet year (Fårö 727 mm). In the late part of the summer 1960 the *Tolypella* oospores germinated, and the full-grown specimens were fruiting in winter 1961. The later parts of the summers 1961 and 1962 were not so wet that the oospores were able to grow, in spite of the fact that these years can be called moist and chilly. Not until the later part of the summer 1963 did favourable conditions occur again. August and September had a rainfall of no less than 194 mm, and rain fell on 24 days.

It seems to be necessary for the germination of the oospores and the further development of the algae that they are submerged rather early in autumn. Because of the higher precipitation in the latest part of the summer and in the autumn 1961 (see Table 2), the shallower areas of the depression were also filled with water, and the plants were consequently able to grow up there. In 1963 the rainfall was not so abundant, and the occurrence of *Tolypella* was restricted to the deeper parts of the pool.

Germination of the oospores and the further development of *Tolypella glomerata* may also be influenced by temperature, especially during autumn and winter. It has already been pointed out that the

Table 2. Precipitation at the meteorological station of Fårö during March—Oct. 1959—1963. From: Precipitation in Sweden 1959—1961 (Sveriges Meteorologiska och hydrologiska inst., Årsbok Vol. 41—43, 1959—1961, 2: 1. Stockholm 1960, 1961, and 1963). The figures for 1962 and 1963 have been provided by Mr. Helge Modén, State Meteorologist.

	1959	1960	1961	1962	1963
March	13	3	25	23	12
Apr.	38	21	27	61	37
May	10	68	27	42	14
June	23	28	70	33	24
July	13	155	59	34	26
Aug.	22	124	83	72	93
Sept.	36	65	18	93	101
Oct.	17	40	22	20	48
Annual total	369	727	471	557	468

autumns in 1863 and 1864 were mild. The autumn and winter in 1960—1961 was so warm that no permanent ice was formed. In 1963, however, only September had a considerably higher temperature than normally. These facts agree with the general distribution of the species in Sweden which is pronouncedly southern (see Fig. 1), the new locality being the northernmost hitherto known.

It is quite obvious that the oospores of *Tolypella glomerata* are able to remain dormant for several years. Wahlstedt (1864 p. 33—35) thought that this species, as well as some other Charophytes which show an irregular occurrence, can be buried in the earth for thousands of years and still remain viable. This seems to be an exaggeration. The investigations of the Fårö locality show that the weather conditions mainly determine when the oospores will germinate there. It is also evident that in other types of habitat the oospores may also germinate in spring and that there are two peaks of germination in the year, the late part of the summer and the spring.

The irregular appearence of *Tolypella glomerata* parallels that of certain other plants growing in water which periodically dries up. *Ranunculus ophioglossifolius* Vill. is described by Vestergren (1924 p. 485) as a very sporadic species in its locality near Visby, where it was growing in a shallow pool. Lagerheim (1880 p. 159), earlier stated that the species probably had been "exterminated" in this locality, but it has since then appeared in great quantities, the last occasion being in 1950. Since then the conditions of the habitat have been radically changed, mainly because the ground is no longer grazed by horses.

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Studies on Variation in Embryo Sac Development

By Hakon Hjelmqvist and Franco Grazi

(Meddelande från Lunds Botaniska Museum, Nr 187)

1. Tamarix odessana

The genus *Tamarix* is known for the possession of several different types of embryo sac development occurring parallelly in the same species and individual. According to investigations of Puri (1939) on *T. chinensis,* Pàroli (1940) on *T. gallica,* Battaglia (1941) on *T. gallica* and *africana,* Johri and Kak (1954) on *T. pentandra* and *Troupii,* four different types occur in the genus: the Drusa, Fritillaria, Adoxa, and Chrysanthemum cinerariifolium types.[1] In *T. gallica* (Battaglia, 1941) and *pentandra* (Johri and Kak, 1954) all these types have been observed, in *T. chinensis* all except the Chrysanthemum cinerariifolium type (Puri, 1939), in *T. africana* all except the Adoxa type (Battaglia, l.c.), in *T. Troupii* all except the Drusa type (Johri and Kak, l.c.). Generally the Fritillaria type is most common: In *T. chinensis, gallica,* and *Troupii* it, thus, is dominating, whereas the other types are comparatively rare. In *T. pentandra,* however, according to Johri and Kak the Adoxa type is somewhat more common, with 48 % of the observed cases as against 38 % for the Fritillaria type, while the Drusa type was found in 8 % and the Chrys. cinerariifolium type in 6 % of the cases. In *T. africana* the Chrys. cinerariifolium type according to Battaglia was the most commonly occurring, with 47 % of the cases, while the Fritillaria type was found in 43 % and the Drusa type in 10 % of the observed cases.

The present authors have made an investigation on *Tamarix odessana* Stev., which is very incompletely known in an embryological respect; there is only a statement by Mauritzon (1936) that the Lilium (=Adoxa)

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[1] The designation of the types follows Maheshwari (1950).

Tab. 1. Temperature conditions (°C) the last 7 days before the fixations (according to measurements at the meteorological institute of the Geographical Institution, Lund).

	Max.	Min.	Middle		Max.	Min.	Middle
Aug. 30	17.3	11.2	14.3	Sept. 24	19.6	11.2	15.4
Aug. 31	18.2	9.8	14.0	Sept. 25	15.2	14.8	15.0
Sept. 1	15.9	13.4	14.7	Sept. 26	12.9	8.8	10.9
Sept. 2	18.3	12.2	15.3	Sept. 27	12.5	9.2	10.9
Sept. 3	21.6	13.8	17.7	Sept. 28	13.6	8.9	11.3
Sept. 4	17.7	11.0	14.3	Sept. 29	11.5	8.0	9.8
Sept. 5	19.1	11.2	15.2	Sept. 30	12.5	9.2	10.9

type occurs in the species. *T. odessana* is related to *T. pentandra*, but differs from this species, i.a., by having only 5 undivided discus lobes, not 10 (five 2-divided) as *T. pentandra.* The aim of the investigation was on the one hand to elucidate the types of development occurring in the species and their frequency and on the other hand to state whether some variation in the development might occur under different external conditions. Only one specimen, cultivated in the Botanical Garden of Lund, was used for the investigation; one fixation was made on September 5 1963, when the temperature was about 15°C on the average, another on September 30, when the average temperature during the last days had been about 10—11°. More detailed particulars about the temperature conditions during the time before the fixations are found in table 1. As is seen from the table, the maximum temperatures during the last 7 days before the first fixation had been about 17—19°, fluctuating between 15.9 and 21.6, and in the week before the late fixation they had been about 12.5° (11.5—13.6), with the exception of the two earliest days, when they rose to 19.6 and 15.2°, respectively.

Fixation was made with the solution of Navashin-Karpechenko; after embedding in paraffin and sectioning the slides were stained in hematoxylin according to Heidenhain.

The general development

All four types earlier known for the genus *Tamarix* proved to occur in *T. odessana.* Most common was the Fritillaria type. The earliest stage when this type could with certainty be distinguished was the coenomegaspore where the four megaspore nuclei had the arrangement 1 : 3, the three lower nuclei being close together in the chalazal part. The division then takes place in agreement with the usual pattern for the Bambacioni phenomenon, the three basal division spindles thus fuse and two triploid nuclei are formed as the result of the division (Fig. 1 *b*).

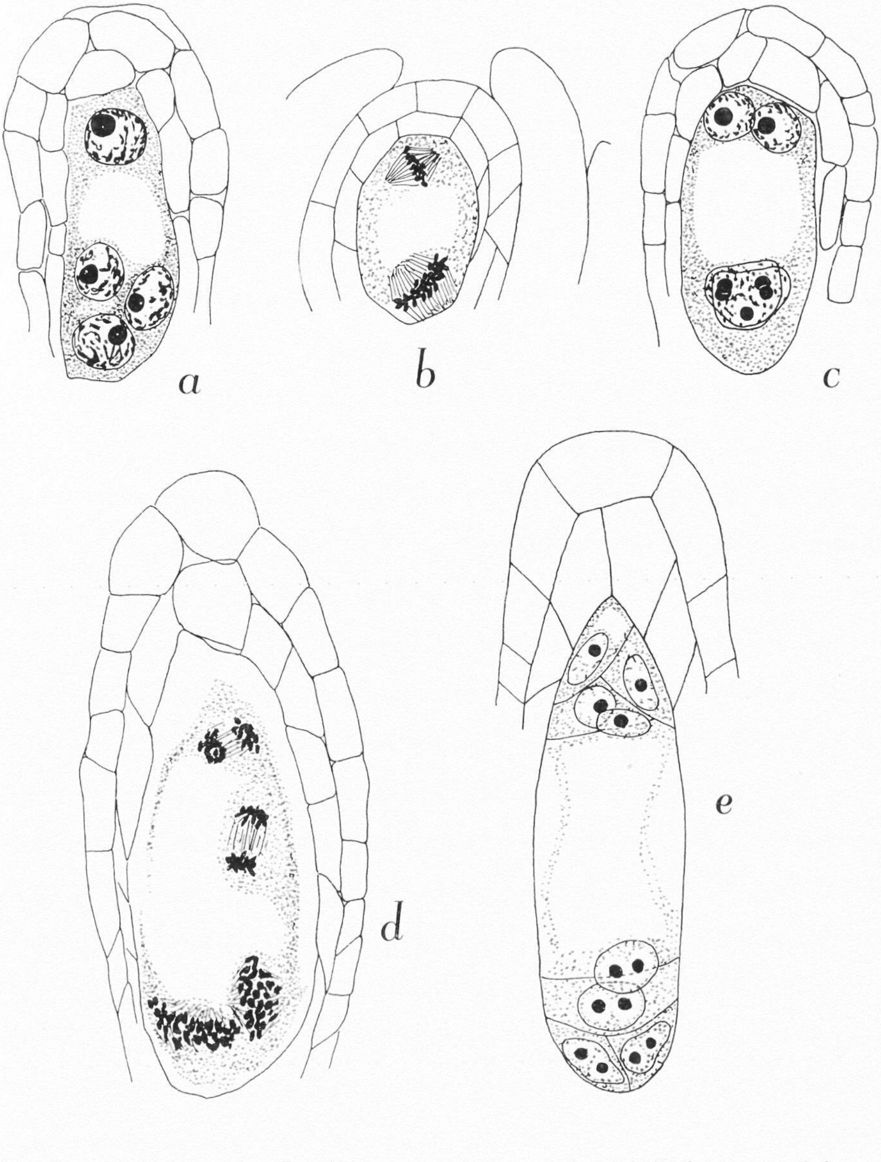

Fig. 1. *Tamarix odessana.* Development according to the Fritillaria type. *a* Primary 4-nucleate embryo sac with the nuclei in 1 : 3-arrangement. *b* Division of the 4 megaspore nuclei; the 3 basal division spindles united into one. *c* Secondary 4-nucleate embryo sac with 2 haploid nuclei above and 2 triploid below. *d* Embryo sac with 4 nuclei in division, 2 haploid and 2 triploid. *e* Mature embryo sac with 4 haploid nuclei above and 4 triploid below. — ×1020.

In the secondary 4-nucleate stage the difference is great between the two small rounded upper nuclei, as a rule with one nucleolus, and the two larger basal ones, with generally 2 or 3 nucleoli (Fig. 1 *c*). The latter are often more or less irregular in shape, roundedly triangular of somewhat lobed. When they divide (Fig. 1 *d*), it is clearly visible that their chromosome number is considerably greater than that of the upper nuclei; it was determined approximately to 36 compared to about 12 in the upper nuclei. The mature embryo sac of this type is recognized by the different polar nuclei, the lower triploid one being larger and usually also having more than 1 nucleolus (Fig. 1 *e*). The antipodals, three in number, are here, of course, also triploid, but since they often early show some tendency to degeneration, they are not so large and deviating; their nuclei, however, are often somewhat oblong and bi- or trinucleolate.

The Adoxa type was also comparatively common. It could be recognized already in the early stage when the four megaspore nuclei have taken up the 2 : 2-position (Fig. 3 *a*). The development later proceeds rapidly: after a short 8-nucleate stage the mature embryo sac is formed, which as in the case of the Fritillaria type is 8-nucleate but has two about equal polar nuclei (Fig. 3 *b*).

The Chrysanthemum cinerariifolium type was on the whole not so common as the two above-mentioned types. It could sometimes be recognized already in the 4-nucleate stage resulting from the meiosis, by the fact that the megaspore nuclei were arranged in the position 1 : 2 : 1, with distinct vacuoles between the three groups (Fig. 2 *a* and *b*); in some cases, however, no certain distinction could be made from the Fritillaria and Drusa types in this early stage. The two intermediate nuclei fuse in the resting stage or at the latest in prophase, and a diploid nucleus is formed (Fig. 2 *c*). Through a following division a 6-nucleate embryo sac is formed (Fig. 2 *d*), with 2 diploid and 4 haploid nuclei; two haploid nuclei are always situated in the upper part, while the diploid pair may have a somewhat varying position in relation to the other haploid one: it may lie beside, above, or beneath it. At the division of the six nuclei it is clearly observable that two of them have a greater chromosome number than the rest (Fig. 2 *e*). The mature embryo sac is in its typical development 12-nucleate, with 7 antipodals, three of these diploid and four haploid, and one haploid and one diploid polar nucleus. In several cases, however, only a smaller number of antipodals could be observed, which may be due to division "strikes" in the chalazal part of the embryo sac or to degeneration of one or more

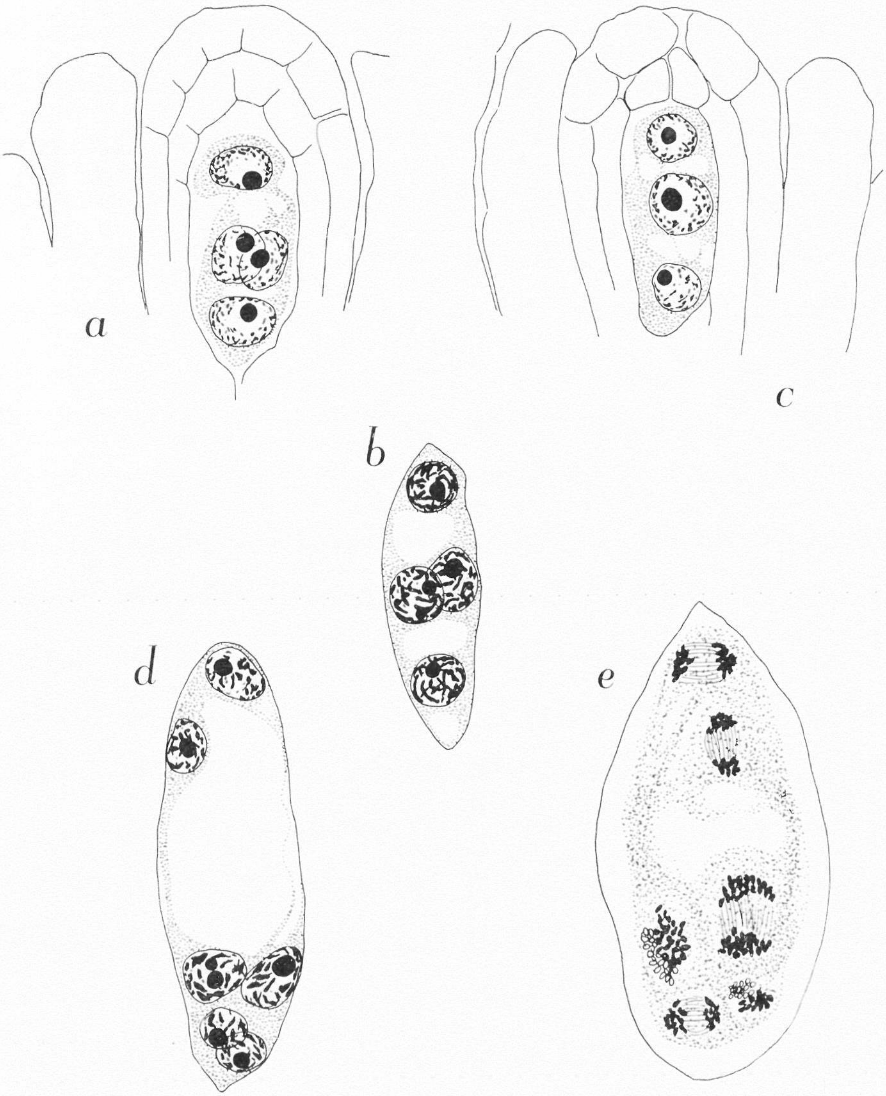

Fig. 2. *Tamarix odessana.* Development according to the Chrysanthemum cinerariifolium type. *a* 4-nucleate embryo sac with the nuclei in the position 1 : 2 : 1. *b* The same, nuclei in prophase. *c* Embryo sac with one haploid nucleus above and below and one diploid in the middle. *d* 6-nucleate embryo sac with two haploid nuclei above, two diploid and two haploid below. *e* Embryo sac with 6 nuclei in division, 4 haploid and 2 diploid. — ×1020.

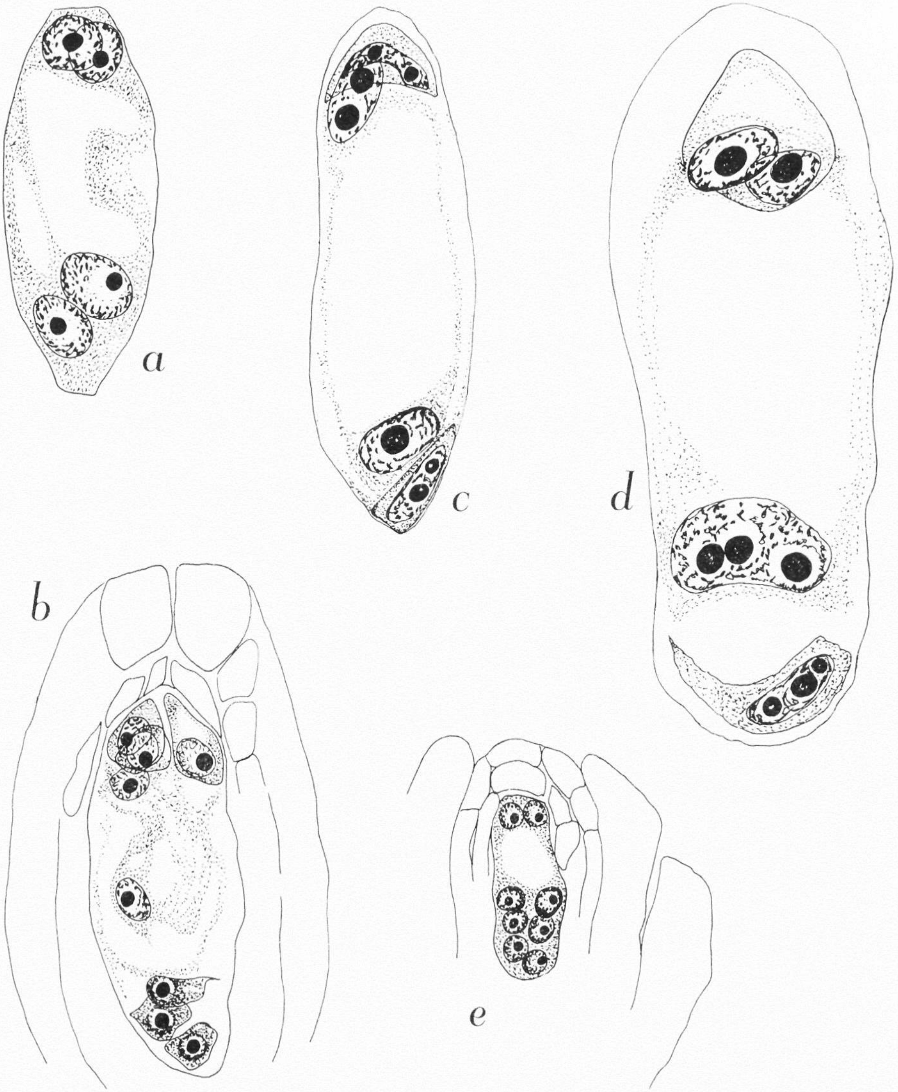

Fig. 3. *Tamarix odessana.* Development according to the Adoxa, the Plumbagella, and the Drusa types. *a* 4-nucleate embryo sac of Adoxa type. *b* Mature embryo sac of Adoxa type. *c—d* two mature embryo sacs of Plumbagella type, in *c* all nuclei about equal (the egg cell probably in degeneration), in *d* the two lower, triploid nuclei distinctly larger than the two apical, haploid nuclei. *e* 8-nucleate embryo sac of Drusa type, with the nuclei in 2 : 6-arrangement. — *a, c, d*×1020, *b, e*×680.

antipodal cells. The type was however in this late stage discernable by the unequal polar nuclei and by the fact that the antipodals had nuclei of varying size, often also different numbers of nucleoli.

The Drusa type was rare. To this type could be referred a few 8-nucleate embryo sacs with the nuclei arranged in the position 2 : 6, all of equal size, rounded and comparatively small (Fig. 3 *e*). Further a few mature embryo sacs proved to belong to this type by the fact that the antipodals were more than 3, of equal size, and the two polar nuclei were equal and comparatively small. In two cases only 5 antipodals were observed; apparently it is a common condition that in this type the 6 basal nuclei of the 8-nucleate embryo sac remain undivided and form one polar nucleus and 5 antipodals (as earlier observed for *Tamarix gallica,* Battaglia, 1941).

In a few cases a development was observed that must be regarded as a fifth type, the Plumbagella type. The mature embryo sac was here only 4-nucleate (Fig. 3 *c, d*) with one cell at each pole of the sac, the egg cell above and an antipodal below, and two free polar nuclei. At least in one case it could be observed that the two lower nuclei were large, oblong, with three nucleoli, just as the nuclei arisen in the Fritillaria type after the Bambacioni phenomenon (Fig. 3 d). This indicates that the development is the same as in the Fritillaria type, but that it has stopped after the third division, a 4-nucleate embryo sac being the result. The type is thus in agreement with the Plumbagella type, previously known only from the genus *Plumbagella.*

Anomalous cases

Some anomalies were observed in different types, partly meaning transitions between the types, partly other deviations.

1) More than one EMC. In one case two 4-nucleate embryo sacs were observed in the same nucellus, the one beside the other (Fig. 4 *a*). This must imply that in this case 2 EMC's have been present in the same nucellus, instead of one, the normal condition. The same anomaly has previously been observed in *Tamarix tetrandra* (Mauritzon, 1936).

2) Transitions between the Fritillaria and the Chrysanthemum cinerariifolium types. In a few cases a development was observed that was greatly reminiscent of the Fritillaria type, but it showed some anomalies that must be regarded as an approach to the Chrys. cinerariifolium type. Fig. 4 *b*, thus, shows an embryo sac with 4 nuclei in the upper part and 7 in the lower. Among the latter there are obviously

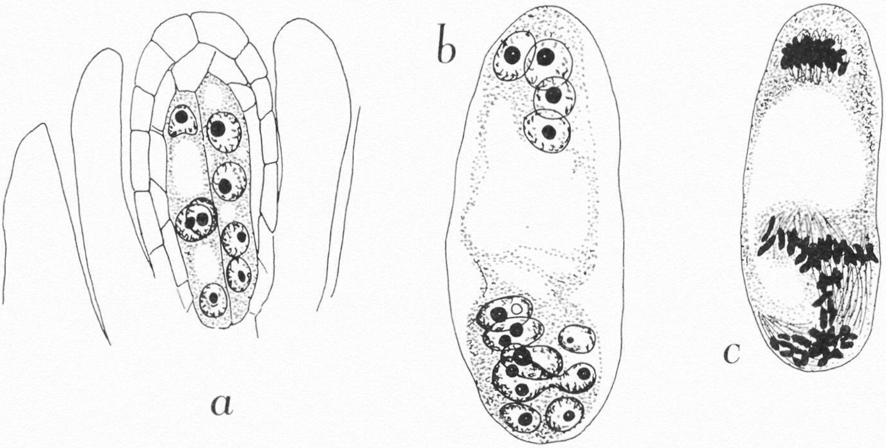

Fig. 4. *Tamarix odessana,* anomalies in embryo sac development. *a* Two 4-nucleate embryo sacs in the same nucellus. *b* Transition between the Fritillaria and the Chrysanthemum cinerariifolium types (in the apical part 4 haploid nuclei, in the basal part probably, counted from above, 2 diploid, 1 diploid+1 haploid, 1 triploid, and 2 haploid). *c* Similar transition in an earlier stage. Further details in the text. — *a*×612, *b, c*×1020.

a pair of diploid and one of haploid nuclei. Further there is a large, oblong, 3-nucleolate nucleus with a constriction, apparently a triploid nucleus that is incompletely divided, and as sister nuclei to this a diploid and a haploid one. The development may have proceeded so that the three basal nuclei of a coenomegaspore have united incompletely when dividing, the result being one triploid, constricted nucleus and in addition one diploid and one haploid. A second division of these nuclei may have given rise to 2 diploid, 2 haploid, and, from division of the triploid nucleus, on the one hand a similar triploid, on the other a diploid and a haploid one.

An earlier stage may to some extent corroborate that there has been a development of this kind (Fig. 4 *c*). This case shows a development most similar to the Fritillaria type, with a fusion in agreement with the Bambacioni phenomenon, but the fusion is incomplete, the nuclear spindle is asymmetrical, probably multipolar, and as result probably a small, about haploid nucleus will be cut off.

3) Transition Fritillaria type—Plumbagella type. In one case a mature embryo sac was observed where only one antipodal was developed, whereas there was no reduction in the egg apparatus. The antipodal nucleus and the lower polar nucleus were considerably larger

than the upper nuclei of the embryo sac and on this account it is apparently a case of an embryo sac of the Fritillaria type, where the last division in the basal part has failed to take place, thus a transition in the direction of the Plumbagella type.

4) Supernumerary nuclei. Additional micronuclei sometimes were observed, especially in the chalazal part of the embryo sac, but also accidentally in the micropylar region, as a result of irregular nuclear divisions. Sometimes also supernumerary nuclei of normal size occurred; in one case, for instance, there were three polar nuclei, lying in a row, in addition to the six cells in the poles of the embryo sac.

The frequency of the different types in different conditions

When investigating the frequency of the different development types it was realized that it was not always possible to distinguish them with certainty in the early 4-nucleate stage, the primary 4-nucleate embryo sac. Those types, the Fritillaria, Drusa, Plumbagella, and, to a certain extent, the Chrysanthemum cinerariifolium type, which are characterized by the arrangement 1 : 3 of the megaspore nuclei, could here not always be separated from each other; only the Adoxa type, characterized by the position 2 : 2, could with certainty be distinguished from the others. With regard to this the early 4-nucleate stage was counted separately and temporarily left out of consideration, so that only later stages were included in the comparisons. A survey of the cases observed is given in table 2.

As seen from the table, on September 5 the Fritillaria type was the commonest, with 71 cases of 166, corresponding to 43 %. The Adoxa type occurred in 48 cases, making 29 %, and the Chrysanthemum cinerariifolium type in 41, corresponding to 25 %. The Drusa type was only observed in 5 cases, which is 3 % of the total number, and the Plumbagella type in 1 case, i.e., less than 1 %.

On the later fixation date, September 30, the Fritillaria type was still the commonest and had even increased a little, counted in percentage; it occurred in 45 cases out of 98, thus 46 %. The Adoxa type was, however, almost as common; it was stated in 40 cases, which implies an increase from 29 to 41 %. The Chrysanthemum cinerariifolium type, on the other hand, had decreased in frequency: it was only observed in 11 cases (=11 %), and the Drusa type had totally disappeared. The Plumbagella type was found in 2 cases (=2 %).

Tab. 2. Embryo sac types of Tamarix odessana at the two fixation dates.

Type	Sept. 5			Sept. 30		
	Early 4-nucl. stage	Later stages		Early 4-nucl. stage	Later stages	
		Number	Per cent		Number	Per cent
Fritillaria type	18	71	43	5	45	46
Chrys. cinerariifolium type		41	25		11	11
Drusa type		5	3		—	—
Plumbagella type		1	1		2	2
Adoxa type	4	48	29	3	40	41
Total	22	166	—	8	98	—

If the early 4-nucleate stage was included in the figures for the Adoxa type of September 5, as well as in those for the other types, the total sum of cases of Adoxa type was 52, and of the other cases 136. In percentage this gives for the two groups 28 and 72, respectively, thus about the same that is obtained if only the later stages are taken into consideration (29 and 71 %). If a corresponding calculation is made for the cases of the second fixation, the percentage figures will be exactly the same as those given in table 2: 41 and 59, respectively.

Sometimes the embryo sacs showed a tendency to degenerate in older stages; this was observed especially in the material of the later fixation. Since this degeneration could be thought to affect different types differently, a comparison was made between earlier stages of two of the types: the Fritillaria and the Chrys. cinerariifolium types. The stages that were compared were the secondary 4-nucleate stage of the Fritillaria type and the 6-nucleate embryo sac of the Chrys. cinerariifolium type, which can be regarded as approximately equivalent. It was then observed that at the early fixation (September 5) 70 stages belonged to this early group and that among these 43 were of Fritillaria type and 27 of Chrys. cinerariifolium type. This corresponds to 61 and 39 per cent, respectively, and if the corresponding percentages are calculated for the entire number of the two types (71 and 41, respectively, see table 2), these will be 63 and 37 %. The agreement must thus be said to be good. At the later fixation (September 30) 32 cases were observed of the secondary 4-nucleate Fritillaria type and 5 cases of the 6-nucleate Chrys. cinerariifolium type. The percentage figures are here 87 and 13, respectively. If all stages of the two types are taken into consideration, the percentages will be 81 and 19, respectively. The agreement, thus, is here not so good; this can, however, be due not only to degeneration phenomena, but also to the fact that the last days before the fixation have had more unfavourable conditions, causing a greater predominance of the Fritillaria type over the Chrys. cinerariifolium type in the younger stages formed in these days, in comparison to the relations in the older stages, which have begun to develop earlier.

Summarizing, thus, it may be said that at the later fixation time, with more unfavourable external cinditions, especially as far as the temperature is concerned, the more complicated types, the Drusa and the Chrys. cinerariifolium types, have shown a considerable retrogression. The Fritillaria type, which demands, it is true, an equal number of divisions as the preceding types, but owing to fusions has a reduced nucleus number, only 8, in the embryo sac, shows a small increase, and the simple Adoxa type a more vigorous one. The Plumbagella type has also increased, but on both occasions it is so rare that no exact idea can be obtained about the relative frequency. The conditions observed, thus, seem rather distinctly to indicate a tendency toward simpler development at lower temperature and otherwise more unfavourable conditions.

2. Tamarix parviflora

The investigation of *Tamarix odessana* was in 1964 completed with a study of another species, *T. parviflora* DC., a spring-flowering species, related to *T. tetrandra* Pall. but distinguished from it, i.a., by the persistent petals. In order to obtain constant temperature conditions and to avoid a possible influence of other varying factors the plants were cultivated this time in pots and placed in climatic chambers. Two different temperatures were used: in one of the chambers the temperature was 25°C (24—26), although one day (February 13) rising to 30°, in the other 15°, with the exception of the two first days, February 12 and 13, when it reached 18 and 24°, respectively. The light conditions were the same in both chambers (12 hours light a day), and also in other respects the conditions were similar. The experiment began on the 12th of February, when the plants, with abundant flower buds, were placed in the chambers. In each of the chambers two pots were placed, with one plant in each of them, and on February 18, when the flowering just began, numerous flowers and flower buds were fixed, in the solution of Navashin-Karpechenko. The embedding, sectioning and staining were made according to the same methods as those used for the preceding species.

An investigation of the material showed that the five embryo sac types that had been observed in *Tamarix odessana* also were present here: The Drusa, Fritillaria, Chrysanthemum cinerariifolium, Adoxa, and Plumbagella types. The Plumbagella type, only rarely met with in *Tamarix odessana,* occurred here in several cases (Fig. 5 *b, c*), and in two of them the chromosomes were visible in the two polar nuclei and there proved to be about 3 times more in the lower than in the upper polar nucleus, which gave a certain proof of the presence of the Plumbagella type. In some cases the two upper nuclei in this type were about as big as the lower ones and had 2 nucleoli.

In addition to the Plumbagella type there occurred several transitions between the Fritillaria and the Plumbagella types. They were distinguished by the lack of the last division either in the basal or the apical part of an embryo sac of Fritillaria type, which meant that only two nuclei were formed here and the embryo sac consequently was 6-nucleate. Usually this division strike occurred in the base, so that only one antipodal was formed (Fig. 5 *d*), but in a few exceptional cases the strike had instead occurred in the apical part, only two nuclei being present here, which meant that no synergids, only an egg cell and a polar nucleus were formed here.

As well as in the Fritillaria type, also in the other types division strikes could occur. In the Drusa and Chrysanthemum cinerariifolium types, thus, the antipodals were as a rule not of the highest possible number, due to lacking divisions. In the latter type there were in some cases even only three antipodals, no divisions having taken place in the basal part after the 6-nucleate stage. A mature embryo sac of this type is of course reminiscent of the Fritillaria type — and to some extent of the Adoxa type —, but it is recognized by the unequal antipodals, of two different types (Fig. 5 *a*). In one or two cases also a strike was observed in the apical part in the Chrys. cinerariifolium type, so that there here was only one cell, the egg cell, and a polar nucleus.

Also in the Adoxa type a reduction sometimes occurred of the nuclear number, so that the embryo sac was 6-nucleate. The reduction could here also occur either in the basal or the apical part, but was in both cases rare. A few embryo sacs were thus, observed where there were only two nuclei in the upper part. That these correspond to megaspore nuclei cannot, however, be maintained with certainty. In two of the cases the nuclei were big and 2-nucleolate, and with respect to the fusion phenomena that have been observed (see below) it is not im-

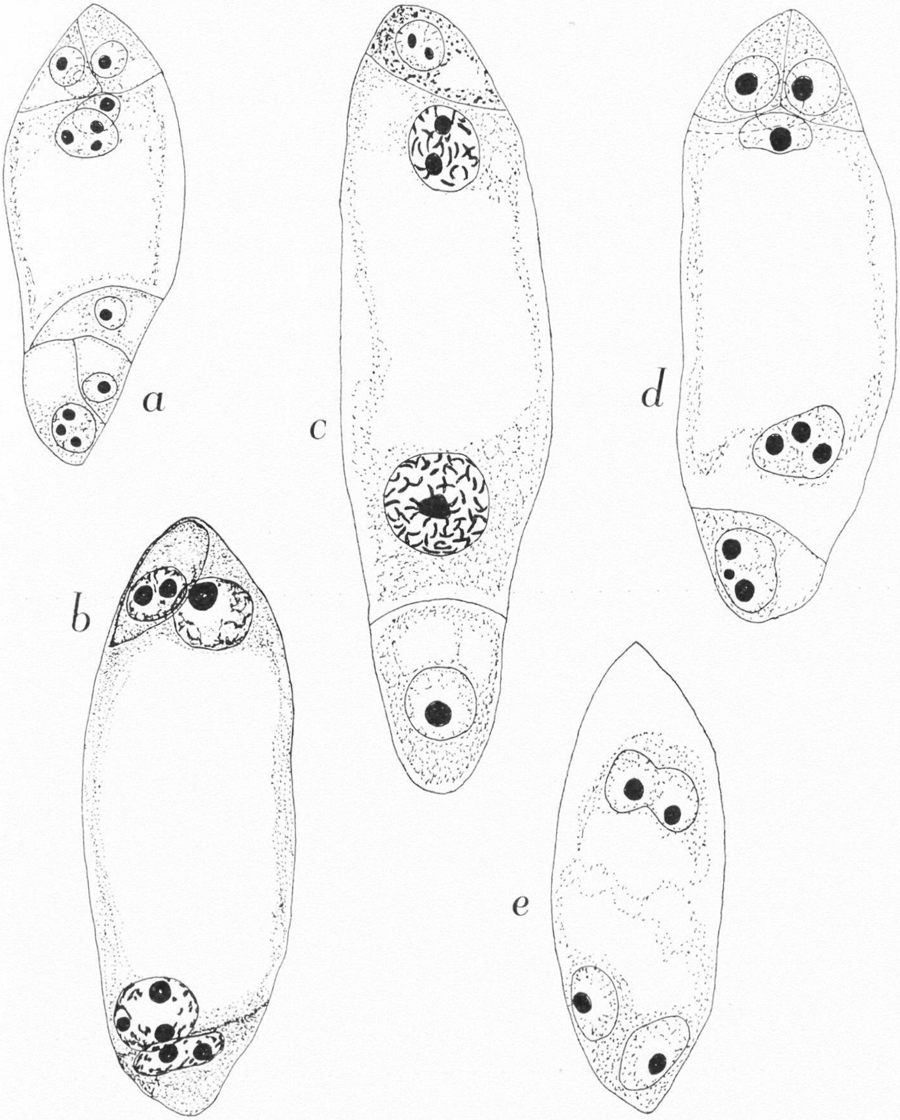

Fig. 5. *Tamarix parviflora.* *a* Mature embryo sac of the Chrysanthemum cinerariifolium type with only 3 antipodals, 2 haploid and 1 diploid. *b*—*c* Mature embryo sacs of the Plumbagella type, in *c* the chromosomes visible in the polar nuclei. *d* Transition between the Fritillaria and the Plumbagella type. *e* Anomalous case with fusion between the two apical nuclei. — *a*×680, *b*—*e*×1020.

possible that here first there has been a fusion between two megaspore nuclei and after that a division. In two other cases the nuclei of the micropylar part were comparatively small, but also such a case may have arisen through an anomaly that sometimes occurs here, the formation of three megaspore nuclei only. That a megaspore nucleus is directly transformed into a gamete, cannot, thus, be asserted with certainty, since there are also other possibilities.

Among the anomalies proper that were observed was the occurrence of micronuclei, which was not very rare, for instance in the Fritillaria type. This was of course a consequence of irregularities in the nuclear divisions. In one case a macronucleus was observed together with a micronucleus, showing that the chromosomes had been distributed unequally between two nuclei in the division.

Sometimes bridges were observed between two nuclei in the embryo sac, and in other cases nuclear fusions of another kind than those characteristic of the Fritillaria, Plumbagella, and Chrys. cinerariifolium types. An instance of such a fusion is shown in Fig. 5 *e*, where in a 4-nucleate embryo sac a fusion takes place between the two micropylar nuclei. The embryo sac is here possibly otherwise of Adoxa type, but it is perhaps more probable, with respect to the size and shape of the basal nuclei, that also these have resulted from a fusion, with a subsequent division. In one case, as a matter of fact, a 4-nucleate embryo sac of Adoxa type was observed, where the two basal nuclei were in fusion. In any case we have here an instance of automixis, the further development of which, however, is unknown. As mentioned above, it is not impossible that similar fusions may have taken place in embryo sacs referred to the Adoxa type, and also in the 4-nucleate embryo sac classified as the Plumbagella type the nuclei of the apical part are often big and 2-nucleolate, so that it could be conceivable that they had arisen through a fusion and subsequent division. In such a case these embryo sacs should not belong to the Plumbagella type, but represent another, possibly auto- or apomictic development. The only cases that could be analyzed with certainty of these 4-nucleate embryo sacs proved, however, to belong to the Plumbagella type.

A survey of the occurrence of the different types in the two temperature conditions used is given in table 3. Also in this case there occurred some early stages — 4-nucleate embryo sacs with the arrangement 1 : 3 of the nuclei — which could not with certainty be attributed to the different types. Since, however, a great number of the primary 4-nucleate embryo sacs could be classified, these have been taken into

Tab. 3. Embryo sac types of Tamarix parviflora at different temperatures.

	About 25°C		About 15°C	
	Number	Per cent	Number	Per cent
Adoxa type	31	25	34	28
Fritillaria type	37	30	40	33
Chrysanthemum cinerariifolium type	37	30	14	12
Plumbagella type	3	2	14	12
Transitions between Fritillaria and Plumbagella types	4	3	12	10
Drusa type	3	2	—	—
Unclassified 4-nucleate embryo sacs with 1 : 3 arrangement	8	7	6	5
Total	123	—	120	—

account in the calculations and those that could not be classified have been taken up separately. These should most probably be referred mainly to the Fritillaria type, in the case of the higher temperature, and to the Fritillaria-Plumbagella groups in the lower, the percentages of these types thus in reality being a little higher than given in the table.

From the table is apparent that at the higher temperature the Fritillaria, Chrys. cinerariifolium, and Adoxa types were dominating. In the lower temperature the Fritillaria and Adoxa types had about the same frequency as in the higher, but the Chrys. cinerariifolium type showed a considerable decrease, from 30 to 12 per cent. Also the Drusa type diminished; at the higher temperature it occurred in a few cases and at the lower it totally disappeared. The Plumbagella type, on the other hand, which in the higher temperature occurred in 3 cases only (=2 %), showed in the lower temperature an increase to 14 cases and 12 %. A similar change was also found in the transition cases between the Fritillaria and the Plumbagella types, which have increased from 3 to 10 per cent.

If a comparison is made with the conditions in *Tamarix odessana,* some similarities are evident, but also certain differences. In both species the Drusa and the Chrysanthemum cinerariifolium types behave similarly: in the higher temperatures the former was present in some few cases, the latter rather richly, in the lower the former had quite disappeared, the latter diminished considerably in number as well as in percentage. The Fritillaria type also behaves about in the same way: it occurs richly both in the higher and the lower temperature without any greater difference in the two alternative cases. As regards the Adoxa type there is however a difference. In *Tamarix odessana* it showed not so small an increase in the lower temperature, in *T. parviflora* it also increased a little, it is true, but this increase is inconsiderable, from 25 to 28 per cent. On the other hand, there is in *T. parviflora* a vigorous increase of the Plumbagella type and the transition between this and the Fritillaria type at the lower temperature; if these two groups are taken together, the number has risen from 7 to 26 and the percentage from 6 to 22. Principally this probably means the same as has been observed in *T. odessana:* that the more complicated types have diminished at lower temperature and the simpler ones have increased. The most complicated type, the Drusa type, and the related Chrys. cinerariifolium type have shown a conspicuous decrease. The Fritillaria type, which to a certain degree is intermediary, as it has the same number of divisions as the preceding types but owing to fusion phenomena is only 8-nucleate, is of about the same frequency, or a little more frequent. The simply organized Adoxa type has in *T. odessana* increased in frequency at the lower temperature; in *T. parviflora* this is less conspicuous, but instead of it the Plumbagella type and the transition between this and the Fritillaria type have increased considerably. The Plumbagella type is, as a matter of fact, of at least as simple a construction as the Adoxa type: it arises as the Adoxa type through 3 divisions (from the EMC), and in addition the nucleus number is through fusion reduced to 4. That this type here partly replaces the Adoxa type, means thus also, in reality to a still higher degree, an increase of a simple type at the cost of more complicated ones.

In both investigated species, thus, a tendency may be noticed at lower temperature to a reduction of the number of divisions, as well as to a diminished nucleus number, brought about through fusions. The extreme is represented by the Plumbagella type, where the reduction is most advanced in both respects. The conditions are here, thus, not quite in agreement with those observed in *Erythronium* by Smith (1955); in this genus there was a certain variation within the species, but the number of divisions did not vary as in *Tamarix,* but appeared always to be constant.

Concerning the causal connections behind the developmental variations which give rise in some cases to one, in other cases to another type, nothing can be said with certainty. It has been supposed that the vacuolization has played a role for the variation, the position of the nuclei — which no doubt is of importance for the development — being dependent on the vacuolization. Fagerlind (1944, p. 45—46) believes however that the vacuolization is dependent on the nuclear position and not vice versa, and also some other authors (e.g., Bambacioni-Mezzetti, 1932; Chiappini, 1955) are of the opinion that this factor has at least a very restricted importance for the embryo sac development. In *Tamarix* it is in any case not sufficient for explaining the variation. Flint and Johansen (1958) have demonstrated that in some Liliaceae with Fritillaria type a homogenous substance is extruded from the nucleolus of the EMC, which together with the main part of the nucleoplasm migrates into the cytoplasm of the EMC and is of great importance for the nuclear activity and also probably is determining for the fusion in the Bambacioni phenomenon. With respect to these observations it may be regarded as probable that in any case some kind of substance, perhaps of hormone nature, is formed, which influences the development that takes place, and that the formation and function of this substance to some extent may be modified by external factors as the temperature. More detailed investigations about the physiological background to the variations in the development are however desirable.

3. Limonium transwallianum

Within the genus *Limonium* several different embryo sac types have been established, occurring in different species, and in addition a formation of unreduced embryo sacs, in connection with apomixis, has been found in one of the species. In *Limonium vulgare* Mill. (*Statice Limonium* L.) the development according to D'Amato (1940) follows the Fritillaria type. In *L. oleaefolium* var. *confusum* (*Statice oleaefolia* var. *confusa*) the propagation according to the same author (1949) as a rule is apomictic, with formation of restitution nuclei and unreduced embryo sacs according to the Ixeris type, while parallelly — in about 20 per cent of the investigated cases — a development of reduced embryo sacs of Adoxa type occurred. In a third, not exactly determined species of the *Eu-Limonium* group (Fagerlind, 1938, p. 476—77) the Penaea type is established. Thus no less than three tetrasporic types have been recorded within the genus: the Fritillaria, the Adoxa, and the Penaea types, always however in different species. The sole variation that has been observed in the same species is the alternation between unreduced and reduced embryo sacs, the latter of Adoxa type, that occurs in *Limonium oleaefolium* var. *confusum*.

As object of the investigation a species was used, *Limonium transwallianum* (Pugsl.) Pugsl., that belongs to the more or less apomictic *binervosum* group and apparently is endemic in England, where it (Clapham, Tutin, Warburg, 1962) occurs only in two limited districts, with one chromosome race in each of them (2n=27 and 35, respectively). The species is assumed to be apomictic (Baker, 1953, p. 329). Plants with flower buds of this species, cultivated in pots, were on October 1, 1963, placed in two of the greenhouses of the Botanic Garden of Lund; two pots were put in a cold greenhouse, frigidarium, two other in a warm, calidarium. After a week (October 7) fixations of flower buds were made; a second fixation was undertaken in the colder house ten days later (October 17). The temperature in the colder house was during the experiment (October 1—17) about 13°C, with small fluctuations, generally between about 11 and 15°. In the hotter house the temperature was during October 1—7 on the average somewhat above 20°, with greater fluctuations, between about 16 and about 30°; on one occasion 37° was reached. In the calidarium the flowers developed rapidly — apparently the conditions were here more or less optimal —, whereas the development was very slow in the frigidarium, as also some plants that were left out of doors showed a very slow development. The temperature out of doors was from Ocotber 1—7 on the average about 10°, varying between 6.0 and 13.2°; earlier, in the end of September, when all plants had been in the open air, it had been a little higher, about 11° in average (8.0—13.6) during the period September 27—30. For comparison fixations were also made of the plants out of doors, on October 7. As fixative the solution of Navashin-Karpechenko was used, and after embedding and sectioning the staining was made by hematoxylin, with a treatment of one or even two days and a short destaining in iron alum.

The development of unreduced embryo sacs

An investigation of the material gave the result that the development of unreduced embryo sacs was predominant, though not occurring alone. In this development the first meiotic development showed a very irregular metaphase, with the chromosomes scattered over the spindle. Thereafter a restitution nucleus was formed; the earliest stage at which it was observed was the one reproduced in figure 6 *b*, when it was somewhat irregular in shape, a little elongated and somewhat constricted from the sides. The dumbbell-like shape that in several cases has been observed in restitution nuclei, also, in certain cases, in *Limonium oleaefolium* var. *confusum* (D'Amato, 1949), was not found here,

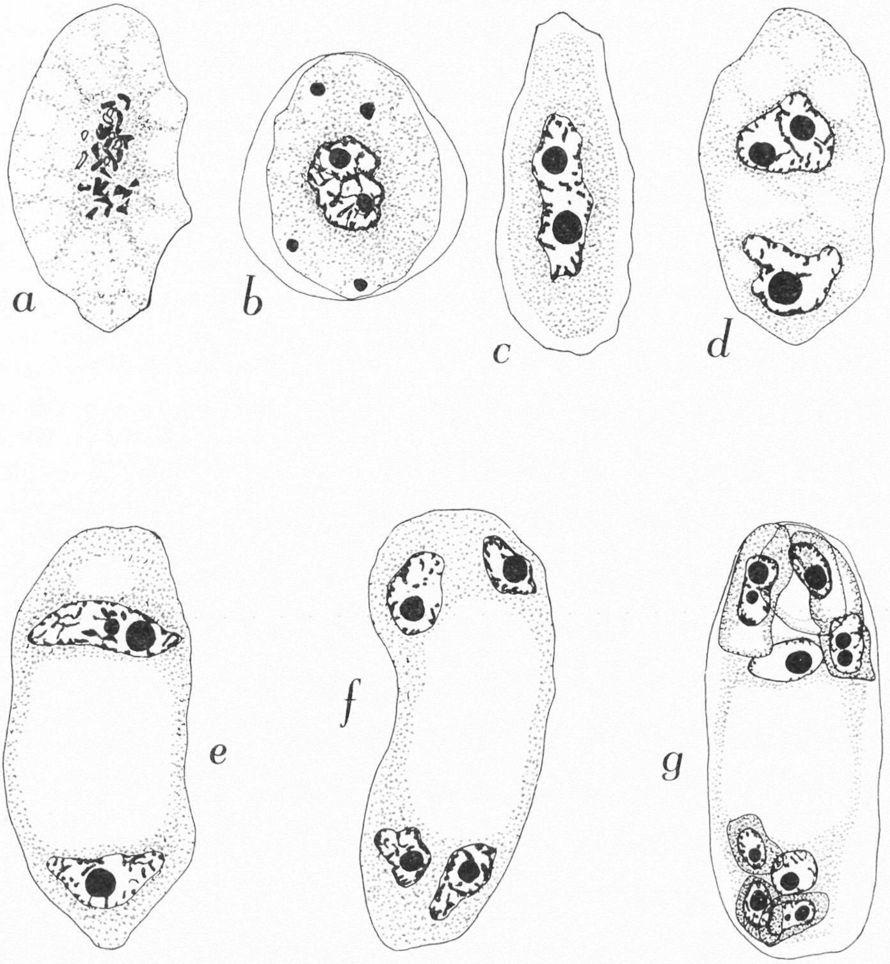

Fig. 6. *Limonium transwallianum,* development of unreduced embryo sacs. *a* Embryo sac mother cell with an irregular metaphase. *b* Restitution nucleus just formed. *c* Restitution nucleus in later stage. *d* 2-nucleate embryo sac, just formed. *e* 2-nucleate embryo sac in later stage. *f* 4-nucleate embryo sac. *g* Mature embryo sac. — *a*—*f* ×1020, *g* ×680.

apparently as a consequence of the fact that the chromosomes had not yet divided into two groups, when the restitution nucleus was formed. Quite soon the restitution nucleus acquired a strongly elongated, narrowly ovate shape (Fig. 6 *c*), a stage that was observed in many slides and obviously had a long duration. This nucleus then divided into two, which were somewhat irregular in shape, often triangular, sometimes oblong, generally with two nucleoli (Fig. 6 *d*—*e*). In this two-nucleate stage the vacuolization was generally great: except in the very earliest stage (Fig. 6 *d*), when the division had just been completed, there was at least a big vacuole between the nuclei, sometimes also other vacuoles outside the nuclei (Fig. 6 *e*). Both nuclei then divided into two pairs, separated by the big central vacuole (Fig. 6 *f*). After one more division the mature embryo sac was formed, 8-nucleate, of a normal appearance, with the micropylar part to a certain extent favoured in comparison with the chalazal one, the cells and nuclei of the former being somewhat larger. This mature embryo sac could not always with certainty be distinguished from the reduced one (see below), but such a case as that one reproduced in Fig. 6 *g* represents certainly an unreduced embryo sac: the antipodals are three, with comparatively small nuclei, and the lower polar nucleus is of the same appearance as, and somewhat smaller than the vigorously developed upper polar nucleus; such a combination of characteristics is, as will be shown below, not found in the reduced embryo sacs.

Development of reduced embryo sacs

Alongside the development of unreduced embryo sacs a parallel formation of reduced embryo sacs occurs. The metaphase of the first meiotic division is here more regular, but also in this case the chromosomes show a certain scattering over the spindle and it is not always possible to distinguish between the two types at this early stage. Instead of a restitution nucleus at first two dyad nuclei (Fig. 7 *c*) and then four tetrad nuclei (Fig. 7 *e*) are formed, without wall formation; these stages could be distinguished from 2- and 4 -nucleate embryo sacs of the preceding type partly through the more rounded shape of the nuclei, partly through the earlier development, before any greater vacuolization has yet taken place. As might be expected with respect to the odd chromosome number ($2n=27$) some irregularities occurred in the meiosis: sometimes one or more micronuclei occurred, in the dyad as well as in the tetrad stage (Fig. 7 *d, f*), and frequently one or even two (Fig. 7 *g*) of the tetrad nuclei were considerably smaller than the others, probably a consequence of an uneven distribution of the chromosomes in the preceding division.

In several cases it was observed that the four megaspore nuclei took the position 1 : 3 (one above and three below), with the three lower nuclei clearly separate from each other. A further development of this

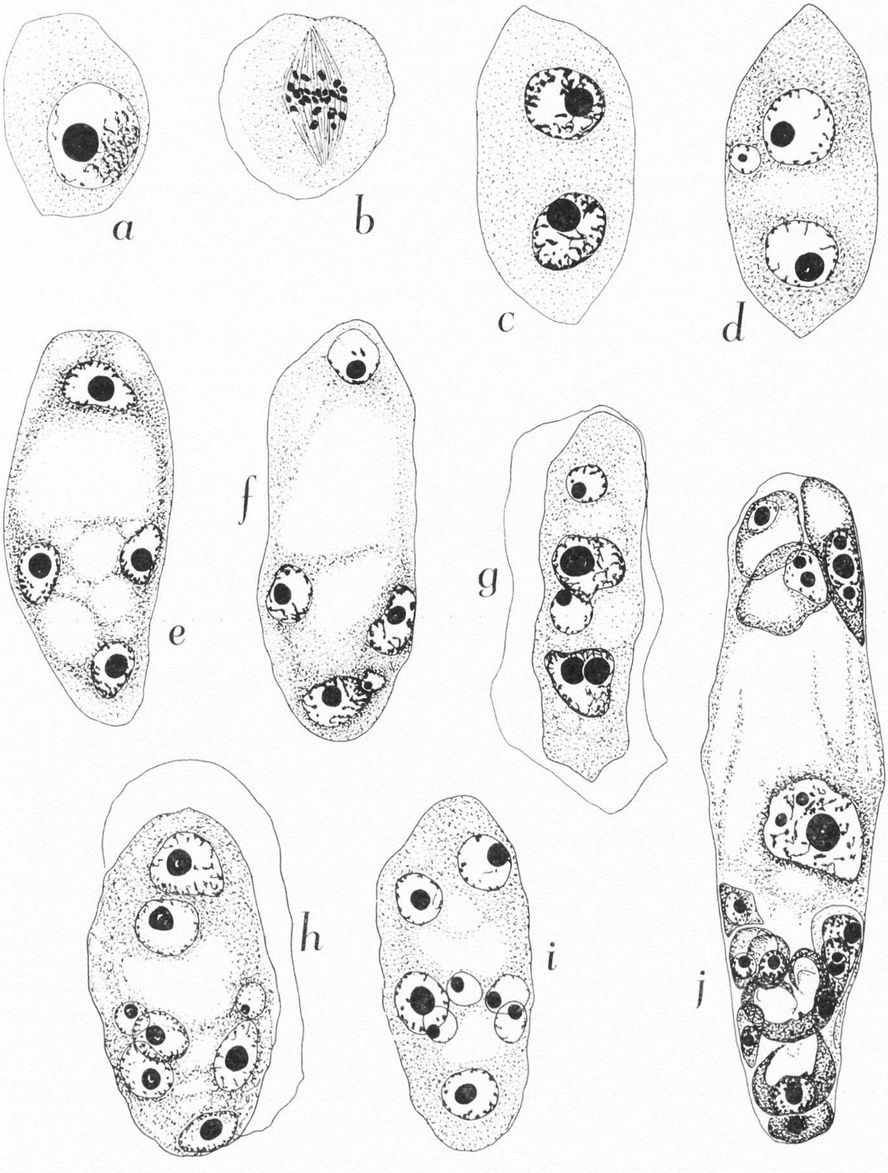

Fig. 7. *Limonium transwallianum,* development of reduced embryo sacs. *a* Embryo sac mother cell with the nucleus in prophase. *b* The same with metaphase, comparatively regular. *c* 2 dyad nuclei formed. *d* 2 dyad nuclei and a micronucleus. *e—f* 4-nucleate embryo sacs with the four megaspore nuclei in the arrangement 1 : 3, in *f* an additional micronucleus. *g* 4-nucleate embryo sac with unequal nuclei. *h* 8-nucleate embryo sac with the arrangement 2 : 6, 2 nuclei smaller. *i* The same, 4 nuclei smaller. *j* Mature embryo sac, of Drusa type. — *a—i* × 1020, *j* × 680.

stage is seen in figure 7 *h*: here two nuclei have been formed above, six below; two of the latter are in this case obviously smaller, apparently originating from a tetrad nucleus of smaller size. Another case is shown in figure 7 *i*; here also 2+6 nuclei occur, but four of the lower nuclei are smaller. These instances show that the development here follows the Drusa type. A mature embryo sac of this type is shown in Fig. 7 *j*; the embryo sac is here not 16-, but 14-nucleate, after the fusion of the polar nuclei into a central nucleus 13-nucleate, owing to the fact that a certain division "strike" has occurred in the last division, and, further, four nuclei (among the antipodals) are conspicuously smaller, certainly because they derive their origin from a megaspore nucleus of reduced size. Another embryo sac was only 10-nucleate, as a consequence of a more pronounced division strike in the chalazal part, and a third embryo sac belonged apparently to the same variant, with ten nuclei, since secondary spindles here were formed between the six basal nuclei, which indicates that the wall formation is imminent in this part, without further increase of the number.

Only a limited number of reduced embryo sacs were so far advanced that their type could be determined, and among them the Drusa type was predominant. Exceptionally, however, one or two other types were observed. In one case, thus, there were in the micropylar part four nuclei, small and rounded, while in the chalazal part there were two very large nuclei, irregular in shape and each with 3—4 nucleoli. Certainly this is a case of a development according to the Fritillaria type, with two triploid nuclei formed in the chalazal part; owing to the fusion that has occurred here the development may have been delayed in this part, so that the micropylar group is a step more advanced: 4 nuclei here and only two below. A similar delay in the chalazal part is earlier known for the Fritillaria type of *Armeria* (D'Amato, 1940), where the apical group even may be two steps more advanced than the basal one; apparently such a delay of the chalazal group is more common when the three basal megaspore nuclei fuse in the resting stage — as in *Armeria* — than when they fuse during the division. An 8-nucleate almost mature embryo sac of the Fritillaria type was also observed; it was of quite typical appearance, with 4 smaller nuclei above and 4 big, irregular nuclei below, with 2 or 3 nucleoli.

Another case, possibly belonging to another type, was also observed. It was a young stage with 4 megaspore nuclei, lying in the position 1 : 2 : 1, and with the middle nuclei in fusion. This may be a development according to the Chrysanthemum cinerariifolium type, which when completely developed results in a 12-nucleate embryo sac with 8 haploid and 4 diploid nuclei. However, the possibility can not be quite excluded that also the basal nucleus may fuse with the two fusing ones, a development of Fritillaria type being the result.

As the development of reduced embryo sacs in *Limonium oleaefolium* var. *confusum* follows the Adoxa type (D'Amato, 1949), this type could also be expected to occur in *L. transwallianum*. In a few cases the megaspore nuclei were not clearly arranged in a 1 : 3-position, but showed a tendency to 2 : 2-arrangement. Possibly those cases represent the Adoxa type; no certain proofs of this development have however been obtained; such proofs are also difficult to establish, since the later stages — mature embryo sacs — of this type cannot with certainty be distinguished from corresponding stages of the unreduced development.

Frequency of unreduced and reduced embryo sacs at different temperatures

For a comparison of the frequency of the different development types at different temperatures the observed cases were divided into three classes of corresponding stages (table 4). Since the result of the first meiotic division is in the unreduced embryo sac a restitution nucleus, in the reduced a dyad, these two stages were regarded as about equivalent and were referred to the same class. In the same way the 2-nucleate unreduced embryo sac and the megaspore tetrad are corresponding, as well as the 4-nucleate unreduced sac corresponds to the 2 : 6-stage of the Drusa type and the secondary 4-nucleate embryo sac of Fritillaria type. Thus these stages form two further classes; the mature embryo sac is not included in the table, owing to the frequent degeneration, apparently most in the reduced embryo sacs.

The results that were obtained are evident from the table. As is seen, there is a clear difference between the proportions in the warmer greenhouse on the one hand, and the colder greenhouse and the outdoor plants on the other. In the warmer house the number of unreduced embryo sacs was 34, while the reduced were only 5, corresponding to 13 per cent of the whole number. In the cold greenhouse the unreduced embryo sacs were 25, the reduced 17, making 40 per cent of the total. Out of doors the corresponding numbers were 36 unreduced and 22 reduced, the latter being 38 per cent of the whole number. Thus there was a good agreement between the plants in the cold greenhouse

Tab. 4. Limonium transwallianum, reduced and unreduced embryo sacs at different conditions.

	Warm greenhouse	Cool greenhouse	Garden
Dyad	2	13	13
1-nucleate embryo sac, unreduced	—	5	9
Tetrad	2	4	8
2-nucleate embryo sac, unreduced	21	12	14
Later stages of reduced embryo sac before the mature sac	1	—	1
4-nucleate embryo sac, unreduced	13	8	13
Reduced embryo sacs, total	5	17	22
Unreduced embryo sacs, total	34	25	36
Reduced embryo sacs, per cent	13	40	38
Unreduced embryo sacs, per cent	87	60	62

and those out of doors, whereas in the warm house the proportion between the two types is clearly different: the unreduced embryo sacs increase, the reduced decrease in relative frequency. These observations are in agreement with those made with *Eupatorium riparium* by Sparvoli (1960); according to this author a plant that was cultivated in a greenhouse (serra) proved to be totally apomictic, whereas two other plants, developed from the same individual through division, one of which was cultivated out of doors, the other in an "arancera" (place for cultivation of orange trees, thus corresponding to a cool greenhouse), had a rather great frequency of meiotic divisions when developing embryo sacs.

It may also be mentioned that in an investigation of the influence of long and short day conditions on the facultatively apomictic grass *Dichantium aristatum* Knox and Heslop-Harrison (1963) could state that in permanent short day treatment the unreduced embryo sacs increased in frequency; since this species is a short day plant, a parallel may be said to exist with *Limonium transwallianum* in so far as the more favourable conditions in both cases have caused an increase of unreduced embryo sacs.

Thus, while a clear difference could be established in the proportion between unreduced and reduced embryo sacs at different temperatures, it was, on the other hand, not possible to obtain a certain idea of the relation between different kinds of reduced embryo sacs. Only few of the reduced embryo sacs were sufficiently advanced (and not too greatly advanced) for determining the type. This was the case especially in the material from the lower temperatures, which may be due to a slow development and a rather frequent degeneration in older stages. Among the types that were stated with certainty to occur, the Drusa type was found in 8 cases (two tetrads, one 8-nucleate, and five mature embryo sacs) in the material from the warm greenhouse, and in 3 cases (one tetrad, one 8-nucleate, and one mature embryo sac) in the outdoor-material. The Fritillaria type was observed two times in the material from the warmer house (one 6-nucleate and one 8-nucleate embryo sac) and one time in the plants in the colder house (8-nucleate sac). With respect to the limited number of reduced embryo sacs in the warm house it may apparently be concluded that the Drusa type here is common, whereas the Fritillaria type seems to be rare. For the material from the lower temperatures the number of observed cases is too small, in relation to the whole number of reduced embryo sacs, to permit any conclusion regarding the frequency.

The main results of the investigation, thus, do not concern the distribution of different types of reduced embryo sacs, but the development of unreduced embryo sacs in comparison with reduced ones. A distinct increase of the unreduced embryo sacs was observed at the higher, favourable temperature conditions. The detailed physiological background of this is unknown. A common theory, however, is that variations in the production of an active hormone produce a variation between reduced and unreduced embryo sacs in partially apomictic plants (Fagerlind, 1944 a; Nygren 1949, 1950; Liljefors, 1953; Hjelmqvist, 1962). To a certain extent this theory is a parallel to the supposition, mentioned above, that the development of different types of reduced, tetrasporic embryo sacs is due to an active substance, possibly formed in the nucleolus of the EMC. If these theories are correct, and the physiological background, thus, is of a similar nature in both cases, it is not difficult to understand that the variation that occurs also in both cases may be influenced by external factors, among them the temperature.

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A Contribution to the Bryophytic Flora of Spain, Especially the Environs of Hellín

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The list here given enumerates some bryophytes collected during the month of March 1962 in the calcareous mountains of the province of Albacete in an area from which apparently no bryophytes previously have been recorded.

The localities are: Hellín, Minas, Tobarra, Pozo Cañada, Elche de la Sierra, and Yeste.

With reference to the report in Rungby (1962) about the frequent occurrence of *Barbula acuta* in the Gandia-Alcoy area it may be mentioned that this species also seems to be rather common in the area here dealt with, and on the whole it can be established that the bryophytes there mainly are the same Mediterranean and calciphile species occurring with much the same frequency as in the former area.

Pterygoneurum lamellatum, rare elsewhere, was found in two localities, and the other two European species of the genus were each of them found in one locality.

In connexion with the excursions in question the area east of Cartagena was visited. The localities are: Peña del Aguila, Estrechos, and los Blancos. 8 species collected there are included in the list, which for their part may serve as a supplement to Cortes (1955). From the area concerned this author mentions only 3 species, remarkable, however, which he calls *Trichostomum viridulum unguiculatum, Funaria dentata mediterranea,* and *Hymenostomum tortile.* None of them was found by me.

A few species, collected in Parque Güell in Barcelona, are added to the list.

In the months of August and September 1962 I collected some bryophytes in the north west of Spain, especially in Galicia. As most of the species apparently have not previously been explicitly recorded from the localities in question, they are added to the list.

The localities are: Orense, Porriño, Samil, Bayona, Oya, Pontevedra, el Grove, la Toja, Santiago, Ordenes, Meirama, Cambre, Lugo, Oviedo, Covadonga, and Altamira.

Campylopus polytrichoides De Not. occurred in most of the localities visited in Galicia. All the specimens examined agreed well with the descriptions and the drawings in Giacomini (1955) and Richards (1963), where the relations of this species to *Campylopus introflexus* (Hedw.) Brid. are discussed. On occasion of these discussions it should be expressly stated that the latter species was not found by me.

The excursions clearly showed the difference between south-eastern dry calcareous areas with their Mediterranean *Trichostoma* and *Barbulae* etc., and more humid north-western areas with the more abundant occurrence of a large number of species demanding more humidity or other substrata, thus giving to the flora a more North European or Central European character.

In the list the localities are indicated in the order above by the first three letters of their names.

The samples are kept in the Botanical Museum of Copenhagen.

Riccia sorocarpa Bisch. — Tob.
Targionia hypophylla L. — Por — Pon — San.
Grimaldia fragrans (Balbis) Corda — Tob.
Conocephalus conicus (L.) Dum. Ore — Ovi — Cov.
Pellia Fabbroniana Raddi — Gül — Mei — Cov.
Nardia scalaris (Schrad.) N.F. Gray — Ore.
Diplophyllum albicans (L.) Dum. — Por — Mei — Cam.
Scapania compacta (Roth) Dum. — Sam.
Scapania curta (Martius) Dum. — Ore.
Lophocolea heterophylla (Schrad.) Dum. — Mei.
Cephaloziella Turneri (Hook.) K.M. — Ore, with *Nardia scalaris*.
Calypogeia Trichomanis Corda forma *luxurians* K.M. — Mei.
Calypogeia arguta Nees et Mont. — Mei.
Porella Thuja (Dicks) Lindb. — Ore — Lug.
Frullania dilatata (L.) Dum. — Mei — Cam.
Frullania tamarisci (L.) Dum. — Por — Sam.
Sphagnum plumulosum Röll — Mei.
Sphagnum subsecundum Nees var. *Gravetii* (Russ.) C.J. — Por — Mei — Cam.
Fissidens cristatus Wils. — Por.
Fissidens bryoides Hedw. — c.fr. Mei.
Ceratodon purpureus (Hedw.) Brid. — Sam — c.fr. Mei.

Anisothecium varium (Hedw.) Mitt. — c.fr. Hell — Min — Cov.

Dicranella heteromalla (Hedw.) Schimp. — Sam — Cam.

Dicranum scoparium Hedw. — Por — Cam — Ord.

Campylopus polytrichoides De Not. — Ore —Por — Sam — Bay — Pon — San — Mei.

Encalypta vulgaris Hedw. — Hell — c.fr. Tob — Poz — c.fr. Yes.

Weisia tortilis (Schwaegr.) C. Müll. — Yes.

Weisia controversa Hedw. — Min.

Gymnostomum rupestre Schleich. — Por — Pon.

Gyroweisia tenuis (Schrad.) Schpr. — Hell — Min.

Trichostomum crispulum Bruch — Hell — Min — Tob — Poz — Yes — Güe — Por — San — Cov.

Trichostomum mutabile Bruch — Min — Agu — Est — Ore — Por — Sam — Bay — Toj — San — Cam — Ovi — Cov.

Trichostomum mutabile Bruch var. *litorale* Dix. — Bay.

Trichostomum mutabile Bruch var. *cuspidatum* Limpr. — Cov.

Tortella flavovirens (Bruch) Broth. — Agu — Est — Bay — Pon.

Tortella tortuosa (Hedw.) Limpr. — Agu — Est — Cov.

Pleurochaete squarrosa (Brid.) Lindb. — Hell — Min — Tob — Yes — Gro, poorly developed, together with *Tortula ruraliformis*.

Timmiella Barbula Limp. — c.fr. Ore — Por.

Barbula convoluta Hedw. — c.fr. Por.

Barbula revoluta Brid in Schrad. — Hell — Min —Yes — Est — Bla — Pon.

Barbula Hornschuchiana Schultz — Hell — Min — Yes.

Barbula unguiculata Hedw. — Tob — Min — Poz — Elch — Yes — Sam, slender form in sand by the sea, together with *Funaria hygrometrica* — Ovi.

Barbula fallax Hedw. — Cov.

Barbula spadicea Mitt. — Min.

Barbula acuta (Brid.) Brid. — Hell — Tob — Poz — Elch.

Barbula vinealis Brid. — Hell — Tob — Yes — Bay.

Barbula rigidula (Hedw.) Mitt. — Hell — Min — Poz — Elch — Yes — Ore — Por — Pon — San — Lug — Ovi — Cov.

Barbula tophacea (Brid.) Mitt. — Hell — Min — Poz — Elch — Yes — Ovi.

Tortula atrovirens (Sm.) Lindb. — Yes.

Tortula canescens (Bruch) Mont. — c.fr. Hell.

Tortula marginata (Br. eur.) Spruce — c.fr. Ore.

Tortula muralis Hedw. — Tob — Poz — Elch — Yes — Ore — Bay — Pon — San — Lug — Ovi — Cov — all c.fr.

Tortula inermis Mont. — Pon — San.

Tortula montana (Nees) Lindb. — Poz.

Tortula ruralis (Hedw.) Schwaegr. — Poz.

Tortula ruralis (Hedw.) Schwaegr. var *ruraliformis* (Besch.) Dix. — Gro, in sand in dunes by the sea.

Tortula princeps De Not. — Yes.

Crossidium squamigerum (Viv.) Jur. — c.fr. Hell — Poz — c.fr. Elch — c.fr. Yes.

Aloina ambigua (Br.eur.) Limpr. — Hell — Min — Tob — Poz — Elch — Yes — Ore — all c.fr.

Pterygoneurum subsessile (Brid.) Jur. — c.fr. Tob.
Pterygoneurum ovatum (Hedw.) Dix. — c.fr. Poz.
Pterygoneurum lamellatum (Lindb.) Jur. — c.fr. Hell — c.fr. Tob.
Pottia bryoides (Dicks.) Mitt. forma *pilifera* (Schultz) Mönkem. — c.fr. Yes.
Pottia Starkeana (Hedw.) C. Müll. — Hell — Min — Tob — Elch — all c.fr.
Schistidium apocarpum (Hedw.) Br. eur. — c.fr. Yes — Ore — Sam — c.fr. Cov.
Schistidium apocarpum (Hedw.) Br. eur. forma *epilosum* Warnst. — Sam.
Grimmia pulvinata (Hedw.) Sm. — Hell — Min — Tob — Poz — Elch — Yes — San — all c.fr.
Grimmia decipiens (Schultz) Lindb. — c.fr. Por — Sam — Mei.
Rhacomitrium heterostichum (Hedw.) Brid. — Ore — Por — Mei.
Rhacomitrium canescens (Hedw.) Brid. — Ore — Pon — San.
Rhacomitrium lanuginosum (Hedw.) Brid. — Por.
Funaria obtusa (Dicks.) Lindb. — c.fr. Ore.
Funaria hygrometrica Hedw. — Poz — Ore — Sam — Mei — all c.fr.
Pohlia albicans Lindb. — Güe — Cov.
Pohlia nutans Lindb. — Ovi.
Bryum caespiticium Hedw. var. *Kunzei* (Hornsch.) Warnst. — Hell — Poz — Elch — Yes.
Bryum caespiticium Hedw. var. *comense* (Schpr.) Husn. — Min — Poz — Elch — Ore — c.fr. Bay — Pon — San — Lug — Cov.
Bryum caespiticium Hedw. subsp. *badium* (Bruch) Jens. & Perss. — Hell — Güe.
Bryum bicolor Dicks. — c.fr. Tob — c.fr. Yes.
Bryum erythrocarpum Schwaegr. — Poz.
Bryum gemmiparum De Not. — Min, partly submerged, on irrigated slopes.
Bryum canariense Brid. — Oya, with *Davallia canariensis* and *Woodwardia radicans.*
Bryum torquescens Br. eur. — c.fr. Yes — c.fr. Ore — Alt.
Bryum Donianum Grev. — c.fr. Por.
Bryum argenteum Hedw. var. *lanatum* (P.B.) Br. & Sch. — Min — Tob — Poz — Yes.
Mnium affine Bland. — Ore.
Aulacomnium palustre (Hedw.) Schwaegr. — Mei.
Bartramia stricta Brid. — Ore.
Orthotrichum anomalum Hedw. — c.fr. Cov.
Orthotrichum anomalum Hedw. var. *saxatile* (Wood) Milde — c.fr. Yes.
Hedwigia ciliata (Hedw.) Br. & Sch. — Ore.
Hedwigia ciliata (Hedw.) Br. & Sch. forma *viridis* Br. eur. — Mei.
Hedwigia imberbis Spruce — Mei.
Pterogonium gracile (Hedw.) Br. eur. — Sam.
Neckera crispa Hedw. — Cov.
Isothecium myosuroides (Brid.) Brid. — Por.
Isothecium filescens (Brid.) Mönkem. — San — Ovi.
Fontinalis squamosa Hedw. — Ore.
Anomodon apiculatus Br. eur. — Cov.
Thuidium tamariscinum (Hedw.) Br. eur. — Mei — Cam — Cov.

Cratoneurum filicinum (Hedw.) Roth — Cov.

Amblystegium riparium (Hedw.) Br. & Sch. — Ore.

Amblystegium serpens (Hedw.) Br. & Sch. — Cov.

Calliergonella cuspidata (Hedw.) Loeske — Mei.

Calliergonella cuspidata (Hedw.) Loeske forma *pungens* (Schimp.) Mönkem. — Cov.

Homalothecium sericeum (Hedw.) Br. eur. — Ore — Por — Bay — Pon — San — Mei — Cam — Lug.

Camptothecium aureum (Lagasca) Br. eur. — Yes.

Camptothecium lutescens (Hedw.) Br. & Sch. — Cov.

Brachythecium rutabulum (Hedw.) Br. & Sch. — Sam — Cam — Ovi — Alt.

Brachythecium rivulare Br. & Sch. — Mei — Ovi.

Brachythecium velutinum (Hedw.) Br. & Sch. — Güe.

Scleropodium caespitosum (Wils.) Br. eur. —Cam — Lug.

Scleropodium illecebrum (Hedw.) Br. & Sch. — Ore — Por — Pon.

Pseudoscleropodium purum (Hedw.) Fleisch. — Por — Sam — Ord — Mei — Cam — Cov — Ovi.

Scorpiurum circinnatum Flschr & Loeske — Agu — Bay — Ovi.

Eurynchium Swartzii (Turn.) Curn. — Mei — Ovi — Cov — Alt.

Eurynchium striatum (Hedw.) Schimp. — Mei — Cam — Cov.

Eurynchium praelongum (Hedw.) Hobk. — Ore — Por — Sam — Mei — Cam — Lug — Alt.

Eurynchium pulchellum (Hedw.) Dix. var. *praecox* (Hedw.) Limpr. — Ore.

Rhynchostegium riparioides (Hedw.) C. Jens. — Ore.

Rhynchostegium megapolitanum (Bland.) Br. & Sch. — Mei.

Isopterygium elegans (Hook.) Lindb. — Por.

Hypnum cupressiforme Hedw. — Mei — Cam — Ovi — Cov.

Hypnum cupressiforme Hedw. forma *lacunosum* (Brid.) C. Jens. — Ore — Sam — San — Ord — Mei — Cam.

Hypnum cupressiforme Hedw. var. *ericetorum* Br. & Sch. — Por — Sam — Pon — Ord — Cam.

Ctenidium molluscum (Hedw.) Mitt. — Cov.

Hylocomium triquetrum (Hedw.) Br. & Sch. — Cov.

Hylocomium squarrosum (Hedw.) Br. & Sch. — Ore — Mei.

Hylocomium splendens (Hedw.) Br. & Sch. — Cov.

Atrichum undulatum (Hedw.) P.B. — Ore — Mei.

Pogonatum aloides (Hedw.) P.B. — Mei — c.fr. Cam.

Polytrichum formosum Hedw. — Por — Mei — Cam — c.fr. Cov.

Polytrichum piliferum Hedw. — Ord — Lug.

Polytrichum juniperinum Hedw. — Sam — San — Ord.

Polytrichum commune Hedw. var. *perigoniale* (Mchx.) Br. eur. — Pon.

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Studies in South African Liliaceae. I.

New species of Wurmbea

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The genus *Wurmbea* (*Liliaceae-Anguillarieae*) has an interesting distribution, being known from South and Tropical Africa, and Australia. Usually only two South African species are recognized, which in Flora Capensis vol. 6 were treated under the names of *W. capensis* Thunb. and *W. kraussii* Bak. (Baker 1897). The former species was subdivided into no less than six varieties.

A study of the South African herbarium material of *Wurmbea* has convinced me that in South Africa several distinct taxa are represented, many of which deserve the rank of species. Five species are described as new in this paper. A full account of the African species cannot be published until a study of European herbarium material has been undertaken, including typification of the old names.

Floral structure provides the most useful diagnostic characters, *e.g.*, the relative length of the perianth tube and segments and of the filaments, the shape and colour of the segments, and the shape of the nectaries. Little is known about the corms, which often are difficult to dig out of the ground, and of the fruits and seeds, which may prove to be useful in a future classification.

Wurmbea minima B. Nord. spec. nov.

Holotype: Esterhuysen 16165 (BOL).
Illustr.: Fig. 1 A—D.

Plantae parvae, glabrae. Folia 3, lanceolata, divergentia, ad 3.5 cm longa. Spica 3—7-flora. Perianthium album, sine tubo distincto. Segmenta perianthii basi solum connata, ungui nectarifero instructa. Stamina perianthio breviora. Ovarium rotundatum, stylis subulatis-filiformibus.

Fig. 1. A—D *Wurmbea minima,* Esterhuysen 16165. A Habit of plant, ×2. B Flower, side view, ×5. C Flower, dorsal view, ×5. D Gynoecium, ×5. — E—H *Wurmbea angustifolia,* Flanagan 2669. E Habit of plant, ×1. F Flower, side view, ×5. G Perianth, split up, ×5. H Gynoecium, × 5. — Auct. del.

Small glabrous plants. Corm not seen. Above ground stems 2.5—5 cm long, slender. Leaves 3, lanceolate, stem-clasping at the base, tapering to narrow points, indistinctly nerved. Lowest leaf ± curved and spreading, channelled, 2—3.5 cm long, 4—7 mm wide. Second leaf usually curved and spreading towards the tip, 2—3 cm long, 5—10 mm wide at the base. Uppermost leaf suberect, acuminate with a straight erecto-patent tip, c. 1 (0.8—2) cm long, 6—10 mm wide at the base.

Spike 2—7-flowered, 1—2 cm long. Perianth white, c. 1 cm in diam. when expanded, without a distinct tube. Perianth segments connate at the base only (to c. 1 mm), 4.5—5 mm long, with a basal claw. Claw c. 1 mm long, 0.8 mm wide. Nectary a distinct elevated ridge on the claw, channelled in the middle. Blade of segment narrowly elliptic-ovate, 3—4 mm long, 1.5—2 mm wide, faintly 3-nerved. Filaments c. 3 mm long. Anthers 1 mm long. Ovary rounded, 2 mm long and wide. Styles subulate-filiform, 2 mm long.

Flowering period: October.

Piketberg: Twentyfour River Mountains above Porterville, moist shallow soil, 22.X.1949, Esterhuysen 16165 (BOL holotype)

This interesting little species differs from most of its congeners in lacking a distinct perianth tube. The segments are connate at the base, however, not free from the base as in *Dipidax*. In this character the new species shows some resemblance to *W. kraussii* from East Griqualand and Natal. The latter species is very different in its vegetative parts, having a basal sheath and a single narrow basal leaf in addition to the two short cauline leaves.

Wurmbea angustifolia B. Nord. spec. nov.

Holotype: Flanagan 2669 (PRE).

Illustr.: Fig. 1 E—H.

Cormus ovoides, niger. Vagina basalis solitaria, apice truncata vel deltoides. Folium perfectum basale 1, lineare. Folia caulina 2 vel interdum 3, ex basi dilatata longe acuminata. Spica pauciflora, laxa, angusta. Perianthium campaniforme, parvum, colore albo vel cereo. Tubus perianthii late cylindricus, segmentis brevior. Stamina perianthio breviora. Ovarium oblongum, stylis subulatis.

Slender glabrous plants. Corm small, ovoid, c. 1 cm long, with black tunics. Above ground stems 7—20 cm long. Basal sheath 1, submembranous, brownish or greyish, with a truncate or deltoid somewhat dilated top. Produced basal leaf 1, erect, linear, 7—20 cm long, 1—2.5

mm wide, gradually tapering to the apex. Cauline leaves 2(—3), long-acuminate from dilated clasping bases. Lowest leaf 4—14 cm long, 3—4 mm wide at the base, ± straight and erect. Upper leaf (leaves) 1—9 cm long, 3—5 mm wide at the base, suberect, acuminate—subulate.

Spike 1—5-flowered, lax and narrow, up to 3 cm long. Perianth cup-shaped, 5 mm long, greenish white—creamy yellow, dotted with brown when dry. Perianth tube broad, 1.5—2 mm long, 2—2.5 mm wide at the base, slightly widening from the base. Perianth segments narrowly ovate-oblong, 3.5 mm long, 1.5 mm wide, obtuse. Nectary a reniform or semicircular elevated ridge near the base of the segment. Filaments 2 mm long. Anthers 0.8 mm long. Ovary 4 mm long, oblong. Styles subulate, 1.5—1.7 mm long.

Flowering period: January—February.

Xalanga: Katberg, between Cala and Ugie, 4—5000 ft., I.1896, Flanagan 2669 (PRE holotype, SAM) — Prope Cala, 5000 ft., 22.I.1896, Bolus s.n., herb. Bolus. n. 27252 (BOL)
Engcobo: In monte Engcobo, 5000 ft., I.1896, Bolus 10346 (BOL)
Natal: Van Reenen, 5—6000 ft., II.1902, J. M. Wood 9817 (SAM)
Basutoland: Little Bokong Camp, 28°8′ E, 29°14′ S, 8500 ft., grassy damp river banks, 7.I.1947, Jacot-Guillarmod 344 (PRE)

W. angustifolia is a rather inconspicuous species, which has been confused with *W. kraussii*. The latter species, however, has a much larger and more expanded perianth with a shorter tube. Together with *W. tenuis* from Kenya and *W. goetzei* from Nyasaland, the species mentioned form a natural group, characterized by heterophyllous leaves. Usually they have one basal sheath, one pronounced basal leaf, which is long and narrow, and further two or three cauline leaves with dilated stem-clasping bases.

Wurmbea compacta B. Nord. spec. nov.

Holotype: Compton 19624 (NBG).
Illustr.: Fig. 2 A—D.

Cormus globosus, niger. Folia 3, lineari-lanceolata. Spica densa, multiflora, cylindrico-oblonga apice rotundata. Perianthium rosaceum—violaceum, tubo cylindrico, segmentis linearibus aeque longo. Filamenta longitudine segmentis perianthii aequata. Ovarium oblongum stylis longis, subulatis-filiformibus.

Corm globose, c. 1.5 cm in diam., with black tunics. Above ground stems 6—20 cm long. Leaves 3, linear-lanceolate, channelled. The two lowest leaves subequal, 5—17 cm long, 0.7—1 cm wide, gradually

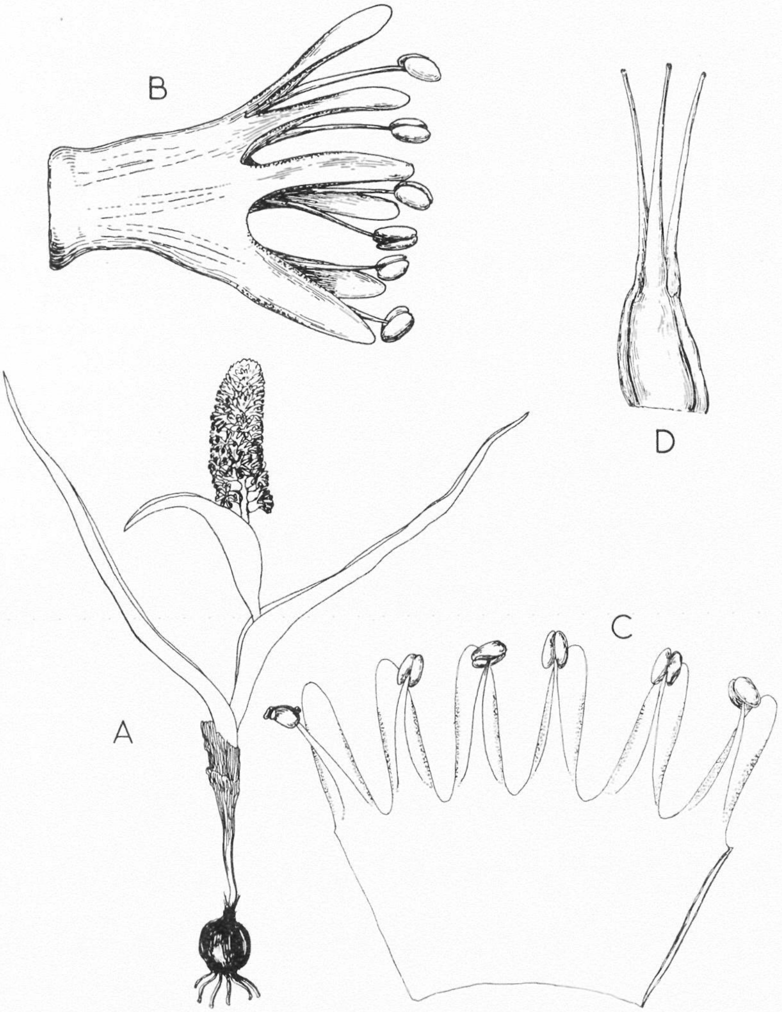

Fig. 2. *Wurmbea compacta,* Compton 19624. A Habit of plant, ×$^{1}/_{2}$. B Flower, side view, ×5. C Perianth, split up, ×5. D Gynoecium, ×5. — Auct. del.

tapering to the apex, straight or somewhat recurved. Uppermost leaf spreading or recurved, acuminate from a dilated base, 2—5(—10) cm long.

Spike dense, many-flowered, 2—5 cm long, 1.2—1.5 cm wide, with a rounded top. Perianth pinky mauve. Perianth tube cylindric, 3—5 mm long, 2—3(—4) mm wide. Perianth segments erecto-patent, linear, 3—5 mm long, 1—1.2 mm wide, obtuse, concolorous. Filaments subulate, 3—4 mm long. Anthers c. 1 mm long. Ovary oblong, 3—4 mm long. Styles subulate-filiform, c. 6 mm long.

Flowering period: June—July.

Montagu: Foot of hill N of Montagu, VIII.1918, Michell s.n., herb. Bolus. n. 15565 (BOL) — 10 m. E of Montagu, 29.VI.1947, Compton 19624 (NBG holotype)

This winter-flowering species is easily recognized by the dense and rather short spike and the long filaments. I have not seen the type of *W. conferta* N.E.Br., but according to the description this has longer and narrower leaves, short styles and filaments.

Wurmbea elongata B. Nord. spec. nov.

Holotype: Lewis 2573 (SAM).

Illustr.: Fig. 3 A—D.

Cormus globosus, obscure cinereus—nigrescens. Folia 3, linearia et elongata, folium secundum vulgo inflorescentiam superans. Spica elongata, angusta, multiflora. Perianthium viridi-luteum—obscure cereum, marginibus segmentorum angustis obscuris. Tubus perianthii cylindricus, quam lobi angusti acuti brevior. Stamina exserta, quam segmenta perianthii paulo breviora. Ovarium oblongum, stylis subulatis.

Corm globose, 1.5—2 cm in diam., with dark grey or blackish tunics. Above ground stems 1—2 dm long. Leaves 3, linear and elongated, gradually tapering to the apex, suberect—spreading or variously curved. The second leaf the longest, normally overtopping the inflorescence. Lower leaves 7—20 cm long, 5—12 mm wide at the base. Uppermost leaf 4—10(—16) cm long, long-acuminate from a dilated base.

Spike long and narrow, many-flowered, normally 5—10 cm long and c. 1 cm wide. Perianth greenish yellow—dark cream. Perianth tube cylindric, 2—2.5 mm long, 2 mm wide, furrowed. Perianth segments spreading, linear-lanceolate, 4.5—5 mm long, 0.7—0.9 mm wide, tapering to an acute apex, with narrow dark margins, sometimes faintly midveined. Nectary distinct, reniform. Filaments 2—2.5 mm long. Anthers c. 0.8 mm long. Ovary oblong, 2—2.5 mm long. Styles subulate, 3 mm long.

Flowering period: September.

Piketberg: Amongst rocks near river Rietfontein, IX.1923, Adamson s.n., herb. SAM n. 39037 (SAM) — East base of Piquetberg Mtn at northern end, 10.IX.1935, Pillans 7675 (BOL) — Bosch Kloof, 22.IX.1940, Bond 544 (NBG) — Kapitein's Kloof, 25.IX.1941, Stokoe 8516 (BOL) — De Hoek,

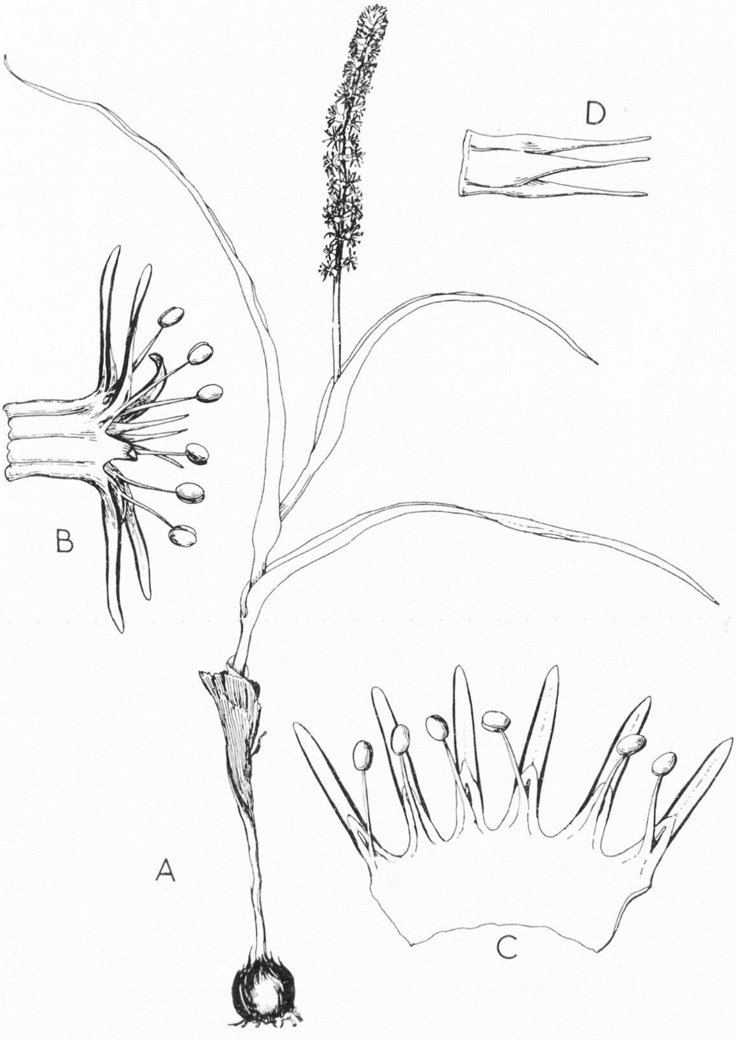

Fig. 3. *Wurmbea elongata,* Lewis 2573. A Habit of plant, ×$^1/_2$. B Flower, side view, ×5. C Perianth, split up, ×5. D Gynoecium, × 5. — Auct. del.

28.IX.1943, Leighton 67 (BOL), Barker 2564 (NBG) — De Hoek, IX.1947, Lewis 2401 (SAM) — Hill slopes at De Hoek, 10.IX.1949, Wilman 858 (BOL)

Clanwilliam: Grey's Pass, 31.VIII.1938, Salter 7490 (BOL) — Elandskloof, IX.1945, Lewis 1429 (SAM) — Citrusdal, 8.IX.1945, Compton 17316 (NBG) — Elands Kloof road near Citrusdal, 8.IX.1945, Leighton 1253 (BOL) — Olifants River Valley, 6.IX.1949, Barker 5609 (NBG) — Olifants

River near Algeria, 10.IX.1949, Barker 5761 (NBG) — Elands Kloof bridge, 10 m S of Citrusdal, 21.IX.1952, Johnson 514 (NBG) — Western end of Elands Kloof, 23.IX.1952, Lewis 2573 (SAM holotype)

A characteristic species with long and narrow spikes, spreading perianth segments, much exserted stamens, and long and narrow leaves.

Wurmbea ustulata B. Nord. spec. nov.

Holotype: Compton 24258 (NBG).

Illustr.: Fig. 4 A—D.

Cormus globosus, niger. Folia 3, lineari-lanceolata, elongata. Spica ovoideo—oblonga, multiflora. Perianthium viridi-luteum—cereum, marginibus et apicibus segmentorum distinctis, latis, obscuris. Tubus perianthii cylindricus, segmentis brevior. Stamina quam segmenta perianthii multo breviora. Ovarium oblongum stylis subulatis.

Corm globose, c. 2 cm in diam., with black tunics. Above ground stems 1—3 dm long. Leaves normally 3, linear-lanceolate, gradually tapering to the tips, often variously curved or recurved. Two lowest leaves 1—2.5 dm long, 0.5—1 cm wide at the base; the second leaf normally the longest. Uppermost leaf usually recurved, acuminate from a dilated base, 3—15 cm long.

Spike ovoid—oblong, many-flowered, 1.5—6 cm long, 1.5—2.5 cm wide. Perianth widely campanulate, c. 1.5 cm in diam. Perianth tube cylindric, 3—3.5 mm long, 3.5 mm wide, greenish yellow—creamy white, concolorous, faintly nerved. Perianth segments lanceolate, erecto-patent—spreading, 6—9 mm long, c. 2 mm wide in the widest portion slightly above the base, tapering to obtuse tips, greenish yellow—creamy white except the margins and tips. Margins of segments thickened, broad, dark purplish brown—blackish, confluent from the middle of the segments, decurrent on the lower sides. Filaments subulate, 1.5—2 mm long. Anthers c. 1 mm long. Ovary oblong, c. 3 mm long. Styles 4—5 mm long, subulate.

Flowering period: August—September.

Calvinia: Marshy soil near Nieuwoudtville, 1000 ft., IX.1898, Leipoldt 791 (BOL) — In argillaceis inter frutices, Oorlogs Kloof Rivier, IX.1898, Leipoldt 791 (SAM)

Clanwilliam: Wupperthal, 29.VIII.1951, Martin 812 (NBG) — Citadel Kop, 7.IX.1953, Compton 24258 (NBG holotype) — "Clanwilliam Flower Show", 2.IX.1954, comm. Mrs. Burton (BOL)

Swellendam: Storms Vlei Kloof, 26.IX.1935, Esterhuysen s.n., herb. Bolus. n. 27246 (BOL)

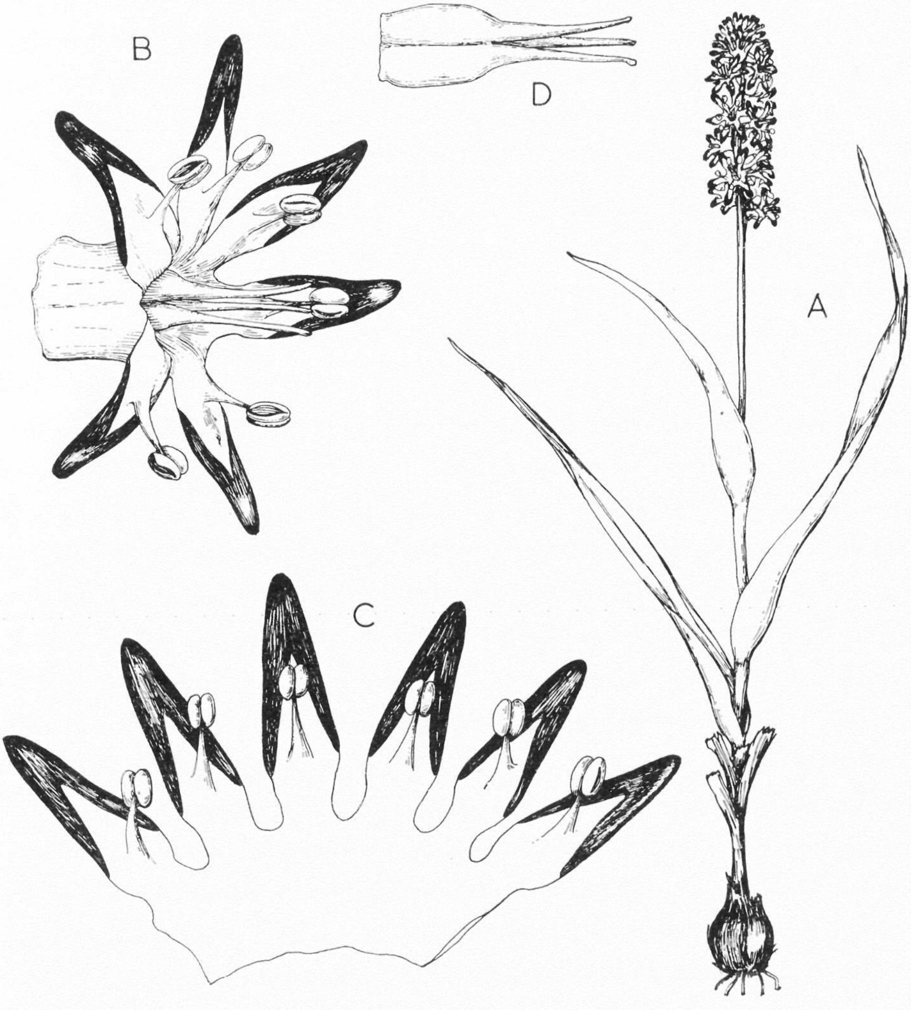

Fig. 4. *Wurmbea ustulata*, Martin 812. A Habit of plant, ×1/2. B Flower, side view, ×5. C Perianth, split up, ×5. D Gynoecium, ×5. — Auct. del.

A striking species, the dark thick margins and tips of the perianth segments being very conspicuous. The flowers are said to be strongly scented.

Acknowledgements

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Studies in South African Liliaceae. II.

Two small species of Bulbine

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The two species of *Bulbine* treated in this paper have flowered in Kirstenbosch from living material, which I collected in 1962. One turned out to be the little-known *B. diphylla* Schltr ex v. Poelln., which was described from dried material. Below I give a more complete description and a drawing of the species. The other is an undescribed species, which I propose to name *B. haworthioides* sp. nov.

Bulbine diphylla Schltr ex v. Poelln.

von Poellnitz 1944 p. 40.

Type: Schlechter 8202 (B holotype not seen, BOL isotype).

Illustr.: Fig. 1 A—E.

Glabrous, except for the filaments. Tuber divided in 3—7 portions, whitish or light brown, fleshy; each portion 0.5—1 cm long, ovoid, obtuse. Stem simple, 1—2.5 dm long incl. the inflorescence. Cauline leaves invariably 2, 1—2 cm above the ground, erect, very succulent and soft, light green, subopposite, unequal. Lower leaf semiterete, shallowly channelled on the adaxial side, 3—5 cm long, c. 1.5 cm wide, indistinctly netted-veined, tapering to an obtuse, soft and often somewhat withered point. Upper leaf always smaller, terete, 1.5—3.5 cm long, up to 1 cm wide, tapering to a subacute and often withered soft point. Raceme lax, 5—10-flowered. Bracts small, 1.5—2 mm long, broadly ovate, acute—short-acuminate, subherbaceous, reddish brown. Pedicels (lower) 1(—1.5) cm long, erecto-patent and ± straight, becoming cernuous near the tip. Outer perianth segments lanceolate, 8 mm long, 2 mm wide, acute, midveined, yellow or slightly greenish. Inner

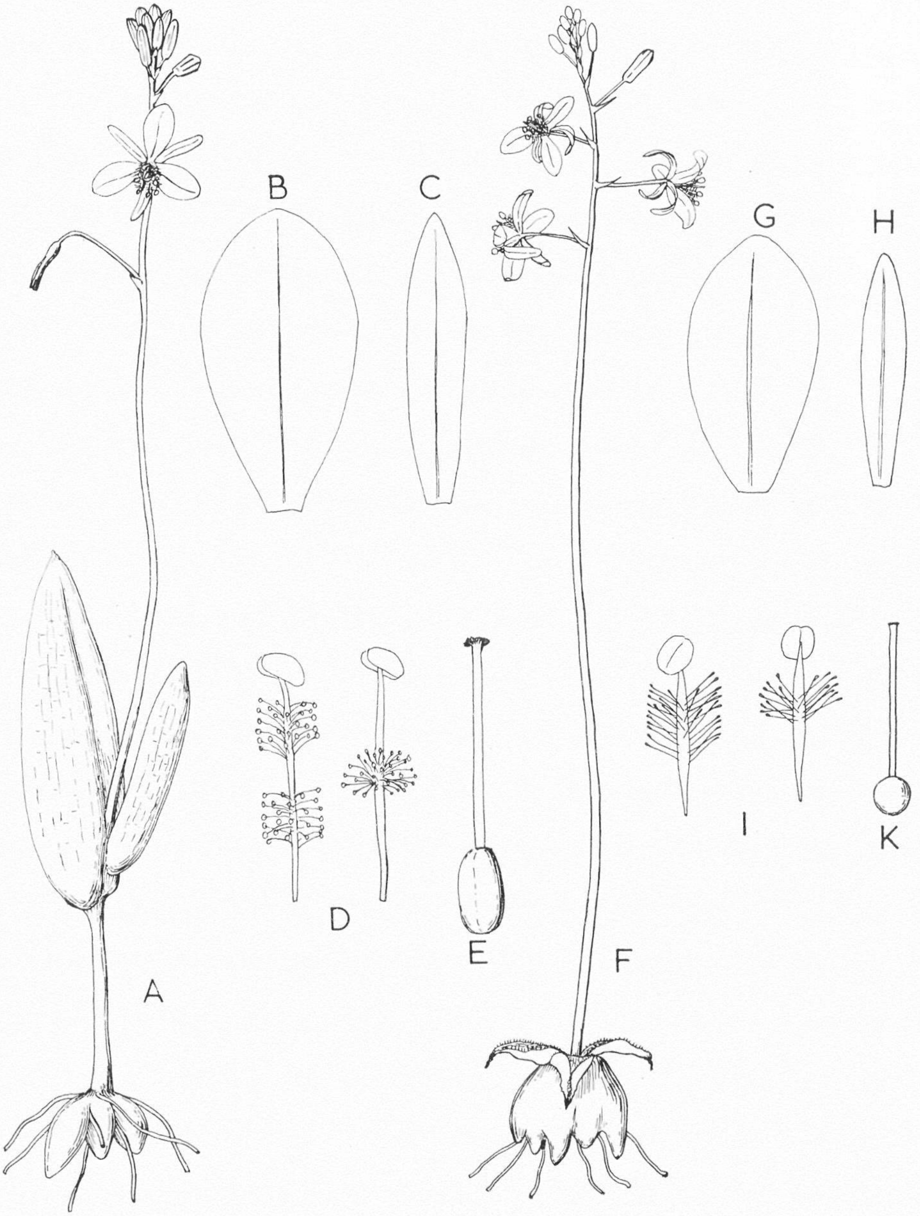

Fig. 1. A—E *Bulbine diphylla,* Nordenstam 815. A Habit of plant, ×1. B Inner perianth segment, ×5. C Outer perianth segment, ×5. D Stamens, ×5. E Gynoecium, ×5. — F—K *Bulbine haworthioides,* Nordenstam 807. F Habit of plant, ×1. G Inner perianth segment, ×5. H Outer perianth segment, ×5. I Stamens, ×5. K Gynoecium, ×5. — Auct. del.

perianth segments elliptic, 8 mm long, 4.5 mm wide, obtuse, yellow, with a distinct green midvein. Filaments 6 mm long, filiform, bearded with clavate hairs in the central portions, yellow. Anthers c. 1 mm long, brown. Style cylindric, 5.5 mm long, yellow, with a truncate tip. Ovary elliptic-oblong, terete, green.

Flowering period: June—July.

Van Rhynsdorp: Karreberge, c. 700 m, Schlechter 8202 (BOL) — 4 m. N of Holriver bridge, quartzite kopje, Nordenstam 815 (LD)

Bulbine haworthioides B. Nord. spec. nov.

Holotype: Nordenstam 807 (LD).

Illustr.: Fig. 1 F—K, fig. 2.

Acaulis. Tuber carnosum, albescens, leviter lobatum. Folia rosulam planam formantia, succulenta, cymbiformia, supra reticulata, margine ciliata. Pedunculus glaber, erectus, simplex. Racemus laxus, c. 10-florus. Bracteae membranaceae, c. 3 mm longae, cuspidatae. Perianthium fulvum, segmentis exterioribus lanceolatis, subacutis, ± reflexis, segmentis interioribus latioribus, obtusis.

Tuber broadly oblong or rounded, fleshy, whitish, c. 1.5 cm long and wide, shortly 5—7-lobed on the lower side. Leaves rosulate, c. 14, spreading in a flattened spiral, succulent, boat-shaped, c. 1 cm long and 0.5 cm wide, obtuse; the lower side convex, green; the upper side ± flat, with a white-reticulate pattern. Leaf margins finely and densely ciliate. Peduncle erect, straight, glabrous, c. 15 cm long. Raceme pyramidic, 3—4 cm long, lax (except towards the top), c. 10-flowered. Bracts membranous, lanceolate and cuspidate from a broad and often somewhat auriculated base, c. 3 mm long, whitish. Lower pedicels patent, 8—10 mm long, straight, becoming cernuous at the tips when fruiting. Perianth dull yellow. Outer segments lanceolate, 6 mm long, 1.2—1.5 mm wide, subacute, with a distinct brown midvein, reflexed. Inner segments elliptic, 6.5—7 mm long, 3—4 mm wide, obtuse, with a distinct brown midvein, spreading or somewhat recurved. Filaments 4—5 mm long, thickest in the middle, bearded with filiform, apically thickened obtuse hairs. Anthers c. 1 mm long. Style terete, straight, 4—5 mm long. Ovary rounded.

Flowering time: October—November (in cult.).

Van Rhynsdorp: 4 m. N of Holriver bridge, quartzite kopje, Nordenstam 807 (LD)

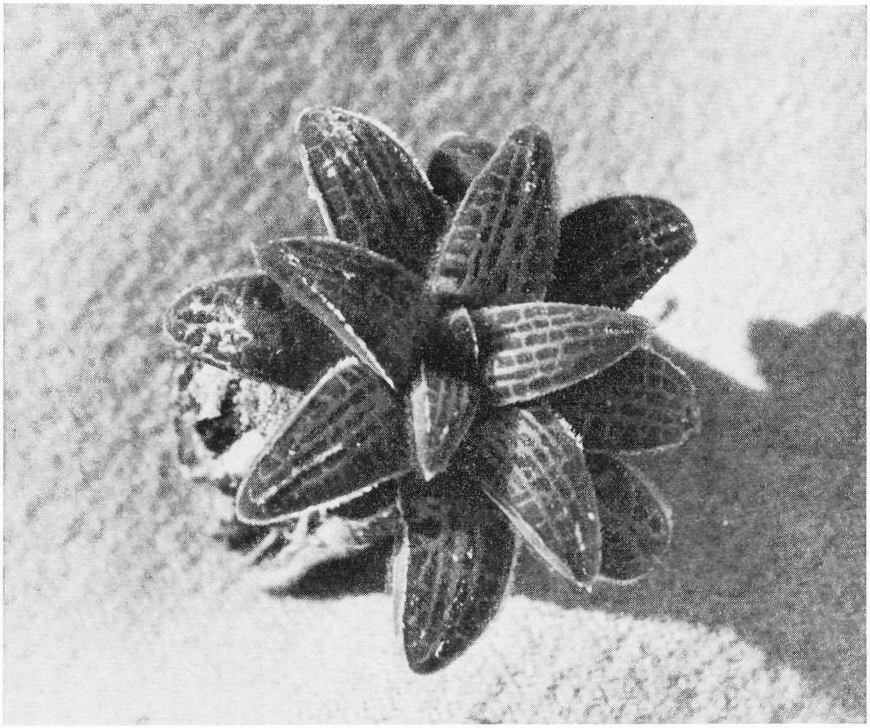

Fig. 2. Leaves of *Bulbine haworthioides*, dorsal view. Plant grown in Kirstenbosch from Nordenstam 807. — Photo author.

Bulbine haworthioides is unique within the genus in its peculiar and decorative foliage, reminiscent of some species of *Haworthia*. The leaves appear in May and are more or less withered when the flowering starts.

Bulbine diphylla and *B. haworthioides* belong to sect. *Acaules* v. Poelln. subsect. *Integrae* v. Poelln., which comprises some small succulent species, e.g., the well-known *B. mesembryanthemoides* Haw.

Both species seem to be confined to quartzite areas in Van Rhynsdorp Division and are perhaps endemic there. These interesting areas, part of which is known as Kners Vlagte, are famous among succulent-collectors. Many species and even genera are endemic here, esp. among the *Mesembryanthemaceae* (*Argyroderma, Oophytum, Maughaniella, Dactylopsis*), but also members of various other families, e.g. *Othonna intermedia* Compt., *Zygophyllum teretifolium* Schltr, and some still undescribed species of *Babiana, Gladiolus, Chrysanthemum, Othonna, Senecio,* and others.

Acknowledgements

I am much indebted to Dr. H. Hjelmqvist for preparing the Latin diagnosis. My botanical research in South Africa was made possible by financial support from the Smuts Memorial Fellowship Trustees (Cape Town), the Swedish Natural Science Research Council, the Royal Swedish Academy of Science, and the Lennander Foundation (Uppsala).

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The Correct Name of the “Rooibos” Tea Plant

By ROLF DAHLGREN
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(Meddelande från Lunds Botaniska Museum, Nr 188)

The “rooibos” or “redbush” plant (fig. 1) is becoming economically important as the source of a beverage or “tea”. The drink is made from the prepared linear leaves in principally the same way as ordinary or Ceylonese tea. The taxonomical position and nomenclature of the species has hitherto been rather confusing.

The aim of the present article is mainly to draw attention to the correct name, *Aspalathus linearis,* for the “rooibos” tea plant and prevent the use of improper names for it. Thereby the correct name for a well-known *Lebeckia* species, *L. contaminata*, is also clarified.

The correct name of the “rooibos” plant should be: *Aspalathus* (subgen. *Nortieria*) *linearis* (Burman fil. 1768) R. Dahlgren 1963.

This was first established in Dahlgren 1963 A, but as it was included in a general systematical survey of *Aspalathus,* this detail ought to be explained separately and in more detail.

During the investigations on the *Aspalathus* species it soon became clear to the present writer that the frequently used name “*A. contaminata* (Thunb.) Druce” was not acceptable. *A. tenuifolia,* the type of which — contrary to what has usually been thought — belongs to the same species, appeared to be the earliest legitimate name for the species.

However, a sample of *Psoralea* specimens from Burman’s herbarium in Geneva was studied, and unexpectedly a proper specimen of the “rooibos” tea plant, identical to the type of “*Psoralea linearis* Burm. fil.”, was found among the sheets. This species was described by N. L. Burman already in 1768 (p. 22) and therefore antedates all other names that come into consideration. The name was combined under

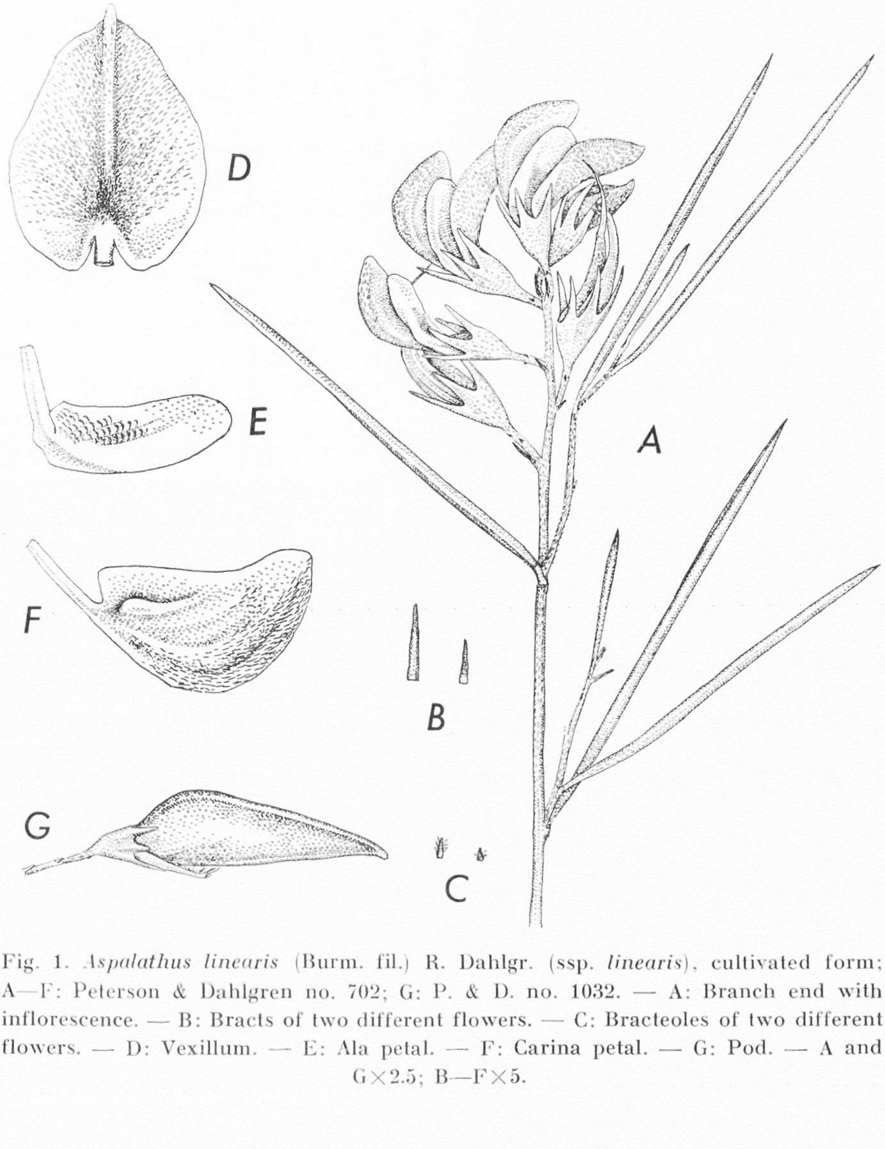

Fig. 1. *Aspalathus linearis* (Burm. fil.) R. Dahlgr. (ssp. *linearis*), cultivated form; A—F: Peterson & Dahlgren no. 702; G: P. & D. no. 1032. — A: Branch end with inflorescence. — B: Bracts of two different flowers. — C: Bracteoles of two different flowers. — D: Vexillum. — E: Ala petal. — F: Carina petal. — G: Pod. — A and G×2.5; B—F×5.

Lebeckia by De Candolle (1825, p. 137), but was apparently otherwise overlooked before 1963, when it was combined under *Aspalathus* by the present writer.

A study of old specimens resulting in the re-identification of old names is often followed by unwelcome changes in the nomenclature, often in rejection of names that have become traditional and well-known to botanists. This is especially the case when the plants are economically important.

In the present case the identification of *Psoralea linearis* should be quite welcome! Studying the nomenclatural history of the "rooibos" tea plant one will soon find that the Latin names have changed. *Aspalathus tenuifolia* DC., the type of which belongs to the present species, was later interpreted wrongly (in Meyer 1836 and later works), whereby the name was used mainly for the related species *A. pendula* R. Dahlgr.

A. corymbosa E. Mey, was first described by Meyer 1832 and became the commonest name of the "rooibos" tea plant before 1917. It was, for example, used by Harvey in Flora Capensis (1862). *A. cognata* Presl, established in 1845, was apparently hardly adopted at all by other botanists. In 1912 Marloth described a particular form of the same species as *Borbonia pinifolia,* but in 1925 he included it in *Aspalathus corymbosa.* Druce in 1917 made the combination "*Aspalathus contaminata* (Thunb.) Druce", which finally became the commonest name of the "rooibos". Also certain manuscript names (which will not be mentioned here) have been used, especially in the herbaria.

The fact that "*A. contaminata*" — for reasons explained below — cannot be accepted for the species would in any case necessitate a change of name. Therefore the incidental identification of *Psoralea linearis* and its combination under *Aspalathus* were most suitable. It is also necessary according to the Code. As a descriptive epithet it is more appropriate than "*contaminata*".

Synonymy of Aspalathus linearis (Burm. fil.) R. Dahlgr.

Aspalathus linearis (Burm. fil.) R. Dahlgr.; Dahlgren 1963 A, p. 283. — *Psoralea linearis* Burm. fil.; N. L. Burman 1768, p. 22. — *Lebeckia linearis* (Burm. fil.) DC.; De Candolle 1825, p. 137 ("L. ? LINEARIS"). — Orig. spec.: "*Psoralea linearis*" in Burman's herbarium (fig. 2; G, lectotype).

"*Aspalathus contaminata* (Thunb.) Druce" sensu Druce 1917, p. 606 [non *Spartium contaminatum* L., nec *Lebeckia contaminata* (L.) Thunb.]

Aspalathus tenuifolia DC.; De Candolle 1825, p. 143. — Orig. spec.: "Lambert. 1816" in De Candolle's herbarium (G-DC, lectotype). — In Meyer 1836, p. 65, the name "*A. tenuifolia* DC." was used for *A. pendula* R. Dahlgr., a wrong identification that was later followed by, for example, Bentham (1848, p. 653), Harvey (1862, p. 139), and Kies (1951, p. 170).

Aspalathus corymbosa E. Mey.; Meyer 1832, p. 159, and 1836, p. 61; Ecklon & Zeyher 1836, p. 204; Bentham 1848, p. 653; Harvey 1862, p. 139; Bolus & Wolley-Dod 1903, p. 254; Marloth 1925, p. 77. — Orig. coll.: "Auf dem Tafelberge", Ecklon (S, lectotype).

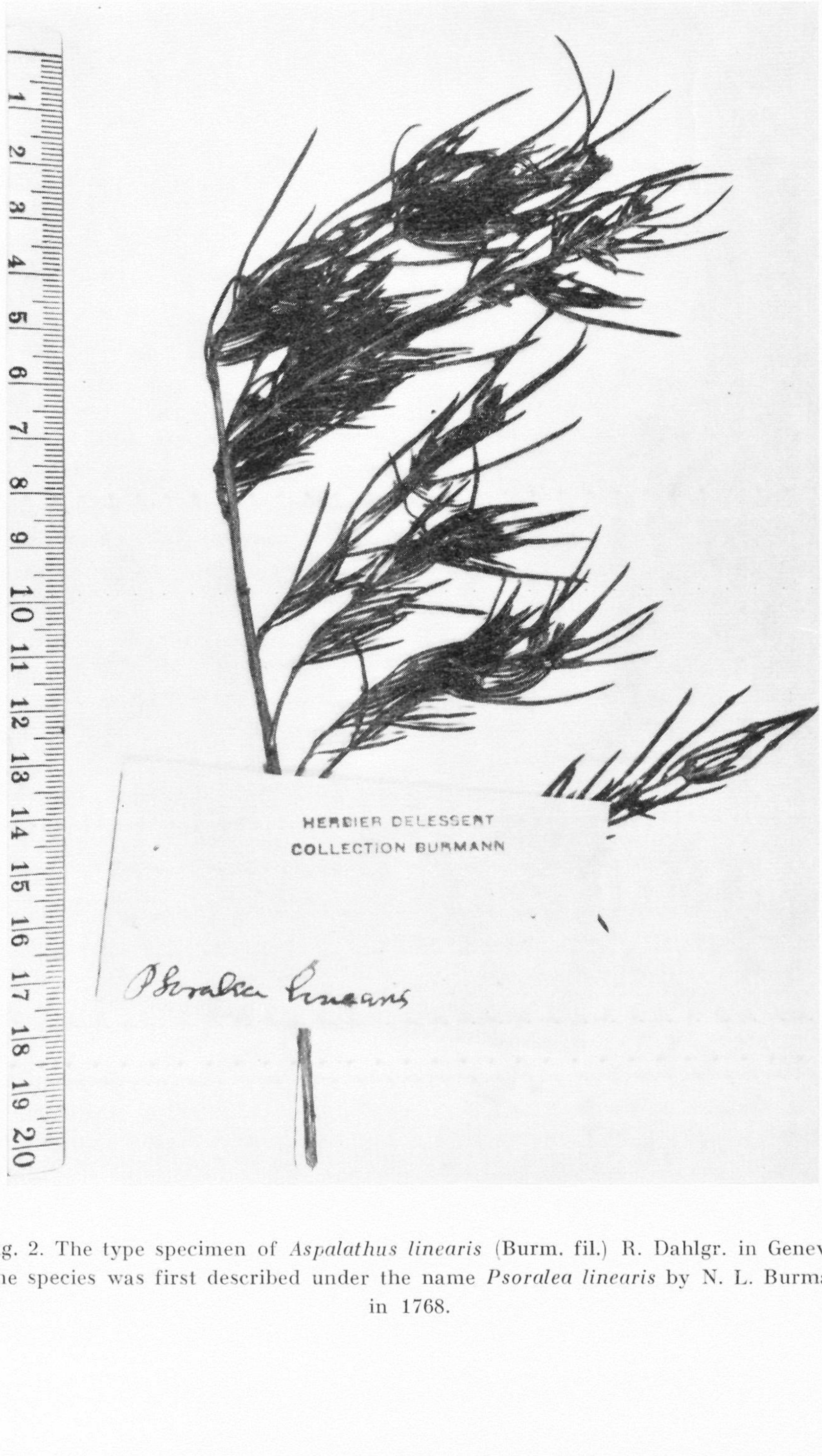

Fig. 2. The type specimen of *Aspalathus linearis* (Burm. fil.) R. Dahlgr. in Geneva. The species was first described under the name *Psoralea linearis* by N. L. Burman in 1768.

Aspalathus cognata Presl; Presl 1845, p. 556. — Orig. coll.: "Cederbergen", Drège: "*A. corymbosa* c" (K, L, P; lectotype not selected).

Borbonia pinifolia Marl.; Marloth 1912, p. 238. — Orig. coll.: "Cedar Mountains", Marloth no. 4728 (NBG, lectotype).

On the Identity of "Aspalathus contaminata (Thunb.) Druce"

In recent systematical and agricultural literature the "rooibos" tea plant has usually been treated under the name "*Aspalathus contaminata* (Thunb.) Druce" (cf., for example, Adamson & Salter 1950, p. 484; Cheney & Scholtz 1963, p. 186). The combination, made by Druce 1917 (p. 606), deserves some comments.

Druce (l.c.) referred back to "*Lebeckia contaminata* Thunb.", which was treated in Thunberg 1800 A, p. 122, Th. 1800 B, p. 140, and Th. 1823, p. 561. The specimens in Thunberg's herbarium named "*Lebeckia contaminata*", it is true, belong to *Aspalathus linearis.* However, Thunberg in all the works mentioned referred to *Spartium contaminatum* L., clearly indicating that *Lebeckia contaminata* was not to be regarded as a new species, but merely as a new combination of Linnaeus' species under Thunberg's new genus *Lebeckia.* The combination was validated in "Genera nova plantarum" (Th. 1800 B, p. 140), where Thunberg established *Lebeckia,* and gave a generic diagnosis. He wrote:

"Sp. 2 L. *Contaminata*: Foliis simplicibus lineari-filiformibus glabris, floribus umbellatis. — *Spartium* contaminatum. Linn. Syst. vegetab. per Gmelin p. 1088, Mantiss. p. 268."

The basionym of *Aspalathus contaminata,* like that of *Lebeckia contaminata,* should therefore be *Spartium contaminatum* L. It may be argued that what Druce combined under *Aspalathus* was *Lebeckia contaminata* in the sense adopted by Thunberg. However, Thunberg clearly indicated that he used the specific name for the same species as Linnaeus, and Thunberg's own specimens may be regarded merely as wrongly determined. By citing Thunberg Druce could be said to refer indirectly to *Spartium contaminatum.* According to Article 33 in the 1961 Code a new combination may be valid even if the basionym is not clearly indicated or the original publication with date and page are not directly referred to, provided that the combination was made before January 1, 1953.

"*Aspalathus contaminata* (»Thunb.») Druce" *sensu* Druce was therefore based on "*Lebeckia contaminata* (L.) Thunb." *sensu* Thunb. *pro parte* (excluding the type). Accordingly, "*A. contaminata*" is not admissible in this sense. "*Aspalathus contaminata* (L. [»Thunb.»])" Druce, strictly after the Code, represents a different species, identical to the true *Lebeckia contaminata* (L.) Thunb., and typified by the original material of *Spartium contaminatum* L.

The last-mentioned name was established by Linnaeus in "Mantissa plantarum altera" (1771, p. 268). It is apparent from the description that it was not used for the "rooibos" tea plant. It was, for example, said to have a long spike. Like many other species described in this work it was based on a collection sent to Linnaeus from Tulbagh, Governor in the Cape Colony. The collector was Auge. The habitat of the Tulbagh specimens was usually indicated by Linnaeus and based on statements in a list of the plants (cf. Jackson 1918). For *Spartium contaminatum* we read in the Mantissa: "Habitat in Cap. b. spei arenosis". There is no doubt that the diagnosis was based on the Tulbagh specimen no. 203, which according to Tulbagh's list (cf. Jackson, l.c., p. 11) was collected on a "sandy veld". The specimen is at present found in the Linnean Society, London.

The type of *Spartium contaminatum* belongs to a *Lebeckia* species (fig. 3) later described as *Lebeckia candolleana* Walp. (in Walpers 1839). However, *Lebeckia contaminata* (L.) Thunb. is the oldest legitimate name for the species, and must be used — in spite of the fact that Thunberg himself used it for specimens of the "rooibos" plant. In De Candolle 1825 (p. 137) and Meyer 1832 (p. 155) and 1836 (p. 32; p.p.) the same species was incorrectly named "*Sarcophyllum carnosum* Thunb." [Thunberg's *Sarcophyllus carnosus,* described in the same paper as *Lebeckia,* Th. 1800 B, p. 135, is the same species as, and a synonym of *Aspalathus capensis* (Walp.) R. Dahlgr.] Druce in 1917 made the combination "*Lebeckia carnosa* (E. Mey.) Druce", also in this case neglecting the original author. This way of combination is hardly permissible, especially as the name "*Sarcophyllus* (-'*um*') *carnosus* (-'*um*') E. Mey." had never been made. If made, it would have been a later homonym of Thunberg's name. In spite of this the name "*Lebeckia carnosa* (E. Mey.) Druce" was accepted and has been used in, e.g., Adamson & Salter 1950 (p. 471).

Conclusion: The name *Lebeckia contaminata* (L.) Thunb. [basionym: *Spartium contaminatum* L.] is the correct name of a *Lebeckia* species (fig. 3), typified by Tulbagh no. 203 (LINN). The name was, at least for some specimens, incorrectly used by Thunberg for the "rooibos"

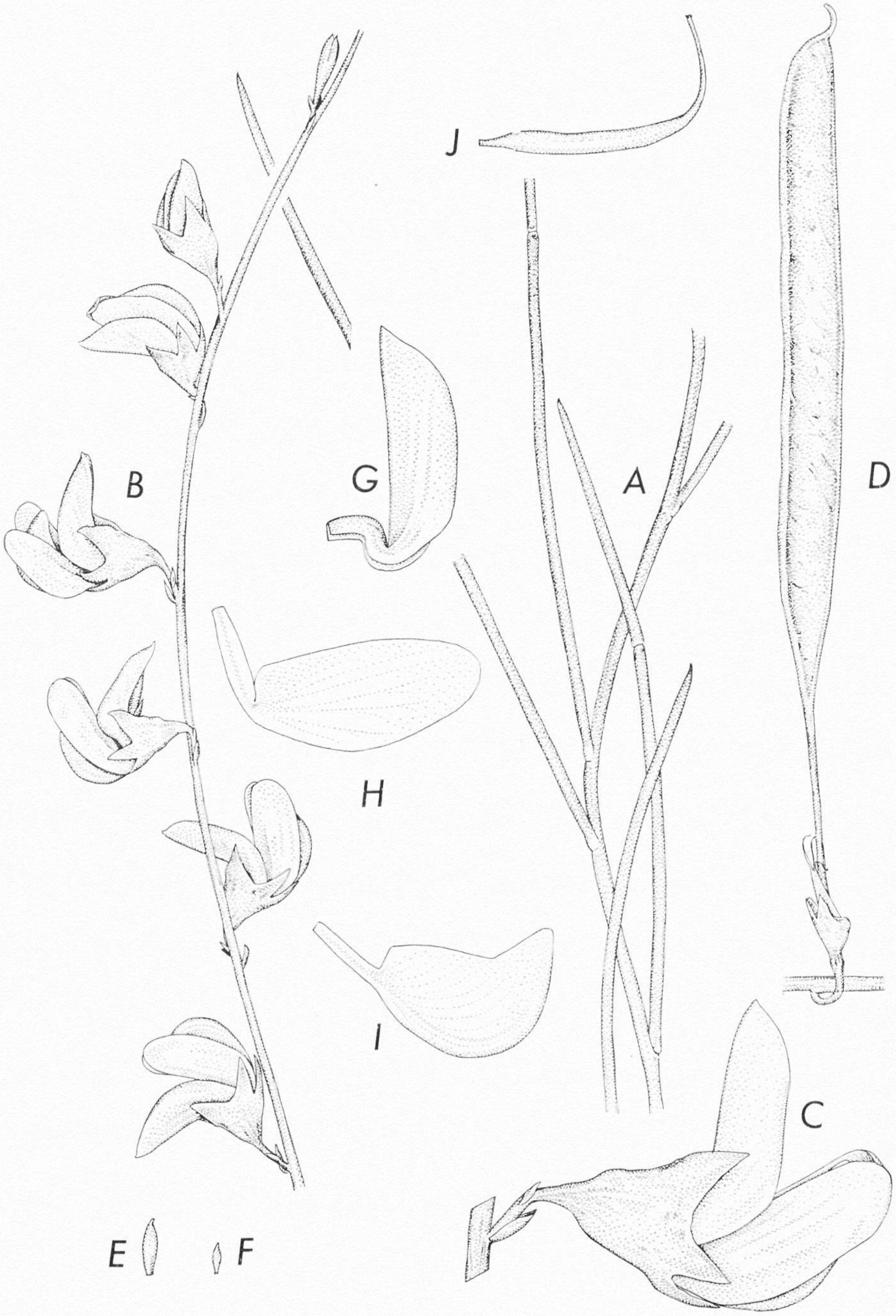

Fig. 3. *Lebeckia contaminata* (L.) Thunb.; Acocks no. 3730. — A: Part of branch with leaves. — B: Part of spike. — C: Flower. — D: Pod (with a long stalk). — E: Bract. — F: Bracteole. — G: Vexillum. — H: Ala petal. — I: Carina petal. — J: Pistil. — A, B, and J×2.5; E—I×5.

tea plant. Due to this, the name "*Aspalathus contaminata* (Thunb.) Druce" was established and used for the latter without taking the basionym *Spartium contaminatum* L. and its original material into consideration.

The systematical position of *Aspalathus linearis* and the closely related *A. pendula* is still somewhat dubious due to problems in interpreting the leaves. The two species were treated as a separate subgenus, *Nortieria*, in Dahlgren 1963 A, where also comments on morphological details, such as the leaves, the variation in carina appearance, and the shape of the trichomes, on systematical characteristics, and on chromosome number, cultivation, and nomenclature were given. The species is divided into three subspecies. The distribution and regional variation were briefly outlined in Dahlgren 1963 B, p. 461. An initiated report on the cultivation of the "rooibos" tea was given by Cheney and Scholtz 1963.

The species will be more exhaustively treated later on in "Revision of the Genus Aspalathus".

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BOTANISKA NOTISER 1964 · VOL. 117 · FASC. 2 · LUND

A New Taraxacum from Australia (A. C. T.)

By GUNNAR MARKLUND
Botaniska Museet, Helsingfors

When Dr Gustaf Haglund passed away on June 10, 1955, he left behind *i.a.* a note showing that he had intended to describe as a new species a *Taraxacum* collected in Australia in 1949 by Dr Olof H. Selling, now Director of the Paleobotanical Department, Swedish Museum of Natural History, Stockholm. Dr Selling has sent me his material and asked me to prepare a publication on it. I have written the following diagnosis and comments, and am using Dr Haglund's manuscript name:

Taraxacum aristum G. Hagl. & Markl. n.sp.

Planta sat humilis. *Folia* angusta, lineari-lingulata—lineari-lanceolata, obtusa, leviter lobata lobis brevissimis, rotundato-obtusis, integris. *Scapi* fructiferi folia c. duplo superantes. *Squamae exteriores involucri* adpressae, breves (c. 5 mm), ovatae, sat subito in apicem obtusiusculum angustatae, in parte basali albido-marginatae. *Squamae interiores* longitudine exteriores c. triplo superantes, ecorniculatae. *Flores* ignoti. *Achenium* fusco-griseum, c. 3 mm longum (pyramide exclusa), c. 1 mm latum, parum supra medium latissimum, superne sat dense breviter spinulosum, inferne leviter tuberculatum—laeve, sat sensim in pyramidem fere cylindricam, c. 1 mm longam abiens, rostro 7—8 mm longo, pappo albo, 4—5 mm longo.

Typus in Paleobotaniska Avdelningen, Naturhistoriska Riksmuseet, Stockholm:

Australia: Territorium capitale (=s.c.t.), Mt Gingera, 5900 pedes s.m., in glarea prope cacuminem (=6092 pedes s.m.) una cum *Poa caespitosa, Celmisia longifolia, Oreomyrrhis andicola, Aciphylla, Cardamine* etc., 30.1.1949; leg. Olof H. Selling, n. 334.

Ill.: Fig. nostrae 1—2.

T. aristum belongs to an assemblage, *Antarctica* Hand.-Mazz., restricted to the Southern hemisphere. Just a few species of this assemblage have so far been described. The best known of them is *T. magellanicum* Comm., Sch.-Bip., a species occurring in Southern Patagonia

Fig. 1. *Taraxacum aristum* G. Hagl. & Markl. n. sp. (Australia: A. C. T., Mt. Gingera, 1949, leg. Olof H. Selling; type specimen in Riksmus. Paleobot. Avd., Stockholm). — $^1/_2$ nat. size.

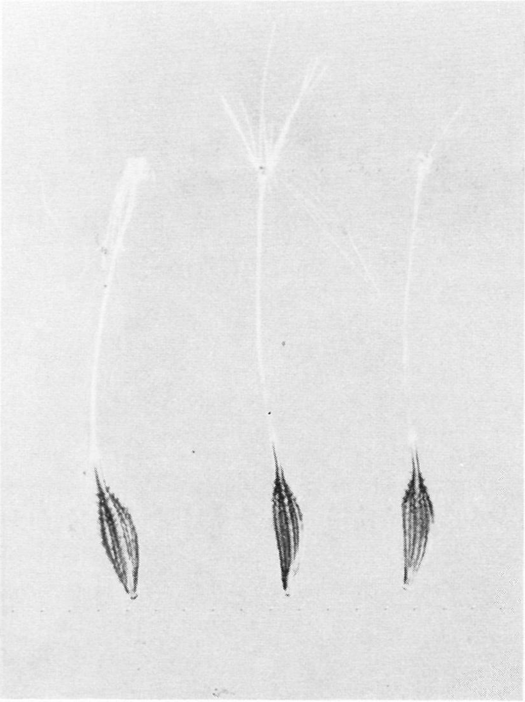

Fig. 2. Fruits of *Taraxacum aristum* G. Hagl. & Markl. n. sp. (type specimen). — 5/1 nat. size.

and Tierra del Fuego. Judging from the material I have been in the position to examine, *T. magellanicum* is fairly variable. It appears not unlikely that on closer study it will have to be split, also if not taken in so wide a sense as Handel-Mazzetti's (1907, p. 56—57). He included material from New South Wales, New Zealand, and Chatham Island.

It can hardly be doubted that *T. aristum* falls within Handel-Mazzetti's collective species *T. magellanicum*. Both by its characteristic, very short, rounded obtuse leaf lobes and by the longer beak of the fruit, *T. aristum* is clearly distinguished from South American *T. magellanicum*. As regards the length of the beak, *T. aristum* matches a species briefly described from New Zealand by Dahlstedt in a footnote (1907, p. 3), *T. zealandicum*, which, however, differs from *aristum* in its light reddish brown colour of the fruit and its dentate leaf lobes.

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Zur Erkenntnis der taxonomischen Probleme der Art Poa balfourii Parn. in Skandinavien

Von J. CHRTEK und V. JIRÁSEK

Lehrstuhl für Botanik der naturwissenschaftlichen Fakultät
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Hylander führt in der Nordisk Kärlväxtflora (1953: 265) aus Skandinavien in dem Bereiche der sehr polymorphen Art *Poa glauca* Vahl nur das einzige intraspezifische Taxon an, und zwar var. *conferta* (Blytt) Hyl., die er mit der *Poa balfourii*, bzw. mit *P. caesia* (*P. glauca*) subsp. *balfourii* in der Auffassung der skandinavischen Autoren identifiziert. Daraus kann man schliessen, dass Hylander die Art *P. balfourii* Parn. aus Skandinavien nicht kennt oder sie nicht anerkennt. Hubbard (1954: 155) führt die *P. balfourii* von den montanen Lagen Grossbritanniens und aus Island an. Das Vorkommen in Skandinavien betrachtet er nur als wahrscheinlich.

In der älteren botanischen Literatur, z.B. Blytt 1861, oder in den Exsikkatsammlungen, z.B. Baenitz: Herbarium Europaeum, *Poa Balfourii* Parn., Flora Norvegica; auf Felsen bei Kongsvold (Dovre Fjeld) 62° n.Br.—900 m, leg. C. Baenitz, 26.7.1890 oder A. Kneucker: *Gramineae exsiccatae* XII. Lief. 1903, Nr 353, *Poa Balfourii* Parnell; Ufer des Evenstadelv bei Kirkesdalen und Maalselven im Amte Tromsö im nördl. Norwegen; Glimmerschiefer. Ca 70 m s.m., 6. Aug. 1902, leg. A. Notó, beziehen sich die Angaben und Pflanzen übereinstimmend mit der Ansicht Hylander's eindeutig auf die Art *P. glauca* Vahl s.l.

Wir studierten das Material aus folgenden Herbarsammlungen: Botanisches Museum in Kopenhagen (C), Kantonales Botanische Museum in Lausanne (LAU), Lehrstuhl für Botanik der naturwissenschaftlichen Fakultät der Karls-Universität in Prag (PRC), botanische Abteilung des National-Museums in Prag (PR), Lehrstuhl für allgemeine und systematische Botanik der J. E. Purkyně-Universität in Brünn (BRNU) und botanische Abteilung des Mährischen Museums in Brünn

(BRNM). In diesem Material konnten wir die Art *P. balfourii* auch aus Skandinavien (Dovre) feststellen. Bei der taxonomischen Wertung dieser Art benützten wir als Grundlage die Merkmalskombination, die z.B. Hubbard (l.c.) anführt, unter Berücksichtigung der Beschreibungen der Art in einigen älteren Arbeiten, z.B. Babington (1843: 367—368).

Ein Ergebnis des Studiums des Herbarmateriales ist die Beschreibung der Art *P. balfourii:*

Pflanzen locker horstig; Halme (25)30—40(70) cm hoch, aufsteigend, glatt oder unterhalb der Ährchenrispe leicht rauh, im Vergleich mit der *P. glauca* dünn; das oberste Halmglied am längsten, gewöhnlich enseitig bogenförmig eingebogen; Halmknoten am häufigsten 3, seltener 2; oberstes Halmblatt (4)6—7(8) cm lang, flach oder mit den Hälften flach gefaltet, ±2 cm breit; Blatthäutchen (1,0)1,2—2,5(3) mm lang, Ährchenrispe (4)7—9(12) cm lang und (1,5)2—3(5,5) cm breit, locker, am häufigsten leicht überhängend; im untersten „Quirl" gewöhnlich nur 2 Ästchen; Ästchen am häufigsten mit 2—3(5) Ährchen; Ährchen (2)3—4(5) blütig, gelbgrün bis gelbbraun, seltener dunkelviolett angelaufen; untere Hüllspelze lanzettlich, (3,7)4—4,5(5) mm lang; obere Hüllspelze eiförmig-lanzettlich, (4)4,2—4,8(5,2) mm lang; Deckspelze der untersten Ährchenblüte länglich, (3,8)4—4,5(5,2) mm lang; Deckspelze im ±unteren 2/3 des Kieles und im unteren 1/4 der Randnerven locker behaart; Haare gerade, bzw. in einem leichten Bogen einseitig eingebogen, nichtgewellt, an der Spitze gewöhnlich kurz zugespitzt, selten zylinderförmig und an der Spitze abgerundet, nach Gerademachen wie 1/2 bis 2/3 der Breite der Deckspelzenhälfte lang (gemessen vom Kiele zum Deckspelzenrand); Mittelnerv deutlich, ähnlich wie die Deckspelzenfläche zwischen den Nerven kahl; Vorspelze schmal länglich, d.h. ihre mittlere Fläche zwischen den Kielen, Kiele mit kurzen, am mittleren Teil des Kieles manchmal verlängerten Zähnchen, mittlere Fläche der Vorspelze zwischen den Kielen gewöhnlich kahl, selten in der unteren 1/2 locker behaart.

Im Herbarmaterial aus Skandinavien stellten wir *P. balfourii* nur aus dem Gebiete von Dovre fest, und zwar von folgenden Lokalitäten: 1. Kongsvold, Dovre, leg. Blytt; sub *P. nemoralis - glauca* (C). 2. Dovre, 21. Sept. 1837, leg. Lindblom (C). 3. Dovre, ex herb. G. W. Montelin 1865 (C). Unsere Feststellungen des Vorkommens von *P. balfourii,* inzwischen auf einem einzigen und kleinen Gebiete schliesst allerdings nicht aus, dass diese sehr interessante Art in Skandinavien nicht auch auf anderen Lokalitäten gefunden werden könnte.

Mit der Art *P. balfourii* ist wahrscheinlich das Taxon *P. glauca* var. *subulata* Lindman (1926) identisch, das der Autor wie folgt charakterisiert: Glumae e basi lanceolata subulato-angustatae, apice longius producto. — Haec secundum specimina scotica est vera *P. Balfourii* Parn., non „*P. Balfourii*" Blytt, Norg. Fl. necque „*P. caesia* var. *Balf.*"

Hartm. necque „*P. glauca* subsp. *Balf.*“ Lindm., abs quibus nomine novo separandam esse credidi (1926: 274). Zu dieser gewiss taxonomisch wichtigen Anmerkung von Lindman äusserten sich die späteren Systematiker nicht.

Im Herbarmaterial fanden wir aber Belege von *P. balfourii* nicht nur aus Skandinavien, sondern auch aus Schottland, Island und Grönland, was auch mit den Angaben von Hubbard (l.c.) teilweise übereinstimmt, der diese Art aus dem Gebirge im nördl. Wales (Caernarvon), dem westlichen Yorkshire (Ingleborough), aus dem Gebiet des Lake District und schliesslich aus einigen zerstreuten Fundorten in Schottland (von Dumfries bis zum östl. und westl. Ross) angibt. Tutin (in Clapham, Tutin und Warburg 1962: 1141) führt *P. balfourii* für das Gebiet der britischen Inseln in der breiten Auffassung der *P. glauca* Vahl an.

Aus dem Gebiete von Mitteleuropa haben wir bei der Revision des Herbarmateriales inzwischen keine Belege für *P. balfourii* gefunden. Die Art *P. balfourii* Parn. führt aber Zapałowicz (1906: 48—49) : *P. balfourii* Parn. f. *carpatica* — Szurin im Gebirge Czarna Hora, 1575 m an, dann Szafer, Kulczyński und Pawłowski (1924: 117): *P. balfourii* Parn. — Czerna Hora bei 1600 m, Jávorka (1925: 93): *P. Balfourii* Parn. — Hoverla, diese Angabe übernahm auch Jirásek (1933: 24) mit der Bemerkung, dass das Vorkommen dieser Art nicht bestätigt wurde, weiter Suessenguth (in Hegi 1935: 413): *P. caesia* Sm. var. *balfourii* Richter — Alpes Lémaniennes und endlich Borza (1947: 16): *P. glauca* var. *balfouri* Parn. — Carp. septentr.-or.

In der neusten Zeit führt Pojarkova (1961: 43) die Art *P. balfourii* aus den Karpaten der UdSSR an, sie führt aber wie aus dem Texte ersichtlich (l.c.) unter diesem Namen montane Typen der Art *P. nemoralis* L. an, vor allem Pflanzen, die zu subsp. *carpatica* V. Jirás. gehören. Dieses Versehen entstand wahrscheinlich dadurch, dass die Autorin die karpatischen Pflanzen ausschliesslich mit den Pflanzen aus Skandinavien, und zwar aus der Exsikkatsammlung-Baenitz, Herbarium Europaeum, Flora Norvegica verglich, die als *P. Balfourii* Parn. bezeichnet sind, die aber eindeutig in den Bereich der Typen von *P. glauca* Vahl gehören, wie wir dies bereits angaben. Pojarkova gibt aber richtig an (l.c.), dass *P. balfourii* Parn. ein nahe verwandter Typ der *P. nemoralis* ist und führt für Begründung dieser Ansicht einige wichtige Merkmale an (Länge des Blatthäutchens, Form der Hüllspelzen, Typ der Deckspelzenbehaarung u.ä.), aber erwähnt andererseits, dass *P. balfourii* in Herbarien oft als *P. nemoralis* L. var. *montana*

Gaud. bezeichnet ist, aber dass man sie nach den folgenden Merkmalen gut erkennt kann: „Pflanzen graugrün, Halme abgeflacht und bedeutend dick, schmale Ährchenrispe manchmal ährenförmig». Dies sind aber insgesamt Merkmale für die *P. nemoralis* subsp. *carpatica* V. Jirás.! Die Lokalitäten für „*P. balfourii*“, die Pojarkova aus den Karpaten aus dem Gebiete der UdSSR angibt, stimmen grösstenteils mit denen überein, die Jirásek (1934: 207—208) angibt. Mit der *P. nemoralis* var. *montana* Gaud. ist sie aber nicht identisch.

Die echte, d.i. die nördliche *P. balfourii* ist mit der Art *P. nemoralis* am nächsten verwandt. Sie unterscheidet sich vor allem durch längere Hüllspelzen und längere Blatthäutchen, die bis 3 mm lang sind (bei der *P. nemoralis* höchstens bis 1 mm). *P. balfourii* erinnert an *P. nemoralis* auch durch den ganzen Habitus der Pflanzen, und zwar durch die Höhe, dünne Halme, verhältnismässig lange Spreite des obersten Halmblattes und nichtverlängertes oberstes Halmglied unterhalb der Ährchenrispe, was ein Merkmal für die typische *P. glauca* Vahl ist.

Der Art *P. balfourii* nähern sich morphologisch einige intraspezifische Taxa der *P. nemoralis* an, insbesondere diejenigen, die in höheren Lagen oder nördlichen Gebieten des Areales der *P. nemoralis* wachsen. Es sind dies vor allem *P. nemoralis caesia* (*P. glaucantha* Gaud. in Alpin. 3: 36, sec. Gaudin 1828: 240) und *P. nemoralis montana* Gaud.

Poa nemoralis „*glaucantha*“ kennzeichnet sich laut Originalbeleg von Gaudin (der Herbarbeleg-LAU-enthält nur den oberen Halmteil mit einem abgebrochenen Halmblatt und die Ährchenrispe) durch folgende Merkmale: Halmteil 33 cm lang (es handelt sich also sicherlich um Pflanzen höher als 50 cm!), graugrün, dick; Spreite des obersten Halmblattes 11 cm lang und 2 mm breit, auf der Fläche glatt, am Rande schwach scharf; Ährchenrispe locker, 23 cm lang und 7,5 cm breit; im untersten Quirl 8 Ästchen; Ästchen mit vielen Ährchen; Ährchen vorwiegend zweiblütig; untere Hüllspelze lanzettlich, ± 3,2 mm, obere ± 3,8 mm lang; Deckspelze der untersten Ährchenblüte ± 3,5 mm lang, schmal länglich, am Kiele in unteren $^{2}/_{3}$, auf den Randnerven ± auf der ganzen Länge behaart; Haare der Deckspelzen auf der Spitze kurz zugespitzt, nach Geragemachen von der Länge ± $^{2}/_{3}$ bis $^{3}/_{4}$ der Breite der Deckspelzenhälfte (gemessen vom Kiel zum Deckspelzenrand); Wollbüschel an der Deckspelzenbasis undeutlich; Zwischennerv hervorragend und ebenso wie die Fläche zwischen den Nerven kahl; Vorspelze schmal lanzettlich, d.h. ihre mittlere Fläche zwischen den Kielen, auf den Kielen mit kurzen Zähnchen; mittlere Fläche der Vorspelze zwischen den Kielen kahl. — Die Pflanze stammt aus den Alpen vom Fundorte „Aux Montets supra Bex".

Aus der angeführten Beschreibung folgt, dass die Pflanze des Herbariums von Gaudin eindeutig in den Bereich von *P. nemoralis* L. gehört. Blytt (1861: 118—119) bezeichnet aber unter dem Namen *P. nemoralis-glaucontha* Typen (insoweit wir die Möglichkeit hatten den Text auf den Etiketten der Herbarbelege zu verfolgen), die der Art *P. balfourii* entsprechen. Das Taxon *P. nemoralis-glaucontha* b. *variegata* Blytt (l.c. 119) ist aber laut den von Blytt bestimmten Belegen durch seine morphologischen Merkmale (insbesondere durch die Färbung der Ährchen, Form der Hüll- und Deckspelzen) ein mittlerer Typ zwischen den Arten der *P. balfourii* und *P. nemoralis*.

In der Literatur wird *P. glaucantha* laufend aus der Art *P. nemoralis* in die Art *P. glauca* umgereiht und als *P. glauca* subsp. *glaucantha* (Gaud.) Lindm. bezeichnet. Dieses Epitheton „*glaucantha*" gehört vorwiegend zu Pflanzen von stattlichen Wuchs, mit einer mächtigen Ährchenrispe und mehrblütigen Ährchen. In Hinsicht darauf, dass die Originalpflanze von Gaudin eindeutig zu *P. nemoralis* gehört, ist es nicht möglich das ursprüngliche Epitheton *glaucantha* („*glaucanthos*") zur Bezeichnung von Pflanzen aus dem Bereiche der Art *P. glauca* Vahl zu verwenden. Die als *P. glauca* subsp. *glaucantha* aufgestellten Pflanzen muss man taxonomisch neu bewerten. Falls sie tatsächlich einen Wert des intraspezifischen oder gar „spezifischen" Taxons (Spezies) besitzen, müssen sie neu benannt werden.

Ein zweiter Typ, der an die *P. balfourii* erinnert, ist die *P. nemoralis montana* von Gaudin. Der Originalbeleg von Gaudin aus dem Jura besteht aus einer einzigen Pflanze. Ihre Beschreibung ist wie folgt: Pflanze 32 cm hoch; Halm glatt, mit 4 Knoten, Spreite des obersten Blattes 10 cm lang und 2 mm breit; Blatthäutchen kragenförmig, sehr kurz; das oberste Halmglied ist nicht auffallend länger als die übrigen; Ährchenrispe 5 cm lang und 1 cm breit, ährchenarm, unterer „Quirl" nur mit einem Ästchen; Ästchen am häufigsten mit einem Ährchen; Ährchen ± 3 blütig; untere Hüllspelze ± 3,2 mm, obere ± 3,6 mm lang; Deckspelze der untersten Ährchenblüte ± 3,8 mm lang, schmal länglich, auf dem Kiele in unteren $^2/_3$ bis $^3/_4$, auf den Randnerven ± auf der ganzen Länge behaart; Deckspelzenhaare zylinderförmig und auf der Spitze überwiegend abgerundet; Zwischennerv deutlich, ebenso wie die Fläche zwischen den Nerven kahl; Vorspelze schmal lanzettlich, d.h. ihre mittlere Fläche zwischen den Kielen, auf den Kielen mit kurzen Zähnchen; mittlere Fläche der Vorspelze zwischen den Kielen kahl.

Die Art *P. montana* Allioni gehört nach dem Belege des Herbariums von Gaudin, der zum Gaudin von Allioni eingesandt wurde, eindeutig zum Bereiche der Art *P. glauca* Vahl (Blatthäutchen deutlich, 1,2—1,5 mm lang; Hüllspelzen sind nicht lanzettlich; Halm auffallend rauh). Im Gaudin's Werk Flora Helvetica 1:249, 1828 ist *P. montana* All. ein Synonym für die *P. caesia* Sm., d.i. *P. aspera* Gaud. Agrost. Helv. 1:198, 1811.

In den Belegen des Herbariums von Blytt befinden sich Pflanzen, die praktisch mit dem Typ von Gaudin identisch sind, weiter Pflanzen, deren Haare auf den Deckspelzen an der Spitze kurz zugespitzt sind (keinesfalls abgerundet-zylinderförmig), mit einer Vorspelze entweder von gleichem Bau mit dem Typ (*P. nemoralis montana* Gaud.) oder mit einer Vorspelze auf deren Kielen auffallend lange Zähnchen sind. Alle diese Typen gehören in den Bereich von *P. nemoralis,* wohin auch *P. parnellii* Bab. (Man. Brit. Fl. S. 368, 1843) gehört, die aber mit *P. nemoralis* var. *montana* Gaud. nicht identisch ist (vgl. z.B. Ascherson und Graebner 1900: 409). Hubbard (1954: 426) erachtet *P. parnellii* nur als eines der Synonyma von *P. nemoralis* L., die er aber in der breitesten Auffassung anführt.

Im Herbarmaterial aus Nordeuropa fanden wir auch Pflanzen, die als *P. dissitiflora* R. et Sch. bezeichnet sind. Meistens handelte es sich um stattliche bis sehr stattliche Exemplare, mit vielblütigen Ährchen. Diese Pflanzen waren aber nicht mit der *P. balfourii* Parn. identisch. Wir hatten weiter Gelegenheit in den Herbarsammlungen ausser typischen Pflanzen der *P. balfourii* auch solche zu studieren, die durch ihre Merkmalskombination zwischen der *P. balfourii* und *P. nemoralis* oder zwischen der *P. balfourii* und *P. glauca* stehen. In einigen Fällen kann man annehmen, dass es sich mit grosser Wahrscheinlichkeit um Pflanzen hybridogenen Ursprungs handelt. Und schliesslich beobachteten wir Herbarbelege, die durch ihr Habitus oder durch einige Merkmale etwas an die *P. balfourii* erinnerten, die aber besonders durch dichte Horste, gerade dicke und zähe Halme mit einer geraden Ährchenrispe und violetten Ährchen auffallen. Die auffallendsten dieser Pflanzen sammelte T. W. Böcher in West-Grönland (Kangersuneq, lat. 68° 50′N, long. 50°43′W, alt. 50 m, 12., 15. und 27.VIII.1958) und bestimmte sie als *P. glauca* Vahl. Diesen Pflanzen nähern sich etwas ähnliche Typen aus Aljaska. Eine taxonomische Bewertung dieser und auch weiterer Typen kann man aber erst nach einer gründlichen systematischen

Bearbeitung ganzer Bereiche der Typen von *P. nemoralis, P. glauca* und *P. balfourii,* bzw. des Umfanges der Sektion *Stenopoa* (Dumort.) Hyl. emend. durchführen.

P. balfourii ist ausser mit der *P. nemoralis* auch mit der *P. glauca* verwandt. *P. glauca* unterscheidet sich aber von *P. balfourii* vor allem durch die Form der Hüllspelzen, die breiter (nach Ausbreitung in die Fläche eiförmig bis elliptisch) und meistens kürzer sind, durch die Halme, am häufigsten dick (bis unterhalb der Ährchenrispe), einseitig bogenförmig eingebogen, durch das oberste Glied, auffallend verlängert, und durch eine meistens zusammengezogene Ährchenrispe.

Nach Ausscheidung der *P. balfourii* aus dem Bereiche der *P. glauca* wird diese Art *P. glauca* meistens in zwei Unterarten geteilt: subsp. *conferta* (Blytt) Lindm. und subsp. *glaucantha* (Gaud.) Lindm., oder nur in zwei Formen, z.B. bei Lid (1944: 97—98). In den Herbarbelegen hatten wir die Möglichkeit die Originalfunde von Blytt der *P. conferta* (Dovre) zu bewerten. Die Pflanzen sind meistens (25)30—40 cm hoch, mit einer gewöhlich lockeren Ährchenrispe, ± ausgebreitet, auffallend nicht zusammengezogen (vgl. das Epitheton des Taxons *confertus* = dicht, angehäuft, eingeengt; es bezieht sich wahrscheinlich auf den Charakter der Pflanzenhorste). Je nach dem Charakter des ganzen Habitus und nach einigen Merkmalen (Form der Hüll- und Deckspelzen, Länge des Blatthäutchens u.ä.) gehört *P. conferta* Blytt aber eindeutig in den Bereich der *P. glauca.* Durch den Typ der Haarenden auf den Deckspelzen, der Behaarung der Vorspelze, und zwar sowohl auf den Kielen als auch der Fläche zwischen diesen, stellt *P. conferta* ein Typengemisch vor, da diese Merkmale bei verschiedenen Pflanzen verschieden kombiniert sind. Durch das Studium des Herbarmateriales hatten wir Möglichkeit festzustellen, dass mit dem Namen *P. conferta* am häufigsten niedrige Pflanzen bezeichnet werden, mit einer länglichen Ährchenrispe, ± dicht, zusammengezogen, keinesfalls solche Pflanzen, die selbst Blytt mit dem Namen *P. conferta* bezeichnete. Löve und Löve (1961: 48) geben im Bereiche der Art *P. glauca* ausser der subsp. *glauca* und subsp. *conferta* (Blytt) Lindm. noch die subsp. *brevma* Hooper (l.c.) an. Diesen Typ konnten wir nicht studieren, da zur Zeit unseres Studiums seine Beschreibung nicht eindeutig veröffentlich ist. In einigen Floren, die Alpengebiete betreffend, ist von der *P. glauca* im Werte einer Subspezies das Taxon *P. glauca* subsp. *briquettii* (Hack.) Becherer abgetrennt (vgl. z.B. Schinz, Keller und Thellung 1914: 34). Über die nomenklatorischen und taxonomischen Probleme der subsp. *glaucantha* haben wir bereits berichtet.

Blytt führt aus Skandinavien noch die Art *P. aspera* Gaud. (Agrost. Helv. 1:198, 1811) an. Diese Art ist laut Originalbeleg (Lokalität M. Gemmi) eine junge, ca 20 cm hohe Pflanze, mit einer Ährchenrispe ±5 cm lang und 1,5 cm breit, mit der Spreite des obersten Halmblattes 5—6 cm lang, mit dem Blatthäutchen 1,5 mm lang, mit dem Halme unterhalb der Ährchenrispe scharf, mit den Ährchen am häufigsten dreiblütig, gelbgrün, mit den Hüllspelzen in der Form wie bei der *P. glauca*. Pflanzen des Bereiches von *P. glauca* mit auffallend scharfen Halmen kommen praktisch nur im Teilareal der Art in den Alpen vor. In der Fl. Helv. 1:249, 1828 führt Gaudin *P. aspera* als ein Synonym für die *P. caesia* Sm.

Die gewöhnlich verwendete Gliederung der Art *P. glauca* in subsp. *glaucantha* und subsp. *conferta* ist unserer Ansicht nach ungeeignet, da sie mit der Veränderlichkeit der Populationen in der Natur nicht übereinstimmt. Diese Teilung beruht vorwiegend auf den morphologischen Merkmalen (Habitus der Pflanze) und berücksichtigt nicht die Merkmale, die nach unserer Erfahrung wichtiger sind, d.s. die Merkmale der Hüllspelzen (Form und Länge), der Deckspelzen (Charakter der Behaarung), der Vorspelzen (Behaarung ihrer Kiele und der Fläche zwischen den Kielen) u.ä. Hitchcock und Chase (1950:129) schieden aus dem Bereiche der Typen der *P. glauca* die *P. glaucantha* Gaud. als selbständige Art aus, mit der Bemerkung, dass *P. glaucantha* (New Foundland bis Quebec, Minnesota, Montana und Wyoming; Europa) eine veränderliche und unklare Art ist, deutlich ein mittlerer Typ zwischen der *P. nemoralis* und *P. glauca*.

P. glauca s.l. ist in der Arktis verbreitet (Nordamerika, bis in die Staaten New Hampshire, Wisconsin, Minnesota und Colorado), Nordwesteuropa (z.B. Wales, Schottland, Faröerinseln, Skandinavien, auch ? Südfinnland, weiter Island und Spitzbergen), Alpen (bis 3000 m ü.d.M.), auf der Babia góra in den Westbeskiden, auf der Balkanhalbinsel (dieses Vorkommen muss neu bestätigt werden), im Kaukasus, Elburs (Nordiran) und im Afganistan. Weiter sahen wir Pflanzen aus den Pyrenäen (*P. caesia* Sm., Plantes Pyrénéennes, Pyrénnées centrales, 18.8.1856, leg. J. E. Zetterstedt). Das Vorkommen von *P. glauca* ist aber dort sehr problematisch, es handelt sich wahrscheinlich um eine Verwechslung der Herbaretikette. Ähnlich wird es notwendig sein auch andere Fundorte von *P. glauca* zu bestätigen, vor allem die Angabe „Carp. reg. alp“ (Borza 1947:16) und weiter „ad fontes Czeremosz Czarny montis Komanowe“ (Zapałowicz 1906:292—294). Die Planzen von dieser Lokalität sind meistens als *P. janczewskii* Zapał. determiniert. Und endlich wäre auch das Vorkommen von *P. glauca* in den südlichen Gebieten Finnlands (vgl. Söyrinki 1955) zu beglaubigen, weil die Belege, die wir sahen und als die *P. glauca* aus Südfinnland bezeichnet sind, eher der Art *P. nemoralis* als der *P. glauca* nahestehen. Die Angaben über *P. glauca* von verschiedenen Lokalitäten der Westkarpaten (ausser der Babia góra) beziehen sich in den meisten Fällen auf die Art *P. nemoralis montana* Gaud. oder *P. nemoralis* subsp. *carpatica* V. Jirás.

Genaue und ausführliche Verbreitung von *P. glauca* wird man erst nach einer systematischen Bearbeitung des ganzen Komplexes der Art und nach Festlegung ihrer taxonomischen Grenzen und Kombinationen der diakritischen Merkmale geben können.

Im Verlaufe des Studiums des reichen Herbarmateriales haben wir festgestellt, dass *P. glauca* eine sehr veränderliche Art ist, vor allem in den nördlichen Gebieten ihres Areales (Arktis). Ein niedrigerer Veränderlichkeitsgrad besteht umgekehrt bei den Pflanzen aus Mitteleuropa (Alpen). Nach einer gründlichen taxonomischen Analyse, zu der wir nicht nur die üblichen morphologischen Kriterien, aber gleichzeitig auch Merkmale der Gräsertaxonomie benützen, die bisher weniger verwendet werden, kamen wir zu dem Schlusse, dass in den bisherigen taxonomischen Grenzen von *P. glauca* sehr verschiedene Typen verborgen sind, gegenseitig sehr unähnlich, nicht verwandt, die aber auch Arten sein können. Von den studierten Typen konnten wir inzwischen nach Bewertung des Herbarmateriales aus dem Bereiche von *P. glauca* nur einige wenige unterschiedliche ausgeprägte Typen ausscheiden, z.B. *P. riphaea* (Asch. et Gr.) Fritsch (ein Endemit des Gesenkes in den Sudeten) und *P. jurassica* Chrtek et V. Jirás. (ein Endemit des Schweizer Jura).

Wir erwähnen noch einige wichtigere Merkmale der Art *P. glauca* und ihre Veränderlichkeit.

Habitus. Die Pflanzen sind in ihrer Höhe sehr veränderlich. Die Länge der Halme ist gewöhnlich von den Standortsbedingungen abhängig. Es ist aber nicht ausgeschlossen, dass bei einigen Populationen die Höhe der Pflanzen in bestimmten Grenzen ein beständiges Merkmal ist. Auffallend sind besonders Pflanzen mit kurzen Halmen, die meistens eine zusammengezogene Ährchenrispe besitzen. Diese Pflanzen sind in den Herbarsammlungen am öftesten als *P. glauca* subsp. *conferta* bezeichnet. Die Halme der niedrigen Pflanzen sind oft deutlich schief, bei höheren Pflanzen dagegen gerade.

Horstbildung. Der Grad der Horstbildung ist sehr verschieden. Wir beobachteten Pflanzen mit dichten bis lockeren Horsten, und zwar je nachdem, ob intra- oder extravaginale Ausläufer vorwiegen. Die ersten überwogen in den meisten Fällen.

Ährchenrispe. Der Character der Ährchenrispe verwendet man meistens zur Gliederung der *P. glauca* in subsp. *glaucantha* (Ährchenrispe gross, ± locker bis überhängend) und subsp. *conferta* (Ährchenrispe schmal, zusammengezogen). Bei der Mehrheit der Pflanzen ist aber die Ährchenrispe ± zusammengezogen, auch wenn die Ährchen voll blühen.

Halm. Die Halme sind meistens auffallend zähe, drahtartig, dick (bis unterhalb der Ährchenrispe), gewöhnlich einseitig bogenförmig eingebogen, glatt bis stark scharf, graugrün bis violett gefärbt.

Blätter. Die Halmblätter mit den Spreiten meistens flach oder mit den Hälften flach gefaltet. Blätter gelbgrün bis blaugrün, mit den Spreiten an den Rändern scharf. Die Spreite des obersten Halmblattes meistens unterhalb der Halmhälfte und deutlich kürzer als ihre Scheide. Typen mit längeren Halmblättern erinnern oft an *P. nemoralis*. Blatthäutchen des obersten Halmblattes meistens ± 2 mm lang, auf beiden Flächen kahl, stumpf, am oberen Rand gewöhnlich bewimpert.

Ährchen. Ährchen meistens 2—3-blütig, grün bis blaugrün, gewöhnlich aber violett gefärbt, glänzend oder matt, manchmal mit einem auffallenden paraffinartigen Überzug. Pflanzen mit mehrblütigen Ährchen sind in den Herbarien meistens als *Poa glauca* subsp. *glaucantha* bezeichnet. Die Ährchenspindel ist in verschiedenem Grade behaart oder kahl, kleinstachelig oder kleinhöckerig (kleinwarzig).

Hüllspelzen. Meistens eiförmig bis breit eiförmig. Es gibt aber auch Typen mit verlängerten Hüllspelzen, d.h. länglich-lanzettlich, die an Hüllspelzen der *P. balfourii* oder *P. nemoralis* erinnern.

Deckspelzen. Deckspelzen länglich, breit länglich bis länglich-eiförmig, an der Basis mit einem kleinen undeutlichen Wollbüschel (fehlt manchmal). Deckspelzenkiel im ± unteren $^2/_3$ behaart, die Randnerven auch im unteren $^2/_3$, oft aber mit kürzerer Behaarung. Länge der Haare $^1/_2$ bis ganze Breite der Deckspelzenhälfte (gemessen vom Kiel zum Deckspelzenrand). Haare an der Spitze kurz oder lang zugespitzt oder zylinderförmig und erst an der Spitze abgerundet. Zwischennerv deutlich, meistens kahl oder mit einzelnen kurzen Haaren. Ähnlich auch die Fläche zwischen den Nerven meistens kahl, manchmal aber in der unteren $^1/_2$ der Deckspelze mit zerstreuten kurzen Haaren. Zeichnung auf den Deckspelzen sehr mannigfaltig. Der Verlauf des oberen Randes des färbigen Teiles der Deckspelze (Verbindungslinie der einzelnen Nervenenden) entweder gewellt oder nicht gewellt.

Vorspelze. Vorspelze kürzer oder so ± lang wie die Deckspelze. Mittlere Fläche der Vorspelze zwischen den Kielen lanzettlich, länglich-lanzettlich bis länglich. Spitze der Vorspelze seicht eingeschnitten. Auf den Kielen entweder Zähnchen (kleine Stacheln), die längste meistens in der Mitte der Vorspelzenkiele, oder im unteren $^1/_3$ verschieden lange Haare, die oft bis die Länge der Breite der Vorspelze haben (zwischen den Kielen). Haare gewöhnlich am längsten im unteren $^1/_3$ der Vorspelzenkiele. Die mittlere Fläche der Vorspelze zwischen den Kielen kahl, kleinstachelig oder behaart, insbesondere in der unteren $^1/_2$ der Vorspelze.

Die angeführten Merkmale zeigen eine grosse Veränderlichkeit der Art *P. glauca,* insbesondere wenn wir bedenken, dass die einzelnen

Merkmale bei den einzelnen Typen in den verschiedensten Kombinationen vorkommen können. Der grossen Veränderlichkeit der Art entsprechen auch die verschiedenen Chromosomenzahlen, 2n=42—78 (vgl. Löve und Löve 1961:48).

Durch Studium des Herbarmateriales stellten wir eine Reihe von Typen fest, welche durch ihre Merkmalskombinationen am Rande der gesamten Veränderlichkeit der Art *P. glauca* sich befinden. Man könnte sie als selbständige Taxa (Unterarten, Arten) bezeichnen, aber ohne die Ergebnisse des taxonomischen Studiums in der Natur ist dies nicht durchführbar. Es ist nämlich nicht ausgeschlossen, dass man in der Natur verhältnismässig leicht Typen mit einer bestimmten Merkmalskombination erkennen könnte, die in bestimmten Gebieten selbständige Populationen bilden würden. Schon heute können wir mit Sicherheit voraussetzen, dass nach einem gründlichen Studium in der Natur der ganze Komplex von *P. glauca* in eine grössere Anzahl von Typen zerfallen wird, die nicht nur morphologisch und zytologisch, aber auch geographisch bezeichnet sind.

Von den auffälligsten Typen führen wir vorläufig nur die folgenden an. 1. Pflanzen dicht horstig, mittelhoch mit reichen Ährchenrispen, Ährchen auffallend violett bis purpur angelaufen, sozusagen paraffinartig glänzend (nur in Grönland). 2. Pflanzen dicht horstig, Halme während der Blütezeit kurz, nicht verlängert, oberstes Halmblatt oft bis zur $^1/_2$ der Ährchenrispe reichend, einzeln auch höher, in den Horsten überwiegen Blätter über die blütentragenden Halme. Ährchen meistens licht, gelblich grün (vor allem in Grönland). 3. Pflanzen locker horstig, ihre unteren Teile erinnern an die Art *P. arctica* R.Br. Ährchen auffallend breit, Fläche zwischen den Deckspelzennerven kahl, aber mit dem zerstreut behaarten Zwischennerv. Es wäre noch zu bemerken, dass die in Grönland üblich wachsenden Pflanzen sich bereits durch ihr Habitus und ihre Färbung etwas von den europäischen Pflanzen (nordeuropäischen und Alpenpflanzen) unterscheiden.

Im Laufe unseres Studiums haben wir auch festgestellt, dass die verwandtschaftlichen Beziehungen zwischen den Arten *P. balfourii, P. nemoralis* und *P. glauca* sehr eng sind. Deshalb sind wir der berechtigten Ansicht, dass *P. glauca* und *P. nemoralis* zur selben Sektion gehören. Vgl. z.B. die Sektion *Stenopoa* (Dumort.) Hyl. emend. oder die Ansicht Janchen's (1959:820). *P. balfourii* ist das mittlere und verbindende Glied zwischen der *P. glauca* und *P. nemoralis,* so dass auch sie zu ihrem gemeinsamen Taxon (Sektion) gehören muss.

Die komplizierte Veränderlichkeit der *P. glauca* s.l. wird man unserer Ansicht nach zumindest teilweise erst durch ein gründliches vergleichendes Studium in der Natur, mit einer ergänzenden Analyse der morphologischen, histologischen, zytologischen und phytogeographischen Merkmale an womöglich zahlreichsten Herbarbelegen klären können.

Zusammenfassung

Auf Grund der Revision eines sehr umfangreichen Herbarmateriales und der Analyse und Bewertung der taxonomischen Merkmale wurde die Art *P. balfourii* Parn. auch in Skandinavien (Dovre) festgestellt. Durch ein vergleichendes Studium wurden die Unterscheidungsmerkmale zwischen dieser Art und den nahe verwandten Arten *P. nemoralis* L. s.l. und *P. glauca* Vahl s.l. festgestellt. Auch die gesamte Veränderlichkeit der Art *P. glauca* wurde verfolgt, weiter zugleich auch die Variabilität einer Reihe von wichtigen Merkmalen. Viele dieser Merkmale, die man bei dieser mit grösster Wahrscheinlichkeit Sammelart (species aggregata) verfolgen kann, kombinieren sich aber auch teilweise verschieden, so dass man nur unter Benützung eines Herbarmateriales und durch Studium lebender Pflanzen in der Natur zu annehmbaren Ergebnissen gelangen kann. Es ist aber sehr wahrscheinlich, und einige besondere Typen deuten dies auch an, dass es sich bei der *P. glauca* um einen umfangreichen Komplex von Typen handelt, der nach einem gründlichen und allseitigen Studium am ehesten in eine Reihe von Taxa eines Arten- und noch weiter eines Unterarten-Wertes zerfallen wird, die nicht nur morphologisch, sondern auch zugleich geographisch, und viele vielleicht auch karyologisch charakterisiert werden können.

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Trachydiscus nov. gen., eine neue Gattung der coccalen Xanthophyceen

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Wie Untersuchungen gezeigt haben, sind coccale Xanthophyceen im Plankton des Süsswassers viel häufiger vertreten als bisher angenommen wurde. Nicht nur dystrophe Gewässer, sondern auch stark eutrophe enthalten viele kleine Xanthophyceen, die meist wegen ihrer kleinen Ausmasse oder grosser Ähnlichkeit mit gewissen Chlorophyceen wahrscheinlich oft übersehen wurden oder unbeachtet blieben. Über viele wurde in letzter Zeit eingehend von Bourrelly, Georges, Skuja und Fott berichtet. Die systematische Stellung dieser Organismen wurde nicht immer einheitlich aufgefasst und bewertet. Das gilt vor allem für jene, deren Zellen im Umriss einfach gebaut sind, deren Membran aber eine deutliche Skulptur oder Struktur aufweist.

Bei gelegentlichen Exkursionen habe ich in verschiedenen Gewässern kleine coccale Xanthophyceen gefunden, die sowohl durch skrobikulierte Membran als auch durch die deutlich abgeplatteten Zellen aufgefallen waren. Ähnliche Organismen wurden schon von Bourrelly und Georges gesehen und als neue Arten der Gattung *Pseudostaurastrum* beschrieben. Fott (1961) bezeichnete in seiner letzten Arbeit solche Formen als *Trachychloron*-Arten. Bevor die abgeflachten Zellen bewertet werden, wollen wir kurz zu Paschers Beschreibung von *Trachychloron* zurückkehren.

Die Membran von *Trachychloron* ist immer in der charakteristischen Weise netzartig skulptiert, vielfach an den Maschenecken dornig oder stachelförmig vorgezogen. Manchmal ist das Netzwerk der leistenförmigen Membranverdickungen sehr weitmaschig und die Dellen können manchmal auch sehr seicht sein oder die Netzpunkte können kurz stachelförmig vorgezogen werden. In Bezug auf die Membranskulptur schliesst *Trachychloron* an *Trachycystis, Arachnochloris* und *Endochloridion.* Ausserdem sind die ellipsoidischen Zellen von *Trachychloron* drehrund, also mit kreisförmigem Querschnitt. Das wird zwar von Pascher nicht besonders betont, aber es ist an seiner Abbildung von *Trachychloron ellipsoideum* ersichtlich. Da die erstbeschriebene Art, *T. ellipsoideum* (Pascher) Pascher als Typus bezeichnet werden kann, was Fott auch getan hat, sind die Zellen der Gattung *Trachychloron* nicht plattgedrückt. Die Charakteristik dieser Gattung ist deshalb sowohl durch ihre charakteristische Netzstruktur der Membran als auch durch die drehrunden Zellen gegeben.

Die von mir untersuchten Organismen besitzen zum Unterschied von *Trachychloron* deutlich linsenförmig plattgedrückte Zellen und eine anders skulptierte Membran. Die Oberfläche der Membran zeigt kein Netzwerk, sondern ist mit grösseren oder kleineren Höckern oder Körnern übersäht. Die Anzahl dieser ist je nach verschiedenen Zellformen, also je nach den einzelnen Arten, verschieden. Diese Unterschiede bewegten mich dazu eine neue Gattung aufzustellen, die folgend beschrieben sei.

Trachydiscus nov. gen.

Zellen stark linsenartig abgeplattet, daher mit ausgesprochener Breit- und Schmalseite. Die Breitseite ellipsoidisch, rundlich bis fast kreisrund, polygonal, sechs- oder viereckig, aber auch etwas unregelmässig gebaut. Schmalseite gestreckt ellipsoidisch oder spindelförmig. Ohne jeden Ausläufer oder Fortsatz. Membran dünn oder stark, einteilig, an der Oberfläche stets skulptiert. Skulptur in Form grösserer oder kleinerer Höcker oder Körner, die an der Oberfläche übersäht sind. Grosse Höcker meist in geringerer Anzahl vorhanden als die kleinen Körner. Chromatophoren stets mehrere vorhanden (gewöhnlich 2—6), diese sind scheibenförmig, wandständig, ohne Pyrenoide. Die einzelnen Chromatophoren liegen der Breitseite der Zellen an. Plasma glashell, mit wenig Öl und anderen Assimilatstoffen.

Ungeschlechtliche Fortpflanzung durch typische Autosporen, die zu zweit oder zu viert gebildet werden. Sie erhalten noch innerhalb der erweiterten Muttermembran ihre charakteristische Form und Membranskulptur. Die Autosporen werden durch einen Riss in der Muttermembran frei. Andere Stadien wurden nicht gesehen. Leitart: *Trachydiscus lenticularis* (Abb. 1). Bisher sieben Arten bekannt.

Bestimmungsschlüssel

- 1 a Zellen mit runder bis kreisrunder Breitseite
  - 2 a Membran mit vielen kleinen Warzen, Breitseite kreisrund .. *T. lenticularis*
  - 2 b Membran mit wenigen, aber grossen Warzen, Breitseite nie kreisrund, mehr abgerundet polygonal .... *T. verrucosus*
- 1 b Zellen mit anders gestalteter Breitseite
  - 3 a Breitseite ellipsoidisch bis spindelförmig
    - 4 a Breitseite ellipsoidisch, beidseits breit abgerundet ...... *T. ellipsoideus*
    - 4 b Breitseite spindelig, beidseits zugespitzt .... *T. fusiformis*
  - 3 b Breitseite eckig
    - 5 a Breitseite sechseckig, Membran mit sehr vielen kleinen, dicht gedrängten Warzen .... *T. sexangulatus*
    - 5 b Breitseite vier- oder fünfeckig, mit wenigen, weit entfernten Warzen
      - 6 a Zellen bis 8 µ gross, Schmalseite biconvex .... *T. minutus*
      - 6 b Zellen bis 14 µ gross, Schmalseite ellipsoidisch .... *T. quadratus*

Trachydiscus lenticularis nov. sp. Abb. 1.

Zellen linsenförmig abgeplattet, von der Breitseite rund bis fast genau kreisrund, von der Schmalseite spindelförmig. Membran mässig stark, mit deutlichen, aber relativ wenigen Warzen an der Oberfläche. Chromatophoren wandständig, scheibenförmig, meist drei, seltener nur zwei in jeder Zelle vorhanden, der Breitseite der Zellen anliegend. Farbe schön gelbgrün. Im Plasma nur wenige Öltopfen. Fortpflanzung durch Autosporen, die in jeder Zelle gebildet werden.

Ausmasse, Breitseite der Zellen 6,5—10 µ im Durchmesser.

Vorkommen: Zerstreut zwischen anderen Planktonten (verschiedene *Chlorococcales* und *Euglenales*) in kleinen leicht eutrophen Tümpeln bei Glaselsdorf (Schönhengst — Juni 1962).

Sehr ähnlich sieht auch *Pseudostaurastrum circulare* Bourrelly et Georges aus. Doch besitzt diese eine andere Skulptur der Membran, die mehr an die von *Goniochloris sculpta* Geitler erinnert. Fott hat *Pseudostaurastrum circulare* in die Gattung *Trachychloron* umgereiht, obzwar die Merkmale denen von dieser Gattung nicht entsprechen. Fott gibt zwei Abbildungen von dem genannten Organismus, wobei es sich höchstwahrscheinlich um zwei unterschiedliche Typen handelt. Zelle mit netzförmiger Membranskulptur ist wohl mit Bourrellys und Georges Organismus identisch. Der Membranskulptur wegen ist sie jedoch aus der Gattung *Trachychloron* auszuscheiden. Die andere Zelle mit der körnigen Skulptur gehört vielleicht zu *Trachycystis*.

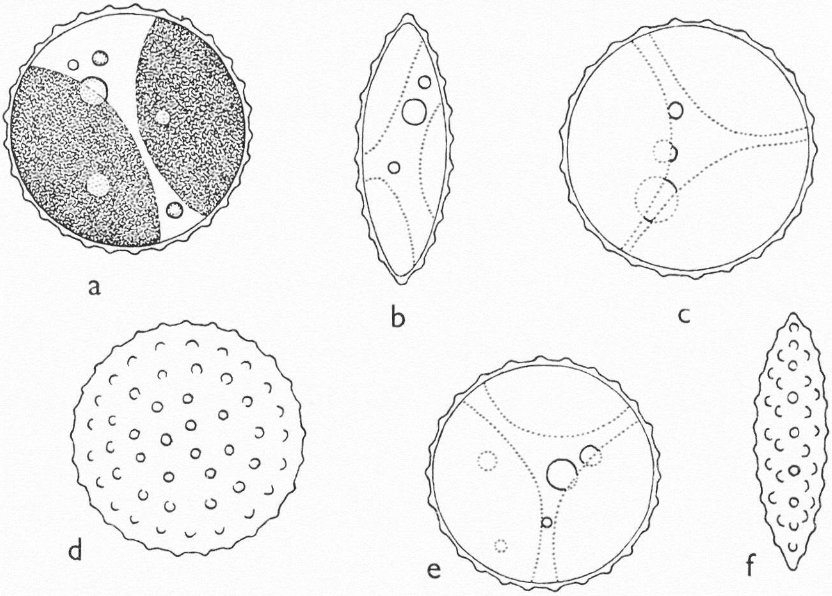

Abb. 1. *Trachydiscus lenticularis* nov. sp.; a Breitseite mit dargestellten Chromatophoren; b Schmalseite; c, e Breitseite (Chromatophoren nur im Umriss dargestellt); d Oberfläche der Breitseite; f Oberfläche der Schmalseite.

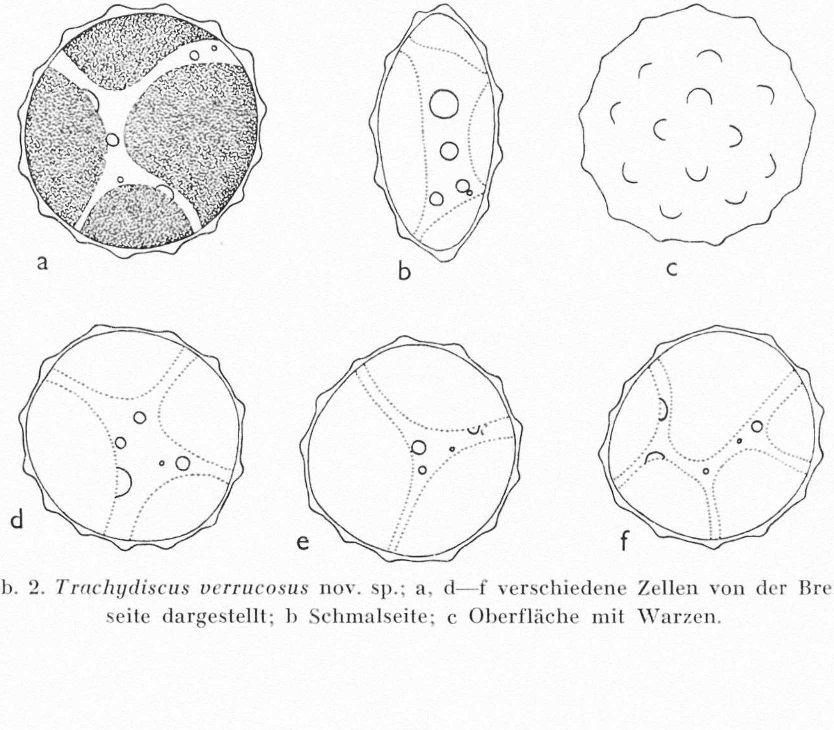

Abb. 2. *Trachydiscus verrucosus* nov. sp.; a, d—f verschiedene Zellen von der Breitseite dargestellt; b Schmalseite; c Oberfläche mit Warzen.

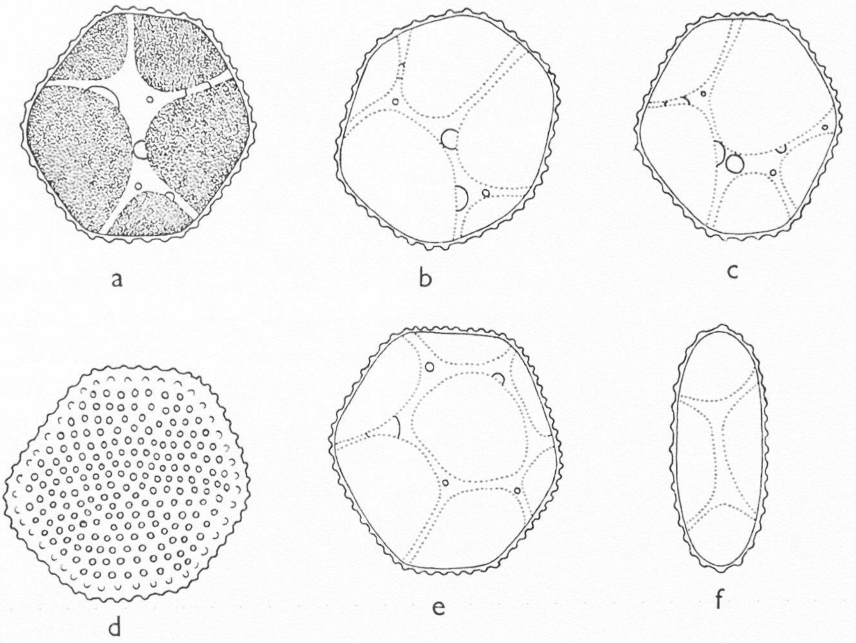

Abb. 3. *Trachydiscus sexangulatus* nov. sp. a—c, e Breitseite mit dargestellten Chromatophoren; d Oberflächenskulptur; f Schmalseite.

Trachydiscus verrucosus nov. sp. Abb. 2.

Zellen von der Breitseite sehr breit ellipsoidisch bis fast kreisförmig, oft auch etwas unregelmässig oder abgerundet polygonal. Schmalseite ellipsoidisch-spindelförmig. Membran mässig stark, mit wenigen, aber grossen Warzen. Drei bis fünf wandständige, scheibenförmige und etwas gelbliche Chromatophoren. Fortpflanzung nicht beobachtet.

Ausmasse: Zellen 8—13,5 μ im Durchmesser (Breitseite).

Vorkommen: Vereinzelt zwischen Algenfäden von *Oedogonium sp.* und *Tribonema vulgare* in einem kleinen mit Sphagnum verwachsenen Tümpel im Pawlover Moor bei Boskowitz (pH-Wert 5,6).

Trachydiscus sexangulatus nov. sp. Abb. 3.

Breitseite abgerundet sechseckig, oft etwas unregelmässig, mit nicht gleichmässig langen Kanten. Schmalseite gestreckt ellipsoidisch. Membran mit vielen kleinen, ziemlich dicht aneinandergedrängten Körnern. Chromatophor wandständig, scheibenförmig oder abgerundet polygonal, in einer Anzahl von fünf bis acht. Assimilate in Form kleiner Fetttropfen. Fortpflanzung durch vier Autosporen.

Ausmasse: Zellen 10,5—16 μ im Durchmesser (Breitseite).

Vorkommen: Zwischen Detritus am Ufer eines kleinen Wiesentümpels bei Krönau. Vereinzelt auch zwischen reichlichem *Chlorococcales*-Plankton im eutrophen Dorftümpel in Ketzelsdorf (Schönhengst — September 1961).

Trachydiscus ellipsoideus nov. sp. Abb. 4 a—e.

Zellen stark plattgedrückt, von der Breitseite schön ellipsoidisch und an den Enden breit abgerundet. Von der Schmalseite gestreckt ellipsoidisch. Membran relativ stark, mit schön perlartigen Warzen, die dem Zellrand im optischen Längsschnitt ein fast regelmässig gewelltes Aussehen verleihen. Drei bis vier wandständige, scheibenförmige Chromatophoren. Diese sind etwas blassgrün. Nur wenige Öltropfen im Protoplast. Fortpflanzung durch vier Autosporen, die in jeder Zelle gebildet werden.

Ausmasse: Zellen 8—12 μ lang, 6—10 μ breit, und 2—3 μ dick.

Vorkommen: Im Plankton eines leicht dystrophen Teiches im Pawlover Moor bei Boskowitz (August 1962).

Trachydiscus fusiformis nov. sp. Abb. 4 f—j.

Zellen stark plattgedrückt, von der Breitseite breit spindelförmig bis ellipsoidisch—spindelförmig, an beiden Enden jedoch immer zugespitzt. Schmalseite gestreckt spindelförmig. Membran zart, mit niedrigen und ziemlich weit voneinander entfernten Warzen. Drei bis fünf scheibenförmige, gelbgrüne Chromatophoren. Fortpflanzung durch vier Autosporen.

Ausmasse: Zellen 7,5—12 μ lang, 5—9 μ breit und etwa 2 μ dick.

Vorkommen: Wiesengraben bei Ramsau im Altvater-Gebirge (Juni 1963).

Den Merkmalen dieser Gattung entsprechen noch zwei Organismen, die von Bourrelly und Fott beschrieben und abgebildet wurden. Sie werden hier der Vollständigkeit wegen kurz angeführt.

Trachydiscus minutus (Bourrelly) nov. comb.

Basionym: *Pseudostaurastrum minutum* Bourrelly (1951), Bull. Mus. Paris 23, p. 670, fig. 7.

Zellen von der Breitseite vier- oder fünfeckig, von der Schmalseite bikonvex spindelförmig, mit abgerundeten Ecken. Membran zart mit deutlichen Körnern, die relativ gross und weit voneinander entfernt

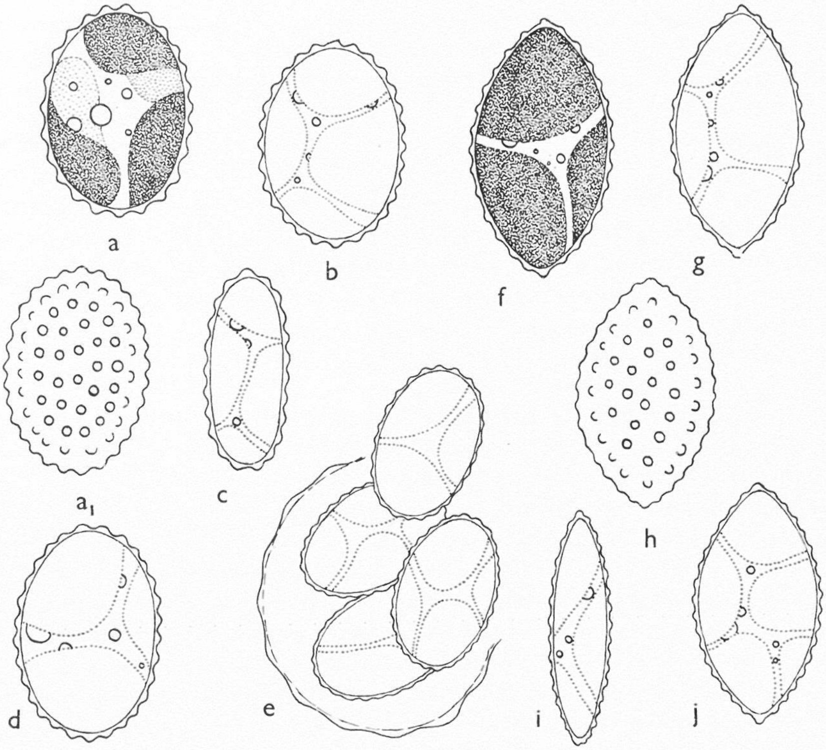

Abb. 4. *Trachydiscus ellipsoideus* nov. sp.; Breitseite mit Chromatophoren; a Oberflächenskulptur; c Schmalseite; e Autosporenbildung. *Trachydiscus fusiformis* nov. sp.; f, g, j Breitseiten mit Chromatophoren; h Oberflächenskulptur; i Schmalseite.

sind. Drei bis vier scheibenförmige Chromatophoren. Fortpflanzung nicht angegeben.

Ausmasse: Ungefähr 8 μ im Durchmesser, 4—5 μ dick.

Vorkommen: Bassin des Botan. Gartens in Paris, Teiche bei Trappes und Boune Mare (Frankreich).

Trachydiscus quadratus nov. sp.

Syn.: *Trachychloron biconicum* Pascher p.p. sensu Fott (1961), Bull. Res. Counc. Israel 10 D, p. 69, fig. 4.

Zellen von der Breitseite viereckig, mit breit abgerundeten Ecken, von der Schmalseite ellipsoidisch. Membran dick, mit deutlichen Warzen besetzt. Warzen ziemlich weit voneinander, in Reihen angeordnet. Meist nur ein einziges Chromatophor, manchmal aber zwei oder drei, seltener mehrere scheibenförmige Chromatophoren vorhanden. Fortpflanzung nicht angegeben.

Ausmasse: Breitseite 8—20 μ, gewöhnlich 14 μ im Durchmesser.

Vorkommen: Im Plankton eines Teiches bei Prag, gemeinsam mit verschiedenen Chlorococcalen. Auch in Fischteichen bei Grzycko (Polen).

Diese Form gehört wegen den abgeplatteten Zellen und gekörnten Skulptur der Membran zu *Trachydiscus. Trachychloron biconicum* Pascher hat drehrunde Zellen und besitzt eine netzartige Skulptur der Membran.

Lateinische Diagnosen

Trachydiscus nov. gen. — Cellulae valde compressae, a fronte ellipsoideae, late ellipsoideae, ellipsoideo-fusiformes, rotundae usque ad circumlatae, interdum quadratae usque ad sexangulares; a latere angustiore longe ellipsoideae vel fusiformes; membrana delicata vel crassa; superficie verrucosa vel granulosa; chromatophoris disciformibus parietalibus, binis usque ad plurimis, sine pyrenoide. Propagatio fit binis vel quaternis autosporis. Typus generis — *T. lenticularis.*

T. lenticularis nov. sp. — Cellulae lenticulariter compressae; a fronte rotundae vel circumlatae, a latere angustiore fusiformes; membrana sat crassa, superficie verrucis claris; 2—3 chromatophoris disciformibus parietalibus. Propagatio fit binis autosporis. Cellulae 6,5—10 μ in diametro. Typus: figura nostra 1.

T. verrucosus nov. sp. — Cellulae compressae, a fronte latissime ellipsoideae usque ad rotundae, interdum irregulares; a latere angustiore ellipsoideo-fusiformes; membrana sat crassa, superficie paucis verrucis magnis; 3—5 chromatophoris disciformibus parietalibus. Propagatio non observata. Cellulae 8—13,5 μ in diametro. Typus: figura nostra 2.

T. sexangulatus nov. sp. — Cellulae a fronte rotundo-sexangulares, saepe irregulariter sexangulares, a latere angustiore longe ellipsoideae; membrana superficie dense granulata; 5—8 chromatophoris disciformibus. Propagatio fit quaternis autosporis. Cellulae 10,5—16 μ in diametro. Typus: figura nostra 3.

T. ellipsoideus nov. sp. — Cellulae a fronte ellipsoideae, polis utrisque rotundatis, a latere angustiore longe ellipsoideae; membrana crassa, evidenter verrucosa; 3—4 chromatophoris, disciformibus parietalibus. Propagatio quaternis autosporis. Cellulae 8—12 μ longe, 6—10 μ latae, 2—3 μ crassae. Typus: figura nostra 4: a—e.

T. fusiformis nov. sp. — Cellulae a fronte late fusiformes vel ellipsoideo-fusiformes, polis utrisque acutis; a latere angustiore fusiformes; membrana delicata, verrucis humilibus; 3—5 chromatophoris disciformibus. Propagatio fit quaternis autosporis. Cellulae 7,5—12 μ longae; 5—9 μ latae, circiter 2 μ crassea. Typus: figura nostra 4: f—j.

T. quadratus nov. sp. — Cellulae a fronte quadratae, angulis rotundatis; a latere angustiore ellipsoideae; membrana crassa, verrucis claris; uno chromatophoro vel 2—4 chromatophoris disciformibus. Propagatio non observata. Cellulae 8—20 μ in diametro. Typus: figura 4 (iconotypus) in Fott 1961.

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Botaniska Notiser 1964 · Vol. 117 · Fasc. 2 · Lund

Smärre uppsatser och meddelanden

Sedum anglicum Huds. inplanterad på Christiansö

I Botaniska Notiser 1963 (s. 105—106) meddelade professor Göte Turesson, att han påträffat *Sedum anglicum* på Christiansö ca 20 km n.ö. om Bornholm. Sammanlagt uppgavs fyra lokaler för växten på Christiansö, varav tre upptäcktes redan i juni 1961 och den fjärde under ett besök i september 1962.

Sedum anglicum räknas till de atlantiska, kustbundna arterna och förekommer i Norden från norra Halland och upp till mellersta Bohuslän samt efter Norges kust upp mot 65° nordlig bredd. I Hulténs Atlas över växternas utbredning i Norden (1950) saknas uppgift om att *Sedum anglicum* skulle förekomma i Danmark. Inte heller i Rostrup-Jörgensen, Den danske Flora (1961) finnes någon antydan om växtens förekomst i Danmark. Det av Turesson meddelade fyndet är mot denna bakgrund mycket intressant. Turesson uppger dock, att *Sedum anglicum* påträffats på Christiansö redan sommaren 1960 vid en inventering från dansk sida av öns flora. Fyndet hade dock ej publicerats. Som jag senare erfarit, var det dr. phil. H. Ødum, som påträffade växten och fyndet omnämndes också av Weimarck i Skånes flora 1963.

Genom en tillfällighet kan jag bidraga till att klarlägga de troliga orsakerna till den anmärkningsvärda förekomsten av *Sedum anglicum* på Christiansö. Jag har aldrig varit på Christiansö men från Sveriges västkust är jag väl förtrogen med *Sedum anglicum* och dess ekologi. Då jag för några år sedan visade konstnären Edvard Wallenqvist (Stockholm) *Sedum anglicum* på Stora Hamburgön i norra Bohuslän — där växten planterats in av mig från det s.k. Ramsvikslandet på Sotenäset — berättade han för mig, att han väl kände till växten från Christiansö. Där hade den planterats in av den kände marin- och landskapsmålaren Carl Oscar Hullgren, vilken som konstnär upptäckte Christiansö redan vid sekelskiftet och vistades där ända fram till sin bortgång 1948.

I samband med meddelandet i Botaniska Notiser om fyndet av *Sedum anglicum* på Christiansö fick jag anledning att ånyo tillfråga konstnären Wallenqvist om hans erfarenheter av *Sedum anglicum.* Edward Wallenqvist kom till Christiansö vid midsommar 1936 och kunde mycket väl erinra sig två bestånd av *Sedum anglicum,* som konstnären Oscar Hullgren och hans maka Julie visade honom. Oscar Hullgren hyrde »Möllegården». Kvarnen var borta men på dess plats högst uppe på ön stod Mistlurstornet. Det ena *Sedum anglicum*-beståndet fanns »till vänster om stigen som gick från huset och upp mot Mistlurstornet». Det andra och större beståndet fanns vid fru Julie Hullgrens lilla av en ojämn stenmur omgärdade trädgårdsanläggning, som låg ett något längre stycke från huset. Det större beståndet blommade vackert och rikligare än det första. Troligen har *Sedum anglicum* inplanterats av Oscar Hullgren före det första världskriget. Om ej så strax efter detta och »*senast* kan växten ha planterats på 20-talet». Så långt Edvard Wallenqvist.

På hans inrådan skrev jag förra sommaren till fru Julie Hullgren i Rungsted Kyst i Danmark och bad om några upplysningar om *Sedum anglicum*. Svaret kom omgående. Det heter där: ». . . *Sedum anglicum,* som vi tog med från Cornwall och Bretagne, och som stortrivdes på Xiansö. Den planterades särskilt på Möllebakken.» Årtalet kunde fru Hullgren dock ej erinra sig.

Med dessa rader har jag velat fästa uppmärksamheten på att *Sedum anglicum* planterats in på Christiansö redan för länge sedan. De av Turesson angivna lokalerna för *Sedum anglicum* sammanfalla dock ej med dem som Edvard Wallenqvist omnämnt. Professor Turesson har meddelat mig, att han endast besökt Möllebakken flyktigt och i dåligt väder. Däremot har han gått över Oscar Hullgrens tomt, dock utan att iaktta *Sedum anglicum*. De fyra av honom funna lokalerna verkade högst »spontana». Med hänsyn till fru Hullgrens uppgifter är det dock uppenbart, att man måste starkt betvivla, att *Sedum anglicum* verkligen är spontan på Christiansö. Med all sannolikhet har *Sedum anglicum* helt människan att tacka för sin förekomst på Christiansö.

Till dessa uppgifter om inplanteringen av *Sedum anglicum* på Christiansö vill jag också foga några ord om växtens sociologi och ekologi, närmast grundade på erfarenheter från Sveriges västkust. Där växer *Sedum anglicum* i grund jord på hällmark och i sällskap med *Rumex tenuifolius, Agrostis canina, Scleranthus perennis, Festuca ovina, Sagina subulata, Aira praecox, Viola tricolor, Leontodon autumnalis* och ännu ett par fanerogamer. Det alltid något öppna fältskiktet tillåter en bottenvegetation av mossor och lavar att utvecklas tämligen väl. Bl.a. förekommer vanligen *Cladonia rangiformis, C. alcicornis, Cornicularia aculeata, Rhacomitrium lanuginosum, Polytrichum piliferum* m.fl. Artsammansättningen pekar fullt tydligt på en näringsfattig miljö. Tüxen (1951, s. 160—161) har vid Sveriges västkust beskrivit samhället som en *Sedum anglicum - Sagina subulata* - assoc., som han där betecknar som en sista utlöpare av Västeuropas euatlantiska *Sedum anglicum* - samhällen. Associationen utgör ett pionjärsamhälle till *Armeria elongata - Rumex tenuifolius* - associationen.

De av Turesson beskrivna lokalerna för *Sedum anglicum* på Christiansö utgjorde i samtliga fall flata, svagt sluttande klipphällar. Som följearter anges *Plantago lanceolata, Hypochoeris radicata, Leontodon autumnalis* och *Aira praecox*. De vittna om en näringsfattig miljö och ge även en klar antydan om att *Sedum anglicum* på dessa lokaler på Christiansö har något spontant över sig i sitt uppträdande.

Turesson tänker sig att *Sedum anglicum* möjligen har kommit till Christiansö med sjöfåglar från de svenska och norska kustlokalerna eller kanske från England. Han pekar på massförekomsten av sjöfåglel på den närbelägna, obebodda ön Gräsholmen, som är fågelreservat sedan 1936. Turesson antyder också möjligheten av att *Sedum anglicum* där kan finnas i en ännu rikligare förekomst än på Christiansö. Jag vill dock gärna understryka, att *Sedum anglicum* är en oligotrof art vid Sveriges västkust och ingalunda gynnas av den nitrifiering, som kännetecknar av måsfåglar och andra sjöfåglar bebodda öar. I det fallet skiljer sig *Sedum anglicum* påtagligt från den nitrofila *S. acre*. Det förefaller mig därför mindre troligt, att just den fågelrika Gräsholmen skulle hysa så lämpliga lokaler för *Sedum anglicum*. — Jämför dock Faegri m.fl. (1960, s. 113), som från Norges kust ange, att *Sedum anglicum* ofta förekommer i sällskap med *Aira praecox* »in places where seabirds rest. In short, open grass, but not in proper meadow vegetation. Nitrophilous».

Bernström (1936), som skildrat Ertholmenes molluskfauna, konstaterar, att Gräsholmen är en av södra Östersjöns mest betydande fågelöar och att de tusental fåglarnas guano bildar en god jordmån åt en synnerligen frodig gräsväxt. Ett liknande utseende hade även de övriga Ertholmene en gång och således även Christiansö. På Christiansö har människan gripit in starkt genom att särskilt till området innanför fästningsmurarna föra jord, som hämtats på Bornholm och Själland. Strandremsan utanför fästningsmurarna har däremot bibehållit sin ursprungliga karaktär med en sparsam vegetation i klippskrevorna. Det är ej överraskande, att Bernström beträffande Ertholmenes molluskfauna kommit till resultatet, att människan i dominerande mån bidragit till att ge den dess nuvarande karaktär. Men även växtligheten har starkt påverkats av människan. Beträffande *Sedum anglicum* har jag genom dessa rader velat fästa uppmärksamheten på att den också kommit till ön med människans hjälp och att de av Turesson meddelade förekomsterna av *Sedum anglicum* mycket väl kunna stå i samband därmed.

Göteborg, april 1964. VILHELM GILLNER

Summary

In 1963 *Sedum anglicum* Huds. was reported by professor Turesson from four places on the small island Christiansö northeast of Bornholm. The plant had been observed there already in the summer of 1960 by a Danish botanist although not published. The author has been told that *Sedum anglicum* was introduced on Christiansö already about fourty years ago (at least) by the Swedish artist Oscar Hullgren who brought the plant from Cornwall and Brittany. Mrs. Hullgren has told the author that the plant thrived very well on Christiansö. The author therefore thinks that the appearance of *Sedum anglicum* on Christiansö is due to man and not to be considered as spontaneous.

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Litteratur

ARTHUR C. GIESE (ed.): Photophysiology I och II. Academic Press, New York och London 1964. Vol. I $14.00; vol. II $15.00.

Academic Press har utgivit två volymer under titeln »Photophysiology», tillsammans innehållande ett tjugotal uppsatser av olika forskare. Verket är redigerat av A. C. Giese, som också inleder med en historisk översikt. Efter denna följer några kapitel med metodik och grundläggande fotokemi: Fotokemiska metoder och principer (Claesson), elektronspinresonans (Blois och Weaver), makromolekylernas fotokemi (McLaren), spektrofotometri och aktionsspektra (M. B. Allen).

Resten av vol. I ägnas helt växternas fotobiologi med en övervägande biofysisk och biokemisk behandling. I tre artiklar behandlas utförligt fotosyntesens ljusreaktioner ur olika synpunkter (Whatley et al., Clayton och Blinks). Fototropismen hos högre växter ägnas också ett längre avsnitt (Briggs), med tonvikt på de tre fotoaktiva systemen i koleoptiler. Ljuseffekter på cytoplasma och plastider behandlas av Virgin. Hendricks har satt rubriken »Photochemical aspects of plant photoperiodicity» på sitt bidrag, medan »The phytochrome system» onekligen hade varit mer adekvat. Hastings skriver om »den biologiska klockan» med tonvikt på ljusets roll för dygnsrytmiken hos dinoflagellaten *Gonyaulax*.

Volym II ägnas djur och mikroorganismer. Ett kapitel om fototaxis (Clayton) är dock av intresse för växtfysiologer. Mutagena effekter, fotoreaktivering och nukleinsyrornas fotokemi är ytterligare tre kapitel som bör nämnas i detta sammanhang.

Allmänt kan om arbetet sägas, att de flesta av de ämnesområden som diskuteras, ganska nyligen varit föremål för behandling i liknande översiktsartiklar. Å andra sidan tycks mig sammanställningen av dessa artiklar i ett verk vara lyckad. De medverkande författarna är kända forskare på sina respektive områden. Arbetet ger en god översikt över de viktigaste fotofysiologiska forskningsfälten. Vad man saknar är kanske främst en artikel om de ljustillväxtreaktioner hos växter som icke styrs av »röd-mörkrödsystemet».

LARS OLOF BJÖRN

W. W. UMBREIT, R. H. BURRIS och J. F. STAUFFER: Manometric Techniques, 4th ed. Burgess Publishing Company, Minneapolis 1964. $6.50.

»Manometric techniques and tissue metabolism» av Umbreit, Burris och Stauffer har blivit ett standardverk på biokemiska och fysiologiska laboratorier. Den fjärde upplagan har nu utgivits. Förutom de ovan nämnda huvudförfattarna medverkar ett tiotal med enstaka avsnitt. En jämförelse med den andra upplagan visar, att titeln något inkonsekvent förkortats till »Manometric techniques», medan innehållet utvidgats med avsnitt om spektrofotometri och kromatografi (allmän teori, kolonn-, pappers-, tunnskikts- och gaskromatografi). Att en bok om manometri utvidgats med just dessa metoder synes mig ganska godtyckligt.

Förutom vad som nämnts ovan innehåller boken ett stort antal recept och beskrivningar för preparation av biologiskt material och fysiologiskt viktiga substanser, samt för kvantitativa analyser (inklusive enzymbestämningar). Många av dessa metoder blir naturligtvis snabbt föråldrade. Som exempel kan nämnas, att den senaste referens som gives för preparation av isolerade kloroplaster är från 1956. Det har sannolikt skrivits mer om isolerade kloroplaster efter detta årtal än före. Allt fler av de metaboliter, på vilkas framställning beskrivning lämnas, blir tillgängliga kommersiellt. Sammanfattningsvis kan dock sägas, att även dessa kapitel innehåller mycket av värde.

Beträffande de manometriska metoderna är verket naturligtvis fortfarande en ovärderlig källa till allmänna metodbeskrivningar, teoretiska formler, empiriska konstanter och praktiska vinkar. Även de nya, automatiskt registrerande manometrarna har fått ett avsnitt. Framställningen är mycket detaljerad, så att man t.o.m. får råd om hur man lämpligen bör ställa upp försöksprotokollen. För växtfysiologen är det av speciellt intresse att även fotosyntesmätningar beskrivs.

Resten av boken har en annan karaktär. Speciellt avsnittet om kromatografi är snarare att betrakta som en introduktion än som en detaljerad laboratoriehandledning. Kapitlet »Thin layer chromatography» omfattar exempelvis mindre än en sida.

Boken avslutas med en omfångsrik referenslista (över 700 arbeten), som sträcker sig fram till 1963, med tyngdpunkten på 50-talet.

LARS OLOF BJÖRN

LEIF M. PAULSSEN: Identification of active charcoals and wood charcoals. Universitetsforlaget. Scandinavian University Books. Tr. i Trondheim. 1964. 113 s. N. Kr. 29:—.

Det föreliggande arbetet är en hjälpreda för bestämning av förkolnat material, huvudsakligen av olika träslag. Förf. har för jämförelse framställt preparat av en rad olika träslag, dels med, dels utan föregående förkolning, och med beskrivningar och mycket instruktiva fotografiska avbildningar angivit deras karakteristiska drag. Med utgångspunkt från detta material göres så en undersökning av ett stort antal i handeln förekommande prov av träkol och liknande produkter, som också beskrives, avbildas fotografiskt och i de flesta fall identifieras. Med förf:s metodik är det möjligt att göra bestämningar på förkolnade korn, som är under 1 mg i vikt. Identifieringen sker med hjälp av mikroskopisk undersökning i belysning vinkelrätt mot objektets yta, sedan kolfragmenten först monterats på lämpligt sätt på ett mjukt underlag. Det visade sig vid undersökning av de olika proven, att bland de ingående träslagen intog boken det främsta rummet; mycket av materialet härstammade emellertid också från torv, en del var bildat av kokosnötskal.

Författarens metodik bör vara till nytta ej blott för identifiering av beståndsdelarna i träkol, förekommande i handeln, utan även för bestämning av förhistoriskt förkolnat material. De talrika goda avbildningarna är därvid givetvis av stort värde.

H. HJELMQVIST

ERNST NILSSON: Johannesörten. Bokförlaget Fabel, Stockholm 1964. 86 s. Kr. 12: 50.

I sin lilla bok om johannesörten behandlar Ernst Nilsson denna växt ur alla tänkbara aspekter. Förf. säger själv i förordet, att han särskilt sökt ägna sig åt sådant, som eljest brukar beröras blott i förbigående, och är det så, är det tydligen mycket som brukar få detta på sin lott, med hänsyn till den utförliga redogörelse som lämnas för växten ur alla möjliga synpunkter. I främsta rummet är det växtens kulturhistoria som behandlas. Sedan mycket länge har *Hypericum perforatum,* och även *H. maculatum,* väckt uppmärksamhet genom den blodröda saft, som kan pressas ur kronbladen, och denna egenhet har gett upphov till en rad folkliga föreställningar och användningssätt, bl.a. till olika användningar i folkmedicinen. Dessa omtalas sakkunnigt av förf., liksom också den nyare användningen som brännvinskrydda. Släktets botaniska egenskaper, variation och ärftlighet beröres också; rec. skulle kanske på den senare punkten önskat ett omnämnande av den intressanta iakttagelsen av Noack, att arthybrider ofta blir klorofylldefekta, och den diskussion detta givit anledning till.

Genom sina utblickar åt olika håll, vittnande om författarens stora kunnighet i skilda discipliner, är boken en underhållande och lärorik läsning.

H. HJELMQVIST

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Notiser

Professors namn. Laborator Axel Nygren, lantbrukshögskolan, har tilldelats professors namn.

Skogshögskolan. Docent N. T. Ingestad har utnämnts till laborator i skogsträdsfysiologi vid skogshögskolan.

Hedersdoktorat. Till filosofie doktor honoris causa promoverades den 30 maj 1964 vid Lunds universitet försöksledare Arvid Nilsson, Landskrona.

Doktorsdisputationer. Vid Uppsala universitet har under vårterminen följande doktorsavhandlingar ventilerats: Den 4 maj: »Plankton and environment of North Patagonian lakes» av K. Thomasson, den 8 maj: »Studies of the physiology, morphology and serology of Exobasidium» av K.-R. Sundström, den 11 maj: »Studies in the physiology of the lichen Collema» av Elisabet Henriksson, den 13 maj: »Epilithische und epigäische Moosvegetation in Laubwäldern der Insel Öland (Schweden)» av E. Sjögren, den 14 maj: »Studies on freshwater Hyphomycetes» av S. Nilsson, den 19 maj: »Forest ecological studies on drained peat land in the province of Uppland, Sweden» av H. Holmen.

Forskningsanslag. Kungl. Fysiografiska Sällskapet i Lund har i mars 1964 utdelat följande anslag till botanisk forskning: Till fil. mag. S. Asker 1.800 kr. för cytogenetiska studier inom apomiktiska *Potentilla*-arter, särskilt avseende effekten av röntgenbestrålning och kemiska mutagener; till fil. mag. Karin Brunsberg 500 kr. för meiosstudier inom *Lathyrus pratensis*-komplexet och 600 kr. för studier av variationen inom *L. sphaericus*; till fil. mag. N. Englesson 2.200 kr. för insamling och studier av annuella *Cerastium*-arter; till docent S. Fröst 2.000 kr. för kväveanalyser av olika stammar av tetraploid råg med olika fertilitetsgrad; till fil. lic. G. Ising 2.000 kr. för fortsatta studier av den kromosomstrukturella variationen hos släktet *Cyrtanthus*; till fil. mag. E. Josefsson 1.000 kr. för analys av senapsoljeglykosiderna hos *Brassica oleracea, B. napus* och *B. campestris* i avsikt att undersöka variationen och möjligheten att sänka glykosidhalten genom växtförädling; till agr. dr G. Julén 1.200 kr. för fortsatta undersökningar av nedärvningsförhållandena för resistens mot *Verticillium albo-atrum* hos lusern; till fil. kand. J. Lindström 900 kr. för undersökning av parningsförhållandena under meiosen hos råg och rågkorsningar med accessoriska kromosomer; till assistent S. Malmborn 1.800 kr för att belysa sambandet mellan kärnstorlek och tidighet hos korn; till fil. kand. Ö. Nilsson 700 kr. för klarläggande av artavgränsningen inom släktet

Montia och detta släktes förhållande till närstående släkten; till fil. lic. Gertrud Nordborg 800 kr. för undersökning av taxonomiska och evolutionära problem inom *Sanguisorba minor*-komplexet; till fil. mag. B. Nordenstam 500 kr. för cytologisk undersökning av sydafrikanska *Compositae* och *Liliaceae*; till professor G. Turesson 700 kr. för undersökningar över ekotyputbildningen inom *Hieracium umbellatum* och formbildningen inom *Hieracium pilosella*; till fil. mag. T. von Wachenfeldt 965 kr. för undersökning av algfloran på Kullaberg, speciellt algernas zonering och zonernas förflyttning under olika årstider, samt till fil. mag. G. Weimarck 1.000 kr. för insamling och fältstudier av *Hierochloë* i Finland.

Statens Naturvetenskapliga Forskningsråd har den 5 maj 1964 utdelat följande anslag till botaniska undersökningar: Docent O. Almborn, Lund, 22.497 kr. för utarbetande av en flora över Sydafrikas lavar; docent H. Baltscheffsky, Stockholm, 34.687 kr. för undersökningar över fotofosforyleringens mekanism och dess roll i fotosyntesen hos gröna växter och fotosyntetiserande bakterier; docent Gerd Bendz o. docent O. Mårtensson, Uppsala, 13.300 kr. för studier av mosspigment; professor K. Björling, Uppsala, 21.084 kr. för undersökningar av spontana och nitritinducerade mutationer av tobakmosaikvirus; docent T. Denward, Lund, 11.016 kr. för forskning över funktionen av inkompatibilitetsallelerna hos rödklöver och variationen hos *Phytophthora infestans* samt karyotypanalys av *Haplopappus* och *Nicotiana*; professor H. Erdtman, Stockholm, 29.488 kr. för kemotaxonomiska studier inom barrträdsgruppen; fil. lic. G. Eriksson, Stockholm, 22.716 kr. för bestämning av mutationsfrekvensen i kornpollen; professor F. Fagerlind, Stockholm, 15.204 kr. för växtmorfologiska studier; laborator S. Florin, Uppsala, 910 kr. för fältarbeten för kompletterande material till utredning över östra Mellansveriges senkvartära nivåförändringar och vegetationsutveckling; docent Lisbeth Fries, Uppsala, 13.512 kr. för undersökning över rödalgernas näringsfysiologi under kontrollerade betingelser; professor N. Fries, Uppsala, 29.800 kr. för studier över gasformiga utsöndringsprodukter från svampar och deras fysiologiska verkningar; docent S. Fröst, Lund, 6.000 kr. för undersökning av accessoriska kromosomer, bestämning av proteinhalt hos tetraploid råg och undersökning av inavlad råg; Genetiska institutionen, Lund, 3.000 kr. för cytologiska undersökningar hos additions- och substitutionstyper av vete erhållna efter bastardering mellan råg och vete; professor Å. Gustafsson, Stockholm, 28.260 kr. för molekularbiologiska och ultrastrukturella studier av nukleinsyror hos högre växter; docent P. Halldal, Göteborg, 12.972 kr. för fotobiologiska undersökningar i ultraviolett; docent O. Hedberg, Uppsala, 12.204 kr. för cytotaxonomiska undersökningar; docent H. Hjelmqvist, Lund, 10.542 kr. för undersökning av variationer i den embryologiska utvecklingen hos vissa växtarter; docent A. Kylin, Stockholm, 15.000 kr. för undersökningar över jonupptagning och svavelomsättning i gröna vävnader och celler i relation till fosfat och fotosyntetiska faktorer; fil. lic. P. E. B. Lindahl, Uppsala, 6.000 kr. för undersökning av växters förmåga att oxidera dimetylditiokarbamat till tetrametyltiuramdisulfid; professor H. Lundegårdh, Penningby, 6.000 kr. för undersökningar över energikonverteringen i växternas fotosyntes; docent B. Lüning, Stockholm, 20.000 kr. för undersökning av alkaloiderna inom *Orchidaceae*; laborator T. Nilsson, Lund, 13.230 kr. för forskning över senkvartär vegetationshistoria i sydöstra Sverige; docent Hedda Nordenskiöld, Uppsala, 9.924 kr. för cytologiska och taxonomiska undersökningar inom släktet *Luzula*; docent B. Norén, Lund, 12.204 kr. för undersökningar över myxobakteriers näringsfysiologi och bakteriolytiska aktivitet; docent N. Nybom, Fjälkestad, 5.000 kr. för studier rörande anthocyanfärgämnena hos släktena *Rubus* och *Ribes*; docent H. Runemark, Lund, 3.500 kr. för insamling av material av släktena *Nigella* och *Allium* i södra Egeis samt 6.102 kr. för cytologisk bearbetning av botaniskt material från Grekland; professor F. Sandberg, Stockholm, 18.696 kr. för fytokemiska undersökningar av chenopodiacé-alkaloider; 1:e museiintendent R. Santesson, Uppsala, 2.975 kr. för lichenologiska studier i norra Wales och södra Skottland; docent M. Wærn, Uppsala, 25.000 kr. för studier över algvegetationen vid Sveriges kuster; fil. dr Gunhild Weimarck, Lund, 2.550 kr. för skogsvetenskapliga forskningar inom Örkeneds socken med allmänbiologisk och ekologisk inriktning; docent B. Wickberg, Stockholm, 5.000 kr. för undersökning av de högre svamparnas kemi; laborator H. Zech, Stockholm, och professor D. von Wettstein, Köpenhamn, 30.190 kr. för elektronmikroskopiska undersökningar över tobakmosaikvirus-reproduktion, samt docent G. Zetterberg, Uppsala, 15.744 kr. för svampgenetiska studier.

Från Anna och Svante Murbecks minnesfond vid Lunds universitet har fil. mag. N. Englesson erhållit 1.250 kr. för insamling av material och studier i fält i Medelhavsområdet av *semidecandrum*-gruppen av släktet *Cerastium* och fil. mag. G. Weimarck 1.250 kr. för insamling av *Hierochloë odorata* i Norge.

Lunds Botaniska Förenings stipendier. Från Lunds Botaniska Förenings jubileumsfond har utdelats 700 kr. till fil. mag. I. Värendh för resa till Spanien för insamling av material och studier i fält av släktet *Valeriana*. Ur Murbeckska fonden har fil. lic. S.-O. Falck erhållit 400 kr. för deltagande i den 7 nordiska växtfysiologiska kongressen i Helsingfors och fil. mag. L. Pålsson 400 kr. för vegetationsundersökningar på de skånska åsarna.