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Studies on Variation in Embryo Sac Development

Second Part[1]

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4. Oxybaphus nyctagineus

In his investigation of the embryology of Centrospermae ROCÉN (1927, p. 23) states that in *Oxybaphus nyctagineus* the megaspore tetrad formation as a rule takes place in a normal way through formation of 4 megaspores, but that certain deviations occur. One case is described and illustrated where the wall formation is suppressed after the first meiotic division but not after the second, so that the tetrad is made up of one binucleate cell in the middle with one uninucleate on each side, thus a tetrad of "Tridax type". In another case the wall formation is lacking not only after the first division but also after the second, at least between the upper nucleus pair; an indication of wall formation could be observed between the two lower nuclei. In spite of extensive investigative work, the author could not follow the further development of these deviating cases and so far regards them as anomalies, which however may have a certain theoretical interest.

In a later investigation of the same species COOPER (1949) has observed only the normal type of development and illustrates also tetrads with 4 megaspores, separated by walls.

In view of the different statements concerning the tetrad formation and the incomplete knowledge of the further development of the possibly occurring deviations, an investigation was made of the embryo sac formation of *Oxybaphus nyctagineus*. The aim of the investigation was also to state whether the external conditions could play some role in the development. Plants were cultivated in pots from seeds obtained

[1] The first part of the investigation was published in Botaniska Notiser 117, 1964, p. 141—166.

from Beal-Garfield Botanical Garden, East Lansing, Michigan, and placed in two greenhouses with regulated and controlled temperature, air humidity and light conditions in the Plant Physiological Institute in Lund, one with higher, the other with lower temperature. The experiment began November 19, 1964. In the cooler greenhouse the temperature was 11—15°C. in the first part of the experiment and about 13—17° in the latter, from December 7 onwards. The temperature variations were as a rule very small; the exceptionally occurring fluctuations were of very short duration. In the warmer house the temperature was about 19—22°C., with brief fluctuations up to 24—26° and down to 17 or 18°. Fixations of flower buds were made in the solution of Navashin-Karpechenko and after embedding in paraffin they were cut in the usual way and stained with hematoxylin according to Heidenhain; counterstaining was made with light-green.

General development

An investigation of the material showed that the tetrad of Tridax type, with the nuclei arranged after the scheme 1 : 2 : 1, was by far the most common. The wall formation thus as a rule is suppressed after the heterotypic division (Fig. 1 *b*), but not after the homotypic (Fig. 1 *c*), resulting in the formation of one binucleate cell in the middle and one uninucleate on either side (Fig. 1 *e*). In all 218 tetrads were observed in the two investigation series, and among these 196, thus 90 per cent, were of the Tridax type. However, observations of the further development never showed any instance of the formation of an embryo sac from the 2-nucleate cell. The embryo sac instead arose from the basal cell, as in

Fig. 1. *Oxybaphus nyctagineus*. *a* Megaspore mother cell. *b* Dyad without wall formation. *c* Tetrad formation. Wall formation after the second division but not after the first. *d* Tetrad formation. In the second division wall formation between the upper nucleus pair but not between the lower. *e* Tetrad of Tridax type. *f* 1-nucleate embryo sac, arisen from a tetrad of Tridax type, the two upper cells degenerated. *g* In a tetrad of Tridax type both 1-nucleate cells have developed into 1-nucleate embryo sacs, the 2-nucleate cell between them has degenerated. *h* Two dyad nuclei in division. No wall formation between them, but an annular swelling of the primary cell wall and an almost complete cytoplasmic separation. *i* Tetrad of the type 2 : 1 : 1, yet with a stripe in the upper cell that possibly corresponds to a degenerated wall. *j* Dyad with wall formation. *k* 4-celled tetrad. *l* In a 4-celled tetrad the basal cell has developed into a 1-nucleate embryo sac, the 3 upper have degenerated. *m* An abnormal case with a tetrad of Tridax type where there is a connection between the two upper cells. — About×1020.

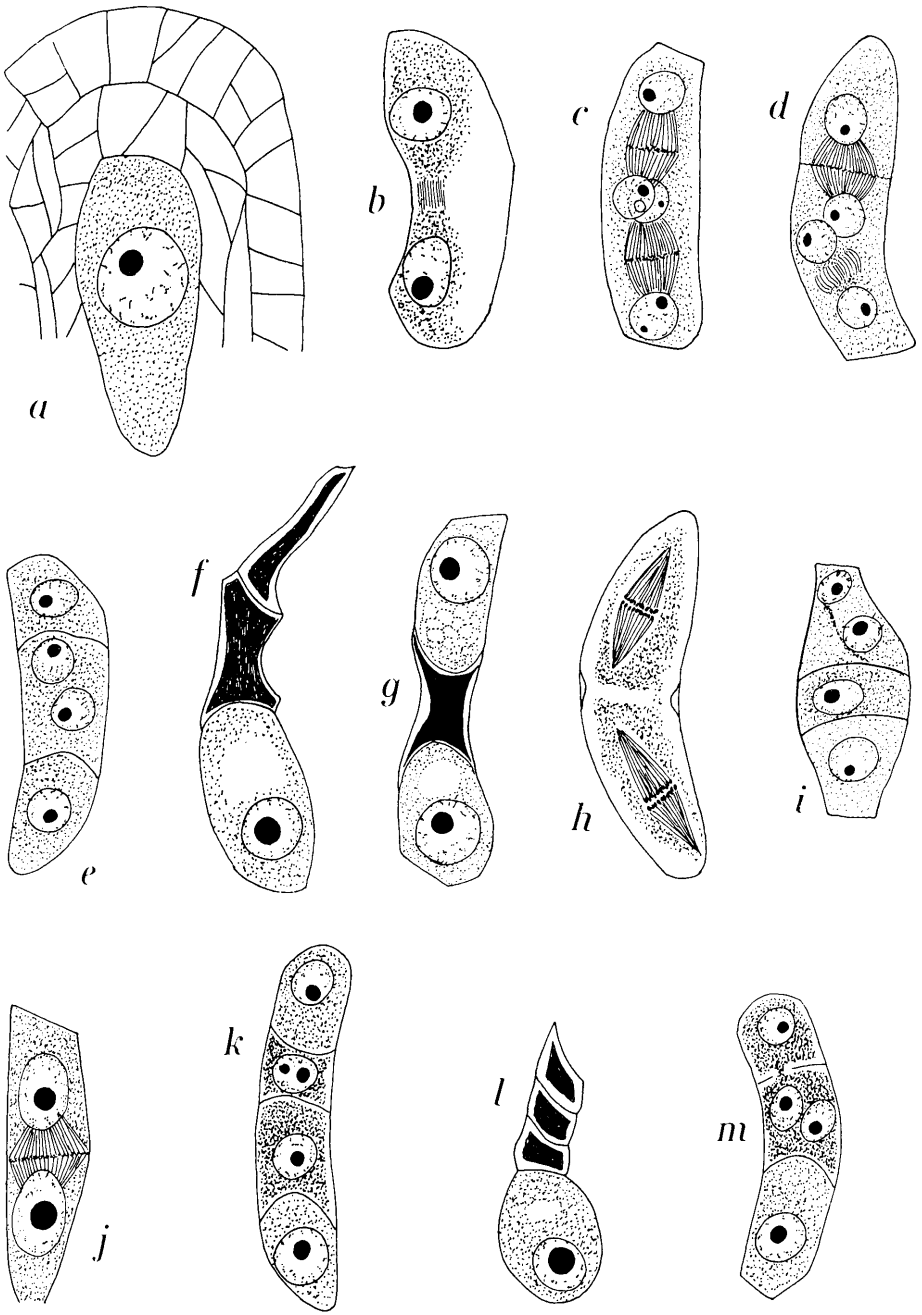

Fig. 1.

the Normal type (Fig. 1 *f*); the sole possibly occurring exception was a case (Fig. 1 *g*) where the upper 1-nucleate cell was equally vigorous as the basal cell in a later developmental stage, while the 2-nucleate central cell was quite degenerated; in this case thus there may be a chance for embryo sac formation from the upper 1-nucleate cell.

In less numerous cases there occurred under both experimental conditions tetrads with 4 separate cells, thus with the formula 1 : 1 : 1 : 1 (Fig. 1 *k*). In total 17 such cases were observed among 218 tetrads, thus about 8 per cent only. In those cases where the embryo sac had begun to develop it was stated that the basal cell formed the embryo sac (Fig. 1 *l*); the development was thus completely in agreement with the Normal type.

In some cases transitions between the two tetrad types occurred, so that an incomplete wall was formed after the first division. In two cases (both at the lower temperature) there thus was in the central cell an incision, about to the middle of the cell lumen, that divided the cytoplasm incompletely. In another case (under the same conditions) there was an almost complete interruption in the cytoplasm in the middle of the cell, but no cell membrane occurred; the wall, however, had an annular swelling in the middle of the cell (Fig. 1 *h*).

In rare cases some further tetrad types were found to occur. In two cases (at the lower temperature) thus tetrads were observed where walls had been formed after the first division, but no wall formation had taken place after the second division in the upper part of the tetrad, the result being a 2-nucleate cell above and two 1-nucleate megaspore cells below, thus with the formula 2 : 1 : 1. In one of the cases, however, there was a narrow stripe in the cytoplasm of the 2-nucleate cell which may be a degenerated wall formation (Fig. 1 *i*). In both cases the nucleus of the basal cell was bigger than the other nuclei, and consequently the development was apparently also in these cases of the monosporic type, the basal cell winning in the competition.

In one case (at the lower temperature) where the four megaspore nuclei were just formed, wall formation occurred between the two upper nuclei but not between the two lower ones (Fig. 1 *d*). In other cases, when there is a difference in time between the development in the upper and lower part, the latter is usually more advanced. Thus it seems probable that no wall would be formed between the lower nucleus pair and a tetrad of the formula 1 : 3 would arise. Possibly, however, a delayed membrane formation would take place in the lower part, so that a tetrad of the common type, 1 : 2 : 1, would be the result.

Another case (at the higher temperature) shows a tetrad that on the whole agrees with the common type, 1 : 2 : 1. However, there is a connection between the two upper cells; the wall between them is incomplete and thus there is here an intermediate type that approaches type 3 : 1 (Fig. 1 *m*). Also in this case the development is certainly monosporic, since the basal cell is largest, has the biggest nucleus, and is in vigorous growth.

With regard to the fact that the most common difference in the tetrad organization concerns the wall formation after the heterotypic division, it may also be of interest to investigate the dyads, where this wall formation may likewise be observed. In order to obtain definite proof that a wall is really lacking in a dyad, it is of course necessary to examine only stages that are comparatively advanced, so that the division is fully complete. In all, 10 cases of such dyads without wall formation were observed and in addition 16 cases where the second division was already in progress but no wall formation had taken place after the first division. Against these 26 cases were 9 where in the dyad stage or a little later a wall had been formed after the first division. The percentage of cases with wall formation thus is higher when the dyads are taken into consideration; this may partly be due to the mentioned aim to record only certain — and consequently late — stages of dyads without a wall, which may reduce the number of this type.

In two dyads (both at the cooler temperature) a transition between the two alternatives was observed: no wall had been formed between the dyad nuclei, although these were already in the next division, but there was an interruption in the cytoplasm and in one of the cases also an annular thickening around it.

The conditions at different temperatures

A comparison was made between the tetrad formation of those plants that were cultivated at the higher and the lower temperature respectively. The frequency of the different types is visible from tab. 1.

As is evident from the table, the normal tetrad formation, with 4 cells separated by walls, was more rare at the higher temperature and had a somewhat greater frequency at the lower. In the colder conditions this type occurred in 13 cases (=13 per cent of the classified cases), in the warmer in 5 cases (=4 per cent), while the tetrad of Tridax type was observed in 82 cases (=84 per cent) at the lower, 114 cases (95 per cent) at the higher temperature. The difference is even somewhat more

Table 1. Oxybaphus nyctagineus. Tetrad development at different temperatures

	Lower temperature (about 12—16°)		Higher temperature (about 19—22°)	
	Number	Per cent	Number	Per cent
Tetrads 1 : 2 : 1	82	84	114	95
Tetrads 1 : 1 : 1 : 1	13	13	5	4
Other tetrads	3	3	1	1
Total	98	100	120	100
Dyads without wall	14	64	12	92
Dyads with wall	8	36	1	8
Total	22	100	13	100
No wall after first division	97	81	127	95
Wall after first division	23	19	6	5
Total	120	100	133	100

evident, if the total number of cases where a wall has been formed after the heterotypic division is compared with those where this wall is lacking; in this case thus the dyads are also taken into consideration. In such a calculation the percentage with wall formation at the lower temperature is 19, at the higher 5, while the cases without wall formation are represented by 81 per cent at the lower and 95 per cent at the higher temperature.

It may appear astonishing that the normal and complete megaspore formation is more common at a lower temperature. In other cases — when the question was of the development of the tetrasporic embryo sac — on the contrary a simpler development was found to be more common at the lower temperature (HJELMQVIST & GRAZI 1964). It is, however, apparently possible to explain the conditions observed by a direct influence of temperature on nuclear division and cell formation, even though the explanation at present must be regarded as only a working hypothesis. The nuclear division no doubt is accelerated by the higher and delayed by the lower temperature. Since the nuclear division is a sensitive and delicate procedure, it is however reasonable to assume that it is more strongly affected than cell division and wall formation. In the unstable conditions that distinguish *Oxybaphus,* where the wall formation sometimes occurs, sometimes is lacking after the first division, it may be conceivable that in a rapid nuclear division the chances of a wall formation between the nuclei are smaller, in a slow nuclear division on the contrary greater. In the former case there is perhaps no time at all for the formation of a wall, or only an incomplete

wall formation takes place, before the beginning of the second nuclear division; in the latter case there is with the prolonged time greater possibilities for a complete wall formation. — This theory is, as will be shown later, in agreement with certain other conditions in parallel cases.

5. Mirabilis jalapa

Mirabilis jalapa has also been investigated by ROCÉN (1927) as to its embryology. This author states that the megaspore formation generally is normal, with a 4-celled tetrad, but that the wall formation sometimes is suppressed, either in the second meiotic division or in both divisions (ROCÉN, 1. c., p. 23, 25, Fig. 37 b, e). Also in this case the further development of the deviating tetrad could not be followed; in solitary cases the author, however, observed mature embryo sacs with up to 5 antipodals (1. c., p. 28, Fig. 44 b).

An investigation was undertaken of the embryo sac development of *Mirabilis jalapa* in order to obtain a more complete picture of the variations that occurred and further with the aim of studying possibly existing differences between different races and between plants cultivated under different temperature conditions.

In the autumn of 1964 fixations were made of different proveniences, cultivated in the Botanical Garden of Lund. The cultivated samples had been grown from seed obtained from different botanical gardens and it was obvious, even from their general appearance, that genetical differences were present: there were variations in flower colour between different samples (red, rose, white, and variegated), further in leaf colour (quite green or more or less yellowish green), in growth vigour etc.

The fixations were made from September 29 to October 3 and the same methods were used as in the case of *Oxybaphus*: the fixation fluid was that of Navashin-Karpechenko and staining was made with hematoxylin according to Heidenhain.

General development of the tetrad

The common condition proved to be that the megaspore tetrad was made up of 4 separate cells (Fig. 2 *a*) and thus was of normal organization. Many deviations occurred, however, as a result of suppression

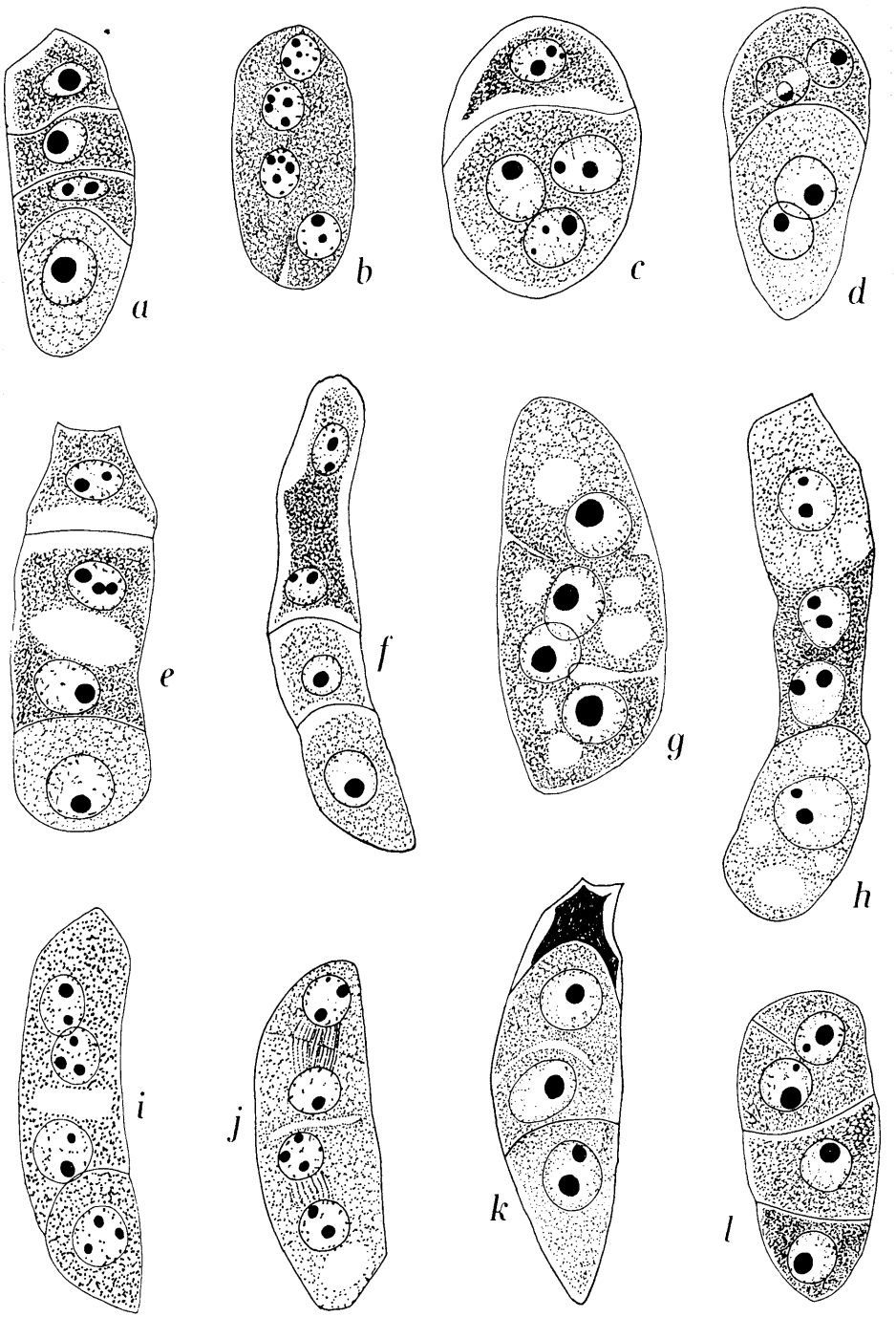

Fig. 2.

of different walls in the tetrad. In rare cases all separating walls were lacking, so that a 4-nucleate coenomegaspore arose. An instance of this is shown in Fig. 1 *b*, where, however, there is a narrow fissure in the cytoplasm in the lower part. About equally rare were the cases where the wall formation had failed to appear after the heterotypic division and after one of the homotypic ones, so that one 3-nucleate and one 1-nucleate cell were formed (Fig. 2 *c*). In other cases there was no wall formation after the first division, but after the second walls were formed in both dyad cells, a tetrad of Tridax type thus being the result (Fig. 2 *e*). In most of the deviating cases, however, a wall was laid down after the first division, whereas no wall formation occurred after the second divisions or after one of them. Fig. 2 *d* thus shows a case where two 2-nucleate cells have been formed and the development is bisporic, of Allium type: a deviation, however, is that in the upper dyad cell there is a fissure in the cytoplasm. In Fig. 2 *f* a case is illustrated where the megaspore nuclei are arranged in the position 2 : 1 : 1; after the second division a wall has been formed in the lower dyad cell but not in the upper. Often also intermediate forms between the different types were found. Besides the deviations already mentioned, the case illustrated in Fig. 2 *g* may be demonstrated as an instance which must me regarded as a tetrasporic embryo sac but where cytoplasm separations have arisen after the second division, reaching about to the middle of the cell. Fig. 2 *h*, on the other hand, shows a transition between a tetrad of Tridax type and a trisporic-monosporic development: in the second division a wall has been formed between the two lowermost nuclei, but between the two upper nuclei only an incomplete wall has arisen. Fig. 2 *i* shows another case; there is here a lacune in the cytoplasm in the middle, where the first wall should have arisen, and in the upper part there is no transversal wall at all: the tetrad type is thus in reality 3: 1. A transition between trisporic and tetrasporic development is shown in Fig. 2 *j*, where the first wall is lacking and is represented by only a separation in the

Fig. 2. *Mirabilis jalapa*. *a* Normal tetrad. *b* 4-nucleate coenomegaspore with a small fissure in the cytoplasm below. *c* Tetrad of the type 3 : 1. *d* Tetrad of the type 2 : 2, with a fissure in the cytoplasm of the upper cell. *e* Tetrad of the type 1 : 2 : 1. *f* Tetrad of the type 2 : 1 : 1. *g* 4-nucleate coenomegaspore with the cytoplasm incompletely divided at two places. *h* Tetrad of Tridax type, but with the upper wall incomplete. *i* Tetrad with a 3-nucleate and a 1-nucleate cell, the upper with a cytoplasmic separation at the middle of the tetrad. *j* Tetrad with a fissure in the cytoplasm at the middle and trace of a wall between the upper nucleus pair. *k* Tetrad of the type 1 : 2 : 1 with a cytoplasmic separation at the middle. *l* Young tetrad of the type 2 : 1 : 1 with an incomplete wall in the upper cell. — About×1020.

cytoplasm and a trace of a wall is found between the two upper megaspore nuclei. It also happens that two 1-nucleate cells are present in the upper or lower part of the tetrad, but that the two remaining nuclei are separated by only an incomplete wall (Fig. 2 *l*). And finally, also a tetrad of Tridax type may have in the middle an incomplete division in the shape of a cytoplasmic interruption (Fig. 2 *k*). All separating walls in the tetrad may thus be incompletely developed and all conceivable combinations may apparently occur between developed walls and incomplete separations.

The further development

In those cases where a normal 4-celled tetrad is formed, the basal cell develops into embryo sac, according to the Normal type. A special interest, however, is linked to the development that takes place when the tetrad has a deviating organization, especially when it is divided by incomplete partitions. In those rare cases when the tetrad has no transverse walls at all, the development is of course tetrasporic. When a tetrad with one 3-nucleate and one 1-nucleate cell occurs, the development is at least in some cases trisporic; this is thus certainly the case in the tetrad reproduced in Fig. 2 *c*. A nuclear arrangement of 2 : 2 in the tetrad of course implies a bisporic development and if two 1-nucleate and one 2-nucleate cells occur with the arrangement 2 : 1 : 1 or 1 : 1 : 2, the development may be both bi- and monosporic. An instance of a monosporic embryo sac formed from this tetrad type is shown in Fig. 2 *f*, a bisporic development is, on the other hand, seen in Fig. 3 *a*: the two basal nuclei have begun to grow out to a common bisporic embryo sac, without any interference from the weak wall trace that is found between them. The tetrad of Tridax type (1 : 2 : 1) also shows the same variation: sometimes the basal 1-nucleate cell forms the embryo sac and the binucleate cell degenerates (Fig. 2 *e*), sometimes the binucleate cell develops, as in the embryo sac shown in Fig. 3 *b*, where the two 1-nucleate cells have begun to degenerate and the middle cell grows out into embryo sac, notwithstanding the fact that an incomplete partition is present.

In Fig. 3 *c*, however, a condition is shown that probably is a stage of a development that is more clearly evident in later stages and implies that two incompletely separated cells grow out into two embryo sacs that communicate and partly fuse. The case reproduced in Fig. 3 *c* obviously is a tetrad that on the middle has been incompletely divided

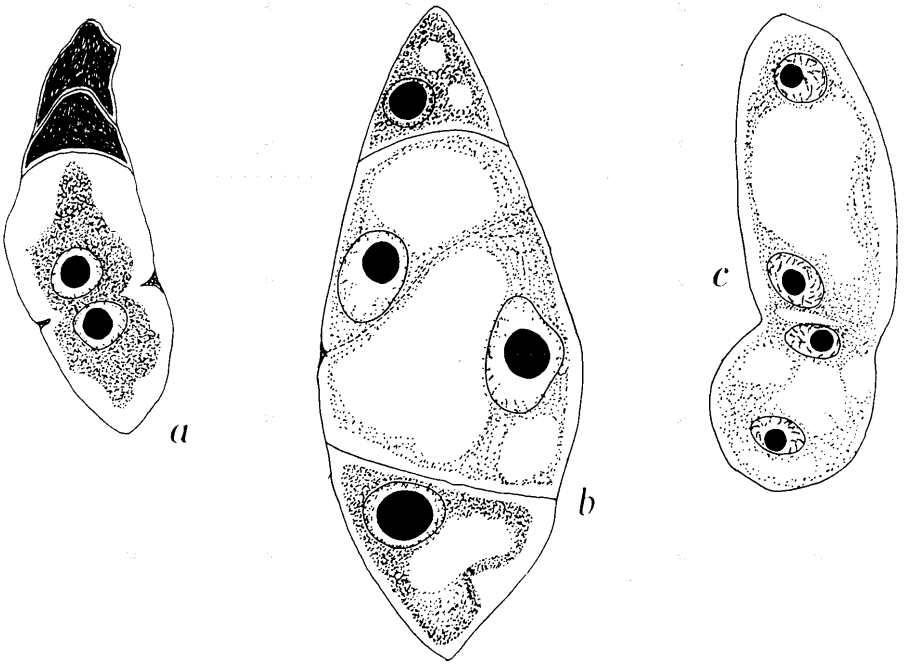

Fig. 3. *Mirabilis jalapa*. *a* 2-nucleate embryo sac arisen from the two lower tetrad cells, with an incomplete wall separation. *b* In a tetrad of Tridax type but with an incomplete wall at the middle a 2-nucleate embryo sac has developed from the middle cell, while the two 1-nucleate cells begin to degenerate. *c* A 4-nucleate coenomegaspore with incomplete separation at the middle has developed into a two-parted embryo sac. — *a*—*b*×1020, *c*×650.

into two 2-nucleate cells, each of which grows out into a bisporic embryo sac.

Later stages are represented in Figs. 4—5. Fig. 4 *a* shows a normal 8-nucleate embryo sac, the other cases illustrate a development of two embryo sacs, the one beside the other, which are united into a common structure. Fig. 4 *b* shows one 8-nucleate and one 4-nucleate embryo sac which are situated alongside each other and have fused together. The 4-nucleate embryo sac has quite small nuclei (designated with *n*) and it is uncertain whether it is going to develop further; perhaps it is beginning to degenerate. The remaining three figures show a very peculiar embryo sac formation. Two incompletely separated embryo sacs have developed from the same tetrad and both have reached the 8-nucleate stage and organized in the usual way. In the apical part,

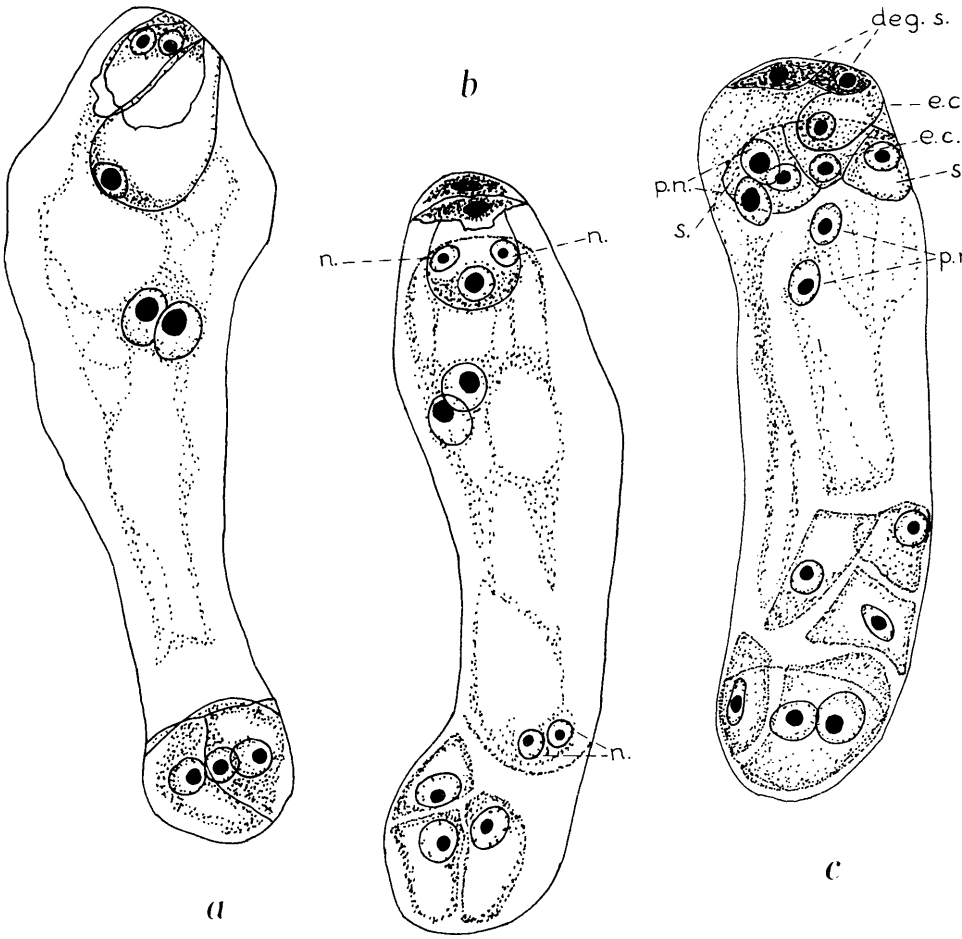

Fig. 4. *Mirabilis jalapa*. *a* Normal mature embryo sac. *b* Mature embryo sac, arisen from two through fusion, the one 8-nucleate, the other 4-nucleate, with small nuclei (*n*). *c* Mature embryo sac arisen through fusion from two. In the basal part 6 antipodals, in the upper part 2 pairs of polar nuclei (*p.n.*) and two egg apparatuses, the one quite normal with egg cell (*e.c.*) and synergids (*s.*), the other with degenerated synergids (*deg. s.*) but the egg cell not yet degenerated (*e.c.*). — About×410.

however, one of the two egg apparatuses have degenerated or is going to degenerate and only one egg apparatus is normally developed. In the basal part, on the other hand, all antipodals are present and those that belong to the two embryo sacs have joined into quite a harmonically developed antipodal group with 6 antipodal cells or with a smaller

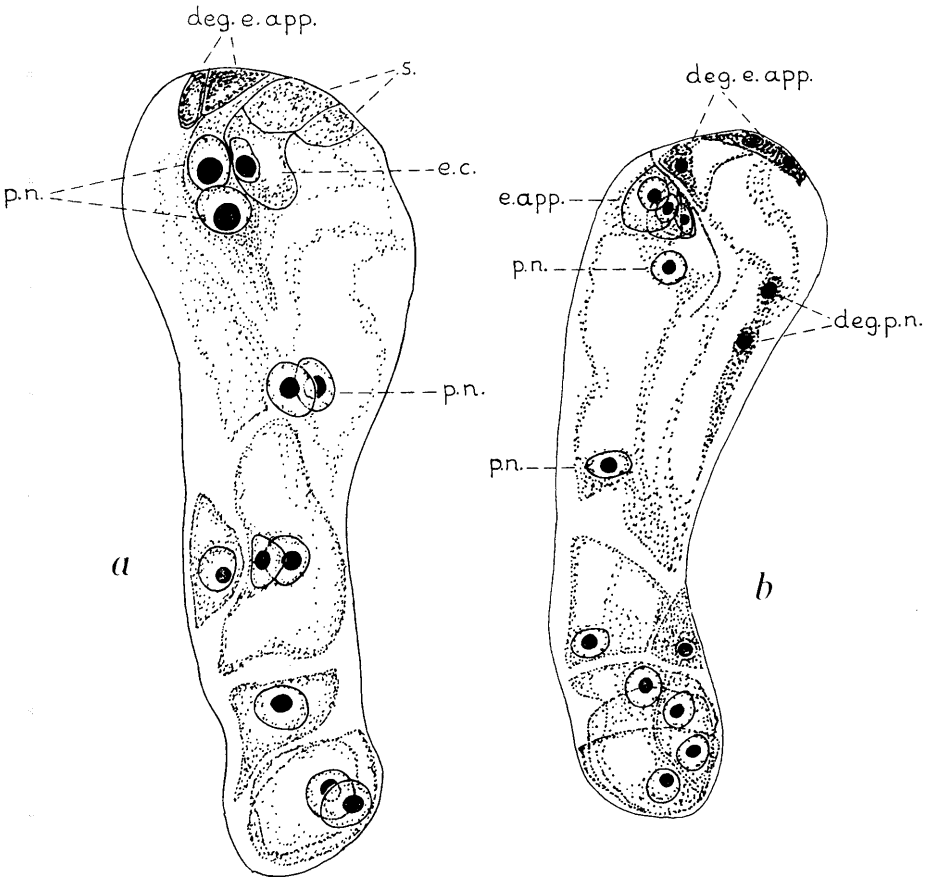

Fig. 5. *Mirabilis jalapa*. *a* Mature embryo sac, arisen through fusion of two. Above one degenerated egg apparatus (*deg. e. app.*) and one functioning (*e.c.* and *s.*). Further 2 pairs of polar nuclei (*p.n.*) and 5 antipodal cells, one of them 2-nucleate. *b* Mature embryo sac of the same kind. In the apex one functioning and one degenerating egg apparatus. 2 degenerated polar nuclei (*deg. p. n.*) and 2 normal (*p.n.*) 6 antipodals. — About×410.

number of cells with together 6 nuclei. The behaviour of the polar nuclei is somewhat varying: sometimes (Figs. 4 *c*, 5 *a*) all 4 polar nuclei (*p.n.*) are present, sometimes (Fig. 5 *b*) the two polar nuclei that belong to one of the embryo sacs have degenerated and only the other two persist. Perhaps this latter alternative is a later stage that will come about later on, even if in younger stages all 4 nuclei are present. The conditions, however, seem to show that in the fusion between two embryo sacs the

basal elements may very well join into a common unity, but that such a harmonic co-operation is impossible in the apical part, where only one egg apparatus can function.

The described peculiar development probably explains the fact, related in earlier investigations, that the antipodal number in *Mirabilis jalapa* as well as in some related species sometimes is greater than 3.

Differences in different proveniences and at different temperatures

In addition to the investigation of the general development a comparison was also made between the various proveniences that were in cultivation as to embryo sac development. A few proveniences were also cultivated in greenhouses with different temperatures and the embryo sac development was studied under the different conditions. A difficulty in such investigations is the limited number of appropriate stages: only one embryo sac is as a rule developed in a flower and there is no strict correlation between the development of flower and embryo sac, so that it is difficult to find the correct fixation time. Most of the investigated samples are on this account represented by a rather small number of cases, in spite of a large material of fixations.

In a comparison between the various samples the deviating cases were first classified according to the number of walls that had been suppressed. When only one wall was lacking, a subdivision was further made into those cases where a wall was formed after the first nuclear division and the tetrad thus formed after the formula 2 : 1 : 1 (the 2-nucleate cell above) or 1 : 1 : 2 (the 2-nucleate cell below), and secondly cases with Tridax tetrad (1 : 2 : 1), where no wall arose after the first division. In the same way the cases with two suppressed walls were subdivided into two classes: on the one hand the type 2 : 2, with wall formed after the first meiotic division, on the other type 3 : 1 (a 3-nucleate cell above) and 1 : 3 (the 3-nucleate cell below), where wall formation had failed after the first division and after one of the second ones. Finally, as a class of their own there were those cases where all walls were lacking within the tetrad and a 4-nucleate cell had arisen. When incomplete partitions occurred, no respect was paid to them in this connection: a 2-nucleate cell with incomplete partition was thus regarded as nothing more than a 2-nucleate cell.

Table 2 shows the occurrence of the different types in the investigated samples cultivated out of doors in the Botanical Garden of Lund. The

Table 2. Mirabilis jalapa. Tetrad types of different proveniences

Type	No. 1 Karlsruhe		No. 2 Poznan		No. 3 Stuttgart		No. 4 Mainz		No. 5 Graz		No. 6 Budapest	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
1 : 1 : 1 : 1 ..	19	83	54	62	14	74	21	88	19	83	30	70
2 : 1 : 1 1 : 1 : 2	2	9	9	10	—	—	3	13	1	4	5	12
1 : 2 : 1	—	—	2	2	2	11	—	—	—	—	2	5
2 : 2	1	4	11	13	—	—	—	—	3	13	1	2
3 : 1 1 : 3	—	—	6	7	1	5	—	—	—	—	3	7
4 : 0	1	4	5	6	2	11	—	—	—	—	2	5
Total	23		87		19		24		23		43	

fixations were made in the autumn of 1964, at the end of September and beginning of October.

As seen from the table, three of the samples, Nos. 1, 4, and 5 show a rather agreeing percentage of normal tetrads, 83—88 per cent. The samples 2 and 6, however, are more deviating: the former has 62 per cent normal cases against 38 per cent deviating; for the latter the corresponding figures are 70 and 30 per cent. Also in the extent of the deviations No. 2 surpasses No. 6; while in the latter the cases with 2 or 3 walls suppressed are 14 per cent, they in No. 2 amount to 26 per cent. No. 3 agrees rather closely with No. 6 in the occurrence of the different tetrad types; especially in this case, however, a reservation must be made for the small number in the sample.

Three samples of *Mirabilis jalapa* were further cultivated in greenhouses with regulated temperature for the study of the influence of temperature on the embryological development. All 3 samples were grown from seed received from the Agrobotanical Garden, Gödöllö, Hungary, and belonged to types with different flower colour. The plants were cultivated under the same conditions as *Oxybaphus nyctagineus,* on the one hand in a greenhouse with about 12—16°C., on the other in a house with about 19—22°C. (see above p. 330). The fixations were made in December 1964 and January 1965. The investigated cases were classified in the same way as in the preceding table. As "3 cells" those cases are designated that have a tetrad with 3 cells only but where owing to degeneration it was not possible to say which of the cells was 2-nucleate.

Table 3. Mirabilis jalapa. Occurrence of different tetrad types at different temperatures

	1 : 1 : 1 : 1	2 : 1 : 1 1 : 1 : 2	1 : 2 : 1	2 : 2	3 : 1	4 : 0	3 cells	Other cases
Higher temperature								
No. 41	20	8	2	—	3	—	4	1
No. 42	—	—	—	—	—	1	—	1
No. 43	24	6	1	1	—	—	1	2
Lower temperature								
No. 41	4	1	—	—	—	—	—	—
No. 42	2	1	—	—	—	—	—	—
No. 43	—	—	—	—	—	—	—	—

The percentage of deviating cases, thus, was at the higher temperature 47 in No. 41 and 31 in No. 43. At the lower temperature the deviating cases in No. 41 were only 20 per cent, but owing to the small number at this temperature the material is scarcely fit for comparison, and the same is true about the samples cultivated out of doors — at a considerably lower temperature —, as they belong to other proveniences and genetically founded differences between different proveniences no doubt exist. Even though any certain conclusions are not possible in this case, it should however be pointed out that the percentage of deviating cases at the higher temperature was considerable, in one of the cases higher than in anyone of the other investigated samples, in the other higher than in all except one. It may thus be said that the results are not contradictory to the assumption that in *Mirabilis jalapa* the same conditions exist as in *Oxybaphus nyctagineus,* viz., that the complete tetrad formation with 4 cells is more common at lower temperature; probably the conditions are here the same, so that the deviating development is favoured by higher temperature. If this is the case, the variation found between different proveniences when cultivated in the open may quite simply be due to different temperature demands of the different samples; a variation in temperature sensitivity should, if the proposed view is correct, bring about varying embryo sac formation in different proveniences.

6. Ulmus glabra

For several *Ulmus* species it has been stated that the embryo sac may develop according to two different types, the Drusa and the Adoxa type (D'AMATO 1940, WALKER 1950, also HJELMQVIST 1964). Tihs

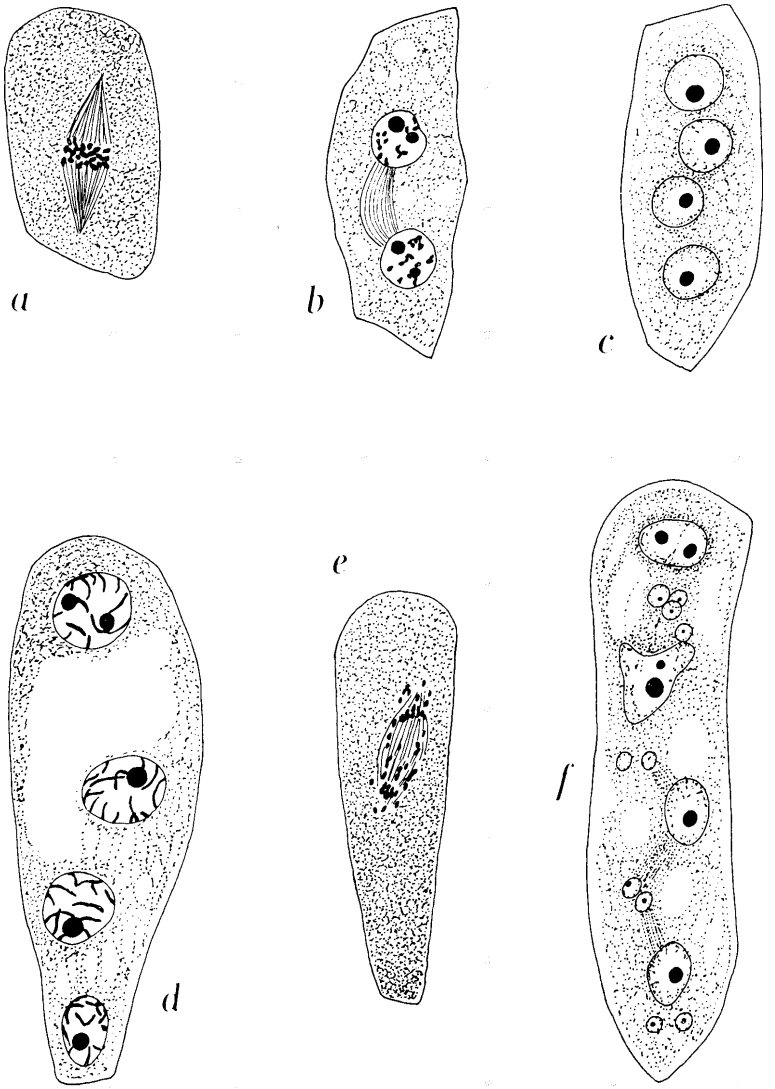

Fig. 6. *Ulmus glabra*. *a* Megaspore mother cell with the nucleus in metaphase, regular division. *b* Dyad. *c* Young tetrad. *d* Embryo sac of Drusa type, with the nuclei in 1 : 3-position. *e* Megaspore mother cell with irregular division, the chromosomes spread over the spindle. *f* Tetrad with 4 bigger nuclei and 10 micronuclei. — ×1020.

statement also has reference to a variety of *Ulmus glabra,* var. *Camperdownii,* that was investigated by WALKER (l.c.). For the main form of *Ulmus glabra,* however, EKDAHL (1941) reports only the Drusa type,

and LELIVELD (1935) has apparently also in *U. hollandica* var. *belgica* only observed this type. On this account a study was made of *U. glabra* in order to make clear whether more than one type occur here and, if this was the case, to investigate whether the occurrence of the types may be influenced by the temperature conditions, which might be thought to explain the divergent statements of earlier authors. For fixation and staining the same methods were used as in the preceding cases.

The Drusa type

Development according to the Drusa type in *Ulmus glabra* has earlier been described by EKDAHL (l.c.) and we do not have much to add to this. After the formation of the dyad and tetrad nuclei (Fig. 6 *a-c*) the nuclei take up the 1 : 3-position (Fig. 6 *d*) and then divide into 8, in the position 2 : 6 (Fig. 7 *a*). After a further division the number is 16, 4+12, if no reduction has occurred. This complete number is however rare and has by us been observed only in one case (Fig. 7 *d*); the usual condition is that division strikes and nuclear degenerations reduce the number. EKDAHL (l.c.) in his material observed that two among the basal nuclei in the 8-nucleate embryo sac did not divide further but degenerated; if they took part in the formation of the mature embryo sac at all, the nuclear number was 14; as a rule, however, it was not more than 12, as these two nuclei had degenerated. Often also further degenerations occurred, so that the number was still smaller. In our material the development was similar; only a somewhat greater variation was observed in earlier as well as in later stages. Instead of a 4-nucleate tetrad, thus, in some cases only three megaspore nuclei were observed, no doubt as a consequence of degeneration of one of the 4 nuclei. In the subsequent stage, that with normal development should consist of 2+6 nuclei, a reduction in the basal group is more common, and it may be reduced to 5, 4 (Fig. 7 *b*), or only 3 nuclei (Fig. 7 *c*). This is of course due to the fact that one or more of the megaspore nuclei have not taken part in the division. If only three nuclei are present in the basal part, it may be due to a failing division of all 3 basal megaspore nuclei, but it is perhaps more probable that there have only been three megaspore nuclei and that one of the two basal nuclei has divided, the other has not. Even when 6 nuclei occur in the basal group of the 8-nucleate embryo sac, two of these are usually smaller than the others and show signs of a beginning degeneration (Fig. 7 *a*). The

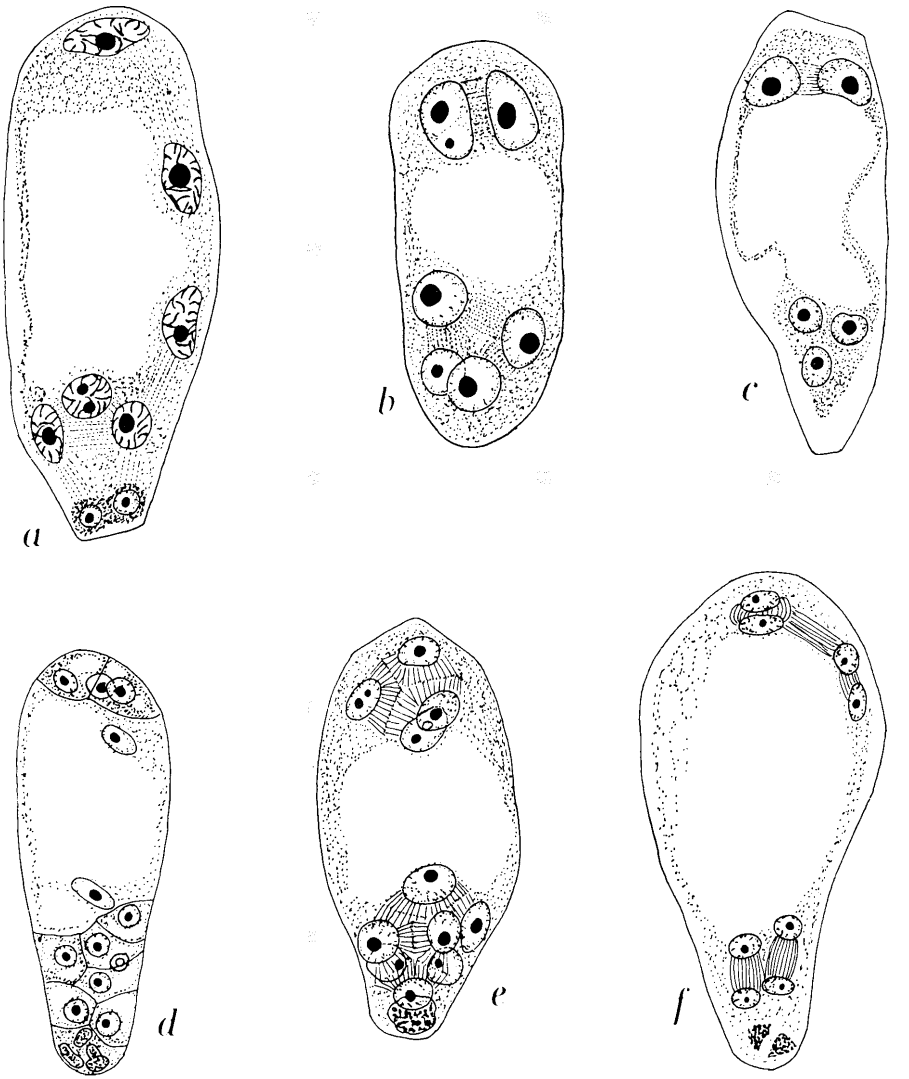

Fig. 7. *Ulmus glabra*. *a* Embryo sac of Drusa type with 2+6 nuclei. The 2 lowermost nuclei small and in beginning degeneration, the other nuclei bigger and in prophase. *b* Embryo sac with 2+4 nuclei. *c* Embryo sac with 2+3 nuclei. *d* Mature embryo sac with 4+12 nuclei, the 4 basal in degeneration. *e* Almost mature embryo sac with 4+8 nuclei, the lowermost in degeneration. *f* Embryo sac with 4+6 nuclei, 2 of the lower in strong degeneration. — *a*—*b*, *e*—*f*×1020, *c*—*d*×650.

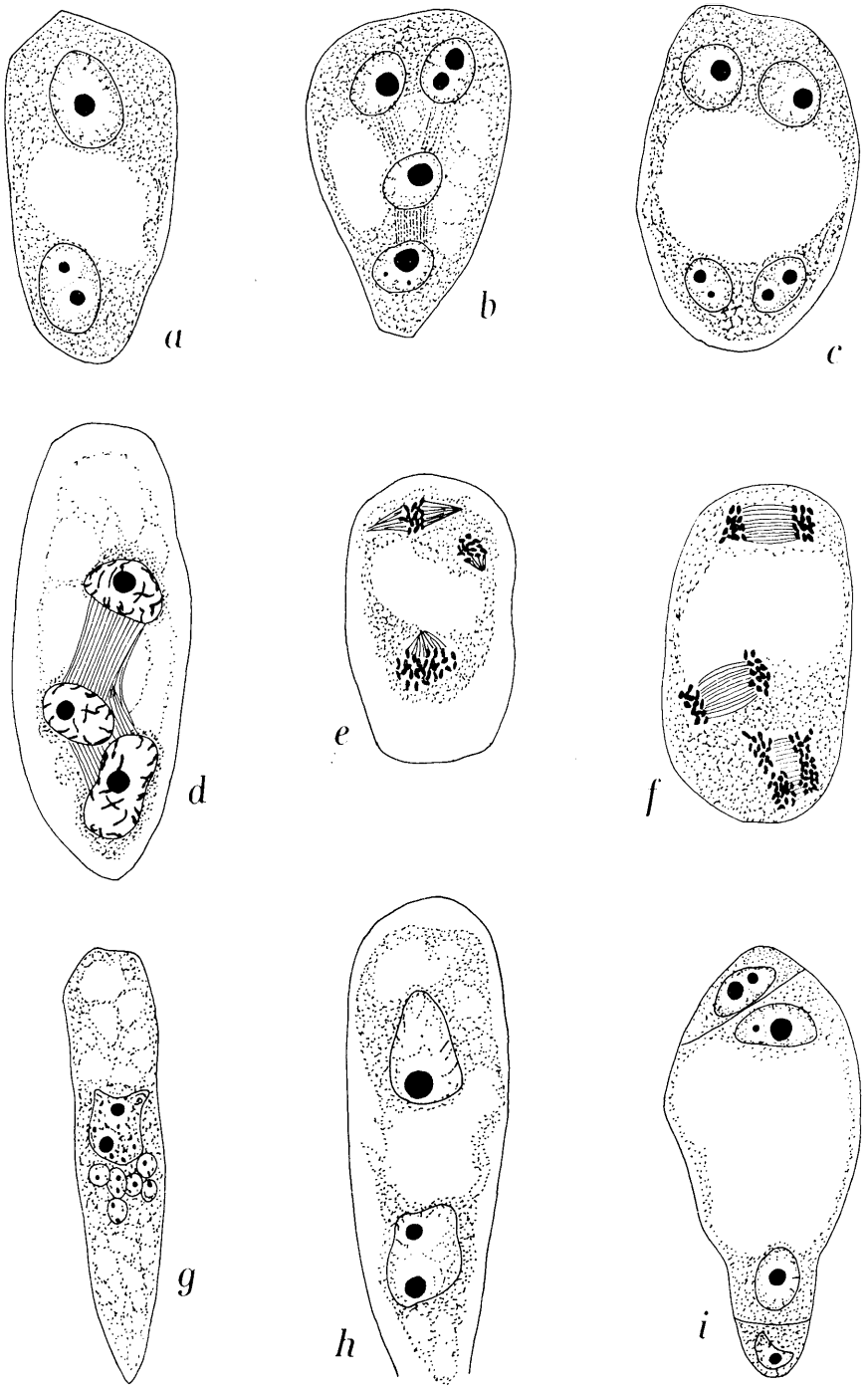

Fig. 8.

reductions in the mature embryo sac are as a rule still stronger. Even in the mentioned 16-nucleate embryo sac (Fig. 7 *d*) the 4 basal nuclei are obviously in degeneration. And in the case shown in Fig. 7 *e* the nucleus number in the embryo sac is 4+8 and among the nuclei in the basal part one, the most basal one, is in beginning degeneration. Several cases with 4+7 nuclei were further observed, as well as with 4+6 nuclei; in one of the latter two nuclei were in degeneration when the cell formation started (Fig. 7 *f*), so that the mature embryo sac would finally be only 8-nucleate and of the same appearance as the normal type, though resulting from another development. A common anomaly is the formation of micronuclei. There may be, for instance, 1—3 such nuclei at the meiosis, which later divide so that the number increases. However, the number may also be greater as in the case reproduced in Fig. 6 *f* where 10 micronuclei are present. The cause of the appearance of these micronuclei is of course irregular nuclear divisions; some chromosome material is not included in the nuclei in formation but forms small nuclei of its own.

The Adoxa type

The Drusa type was in our material of *Ulmus glabra* the dominating. Parallel to this, however, there occurred in some cases a development of Adoxa type. The first sign of this development is the migration of the two dyad nuclei to different poles of the embryo sac and the formation of a vacuole between them (Fig. 8 *a*). In the subsequent development two nuclei are formed in the upper and two in the lower part of the embryo sac, separated by the central vacuole (Fig. 8 *b*—*c*). The basal nuclei sometimes are smaller than the apical ones (Fig. 8 *c*), in agreement with the general tendency to favour the micropylar part as against the chalazal part of the embryo sac, which also could be observed in the Drusa type. Through a further division an 8-nucleate embryo sac is formed of normal appearance. However, this 8-nucleate embryo sac

Fig. 8. *Ulmus glabra*. *a* 2-nucleate embryo sac of Adoxa type. *b* 4-nucleate embryo sac with 2 nuclei at the side of each other in the upper part, 2 in the lower part. Adoxa type. *c* 4-nucleate embryo sac of Adoxa type, a little older stage. *d* 3-nucleate embryo sac with the basal nucleus bigger, certainly arisen through fusion of two. *e* 3-nucleate embryo sac with the nuclei in division, in the two upper nuclei about 14 chromosomes, in the basal about the double number. Chrys. cinerariifolium type. *f* Another case of the same type, the same division. *g* Megaspore mother cell with restitution nucleus and 6 micronuclei. *h* 2-nucleate embryo sac with big and irregular nuclei. *i* Mature embryo sac with 4 nuclei only. — *a*—*h*×1020, *i*×650.

may be difficult to recognize with certainty, as also the development of Drusa type through degeneration may result in an embryo sac of similar structure. However, if an 8-nucleate embryo sac is just in formation or has just been formed, but no degenerating nuclei are perceivable, it in all probability is a case of the Adoxa type.

Also in this type micronuclei sometimes occur: in one case there were in addition to 4 bigger nuclei, 2 above and 2 below, 2 quite small micronuclei.

The Chrysanthemum cinerariifolium type

A third type, the Chrysanthemum cinerariifolium type, was also found to occur in *Ulmus glabra* now and then. When the megaspore nuclei were in division, it could in a few cases be observed that there were three division figures, two small and one bigger (Fig. 8 *e* and *f*). The two smaller chromosome groups contained — even if no exact calculation was possible — certainly the haploid chromosome number. This number is according to earlier investigators 14, which we have had an opportunity to confirm, in megaspore mother cells as well as in pollen mother cells. The greater chromosome group had about twice the number. This group was situated at the base of the embryo sac, one of the smaller in the apex, the other between these two. The fusion between the two megaspore nuclei can obviously take place as early as in their resting stage; Fig. 8 *d* shows a coenomegaspore with three nuclei, one of which, the basal one, apparently has arisen through fusion of two. One embryo sac of this type was further observed in the 6-nucleate stage; it contained at the base two big, somewhat irregular nuclei with several nucleoli and in the same basal group, beneath the main vacuole, two smaller nuclei with one nucleolus each; in the upper part of the embryo sac the nuclei were indistinct, but there were here probably two smaller nuclei. This embryo sac type should through a further division become 12-nucleate, with 8 haploid and 4 diploid nuclei, the latter in the basal part; it is however difficult to recognize, since differences in size between the antipodals occur also when they are of the same chromosome level and reductions of the basal nuclei in both types make the antipodal number undecided.

The occurrence of diploid antipodals, as a result of a development according to the Chrys. cinerariifolium type, has a special interest with regard to the statements given by EKDAHL (l. c.) about embryo formation from antipodals in *Ulmus glabra*. He found that one or two

of the antipodals, which were big and resembled eggcells, could grow out into embryos, as big and vigorous as the embryo formed from the egg cell. When an extra embryo was formed beside the normal one, thus from a synergid, it on the contrary was considerably more weakly developed. A reasonable explanation is that such an embryo owing to its haploid nature is weakly developed and that the antipodal embryos are diploid and on this account equally vigorous as that one that is formed from the egg cell. The diploid character of some antipodals, thus, should be the explanation of the fact that from here sometimes embryos are formed with quite a normal appearance. It is here — if this explanation is correct — not a case of true apomixis, but of pseudomixis in the sense of WINKLER; a reduction division has taken place and after that a fusion between two nuclei in the embryo sac.

Special deviations

In one case a mature embryo sac was observed that had a peculiar structure, only 4 nuclei, one egg cell, two polar nuclei, and one antipodal (Fig. 8 *i*). Such an embryo sac is of the same organization as an embryo sac of the Plumbagella type, but a fusion of 3 nuclei according to the Bambacioni phenomenon, which is characteristic of the Plumbagella and Fritillaria types, has not been observed in the species, and nothing in the size of the nuclei indicates a precedent fusion. We should rather interpret this embryo sac as having arisen without reduction as a stage in a rare apomictic development. The meiosis is in *U. glabra* frequently rather irregular, the chromosomes are often irregularly spread over the spindle (Fig. 6 *e*), lagging chromosomes may occur, and micronuclei are not seldom formed. In connection with these irregularities is the fact that restitution nuclei occasionally occur. An instance of this is shown in Fig. 8 *g*, where a big irregular restitution nucleus and 6 micronuclei have been formed as a result of the first meiotic division. Fig. 8 *h* may represent a later stage in the development of the restitution nucleus: there are here two big, somewhat irregular nuclei that have migrated to the poles of the embryo sac, separated by a large vacuole. A development of unreduced embryo sacs thus does not appear impossible, and if the observed deviating embryo sac is such a one, this could explain its peculiar structure, without synergids and with only 4 nuclei. It may be pointed out that many partially apomictic grass species (BROWN & EMERY 1958) on the one hand have normal 8-nucleate embryo sacs, on the other unreduced embryo sacs which as a rule have

Table 4. Ulmus glabra. Occurrence of various embryo sac types in different temperatures

Treatment	Drusa type		Adoxa type		Chrys. cin. type		Chrys. cin. or Drusa type		Others		Cell formation	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
15—19°	62	78	14	18	1	1	1	1	—	—	1	1
26—27°	46	87	3	6	1	2	—	—	1	2	2	4

only 4 nuclei (yet with another organization than the 4-nucleate embryo sac of *Ulmus).* If the interpretation of the 4-nucleate embryo sac is correct, it should correspond to an embryo sac of the Adoxa type with one division less than normal. That the development in an embryo sac arisen from a restitution nucleus is abbreviated is rather plausible with regard to the fact that the formation of the restitution nucleus corresponds to the first meiotic division and the subsequent 2-nucleate stage may be regarded as a correspondence to the tetrad formation, with 2 diploid spore nuclei instead of 4 haploid ones. In both unreduced and reduced embryo sacs, thus, one division takes place after the spore formation.

Influence of temperature conditions

In order to study the influence of the temperature conditions on the embryo sac development an experiment was made in February 1964 with cut off branches which were put in climatic chambers with different temperatures.

The branches were taken from one tree only, cultivated in Lund, and were placed in water, one sample in a climatic chamber with 26—27°C., another in a chamber with 15—19°C. The experiment began February 20 1964. Fixations were made with short intervals; appropriate stages were obtained in the fixations from Febr. 24—26 in the higher temperature, from Febr. 26—29 in the lower. The occurrence of different embryo sac types in the two temperatures is visible from Tab. 4. Dubious cases were left out of account.

As visible from the table, the Drusa type is the dominating, with 78 and 87 per cent, respectively, of the determined cases, whereas the Adoxa type is comparatively infrequent and the Chrys. cinerariifolium type still more rare. It is however possible that some cases of mature embryo sacs that have been classified as the Drusa type belong in reality to the

Chrys. cinerariifolium type, since, as mentioned above, it is very difficult to distinguish between the two types in later stages. Thus, in a comparison it seems most correct to put these two types together; in the higher temperature the number then vill be 64, i.e. 81 per cent, in the lower 47, making 89 per cent.

In a comparison between the two temperatures the great difference as to the Adoxa type is especially conspicuous. In the lower temperature it occurs in 18 per cent of the cases, in the higher only in 6 per cent. If the Adoxa type is compared with the total number of Drusa and Chrys. cinerariifolium cases in the lower temperature the percentage is 22 (14 out of 64), in the higher 6 (3 out of 47).

Those cases which have been designated in the table as "cell formation" no doubt represent a break-down of meiosis, with formation of a cell row from the megaspore mother cell instead of an embryo sac. This development was more common in *Ulmus laevis* and will on this account have a more detailed treatment in the following chapter.

7. Ulmus laevis

An investigation of the embryo sac development was also made in *Ulmus laevis,* a species that has not been treated earlier. Material was obtained from two trees cultivated in the Botanical Garden of Lund and the investigation was performed in the beginning of the years 1964 and 1965; branches of the trees were then cut off and placed in water in greenhouses with regulated temperature. Fixation and staining methods were the same as in *U. glabra.*

The Drusa type

The development of *Ulmus laevis* was on the whole the same as in *U. glabra.* The tetrad arose without wall formation (Fig. 9 *a*); also here there were sometimes only 3 megaspore nuclei, probably owing to degeneration of one of the original 4 nuclei, a degeneration that could be observed in some case. A formation of micronuclei was also here not rare. The Drusa type was dominating: the 4 megaspore nuclei took up a 1 : 3-arrangement (Fig. 9 *b*) and after a new division the number was 2+6 (Fig. 9 *c*). Also in this stage some degeneration phenomena were observed in the basal part, or at least a less good development here; thus in one or two cases there were 4 small nuclei at the base that did

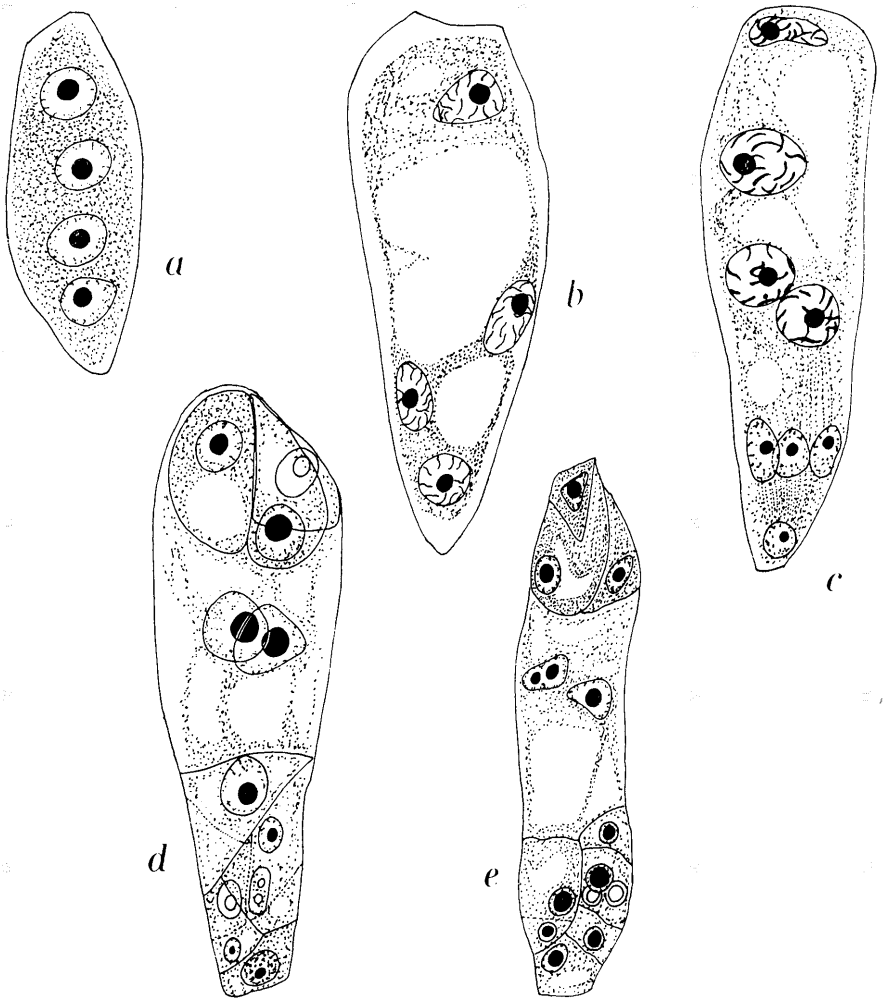

Fig. 9. *Ulmus laevis*. *a* Young tetrad. *b* The tetrad nuclei arranged in 1:3-position. Drusa type. *c* 8-nucleate embryo sac with 2+6 nuclei, the 4 lower nuclei smaller and in resting stage, the remaining larger and in prophase. *d* Mature embryo sac with 6 antipodals. *e* Embryo sac with 8 antipodals. — ×1020.

not show any signs of division, while two bigger nuclei above them as well as the two apical nuclei were in prophase of the next division (Fig. 9 *c*). If the 4 small nuclei persist in the mature embryo sac, the number of nuclei will be 12, 4+8,: however a degeneration of one of them or more may reduce the number. It was observed that the number

of antipodals could vary between 4 and 8; if the lower polar nucleus was included, the nucleus number in the lower part of the embryo sac was thus 5—9 instead of 12, as a consequence of division strikes and degenerations. Fig. 9 *d* shows an embryo sac where only 6 antipodals are present, Fig. 9 *e* an embryo sac with 8 antipodals.

Development according to the Adoxa type

As in *Ulmus glabra,* in rare cases there occurs a development according to the Adoxa type also in *U. laevis.* The total number of cases with Drusa development that were observed was 69, while the Adoxa type was stated in 5 cases only. An instance of this type is shown in Fig. 10 *a,* a 4-nucleate embryo sac with 2 nuclei above, 2 below the large central vacuole. It is here also a case of favouring of the apical part of the embryo sac in relation to the basal region; the two upper nuclei are greater and in prophase of division, whereas the basal nuclei are distinctly smaller and still in resting stage. Two excluded chromosome fragments are visible outside the nuclei; in other cases micronuclei are formed, as in the embryo sac reproduced in Fig. 10 *b,* which has two larger nuclei in the upper and two in the lower part and consequently belongs to the Adoxa type, but where there in addition is one micronucleus. Mature embryo sacs of Adoxa types no doubt also occurred; also in this species they are, however, difficult to distinguish from embryo sacs of Drusa type with strong nuclear degeneration.

The Chrysanthemum cinerariifolium type

In one or two cases also in *Ulmus laevis* a development according to the Chrysanthemum cinerariifolium type could be stated. In one of the cases the embryo sac in question was 6-nucleate (Fig. 10 *c*), with 2 nuclei in the upper part, 4 in the lower. The two upper nuclei as well as 2 of the lower ones were in division and the chromosomes were here certainly of the haploid number. One of the two remaining nuclei was in prophase to division; it was very great and contained approximately 28 chromosomes, while the other, at the base of the embryo sac, was also comparatively large, but was in resting stage, possibly going to degenerate, as often happens with the basal nuclei of *Ulmus.* In all probability this embryo sac has developed according to the Chrysanthemum cinerariifolium type. The division of the megaspores has given rise to 4 haploid and 2 diploid nuclei, most of which now undergo a

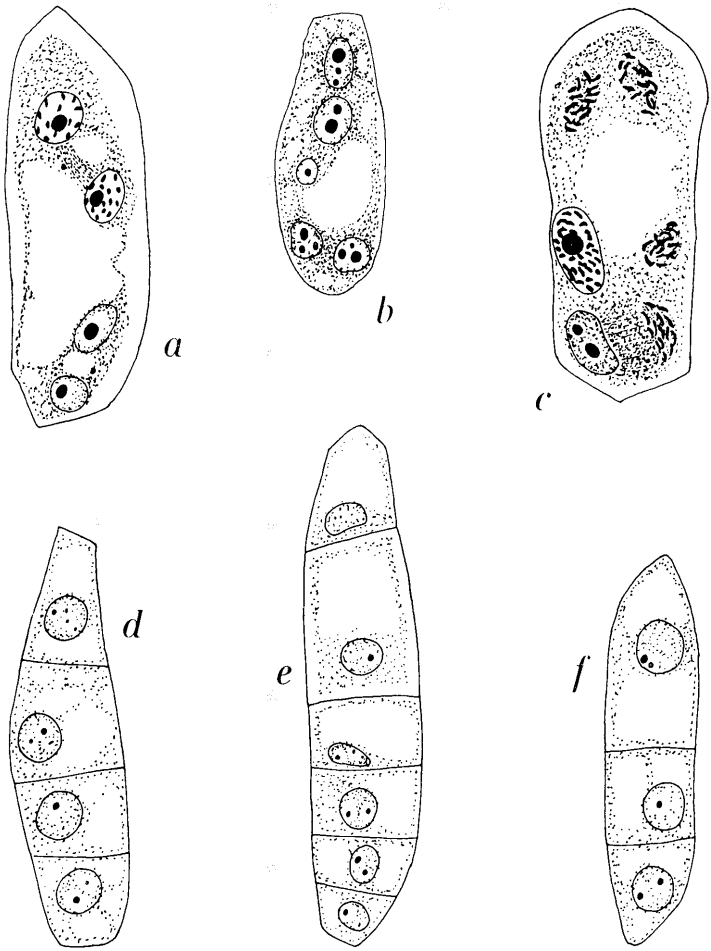

Fig. 10. *Ulmus laevis*. *a* 4-nucleate embryo sac of Adoxa type. *b* Embryo sac of Adoxa type with 4 big nuclei and one micronucleus. *c* Embryo sac of Chrys. cinerariifolium type with 6 nuclei, 4 of them in metaphase (obliquely cut), one in prophase with about 28 chromosomes, one in resting stage. *d*—*f* Cell formation from the megaspore mother cell with 4, 6, and 3 cells, respectively. — ×1020.

new division, probably giving 11 nuclei as a result. — In another case a younger stage was observed where the megaspore nuclei were just in division. There were here 3 division figures: one haploid chromosome plate in the apex, one division figure of about the same size in the middle, and a third division figure in the lower part. This basal group was seen from the side and the closely packed chromosomes were

Table 5. Ulmus laevis. Trials with different temperature.

Treatment	Drusa type	Adoxa type	Chrys. cin. type	Early stages without wall	Cell formation
30°C.	15	2	1	32	48
20°C.	40	—	1	21	28
10°C.	14	3	—	35	—

impossible to count, but apparently they were of a considerably higher number than in the two other division figures. Probably it was a case of the Chrys. cinerariifolium type, with one diploid and two haploid nuclei.

Influence of temperature

Also in the case of *Ulmus laevis* a few experiments were made concerning the influence of different temperatures on the embryo sac devevlopment. One of the trials began December 31, 1963, when twigs from two trees cultivated in the Botanical Garden of Lund were placed in two climatic chambers, one of them with a temperature of about 30°C., the other with about 20°. In the former the fixation of the flower buds was made January 7, 1964, in the other January 8—14. In the beginning of 1965 a new trial was made with twigs from the same trees that had been used in the preceding year. The trial began January 23. This time a lower temperature was used, about 10°C. The fixations were made February 6—9 and the temperature had then since January 27 been almost constant, 10—11°C. The results are evident from table 5.

As seen from the table, a comparatively great number of megaspore mother cells (designated "cell formation") had not developed in the usual way through meiosis without wall formation, but had divided through mitotic divisions, forming a row of 1-nucleate cells. Often the number of cells in such a row was 4, as in a megaspore tetrad (Fig. 10 *d*), but it could also be greater, 5—6 (Fig. 10 *e*) or smaller, only 3 (Fig. 10 *f*). As a rule the cells and nuclei that arose in this way had quite the same appearance as common somatic cells and nuclei. Obviously it was here a case of break-down of meiosis, which — in the actual conditions — was more common in *Ulmus laevis* than in *U. glabra*. In exceptional cases the nucleoli in these cells were somewhat deviating, bigger than the nucleoli of somatic cells, and in a few cases the nuclei had divided into two and the cell grown out into a structure similar to a 2-nucleate embryo sac. No further development was however observed,

and the instances mentioned should perhaps be regarded as a reminiscence of a development that was never fulfilled. From the table is clear that the break-down of meiosis occurred especially in higher temperatures. In the highest temperature, 30°, in no less than 48 cases or about half the total number, the meiosis was replaced by common cell divisions. In a temperature of 20° the number was lower, 28 of 90, thus 31 per cent, and in the lowest temperature, 10°, no such cases were observed.

As to the relation between the different embryo sac types it is firstly evident that the Drusa type was also here considerably more common than the Adoxa type. In the intermediate temperature, 20°, as a matter of fact no case at all of Adoxa type was observed, whereas 40 cases of development of Drusa type occurred. In the lower temperature, 10°, however, the Adoxa type appeared in 3 cases against 14 for the Drusa type, in agreement with the conditions stated for *Ulmus glabra* that the Adoxa type is favoured by lower temperature. Also in the highest temperature, 30°, there were however two cases of the Adoxa type, against altogether 16 of Drusa and Chrys. cinerariifolium type. It is possible that a high temperature that is above the optimal conditions to some extent may also favour the Adoxa type.

Discussion

The theory that was used to explain the variations in *Oxybaphus nyctagineus* may also be applied to the conditions in *Ulmus*. We should thus explain the varying frequency of the Drusa and Adoxa types at different temperatures with the balance that is present between the nuclear division on the one hand and the cell growth on the other. Our theory is that the nuclear division as a more sensitive process is more strongly affected by a change in temperature than the cell growth and the vacuolization associated with this. At low temperature the nuclear division is on this account delayed in relation to the cell growth and in a megaspore mother cell of *Ulmus* it comparatively often occurs that after the formation of the dyad nuclei the cell already is so large that a central vacuole is formed; with that a development according to the Adoxa type is decided. At higher temperature the nucleus divides rather rapidly in relation to the cell growth and the 4-nucleate stage has then in numerous cases been reached before vacuolization takes place; consequently the nuclei can without interference take up the 1 : 3-position and the Drusa (or Chrys. cinerariifolium) type may arise. It is possible that in very high temperature the nuclear division is again

delayed in relation to the cell growth and the Adoxa type on this account has a greater frequency.

This theory may apparently also be applied to other genera with varying embryo sac development, as *Tamarix*. In *Tamarix* the Plumbagella type also occurs and especially in *T. parviflora* it showed a considerable increase at lower temperature. This may be explained by a delay of the nuclear divisions in relation to the growth of the embryo sac, implying a tendency to cell formation even at the (secondary) 4-nucleate stage. In any case the variation in embryo sac formation should certainly not be explained by a capacity of the plant to choose at lower temperature a simpler development; the plant does not reflect and choose the one or the other way of development. A direct influence of external conditions must instead be the deciding factor for the development and an assumption about different sensitivity of the nuclear division and the cell growth appears to give a reasonable explanation of the variations.

Summary

In *Oxybaphus nyctagineus* the megaspore tetrad usually consists of one 2-nucleate cell in the middle and one 1-nucleate on either side. The 2-nucleate cell, however, never devlops further, but the development is monosporic. In less numerous cases a tetrad was also found that was made up of four 1-nucleate cells. A comparison between the development in two different temperatures showed that the normal, 4-celled tetrad was more common in the lower temperature.

In *Mirabilis jalapa* the tetrad is in most cases formed according to the normal type, but numerous deviations occur, distinguished by the suppression of one or more of the transversal walls. The development may be mono-, bi-, tri-, or tetrasporic. Incomplete partitions often occur and the mature embryo sac may then sometimes be formed by fusion of two embryo sacs and have 6 antipodal nuclei, and 4 polar nuclei, but only one functioning egg apparatus, the second having degenerated. A certain difference in the occurrence of deviations was found between different proveniences and also in this species there is probably an increase of the deviating types at higher temperatures.

In *Ulmus glabra* the Drusa type is dominating but the Adoxa type sometimes occurs and the Chrysanthemum cinerariifolium type was found in some cases. When the latter type occurs, a formation of diploid antipodal embryos may be thought to occur. Degeneration of nuclei is common, especially in the basal part of the embryo sac, and the occurrence of micronuclei is not rare. In one case a 4-nucleate embryo sac was observed that was assumed to have arisen without reduction as a link in an apomictic development. A comparison of the development at two different temperatures showed that the Adoxa type was more rare in the higher temperature.

In *Ulmus laevis* the conditions are, broadly spoken, the same as in *U. glabra*. The same embryo sac types occurred here and the Adoxa type was also here rare: it was totally absent in a trial with about 20° temperature and occurred in a few cases in a lower as well as in a higher temperature.

In both *Ulmus* species a break-down of meiosis was observed in a number of cases. This phenomenon was more common in *Ulmus laevis* and occurred there especially at higher temperatures.

The variation between different types of embryo sac development in the same species and even individual can perhaps be due to changes in the balance between nuclear division and cell growth.

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Floran i Stoby socken

Ormbunkar och fröväxter

AV ALF OREDSSON

Botaniska museet, Lund

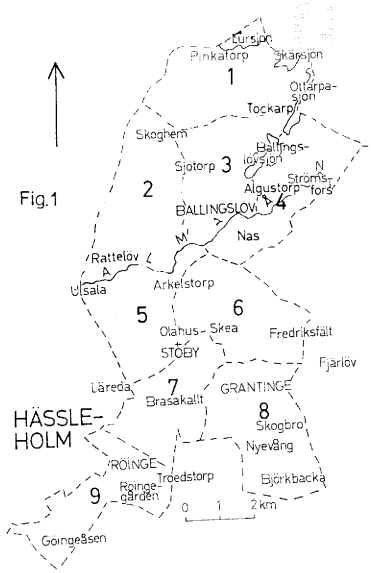
Inventering

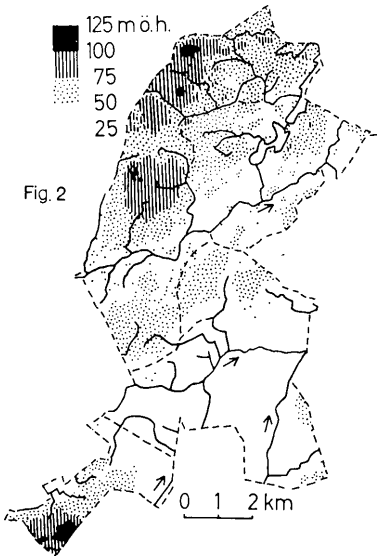
Floran i Stoby socken inventerades 1952—56 av en grupp ungdomar från socknen, bestående av ÅKE LÖNN, THORSTEN PERSSON, ÅKE PERSSON, KURT SVENSSON, ROLF WITTSTRÖM och förf. Den del av socknen som ligger söder om järnvägen Hässleholm—Kristianstad (sekt. 9) ingick i H. WEIMARCKS undersökning av flora och vegetation i Nävlingeåsområdet 1942. Ett 20-tal botanister har vid enstaka tillfällen fört anteckningar i Stoby socken, flitigast F. HÅRD AV SEGERSTAD 1920. Från Ballingslöv har åtskilliga lokaler meddelats av en ortsbo, NILS KARLSSON (†).

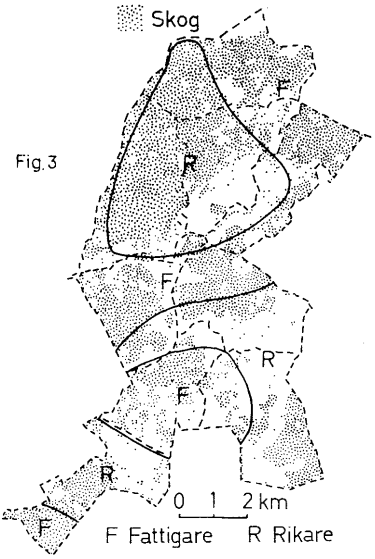
Geografi

Stoby socken är belägen i det inre av nordöstra Skåne. Från en punkt 4 km S Hässleholm sträcker sig socknen 17 km åt NNO till Lursjön. Ytan är 73 km², sedan staden 1942 inkorporerat 13 km² mellan Finjasjön och Ljungdala mosse. Almaån, som avvattnar Finjasjön till Helga å, ringlar i ostnordostlig riktning genom socknen. I norra delen av Stoby socken finns 4 större sjöar. De ligger i rad på kortare inbördes avstånd än 1 km. Tre av dem delas med grannsocknar. Två järnvägslinjer passerar genom Stoby, nämligen Malmö—Stockholm med 10 km och Hässleholm—Kristianstad med 2,5 km. Socknen har indelats i 9 sektioner. Fig. 1 och 10.

Lägst höjd över havet har bäcken mellan sekt. 6 och 8 med 27 m. Lägre än 50 m ligger drygt hälften av socknens yta. Av återstoden når större delen ej 75 m. Sålunda är endast 1/10 av socknens yta belägen







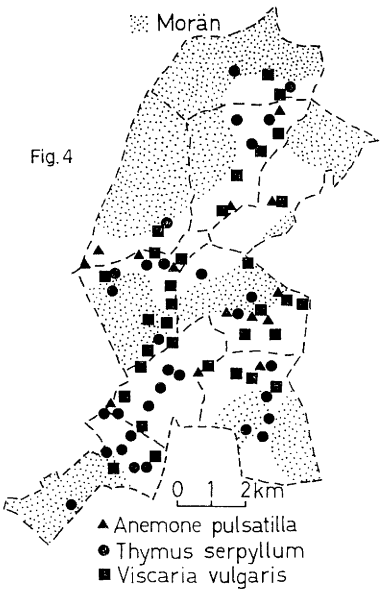


Fig. 1. Stoby socken, indelad i 9 sektioner.
Fig. 2. Höjdförhållanden. Vattendrag.
Fig. 3. Skog. Områden med fattigare, resp. rikare vegetation.
Fig. 4. Områden med nästan enbart morän, med smärre insprängda torvpartier. Några arter som växer på torra, öppna platser, vanligen på sand eller rullsten.

mellan 75 och 100 m ö.h., medan knappt 1 km^2 överstiger 100 m. Högst når en punkt på Göingeåsen i södra sekt. 9 med c. 120 m. Fig. 2.

På över 50 meters höjd finns nästan enbart morän, med smärre insprängda torvpartier. Skogen, som täcker omkring hälften av socknens yta, växer huvudsakligen på morän. *Fagus sylvatica* är det dominerande trädslaget i sekt. 1, 2 och 3, samt på Göingeåsen. I övrigt förekommer mest blandskog med *Betula verrucosa, Pinus sylvestris* och *Quercus robur*. Planterad eller självsådd *Picea abies* är vanlig. Fig. 3 och 4.

Lägre områden täcks huvudsakligen av sand och torv. Rullsten finns i ett åssystem från Röinge till Ballingslövsjön, i ett kortare åssystem i Rättelöv, samt mellan dem i sekt. 5. På torra, öppna platser, vanligen på sand eller rullsten, förekommer över hela socknen *Anemone pulsatilla, Filago minima, Jasione montana, Teesdalia nudicaulis, Thymus serpyllum, Veronica verna* och *Viscaria vulgaris*. Fig. 4.

Hornbländegnejs går i dagen flerstädes i sekt. 1, 2 och 3, samt i södra sekt. 9. Inom både det större området i nordväst och det mindre i söder finns *Carex elongata* i många av kärren. I övrigt är arten känd från 3 lokaler. *Asplenium trichomanes, Cardamine hirsuta* och *Carex digitata* är i det närmaste begränsade till nämnda nordvästra område och är där ganska vanliga. Fig. 5.

Med avseende på vegetationen kan socknen indelas i 4 fattigare och 3 rikare områden. Ett underjordiskt kalkbrott finns i det södra rikare området, vid Röinge. Smärre kalktag förekommer både i det mellersta och det norra rikare området. Fig. 3.

Fattigare vegetation

Hedskog är förhärskande. Vanliga i socknen och karaktäristiska för urbergsbygder är *Equisetum sylvaticum, Lycopodium annotinum, Phegopteris polypodioides, Pteridium aquilinum, Ramischia secunda, Trientalis europaea, Vaccinium myrtillus* och *V. vitis-idaea*. *Goodyera repens* har påträffats i Arkelstorp, *Listera cordata* i Arkelstorp och Algustorp, *Lycopodium clavatum* i sekt. 1, 2, 4, 6 och 9, *Moneses uniflora* vid Pinkatorp. *Quercus petraea* är vanlig längst i nordost.

På hedar i fattigare områden förekommer flerstädes *Antennaria dioica, Arctostaphylos uva-ursi, Arnica montana* och *Hypochoeris maculata*.

Fukthed, vanligen använd som betesmark, finns huvudsakligen i fattigare delar av sekt. 5, 6, 7 och 8. I dessa sektioner har *Erica tetralix* noterats på 14 lokaler, i övriga sektioner på 4, *Juncus squarrosus* på 3

Fig. 5

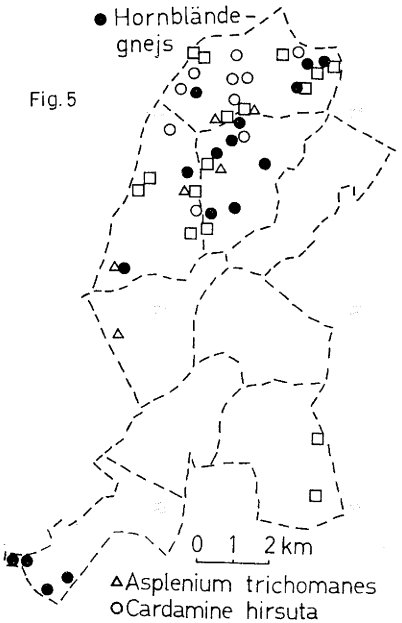


Fig. 6

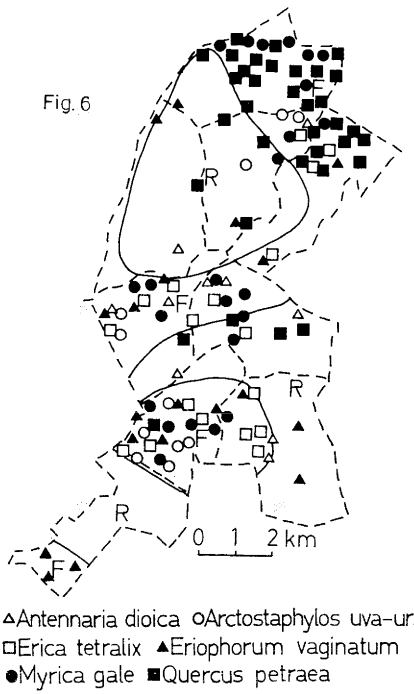


Fig. 7

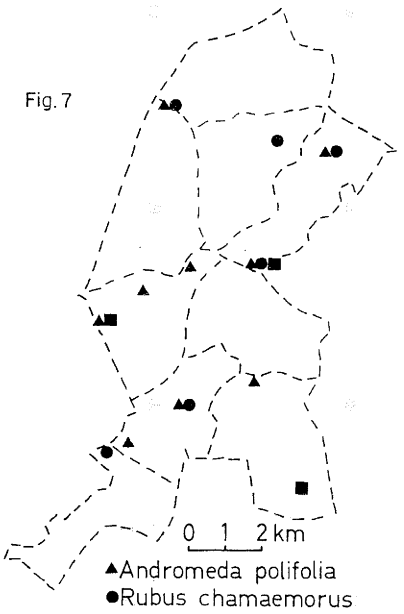


Fig. 8

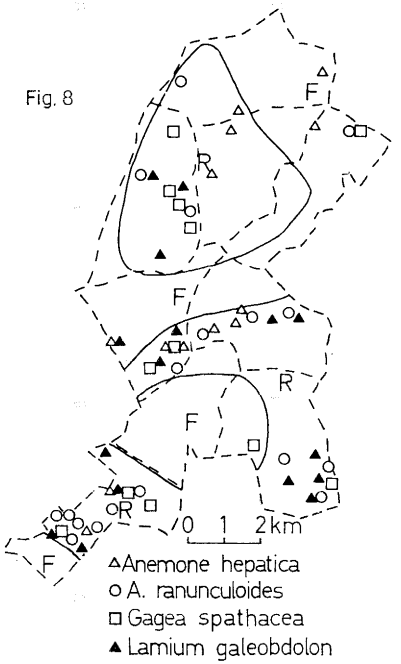


Fig. 5—8.

resp. 1, *Pedicularis sylvatica* på 4 resp. 2, samt *Vaccinium uliginosum* på 20 resp. 8.

Dikning och torvtäkt har förekommit på alla större och de flesta mindre mossar. På Näs mosse, bäst bevarad av de större, domineras planet av *Calluna vulgaris, Empetrum nigrum* och *Eriophorum vaginatum,* med inslag av *Andromeda polifolia, Betula verrucosa, Erica tetralix, Pinus sylvestris, Rubus chamaemorus, Trichophorum caespitosum* ssp. *caespitosum* m.fl. I torvgravarna växer, förutom mera triviala arter, *Drosera intermedia, D. rotundifolia, Ledum palustre, Oxycoccus palustris* och *Rhynchospora alba.*

Fattigkärren, gärna i anslutning till fukthed eller mosse, närmar sig oftast magra typer av rikkärr. Mest utpräglat är ett fattigkärr, till en del övergående i mosse, beläget NV Brasakallt. Här förekommer *Andromeda polifolia, Betula pubescens, Calluna vulgaris, Carex canescens, C. diandra, C. limosa, C. nigra, C. rostrata, Deschampsia flexuosa, Drosera intermedia, D. rotundifolia, Dryopteris spinulosa, Erica tetralix, Eriophorum angustifolium, E. vaginatum, Equisetum fluviatile, Ledum palustre, Menyanthes trifoliata, Oxycoccus palustris, Peucedanum palustre, Pinus sylvestris, Potentilla erecta, P. palustris, Rhynchospora alba, Rubus chamaemorus, Salix aurita, Vaccinium uliginosum* och *V. vitis-idaea.*

Osmunda regalis växer i Almaån vid Algustorp och Strömsfors, samt i en bäck 1 km NV Tockarp, *Potamogeton alpinus* i samma bäck mellan Pinkatorp och Tockarp, *P. polygonifolius* 1 km SV Ballingslöv, Ö Sjötorp och 1,5 km NNO Strömsfors, *Sparganium glomeratum* NNO Skoghem och 1 km NNV Skoghem. Samtliga lokaler för dessa 4 arter är sålunda belägna i norra hälften av socknen. *Calla palustris* förekommer inom samtliga fattigare områden, men har endast i sekt. 1 observerats inom ett rikare.

Lursjön (55 m ö.h.) är socknens enda växtplats för *Sparganium Friesii.* I Lursjön och Skärsjön (51 m) är *Lobelia dortmanna* vanlig, medan arten i Ottarpasjön och Ballingslövsjön (båda 41 m) påträffats på 3 lokaler. *Carex elata,* som föredrar näringsrikt vatten, förekommer flerstädes i de båda lägre sjöarna, men saknas i Lursjön och Skärsjön.

Arter karaktäristiska för den fattigare vegetationen har karterats på fig. 6 och 7.

Fig. 5. Hornbländegnejs. Arter som i det närmaste är begränsade till det större, nordvästra området med denna bergart och där är ganska vanliga.
Fig. 6. Några arter karaktäristiska för den fattigare vegetationen.
Fig. 7. Några arter begränsade till torvmossar.
Fig. 8. Ängsskogsarter.

Fig. 9

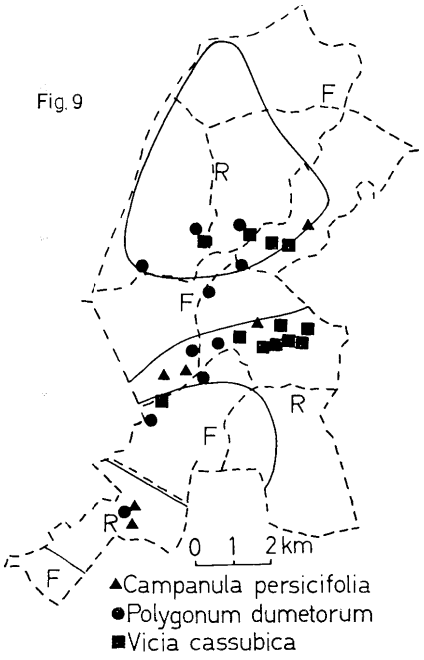


Fig. 10

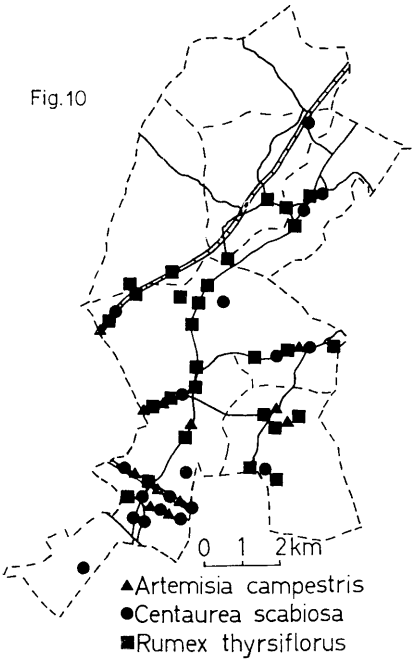


Fig. 11

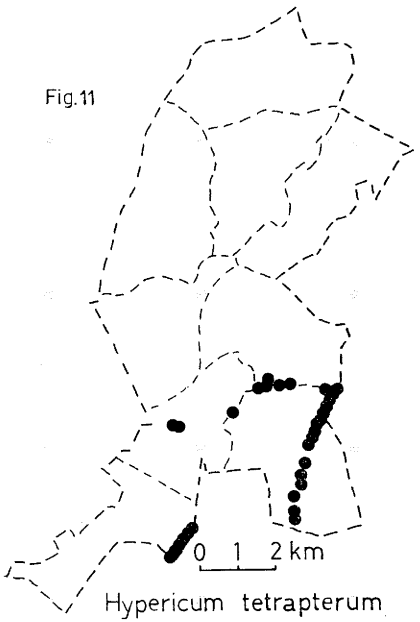


Fig. 12

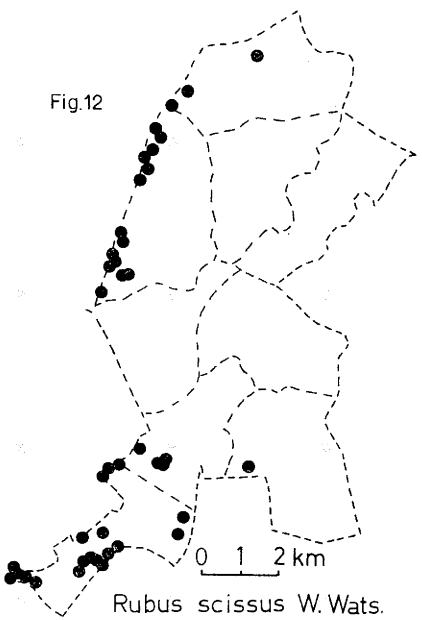


Fig. 9—12.

Rikare vegetation

Lövbackarna NV Röingegården har socknens rikaste lundvegetation. Här förekommer, tillsammans med trivialare arter, *Acer platanoides, Adoxa moschatellina, Alliaria petiolata, Allium oleraceum, Anemone hepatica, Arctium vulgare, Campanula persicifolia, C. trachelium, Corydalis fabacea, Crataegus monogyna, Cuscuta europaea, Fraxinus excelsior, Euonymus europaeus, Gagea lutea, G. spathacea, Geranium sanguineum, G. sylvaticum, Lamium galeobdolon, Melampyrum nemorosum, Melica nutans, Milium effusum, Paris quadrifolia, Polygonatum multiflorum, P. odoratum, P. verticillatum, Polygonum dumetorum, Primula veris, Ranunculus ficaria, Rhamnus cathartica, Stachys sylvatica, Satureja vulgaris, Ulmus glabra, Valeriana officinalis, V. sambucifolia* och *Viola odorata.* Av dessa är *Alliaria petiolata, Melampyrum nemorosum* och *Milium effusum* begränsade till denna lokal. 1 km OSO Röingegården finns socknens enda lokal för *Orchis mascula.*

I det mellersta rikare området förekommer i ängsskogsfragment *Adoxa moschatellina,* V Olahus, *Agropyron caninum,* N Skogbro och S Nyevång, *Allium oleraceum,* V Olahus, VNV Fredriksfält och N Skogbro, *Campanula trachelium,* SV kyrkan och V Olahus, *Lathyrus niger,* V Olahus, samt *Mercurialis perennis,* SV kyrkan, 1 km NV Fredriksfält och VNV Björkbacka. Ingen av dessa arter har påträffats i det norra rikare området, medan 3 iakttagits i det södra.

Huvudsakligen inom de rikare områdena förekommer i ängsskogspartier *Anemone hepatica, A. ranunculoides, Carpinus betulus, Corydalis fabacea, Gagea lutea, G. spathacea, Lamium galeobdolon, Melica nutans, Primula veris, Ranunculus ficaria* och *Stachys sylvatica.* Fig. 8.

På torrängar, ofta i anslutning till ängsskog, växer flerstädes *Campanula persicifolia, Filipendula vulgaris, Polygonum dumetorum, Saxifraga granulata, Turritis glabra, Veronica spicata* och *Vicia cassubica. Geranium sanguineum* finns i östra sekt. 9 och på rullstensåsar från Läreda till Näs. Fig. 9.

Av arter som är sällsynta eller saknas i urbergsbygder må nämnas *Agrimonia odorata,* vid Skogbro, *Helianthemum chamaecistus* ssp.

Fig. 9. Några arter som växer på torrängar, ofta i anslutning till ängsskog.

Fig. 10. Allmänna vägar och järnvägar. Arter som mest förekommer utmed dem och som i Skåne är allmänna i kalktrakter och sällsynta i urbergsbygder.

Fig. 11. I bäckar i södra hälften av socknen har denna art, karaktäristisk för skånska extremrikkärr, sina västligaste lokaler i anslutning till kristianstadskritan.

Fig. 12. Denna atlantiska art (i Sverige tidigare felaktigt benämnd *R. fissus*) har i socknen en del av sin skånska östgräns.

hirsutum, i Arkelstorp och 1 km ONO Brasakallt, *Helictotrichon pratense,* SV kyrkan och 1 km ONO Brasakallt, *Hypericum montanum,* 1 km SSV Ballingslöv, *Melampyrum cristatum,* V Näs, *Saxifraga tridactylites,* NV Röingegården, samt *Silene nutans,* Ö Röingegården och 1 km NV Röinge. Samtliga lokaler för dessa 7 arter är belägna söder om Almaån.

Mest utmed större vägar, men även vid järnvägarna, i grustag och på andra torra ställen, växer 3 arter som alla är allmänna i kalktrakter men sällsynta i urbergsbygder, nämligen *Artemisia campestris, Centaurea scabiosa* och *Rumex thyrsiflorus.* Fig. 10.

Mellan Ulsala och Ottarpasjön har utmed järnvägen påträffats 21 arter, vilka eljest saknas. Tretton av dem har endast observerats på en utfyllnad S Ulsala, nämligen *Bromus inermis, Carduus acanthoides, Carex arenaria, C. flacca, Diplotaxis muralis, Geranium columbinum, G. pyrenaicum, Medicago falcata, Melilotus albus, Ononis repens, Potentilla reptans, Scabiosa columbaria* och *Trifolium spadiceum.* På enstaka lokaler spridda utmed järnvägen har iakttagits *Bunias orientalis, Carex disticha, Chaenorrhinum minus, Diplotaxis tenuifolia, Euphrasia micrantha, Lepidium densiflorum, Salvia pratensis* och *Senecio viscosus.*

Förhärskande är magra typer av rikkärr. *Epilobium parviflorum* förekommer endast i de rikaste och saknas i norra hälften av socknen. Arten har påträffats NNV Röingegården, i bäcken S Troedstorp, V kyrkan, NNO kyrkan, S Skea, 1 km NV Fredriksfält, i en bäck 1 km S Fredriksfält, samt flerstädes utmed Skogbroån.

Av forna ängsmarker, vilka nästan undantagslöst blivit åker, finns rester kvar kring vissa rikkärr. *Trollius europaeus* är funnen på 7 lokaler, alla i socknens södra hälft.

Veronica beccabunga finns på åtskilliga ställen utmed bäckar i det södra och i det mellersta rikare området, men endast på ett fåtal lokaler i angränsande fattigare områden. Arten förekommer dessutom i sekt. 1 och norra sekt. 4.

Skogbroån, som rinner norrut genom sekt. 8 på 29—27 m ö.h., har rikast vegetation av socknens bäckar. Tillflöden kommer från Röinge, Gulastorp, Ignaberga och Sjunkaröd. Bäcken löper ut i Almaån vid Fjärlöv. De vanligaste arterna utmed Skogbroån är *Achillea ptarmica, Alisma plantago-aquatica, Angelica sylvestris, Carex acutiformis, Centaurea jacea, Cirsium oleraceum, Eupatorium cannabinum, Filipendula ulmaria, Glyceria fluitans, Hypericum maculatum, H. perforatum,*

Lathyrus pratensis, Linaria vulgaris, Lysimachia vulgaris, Lythrum salicaria, Mentha arvensis, Myosotis palustris, Myriophyllum alterniflorum, Phalaris arundinacea, Rhinanthus serotinus, Rumex crispus, Scirpus silvaticus, Scrophularia nodosa, Sparganium simplex, Valeriana sambucifolia och *Veronica anagallis-aquatica.* Vidare växer i Skogbroån, förutom ett drygt 50-tal mera triviala arter, *Carex riparia, Epilobium hirsutum, E. parviflorum, E. roseum, Hypericum tetrapterum, Lemna trisulca, Mentha aquatica, Poa palustris, Rorippa islandica, R. sylvestris, Sium latifolium, Solanum dulcamara, Sparganium erectum, Thalictrum flavum* och *Veronica beccabunga. Carex riparia, Lemna trisulca* och *Rorippa sylvestris* har endast iakttagits i denna bäck.

Av arter helt eller i det närmaste begränsade till kalktrakter förekommer, förutom i Skogbroån, *Cirsium oleraceum* i bäcken S Troedstorp, *Epilobium hirsutum* i bäcken S Troedstorp, i en bäck N Röinge och 1 km ONO Röinge, samt i ett kärr NNO kyrkan, *E. roseum* i bäcken S Troedstorp, vid Brasakallt och 1 km SV Fredriksfält, *Hypericum tetrapterum* i bäcken S Troedstorp, samt flerstädes utmed en bäck från Läreda till Fjärlöv, samt *Veronica anagallis-aquatica* i bäcken S Troedstorp. Samtliga lokaler för dessa 5 arter är belägna i södra hälften av socknen. Fig. 11.

Utmed Almaån (41 m ö.h. vid Rättelöv, 36 m efter Strömsfors) finns spridda lokaler för 11 arter, som är sällsynta eller saknas i urbergsbygder, nämligen *Bidens cernua, Butomus umbellatus, Elodea canadensis, Glyceria maxima, Mentha aquatica, Potamogeton gramineus, Rorippa amphibia, Rumex hydrolapathum, Sium latifolium, Thalictrum flavum* och *Valeriana sambucifolia.*

Sålunda är den nordöstligaste delen av Stoby socken i det närmaste ren urbergsbygd, medan de rikare områdena i socknens södra hälft anknyter till floran på Kristianstadsslätten. Dock saknas åtskilliga kalkgynnade arter, som förekommer i Ignaberga (grannsocken i söder ingående i Nävlingeåsområdet).

Jämförelse mellan Stoby och Norra Sandby socknars flora

En komplett artlista för Norra Sandby (grannsocken i öster) har tidigare redovisats (OREDSSON 1961).

I Stoby påträffades omkring 660 arter under inventeringen. *Rubus scissus* W. Wats., vars östgräns i Skåne passerar genom socknen, har karterats 1959 och senare. Fig. 12.

Av före 1952 uppgivna arter har 21 inte kunnat återfinnas. Skånes Floras arkiv innehåller uppgifter om *Anemone vernalis, Blechnum spicant, Carex lepidocarpa, Circaea intermedia, Juncus capitatus, Lycopodium tristachyum, L. inundatum, Peplis portula, Petasites hybridus, Radiola linoides, Senecio palustris* och *Utricularia neglecta.* NILS KARLSSON har meddelat *Chamaepericlymenum suecicum, Gentiana pneumonanthe, Gentianella campestris, Linnaea borealis, Listera ovata, Pinguicula vulgaris* och *Serratula tinctoria.* MARTIN P:SON-NILSSON har angivit *Botrychium lunaria* och *Narthecium ossifragum.*

Förutom 8 av de arter som inte kunnat återfinnas *saknas* i Stoby 46 som påträffats i Norra Sandby 1957—60, nämligen *Alchemilla micans, Anthemis cotula, Arctium lappa, Brassica nigra, Campanula patula, Carex caespitosa, C. chordorrhiza, C. dioica, C. pulicaris, Chenopodium urbicum, Dactylorchis majalis, Eleocharis multicaulis, Epilobium adenocaulon, E. collinum, Equisetum palustre, Eriophorum gracile, Festuca trachyphylla, Galinsoga parviflora, Hieracium sylvaticum, Juncus compressus, Lathraea squamaria, Lathyrus vernus, Leersia oryzoides, Lonicera xylosteum, Melampyrum sylvaticum, Melandrium rubrum, Melica uniflora, Myriophyllum verticillatum, Nymphaea alba* ssp. *candida, Ornithopus perpusillus, Pilularia globulifera, Rhynchospora fusca, Sagina nodosa, Salix starkeana, Scheuchzeria palustris, Sherardia arvensis, Spirodela polyrrhiza, Stachys arvensis, Symphytum asperum, Taraxacum Erythrosperma, T. Obliqua, Trichophorum alpinum, T. caespitosum* ssp. *germanicum, Vicia lathyroides, Viola mirabilis* och *V. stagnina.*

I Stoby har påträffats 85 arter som saknas i Norra Sandby. Av dem har hittills inte nämnts *Agrostemma githago, Anthemis tinctoria, Aquilegia vulgaris, Arabis arenosa, Arctium tomentosum, Arnoseris minima, Asplenium septentrionale, Berberis vulgaris, Bromus tectorum, Calystegia sepium, Cardamine flexuosa, Cardaria draba, Centaurera nigra, Ceratophyllum demersum, Cirsium heterophyllum, Cuscuta epithymum, Echium vulgare, Eleocharis uniglumis, Equisetum hyemale, Euphorbia peplus, Galinsoga ciliata, Heracleum sphondylium* ssp. *sibiricum, Herniaria glabra, Hypericum humifusum, Juncus alpinus* ssp. *nodulosus, Lathyrus sylvestris, Lamium hybridum, Lithospermum arvense, Malva pusilla, Myriophyllum spicatum, Pastinaca sativa, Poa supina, Rubus radula, Satureja acinos, Silene dichotoma, S. pendula, Sisymbrium altissimum, Symphytum officinale, Thalictrum aquilegiifolium, Tragopogon pratensis* ssp. *minor, Trifolium aureum, Ulex*

europaeus, Verbascum thapsus, Vicia sylvatica, V. villosa och *Viola reichenbachiana.*

Carex tumidicarpa och *Rumex tenuifolius* förekommer i båda socknarna, liksom *Epilobium obscurum* (i artlistan för Norra Sandby benämnd *E. tetragonum* L.). Ett tillägg till artlistan upptar 4 ruderatväxter, av vilka inte någon anträffats i Stoby. I båda socknarna finns *Bromus arvensis, Carum carvi, Sambucus nigra* och *S. racemosa.* Odlingsrester som endast påträffats i Stoby är *Levisticum officinale, Nepeta cataria* och *Onopordon acanthium.*

Av växter i bryn, på hedar och ängar har Stoby sålunda omkring 15 fler än Norra Sandby, medan förhållandet är det omvända beträffande kärrväxter. I Norra Sandby saknas 18 av de 21 arter som i Stoby endast påträffats utmed järnvägen Malmö—Stockholm. Av kulturbetingade arter därutöver har Stoby 15—20 fler än Norra Sandby.

Antalet urbergsbygdsväxter är ungefär samma i de båda socknarna. Av kalktraktsväxter har Stoby, järnvägsfloran oräknad, 15—20 fler än Norra Sandby.

Summary

Vascular Plants in the Parish of Stoby

The parish of Stoby is situated in the inner part of northeastern Scania, between the South-Swedish uplands and the Kristianstad plain. The parish can be divided in four poorer parts and three richer ones (see fig. 3 that also shows the occurrence of forests). The connection with the rich flora of the Kristianstad plain is obvious in the southern part, while the northeasternmost part of the parish belongs to the poor area of north Scania. *Hypericum tetrapterum,* which in Sweden occurs only in Scania and merely in extreme-rich-fens, is found along streamlets in the south (fig. 11). *Rubus scissus* W. Wats., an oceanic species, has its eastern limit in Scania partly in the parish (fig. 12). The investigation has revealed about 660 species of vascular plants. 21 species earlier reported for the district could not be refound in 1952—56. 46 species that were found in the neighbouring parish of Norra Sandby, situated east of Stoby, could not be found in the latter parish. But 85 species not found in Norra Sandby 1957—60, are reported from Stoby during the investigation. Except 18 species, found along a railway, Stoby has 15—20 species more than Norra Sandby of the group that prefers lime occurrences.

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Phlebopteris angustiloba (Presl) Hirmer et Hörhammer (Matoniaceae) from "Olstorp" Shaft, Bjuv, Scania

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Introduction

In the spring of 1965 workers at "Olstorp" shaft in Bjuv, Scania, found a "new and unknown fossil" in the upper coal bed of the shaft. The specimen was handed over to staff members of the Palaeontological Institute of the University of Lund during a collecting trip through Scania. This fossil turned out to be *Phlebopteris angustiloba* (Presl) Hirmer et Hörhammer, which actually was unknown in this part of the Rhaeto-Liassic coal field of NW Scania. Previous records are known from the Upper deposits at Pålsjö (NATHORST 1878, p. 22) Munka Tågarp (MÖLLER & HALLE 1913, p. 8), and Billesholm (LUNDBLAD 1950, p. 23 ff.), and from the Lower Liassic beds of Höör (ANTEVS 1919, p. 16, 17), Sofiero (CHOW 1924, p. 3), and Stabbarp (LUNDBLAD in TROEDSSON 1947, p. 292). The Lower Liassic occurrence from Rödalsberg (MÖLLER & HALLE 1913) is doubtful according to the opinion of LUNDBLAD (1950, p. 23). All specimens mentioned above are kept at the Swedish Museum of Natural History, Palaeobotanic section, Stockholm.

The occurrence of the species outside Scania, according to the point of view held by HIRMER & HÖRHAMMER (1936, p. 33, text plate D), is in the island of Bornholm, on Greenland, in Poland, Germany, Italy and Japan. However HARRIS (1937, p. 22) feels some doubt about "a good many poorly figured specimens" in the list of synonymy given by HIRMER & HÖRHAMMER.

Description

Provenience: Scania, Bjuv, Shaft Olstorp, upper coal bed.

Macroscopic remains: Two fragmentary pinnae (fig. 1 A) ±11.0 cm

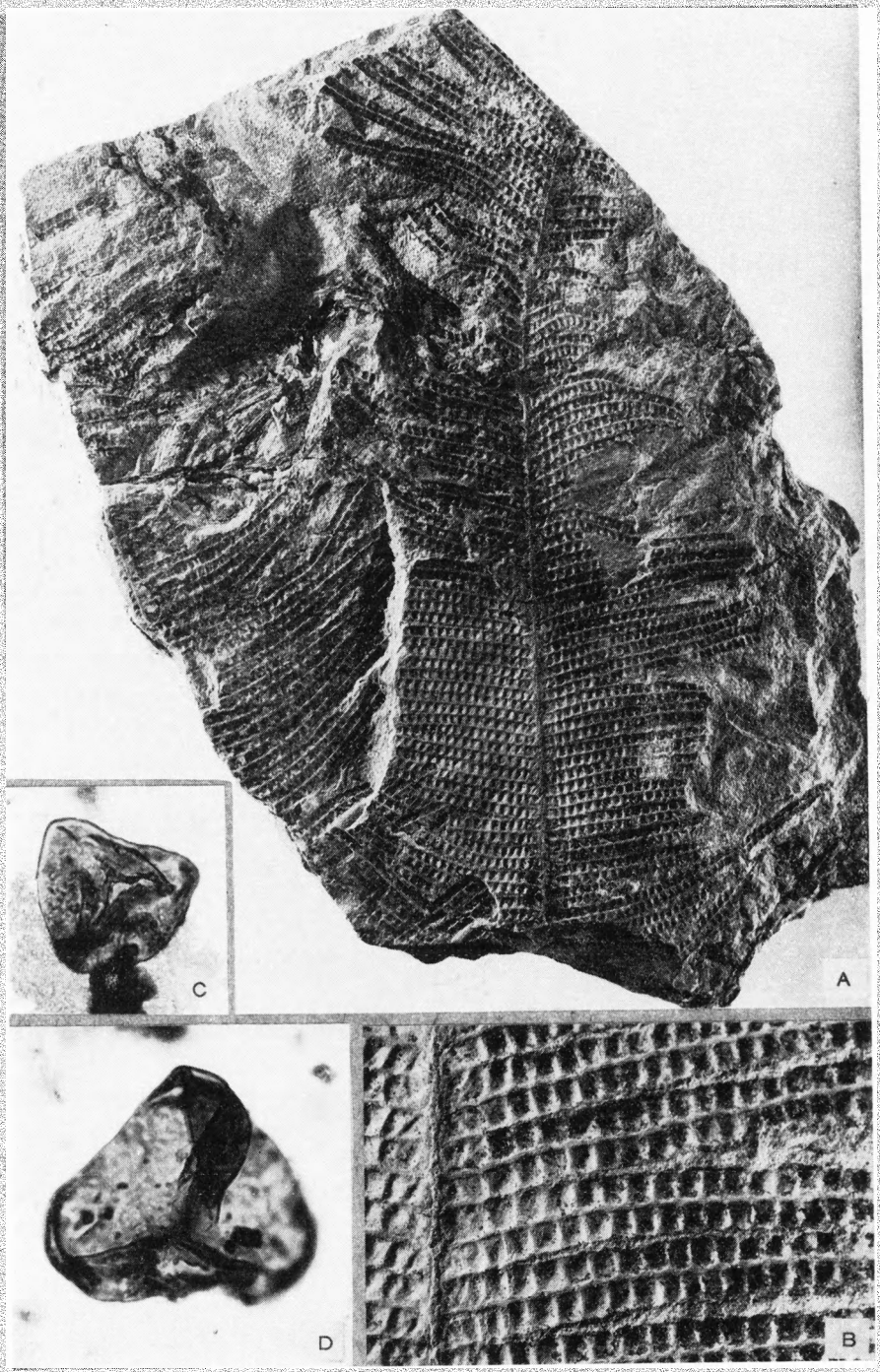

Fig 1 a—d.

long, reconstructed original breadth (half the length of pinnules) ±9.0 cm. Pinnules making almost a right angle with the midrib, ±0.3 cm broad, with characteristic pit-like, deeply convex square "fields", markedly coalescent in basal parts (fig. 1 B), margin entire and somewhat incurved, venation indistinct.

Microscopic remains: Spores trilete, ±40 μ. Roundish triangular in polar view. Triradiate mark obviously formed by cutinized ridges (fig. 1 C). Exine smooth.

Remarks: The specimen can be referred to the "*Andriana*" type (cf. HARRIS 1931, p. 76), because of the crowded pinnules of the leaf. The pinnules show, however, convex "fields" typical of the "*Gutbiera*" type. The leaves also, as almost all Scanian specimens, differ in size from the specimens described from Scoresby Sound, East Greenland, by HARRIS (1931, p. 74 ff.). The pinnules of the Greenland material are about 15—25 mm, of the Billesholm material about 50 mm, and the pinnules of the present material are about 45 mm long. These size differences may be due to ecological factors.

A relatively limited number of spores obtained show a remarkable variation in size, which is 40±10 μ. Still, they compare well with spores of this species described previously (cf. POTONIÉ 1962). They are similar to spores of *Phlebopteris muensteri* (Schenk) Hirmer et Hörhammer, but are distinguished from these by their smaller size.

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Fig. 1. A: *Phlebopteris angustiloba* (Presl) Hirmer et Hörhammer, Shaft "Olstorp", Bjuv, Scania; two fragmentary pinnae, nat. size; B: pinnules of the same specimen, 3 ×; C—D: spores of the same specimen, 600 ×. — Original material: Palaeontological Institute, University of Lund. — K. E. SAMUELSSON phot.

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The Usefulness of Thin-Layer Chromatographic Analysis of Phenolic Compounds in European Lathyrus L.

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With this work the present author wants to illustrate the usefulness in plant taxonomy of biochemical analysis of phenolic compounds in the leaves of European *Lathyrus* L. (*Papilionaceae*). Could such a method be helpful in efforts to separate genera, subgenera, species and subspecies? This examination would also show the variation between and to some extent within collections, which has not been emphasized in earlier works. Samples with different chromosome numbers in the same species were compared from a biochemical point of view.

The use of chromatographic separations of various compounds obtained from plant materials in taxonomy has received considerable attention in recent years. BLANK (1947) described the anthocyanin pigments of plants from a chemical and physiological point of view. Methods for the identification of phenolic substances on paper chromatograms were introduced by BATE-SMITH (1948, 1950). The possibilities of identification of anthocyanidins formed from leuco-anthocyanins in plant tissues was shown by BATE-SMITH (1954 a). BATE-SMITH & LERNER (1954) and BATE-SMITH (1956) have studied the systematic distribution of leuco-anthocyanins in leaves and analysed about 500 species. They say that leuco-anthocyanins occur much more commonly in the tissues of woody plants than in those of herbaceous plants. Later thin-layer chromatography using cellulose-coated glass plates instead of free hanging paper has much improved the analyses. Such examinations using fruits and flowers have been made by NYBOM (1964).

With help of paper-chromatographic analysis of phenolic compounds e.g. STEBBINS, HARNEY et al. (1963) identified the ancestry of an amphiploid *Viola,* and HARNEY & GRANT in 1964 studied the *Lotus corniculatus* group. RILEY & BRYANT (1961) separated nine species of the *Iridaceae* by paper chromatography.

In *Lathyrus,* by paper chromatography PECKET (1959, 1960) analysed the constituents of leaf extracts in 28 species and the nature of the variation in

flower colour of 19 species. He found only two flavonols and two coumaric acids that occur frequently in the analysed leaf extracts. PECKET says: "Similar complements of these substances were present in species which have been considered to be closely related on the basis of morphology, cytology and genetics. This is regarded as an indication of the usefulness of such biochemical data in checking species relationship based on more obvious criteria. The data for four species (*L. hirsutus, L. pratensis, L. palustris* and *L. maritimus*), which have been placed in different sections of the genus by different workers, provide support for these classifications in which these species have been allotted to the section Eulathyrus. Support is also provided for the view that in the Papilionaceae, leucoanthocyanins are generally lacking in leaves of species of the tribe Vicieae." In flowers PECKET found the anthocyanidins delphinidin, petunidin and malvidin. He writes, "Thus, even where the standard and wings were markedly dissimilar in colour, pH differences are unlikely to play any part (except perhaps in *L. hirsutus*) and in view of what has been said earlier it can be assumed that the effect is due to co-pigmentation alone. . . . Although a correlation exists between flower and occurrence of co-pigments, the division of the species according to flower colour does not correspond with any taxonomic arrangement."

BELL (1962) divided the species of *Lathyrus* examined by him into five groups on the basis of ninhydrin-positive compounds in seed extracts.

Material and Methods

The plants used in this study include nearly all of the known European species of the genus *Lathyrus*. The plants were cultivated in greenhouses in the Botanical Garden, Lund, Sweden. All plants were grown from seeds, and where possible, the seeds were collected from naturally occurring populations. Species determinations were made from comparison with herbarium material and the existing monographs (e.g. HITCHCOCK 1952). There is no monograph of the European species of *Lathyrus* so the author had to follow the nomenclature of the partially obsolete work, "Synopsis der Mitteleuropäischen Flora" from 1906—10 by ASCHERSON & GRAEBNER.

The material used must be correctly determined and compared with herbarium material available and existing monographs and also be kept dried to verification. In such a genus as *Lathyrus* where many synonyms occur it is important that the names of the taxa are followed by the names of the authors. Otherwise they may be difficult to compare with other examinations. For example, BELL (1962) did not give the names of the authors in his work on ninhydrin-reacting compounds in seeds in *Lathyrus*. In his table of examined species there are synonyms treated as separate species (e.g. *L. maritimus* and *L. japonicus*). Another example is *L. variegatus* without the name of the author which can mean *L. sylvestris* L., *L. multiflorus* Peterm. or *L. hirsutus* Lam.

In order to get comparable results of the biochemical analyses it is necessary to use as nearly identical conditions as possible in cultivation. The formation of anthocyanins in plants is influenced by temperature and light (wave-length,

Table 1. Analysed spots and their R_f-values in solvent I and II. The variation of the R_f-values were ±0.02 up to ±0.03. The letters mean A white, absorbing, R red and Y yellow spots

Compound	Spot number and colour	R_f-values in solv. I	R_f-values in solv. II
Unknown	A_1	0.94	0.46
Sinapic acid	A_2	0.84	0.73
Ferulic acid	A_3	0.79	0.78
Unknown	A_4	0.71	0.87
Caffeic acid	A_5	0.66	0.78
Unknown	A_6	0.16	0.21
„	R_1	0.93	—
„	R_2	0.81	0.76
Cyanidin	R_3	0.52	0.60
Delphinidin	R_4	0.40	0.36
Unknown	Y_1	0.64	0.58
„	Y_2	0.50	0.67
„	Y_3	0.40	0.70
Kaempferol	Y_4	0.35	0.85
Unknown	Y_5	0.28	—
Quercetin	Y_6	0.24	0.69
Myricetin	Y_7	0.19	0.76

intensity and duration of the illumination), pH, and fertilizers, e.g. nitrogen (BLANK 1947). Many authors describe an increase in anthocyanin formation in plants attacked by parasites, in infected plants and those which have suffered some sort of injury.

For analyses of this kind the method used must be reliable. The results should be the same when one plant is analysed at different times. Usually phenolic compounds occur in plants as glycosides with a great variation of the bonds. Glycosylation occurs at the end of the biosynthesis (HARBORNE 1962). At hydrolysis the sugar is split up from the phenolic compound and the more primary structure can be analysed.

All plants used in this study had the same soil (50 % sand and 50 % humus), water supply, atmospheric humidity, temperature, and light. Leaves from the middle regions of well-developed plants were harvested in the mornings. They were weighed immediately, and hydrolysed. Extracts of 0.5 g fresh leaves were prepared by hydrolysing the tissue with 3.5 ml of 2N HCl for 20 minutes at 100°C in a water bath in order to split the glucosides into aglycones and their sugar components. After centrifugation, 2 ml of the cooled extracts were transferred to a test tube and extracted with 0.2 ml of amyl alcohol. For chromatographic analysis 3 µl was used.

For the thin-layer chromatographic analyses smooth glass plates (20×20 cm) were covered with an even, thin layer of cellulose powder by spreading a well-stirred mixture of 15 g of cellulose powder (Machery, Nagel & Co., MN 300) and 90 ml of distilled water with a thin-layer applicator. The plates were dried at 110°C for one hour. One spot of the amyl alcohol extract was applied at a distance of 3 cm from the corner of each plate. After drying the

plates were placed in jars and were developed in the first direction with a modified "Forestal" solvent composed of formic acid — hydrochloric acid — water (10 : 1 : 3). When the solvent front had travelled about 15 cm, the plates were removed from the jars and air-dried. After that the plates were rotated 90° and developed in the second solvent composed of amyl alcohol—acetic acid—water (2 : 1 : 1). Each solvent required about two hours for development. After air-drying the chromatograms were examined in visible and ultraviolet light. Ammonia vapor did not reveal any previously undetected spots. It was found valuable to examine plates with ultraviolet light after development in each solvent, because some compounds that occurred in low concentrations were "diluted" by the second development to a point at which they were not detectable.

The spots were identified by their colours and R_f-values (distance spot travelled/distance solvent front travelled) (table 1). Various factors such as thickness of the cellulose layer, equilibration of the solvent inside the chromatographic chamber, temperature, etc., may influence the R_f-values. Therefore the above mentioned factors were as constant as possible during all trials. As a reference compound, cyanidin was used, giving a R_f-value of 0.52 in the modified "Forestal" solvent and 0.60 in the other solvent. [BATE-SMITH (1954 a) has given R_f of cyanidin of 0.50 in "Forestal" solvent, while NYBOM (1964) stated R_f of cyanidin in the second solvent of 0.53.] Each compound was given a number. In the tables the spots that absorb and give a light flourescence in ultraviolet light have the numbers A_1—A_6. The red spots visible in daylight are R_1—R_4 and the yellow coloured spots in ultraviolet light have the numbers Y_1—Y_7. Table 1 gives the R_f-values obtained. Chromatographic comparison with pure samples of some common phenolic compounds (BATE-SMITH 1954 a, b, 1956) made it possible to identify some spots (tab. 1). No spots were identical with pure samples of malvidin and p-coumaric acid. It can be added that at the hydrolysis caffeic acid and ferulic acid were decomposed to a small degree. The artefacts were seen as yellow spots near the front and were excluded at the interpretation of the chromatograms. The other identified compounds remained stable to this treatment. Eventually, some unidentified compound may in the same manner be decomposed and may be seen as more than one spot on the chromatograms.

In the tables the European species are tabulated according to the classification of ASCHERSON & GRAEBNER (1906—10) using their nomenclature. The genus *Lathyrus* was there after TAUBERT (1894) divided into the two sections: *Archilathyrus* Taub.[1] and *Orobus* (L. as genus). *Archilathyrus* Taub. was divided into six subsections: *Aphaca* Tourn., *Cicerula* Mnch., *Clymenum* DC., *Eulathyrus* Ser.,[1] *Nissolia* Tourn. and *Orobastrum* Gren. & Godr. The species order within the groups is that of the present author. In most cases several samples of each species were analysed and each collection was biochemically analysed three or more times. The number of plus signs in the tables is roughly proportional to the amounts of the substances that were found on examination of the chromatograms in visible and ultraviolet light. One plus sign indicates a small amount of substance or even a trace. The names of the

[1] The correct name is *Lathyrus*.

Table 2. Some taxa in Lathyrus the somatic chromosome numbers of which have not been published earlier

2n=14	
L. alpestris Rchb.	*L. neurolobus* Boiss. & Heldr.
L. binatus Pančić	*L. palustris* var. *myrtifolius* Gray
L. davidii Hance	*L. pannonicus* var. *versicolor* Maly
L. hallersteinii Baumg.	*L. pseudoaphaca* Boiss.
L. incurvus Willd.	*L. quadrimarginatus* Ch. & B.
L. inermis Roch ap. Friv.	*L. saxatilis* (Vent.) Vis.
L. laetiflorus Greene	*L. sphaericus* var. *stenophyllus* Boiss.
L. luteus var. *aureus* Beck	*L. undulatus* Boiss.
L. luteus var. *laevigatus* Beck	*L. vernus* var. *flaccidus* Arcang.
L. luteus var. *transsylvanicus* Beck	*L. vernus* var. *gracilis* Arcang.
L. mulkak Lipsky	

countries are abbreviated in the same manner as in TUTIN et al. (1964). The names of regions and localities are generally after the atlas "The Times" (BARTHOLOMEW 1955—56). The material examined was commonly spontaneous but in some cases seeds from botanical gardens or institutes (in the tables marked with Bot. Gn. or Bot. In.) were used. It should be pointed out that in the last case the different samples of one taxa may have the same origin. The analysed plants were dried and are kept in the Botanical Museum, Lund, Sweden.

The chromosome numbers of all collections used were determined. All countings were done in 15 μ thick sections of root tips fixed in the Svalöv modification of the Navashin-Karpechenko fixative and stained in crystal violet. The root tips were pre-treated in 5°C water for three hours to contract the chromosomes.

Results

The results of the two-dimensional thin-layer chromatographic analysis of phenolic compounds in leaves of species in *Lathyrus* are shown in the tables 3—10. At the same time the chromosome numbers of all analysed collections and information of the localities are given. Earlier unpublished chromosome numbers of some taxa in *Lathyrus* are presented in table 2.

About fifty taxa of the genus *Lathyrus* were analysed and it is clear that the distribution of different pigments is variable (tabs. 3—10). In all sections and subsections (except *Nissolia*) the following spots were found: A_2 (20), A_3 (56), A_5 (43), R_1 (26), Y_2 (38), Y_4 (52) and Y_6 (49) (tab. 11). The numbers in parenthesis show the number of taxa in which phenolic compounds were found.

The absorbing spot A_1 in ultraviolet light occurred only in *L. luteus* Peterm. and *L. pannonicus* Garcke while sinapic acid (A_2) was represented in all groups except *Nissolia* and existed in 35 % of the analysed taxa. Ferulic acid (A_3) was found in all examined species. The unknown compound A_4 was seen only in *L. luteus* var. *aureus* Beck and in *L. montanus* Bernh. Caffeic acid (A_5) was found in 77 % of the studied taxa and occurred in all the groups but *Nissolia*. The unknown compound A_6 was found in *L. luteus* var. *aureus* Beck and in *L. montanus* Bernh. like A_4, but also in *L. davidii* Hance and in some collections of *L. vernus* Bernh.

The anthocyanidins were not found in many of the species of the genus *Lathyrus*. The unknown compound R_1 appeared in 46 % of the analysed taxa. The red spot R_2 was rare, occurring in *L. alpestris* Rchb., *L. luteus* var. *laevigatus* Beck, *L. nissolia* L., *L. palustris* L. var. *palustris*, *L. vernus* var. *gracilis* Arcang. and *L. undulatus* Boiss. Cyanidin (R_3) was only found in eleven of the analysed species. NYBOM (1964), who has analysed some flowers and fruits of species from different families, reported cyanidin in 90 % of the investigated species. SUOMALAINEN & KERÄNEN (1961) considered that cyanidin is the primary anthocyanidin from a biosynthetical point of view and therefore it should be common. In *Lathyrus*, cyanidin was found in the following species: *L. aphaca* L., *L. binatus* Pančić, *L. hallersteinii* Baumg., *L. incurvus* Willd., *L. inermis* Roch. ap. Friv., *L. maritimus* Bigel., *L. neurolobus* Boiss. & Heldr., *L. pratensis* L., *L. sphaericus* Retz., *L. tuberosus* L., and *L. venetus* Rouy. The anthocyanidin delphinidin (R_4) was found in leaves of *L. incurvus* Willd., *L. maritimus* Bigel., *L. neurolobus* Boiss. & Heldr., *L. odoratus* L., *L. pratensis* L., *L. tingitanus* L., *L. tuberosus* L., *L. venosus* Muhl. ex. Willd., and *L. vernus* Bernh.

In this biochemical analysis of *Lathyrus* seven different yellow spots were found. The sharply yellow spot Y_1 occurred in *L. annuus* L., *L. cicera* L., *L. nissolia* L., *L. saxatilis* (Vent.) Vis., and *L. undulatus* Boiss. The unidentified spots Y_2 and Y_3 were found in about two thirds and one fourth, respectively, of the analysed taxa. Kaempferol (Y_4) was seen in all species except in *L. davidii* Hance, *L. incurvus* Willd., *L. neurolobus* Boiss. & Heldr., and *L. saxatilis* (Vent.) Vis. The unknown compound Y_5 was generally occurring in *L. maritimus* Bigel., *L. binatus* Pančić and *L. hallersteinii* Baumg. and was rare in *L. pratensis* L., all of which are included in the subsection *Orobastrum*. Besides, Y_5 occurred in *L. niger* Bernh. (section *Orobus*) and *L. undulatus* Boiss. and was common in the whole *L. sylvestris* group that includes *L. hetero-*

Table 3. Analysed spots in the subsections Aphaca Tourn., Cicerula Mnch. and Clymenum DC.

	Coll. no.	A_1	A_2	A_3	A_4	A_5	A_6	R_1	R_2	R_3	R_4	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7
APHACA Tourn.																		
L. aphaca L. 2n=14																		
Ga, Aude, Sonnac	R 938	.	+	++	.	++	.	+	.	++	.	.	.	.	+	.	+	.
Lu, Bussaco	R 1190	.	+	++	.	++	.	+	.	+	.	.	.	.	+	.	+	.
L. pseudoaphaca Boiss. 2n=14																		
Gr, Sámos, Kerki	R 1189	.	+	++	.	++	.	.	.	.	.	.	+	.	+	.	.	.
CICERULA Mnch.																		
L. annuus L. 2n=14																		
It, Bologna, Bot. Gn.	R 1222	.	.	+	.	++	.	+	.	.	.	+	+	.	++	.	+	.
Br, Kew, Bot. Gn.	R 1209	.	.	+	.	++	.	.	.	.	.	+	+	.	++	.	++	.
L. cicera L. 2n=14																		
Ga, Vaucluse, Pernes	R 949	.	.	+	.	+	.	+	.	.	.	.	++	++	+	.	+	.
Ga, Cantal, Ytrac	R 945	.	.	++	.	++	.	+	.	.	.	.	+	+	+	.	++	.
Gr, Kikladhes, Anafi, Kalamos	R 1219	.	.	+	.	+	.	+	.	.	.	+	+	.	+	.	+	.
L. hirsutus L. 2n=14																		
Ga, Cantal, Ytrac	R 965	.	.	++	.	++	.	++	.	.	.	.	+	.	++	.	++	.
Lu, Estremadura, Amadora	R 967	.	+	+	.	+	.	++	.	.	.	.	+	.	++	.	++	.
L. sativus L. 2n=14																		
Ga, Doubs, Beure	R 864	.	.	+	.	.	.	+	.	.	.	.	+	.	+	.	+	.
Ge, Berlin, Kopenick	R 1034	.	.	+	.	.	.	+	.	.	.	.	.	.	+	.	+	.
Ju, Hrvatska, Zadar	R 1071	.	.	++	.	.	.	.	.	.	.	.	+	.	+	.	++	.
L. quadrimarginatus Ch. & B. 2n=14																		
Lu, Coimbra, Bot. Gn.	R 1143	.	.	+	.	+	.	+	.	.	.	.	.	.	+	.	++	.
Ge, Berlin, Bot. In.	R 1161	.	.	+	.	+	.	+	.	.	.	.	.	.	+	.	++	.
CLYMENUM DC.																		
L. articulatus L. 2n=14																		
Su, Uppsala, Bot. Gn.	R 959	.	.	++	.	++	.	+	.	.	.	.	+	.	++	.	++	.
L. clymenum L. 2n=14																		
Su, Uppsala, Bot. Gn.	R 972	.	.	+	.	.	.	.	.	.	.	.	+	+	++	.	+	.
L. ochrus DC. 2n=14																		
Su, Uppsala, Bot. Gn.	R 958	.	.	++	.	++	.	.	.	.	.	.	+	.	+	.	+	.
Ga, Drome, Crest	R 1159	.	+	++	.	++	.	+	.	.	.	.	+	.	+	.	+	.

phyllus L., *L. latifolius* L. and *L. sylvestris* L. in the subsection *Eulathyrus*. Quercetin (Y_6) appeared in most of the studied taxa. Myricetin (Y_7) was only found in *L. incurvus* Willd. and in two samples of *L. pratensis* L.

Subsect. *Aphaca* Tourn.

Adult plants of *L. aphaca* L. and *L. pseudoaphaca* Boiss. have no laminae, so their stipula were hydrolysed instead and the pigments analysed. PECKET (1959) found the four compounds caffeic acid, ferulic acid, kaempferol and quercetin in the genus *Lathyrus,* but did not find kaempferol in *L. aphaca* L. It was found in the three collections examined here (tab. 3).

Subsect. *Cicerula* Mnch.

About the same red and ultraviolet absorbing spots were found in all species in this subsection (tab. 3). In *L. sativus* L., however, caffeic acid was not found in any examination. PECKET (1959) did not find ferulic acid in *L. cicera* L. and *L. sativus* L., but it was seen clearly on thin-layer chromatograms in the present investigation. PECKET says: "The leaf extracts of *L. cicera* and *L. sativus* are indistinguishable from one another. This confirms the close relationship of the species which was indicated by their ability to hybridize (Saw Lwin, 1956)." In the present study there were some differences between the two species, for instance the compounds Y_2 and Y_3 were common in *L. cicera* L. like caffeic acid.

Subsect. *Clymenum* DC.

The three species, *L. articulatus* L., *L. clymenum* L. and *L. ochrus* DC., had about the same phenolic compounds in their leaves (tab. 3). This is evident from this investigation and that by PECKET (1959), who, however, only found quercetin and kaempferol in this group. BELL (1962) has in his examination of ninhydrin-reacting compounds in seeds found exactly the same components in the three species, too.

Subsect. *Eulathyrus* Ser.

The most obvious result (tab. 4) was the remarkable correlation between *L. heterophyllus* L., *L. latifolius* L., *L. sylvestris* L. and also *L. odoratus* L. The first three species are very similar in several characteristics and the biochemical results support the generally accepted view that the species are closely related to one another. In the literature, taxa of the *L. sylvestris* group have often been subdivided. The three species are to a high degree autogamous. On isolation of their flowers to

Table 4. Analysed spots in the subsections Eulathyrus Ser. and Nissolia Tourn.

	Coll. no.	A_1	A_2	A_3	A_4	A_5	A_6	R_1	R_2	R_3	R_4	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7
EULATHYRUS Ser.																		
L. cirrhosus Ser. 2n=14																		
He, Genève, Bot. Gn.	R 943	.	.	+	.	+	.	.	.	.	.	.	+	.	+	.	+	.
L. grandiflorus Sibth. et Sm. 2n=14																		
Po, Poznan, Bot. In.	R 768	.	.	+	.	.	.	.	.	.	.	.	++	++	+	.	++	.
L. odoratus L. 2n=14																		
It, Sicilia, Palermo	R 1036	.	.	+	.	.	.	+	.	.	+	.	+	.	+	.	+	.
Tu, Istanbul, Boyalik	R 1172	.	.	+	.	+	.	.	.	.	.	.	+	.	+	.	+	.
L. heterophyllus L. 2n=14																		
He, Valais, Val de Réchy	S 99	.	.	++	.	++	.	.	.	.	.	.	+	.	+	+	++	.
Rs, Rostov	S 437	.	.	++	.	++	.	.	.	.	.	.	+	.	+	+	++	.
L. latifolius L. 2n=14																		
Ga, Rhône, Millery	S 366	.	.	++	.	++	.	+	.	.	.	.	+	.	+	+	++	.
Ju, Hercegovina, Brocanac ..	S 337	.	.	++	.	++	.	.	.	.	.	.	.	.	+	+	++	.
L. sylvestris L. 2n=14																		
Su, Södermanland, Ösmo ...	S 1	.	.	++	.	++	.	.	.	.	.	.	+	.	+	+	++	.
Br, Wales, Montgomeryshire	S 247	.	.	++	.	++	.	.	.	.	.	.	+	.	+	+	++	.
L. sylvestris var. *platyphyllus* Aschers. 2n=14																		
Cz, Slovensko, Bratislava ...	S 183	.	.	++	.	++	.	.	.	.	.	.	.	.	+	+	++	.
L. tingitanus L. 2n=14																		
Rs, Minsk, Bot. Gn.	R 1146	.	.	+	.	+	.	.	.	.	+	.	++	+	+	.	+	.
L. tuberosus L. 2n=14																		
Ga, Lozère, Ca Mende	R 1180	.	+	++	.	.	.	.	.	.	.	.	.	.	+	.	++	.
Cz, České Země, Roudnice ..	R 762	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	++	.
Rs, Thbilissi	R 838	.	.	+	.	.	.	.	.	+	+	.	.	.	+	.	+	.
NISSOLIA Tourn.																		
L. nissolia L. 2n=14																		
Ge, Hessen, Wetterau	R 1228	.	.	+	.	.	.	.	+	.	.	+	+	.	++	.	+	.
Ga, Orne, Le Pin	R 1230	.	.	+	.	.	.	.	.	.	.	+	+	.	+	.	+	.

prevent pollination from other individuals, fruits develop from nearly all the flowers. In nature most individuals have probably arisen by autogamy, but occasionally a crossing occurs and gives a variable offspring (e.g. F_1, I, F_2). The many taxonomic problems in the *L. sylvestris* group may be due to the fact that few plants arise by crossing in nature and that various individuals from crossings have often been given new names. PECKET (1959) does not mention kaempferol in the *L. sylvestris* group, which was found in this analysis. He also says that

L. tingitanus L. lacks quercetin, which however was seen in the collection analysed here. PECKET (1959) also contends that *L. hirsutus* L. (A_3, A_5, Y_4, Y_6) belonging to *Cicerula,* and *L. pratensis* L. (A_5, Y_4, Y_6), *L. palustris* L. (A_5, Y_4, Y_6) and *L. maritimus* Bigel. (A_5, Y_6), which all belong to *Orobastrum,* should be placed in the subsection *Eulathyrus.* (Markings in parenthesis are the compounds that PECKET has found in his investigation of these species.) The four compounds (A_3, A_5, Y_4, Y_6) are very common in the genus *Lathyrus* and were found in all the four above mentioned species by thin-layer chromatographic analysis. The species belonging to the subsection *Eulathyrus* were placed in three different groups by BELL (1962).

Subsect. *Nissolia* Tourn.

In *L. nissolia* L. the laminae are reduced and instead the leaflike phyllodia were analysed. *L. nissolia* L. was characterized by the yellow spot Y_1 and absence of sinapic acid (A_2) and the red spot R_1 (tab. 4).

Subsect. *Orobastrum* Gren. & Godr.

The *L. pratensis* group belonging to *Orobastrum* is presented in table 5, where thirty collections were biochemically analysed. The author distinguishes *L. binatus* Pančić and *L. hallersteinii* Baumg. from *L. pratensis* L. ASCHERSON & GRAEBNER (1906—10) included these two taxa in *L. pratensis* L. A detailed investigation of this group in cytology, ecology, geographical distribution, morphology and crossing experiments reveals that *L. binatus* Pančić, *L. hallersteinii* Baumg. and *L. pratensis* L. are distinct species. These results will be published later. There were also biochemical differences between the species. It is necessary to point out, which has not been done in earlier biochemical analyses of this sort, that there was some variation between collections from the same species, although there was little or no variation in pigments of the leaves of individuals in the same collection (table 10). Autogamy occurs in many species of the genus *Lathyrus* and is probably a main cause of the slight intravariation. There were no recognizable differences between diploid and tetraploid *L. pratensis* L. Thus, *L. pratensis* L. with both the somatic chromosome number $2n=14$ and $2n=28$ had delphinidin (R_4), which was not found in *L. binatus* Pančić and *L. hallersteinii* Baumg. Similarly, *L. pratensis* L. had the yellow spot Y_2, while the other two species had instead the yellow compound Y_5. The

Table 5. Analysed spots in thirty collections of the L. pratensis group (subsection Orobastrum Gren & Godr.)

	Coll. no.	A_1	A_2	A_3	A_4	A_5	A_6	R_1	R_2	R_3	R_4	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7
L. pratensis L. 2n=14																		
Su, Skåne, Mölle	PCO	.	.	+	.	++	.	+	.	+	+	.	+	.	+	.	+	.
Da, Mön	PEY	.	.	+	.	++	.	.	.	+	+	.	+	.	+	.	.	.
Ge, Niedersachsen, Celle, 10 km S	PKS	.	.	++	.	++	.	.	.	+	+	.	+	.	+	.	+	.
Ge, Niedersachsen, Hildesheim, 20 km S	PKT	.	.	+	.	+	.	.	.	+	+	.	+	.	+	.	.	.
He, Zürich, Lägern, Niederweningen	PRB	.	.	+	.	+	.	.	.	+	+	.	++	.	+	.	+	+
Au, Steiermark, Vordenberg	PTQ	.	.	+	.	++	.	+	.	+	+	.	+	.	+	.	.	.
Rm, Brasov, Făgăras	PUJ	.	.	+	.	+	.	.	.	++	+	.	+	.	+	.	+	.
Rm, Piteşti, Rîmnicu Vîlcea, Gurano	PUN	.	.	+	.	+	.	.	.	++	++	.	++	.	++	.	++	.
Ju, Srbija, Kragujevac, Grošnica	PYM	.	.	+	.	+	.	.	.	++	+	.	+	.	+	.	++	+
Ju, Slovensko, Storje	PXB	.	.	+	.	++	.	.	.	++	+	.	+	.	+	+	+	.
L. pratensis L. 2n=21																		
Su, Blekinge, Lösen	PCG	.	.	++	.	++	.	.	.	++	+	.	+	.	+	.	++	.
L. pratensis L. 2n=28																		
Ho, Zuidholland, Noordwijk	PHM	.	.	++	.	++	.	+	.	+	+	.	++	.	++	.	+	.
Be, Oost-Vlandern, Ursel	PJG	.	.	+	.	+	.	.	.	+	+	.	+	.	+	.	.	.
Ga, Nord, Au-Bac	PPC	.	.	+	.	++	.	.	.	++	+	.	+	.	+	.	+	.
Ga, Rhône, Irigny	PQK	.	.	+	.	+	.	.	.	++	+	.	+	.	+	.	+	.
He, Valais, Champex-Lac	PSD	.	.	+	.	+	.	.	.	+	+	.	+	.	+	.	.	.
He, Uri, Ursental, Hospenthal	PSG	.	.	+	.	+	.	.	.	+	+	.	+	.	+	.	++	.
It, Valle d'Aosta, Col de Petit St Bernhard	PVD	.	.	+	.	+	.	+	.	++	+	.	+	.	+	.	+	.
L. pratensis L. 2n=42																		
Ga, Paris, Forêt de Sénart	PPR	.	.	+	.	+	.	.	.	++	++	.	+	.	+	.	+	.
L. binatus Pančić 2n=14																		
Ju, Bosna, Trebević	BAA	.	.	++	.	++	.	.	.	++	.	.	.	.	+	+	++	.
Ju, Bosna, Trebević	BAF	.	.	+	.	++	.	.	.	+	.	.	.	.	+	+	++	.
Ju, Bosna, Ljubogosča	BAD	.	.	++	.	++	.	.	.	++	.	.	.	.	+	+	++	.
Ju, Srbija, Mokra Gore	BAE	.	.	++	.	++	.	.	.	++	.	.	.	.	+	+	++	.
L. hallersteinii Baumg. 2n=14																		
Rm, Cluj, Aghires	HAA	.	.	+	.	++	.	.	.	+	.	.	.	.	+	+	++	.
Rm, Hunedoara, Gura Zlata	HAE	.	.	+	.	++	.	.	.	+	.	.	.	.	+	+	++	.
Rm, Ploesti, Sinaia	HAJ	.	.	+	.	++	.	.	.	+	.	.	.	.	+	+	++	.
Ju, Srbija, Titovo Užice	HBA	.	.	+	.	+	.	.	.	++	.	.	.	.	+	+	++	.
Ju, Srbija, Kragujevac, Grošnica	HBC	.	.	+	.	+	.	.	.	++	.	.	.	.	+	+	++	.
Ju, Srbija, Ozren, Soko Banja	HBD	.	.	+	.	++	.	.	.	++	.	.	.	.	+	+	++	.
Ju, Srbija, Ozren, Soko Banja	HBE	.	.	+	.	++	.	.	.	++	.	.	.	.	+	+	+	.

amount of quercetin (Y_6) was much larger in the collections of *L. binatus* Pančić and *L. hallersteinii* Baumg. Thus, a biochemical examination of phenolic compounds in leaves in the *L. pratensis* group is a good

Table 6. Analysed spots in twenty collections of L. sphaericus Retz. (subsection Orobastrum Gren & Godr.)

	Coll. no.	A_1	A_2	A_3	A_4	A_5	A_6	R_1	R_2	R_3	R_4	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7
L. sphaericus Retz. 2n=14																		
Su, Bohuslän, Brattön	E 16	.	.	+	.	.	.	.	.	+	.	.	.	.	++	.	.	.
Su, Skåne, Kullaberg	E 2	.	.	+	.	.	.	.	.	+	.	.	.	.	++	.	.	.
Da, Bornholm, Hammershus.	E 15	.	.	+	.	.	.	.	.	+	.	.	.	.	++	.	.	.
Da, Sjælland, Rörvig	E 14	.	.	+	.	.	.	.	.	+	.	.	.	.	++	.	.	.
Da, Hesselö	E 13	.	.	+	.	.	.	.	.	+	.	.	.	.	++	.	.	.
Da, Samsö, Maarup	E 12	.	.	+	.	.	.	.	.	+	.	.	.	.	++	.	.	.
Ju, Srbija, Beograd, Košutnjak	E 17	.	.	+	.	.	.	+	.	.	.	.	.	.	++	.	.	.
Ju, Srbija, Kragujevac, Grošnica	E 18	.	.	+	.	.	.	+	.	.	.	.	.	.	++	.	.	.
Ju, Dalmatia, Rudine	E 19	.	.	+	.	.	.	+	.	.	.	.	.	.	++	.	.	.
Ju, Dalmatia, Makarska	E 20	.	.	+	.	.	.	+	.	.	.	.	.	.	++	.	.	.
Ju, Hrvatska, Karlobag	E 21	.	.	+	.	.	.	.	.	.	.	.	+	.	++	.	.	.
It, Friuli Venezia Giulia, Gorizia	E 22	.	.	+	.	.	.	.	.	.	.	.	+	.	++	.	.	.
It, Trentino Alto Adige, Bolzano	E 23	.	.	+	.	.	.	.	.	.	.	.	+	.	++	.	.	.
It, Sicily, Piana di Catania, Palagonia	E 7	.	.	+	.	.	.	.	.	.	.	.	+	.	++	.	.	.
Lu, Beira Litoral, Coimbra, Cerna	E 9	.	.	+	.	.	.	.	.	.	.	.	+	.	++	.	.	.
Marocco, Zaërs, Bni-Abid ...	E 3	.	.	+	.	.	.	.	.	.	.	.	+	.	++	.	.	.
Gr, Sámos, Kerki	E 4	.	.	+	.	.	.	.	.	.	.	.	+	.	++	.	.	.
Bu, Blago-Evgrad, Sandanski	E 8	.	.	+	.	.	.	.	.	.	.	.	+	.	++	.	.	.
Rs, Ashkhabaq, Bot. Gn.	E 10	.	.	+	.	.	.	.	.	.	.	.	+	.	++	.	.	.
L. sphaericus var. *stenophyllus* Boiss. 2n=14																		
Da, Köbenhavn, Bot. Gn. ..	E 24	.	.	+	.	.	.	+	.	.	.	.	+	.	++	.	.	.

additional criterion to other methods used in taxonomy, viz., studies in anatomy, cytology, ecology, physiology, morphology, palynology, and crossing experiments.

The results of twenty analysed populations of *L. sphaericus* Retz. (*Orobastrum*) are shown in table 6. In Europe, this species is common in the Mediterranean area with few localities to the north e.g. the south valley of the Rhine. Besides, there are six known localities in Denmark and Sweden. The biochemically analysed collections can be divided into three groups, which also have different geographical distribution. One group with populations from northern Europe had cyanidin (R_3) but not the red spot R_1 or the yellow spot Y_2. Four collections from Dalmatia and Serbia in Yugoslavia were characterized by R_1 but lacked R_3 and Y_2. The last group from the southern part of Europe had Y_2 but no red spots (fig .1). All the collections had the somatic chromo-

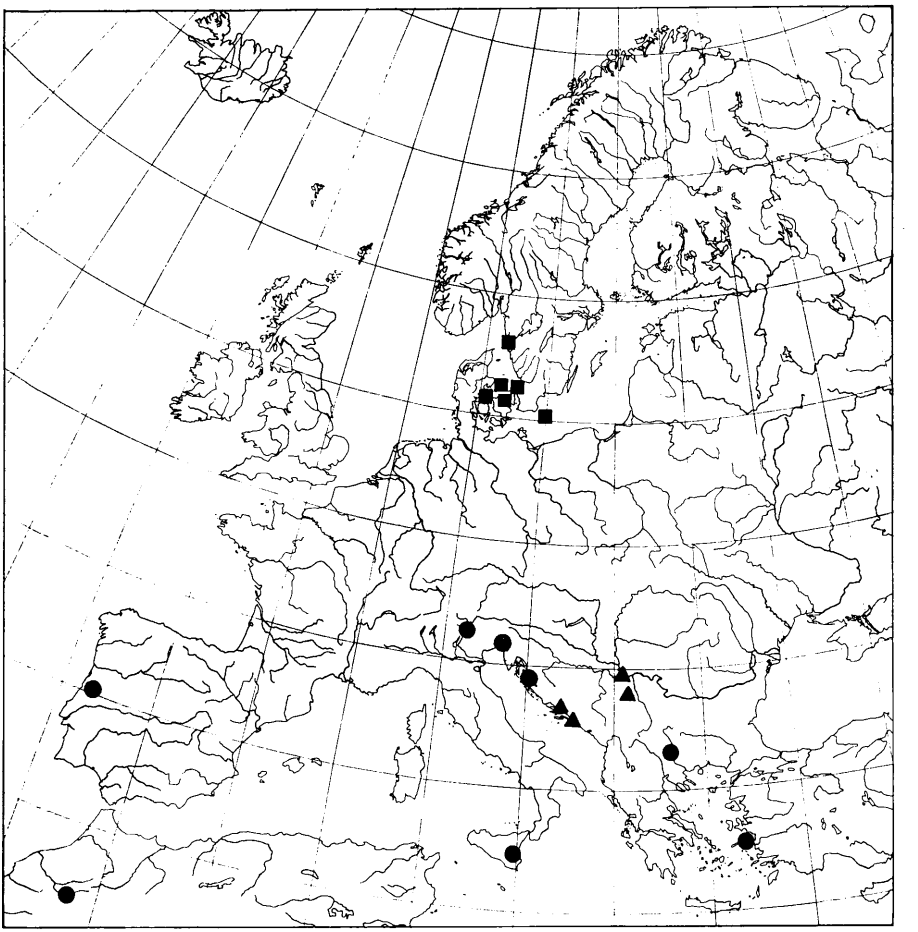

Fig. 1. The geographical distribution of the analysed samples of *L. sphaericus* Retz. The collections were characterized by the following spots, square (■) R_3, triangle (▲) R_1 and circle (●) Y_2.

some number 2n=14. The six populations from Denmark and Sweden are morphologically differentiated from the other collections. Their leaves are shorter and wider than samples from south Europe. It is not possible at this time to separate other groups on morphological grounds. Further investigations are going on in *L. sphaericus* Retz.

In the *L. palustris* group [1] (tab. 7) only the variety *palustris* with the somatic chromosome number 2n=42 grows in Europe. From these

[1] The taxonomy follows HITCHCOCK (1952).

Table 7. Analysed spots in some species of the subsection Orobastrum Gren. & Godr.

	Coll. no.	A_1	A_2	A_3	A_4	A_5	A_6	R_1	R_2	R_3	R_4	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7
OROBASTRUM Gren. & Godr.																		
L. incurvus Willd. 2n=14																		
Su, Blekinge	R 814	.	+	+	.	++	.	.	.	+	++	.	.	.	.	.	+	++
L. maritimus Bigel. 2n=14																		
Fe, Uusimaa, Tammisaari	R 1150	.	.	++	.	.	.	.	.	.	.	.	.	.	+	.	++	.
Fe, Oulu	R 1186	.	.	++	.	.	.	.	.	.	.	.	++	.	+	+	+	.
Fe, Uusimaa, Oulunkylä	R 1148	.	.	++	.	.	.	.	.	+	++	.	++	+	+	+	+	.
Su, Skåne, Vitemölla	R 861	.	.	++	.	.	.	.	.	.	.	.	+	.	+	+	+	.
Po, Gdansk, Rozewie	R 1098	.	+	+	.	.	.	.	.	.	.	.	.	.	+	.	+	.
L. maritimus f. *albo* 2n=14																		
Da, Köbenhavn, Bot. Gn.	R 1156	.	.	++	.	+	.	.	.	.	.	.	++	.	+	.	+	.
L. neurolobus Boiss. & Heldr. 2n=14																		
He, Genève, Bot. Gn.	R 969	.	.	+	.	.	.	.	.	++	++	.	.	.	.	.	+	.
Gr, Kríti, Iráklion, Cnossos	R 974	.	.	+	.	.	.	.	.	++	++	.	.	.	.	.	+	.
L. palustris L. var. *palustris* 2n=42																		
Su, Uppland, Lidingö, Ekholmsnäs	L 419	.	.	+	.	+	.	.	.	.	.	.	+	+	+	.	++	.
Fe, Oulu, Kempele	L 918	.	.	+	.	+	.	+	.	.	.	.	+	.	+	.	+	.
Rs, Lithuania, Kaunas	L 874	.	+	++	.	++	.	.	.	.	.	.	.	.	+	.	++	.
Br, Huntingdonshire, Wicken Fen	L 880	.	+	++	.	++	.	+	+	.	.	.	.	.	+	.	++	.
Ho, Drenthe, Selter Wijde	L 765	.	.	++	.	++	.	.	.	.	.	.	+	++	++	.	++	.
Ge, Schleswig-Holstein, Lübeck, 3 km NW	L 827	.	.	++	.	++	.	+	.	.	.	.	.	+	++	.	++	.
L. palustris var. *pilosus* Ledeb. 2n=14																		
Rs, Vladivostok	L 919	.	.	+	.	+	.	.	.	.	.	.	+	.	+	.	+	.
L. palustris var. *myrtifolius* Gray 2n=14																		
U.S.A., Alaska, Palmer	L 849	.	.	++	.	++	.	+	.	.	.	.	+	.	++	.	++	.
U.S.A., Michigan, Oakland Co	L 836	.	.	+	.	+	.	.	.	.	.	.	+	+	+	.	++	.
L. pisiformis L. 2n=14																		
Hu, Ursotallumar	R 1113	.	+	++	.	++	.	.	.	.	.	.	+	+	+	.	++	.
Rs, Omsk, Kirov	R 713	.	.	+	.	.	.	.	.	.	.	.	+	+	+	.	+	.
Rs, Leopolis	R 819	.	.	+	.	.	.	.	.	.	.	.	.	+	++	.	+	.
L. saxatilis (Vent.) Vis. 2n=14																		
Rs, Turcomania, Ashkhabaq, Bot. Gn.	R 1232	.	.	+	.	+	.	+	.	.	.	+	+	.	.	.	.	.

few analyses it was not possible to distinguish that variety from the varieties *pilosus* and *myrtifolius,* both with 14 chromosomes. Morphologically the American variety *myrtifolius* is characterized by its rela-

Table 8. Analysed spots in the section Orobus (L.)

	Coll. no	A_1	A_2	A_3	A_4	A_5	A_6	R_1	R_2	R_3	R_4	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7
OROBUS (L.)																		
L. inermis Roch. ap. Friv. 2n=14																		
Ju, Srbija, Priština	P 3024	.	+	++	.	++	.	.	.	++	.	.	.	+	+	.	++	.
L. luteus var. *aureus* Beck 2n=14																		
Rm, Cluj, Aghires	R 1135	+	+	++	++	++	++	.	.	.	.	.	.	.	++	.	++	.
Br, Manchester, Bot. Gn. ...	R 1039	.	+	++	++	++	+	.	.	.	.	.	+	.	++	.	++	.
Rm, Cluj, Făgăras	R 1041	.	+	++	++	++	+	++	.	.	.	.	.	.	++	.	++	.
Po, Wroclav-Kanonia	R 807	.	+	+	++	++	+	.	.	.	.	.	.	.	++	.	++	.
L. luteus var. *laevigatus* Beck 2n=14																		
Rm, Cluj, Făget	R 1020	.	.	++	.	+	.	.	+	.	.	.	.	.	++	.	.	.
Ge, Berlin, Bot. Gn.	R 1024	.	.	++	.	++	.	+	.	.	.	.	.	.	+	.	.	.
L. luteus var. *transsylvanicus* Beck 2n=14																		
Rm, Cluj, Făget	R 1046	++	.	++	.	.	.	.	.	.	.	.	+	+	+	.	++	.
L. montanus Bernh. 2n=14																		
Ga, Saone-et-Loire, Gray	R 628	.	.	+	++	+	++	.	.	.	.	.	.	.	+	.	++	.
Ge, Hessen, Marburg	R 716	.	.	+	++	+	++	.	.	.	.	.	.	.	+	.	++	.
Ge, Mecklenburg, Reinberg ..	R 738	.	.	+	++	+	++	.	.	.	.	.	.	.	+	.	++	.
L. niger Bernh. 2n=14																		
Su, Bohuslän, Holm	R 736	.	.	+	.	.	.	.	.	.	.	.	.	+	++	.	++	.
Rm, Cluj, Aghires	R 1132	.	.	+	.	+	.	.	.	.	.	.	+	+	+	+	+	.
Hu, Ursotallumar	R 1122	.	.	.	.	.	.	.	.	.	.	.	+	.	++	.	++	.
Cz, České Země, Karlštejn ..	R 1107	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	++	.
L. pannonicus var. *versicolor* Maly 2n=14																		
Hu, Ursotallumar	R 1118	+	.	++	.	++	.	.	.	.	.	.	+	+	+	.	+	.
L. venetus Rouy 2n=14																		
He, Genève, Bot. Gn.	R 1029	.	.	++	.	++	.	.	.	.	.	.	+	.	+	.	+	.
Rm, Ploesti, Caragiale	R 1059	.	.	++	.	++	.	.	.	+	.	.	+	+	++	.	++	.
Ju, Srbija, Soko Banja	R 871	.	+	++	.	++	.	.	.	.	.	.	+	.	++	.	+	.
Ju, Srbija, Mokra Gore	R 1068	.	.	++	.	++	.	.	.	.	.	.	+	+	+	.	++	.
Ju, Hercegovina, Konjic	R 866	.	.	++	.	++	.	.	.	.	.	.	+	+	++	.	++	.
L. vernus Bernh. 2n=14																		
Rs, Leningrad, Kolpino	R 882	.	++	++	.	+	.	.	.	.	.	.	.	.	++	.	+	.
Cz, Morava, Jihlava	R 874	.	+	++	.	+	.	++	.	.	.	.	.	.	++	.	+	.
Au, Oberösterreich, Steyr ...	R 894	.	+	++	.	+	.	+	.	.	.	.	.	.	++	.	+	.
Rm, Cluj, Făget	R 1052	.	+	++	.	+	.	+	.	.	.	.	.	.	++	.	+	.
It, Lombardia Brescia, Valvestino, Torano	R 1075	.	+	++	.	+	+	.	.	.	.	.	.	.	++	.	++	.
L. vernus f. *albidus* Döll 2n=14																		
Ge, Halle, Bot. Gn	R 918	.	+	++	.	+	.	+	.	.	.	.	+	+	++	.	++	.

Table 8. Continued.

	Coll. no.	A_1	A_2	A_3	A_4	A_5	A_6	R_1	R_2	R_3	R_4	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7
L. vernus f. *roseus* Beck 2n=14																		
Su, Stockholm, Bot. Gn.	R 916	.	+	++	.	+	.	++	.	.	+	.	.	+	++	.	+	.
Ge, Halle, Bot. Gn.	R 910	.	+	++	.	+	.	++	.	.	+	.	.	.	++	.	+	.
L. vernus var. *flaccidus* Arcang. 2n=14																		
Su, Stockholm, Bot. Gn.	R 900	.	+	++	.	+	.	+	.	.	.	.	.	.	++	.	+	.
Be, Gent, Bot. Gn.	R 1005	.	+	++	.	+	.	+	.	.	.	.	.	.	++	.	+	.
It, Lombardia Brescia, Valvestino, Torano	R 999	.	+	++	.	+	.	++	.	.	.	.	.	.	++	.	+	.
L. vernus var. *gracilis* Arcang. 2n=14																		
Ho, Utrecht, Bot. Gn.	R 896	.	+	+	.	.	.	+	.	.	.	.	.	.	++	.	+	.
Ho, Utrecht, Bot. Gn.	R 995	.	+	+	.	.	.	+	+	.	.	.	.	.	++	.	+	.
L. alpestris Rchb. 2n=14																		
Ga, Strasbourg, Bot. In.	R 1090	.	.	+	.	+	.	+	+	.	.	.	.	.	++	.	.	.

tively short and wide leaves. PECKET (1959) considered that *L. maritimus* Bigel., *L. palustris* L. and *L. pratensis* L. from this subsection ought to be brought to the subsection *Eulathyrus*. BELL (1962) placed species from *Orobastrum* in three different groups.

Sect. *Orobus* (L.)

PECKET (1959) has found that . . . "This section shows some variation in the constitution of leaf extracts but there are a number of similarities between the species". Remarkably many absorbing compounds were seen in ultraviolet light in *L. luteus* Peterm. and *L. montanus* Bernh. (tab. 8). The variation in pigments was small in the latter species. *L. luteus* var. *aureus* Beck had A_1—A_6, *L. luteus* var. *laevigatus* Beck had only A_3 and A_5, and *L. luteus* var. *transsylvanicus* Beck had A_1 and A_3. This taxon is partially biochemically separated from other varieties in *L. luteus* Peterm., e.g. it had no anthocyanidins but did have the additional yellow spot Y_3. Morphologically, *L. luteus* var. *transsylvanicus* Beck is recognizable by its size, light flowers and abundant pubescence. This autonomous taxon has a limited distribution with its few localities in Transsylvania. The opinion of the author is that it should be treated as a separate species. In BELL's work (1962) it is interesting that taxa from the *L. luteus* group are placed in three of his

Table 9. Analysed spots in some Extra-European species of Lathyrus and in Pisum sativum L. and Vicia angustifolia L.

	Coll. no.	A_1	A_2	A_3	A_4	A_5	A_6	R_1	R_2	R_3	R_4	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7
L. davidii Hance 2n=14																		
Rs, Vladivostok, Bot. Gn. ...	R 1181	.	+	+	.	+	++	.	.	.	.	.	.	.	.	.	+	.
L. laetiflorus Greene 2n=14																		
U.S.A., California, Claremont	R 1152	.	.	++	.	+	.	.	.	.	.	.	++	+	+	.	.	.
L. mulkak Lipsky 2n=14																		
Rs, Tadzhikistan, Duschanbe	R 852	.	+	++	.	.	.	+	.	.	.	.	.	.	+	.	+	.
L. venosus Muhl. ex Willd. 2n=28																		
Canada, Montreal, Bot. Gn...	R 1185	.	+	++	.	.	.	.	.	.	+	.	+	.	++	.	+	.
L. undulatus Boiss. 2n=14																		
Br, Kew, Bot. Gn.	R 1225	.	.	++	.	++	.	.	+	.	.	+	+	.	++	+	+	.
Pisum sativum L. 2n=14																		
Su, Lund, Bot. Gn.	R 1500	.	.	++	.	+	.	.	.	.	.	.	+	.	+	+	++	.
Vicia angustifolia L. 2n=14																		
Su, Blekinge, Lösen	R 1501	.	.	++	.	.	.	+	.	+	.	.	+	+	++	.	+	.

five groups. BELL does not give the names of any authors and a comparison with other works is difficult.

Many yellow spots occurred in *L. niger* Bernh. In the *L. vernus* group R_1 was common but not in *L. venetus* Rouy. These species are generally considered as closely related to each other. The two yellow spots Y_2 and Y_3 were common in *L. venetus* Rouy but not in *L. vernus* Bernh. Ferulic acid (A_3) was also more common in the *L. vernus* group. It may be mentioned that ASCHERSON & GRAEBNER (1906—10) brought these two species together as "Gesammtart *L. vernus*". Morphologically the two taxa are dissimilar in the form of the leaves, the size of the flowers, the number of flowers per peduncle and the colour of the flowers. Their geographical distributions are partly different. *L. vernus* Bernh. exists in most of Europe but is rare or missing in the south-east area, that is, in the south part of Roumania, Yugoslavia, Bulgaria and Greece, while *L. venetus* Rouy grows in south-east Europe. A more detailed investigation of *L. vernus* Bernh. and *L. venetus* Rouy is planned.

In table 9 there are some analysed taxa that have no natural distribution in Europe. There are also analyses of *Pisum sativum* L. and *Vicia angustifolia* L. The genus *Pisum* is considered to be the nearest related genus to *Lathyrus*.

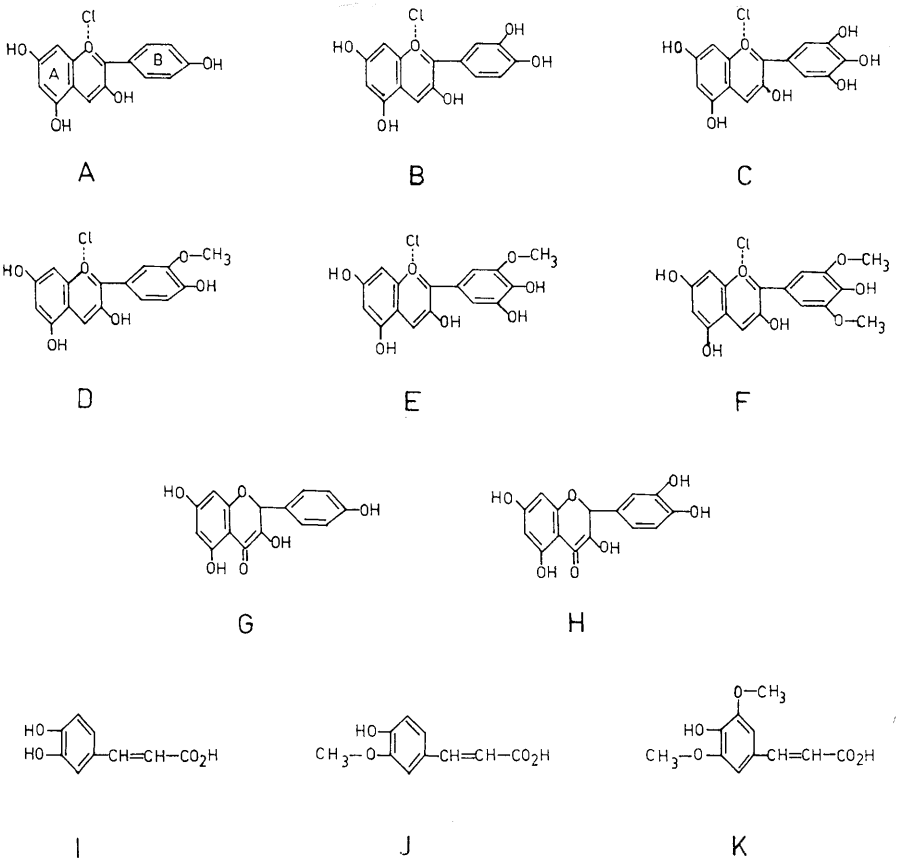

Fig. 2. The chemical structures of some common phenolic compounds. A pelargonidin, B cyanidin, C delphinidin, D peonidin, E petunidin, F malvidin, G kaempferol, H quercetin, I caffeic acid, J ferulic acid and K sinapic acid.

Discussion

The genetic background of biochemical differences in plants have been stated in only relatively few cases. SANYAL, GHOSH & KUNDU (1961) studied inheritance of anthocyanin pigmentation patterns in *Hibiscus sabdariffa* L. and said that 18 factors are responsible for the colour production in that species.

The variation of flower colour in *Lathyrus odoratus* L. is treated in several works. BEALE, ROBINSON, et al. (1939) reported that the genes affecting the anthocyanidin type do not influence the flavonol composition in *Lathyrus odoratus* L. and remarked: "In conclusion it may be

stated that a genetical and chemical analysis of *L. odoratus* shows it to accord admirably with the majority of other plants which have been investigated in a similar way. In this connexion it is perhaps important to recall the fact that all variations which occur in the modern sweet peas have most likely arisen as mutations from a single wild form . . . Interspecific hybridization, which succeeds only rarely within the genus *Lathyrus* (see Senn, 1938), has apparently not been involved." SCOTT-MONCRIEFF in 1936 stated that nine factors are responsible for the variation in flower colour in *Lathyrus odoratus* L.

The resemblance in chemical structures of some commonly occurring phenolic compounds is shown in fig. 2. In the last few years C^{14}-tracer studies have shown the early precursors of the anthocyanins and of related flavonoids. The A-ring (fig. 2) of anthocyanidins originates from three acetate units, while the B-ring (fig. 2) and the central three-carbon moiety are derived from a phenylpropanoid unit. The nature of the intermediates between these precursors and the intact pigment are still largely unknown. The biosynthesis of flavonols and anthocyanins probably differ at the C_9 level. Glycosylation appears to occur nearly at the end of the synthesis and may be associated with methylation and acylation (HARBORNE 1962).

The genetic background of biochemical differences in plant pigments is probably very variable in different genera and species. When the genetic basis of these differences is known, the possibility of determining the systematic significance of biochemical differences will be much greater. In evolution the selective value of phenolic compounds may be limited.

Phenolic compounds may have a restricted value in plant taxonomy to separate genera and subgenera. The author also believes that while the qualitative distribution of amino acids is of limited value, peptids, proteins and enzymes will eventually serve as primary characteristics for taxonomic evaluation.

Some specific compounds may have a good but limited taxonomic value. The amino acid lathyrine was identified in *Lathyrus tingitanus* L. (BELL 1961, BELL & FOSTER 1962). About 300 species of *Leguminosae* have been tested for the presence of lathyrine but this acid has only been detected in some species of *Lathyrus*.

Writing about the disease lathyrism SELYE (1957) says: ". . . it is clear that *L. odoratus* produces predominantly (if not exclusively) osteolathyric changes, particularly in the rat. It is not known whether this pea is poisonous to man. *L. sativus, L. cicera, L. clymenum, L. lati-*

folius, L. splendens, L. sylvestris and *L. sphericus* appear to produce only neurolathyrism in animals and in man. *L. pusillus* and *L. hirsutus* are claimed to damage the bones and the nervous system." SELYE states that probably different factors are responsible for the skeletal and the nervous disease. In seeds of *L. odoratus* L. this factor is described as β-(N-γ-L-glutamyl)-aminopropionitrile (SCHILLING & STRONG 1955) and the same toxic component is found in *L. pusillus* Elliot (DUPUY & LEE 1956). The neuroactive factor in *L. latifolius* L. has been identified as L-α,γ-diaminobutyric acid. This amino acid has also been found in the seeds of *L. sylvestris* L. (RESSLER et al. 1961). These toxic components exist in species that taxonomically are placed in several subsections of the genus *Lathyrus*. It can be pointed out that the two related species *L. latifolius* L. and *L. sylvestris* L. have the same toxic factor, while *L. odoratus* L. in the same subsection has the other toxic component.

In this investigation no characteristic differences in the nature of the analysed phenolic compounds between the two related genera *Lathyrus* and *Pisum* were found, which was also valid for *Vicia*. This result cannot be generalized, and such an analysis may have a systematic value in other genera. However, to separate genera there are often other and perhaps better criteria, such as cytology, morphology and palynology. On a higher taxonomic level than the genus qualitative differences may exist between separate groups from a biochemical point of view.

From this investigation in which 17 different spots were seen it is clear that it is impossible to separate sections and subsections in *Lathyrus*. PECKET (1959), who has also analysed leaves in *Lathyrus,* has found four different compounds by paper chromatographic analysis. From those results he implied that the four species *L. hirsutus* L., *L. maritimus* Bigel., *L. palustris* L. and *L. pratensis* L. which all have been placed in other subsections of the genus may be brought to the same subsection, *Eulathyrus*. However, the four compounds seen by PECKET are very common in the whole genus and all of them were found in the four mentioned species with help of the improved analytic method of thin-layer chromatography in the present study. Thus, it is dangerous to draw conclusions and to separate subsections based on so few components.

BELL (1962) studied ninhydrin-reacting compounds of the seeds in

Table 10. Examples of intravariation in Lathyrus

	Coll. no.	A_1	A_2	A_3	A_4	A_5	A_6	R_1	R_2	R_3	R_4	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7
L. binatus Pančić 2n=14																		
Ju, Bosna, Trebević	BAA: 1	.	.	++	.	++	.	.	.	++	.	.	.	.	+	+	++	.
	BAA: 2	.	.	+	.	++	.	.	.	++	.	.	.	.	+	+	++	.
	BAA: 3	.	.	+	.	++	.	.	.	++	.	.	.	.	+	+	++	.
L. pratensis L. 2n=28																		
He, Urserenthal, Hospenthal Reuss	PSG: 1	.	.	+	.	++	.	.	.	++	.	.	+	.	+	.	++	.
	PSG: 2	.	.	+	.	+	.	.	.	++	.	.	+	.	+	.	++	.
	PSG: 3	.	.	+	.	++	.	.	.	++	.	.	+	.	+	.	++	.
	PSG: 4	.	.	+	.	++	.	.	.	++	.	.	+	.	+	.	++	.
L. sphaericus Retz. 2n=14																		
Da, Samsö, Maarup	E 12: 1	.	.	+	.	.	.	.	.	+	.	.	.	.	++	.	.	.
	E 12: 2	.	.	++	.	.	.	.	.	+	.	.	.	.	++	.	.	.
	E 12: 3	.	.	+	.	.	.	.	.	+	.	.	.	.	++	.	.	.
	E 12: 4	.	.	+	.	.	.	.	.	+	.	.	.	.	++	.	.	.
L. luteus var. *transsylvanicus* Beck 2n=14																		
Rm, Cluj, Făget	R 1046: 1	++	.	+	.	.	.	.	.	.	.	.	+	+	+	.	++	.
	R 1046: 2	++	.	++	.	.	.	.	.	.	.	.	+	+	+	.	+	.
	R 1046: 3	++	.	++	.	.	.	.	.	.	.	.	+	+	+	.	++	.
	R 1046: 4	++	.	++	.	.	.	.	.	.	.	.	+	+	+	.	++	.

Lathyrus and he found at most five such components in some species. He writes: "... within the genus there existed well defined groups of species that were characterized, not by the presence of an arbitrary concentration of one specific ninhydrin-reacting compound, but rather by the presence of associated groups of such compounds. These groups of associated compounds appeared as characteristic patterns after the seed extracts had been chromatographed or subjected to ionophoresis on paper. In the extracts of most, but not all, of the species examined the spots forming the characteristic patterns were of comparable size and intensity." It can be pointed out that BELL's classification does not agree with the limits of the sections and subsections of *Lathyrus*. In this investigation it has not been possible to divide the analysed species after associated different groups of compounds.

On examination of the critical groups of species a biochemical analysis of phenolic compounds may be a good complement to the taxonomic work. From this investigation it is evident how great the resemblance is between *L. heterophyllus* L., *L. latifolius* L. and *L. sylvestris* L. These species are very similar in several morphological charac-

teristics, too. Thus, the biochemical analysis here is a good support to the commonly accepted view that these species are closely related.

In the *L. pratensis* group the author has made a detailed investigation in cytology, ecology, geographical distribution, morphology and crossing experiments (unpublished). Based on these examinations the author distinguishes the three species *L. binatus* Pančić, *L. hallersteinii* Baumg. and *L. pratensis* L. (LINNAEUS 1753, BAUMGARTEN 1816, PANČIĆ 1874). The test of phenolic compounds in leaves gave good differences between these taxa. *L. pratensis* L. had delphinidin and the yellow spot Y_2. *L. binatus* Pančić and *L. hallersteinii* Baumg. lacked these compounds but had, instead, the yellow spot Y_5. Thus, a biochemical analysis of phenolics in leaves of the *L. pratensis* group is a good additional criterion to other systematic methods.

Generally *L. vernus* Bernh. and *L. venetus* Rouy are considered to be closely related and ASCHERSON & GRAEBNER (1906—10) even bring the two species together to "Gesammtart *L. vernus*". In addition to some morphological differences between the species their phenolic compounds in leaves were partly different. The red spot R_1 was common in *L. vernus* Bernh. but lacked in *L. venetus* Rouy which instead had the yellow spots Y_2 and Y_3.

In the *L. luteus* complex there were some differences between the analysed taxa. Thus, the variety *aureus* had the absorbing spots A_1—A_6, while the other varieties analysed only had two such spots. The variety *transsylvanicus* is both morphologically and biochemically distinct from the others. That variety also has a limited distribution occurring only in Transsylvania. The opinion of the author is that *transsylvanicus* ought to be treated as a separate species. There are clear differences between the two other taxa analysed, but as no relation with studies in cytology, ecology and morphology can be made at this time it is impossible to evaluate their taxonomical importance.

Some few species in *Lathyrus* had relatively characteristic systems of phenolic compounds in leaves; e.g. in *L. montanus* Bernh. many absorbing spots were found.

A comparison was made in species with more than one chromosome number. Collections of *L. pratensis* L. in Europe have either 14 or 28 chromosomes in somatic tissue (seldom 21 or 42). From table 5 it is clear that there were no differences in the phenolic compounds of the leaves of taxa with different chomosome numbers. However, the resem-

Table 11. The distribution of chromatographic spots in relation to the numbers of taxa analysed in different groups

Groups	No. of taxa	A_1	A_2	A_3	A_4	A_5	A_6	R_1	R_2	R_3	R_4	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7
Aphaca Tourn.	2	.	2	2	.	2	.	1	.	1	.	.	1	.	2	.	1	.
Cicerula Mnch.	5	.	1	5	.	4	.	5	.	.	.	2	4	1	5	.	5	.
Clymenum DC.	3	.	1	3	.	2	.	2	.	.	.	.	3	1	3	.	3	.
Eulathyrus Ser.	9	.	1	9	.	7	.	2	.	1	3	.	7	2	9	4	9	.
Nissolia Tourn.	1	.	.	1	.	.	.	.	1	.	.	1	1	.	1	.	1	.
Orobastrum Gren. & Godr.	17	.	4	17	.	13	.	7	1	10	7	1	13	4	14	4	14	2
Orobus (L.)	14	3	8	14	2	12	3	8	3	2	1	.	6	7	14	1	12	.
Extra-European species	5	.	3	5	.	3	1	1	1	.	1	1	3	1	4	1	4	.
Sum total	56	3	20	56	2	43	4	26	6	14	12	5	38	16	52	10	49	2

blance in morphology between diploid and tetraploid *L. pratensis* L. is great.

L. palustris L. has in Europe only the chromosome number 2n=42. In America and Asia there are also populations with 14 chromosomes in somatic tissue. Their phenolic compounds in leaves are about the same. In the species examined with different chromosome numbers in *Lathyrus* it was not possible to draw any conclusions from differences in phenolic compounds in leaves. However, the results of a such a comparison of species with several chromosome numbers in other genera may be different. A study of anthocyanidins in *Lathyrus* showed that they are distributed in about the same number of annuals and perennials.

In studies of variation between collections in the same taxon biochemical tests with thin-layer chromatography can give interesting results. From this investigation in *Lathyrus* it is evident that there is some variation between collections in the same species. This fact has not been emphasized enough in earlier works. To get reliable results it is necessary to analyse several samples of the same taxon. In most of the earlier examinations only one collection of every species has been analysed.

Twenty collections of *L. sphaericus* Retz. were analysed and from a biochemical point of view they could be divided into three groups which had different geographical distribution (tab. 6, fig. 1).

The variation of phenolic compounds between populations in the same taxon in some cases may be determined by relative simple genetic factors. Certainly the variation between collections is different in autogamous and allogamous species.

In the same way there was little variation between individuals in the

same collection in the mainly autogamous genus *Lathyrus* (tab. 10). The intravariation in allogamous genera might be larger.

A thin-layer chromatographic analysis of phenolic compounds in leaves is a good additional criterion to other accepted ones in taxonomy particularly in studies on the level of species or taxa of lower ranks. The method may also be used in studies of hybrids or for identification of the ancestry of some taxa (STEBBINS et al. 1963) and may be used to detect species-specific compounds for diagnostic purposes.

All biochemically analysed collections were determined as to their chromosome numbers. All taxa had the somatic chromosome number 2n=14 with the exception of *L. palustris* L. which also had 2n=42, *L. pratensis* L. with 2n=14 or 2n=28 (seldom 2n=21 or 42) in somatic tissue, while *L. venosus* Muhl. ex Willd. only had 2n=28. Thus, the genus *Lathyrus* has very unitary chromosome numbers, cf. also SENN (1938 a, b).

Summary

Species of the genus *Lathyrus* mainly from Europe were analysed as to their phenolic compounds in leaves. The material used was when possible spontaneous and was sown and cultivated in the Botanical Garden, Lund, Sweden, under comparable conditions. The alcohol-phases of hydrolysed extracts of leaves were analysed, using two-dimensional thin-layer chromatography. The spots received were identified by their colours and R_f-values and chromatographic comparison with pure samples of some common phenolic compounds made it possible to identify some spots (tab. 1). The results of the analyses are given in the tables 3—11, where the number of plus signs is roughly proportional to the amounts of the substances that were found on examination of the chromatograms in visible and ultraviolet light. The nomenclature used is after ASCHERSON & GRAEBNER (1906—10) and the names of the countries are abbreviated in the tables in the same manner as in TUTIN et al. (1964).

The investigation was intended to illustrate the usefulness of biochemical analyses of phenolic compounds in leaves for taxonomic works with *Lathyrus* on generic, subgeneric, specific and subspecific levels and to illuminate the variation between and to some extent within populations. Comparisons with other biochemical works within *Lathyrus* are done (e.g. SELYE 1957, PECKET 1959, 1960, BELL 1962). In this study no characteristic differences in the nature of the analysed phenolic compounds between the genera *Lathyrus, Pisum* and *Vicia* were found (tab. 9). In the same manner it was not possible to separate different groups within the genus *Lathyrus* (tabs. 3—9, 11). Some commonly occurring phenolic compounds resemble each other in chemical structure (fig. 2) and may be dependent on relatively simple genetical factors. Thus, phenolic compounds may have a restricted value in plant taxonomy to separate genera and subgenera. On examination of the critical groups of species a biochemical analysis of phenolic compounds may be a good additional criterion to other accepted ones such as anatomy, cytology, ecology, palynology, physiology,

morphology and crossing experiments e.g. in the *L. pratensis* group (tab. 5). Species with different chromosome numbers showed no differences of phenolic compounds (tab. 5, 6). In *Lathyrus,* anthocyanidins were distributed in the same number of annuals and perennials. Some variation of the occurring spots between collections in the same taxon was often found. Thus, twenty collections of *L. sphaericus* Retz. could be divided into three groups which had different geographical distributions (tab. 6, fig. 1). The variation between individuals in the same collection was small in the mainly autogamous genus *Lathyrus,* but the intravariation in allogamous genera might be larger (tab. 10). Besides the usefulness of thin-layer chromatographic analyses, especially on the levels of species or taxa of lower ranks, the method may be successful for identification of the ancestry of some taxa (STEBBINS et al. 1963) and to detect specific compounds for diagnostic purposes. All biochemically analysed collections were determined as to their chromosome numbers (tabs. 3—10). Earlier unpublished somatic chromosome numbers of some taxa in *Lathyrus* are presented in table 2.

Acknowledgements

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Arctotis venusta T. Norl. spec. nova, an Ornamental Plant from Southern Africa

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The first collections of *Arctotis venusta* date back to 1824 and to the 1830's, when ZEYHER gathered them in three localities, i.e. in the south-eastern and north-eastern parts of the Cape Province in the Somerset East and Aliwal North districts and in the southernmost part of the Orange Free State in the Rouxville district. Those of his specimens which are kept in SONDER's herbarium (S),[1] were collected at an early flowering stage, when they appeared as rosette plants. Their seeming lack of stems caused them to be misinterpreted and they were originally named *Arctotis acaulis,* which is a perennial herb quite different from the species in question.

When LEWIN published his monograph on the genus *Arctotis* in 1922, he made several nomenclatural mistakes and named the plant, now to be called *A. venusta, "A. stoechadifolia"* (p. 69). This is surprising, as BERGIUS' exhaustive and excellent diagnosis does not fit this plant (NORLINDH 1963, p. 193). The latter name *"A. stoechadifolia"* has, since LEWIN started his work on *Arctotis,* quite naturally been used by most botanists, for instance DINTER and MARLOTH. As a matter of fact DINTER had three years earlier used this erroneous name for the same species (DINTER 1919, p. 341) but as LEWIN at that time had already begun his work on the tribe *Arctotideae,* one must suppose that it was LEWIN and not DINTER who originally perpetrated this misinterpretation of *A. stoechadifolia.*

For the true *Arctotis stoechadifolia* Berg., LEWIN used the name *A. decumbens* Thunb. (p. 67), which is merely a synonym. This is a perennial plant, only known from the Cape proper, where it mainly

[1] Herbarium abbreviations according to LANJOUW & STAFLEU, Index Herbariorum I, ed. 5 (1964), pp. 205—228.

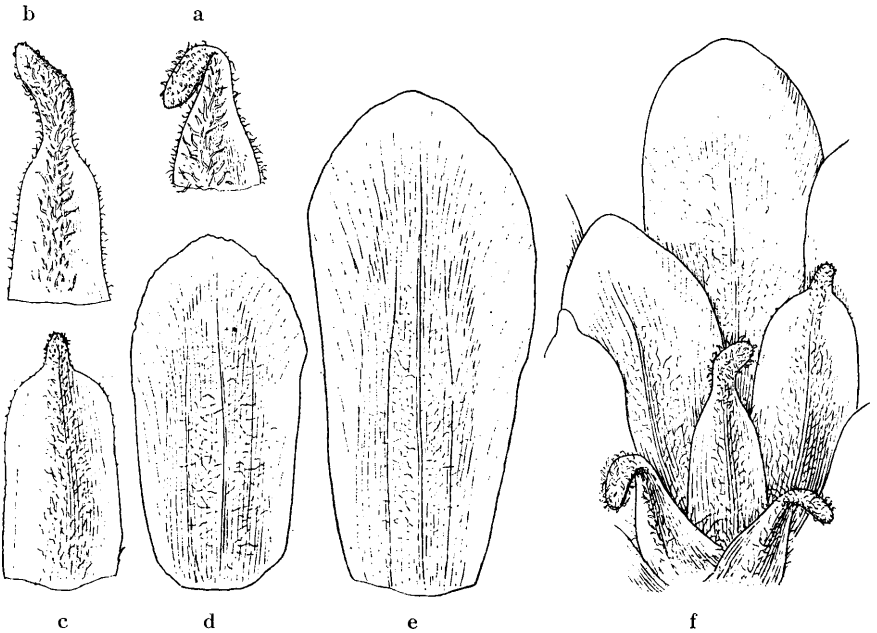

Fig. 1. *Arctotis venusta* T. Norl. *a*—*e* form series of involucral scales, arranged approximately into five rows. — *a* outermost triangular scale ending in a fairly short linear—elliptic appendix, only about half as long as the remaining part of the scale. — *b* next to outer triangular-oblong scale ending in a linear-oblanceolate appendix. — *c* median oblong scale with a mucro. — *d, e* next to inner and innermost obovate-oblong membrane-tipped scales, lacking appendix or mucro. — *f* part of involucre. — [*a*—*f* drawings from a cultivated specimen raised from seed of a collection from Bloemfontein, NORLINDH, n. 5834 (S)]. — *a*—*e* ×5; *f* ×4.2.

occurs in sand dunes or other sandy localities. It is characterized i.a. by a decumbent stem, more or less lignified, which already from its basal parts sends out decumbent branches of up to a metre's length in various directions.

A detailed account of the differences between *A. stoechadifolia* Berg. and *A. venusta* T. Norl. has already been given by the author (NORLINDH 1964, pp. 199—202). As is evident from the diagram in this paper (p. 200), these species differ with regard to so many essential characteristics that there is good reason for placing them in different sections of the genus.

Arctotis venusta is an annual herb, usually with an erect stem. It does not occur wild in the Cape proper. This species grows mainly in semi-

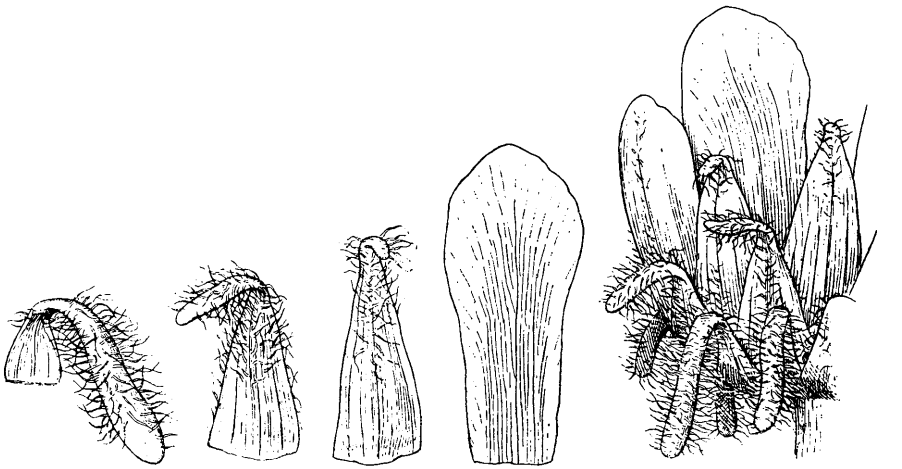

Fig. 2. *Arctotis leiocarpa* Harv. *a*—*d* form series of involucral scales. — *a* outermost ovate-triangular scale ending in a long appendix, more than 2 times longer than the remaining part of the scale. — *b* next to outer triangular scale with a linear appendix. — *c* median elongated triangular scale with a short appendix. — *d* obovate-oblong membrane-tipped scale representative of the two inner rows, lacking appendix. — *e* part of involucre (about 5-seriate). — [*a*—*e* drawings from a cultivated specimen raised from seed of a collection from the Prince Albert District, NORLINDH, n. 5643 (S)]. — *a*—*d* ×5; *e* ×4.2.

arid regions. The main distribution area extends from the Orange Free State to far up in South West Africa and its southernmost outposts as a wild species seem to be in the Karroo. The indigenous name "the gousblom of the Karroo" (MARLOTH 1932, p. 278), does not fit this species well, because the Karroo only forms a small part of its distribution area.

Already in 1939—1940, in connection with the naming of a profuse material of *Arctotis,* gathered, among others, by ADOLF HAFSTRÖM and ERIK WALL, and after a close study of BERGIUS' type specimen, as well as of his diagnosis of *Arctotis stoechadifolia,* I realized that LEWIN had completely misinterpreted this species. The plant which LEWIN had in mind, I gave the preliminary name *Arctotis venusta,* and I also gave the ACOCKS et HAFSTRÖM collection (S), 1936, n. 908, Griqualand West, from sandy soil along a road at Dronfield, this name. However, at that time I did not consider my knowledge of the genus sufficient for the description of this plant as a new species. It was possible that among the large

number of *Arctotis* species described in the past, particularly by JACQUIN, there might perhaps be one identical with *Arctotis venusta*. This has not, however, proved to be the case. In 1963, before my second journey to Southern Africa, I recommenced my study of *Arctotis*, and since then I have been able to make such a profound investigation of the numerous species in this genus that I feel sure that the species preliminarily named *Arctotis venusta* by me has not previously been described. Therefore I now consider it time to publish this species validly.

Arctotis venusta T. Norl. spec. nova

T. NORLINDH in Svensk Bot. Tidskr., Bd 58 (1964), pp. 199—202.

S y n.: "*Arctotis stoechadifolia*" (non Berg.) Dinter in Fedde, Repert. spec. nov. regn. veg., Fasc. 15 (1919), p. 341; op. cit., Beih. 3 (1921), pp. 41, 123, 134, 136, 139, 142 et Beih. 53 (1928), pp. 11, 13. — LEWIN in Fedde, op. cit., Beih. 11 (1922), pp. 69—70. — MARLOTH, Fl. S. Africa, Vol. III: 2 (1932), pp. 221, 278. — "*Arctotis grandis*" (non Thunb.) Wittmack, Gartenflora 49 (1900), p. 557. — BOYNTON in Addisonia, Vol. 3 (1918), pp. 45—46. — BAILEY, Stand. Cyclop. Hortic., Vol. 1 (1950), p. 386. — "*Arctotis stoechadifolia* var. *grandis*" (non Less.) Warren in Ann. Natal Mus., Vol. VI (1929), p. 171.

I c o n.: WITTMACK, op. cit., p. 556, Fig. 71. — BOYNTON, op. cit., Tab. 143. — LEWIN, op. cit., Tab. 3, 4. — WARREN, op. cit., Fig. 1—7 (partly) and Tab. 12 (partly). — BAILEY, op. cit., Fig. 386. — Fig. nostrae 1 *a*—*f*, 3 *a*.

T y p u s s p e c i e i: South Africa, Griqualand West, along road at Dronfield, ACOCKS et HAFSTRÖM, 1936, n. 908, in herb. Holm. (S).

H e r b a annua 1—6 dm alta; radix perpendicularis lignescens; caules singulares vel pauci e collo herbaceo exeuntes erecti vel adscendentes usque 1 cm crassi e basi ramosi vel (in speciminibus junioribus vel depauperatis) simplices; caules et rami fistulosi striato-sulcati; planta tota tenuiter cano-arachnoideo-tomentosa vel in partibus vetustioribus glabrata. F o l i a alterna crassiuscula valde variabilia; basalia conferta ± conspicue rosulata elliptica—obovata obtusa margine grosse sinuato-dentata—pinnatilobata, dentibus vel lobis obtusis utrinque 3—5, petiolata, petiolo usque 5 cm longo; folia caulina et ramealia ± remota, internodiis usque 7 cm longis, inferiora basalibus similia, cetera (summis exceptis) ambitu oblanceolata—anguste oblonga sinuata—pinnatilobata—lyrata sessilia vel basin versus in petiolum angustata semiamplexicaulia saepe ± auriculata; nervus medius subtus valde elevatus, nervi laterales vulgo duo conspicui. C a p i t u l a spectabilia in apicibus caulium et ramorum solitaria vel rarissime in corymbum laxum disposita pedunculata; pedunculi (rami capituliferi) longitudine valde variabiles usque 14 cm longi subnudi, bracteis foliaceis 1—2 linearibus vel lineari-oblanceolatis integerrimis vel sinuato-dentatis instructi. I n v o l u c r i s q u a m a e virides et herbaceae (marginibus et apice interiorum exceptis) inaequilongae ± conspicue 5-seriatae, dorso (interioribus exceptis) tenuiter floccoso-tomentosae; exteriores fere triangulares in appendicem breviter lineari-ellipticam obtusam obscure viridem elongatae; subexteriores triangulari-oblongae in appendicem line-

arem productae; mediae oblongae ±conspicue mucronatae marginibus anguste hyalino-scariosae; subinteriores et interiores obovato-oblongae dorso subglabrae marginibus et apice sat late hyalino-scariosae; squamae interiores exterioribus multo longiores; appendix squamarum exteriorum parte cetera fere dimidio brevior. Flores radii involucrum plus duplo superantes; ligulae supra albae basi flavae subtus cupreo-purpureae vel rubro-lilacinae vel ± violaceae; discus obscurus caeruleo-lilacinus vel purpureus vel atro-purpureus. Achaenia dura obscura subobovoidea c. 3 mm longa, lateribus tangentialibus glabris vel subglabris, latere ventrali ±dense piloso, basi fasciculo pilorum copioso ornata et apice pappo hyalino biseriato, paleis interioribus 3—4 mm longis exterioribus multo minoribus, coronata; cavities oblongae, parietes laterales cavitierum margine involuti et ±distincte dentati.

Cape Province: Somerset East: "Heideartig an Höhen der 1:sten Region unweit Sommerset", (ECKLON et) ZEYHER, 1824, s.n. (S). — Herschel: 17.2 miles SE. of Tele Police St. on Lundean's Nek road. Dry scrubby hillside. MARAIS, 1955, n. 1058 (LD). — Aliwal North: "Cis-Garipina, vom nördlichen Fuss der Stormbergen bis Buffelvalei am Garip", 4000—5000′ [119.9], ZEYHER, s.n. (S). — Albert: District of Albert, COOPER, 1861, n. 666 (W). — Colesberg: Colesberg, SHAW, s.n. (W). — Griqualand West: North of Kimberley, HAFSTRÖM, 13 Oct. 1936, s.n. (S). — Sandy soil along road at Dronfield, ACOCKS et HAFSTRÖM, 1936, n. 908 (PRE, S). — Riverton, 20 miles W. of Kimberley, HALL, 1953, n. 647 (NBG, S). — Bushweld an der Pad Warrenton-Kimberley, MERXMÜLLER, 1957, n. 682 (W). — Gordonia: Upington, STEYN, 1950, n. 980 (NBG).

Basutoland: Leribe, DIETERLEN, n. 426 (NH, SAM). — Maseru, COMPTON, 1951, n. 22552 (NBG).

Orange Free State: Rouxville: "Trans-Garipina, Nieuwejaarspruit, zwischen Garip und Caledonriver, am Fuss der Witbergen," 4000—5000′ [114.10], ZEYHER, s.n. (S). — Reddersburg: 12 miles W. of Reddersburg, BARKER, 1959, n. 8849 (NBG, S). — Bloemfontein: Near Bloemfontein. Common roadside plant. PROSSER, 1950, n. 1524 (NBG). — Near Bloemfontein, roadside, NORLINDH, 1963, n. 5834 (S). — Eod. loco, NORLINDH et VAN ZINDEREN BAKKER jr, 1963, n. 5835 (S). — Betlehem: Between Kestell and Betlehem. At foot of Loskop, c. 1700 m s.m., DAHLGREN et PETERSON, 1957, n. F179 (LD). — Harrismith: Rensburgskop, c. 13 miles SE. of Harrismith, JACOBSZ, comm. NORLINDH, 1963, n. 5815.

Transvaal: Chunes Poort, South of Pieterburg, at edge of river, 4500 ft, WALL, 1938, s.n. (S).

S. W. Africa: Windhoek: Okahandja. An und in Rivieren, 1300 m s.m., DINTER, 1907, n. 427 (SAM). — Windhoek: Windhoek, Neudam Exp. Farm. Growing in vlei, v. VUUREN, 1960, n. 1050 (W). — 16 miles east of Windhoek, farm Ludwig 64. Road side, gravel, sand on rocky ground. Locally common, c. 2000 m s.m., KERS, 1963, n. 863 (S). — Gobabis: Witvlei. Witnossob River. Growing plenty as annuals on a dried up river bed, c. 1200 m s.m., KERS, 1963, n. 889 (S). — Furthermore there are 10 collections of this species, sub nom. *"A. stoechadifolia"*, from S. W. Africa cited by LEWIN (1922, pp. 69—70) in his monograph of the genus *Arctotis*. Those collections, which were kept in Berlin-Dahlem, were unfortunately destroyed during the last world war and it is uncertain if more than one of them, i.e. above mentioned DINTER n. 427, is in keeping as a duplicate.

Arctotis venusta often occurs as a weed in corn-fields and in certain regions this species can be included in the more common weeds, e.g. in the Orange Free State.

This species seems to have been introduced in Europe for the first time at the turn of the century. In WITTMACK's "Gartenflora", the 49th issue (1900), p. 556, it is pictured under the name *"Arctotis grandis"*. Besides a description of this "ausserordentlich schöne neue Annuelle" and its cultivation, one also finds there the interesting information that it originates from S. W. Africa. *Arctotis grandis* Thunb. is, however, as I have proved in an earlier investigation, only to be considered as a luxuriant habitat modification of the true *A. stoechadifolia* Berg. (NORLINDH 1964, p. 199).

Arctotis venusta is an easily cultivated annual with very beautiful flowers. It can therefore in course of time be expected to become a popular ornamental plant in European and North-American gardens. For instance at such a northerly degree of latitude as central Scandinavia (about 60°) the seeds ought, however, to be germinated in a hot-bed already during March or April in order to enable the plant to reach its most beautiful flowering. In Europe and America it has hitherto mostly been cultivated in botanical gardens, where it has been given the erroneous names of *"A. stoechadifolia"* and *"A. grandis"*. In seed catalogues it has long been offered under those names.

As a participant of the Botanical Tour in South Africa in 1963, arranged by the Kirstenbosch Golden Jubilee Council, I was happy to have the opportunity of studying numerous specimens of *Arctotis venusta,* which were growing on the outskirts of Bloemfontein in the Orange Free State. In so doing I got a good insight into the great variation within this species. A profuse material of the plant was gathered at different stages of development and in various habitat modifications, from depauperated to luxuriant forms. Furthermore, germinable seeds were gathered for the purpose of experimental cultivation of the plant in Swedish botanical gardens.

During two very rainy summers I have now had this plant from Bloemfontein under cultivation in the botanical gardens of Lund and Stockholm (Hortus Bergianus) and it has developed into a luxuriant form. The specimens have grown to about 3/4 metre's height, with considerable ramification and have produced a profusion of flowering heads. In their habit they deviate considerably from the mother plant, the wild form, growing on the steppe at Bloemfontein, i.a. through their greater ramification, their larger and more lobate, less hairy and greener

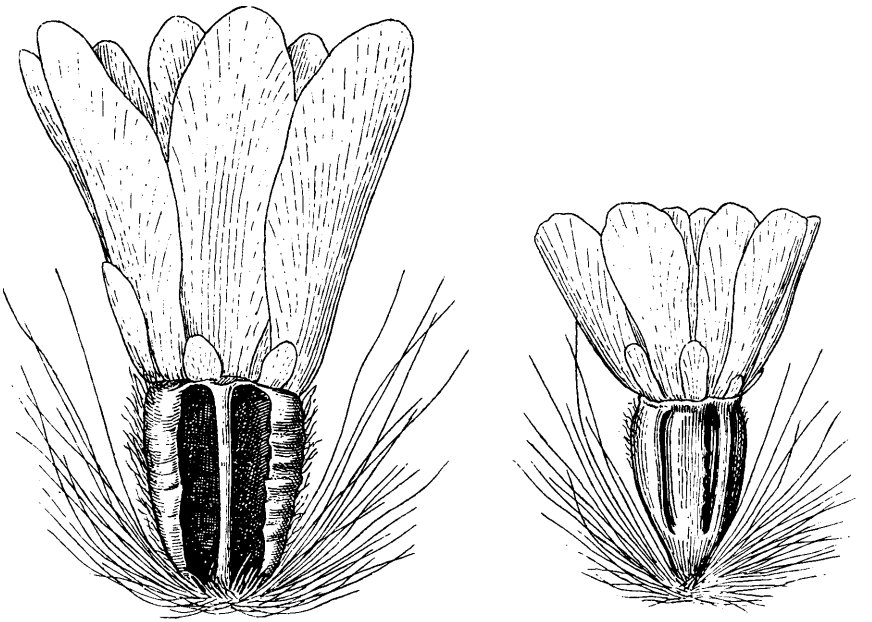

Fig. 3. Achenes of *Arctotis* figured from dorsal side, showing: 1) the basal tuft of long hairs (but anterior ones not drawn out) 2) the body with three vertical, dilated ridges (wings), of which the two lateral ones bend toward the central one, forming two longitudinal cavities 3) the biseriate pappus with an inner ring of large and an outer ring of small paleae. — *a A. venusta* T. Norl., achene obovoid, slightly hairy on the tangential sides. — *b A. leiocarpa* Harv., achene obconic, only slightly hairy on upper part of the tangential sides. — *a A. venusta* T. Norl. Bloemfontein, NORLINDH, n. 3534 (S). — *b A. leiocarpa* Harv. Prince Albert Distr., in Karroo, NORLINDH, n. 5643 (S). — *a—b* ×10.

leaves. With regard to the habit of growth, the coarse stems and branches, these cultivated specimens are most reminiscent of the luxuriant specimens, gathered by rivers, e.g. KERS n. 889 from S. W. Africa, the Gobabis district, Witnossob, on a dried up river bed, and WALL, 4/10/38, from Transvaal, Chunes Poort, at the river's edge; the latter two collections, however, show somewhat more canescent leaves.

During cultivation in Lund and Stockholm of the closely allied species *Arctotis leiocarpa* Harv., collected by the author in Karroo in the Prince Albert District (NORLINDH n. 5643), the plant has under the influence of the damp climate been modified in a corresponding manner, i.e. developed a highly luxuriant form.

A cytological examination of my cultivated specimens of *Arctotis venusta* from Bloemfontein (NORLINDH n. 5834) and *A. leiocarpa* from Karroo (NORLINDH n. 5643) has proved them to have the same number of chromosomes, 2n=18. Their areas of distribution partly overlap, contrary to the case of *A. venusta* and *A. stoechadifolia,* which have quite separate areas.

From a morphological point of view *Arctotis venusta* is more closely allied to *A. leiocarpa* than to any other species in this genus. The most essential distinguishing characters regard the involucre and disc. In involucres of *A. venusta,* when normally developed, the appendix of the outermost scales are considerably shorter than the remainder, ± triangular part of the scale (usually about half as long; see Fig. 1 *a*). However, in *A. leiocarpa* the appendix of the outermost scales is considerably longer (about two times) than the other part of the scale (see Fig. 2 *a*).

The disc of *A. venusta* is obscure with the colour of the corolla lobes varying considerably, e.g. dark blue-lilac, mauve blue, blue-black or purple. In *A. leiocarpa* the disc is usually yellow. However, this species population also comprises forms, in which the cucullate lobes of the central disc florets are somewhat obscure. The collection of *A. leiocarpa* I made in Karroo in the Prince Albert district, about 5 miles east of the northern end of Seven Weeks Poort Pass, NORLINDH n. 5643, comprises both forms. When cultivated in the botanical gardens of Stockholm and Lund these forms proved to stay constant and seemed to be identical in all characteristics, except in the colour of the central disc florets.

The characteristics of the indumentum are less essential and useful for the purpose of distinguishing these species. According to HARVEY the achenes of *A. leiocarpa* are quite glabrous on the surface. But this characteristic has not proved to be quite constant. As a rule the achenes are glabrous on the tangential sides, but often pubescent on the ventral side. In *A. venusta* the achenes are usually slightly hairy on the tangential sides, but more densely hairy or woolly on the ventral side. Contrary to *A. venusta, A. leiocarpa* is provided with more or less crispid hairs on branches, leaves and involucre, but in some extreme forms these hairs are very sparse and sometimes difficult to detect.

The achenes of *Arctotis venusta* and *A. leiocarpa* usually appear different in shape as seen from the illustrations (Fig. 3 *a* and *b*), those of the latter being ± obconic and somewhat smaller. However, the achenes vary considerably in shape as well as indentation of their two lateral ridges (wings). In some cases the differences between the achenes of these species have proved to be slight.

Arctotis venusta is able to form hybrids with other species in the genus. It is surprising that a hybridization has taken place with *Arctotis aurea* (DC.) Lewin (syn. *Venidium Wyleyi* Harv.) which belongs to the group *Hirsutae,* differing considerably from *A. venusta,* above all in the morphology of its achenes. This hybrid has been exhaustively treated by E. WARREN in his paper "On a Natural Hybrid between the Genera Venidium and Arctotis" (Ann. Natal Museum, Vol. VI: 2, 1929).

Acknowledgements

I beg to tender my sincerest thanks to the Directors and Curators of the above mentioned herbaria and museums for having made *Arctotis* material available for my research. I also wish to thank Mr S. EKBLOM, Stockholm, for his drawings of the floral parts of the species.

Summary

This beautiful ornamental plant seems to have been introduced from South West Africa to Europe for the first time at the turn of the century. From a morphological point of view *Arctotis venusta* T. Norl. is more closely allied to *A. leiocarpa* Harv. than to any other species in the genus. These species also have the same chromosome number, 2n=18. They mainly differ in regard to the length of the appendices of the outermost involucral scales (see Fig. 1 *a* and 2 *a*) and the colour of the disc. In *Arctotis venusta* the appendix of these scales is only about half as long as the remaining, ±triangular part of the scale, but in *A. leiocarpa* it is about twice as long as the other part of the scale. As to the colour of the flowers, *Arctotis venusta* differs from *A. leiocarpa* in having a non-yellow disc.

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Embryology of Frankenia Linn. with Some Comments on the Systematic Position of the Frankeniaceae

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The family *Frankeniaceae* is named after a Swedish botanist J. FRANKENIUS. Due to the presence of a decussate, heath-like foliage on the stem of *Frankenia* it is commonly referred to as the 'sea heath' family. Of the 5 genera comprising this family, *Frankenia* has the widest distribution, covering north and south temperate regions as well as the warm and dry parts of all the continents. HOOKER (1875) reports *F. pulverulenta* from the plains of Punjab and Sind. The other genera, however, are much restricted in distribution: *Hypericopsis* to S. Persia, *Beatsonia* to the Island of St. Helena (Africa), *Anthobryum* to W. South America, and *Niederleinia* to Patagonia (S. America).

The systematic position of the *Frankeniaceae* has been an unsettled problem since the time of BENTHAM & HOOKER (1862—1883). Studies on floral morphology and anatomy have indicated its possible affinities with some polypetalous families such as the *Tamaricaceae, Caryophyllaceae* and *Elatinaceae,* as well as a sympetalous family, the *Plumbaginaceae.* GUNDERSEN (1927) considers the *Frankeniaceae* "as a link in the classification of dicotyledons" especially between the *Parietales* and the *Caryophyllaceae.* Yet there is hardly any work on the embryology of this family. MAURITZON (1933) provides meagre data on the development of the embryo sac in *Frankenia hirsuta* which is of the Polygonum type; the pollen grains are 2-nucleate. DAHLGREN (1928) mentions the presence of hooked synergids in *F. hirsuta.* This investigation was, therefore, undertaken with a view to fill up, as far as possible, this lacuna in the existing literature on the embryology and to elucidate the systematic position of the family.

Materials and methods

Flowering specimens of *Frankenia hirsuta* Linn. were very kindly fixed in formalin-acetic-alcohol by Professor P. MAHESHWARI from the botanical gardens at Cambridge and Kew in August, 1961, and by one of us (R.N.K.) from the Kew Gardens in September, 1963. Some material of *F. pulverulenta* Linn. was collected by Professor P. MAHESHWARI from Berlin in August 1961, and subsequent collections were obtained by him from Germany through the courtesy of Professor THEODORE ECKARDT, Director of the Botanical Gardens and Museum, Berlin. We extend our grateful thanks to them.

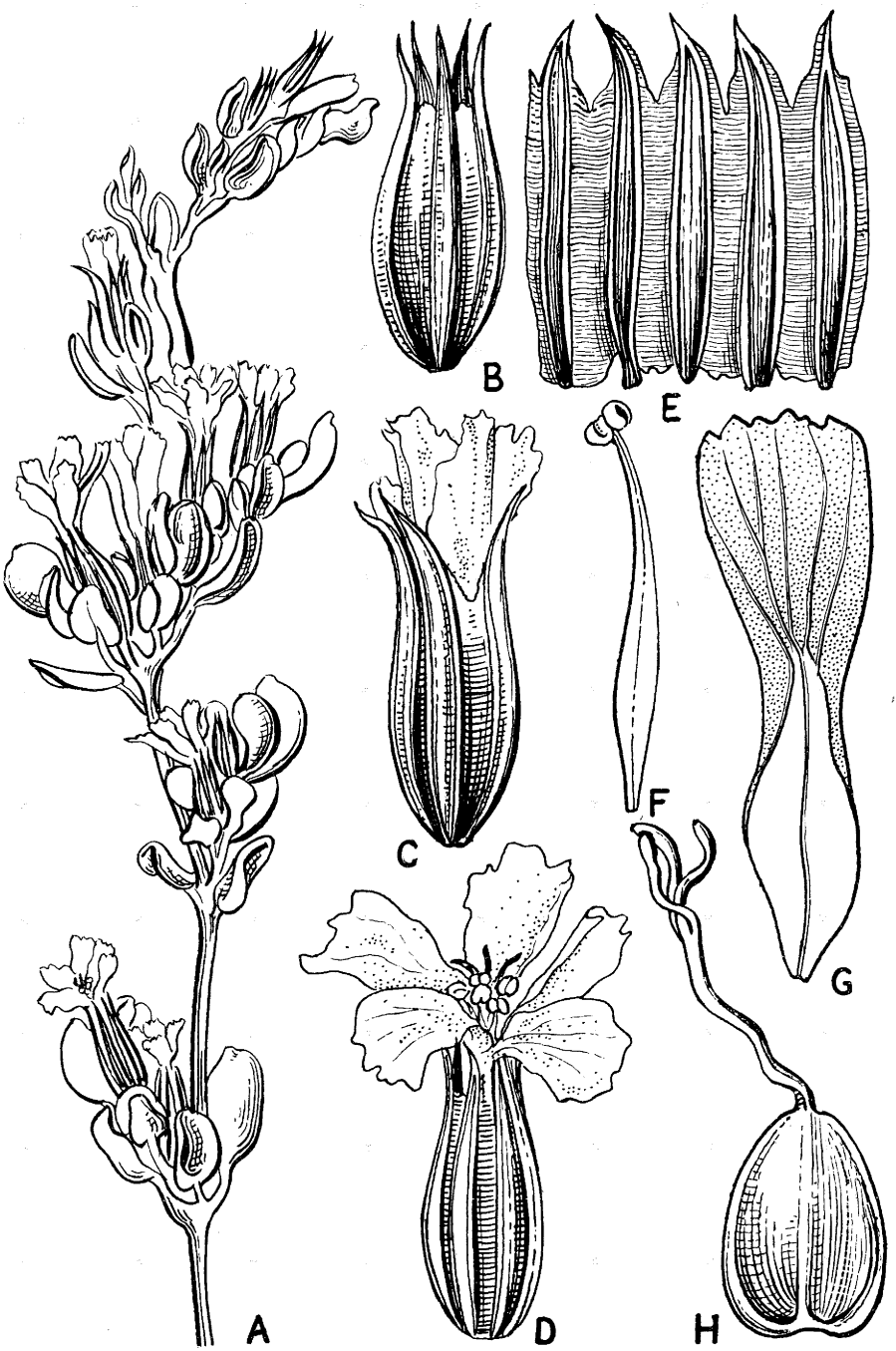
The material was dehydrated by passing through the alcohol-xylene series and imbedded in paraffin wax of 56—58°C melting point. To facilitate infiltration through the crustaceous seed coat, the young and old fruits were imbedded in rubber wax. This was prepared by dissolving 5 gms of vulcanized rubber in smoking hot paraffin to obtain a stock solution. Five grams of this stock solution were added to 100 grams of paraffin before use. Serial transverse and longitudinal sections of buds and flowers of different ages were cut between 7 and 30 microns. Both safranin-fast green and haematoxylin-fast green combinations were used for staining. ERDTMAN's (1960) schedule was employed for making acetolysed preparations of pollen grains.

Floral morphology

Frankenia is a small xerophytic herb blooming in the months of June and July. The leaves are opposite and decussate and their axils are adorned by small but conspicuous pink blossoms (Fig. 1 A). The flowers are sessile, bisexual, actinomorphic and bracteate (Fig. 1 B—D). The calyx consists of 5 coriaceous sepals (Fig. 1 E) which are united for most of their length to form a tube around the floral parts. There are 5 free petals which are clawed and have a scale-like appendage on the inside (Fig. 1 G). The androecium consists of 5 stamens, each of which consists of an elongated, flattened filament terminated by a small, round, versatile anther (Fig. 1 F). The gynoecium is tricarpellary, syncarpous and superior. The style is sinuous and terminated by three clavate lobes of the stigma (Fig. 1 H).

Microsporangium

A transection of the youngest anther available revealed a group of microspore mother cells surrounded by a tapetum, 2 or 3 middle layers, endothecium and an epidermis (Fig. 2 A, C). The cells of the epidermis become cutinized and persist in the dehiscing microsporangia. Except in the region of the stomium, the cells of the endothecium develop fibrous thickenings (Fig. 2B, D). The middle layers degenerate at the


A
B
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uninucleate stage of the pollen grains. With the inception of meiosis in the microspore mother cells, the tapetum becomes binucleate and 2-layered at places (Fig. 2 E—G). At the completion of reduction divisions, however, the tapetal cells commence degeneration in situ. Thereafter, the partition wall between two adjacent microsporangia disorganizes and dehiscence is effected in the region of the stomium by means of 2 longitudinal slits.

Microsporogenesis and male gametophyte

The microspore mother cells secrete a thick mucilaginous wall, undergo reduction divisions (Fig. 2 H, I) and yield tetrahedral, decussate or isobilateral tetrads by simultaneous furrowing (Fig. 2 J—L). Abnormal meiosis sometimes results in lagging chromosomes and chromatin bridges (Fig. 2 H) distributed in the cytoplasm.

The young microspore enlarges, becomes rounded and develops a thick exine and a thin intine with 3 germ pores (Fig. 2 M). Its nucleus divides to cut off a smaller generative and a larger, vacuolate vegetative cell. Sometimes an extra nuclear body which might have resulted from a lagging chromosome is also seen in a pollen grain (Fig. 2 N). Subsequently, the generative cell, surrounded by a characteristic halo, moves into the cytoplasm of the vegetative cell and elongates (Fig. 2 O) prior to its division engendering the 2 male gametes. The pollen grains are tricolpate (Fig. 2 P, Q) and are shed at the 3-celled stage.

Megasporangium

A young ovary shows several ovular primordia arising from the parietal placentae. While the primordia are still curving, the initials of the inner integument become distinguishable. Subsequently, the outer integument makes its appearance (Fig. 3 A, B), and very soon, the locule of the ovary becomes packed with anatropous and biteguminal ovules (Fig. 3 C). A characteristic feature of these ovules is the development of long funiculi. In *Frankenia hirsuta* we frequently came across ovules with an incipient third integument which arises from the outer integu-

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Fig. 1. *Frankenia pulverulenta*. — A. Portion of a flowering shoot. — B, C. Young and old buds. — D. Flower at the time of anthesis. — E. Calyx tube opened out. — F. Stamen. — G. Petal with scale-like appendage (unshaded). — H. Pistil after pollination. — A ×6; B, C ×17; D, E ×15; F ×24; G ×19; H ×15.

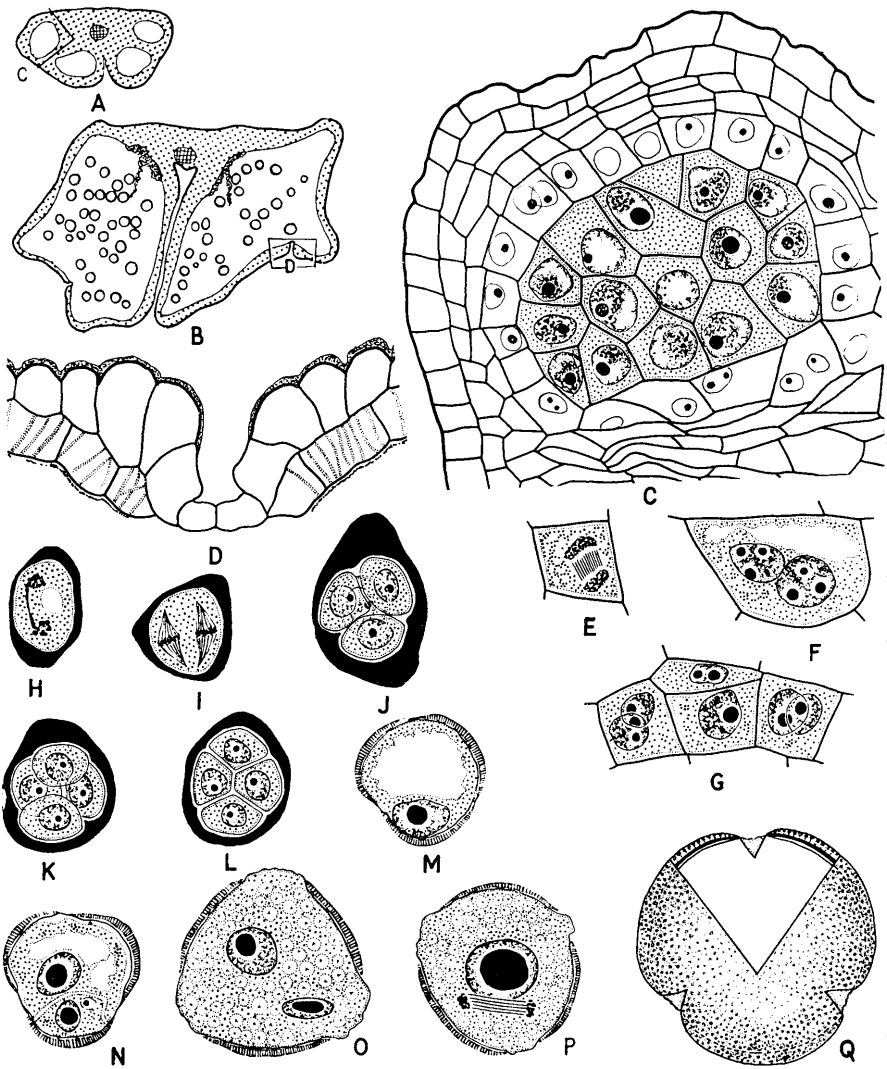

Fig. 2. *Frankenia hirsuta.* — A, B. T.s. young and old anthers (diagrammatic). — C. Portion marked "C" in A enlarged to show wall layers and sporogenous cells. — D. Portion marked "D" in B enlarged to show the region of stomium. — E—G. Divisions in tapetal cells leading to binucleate and bicelled condition. — H, I. Meiosis in microspore mother cells; H shows a chromatin bridge. — J—L. Tetrahedral, decussate and isobilateral tetrads. — M—P. Formation of 3-celled pollen grains; note extra nuclear body in generative cell in N. — Q. Palynogram. — A, B ×66; C, D ×544; E—Q ×681.

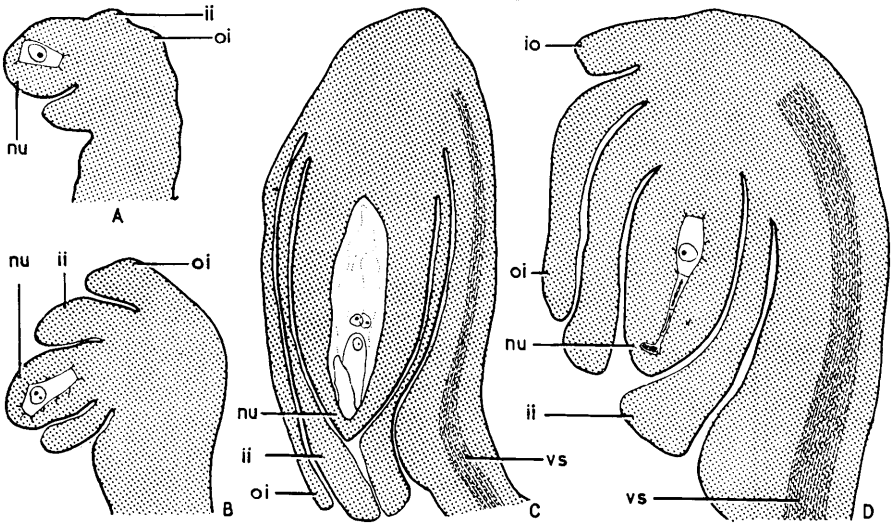

Fig. 3. *Frankenia hirsuta.* (*ii,* inner integument; *io,* integumentary outgrowth; *nu,* nucellus; *oi,* outer integument; *vs,* vascular supply). — A—C. Stages in the development of ovule which is anatropous, and bitegminal. — D. L.s. ovule showing primordium of the third integument. — A, B ×232; C ×135; D ×300.

ment (Fig. 3 D). However, the growth is invariably arrested at the primordial stage and it is never seen to develop into a full-fledged integument. Sometimes the cells of the inner integument may also proliferate in the micropylar region.

Megasporogenesis and female gametophyte

The archesporial cell is hypodermal and functions directly as the megaspore mother cell (Fig. 4 A, B). An unusual feature observed during gametogenesis is the enlargement of 2 or 3 nucellar cells. These accumulate dense cytoplasm, acquire prominent nuclei, and simulate megaspores but do not develop further. Frequently, a cell of the nucellar epidermis, lying immediately above the megaspore mother cell, undergoes a periclinal division giving rise to 2 superposed cells (Fig. 4 C). The megaspore mother cell undergoes Meiosis I to form a dyad (Fig. 4 D) which gives rise to linear (Fig. 4 E—H) or T-shaped tetrads. The 3 micropylar megaspores of the tetrad do not show any uniformity in their order of degeneration (Fig. 4 E—G). Ultimately, however, all the three are crushed and the chalazal megaspore alone functions (Fig. 4 H).

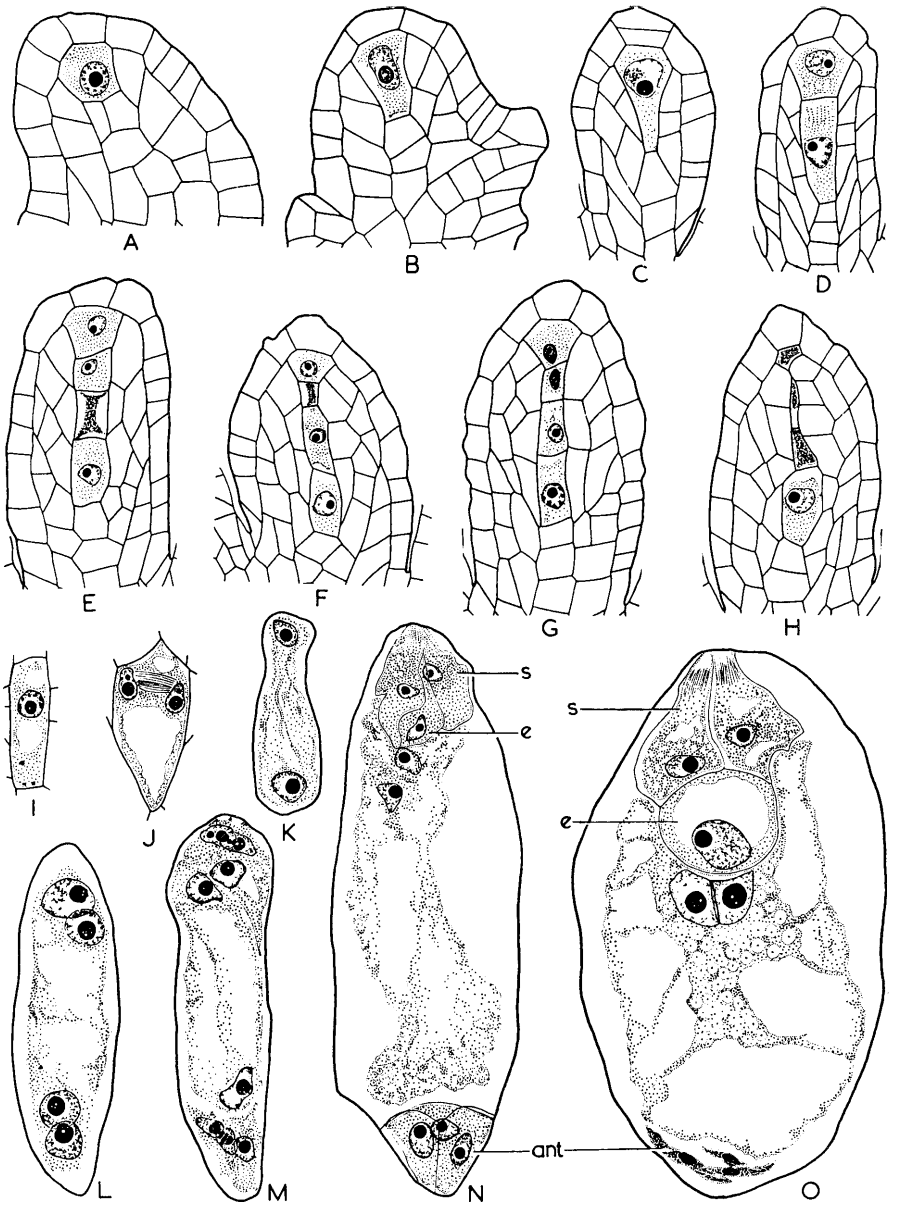

Fig. 4. *Frankenia hirsuta*. (*ant,* antipodal cells; *e* egg; *s* synergid). — A—C. L.s nucelli at the archesporial, sporogenous and megaspore mother cell stages respectively. No parietal cell is cut off. — D. Dyad cells. — E—H. Tetrads of megaspores; note lack of uniformity in the order of degeneration of upper 3 megaspores. — I. Functional megaspore. — J, K. Two-nucleate embryo sacs showing lateral and polar disposition of the 2 nuclei respectively. — L. Four-nucleate embryo sac. — M—O. Mature embryo sacs; the antipodal cells have degenerated in O. — A—O ×475.

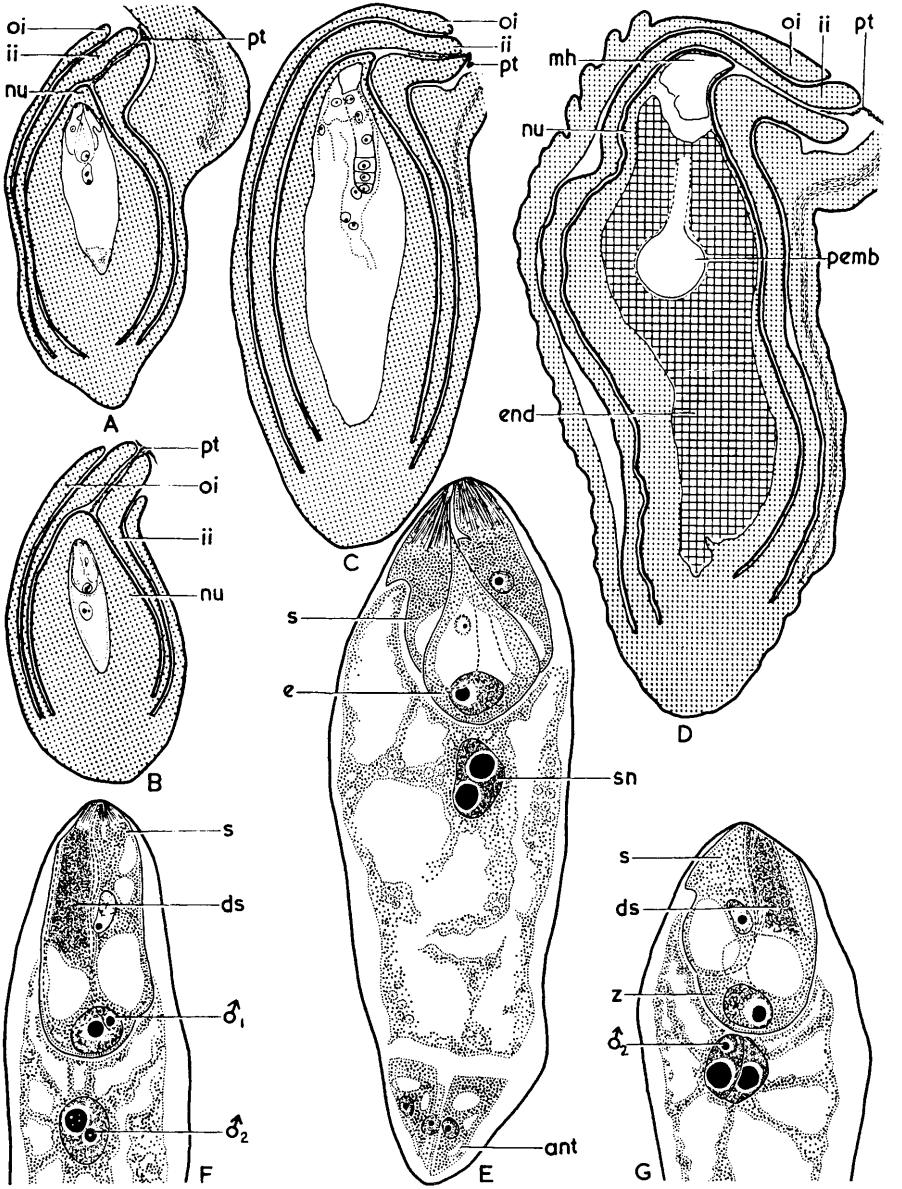

Fig. 5. *Frankenia pulverulenta.* (*ant,* antipodal cells; *ds,* degenerated synergid; *e,* egg; *end,* endosperm; *ii,* inner integument; *mh,* micropylar haustorium; *nu,* nucellus; *oi,* outer integument; *pemb,* proembryo; *pt,* pollen tube; *s,* synergid; *sn,* secondary nucleus; *z,* zygote; δ_1 and δ_2, male gametes). — A, B. L.s. ovules at the time of fertilization to show the entry of pollen tube. — C, D. Young and old seeds showing persisting remnants of pollen tube in the micropyle. — E. Embryo sac at the time of arrival of pollen tube in the micropyle. — F. Upper portion of embryo sac enlarged from B to show double fertilization. — G. Part of embryo sac showing triple fusion after syngamy has taken place. — A—D ×145, E—G ×627.

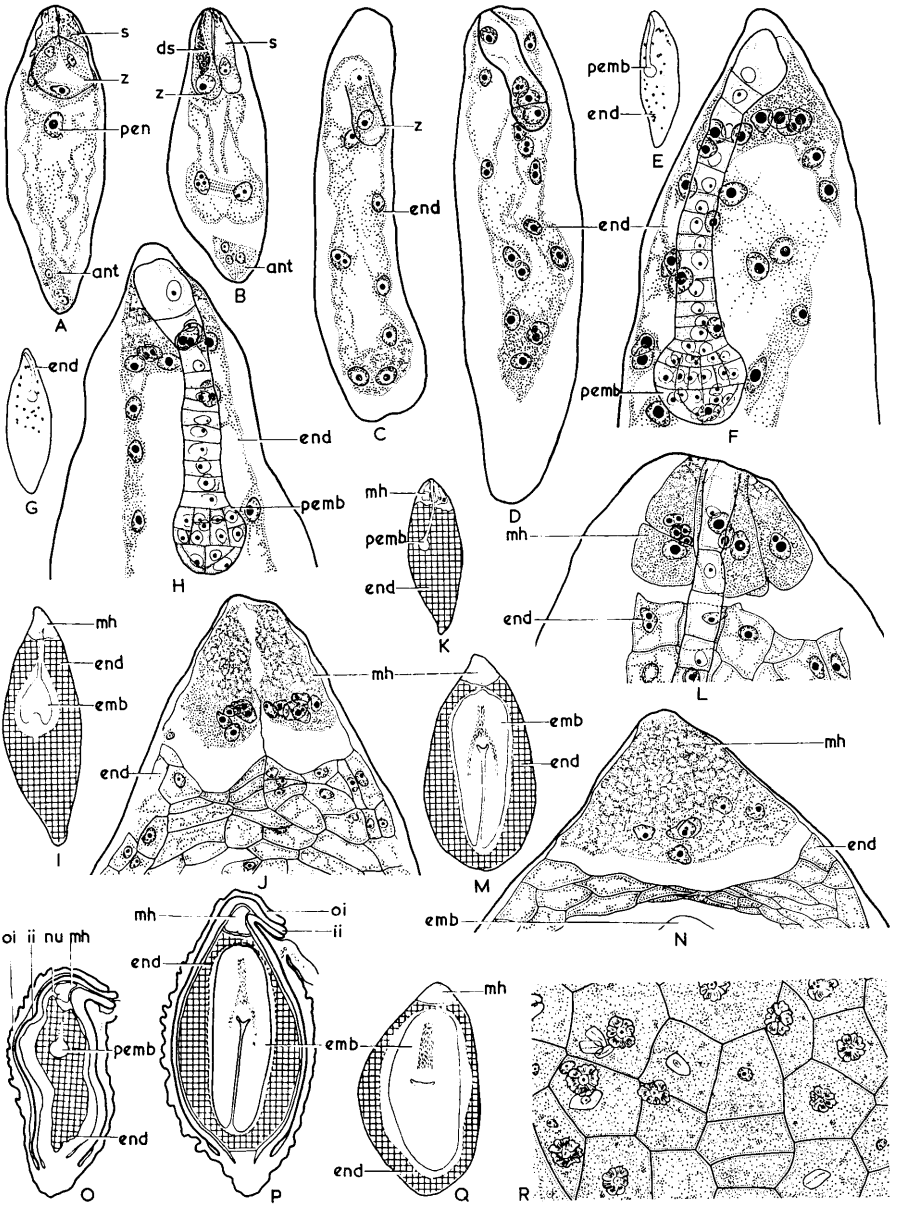

Fig. 6. *Frankenia pulverulenta.* (*ant,* antipodal cells; *ds,* degenerated synergid; *emb,* embryo; *end,* endosperm, *ii,* inner integument; *mh,* micropylar haustorium; *nu,* nucellus; *oi,* outer integument; *pemb,* proembryo; *pen,* primary endosperm nucleus; *s,* synergid; *z,* zygote). — A. Embryo sac showing zygote and primary endosperm nucleus. — B—D. Two, 8 and 16-nucleate endosperm. — E, G, I, K, M, Q. Outline diagrams of endosperm at various stages of development. — F. Micropylar portion

The first mitotic division in the functional megaspore (Fig. 4 I) results in 2 nuclei which become separated towards the 2 poles (Fig. 4 K). Rarely, however, the 2 daughter nuclei occupy lateral positions (Fig. 4 J). Two successive mitoses give rise to the 4- (Fig. 4 L) and 8-nucleate embryo sacs in which the chalazal quartet may organize earlier than the micropylar. The mature embryo sac shows an egg apparatus, 2 polar nuclei and 3 uninucleate antipodal cells (Fig. 4 M, N). The cytoplasm is usually packed with starch grains. The synergids show well developed filiform apparatus. The antipodal cells degenerate before or soon after fertilization (Fig. 4 O).

Fertilization

The pollen tube enters the embryo sac through the micropyle (Fig. 5 A, B) and presumably destroys one of the synergids on its way. Syngamy and triple fusion may or may not take place simultaneously (Fig. 5 E—G). Except for a small length of the pollen tube which persists at the tip of the micropyle (Fig. 5 C, D), the rest of it invariably degenerates after releasing the male gametes.

Endosperm

The primary endosperm nucleus divides to form 2 free nuclei (Fig. 6 A, B). Successive mitoses produce a large number of free nuclei which become distributed along the periphery of a central vacuole (Fig. 6 C—F). The nuclei at the micropylar and chalazal ends, however, become embedded in a dense mass of cytoplasm. The micropylar region of the endosperm develops striations closely simulating the filiform apparatus of the synergids (Fig. 6 G—J). The nuclei in this region of the cytoplasm fuse amongst themselves to produce polyploid masses. Meanwhile, wall formation commences at the chalazal end of the embryo sac and gradually proceeds upwards. However, the micropylar portion of the endosperm remains free nuclear and appears haustorial. Subsequently 1 or 2 vertical walls may be formed giving rise to a 2- or 4-celled structure (Fig. 6 I, J). Nuclear fusions continue in these cells

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of embryo sac showing aggregation of endosperm nuclei. — H. A filiform apparatus-like structure is developing from the cytoplasm at the micropylar end. — J. Cellular endosperm and 2 coenocytic cells of the micropylar haustorium. — L. Enlargement from K showing cellular endosperm and 5-celled micropylar haustorium. — N. Micropylar haustorium from mature seed. — O, P. L.s. young and old albuminous seeds. — R. Cells of mature endosperm showing crystals of varying shapes. — A—D ×241; E, G, I, K, M, O, P, Q ×57; F, H, J, L, N ×273; R ×241.

and rarely 1 of them may undergo a transverse division (Fig. 6 K, L). This structure at the micropylar end remains active up to the mature stage of the embryo (Fig. 6 M—P). The chalazal end of the endosperm shows a layer of large, multinucleate cells. At maturity, the endosperm contains numerous starch grains and crystals (Fig. 6 Q, R).

Embryo

The zygote divides transversely to procreate the cells *ca* and *cb* (Fig. 7 A, B). Further transverse divisions in both these cells produce a filamentous proembryo of about 9 cells (Fig. 7 C—E). The terminal cells undergo 2 vertical divisions leading to the quadrant and octant stages (Fig. 7 F, G). Subsequent transverse and longitudinal divisions in the tiers *l* and *l'* engender the globular embryo (Fig. 7 H—J) which later differentiates into the heart-shaped and cotyledonary embryos (Fig. 7 K—M). The embryogeny, thus, corresponds to the Solanad type. The mature embryo is devoid of a suspensor, has 2 cotyledons (Fig. 7 N), and a well developed vascular supply.

Seed coat

Both the inner and outer integuments in a young, unfertilized ovule are characterized by 2 or 3 layers of cells (Fig. 8 A, E). The cells at the tips of both the integuments, however, tend to divide, this tendency being more pronounced in *Frankenia hirsuta* than in *F. pulverulenta*.

The trigger of fertilization entails marked changes in the seed coat. The cells of the inner epidermis of the inner integument enlarge radially become filled with tannin and develop a thick cuticle on their inner tangential walls (Fig. 8 B—D, F—H). The cells of the outer epidermis of the inner integument gradually become stretched and ultimately collapse (Fig. 8 C, G). Thus, in the mature seed the inner integument is represented by a single layer of tanniniferous cells.

The outer epidermis of the outer integument undergoes considerable modification. Its cells enlarge, become papillate and the nucleus migrates to the tip of the papilla. These cells elongate further and thickening is deposited at their tips in such a way that it gives them the curious appearance of a human finger and its nail (Fig. 8 D, H). The cells of the inner epidermis of the outer integument become tangentially elongated and persist as such in the mature seed.

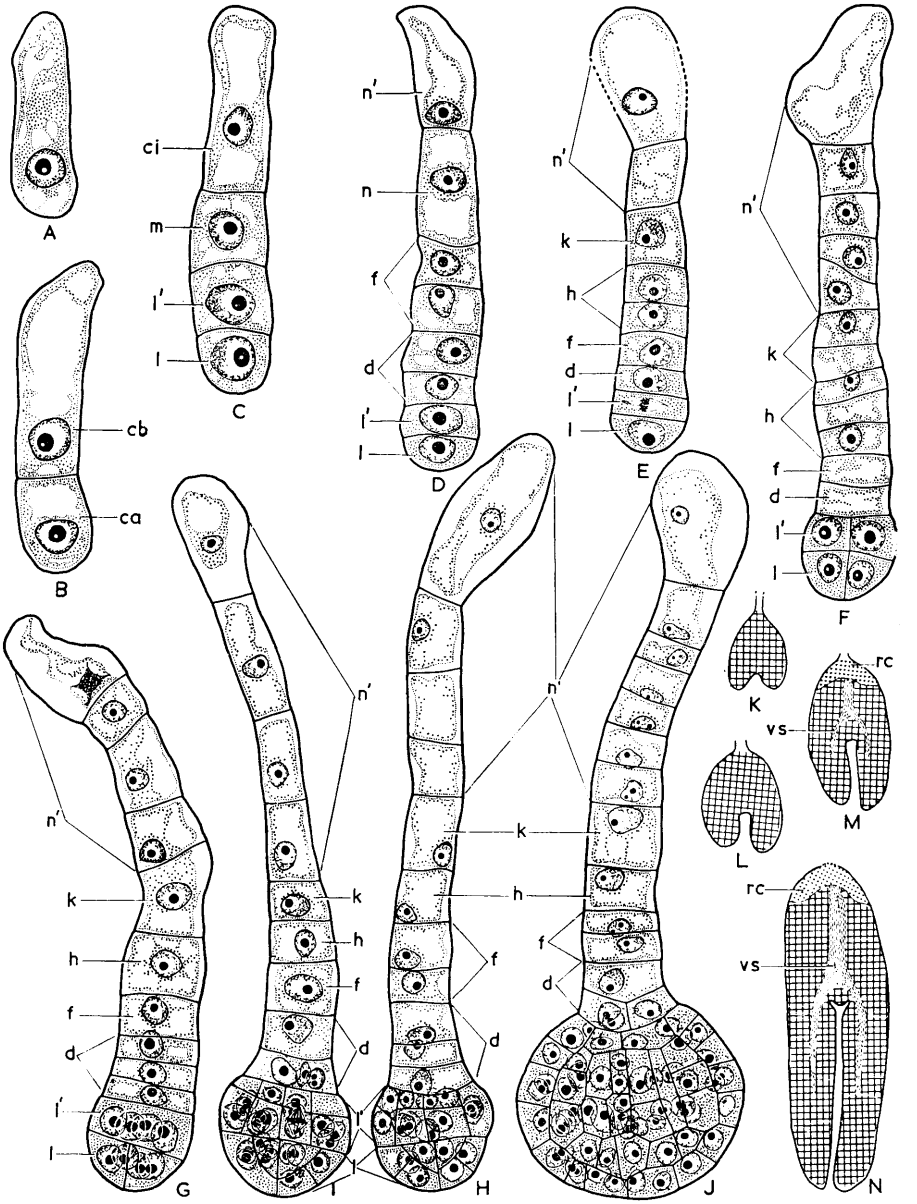

Fig. 7. *Frankenia pulverulenta*. (*rc*, root cap; *vs*, vascular supply). — A. Zygote. — B—D. Two, 4 and 8- celled proembryos. — E—J. Stages leading to the formation of a globular embryo; the suspensor is long and uniseriate. — K—N. Formation of a mature dicotyledonous embryo, the suspensor has degenerated in N. — A—J ×523, K—N ×97.

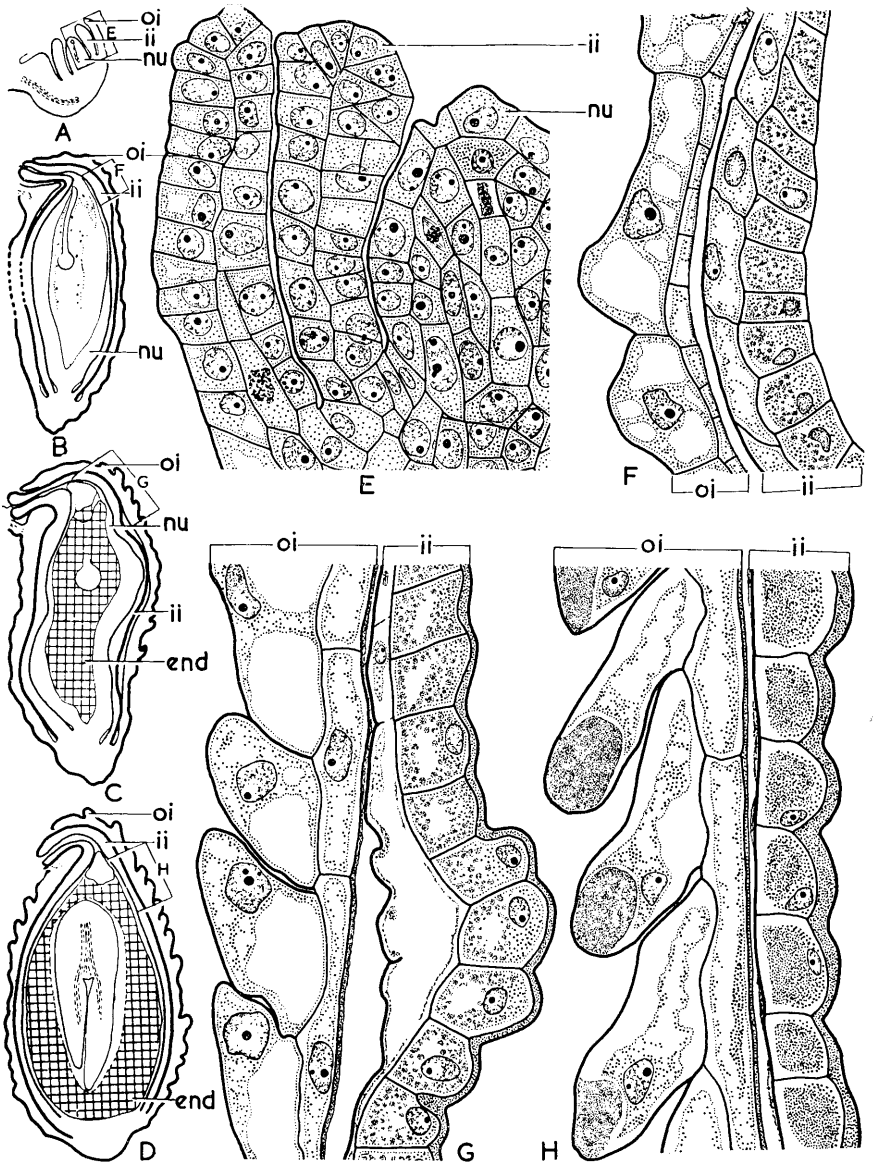

Fig. 8. *Frankenia.* — A, E, *Frankenia hirsuta*; B—D, F—H, *F. pulverulenta.* (*end,* endosperm; *ii,* inner integument; *nu,* nucellus; *oi,* outer integument). — A—D. L.s. developing seeds (diagrammatic). — E. Enlargement of portion marked "E" in A to show 2 or 3-layered outer integument and 2-layered inner integument. — F. Enlargement of portion marked "F" in B. Cells of the outermost layer of the seed coat are becoming papillate and those of the innermost layer are filled with tannin. — G. Portion marked "G" in C enlarged to show degeneration of outer epidermis of inner integument. — H. Magnified view of portion marked "H" in D. The outer epidermis of the seed coat shows finger-like outgrowths with nail-like thickening at the tip. The inner epidermis of the inner integument has developed thick cuticle. — A—D ×83; E—H ×681.

Discussion

Some of the embryological features of *Frankenia* and the systematic position of the *Frankeniaceae* are discussed below.

Embryology: The ovules of *F. hirsuta* show the presence of an incipient third integument although this does not grow beyond the primordial stage. In some members of the *Anonaceae,* viz. *Canangium, Mezzettia* and *Xylopia,* a middle integument develops just after fertilization (CORNER 1949). In *Cananga* also, PERIASAMY & SWAMY (1961) find that a third integument arises in between the inner and outer integuments during megasporogenesis.

Although the Cellular endosperm is frequently known to give rise to haustorial structures, only a few taxa show haustoria arising from the Nuclear endosperm. In the *Leguminosae, Cucurbitaceae, Proteaceae* and some members of the *Malpighiaceae* (SINGH 1959) and *Euphorbiaceae* (VENKATESWARLU & NARASIMHA RAO 1963) they arise at the chalazal end. In *Frankenia* the haustoria are micropylar. They resemble the synergids in possessing a filiform apparatus and can thus be easily mistaken for synergid haustoria. It may be mentioned that COOPER (1942) described synergid haustoria in *Lobelia* but these were later proved to be derived from the endosperm cells by MAHESHWARI (1944) and SUBRAMANYAM (1951). Earlier, a similar mistake was made by HEINRICHER (1931) in *Lathraea* and the correction came from GLIŠIĆ (1932).

Systematic position: BENTHAM & HOOKER (1862—1883) observed some resemblances between the *Frankeniaceae* and *Caryophyllaceae* and assigned the former to their *Caryophyllinae.* According to them (BENTHAM & HOOKER 1947) *Frankenia* is a monogeneric member of the *Frankeniaceae* and differs from the *Caryophyllaceae* only in the parietal placentation of the ovary and capsular fruit. However, WILLIS (1948) remarked that the likeness is only superficial. EICHLER (1875) contends that an assignment of the *Frankeniaceae* near the *Caryophyllaceae* is contradicted by the placentation.[1] GUNDERSEN (1927) emphasized the similarities between these two families and added that with respect to placentation also "there are suggestive resemblances" since in the *Basigonia* section of *Frankenia* there are usually 3 basal ovules as in the *Alsine* subfamily of *Caryophyllaceae* which has a

[1] The placentation in the *Frankeniaceae* is parietal whereas in the *Caryophyllaceae* it is free central (HUTCHINSON 1959).

Table 1

	Frankenia	*Tamaricaceae*
Pollen grains	3-celled	2-celled
Parietal cells	Absent	Present
Embryo sac	Monosporic	Tetrasporic
Endosperm	Nuclear; haustoria present	Nuclear; haustoria absent
Embryogeny	Solanad type, polyembryony absent; mature embryo straight and without suspensor	Solanad type, polyembryony frequent; mature embryo straight with massive suspensor
Seed	Albuminous	Exalbuminous
Seed coat	Derived from both integuments	Derived only from outer integument
Chromosome number	n=5(?)	n=12

single basal ovule. Moreover the calyx in *Frankenia* is similar to that of *Plumbago,* a genus belonging to the gamopetalous family *Plumbaginaceae.* METCALFE & CHALK (1950) observed that the characteristic epidermal glands of *Frankenia* also occur in the *Tamaricaceae* and *Plumbaginaceae,* but add: "The glands are probably to be regarded as an ecological specialization which may quite well have arisen independently in each of these families." WETTSTEIN (1935), followed by RENDLE (1952), included the *Frankeniaceae* in the order *Parietales* between the *Elatinaceae* and *Tamaricaceae.* On the basis of habit, the presence of small exstipulate leaves and a parietal placentation, HUTCHINSON (1959) as well as TAKHTAJAN (1959) assigned the *Frankeniaceae,* along with *Fouquieriaceae* and *Tamaricaceae,* to the order *Tamaricales.* The comparative embryological features of the *Frankeniaceae* and *Tamaricaceae* are given in Table 1 above (for literature see JOHRI & KAK 1954, DARLINGTON & WYLIE 1955).

As Table 1 shows, the embryology of *Frankenia* differs radically from that of the *Tamaricaceae.* Its assignment to the order *Tamaricales* (HUTCHINSON 1959, TAKHTAJAN 1959) is, therefore, unjustifiable.

The *Caryophyllaceae* are characterized by the following features: free central placentation, 3 to 6 or 12-porate pollen grains, multicelled archesporium, presence of parietal cells in the nucellus, Caryophyllad type of embryogeny (Solanad in *Polycarpon*), curved embryo, exalbuminous seeds, perisperm, seed coat formed only by the outer integument, and absence of endosperm haustoria (JOSHI 1936 a, b; PAL 1952). However, none of these characters occurs in the *Frankeniaceae.* Therefore, BENTHAM & HOOKER's (1862—1883) assignment of this family to the *Caryophyllinae* is also unjustified.

On the other hand, the family *Elatinaceae* appears to resemble the *Frankeniaceae* in several embryological characters. These are: presence of 3-celled pollen grains; bitegminal ovules; absence of parietal cells; monosporic embryo sac; Nuclear endosperm; and wall formation in endosperm at the chalazal end (see SCHNARF 1931). Thus the most appropriate place for the *Frankeniaceae* is in the order *Parietales* near the *Elatinaceae* as also suggested by WETTSTEIN (1935) and RENDLE (1952).

Very little is known about the embryology of the *Fouquieriaceae* which differs from the *Frankeniaceae* in having 3-colporate pollen grains and tenuinucellar ovules (JOHANSEN 1936, KHAN 1943). However, more data are needed before considering the validity of HUTCHINSON's (1959) view.

The possibility of relationship between the *Frankeniaceae* and *Plumbaginaceae* seems to be ruled out by their markedly dissimilar embryological characters. The *Plumbaginaceae* are characterized by an amoeboid tapetum, circinotropus ovules, presence of parietal cells, tetrasporic embryo sac and chalazal endosperm haustoria (see SCHNARF 1931). None of these characters is seen in the *Frankeniaceae*.

It may be concluded that the *Frankeniaceae* should be included in the *Parietales* near the family *Elatinaceae*.

Summary

In *Frankenia* the flowers are bisexual and actinomorphic. The sepals are fused, but the petals are free and clawed. The fruit is a capsule.

The anther wall consists of 5 or 6 layers. The tapetum is binucleate and irregularly 2-layered. The middle layers degenerate at the uninucleate stage of the pollen grains. The epidermis persists in the dehiscing anther. Cytokinesis in the microspore mother cells is simultaneous. Lagging chromosomes during meiosis frequently give rise to extranuclear bodies. The pollen grains are tricolpate and 3-celled.

The ovules are anatropous, and bitegminal. The primordium of an incipient third integument sometimes originates from the outer integument. The archesporial cell functions directly as the megaspore mother cell. The development of the embryo sac is of the Polygonum type.

Fertilaztion is porogamous and syngamy and triple fusion may or may not take place simultaneously. A portion of the pollen tube persists in the seed at the tip of the micropyle.

The endosperm is Nuclear. Wall formation commences at the chalazal end and proceeds upward. A 2 to 4-celled haustorium containing polyploid nuclei is delimited at the micropylar end. The cells of mature endosperm contain starch and crystals. The embryogeny conforms to the Solanad type.

Both integuments contribute to the formation of the seed coat. The outer epidermis of the seed is thrown into finger-like outgrowths with nail-like thickenings at the tip which give a warty appearance to the seed.

The present study supports the inclusion of the *Frankeniaceae* in the order *Parietales* near the family *Elatinaceae* as also done by WETTSTEIN (1935) and RENDLE (1952).

Acknowledgements

We are grateful to Professor P. MAHESHWARI F.R.S. for guidance and encouragement, and to Dr N. N. BHANDARI for helpful suggestions. Thanks are also due to the Council of Scientific and Industrial Research for the award of a research fellowship to one of us (K.W.).

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Smärre uppsatser och meddelanden

Några skånska fynd av adventivväxter

Under slutet av 1800-talet och början av 1900-talet ägnade många botanister stort intresse åt den adventiva floran. Detta intresse har åter uppblossat, vilket framgår av moderna floror (HYLANDER 1953, WEIMARCK 1963). Tyvärr har åtskilliga lokaluppgifter från sekelskiftet om tillfälliga invandrare gått förlorade. Fynden är endast sällan publicerade och våra offentliga herbarier hade förr ej resurser att annat än undantagsvis lägga in herbariematerial. Det kan därför vara berättigat att lämna en lista över några skånska lokaler.

Här nämnes endast fynd, som ej tidigare publicerats (HYLMÖ 1947, LANGE, FLINCK & HYLMÖ 1954, HYLMÖ 1958, WEIMARCK 1963). Tyvärr har jag ej systematiskt fört anteckningar, varför åtskilliga arter och lokaler fallit ur minnet. Bland lokalerna skall särskilt nämnas Malmö, där stadens soptipp Sjölunda — numera industriområde vid hamnen — var ett eldorado och träffpunkt för amatörbotanister under 1930-talet. Alldeles säkert finns i glömda eller redan förstörda herbarier åtskilliga i vårt land sällan iakttagna inkomlingar. Jag besökte endast Sjölunda avstjälpningsplats ett fåtal gånger. En andra lokal är Malmö-Limhamn, Vik d.v.s. den remsa som lämnats outfylld av kalkbrottets enorma fyllnadsmassor söder om badplatsen Sibbarp. Här har många amatörbotanister samlat mängder av intressanta ruderatväxter.

Setaria verticillata (L.) Beauv. — Hälsingborg vid Ramlösa järnvägsstation 1950.

S. glauca (L.) Beauv. — Saxtorp, Flygeltofta gård i lökodling 1951 (K. E. FLINCK).

Panicum miliaceum L. — Malmö, Sjölunda 1932.

Echinochloa crus-galli (L.) Beauv. — Löddeköpinge, sandiga åkrar, massförekomst 1949—1955. Bjuv, Mörshög 1947. Arten uppträdde som ogräs i köksväxter på ett flertal ställen i västra Skåne 1947—1957.

Anthoxanthum aristatum Boiss. — Malmö, Sjölunda 1934.

Bromus japonicus Thunb. — Malmö, turbinen 1909 (D. HYLMÖ).

B. squarrosus L. — Malmö, turbinen 1907 (D. HYLMÖ).

Hordeum jubatum L. — Malmö, Sjölunda, massförekomst 1933—1945 (jfr ASKER 1959).

Fagopyrum esculentum Moench — Fleninge, i konservärter (amerikanskt utsäde) 1944.

Chenopodium murale L. — Malmö, Sjölunda 1936. Lackalänga, ullruderat 1953.

Ch. pratericola Rydb. — Malmö, Sjölunda 1933.
Axyris amaranthoides L. — Malmö, Sjölunda 1932.
Amaranthus retroflexus L. — Malmö, Limhamn 1932.
Claytonia perfoliata Donn — Falsterbo, tångvall (F. ÅBOM) 1932—1955.
Silene dichotoma Ehrh. — Allmän i klövervallar Bjuv, Mörarp och Hässlunda socknar 1945—1960.
Brassica juncea (L.) Czern — Malmö, Sjölunda 1933, 1934.
Erucastrum gallicum (Willd.) O. E. Schulz — V. Klagstorp, Klagshamn hamnområdet, massvis 1931.
Diplotaxis tenuifolia (L). DC. — Limhamn, hamnen 1930—1945.
Lepidium perfoliatum L. — Malmö, Sjölunda 1932.
Erysimum repandum L. — Malmö, Sjölunda 1932.
Sisymbrium orientale L. — Malmö, Sjölunda 1934.
Camelina sativa (L.) Cr. ssp. *sativa* — Svedala 1934.
Reseda lutea L. — Malmö, Sjölunda 1938.
R. luteola L. — Lackalänga, ullruderat 1949.
R. alba L. — Limhamn hamnområde 1931.
Potentilla norvegica L. — Barsebäck, Oxhagslyckan 1947.
P. intermedia L. — Malmö, Sjölunda 1934.
Trifolium scabrum L. — Lackalänga, ullruderat 1949.
Coronilla varia L. — Åkarp, banvall 1952.
Vicia pannonica Cr. ssp. *pannonica* — Limhamn, mängder i rågåker 1936 (F. ÅBOM).
ssp. *striata* (Bieb.) Gris. — Malmö, Sjölunda 1932; Simrishamn 1934.
V. dasycarpa Ten. — Malmö, Sjölunda 1934.
Lathyrus heterophyllus L. — Norra Vram, Söderåsen, i granskog 1943—1962.
Oxalis europea Jord. — Mörarp, Magnehill 1947—1960; Halmsta by 1960—1965.
O. corniculata L. — N.V. Ringsjön, dominerande hektarvis i ett flertal flerårsvallar 1937.
Chaerophyllum bulbosum L. — Lomma, Alnarps Mellangård, förvildad 1937.
Anthriscus cerefolium (L.) Hoffm. — Limhamn, Sibbarp 1934, kvar på 1950-talet.
Scandix pecten-veneris L. — Lomma, rågåker, massvis 1938.
Smyrnium perfoliatum L. — Alnarp 1936—1950.
Falcaria vulgaris Bernh. — Limhamn, Hyllie kyrkoväg, en planta, ca 1905 (D. HYLMÖ), kvar 1955; Malmö, Bellevuevägen ca 1905—1945 (under de sista åren brukades ej angränsande åker och den ursprungliga plantan förökade sig vegetativt för att slutligen täcka en yta av flera 100 m^2).
Cuscuta australis R. Br. — Kropp sn, Mörarp sn, Tågarp sn och Eslöv, massförekomst i rödbetor, utsäde från Holland 1963.
Phacelia tanacetifolia Benth. — Limhamn, hamnen 1931.
Lappula myosotis Moench — Malmö, Sjölunda 1932.
Dracocephalum thymiflorum L. — Malmö, Sjölunda 1932.
Stachys annua (L.) L. — Lund, veteåker 1936; Lomma, rågåker 1936.
Salvia verticillata L. — Kvarnby, banvall 1936.
Mentha spicata L. — Malmö, Sjölunda 1932; Limhamn 1932.

M. gentilis L. — Limhamn 1932.
M. longifolia (L.) L. — Limhamn 1932.
Solanum adventitium Polgán. — Lomma, Alnarps Mellangård, kvarleva från genetiska undersökningar 1937—1950.
Scrophularia vernalis L. — Alnarps park 1938—1962.
Dipsacus fullonum L. ssp. *sativus* (L.) Thell. — Malmö, Sjölunda 1932.
D. strigosus Willd. — Åkarp, banvall 1931—1965; Limhamn 1932—1965 (jfr ASKER 1959).
Erigeron annuum (L.) Pers. — Malmö, Slottsparken, stationär vid fågeldamm 1931—1965, Sjölunda 1938; Bjuv, inkommen med plantskolematerial från Schweiz 1957—1965.
Telekia speciosa (Schreb.) Baumg. — Norra Vram, i bokskog 1949—1960.
Ambrosia psilostachya DC. — V. Klagstorp, Klagshamn, hamnen, massvis 1931—1932 (först felaktigt bestämd till *A. artemisiifolia* L; WEIMARCK 1963).
Xanthium spinosum L. — Malmö, Sjölunda 1934.
Rudbeckia hirta L. — Bjuv, Lilla Mörshög 1947.
Chrysanthemum macrophyllum W. & K. — Alnarp 1927; Mölle hamn 1936—1955.
Carduus leiophyllus Petrov. — Malmö, Sjölunda 1933.
Centaurea nigra L. — Limhamn, Sibbarp 1936 (F. ÅBOM).
C. jacea×*nigra* — Limhamn, Sibbarp 1936.
C. rhenana Bor. — Kvarnby, massvis 1936—1945.
Leontodon nudicaulis (L.) Banks ex Lorve — Malmö, Slottsparken, stationär 1934—1965.
Tragopogon porrifolius×*pratensis* ssp. *pratensis* — Lomma Mellangård 1938.

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BERTIL HYLMÖ
Findus-Nordreco, Bjuv

En nyupptäckt lokal för Scutellaria minor på Bjärehalvön i Skåne

NILS DAHLBECKS sensationella fynd av *Scutellaria minor* i nordvästra Skåne år 1944 — tidigare ej funnen i Skandinavien — publicerades i Botaniska Notiser 1944 av HELGE RICKMAN med orden: »S. minor: en klimax i en botanists liv att i naturen få skåda denna i år för Skandinavien nyupptäckta växt.» Växtlokalen, ett kärr utmed stranden söder om Torekov, besöktes d. 20.9.1944. »Trots årstiden funnos ännu gott om blommande exemplar och hela individantalet torde uppgå till flera 100-tal.»

STEN SELANDER har i en vacker och intressant essay i form av understreckare i Svenska Dagbladet den 3.7.1948 skildrat bl.a. detta märkliga nya växtfynd: »Särskilt kärren mot landsidan, där källflöden ur grusbacken silar över den svaga sluttningen, hyser en artrik och ytterst spännande flora; varje gång jag varit här nere har jag hittat någon växt, som jag tidigare gått förbi. Häromåret fann Nils Dahlbeck vid en av sumparna en frossört, Scutellaria minor, som förut inte var känd från närmare håll än från England och en eller annan lokal i Västtyskland. Ännu har jag inte uppgivit hoppet om att lyckas leta reda på den också vid någon annan göl, fast den frossört som växer vid ett par av dem opassande nog visat sig ha blå blommor som våra två vanliga svenska arter och inte skära som minor.»

Inspirerade av SELANDERS understreckare lyckades jag och min fru efter systematiskt sökande på strandängarna söder om Torekov den 5.7.1948 uppspåra den sällsynta lilla växten med de små skära blommorna vid Påarp i V. Karup, sannolikt vid samma sump som ovan nämnts.

STEN SELANDER hade för sin år 1959 postumt utgivna essaysamling »Mark och rymd» bearbetat den förut omnämnda essayen »Strand vid Kattegatt» och där gjort bl.a. följande tillägg: »Och sedan har jag hittat den (S. minor) i många av de kärr där källflöden ur grusbacken silar över den svaga sluttningen. När kom den hit, och hur? Och varför växer den bara här, längs någon halvmil av stranden, och inte likaväl uppåt Hov, där det finns gott om alldeles likadana strandgölar? Fråga mig inte: varken jag eller någon annan kan ge ett svar.»

HENNING WEIMARCK har i sin år 1963 utkomna »Skånes Flora» infört bl.a. följande uppgifter: »S. minor. Huds. 1762 — Småfrossört. — Oceanisk; fukthedar, kärr; från Påarp till Dagshög i V. Karup, upptäckt av DAHLBECK 1944 (RICKMAN BN 1944), f r i d l y s t 1944; närmaste fyndorter i n.v. Tyskland, Belgien, Holland och England.» I floran finns även uppgifter om hybriden »S. galericulata×minor. — Påarp (WEIMARCK 1952, HYLANDER 1955 BN 1959, LÖVKVIST 1958 1960) och Dagshög (WEIMARCK 1952) i V. Karup.»

Åren 1948—1965 (undantag 1964) har jag inspekterat Påarpslokalen och med tillfredsställelse kunnat konstatera, att *S. minor* hållit sin position. Individantalet har givetvis växlat år från år, men någon tydlig tendens till ökning eller minskning har jag ej kunnat fastställa; den rätt hårda kreatursbetningen utgör kanske en reglerande faktor för status quo.

År 1963 företog jag tillsammans med tandläkaren FOLKE HARBOE, Ängelholm, den sedvanliga inspektionen den 19 juli. Från Påarpslokalen i V. Karup gick färden vidare samma dag till Hov socken, där vi strövade på strandängarna s.v. Hovshallar. Och döm om vår glädje, när vi helt plötsligt och oväntat stod öga mot öga med *Scutellaria minor*! Beståndet var fåtaligt; endast två exemplar kunde vi finna, det ena vackert blommande, det andra naggat i toppen av beteskreatur.

S. minor är alltså funnen »likaväl uppåt Hov». Med hänsyn till det nya fyndet behöver kanske för arten gällande fridlysningsbestämmelser kompletteras.

Den 30 augusti 1965 gjorde vi tillsammans ett nytt besök på exakt samma plats men kunde då tyvärr inte finna något exemplar av *S. minor*. Växtplatsen för 1963 års fynd var till följd av det myckna regnandet starkt vattendränkt

och dessutom trampad av kreatur. Av allt att döma torde *S. minor* vara en känslig och i många avseenden ytterst kräsen liten växt, som detta år måhända föredrog att avvakta gynnsammare betingelser för sitt framträdande. Vid Påarpslokalen, som även besöktes ovannämnda dag, funno vi vackert blommande exemplar på torrare mark, däremot inte i själva kärret, som var ovanligt blött. Vi ha dock ansett det vara av intresse att registrera vårt fynd från 1963, vilket kanske kan tolkas så, att arten kan vara stadd i spridning.

CARL VON DELWIG
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Nordisk förening för taxonomisk botanik 1965

Föreningens tillkomst

Förslag om bildandet av en nordisk sammanslutning av för systematisk botanik intresserade väcktes vid en diskussion i Lund våren 1964. Närvarande vid diskussionen var prof. WEIMARCK, doc. DAHLGREN och doc. RUNEMARK, alla Lund, samt doc. HEDBERG, Uppsala.

I dec. 1964 utsändes en cirkulärskrivelse till kolleger i Norden med förfrågan om intresset för en sådan förening och med förslag att förlägga det första mötet i Lund i juni 1965. Ett stort antal positiva svar inkom.

I en skrivelse i febr. 1965 inbjöds nordiska växtsystematiker till ett konstituerande möte i Lund den 8—12 juni 1965. 55 deltagare från Danmark, Finland, Norge och Sverige anmälde sig. Alla kunde dock ej infinna sig.

En organisationskommitté för detta möte, bestående av prof. WEIMARCK, doc. RUNEMARK och fil. kand. KARIN NILSSON, bildades.

Protokoll fört vid föreningens första möte den 8—12 juni 1965

Den 8 juni. Sammanträde på Histologiska institutionens föreläsningssal (reparationsarbetena på Botaniska institutionen hade ännu ej avslutats). Närvarande omkr. 50 personer.

§ 1. Prof. WEIMARCK hälsade de närvarande hjärtligt välkomna.

§ 2. Prof. WEIMARCK frågade deltagarna, om de ville bilda en nordisk förening. Frågan besvarades enhälligt jakande.

§ 3. Det föreslogs, att organisationskommittén för mötet skulle fungera som presidium denna gång, med prof. WEIMARCK som ordf. och doc. RUNEMARK som sekr. Beslut fattades i enlighet med detta förslag.

§ 4. Ett stencilerat utkast med i vissa fall alternativa förslag till stadgar hade tillställts deltagarna vid ankomsten till Lund. Föreningen beslöt att diskutera stadgarnas utformning med utgångspunkt från detta förslag.

§ 5. Prof. WEIMARCK föreslog, att en kommitté skulle bildas med en representant för varje deltagande nordiskt land och att denna med ledning av en

inom föreningen förd diskussion skulle utarbeta definitivt förslag till stadgar. Föreningen beslöt i enlighet med detta.

§ 6. Vid den följande diskussionen föreslog prof. NANNFELDT åtskilliga formella ändringar i det ursprungliga stadgeförslaget. Beträffande § 1 ansåg stipendiat SKOGEN, att vissa delar av växtgeografin borde innefattas i föreningens intresseområde. Beträffande § 3 föreslog prof. NANNFELDT, att ordinarie sammanträde bör hållas vartannat år, att vid ett sammanträde plats bestämmes för det nästkommande och att under mellanliggande år exkursion kan anordnas. Prof. LARSEN stödde prof. NANNFELDTS mening, och doc. RUNEMARK framhöll värdet av exkursioner.

Prof. NANNFELDT föreslog ang. § 4 att en styrelseledamot från varje nordiskt land utses av resp. länders representanter, medan föreningen i dess helhet utser ordförande och sekreterare.

Beträffande § 6 ifrågasatte prof. NANNFELDT lämpligheten av förslaget att ett medlemsblad skulle innehålla recensioner och förteckning över nordisk systematisk och floristisk litteratur. Doc. RUNEMARK argumenterade för en ovannämnd dylik förteckning, och denna mening stöddes av prof. LARSEN och dr KNABEN. Doc. HEDBERG ansåg en förteckning önskvärd men betvivlade, att föreningens ekonomi skulle tillåta ett sådant projekt.

§ 7. Till stadgekommitté utsågs prof. LARSEN, prof. VAARAMA, dr KNABEN och prof. NANNFELDT med prof. NANNFELDT sammankallande. Kommittén åtog sig att framlägga förslag sista sammanträdesdagen, d.v.s. fred. den 11 juni.

§ 8. Föreningens medlemmar deltog i en av Lunds stad anordnad lunch på restaurang Åke Hans.

§ 9. Prof. WEIMARCK redogjorde för de olika forskningsriktningarna vid institutionen för systematisk botanik i Lund och lämnade en redogörelse för de pågående undersökningarna över Skånes flora.

§ 10. Institutionen med trädgård och växthus demonstrerades av prof. WEIMARCK, doc. RUNEMARK, lic. SNOGERUP och lic. STRANDHEDE.

Den 9 juni. Sammanträde på Histologiska institutionen.
Närvarande omkr. 50 personer.

§ 1. Föredrag av dr KNABEN om »Cytotaksonomiske studier i Pyrolaceae». Efter föredraget yttrade sig prof. WEIMARCK och doc. RUNEMARK.

§ 2. Föredrag av lic. STRANDHEDE om »Problem inom Eleocharis palustris-komplexet». I den efterföljande diskussionen yttrade sig prof. NANNFELDT, prof. MUNK och mag. TENGNÉR.

§ 3. Föredrag av lic. NORDBORG om »Artavgränsning inom Sanguisorba minor-komplexet». Efter föredraget yttrade sig prof. WEIMARCK.

§ 4. Föredrag av intendent SPARRE om »Linnés Tropaeolum-arter och deras historiska bakgrund».

§ 5. Föredrag av amanuens ALFRED HANSEN om »De i Danmark fundne Amaranthus-arter».

§ 6. Föredrag av mag. TENGNÉR om »Dacrydium — anatomi och systematik».

§ 7. Lunds universitet representerat av prorektor prof. STJERNQUIST och universitetsrådet HAMMAR, anordnade mottagning för föreningen i universitetets pelarsal.

Den 10 juni. Exkursion till östra Skåne under ledning av prof. WEIMARCK. Deltagare 46 personer.

Vid Bäckahalladalen och Gladsax hallar studerades oligotrof flora på vittringsjord från sandstenen och eutrof flora på den kalkrika moränen. Bland mera anmärkningsvärda arter märktes *Drosera rotundifolia, Juncus squarrosus, Trichophorum caespitosum, Helianthemum nummularium, Orchis morio* samt den naturaliserade *Ulex europaeus.*

Vid Stenshuvud, som utgör ett naturskyddat område, sågs en av Sveriges största skogar av *Carpinus betulus.* Bland övriga arter märktes *Hedera helix, Montia minor* och *Orchis majalis.* På de sydexponerade branterna med kalkrik sand vid Galgbacken i Brösarp sågs bl.a. *Alyssum calycinum, Androsace septentrionalis, Anthericum liliago* (ännu ej i blom), *Festuca polesica, Hutchinsia petraea, Poa bulbosa* och *Koeleria glauca.*

Vid Ravlunda skjutfält betonade prof. WEIMARCK, att samarbetet mellan naturskydd och militära myndigheter varit gott, och en stor del av skjutfältet i söder utefter Skepparpsån (Verkeån) hade kunnat skyddas och undantagas från militära övningar. Exkursionen följde ett stycke av den väg, nu kallad Linnés väg, som LINNÉ kom 1749 på sin färd från Maglehem till Ravlunda. På backarna intill denna väg iakttogs bl.a. *Botrychium lunaria, Hutchinsia petraea* och *Silene conica.* Vid Havängsdösen sågs mängder av *Anemone pratensis* och *Dianthus arenarius.*

Vid Breabäck i Andrarum stannade exkursionsdeltagarna vid en rik lövskog på fuktig mark. Här fanns bl.a. *Campanula latifolia, Lunaria rediviva, Lysimachia nemorum, Petasites albus* och *Thalictrum aquilegiifolium.*

Vid Vitemölla slutligen studerade man växtligheten på kalkhaltig sand. Särskilt *Astragalus arenarius* tilldrog sig uppmärksamhet. Exkursionen avslutades med gemensam middag på Vitaby hotell.

Den 11 juni. Sammanträde på Histologiska institutionen.

§ 1. Föredrag av doc. MÄKINEN om »Morfologisk variation av finska Phragmidiumarter». Efter föredraget yttrade sig prof. NANNFELDT och doc. RUNEMARK.

§ 2. Föredrag av doc. ALMBORN om »Artproblemet inom lavsystematiken». I diskussionen deltog prof. MUNK och doc. RUNEMARK.

§ 3. Föredrag av prof. MUNK: »Om taksonomiske kriterier». Efter föredraget yttrade sig prof. LARSEN.

§ 4. Prof. NANNFELDT föredrog stadgekommitténs förslag till stadgar. Synpunkter framfördes av prof. LARSEN, prof. VAARAMA, doc. MÄKINEN och stipendiat SKOGEN. Stadgeförslaget godkändes enhälligt i föreliggande skick.

§ 5. Föreningen beslöt att med tacksamhet acceptera prof. VAARAMAS erbjudande att ordna nästa sammanträde för föreningen 1967 i Åbo.

§ 6. Prof. LUTHER, Helsingfors, valdes enhälligt till föreningens ordförande för den kommande perioden.

§ 7. Till sekreterare valdes, likaledes enhälligt, doc. AARNO ROUSI, Åbo.

§ 8. Till suppleant för sekreteraren valdes enhälligt doc. TEUVO AHTI, Helsingfors.

§ 9. Till styrelseledamöter jämte suppleanter valdes: för Danmark prof. LARSEN — suppl. prof. MUNK, för Finland prof. VAARAMA — suppl. prof. JALAS, för Norge dr KNABEN — suppl. stipendiat SKOGEN, för Sverige prof. WEIMARCK — suppl. prof. NANNFELDT.

§ 10. Till revisorer valdes prof. NORLINDH och konservator KAASA och till suppleanter för dessa doc. ALMBORN och dr JACOBSEN.

§ 11. Prof. MUNK föreslog, att stadgarna genom styrelseledamöternas försorg skulle översättas till de olika nordiska språken. Föreningen beslöt enligt förslaget.

§ 12. Föredrag av mag. NORDENSTAM om »Synpunkter på Karroofloran». Efter föredraget yttrade sig prof. NORLINDH.

§ 13. Föredrag av assistent STRID om »Populationsstudier inom Nigella arvensis-gruppen».

§ 14. Föredrag av doc. RUNEMARK om »Statistiska synpunkter på spridning». I diskussionen deltog civ.ing. RYVARDEN, stipendiat SKOGEN, mag. NORDENSTAM, doc. DAHLGREN och prof. NANNFELDT.

Den 12 juni. Exkursion till Skäralid och Kullen under ledning av prof. WEIMARCK.

Omkr. 35 deltagare.

Sprickdalen vid Skäralid demonstrerades av doc. ÅKE PERSSON. Bl.a. påpekade han förekomsten av dels oceaniska och dels nordliga växter, framförallt bland mossor och lavar. Särskilt nämndes *Porella laevigata, Cladonia alpestris, C. bellidifolia* och *Normandina pulchella.* I bäckdalen växte rikligt *Thalictrum aquilegiifolium.* Deltagarna vandrade förbi Forshall och tog den lättgångna stigen upp till Kopparhatten, där bussen väntade.

Vid Kullen startade man från Mölle och vandrade längs stranden till Badviken, där bussen mötte. Krattskogen och främst *Quercus petraea* och *Fraxinus excelsior* studerades med dess fältskikt av bl.a. *Alliaria officinalis, Allium ursinum* och *Lathyrus niger. Lathyrus sphaericus* eftersöktes förgäves. Vid Ablahamn besågs det praktfulla beståndet av *Lunaria rediviva.*

Exkursionen avslutades vid Systrarna Lundgrens berömda kaffestuga, Skäret.

Deltagare i symposiet med Nordisk förening för taxonomisk botanik 8—12 juni 1965

ALMBORN, OVE, docent, Inst. för syst. bot., Ö. Vallg. 18, Lund, Sverige
ALMESTRAND, ASTA, fil. dr, S:t Petri Kyrkogata 15, Lund, Sverige
BJÖRKQVIST, INGEMAR, fil. lic., Inst. för syst. bot., Ö. Vallg. 18, Lund, Sverige
VON BOTHMER, ROLAND, amanuens, Inst. för syst. bot., Ö. Vallg. 18, Lund, Sverige
DAHLGREN, ROLF, docent, Inst. för syst. bot., Ö. Vallg. 18, Lund, Sverige
ENGLESSON, NILS, fil. mag., Inst. för syst. bot., Ö. Vallg. 18, Lund, Sverige
FLENSBURG, TOM, fil. lic., Fack, Stockholm 6, Sverige
HANSEN, ALFRED, amanuensis, Bot. Mus., Gothersgade 130, Köpenhamn K, Danmark

HANSEN, KJELD, cand. mag., Den Kgl. Vet.- og Landbohöjsk., Afd. for syst. botanik, Rolighedsvej 23, Köpenhamn V, Danmark
HEDBERG, OLOV, docent, Inst. för syst. bot., Box 123, Uppsala, Sverige
HIIRSALMI, HEIMO, fil. kand., Bot. inst., Turku universitet, Turku, Finland
HJELMQVIST, HAKON, docent, Inst. för syst. bot., Ö. Vallg. 18, Lund, Sverige
ISOVIITA, PEKKA, fil. kand., Bot. inst., Unionsgatan 44, Helsingfors, Finland
JAKOBSEN, KNUD, lektor, Inst. for syst. bot., Gothersgade 140, Köpenhamn K, Danmark
JONSELL, BENGT, fil. lic., Inst. för syst. bot., Box 123, Uppsala, Sverige
JUNELL, LENA, fil. lic., Inst. för syst. bot., Box 123, Uppsala, Sverige
KAASA, JON, konservator, Bot. Museum, Trondheimsv. 23 B, Oslo 5, Norge
KJELLQVIST, EBBE, fil. lic., Inst. för syst. bot., Ö. Vallg. 18, Lund, Sverige
KNABEN, GUNVOR, dr. phil., Bot. laboratorium, Blindern, Oslo 3, Norge
LAINE, UNTO, fil. mag., Bot. inst., Turku universitet, Turku, Finland
LAINE, KAIJA, hum. kand., Bot. inst., Turku universitet, Turku, Finland
LARSEN, KAI, professor, Bot. inst., Aarhus universitet, Århus C, Danmark
LINDBERG, KURT, fil. kand., Inst. för syst. bot., Ö. Vallg. 18, Lund, Sverige
LÖVKVIST, BÖRJE, laborator, Lantbrukshögskolan, Alnarp, Sverige
MUNK, ANDERS, professor, Sauntes Vænge 9, Gentofte, Danmark
MÄKINEN, LIISA, fil. mag., Bot. inst., Turku universitet, Turku, Finland
MÄKINEN, YRJÖ, docent, Bot. inst., Turku universitet, Turku, Finland
NANNFELDT, J. A., professor, Inst. för syst. bot., Box 123, Uppsala, Sverige
NILSSON, KARIN, fil. kand., Inst. för syst. bot., Ö. Vallg. 18, Lund, Sverige
NILSSON, ÖRJAN, fil. kand., Inst. för syst. bot., Ö. Vallg. 18, Lund, Sverige
NORDBORG, GERTRUD, fil. lic., Inst. för syst. bot., Ö. Vallg. 18, Lund, Sverige
NORDENSTAM, BERTIL, fil. mag., Inst. för syst. bot., Ö. Vallg. 18, Lund, Sverige
NORLINDH, TYCHO, professor, Riksmuseets bot. avd., Stockholm 50, Sverige
NORLINDH, ELSA, fru, Svanegatan 7 b, Lund, Sverige
NYHOLM, ELSA, intendent, Riksmuseets paleobot. avd., Stockholm 50, Sverige
OLSSON, ULF, fil. mag., Inst. för syst. bot., Ö. Vallg. 18, Lund, Sverige
PETERSON, BO, intendent, Bot. trädgården, Frölundag. 22, Göteborg SV, Sverige
RUNEMARK, HANS, docent, Inst. för syst. bot., Ö. Vallg. 18, Lund, Sverige
RYVARDEN, LEIF, civ.ing., Blindernveien 46 C, Oslo 3, Norge
SANTESSON, ROLF, docent, Inst. för syst. bot., Box 123, Uppsala, Sverige
SKOGEN, ARNFINN, forskningsstipendiat, Bot. avd., Det Kgl. Norske Videnskabers Selskab, Museet, Trondheim, Norge
SNOGERUP, SVEN, museiintendent, Inst. för syst. bot., Ö. Vallg. 18, Lund, Sverige
SPARRE, BENKT, intendent, Riksmuseets bot. avd., Stockholm 50, Sverige
STRANDHEDE, SVEN-OLOV, fil. lic., Inst. för syst. bot., Ö. Vallg. 18, Lund, Sverige
STRID, ARNE, fil. kand., Inst. för syst. bot., Ö. Vallg. 18, Lund, Sverige
TENGNÉR, JAN, fil. mag., Bergianska trädgården, Stockholm 50, Sverige
TRALAU, HANS, docent, Riksmuseets paleobot. avd., Stockholm 50, Sverige
VAARAMA, ANTERO, professor, Bot. inst., Turku universitet, Turku, Finland
WEIMARCK, GUNNAR, fil. mag., Inst. för syst. bot., Ö. Vallg. 18, Lund, Sverige
WEIMARCK, HENNING, professor, Inst. för syst. bot., Ö. Vallg. 18, Lund, Sverige
WEIMARCK, GUNHILD, fil. dr, St. Tomegatan 8, Lund, Sverige
WIDÉN, KARL-GUSTAV, fil. kand., Lönnrotsg. 9 D 1S, Helsingfors, Finland

Senare tillkomna medlemmar, som ej deltog i symposiet[1]

AFZELIUS, KARL, fil. dr, Riksmuseets bot. avd., Stockholm 50, Sverige
ASPLUND, ERIK, professor, Riksmuseets bot. avd., Stockholm 50, Sverige
Botanisk laboratorium, Danmarks Farmaceutiske Höjskole, Universitetsparken 2, Köpenhamn Ö, Danmark
BÖCHER, TYGE W., professor, Inst. for planteanatomi og cytologi, Gothersgade 140, Köpenhamn K, Danmark
DEGELIUS, GUNNAR, docent, Jättegrytsväg 3, Askim, Sverige
ECKBLAD, FINN-EGIL, cand. real., Botanisk laboratorium, Blindern, Oslo, Norge
EINARSSON, EYTHOR, mag. scient., Grasafraedideild Náttúrugripsafnsins, P.O. Box 532, Reykjavik, Island
FAEGRI, KNUT, professor, Postbox 2637, Bergen, Norge
FAGERLIND, FOLKE, professor, Universitetets bot. inst., Frescati, Stockholm 50, Sverige
GULDEN, GRO, cand. real., Botanisk laboratorium, Blindern, Oslo, Norge
HARLING, GUNNAR, professor, Inst. för syst. bot., Frölundagatan 22, Göteborg SV, Sverige
HASSELROT, TORSTEN, intendent, Riksmuseets bot. avd., Stockholm 50, Sverige
HOLMEN, KJELD, cand. mag., Bot. Mus., Gothersgade 130, Köpenhamn K, Danmark
HULTÉN, ERIC, professor, Riksmuseets bot. avd., Stockholm 50, Sverige
HYLANDER, NILS, docent, Vikingagatan 52, Uppsala, Sverige
HÖST, OLE, amanuensis, Den Kgl. Vet.- og Landbohöjskole, Afd. for syst. bot. B, Rolighedsvej 23, Köpenhamn V, Danmark
JALAS, JAAKO, professor, Bot. inst., Unionsgatan 44, Helsingfors, Finland
Inst. för syst. bot., Ö. Vallg. 18, Lund, Sverige
JENSEN, JÖRGEN, amanuensis, Den Kgl. Vet.- og Landbohöjskole, Afd. for syst. bot. B, Rolighedsvej 23, Köpenhamn V, Danmark
JUEL, INGER, mag. scient., Inst. for syst. bot., Gothersgade 140, Köpenhamn K, Danmark
KALELA, AARNO, professor, Bot. inst., Unionsgatan 44, Helsingfors, Finland
KALLIO, PAAVO, professor, Tarkkampujank. 26, Turku, Finland
KERS, LARS, fil. kand., Universitetets bot. inst., Frescati, Stockholm 50, Sverige
LAURSEN, FRANS, agronom, Den Kgl. Vet.- og Landbohöjskole, Afd. for syst. bot. B, Rolighedsvej 23, Köpenhamn V, Danmark
LUTHER, HANS, professor, Bot. inst., Unionsgatan 44, Helsingfors, Finland
MIKKELSEN, VALD. M., professor, Den Kgl. Vet.- og Landbohöjskole, Afd. for syst. bot. B, Rolighedsvej 23, Köpenhamn V, Danmark
NORDHAGEN, ROLF, professor, Universitetets bot. museum, Trondheimsv. 23 b, Oslo 5, Norge
ÓSKARSSON, INGIMAR, dr, Langholtsvegur 3, Reykjavik, Island
OUREN, TORE, dosent, Norges Handelshöyskole, Geografisk Institutt, Bergen, Norge
PEDERSEN, ANFRED, seminarielektor, Platanvej 15, Vordingborg, Danmark
RYBERG, MÅNS, docent, Bergianska trädgården, Stockholm 50, Sverige

[1] Sedan denna lista färdigställts har ett flertal nya medlemmar tillkommit.

RÖNNING, OLAF I., dr. philos., Det Kgl. Norske Videnskabers Selskab, Museet, Den bot. avd., Trondheim, Norge
SJÖSTEDT, BO, fil. mag., Riksmuseets bot. avd., Stockholm 50, Sverige
SKIFTE, OLA, konservator, Bot. Avd., Tromsö museum, Tromsö, Norge
STEINDÓRSSON, STEINDÓR, mag. scient., Akureyri, Island
STORK, ADELAIDE, fil. lic., Riksmuseets bot. avd., Stockholm 50, Sverige
STÖRMER, PER, förstekonservator, Universitetets bot. museum, Trondheimsv. 23 b, Oslo 5, Norge
SÖRENSEN, THORVALD, professor, Inst. for syst. bot., Gothersgade 140, Köpenhamn K, Danmark
SÖYRINKI, NIILO, professor, Bot. inst., Oulu universitet, Oulu, Finland
TUOMIKOSKI, RISTO, professor, Bot. inst., Unionsgatan 44, Helsingfors, Finland
VALLIN, HERVID, fil. dr., Hunnetorpsvägen 115, Hälsingborg, Sverige
WENDELBO, PER, professor, Inst. för syst. bot., Frölundagatan 22, Göteborg SV, Sverige
WISCHMANN, FINN, stip., Universitetets bot. museum, Trondheimsv. 23 b, Oslo 5, Norge
ÖDUM, SÖREN, amanuensis, Den Kgl. Vet.- og Landbohöjskole, Afd. for syst. bot. B, Rolighedsvej 23, Köpenhamn V, Danmark

Stadgar för Nordisk förening för taxonomisk botanik

§ 1. Föreningens uppgift är
att främja den rena och tillämpade taxonomiska botaniken med därtill anknutna vetenskapsgrenar och bevaka dessa vetenskapers intressen samt att underlätta och stärka kontakten och samarbetet mellan Nordens växttaxonomer.

§ 2. Medlem av föreningen kan varje person eller institution bli, som är intresserad av föreningens syfte och som anmäler sig till någon styrelseledamot eller suppleant.

§ 3. Ordinarie sammanträde med exkursion(er) hålles vartannat år på plats, som alternerar mellan de nordiska länderna. Vid ordinarie sammanträde bestämmes plats för nästa sammanträde.
Mellanliggande år kan en exkursion ordnas inom Norden eller till annat område, där nordiska botanister bedriva forskning.

§ 4. Föreningens styrelse består av ordförande, sekreterare och en ledamot från varje nordiskt land. Ordföranden och sekreteraren jämte en suppleant för den senare väljas av föreningen i dess helhet, övriga styrelseledamöter jämte en suppleant för var och en av dem väljas av föreningsmedlemmarna från respektive land. Alla val förrättas å ordinarie sammanträde och avse tiden till nästa ordinarie sammanträde.
Styrelsen utser inom sig vice ordförande.

§ 5. Sammanträden och exkursioner organiseras i samråd med styrelsen av medlemmar från berörda institutioner.

§ 6. Föreningen utger ett årsmeddelande innehållande föreningsangelägenheter, förteckning över aktiva forskare, deras aktuella adresser och arbetsuppgifter och andra meddelanden av intresse för medlemmarna. Föreningens sekreterare tjänstgör som redaktör.

§ 7. Årsavgiften är 10 sv. kronor för enskilda medlemmar och 100 sv. kronor för institutioner.
§ 8. Föreningens sekreterare tjänstgör som kassör. Räkenskaperna skola avslutas kalenderårsvis.
§ 9. Vid ordinarie sammanträde väljas 2 revisorer jämte 2 suppleanter för löpande och nästkommande kalenderår.
Revisionsberättelsen skall föreligga vid följande ordinarie sammanträde.

Autoreferat av föredrag hållna vid symposiet med Nordisk förening för taxonomisk botanik 8—12 juni 1965

Organisation och verksamhet vid Institutionen för systematisk botanik i Lund

Institutionen inrymmes i flera byggnader i Botaniska trädgården. Trädgården och de äldsta byggnaderna, Agardhianum och växthusen, tillkom under J. G. AGARDHS tid på 1860-talet. Före denna tid hade trädgården legat mellan Akademiska föreningen och nuvarande universitetsbyggnaden. Vid trädgårdens sydvästra hörn ligger den vita institutionsbyggnaden, f.d. Botaniska laboratoriet, som till 1964 var Institutionen för fysiologisk botanik och nu inrymmer undervisningslokaler för systematisk botanik och ekologisk botanik samt laboratorier för det senare ämnet. I trädgårdens mitt vid Ö. Vallgatan ligger Botaniska muséet, som byggdes under prof. MURBECKS tid och blev färdigt 1912. Nära muséet ligger de äldre, nu till en del helt ombyggda växthusen och nära Agardhianum de nya experimentväxthusen samt trädgårdskontoret och den nytillkomna personal- och verkstadsbyggnaden.

Vid institutionen bedrivs växttaxonomi, grundad på morfologi och växtgeografi, cytotaxonomi och på senare tid även kemotaxonomi.

Morfologin och växtgeografin har hemvist på Botaniska muséet. Där arbetar doc. ALMBORN med lavar, f.n. särskilt med lavar från Afrika, doc. DAHLGREN med sydafrikanska fanerogamer, framför allt med papilionacésläktet *Aspalathus,* doc. HJELMQVIST med morfologiska och embryologiska problem samt med kulturväxternas, särskilt våra sädesslags historia, fil. kand. LINDBERG med kompositésläktet *Phagnalon,* assistent ÖRJAN NILSSON med fam. *Portulacaceae,* fil. mag. NORDENSTAM med kompositéer från Aegeis och Sydafrika, fru ELSA NYHOLM (f.n. tjänstledig) med Skandinaviens mossflora samt undertecknad med fanerogamer och Skånes flora.

Cytotaxonomi och kemotaxonomi hör hemma på Agardhianum, och dess representanter har experimentodlingar i trädgården, bänkgården och de nya växthusen. Här bearbetar lic. BJÖRKQVIST *Alismataceae,* fil. kand. v. BOTHMER *Allium* från Aegeis, mag. BRUNSBERG *Lathyrus,* mag. ENGLESSON *Cerastium semidecandrum*-gruppen, lic. KJELLQVIST *Festuca rubra*-komplexet, fil. kand. KARIN NILSSON *Artemisia,* lic. NORDBORG *Sanguisorbeae,* mag. ULF OLSSON *Mentha,* doc. RUNEMARK evolutionsproblem inom Aegeis, lic. SNOGERUP *Juncus* och *Cheiranthus,* lic. STRANDHEDE *Eleocharis palustris*-gruppen, fil. kand. STRID *Nigella,* mag. WEIMARCK *Hierochloë* och mag. VÄRENDH *Valeriana.*

Därefter redogjordes för undersökningarna över floran i Skåne, vilka pågått sedan 1938. 1963 kom en första upplaga av Skånes Flora, omfattande omkr. 1200 indigena och naturaliserade arter samt ett stort antal adventiver och hybrider. Av Skånes 11250 kvkm återstår nu omkr. 900 kvkm att undersöka. Det är meningen, att en ny upplaga med illustrationer och kartor skall komma ut, när hela fältarbetet är genomfört.

Skåne har högst skiftande jordar och växlande klimat. De högre belägna delarna är i allmänhet täckta av urbergsmorän och hör edafiskt och klimatiskt till Fennoskandia, de mellersta och de lägre belägna områdena har i regel ±kalkrika, ofta leriga jordar och hör till Skanodania och därmed växtgeografiskt till Mellaneuropa.

Prov på utbredningskartor visades. Omkr. 800 arter har en sådan utbredning, att kartering är motiverad.

Många för landskapet nya arter har upptäckts under arbetets gång, åtskilliga klassiska fynd har kunnat verifieras, medan andra arter försvunnit.

HENNING WEIMARCK

Cytotaxonomical Studies in Pyrolaceae

Genera, species and taxa of lower rank in *Pyrolaceae* vary clearly in quantitative characters. The distinguishing characters are measurable and surely multifactorial: size of leaves, length of racemes, number of flowers, length of styles and calyx lobes, likewise, size of anthers, etc. In *Pyrolaceae* there are all transitions from the contrasting characters separating genera and remote species to those e.g. of the *Pyrola rotundifolia* complex which have been difficult to analyse and appreciate taxonomically. The rank of the taxa in this group has also been difficult to ascertain, some of them having been by some authors regarded as species, by others as subspecies.

The Linnean *P. rotundifolia* complex comprises a large number of taxa in temperate and arctic areas in the northern hemisphere. Today they are treated as specifically distinct: *incarnata, japonica, asarifolia, americana, elliptica, picta, grandiflora, norvegica* and *rotundifolia* s.str. The latter is now identical with subsp. *rotundifolia* in temperate Eurasia westwards to Central Europe and Southern Scandinavia. The eastern boundary in Asia is uncertain. Along the British Channel and on or near the shores in Jutland, Scania and South Norway it is replaced by subsp. *maritima* (Kenyon) Warb. (syn. var. *arenaria* Koch). It can be mentioned that the latter taxon was given under the name *arenaria* also from the valleys of the lower Alps by Dr. ALEFELD and later by HEGI, and in accordance with this, by Polish and Czecho-Slovak manuals, from Tatra. Dr. B. KŘÍSA refers the Central European subalpine taxon to *P. intermedia,* a nomen nudum first published in SCHLEICHER's flora lists from Helvetia in 1815. KŘÍSA holds that *P. intermedia* also occurs in Scandinavia in arctic, subarctic and montane areas where *norvegica* belongs. The latter has been given subspecific rank in the combination *P. grandiflora* Rad. subsp. *norvegica* (Knaben) Löve & Löve in agreement with professor E. HULTÉN who thinks that *P. grandiflora* is circumpolar, and that *norvegica* has arisen through introgression in the Scandinavian area, where *P. grandiflora* and *P. rotundi-*

folia meet. It is true that *P. norvegica* in some respects shows transition as to some characters standing between *P. rotundifolia* and *P. grandiflora.*

The present author has come to the conclusion that the three taxa, *P. grandiflora, P. norvegica* and *P. rotundifolia* s.str., are standing on the same step in evolution. They are to be treated as taxa with the same rank, either species, or subspecies of a broad *P. rotundifolia* L. Through thorough analyses, on cytological and morphological grounds, she has found clear discontinuities separating them. This is discussed in a paper now in print in Bergen University Annals.

Here only a few comments. The taxa have all n=23 chromosomes, but they are distinct as to chromosome structure. The present author pays great attention to this fact, because she has unravelled a similar karyotypical variation in all investigated *Pyrolaceae* taxa at the specific and generic level. She does not agree with KŘÍSA's points of view. There is no reason for splitting up the *P. grandiflora—P. norvegica* complex in northern Eurasiatic areas introducing a third taxon, *P. intermedia,* there. All the herbarium specimens determined to *P. intermedia* by KŘÍSA, which belong to the Scandinavian Botanical Museums, is seen by the present author. They are either *P. norvegica* or *P. grandiflora.*

In the opinion of the present author subsp. *maritima* is a good morphological-ecological race of *P. rotundifolia.* It shows the same leaf and calyx characteristics as this species, and agrees also in anther morphology. The few dried specimens available from the lower Alps of the subalpine form of *P. rotundifolia* s.str. are not identical with *P. norvegica* from subalpine districts in Scandinavia. Whether the type deserves a specific name of its own in line with *P. norvegica-grandiflora* cannot be ascertained on the available material.

The author had in 1960 opportunity to see the herbarium material of *P. rotundifolia* from Great Britain, belonging to British Museum and to the Royal Botanical Garden in Edinburgh. The collections from Scotland in many respects show agreement with *P. norvegica.* It would be of interest to analyse mass collections from this area after the same methods as used in treating the occurrences in Scandinavia.

Pyrolaceae are not suitable for experimental studies, because the germination physiology of the seed in relation to the growth of mycorrhiza is not known. There are considerable difficulties in raising plants from seeds. *P. norvegica* and *P. rotundifolia* have, therefore, been analysed on morphological grounds on the large herbarium material available from the Scandinavian area, — of *P. grandiflora,* on material from Alaska, Greenland, and the few localities known of it in the Siberian area. Besides, mass collections of single individuals of different clones from series of populations of *P. norvegica* and *P. rotundifolia* have been investigated. These species have been studied also in extensive field studies in the Norwegian area.

In *P. norvegica* and *P. rotundifolia* the population studies on the Scandinavian material revealed significant differences in the following characteristics: length of petioles, length and breadth of laminas, thickness and length of the scapes, length and number of flowers of the racemes, and number of free vein ends in the petals. Length of anthers and length of petioles and laminas were treated statistically on specimens from collections evenly distributed in Norway. The material for this explicit treatment was chosen as follows: three leaves from each of three specimens from 100 localities through-

out Scandinavia were picked out. In this material the length of petioles and laminas and the ratios: length of petiole/length of lamina show highly significant differences in the two taxa.

The anthers also show significant differences as calculated on 300 anthers of each taxon from 20 localities evenly distributed throughout Scandinavia.

The field studies have revealed the great individual modifiability of all the investigated taxa. The specimens of *P. norvegica* from sunny, dry or rocky habitats are of low stature, short-leaved and with thick scapes. The floral characters: calyx and calyx lobes vary also in accordance with the change in environments. In sunny habitats the calyx wall becomes yellowish red, almost as red as the style, and gets an uneven surface. It seems as if the epidermis is too wide, and it forms a corolla-like fold at the base. This fold may appear in single individuals of *P. rotundifolia*, but it is never as pronounced in this species as in *P. norvegica*. Individuals of *P. norvegica* in subalpine birch and pine woods stretch, seemingly, becoming taller with more flowers in the racemes and more leaves in the rosettes. The graphs of the length of the petioles and laminas show a conspicuous positive skewness due to the fact that there is a limit for the modification of the petiole to the left, — it cannot be shorter than half a centimeter —, whereas the petioles in specimens growing up from under twigs or in a thick moss carpet can be curiously long. The measurements show that the petioles in *P. norvegica* vary in length between 0.4 and 6 cm, with mean $\bar{x}=2.25$ cm and median $M=3{,}2$ cm.

The leaves and calyx in *P. rotundifolia* and *P. grandiflora* are modified in the same way as *P. norvegica*. This is one of the reasons why *P. norvegica* seems to constitute a transition, connecting the two species.

The petioles in *P. rotundifolia* vary in length between 1.6 and 9.6 cm, with mean $\bar{x}=5.00$ cm and median $M=5.6$ cm.

P. grandiflora stands out as to vegetative and floral characters by the characteristics generally mentioned in the manuals. The leaves in the specimens from the westernmost occurrences in Siberia on the shores of the Arctic Sea at Kolgujev Island, Novaya Zemlya and Waigatch, are small with the characteristic red tinge of this species. The stature of the plants is low, the scapes, however, with the characteristic broad scales and large but few flowers. The specimens are modified in the same direction as *P. norvegica* is in the Kola Peninsula (Ponoj and Murmansk) and Rybachi Peninsula, i.e. at its eastern boundary. The fact that the two taxa do not show continuous variation is best seen from the morphology of the calyx lobes and the anthers. The calyx lobes are broader and longer acuminate in *P. grandiflora* than in *P. norvegica*. The anthers are terminating in short tubes of the same breadth as the pollen sacks in *P. grandiflora*. In *P. norvegica* they terminate in tubes much narrower than the pollen sacks and are therefore more conspicuous than in *P. grandiflora*. Further the flowers are smaller in *P. norvegica* from Kola, with a longer style than in *P. grandiflora* growing farther east.

Judged from the records in the literature it is evident that the *Pyrola* species do not find suitable conditions on the shores of the Siberian Arctic Sea. They are rare here, and flower scarcely on the localities where they have been found. They are absent in the Svalbard Islands.

The present studies have shown that *P. grandiflora* seems to belong to the

group of the arctic species which has penetrated along the Siberian coast from the Bering Strait, but has not reached Scandinavia over a land bridge Cape Kanin—Kola Peninsula, whereas *P. norvegica* has not come to Scandinavia either from east or from the west. Its relation to the montane-subalpine types in Scotland and Central Europe, founded on the species concept of the present author will be treated on a later occasion.

GUNVOR KNABEN

Problem inom Eleocharis palustris-komplexet

Med anknytning till de cytologiska förhållanden, som presenterats i en serie uppsatser, »Chromosome Studies in Eleocharis, subser. Palustres I—IV» (STRANDHEDE 1965 a—d), konstaterade föredragshållaren det anmärkningsvärda förhållandet, att de cytologiskt mest variabla enheterna (*E. palustris* ssp. *vulgaris* och *E. uniglumis* ssp. *sterneri*) är de morfologiskt mest konstanta, en egenskap, som också tillkommer *E. mamillata* ssp. *mamillata* och ssp. *austriaca*. Dessa enheter är vidare självfertila i motsats till de övriga (*E. palustris* ssp. *palustris* och *E. uniglumis* ssp. *uniglumis*), vilka är självsterila. Självbefruktning i de först nämnda arterna motverkas emellertid av en förlängning av tiden mellan gynes och anthes hos de självfertila enheterna.

Hybridbildningen i naturen diskuterades (cf. STRANDHEDE 1965 c), och pågående experimentella hybridförsök presenterades samt, i anslutning till dessa, följande specialförsök. Försöket omfattar frösådd från enstaka plantor efter fri avblomning i experimentodlingarna. Förutsättningarna för spontan hybridbildning torde ha varit optimala, och försöket avser att giva en uppfattning om arternas benägenhet att spontant bilda hybrider. Resultaten är att betrakta som preliminära, och någon ingående analys har ännu ej företagits.

Ur en sådd av 500 frukter från *E. uniglumis* ssp. *uniglumis* (2n=46) har hittill endast 16 plantor kromosomtalsbestämts. 8 av dessa plantor är emellertid hybrider med *E. palustris* ssp. *vulgaris* och har 2n=42 eller 2n=43. Denna tendens att bilda hybrider med ssp. *vulgaris* kommer också till synes i naturen.

I en sådd av 500 frukter från en *E. palustris* ssp. *vulgaris*-planta med 2n=38 påträffades inga hybrider men däremot en kromosomtalsvariation, som är direkt proportionell mot den som konstaterats i det insamlade spontana materialet av denna subspecies (tab. 1). Någon förklaring till detta unika förhållande kan ej givas för närvarande, men föredragshållaren hänvisade till de säregna cytologiska förhållanden, som konstaterats i *E. palustris* ssp. *vulgaris* (STRANDHEDE 1965 c). Försöket fortsätter.

Avslutningsvis diskuterade föredragshållaren, vilken taxonomisk rang en-

Tabell 1. Jämförelse mellan frekvensen av olika kromosomtal i fröplantor från en moderplanta med 2n=38 och spontant material av E. palustris ssp. vulgaris

Kromosomtal bestämt i	somatiska kromosomtal (%)					
	36	37	38	39	40	41
fröplantor	2	9	56	26	6	1
spontant material	1	6	57	26	9	1

heterna i komplexet bör ha med utgångspunkt från konstaterade morfologiska och cytologiska förhållanden samt förekomsten av spontana hybrider. Alla enheterna tillhör biologiskt sett samma coenospecies, men ur genetisk synvinkel kan komplexet uppdelas i tre grupper, (1) *E. mamillata* s.l., (2) *E. palustris* ssp. *palustris* och (3) *E. uniglumis* s.l., vilken innefattar *E. palustris* ssp. *vulgaris*. Denna indelning sammanfaller ej med hävdvunna artgränser och är ur floristisk synpunkt opraktisk, då *E. palustris* ssp. *vulgaris*, före utbrytningen såsom eget taxon, alltid inordnats i *E. palustris* s.l. Föredragshållaren föreslog en floristiskt användbar kompromisslösning, som också kan motiveras biologiskt. Under *E. mamillata* Lindb. fil. infogas såsom subspecies *E. mamillata* s. str. och *E. austriaca* Hayek, då dessa taxa är morfologiskt, cytologiskt och av allt att döma även fylogenetiskt närstående och väl differentierade från övriga taxa i komplexet. Under *E. palustris* (L.) R.&S. infogas såsom subspecies *E. palustris* ssp. *palustris* (STRANDHEDE 1960) och *E. palustris* ssp. *vulgaris* Walters, då dessa två enheter morfologiskt är mycket närstående och även genetiskt och fylogenetiskt uppvisar ett samband. Emellertid är gränsen mellan *E. palustris* ssp. *vulgaris* och *E. uniglumis* ssp. *uniglumis* oskarp ur genetisk synpunkt. *E. uniglumis* (Link) Schult. omfattar likaledes två subspecies i Skandinavien: *E. uniglumis* ssp. *uniglumis* och *E. uniglumis* ssp. *sterneri* Strandh., vilka morfologiskt är mycket närstående, men väl skilda kromosomtalsmässigt, ehuru de spontant bildar fertila hybrider. Komplexets taxonomi har tidigare behandlats i ett separat arbete (STRANDHEDE 1961).

SVEN-OLOV STRANDHEDE

Citerad litteratur

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Artavgränsning inom Sanguisorba minor-komplexet

Det s.k. *Sanguisorba minor*-komplexet är en polymorf grupp av taxa, som är varandra så lika, att de ej med säkerhet kan skiljas i andra morfologiska karaktärer än fruktbägarens utseende. Även beträffande denna karaktär är intermediärer mellan taxa vanliga.

Huvudkomponenterna i komplexet är *S. minor* Scop. ssp. *minor* (2n=28), ssp. *muricata* (Spach) Rouy (2n=28 och 56) och ssp. *magnolii* (Spach) Rouy (2n=28), tillsamman utbredda i större delen av Europa. Övriga arter och underarter är m.l.m. lokala endemer, de flesta mediterrana.

Varken traditionella morfologiska skiljekaraktärer, cytologi, anatomi eller palynologi ger några distinkta skillnader. Den i naturen förekommande variationen kan delvis förklaras genom korsningsexperiment. Inga sterilitetsbarriärer råder mellan lika kromosomtal. Korsningar och återkorsningar uppvisar praktiskt taget samma variation i fruktbägarutseende som funnits i naturen. Genom att plantorna är helt självfertila och i stor utsträckning autogama stabiliseras eventuellt bildade hybrider.

Framställda hexaploider är nästan helt sterila. Vid pollination med en tetraploid som fader har dock i enstaka fall grobara frön erhållits, som kan ge upphov till individ med varierande kromosomtal, av vilka endast oktoploider utvecklas normalt och blir fertila. En stark tendens till apospori finns i komplexet, och nämnda oktoploider har troligen uppkommit genom att en oreducerad äggcell befruktats av en reducerad gamet från tetraploiden. Experimentellt har oktoploiderna också framställts genom allopolyploidi och genom autopolyploidi. Oktoploiderna, som i naturen är mycket heterogena, kan tänkas ha ett polyfyletiskt ursprung.

Det taxonomiska resultatet har blivit, att de flesta av de c:a 30 beskrivna arter (synonymer undantagna), som bör föras till komplexet, har fått reduceras till underarter eller indragas som synonymer i någon av huvudkomponenterna. Tetraploider och oktoploider av ssp. *muricata* är ej morfologiskt urskiljbara, och de ingår båda i samma subspecies. Kvar som arter blir endast enstaka ekologiskt specialiserade endemer.

GERTRUD NORDBORG

Linnés Tropaeolum-arter och deras historia

LINNÉ presenterade i Species plantarum (1753) 3 arter av släktet *Tropaeolum: T. minus, T. majus* och *T. peregrinum*. De första två baserades dels på odlat material, dels på tidigare planschverk. Bortsett från en del förvirrande problem i slutet av 15- och början av 1600-talet för *T. minus* — som första gången omtalas säkert av LOBEL 1576 — råder ingen tvekan om vad LINNÉ menade. *T. minus* typifieras lämpligast med ett exemplar i BURSER's herbarium i Uppsala, med paratyper i Cliffordherbariet i British Museum, Linnéherbariet i Stockholm och Linnean Society i London. *T. majus,* som beskrevs första gången av HERMANN 1687, måste lämpligast typifieras med det vackra exemplaret i Cliffordherbariet; dessutom finns en paratyp i Linnean Society. *T. hybridum,* ett nytt namn, som skapades av LINNÉ 1767 för BERGII *T. quinquelobum* (1765), måste uppfattas som en monstrositet av *T. majus*. Vad gäller den nu allmänt odlade formen av *T. majus,* morfologiskt knappast skiljbar från de vilda populationerna runt Callao och Arequipa i Peru, bör ett nytt namn sökas, då den genetiskt är helt skild som ett resultat av flitig inkorsning med *T. minus* och *T. peltophorum* (*T. lobbianum*), framför allt under mitten av 1800-talet.

Beträffande *T. peregrinum* är problemet större. Den beskrevs 1753 på en bild av FEUILLÉE (1714) utan att LINNÈ sett material. 1771, sedan LINNÉ fått material från DUCHESNE, beskrev han en ny art under samma namn — denna har långt senare (1843) döpts till *T. hayneanum* av BERNHARDI. Trots det goda material, som finns i Linnean Society, måste den lämpligast typifieras med ett exemplar i Missouri Botanical Garden, som härrör från BERNHARDIS trädgård i Erfurt. Ytterligare material, denna gång från MUTIS i Colombia, inkorporerades i LINNÉS herbarium och döptes senare (ej av LINNÉ!) till *T. peregrinum* av J. E. SMITH; denna kallades senare av DE CANDOLLE (1824) för *T. smithii* och typifieras med ett av MUTIS' exemplar, trots en viss konfusion i DE CANDOLLES uppfattning. På grund av sin missuppfattning av Linnématerialet och framför allt FEUILLÉES bild, beskrev så SMITH den rätta *T. peregrinum* på nytt (1819) som *T. aduncum* (typen i SMITHS herbarium i Linnean Society). Även en del andra, mindre allvarliga, misstag uppstodo. Typmaterial för den äkta *T. peregrinum* saknas alltså helt, och arten måste typifieras med FEUILLÉES bild. På grund av de talrika misstagen ha flera olika arter beskrivits som *T. peregrinum* eller *T. hayneanum*; dessa ha nu reviderats och i flera fall nybeskrivits. *T.* »*canariense*» slutligen är endast ett synonymt trädgårdsnamn för den äkta *T. peregrinum,* utan någon antagbar beskrivning.

BENKT SPARRE

Om de i Danmark fundne Amaranthus-arter

Amaranthus-slægten omfatter ca. 100 arter, der især bebor de varme og tempererede egne af kloden. Flere arter har vist en fantastisk evne til at brede sig og erobre nye arealer, er blevet til kosmopolitter; andre arter har som kulturflygtninge eller som opgivne nytteplanter kunnet erobre nye arealer. I Europa regner man kun med 2 hjemmehørende arter (og kun i Middelhavsegnene), nemlig *Amaranthus graecizans* (var. *silvestris*) og *A. lividus* (var. *adscendens*). Men siden de store opdagelsesrejsers tid har Europa modtaget en større invasion af fremmede arter, en invasion, som især i de sidste årtier er blevet påfaldende intensiveret, et udtryk for den stærkt øgede samfærdsel mellem verdensdelene. Ingen af arterne spiller dog i Danmark og de øvrige skandinaviske lande nogen økonomisk eller praktisk rolle, og ingen af dem kan siges at være naturaliseret. De kommer og går, og deres fortsatte eksistens er vel mest afhængig af fortsat tilførsel udefra af frø. Amarant-arterne er sentblomstrende planter, der først når i blomst i august-september og oktober, og da de er stærkt frostfølsomme, forsvinder de med den først efterårsnattefrost. Visse arter er dog sikkert i stand til at modne frø under nordiske klimaforhold.

Følgende 17 arter er hidtil påvist i Danmark: *A. albus* L., *A. blitoides* Wats., *A. caudatus* L., *A. deflexus* L., *A. gracilis* Desf., *A. graecizans* L. (var. *graecizans,* var. *silvestris*), *A. hybridus* L. (incl. *A. chlorostachys* Willd., *A. patulus* Bertol., *A. paniculatus* L.), *A. lividus* L. (*A. blitum*), *A. macrocarpus* Benth., *A. muricatus* Gill., *A. quitensis* H.B.K., *A. retroflexus* L., *A. spinosus* L., *A. standleyanus*

Parodi (*A. vulgatissimus* auct. non Speg.), *A. thunbergii* Moq., samt *A. palmeri* S.Wats. og *A. tamariscinus* Nutt. De hyppigst optrædende arter er følgende: *A. albus, A. hybridus, A. retroflexus* og *A. standleyanus*. Ældst kendte art i Danmark er *A. caudatus,* kendt siden 1825.

ALFRED HANSEN

Dacrydium — Anatomy and Taxonomy

The conifer genus *Dacrydium* of the *Podocarpaceae* comprises 22 described species from S.E. Asia (*Malaysia:* 8 spp.; *New Caledonia:* 5 spp.), Australia (*New Zealand:* 7 spp.; *Tasmania:* 1 sp.) and South America (*Chile:* 1 sp.). There are at least 3 new species (from Borneo and N. Guinea) to be added to this number.

Evidence from external morphology of vegetative and reproductive organs as well as from pollen morphology and cytology has shown that the genus with its present delimitation is very heterogeneous. Accordingly most botanists (e.g., PILGER 1926, FLORIN 1931) have divided the species into three groups (designated A, B, and C; cf. table 1).

Investigations by the present writer into the anatomy of certain vegetative organs have confirmed this heterogeneity. The following anatomic characters were especially studied:

A. Secondary xylem:
   1. Occurrence of distinct annual ring boundaries.
   2. „ „ wood parenchyma.
   3. Type and number (per cross field) of cross field pits.

B. Primary axis:
   4. Occurrence of phloem fibres.

C. Adult leaf:
   5. Occurrence of leaf hypodermis.
   6. „ „ vascular fibres.
   7. „ „ resin ducts.

D. Pollen grains of most species have furthermore been studied as to (8) type and (9) the occurrence of well delimited air bladders.

The results of the anatomic studies are finally compared with chromosome conditions within the genus, as described by HAIR & BEUZENBERG 1958.

A summary of the above-mentioned characters is to be found in the accompanying table (table 1).

From this table is evident that the genus *Dacrydium* s.lat. divides quite naturally into two main parts (I and II), which should indubitably be treated as different genera. The deviating leaf morphology and anatomy within group I A (*D. falciforme, D. taxoides,* etc), together with pollen conditions in the same group, furthermore makes it probable that it should be separated from the rest of group I to form a genus of its own.

Two of the groups within the genus (I B and II) may further be divided into a number of subgroups, considering anatomic conditions as to cross field

Table 1. Summary of Certain Anatomic Characters in Dacrydium Compared with Pollen Morphology and Chromosome Characters

Dacrydium Groups and species	Secondary xylem			Axis	Adult leaves			Pollen		Chromosomes (acc. to HAIR)		
	Ring boundary	Wood parenchyma	Cross field pits (type and number)	Phloem fibres	Leaf hypodermis	Vascular fibres	Resin ducts	Type	Well delimited air bladders	2n	V+I (types of chromosomes)	"sum" of chromosome arms
A.												
falciforme	—	+	T. 0—2	+	+	—	+	A	—			
nov. spec.	—	+	T. 0—2	+	+	—	+	A	—			
taxoides	—	+	T. 0—2	+	+	—	+	A	—	20	10+0	20
B. 1. a												
araucarioides	—	+	T. 1—2	+	+	+	+	B	—	20	10+0	20
Balansae	—	+	T. 0—2	+	+	+	+	B	—	20	10+0	20
lycopodioides	—	+	T. 0—2	+	+	+	+	B	—	20	10+0	20
B. 1. b												
Guillauminii	—	+	T. 0—4	+	+	+	+	C	—	20	10+0	20
B. 2.												
Beccarii	—	+	T. 0—3	+	+	+	+	D	—			
comosum	—	+	T. 0—1	+	+	+	+		(—)			
nov. spec.	—	+	T. 0—2	+	+	+	+					
Gibbsiae	—	+	T. 1—4	+	+	+	+		(—)			
xanthandrum	—	+	T. 0—2	+	+	+	+					
elatum	—	+	T. 0—2	+	+	+	+	D	—	20	10+0	20
Pierrei	—	+	T. 0—2	+	+	+	+		—			
novo-guineense	—	+	T. 0—2	+	+	+	+					
B. 3.												
cupressinum	—	+	C. 0—2	+	+	(+)	+	E?	—	20	10+0	20
(C) 1. a.												
intermedium	+	—	C. 1—8	(+)	—	—	—	F	+	30	5+10	20
laxifolium	+	—	C. 2—8	+	—	—	—	F	+	30	5+10	20
1. b.												
Fonkii	+	—	C. 2—5	—	—	—	—	F?	+			
1. c.												
Colensoi	+	—	F. 1(—2)	+	—	—	+	F	+	20	10+0	20
2.												
Franklinii	+	— (+)	F. 1(—2)	+	—	—	+	G	+	30	5+10	20
3.												
biforme	+	—	F. 1—2	—	—	—	+	F	+	24	4+8	16
Kirkii	+	—	F. 1—2	—	—	—	+	F	+	22	5+6	16
Bidwillii	+	—	F. 1—2	—	—	—	+	F	+	18	7+2	16

=taxodioid, C=cupressoid, F=fenestriform pits

pits, phloem fibres, and resin ducts of the leaves, as well as pollen types and chromosome conditions. It is to be hoped that further investigations into the morphology and anatomy of vegetative as well as reproductive organs will elucidate the taxonomic status of these subgroups.

JAN TENGNÉR

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On the Evolutionary Relationships of the Finnish Phragmidium Species

Evolutionary relationships among the Finnish rose-parasitizing species of the genus *Phragmidium* (*Uredinales*) were examined morphologically by spore measurements. In the following, emphasis will mainly be on *P. fusiforme* with some remarks also about *P. mucronatum* and the account is based on the results of MÄKINEN (1965 and unpublished).

Correlation analyses indicated that the following teliospore characters are generally in a very significant correlation and are thus valuable taxonomic characters: length of spore, breadth of spore, length of pedicel, length of apiculus, and number of cells. Measurements were also made on aecio- and urediospores.

P. fusiforme is found in Finland in two separate areas: in the larger, eastern area it is common on *Rosa acicularis* but also occurs on *R. majalis*; in the smaller, western area it is rare on *R. majalis*. This distribution raises the following questions: (1) Are the rusts of the western and eastern areas identical? (2) Are the rusts attacking *R. majalis* and *R. acicularis* identical? (3) If differences will be found, what will be their probable explanation?

In the eastern area the rusts on *R. majalis* and *R. acicularis* resemble each other fairly closely, even when they differ in two of the seven teliospore characters tested (Fig. 1): the spores on *R. acicularis* are relatively longer and contain more cells than on *R. majalis*. This is probably due to some genetical specialization since on *R. majalis* both the shape of the spores and the number of the cells differ so as to resemble *P. mucronatum* (of which the main host in Finland is *R. majalis*). We can thus suppose that as a result of hybridization between *P. mucronatum* and *P. fusiforme* a new race of *P. fusiforme* has arisen which morphologically deviates only slightly from the main race on *R. acicularis* but physiologically has become capable of infecting a new host, *R. majalis*. Another evidence suggests for an ancient hybridization between *P. fusiforme* and *P. mucronatum*. Almost all of the Finnish specimens of *P. mucronatum* differ from the Central European specimens in that they show features of *P. fusiforme*. It is further interesting to note that only the telio- and urediospores exhibit these deviating characters, but not the aeciospores.

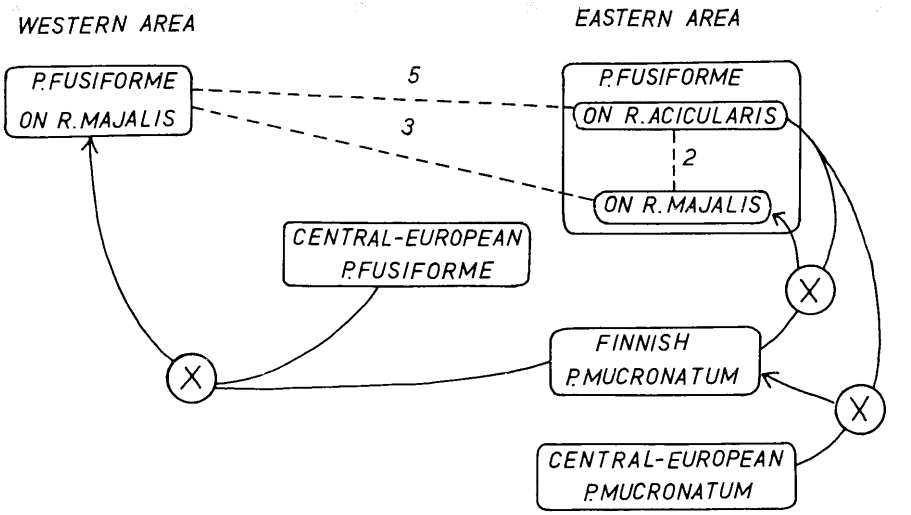

Fig. 1. Probable evolutionary relationships in the Finnish *Phragmidium fusiforme*. The figures at the broken lines show the number of the differentiating characters; the crosses indicate possible ancient hybridizations.

This is explained by the fact that most of the aecial specimens belong to races which have lost their sexual cycle and thus have no direct possibility of obtaining genes from *P. fusiforme* through hybridization.

The rusts on *R. majalis* in eastern and western Finland differ in 3 teliospore characters, and the rusts on *R. majalis* in western Finland and on *R. acicularis* in eastern Finland differ in 5 characters (Fig. 1). The last-mentioned differences are thus probably partly due to the different host species, but partly due to some other factors.

In Central-Europe, *P. fusiforme* (=*P. rosae-alpinae*) is fairly common on *Rosa alpina*. All of the Finnish specimens of *P. fusiforme* clearly differ from the Central European *P. fusiforme*. For example the spores are shorter, the apiculus is shorter and the cells fewer in Finland than in Central Europe. These differences are, I think sufficient to separate these two rusts into different taxa at a varietal level.

Among the Finnish races, the rust on *R. acicularis* most resembles the Central-European forms since both have longer spores and more numerous cells than the other races. Ever since the latest glaciation both of these races have probably been in a very close connection. However, the western *majalis* group also shows some features (long spores and long apiculus) which point to the Central European population of *P. fusiforme* (Fig. 1). It seems as if the western population in Finland has received genes from the Central European population, and perhaps has arisen through hybridization between *P. mucronatum* and the Central European *P. fusiforme*.

YRJÖ MÄKINEN

Reference

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The Species Concept in Lichen Taxonomy

LINNAEUS (1753 pp. 1140—1156), which is the starting-point of the lichenological nomenclature, recorded 80 species of lichens under the genus *Lichen* (as "*Algae*"). ACHARIUS, the "father of lichenology" (1810, 1814), described 906 species from all parts of the world. NYLANDER (1857, the first "check-list" of the world's lichens) counted with 1361 species. ZAHLBRUCKNER's wellknown catalogue (1921—1940) listed 17364 species. LAMB (1963) listed an addition of 8205 species described in the years 1932—1960.

These increasing figures do not only reflect the increased material available to the lichenologists during the last two centuries, not least from exotic countries, but also a species concept changing towards more and more "narrow" species. As the criterion of a lichen species seems to be more vague and deliberate than in many other plant groups, a critical examination of the current species concept in lichenology may be justified.

Broadly speaking, we can conceive four principles:

1. Characters from external morphology.

LINNAEUS, ACHARIUS and authors up to the middle of the past century founded nearly all taxonomy on externally visible characters, such as colour, pilosity, cilia, cyphellae, pseudocyphellae, soredia, isidia, external shape of apothecia, etc. The evaluation of such characters has changed considerably. The presence or absence of soredia and/or isidia was considered as good specific criteria by ACHARIUS but was almost entirely neglected towards the end of the 19th century. DU RIETZ (1924) rightly emphasized the importance of soredial and isidial characters in lichen taxonomy. HALE & KUROKAWA (1964) and HALE (1965) pointed out that good specific characters can be derived from the shape of the rhizines. The present author believes that most, perhaps all, good lichen species should be recognized by the trained eye (aided with a lens or a binocular) without a detailed microscopic examination.

2. Characters from internal morphology.

The rapid development of lichen anatomy, especially the morphology of apothecia and spores, in the 1840's to 1860's caused fundamental changes in lichen taxonomy. Different spore types proved to be useful for the delimitation of a large number of genera. Many of them (e.g., *Diploschistes, Catillaria, Lopadium, Phlyctis*) are well-established in the lichen taxonomy of to-day.

Many lichenologists have also used anatomical characters as main criteria for specific segregation. MAGNUSSON (1929 and several other papers) often used data such as thickness of the cortex, height of the hymenium, size of

the spores, etc., as essential or only specific characters. WEBER (1962), who has worked on a large material of crustose lichens from arid districts in the U.S., has rightly emphasized that ecologic factors can cause a considerable modificative variation in the internal as well as in the external morphology of the species. Many descriptions, though often long and detailed, have been founded on very scarce material. In many cases they describe a specimen, not a species.

The author means that microscopic characters, such as those mentioned above, should be used with great caution if they are not combined with characters from external morphology. Some examples: *Parmelia tuckermanii* Du R., which differs from *P. crinita* Ach. only in having smaller spores, should not have a specific rank (HALE 1965 p. 284). *Opegrapha devulgata* Nyl. differs from *O. vulgata* Ach. only in having shorter pycnoconidia. (Cf. REDINGER 1938 p. 358.) Such variations, if constant, should not be given higher taxonomic rank than *forma.*

3. Characters from the algal component.

The recognition of the lichen symbiosis towards the end of the past century gave rise to several problems in lichen taxonomy. ZAHLBRUCKNER (1926) recorded some genera (e.g., *Allarthonia* and *Lobarina*) differing (from *Arthonia* and *Lobaria,* respectively) only in having another algal genus as symbiont. In other cases (e.g., *Sticta,* sect. *Eusticta* and sect. *Stictina*) he used similar differences for the subdivision of a genus. As the present Code of Botanical Nomenclature (§ 13) states that "names given to lichens shall be considered as applying to their fungal components", such genera (subgenera, sections) are untenable.

Also species, whose main or only criteria are different algal symbionts, should be reduced to synonymy, e.g., *Lobaria retigera* (Bory) Trevis. (syn. of *L. pulmonaria* (L.) Hoffm.) and *Solorina simensis* Hochst. (syn. of *S. saccata* (L.) Ach.).

4. Characters from lichen chemistry.

Since the 1860's, colour reactions with chemical reagents (first potassium hydroxide, calcium hypochlorite and iodine, later also paraphenylenediamine) have been used in identifying lichen species. During the last three decades our knowledge of the substances in the lichen thalli causing such reactions has increased considerably. In many cases their chemical structure is known, and accurate methods for their identification have been tested.

The numerous results from lichen chemistry have been frequently used to describe lichen species founded mainly or only on chemical criteria. Some trends in the present lichen taxonomy concerning the evaluation of the "chemical characters" can be summarized thus:

a. A constant chemical difference should be regarded as a specific character even if the lichens are morphologically identical. Cf. ASAHINA (earlier works), and CULBERSON (1960). Example: *Thamnolia vermicularis* (Sw.) Ach. (containing thamnolic acid) and *Th. subvermicularis* Asahina [sec. CULBERSON=

Th. subuliformis (Ehrh.) Culb] (lacking thamnolic acid but containing squamatic and baeomycetic acids).

b. A constant chemical difference not correlated with any morphological difference can be used for specific segregation if it is correlated with a different distribution (HALE 1965). Example: *Parmelia arnoldii* Du R. (containing alectoronic acid; distributed in many oceanic districts) and *P. margaritata* Hue (containing salacinic acid; distribution restricted to N. America).

c. A constant chemical difference not correlated with any morphological difference but with a distinct distribution should be quoted as a subspecies or a variety [ASAHINA 1964: subspecific division of *Haematomma puniceum* (Sm.) Mass.].

d. A constant chemical difference in morphologically indistinguishable individuals should not be given any nomenclatural status but be quoted as a "chemical strain" (LAMB 1951: species of *Stereocaulon*).

The present author would agree with LAMB. In my opinion, the principles under a—c should not be used to distinguish any taxonomic units under the Code of Nomenclature. It should be emphasized, however, that data from lichen chemistry often give valuable aid to lichen taxonomy if they are correlated with constant morphological characters.

Such a restrictive attitude towards the "chemical taxa" together with stronger observance of the modificative variation caused by environmental factors would reduce a considerable number of the lichen "species" described in recent years to synonymy. It is essential that lichen taxonomy be founded on firm principles not deviating too much from those generally accepted in other plant groups.

OVE ALMBORN

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Om taxonomiske kriterier

Med udgangspunkt i de højere svampes taxonomi behandledes nogle principielle spørgsmål vedrørende anvendelsen af taxonomiske kriterier og udformningen af taxonomisk litteratur.

Taxonomiens første mål var af diagnostisk art: Man heftede sig ensidigt ved de karakterer, som fandtes hos alle medlemmer af et taxon, og som derfor kunne tjene til genkendelse og bruges i bestemmelsesnøgler. Nu derimod har taxonomien i høj grad opmærksomheden henledt på den information, som foreligger i de karakterer, der udviser variation inden for et taxon; de faste diagnostiske karakterer spiller erfaringsmæssigt en ret beskeden rolle i nyere overvejelser vedrørende opdeling eller sammenknytning af højere taxa. Det skønnes at være vigtigt, ikke mindst med henblik på det rent praktiske aspekt, at denne forskel mellem taxonomien før og nu erkendes: Den tradition for formulering af mykologisk taxonomisk litteratur, som stammer fra taxonomiens »diagnostiske fase», er stadig fremherskende, trods de nye signaler i selve forskningen; og, som det var at vente, resultatet er ofte uhensigtsmæssigt. Et eksempel: Det forringer en bogs anvendelighed, hvis dens bestemmelsesnøgler (som læseren henvises til til diagnostisk brug) tilsigter at afspejle resultaterne af forfatterens taxonomiske overvejelser (som har drejet sig om variationsmønstre).

Heller ikke når en forfatter vil dokumentere sine anskuelser, fungerer den traditionelle »litterære stil» hensigtsmæssigt: De diagnostiske karakterer kommer let til at indtage en utilsigtet hædersplads; og den egentlige dokumentation kommer dels til at stå som en perspektivløs opremsning, der ikke lader ane meget om forfatterens eventuelle dybtgående overvejelser, dels kommer den til at befinde sig ufremhævet og diffust i teksten, hvorfra den alt for ofte kun lader sig uddrage af den læser, som af selvsyn kender de pågældende organismer.

Med den mangelfulde viden, vi endnu i dag har om svampenes taxonomi, vil en klart fremsat dokumentation oftest være langt fra at kunne tilkendes objektiv gyldighed. Men den bør kunne udformes, således at den bliver o b j e k t i v t v u r d e r b a r.

Med henblik på de højere svampe, hvor konvergens, divergens og parallelevolution i eminent grad tilslører de naturlige slægtskabsforhold, blev gennemgået nogle eksempler på, hvorledes kendskabet til disses svampes biologi og økologi kan være til nytte som en rent foreløbig rettesnor for taxonomisk arbejde: De karakterer, som har indlysende biologisk selektionsværdi, har vist sig at være upålidelige som taxonomiske kriterier.

Der føles et behov for en ny »litterær stil», i lærebøger såvel som i videnskabelige afhandlinger, som er mere hensigtsmæssig end den traditionelle til

kommunikation af taxonomisk information. Hertil vil, så vidt det ses, en omfattende teoretisk analyse af taxonomisk metode være nødvendig. En sådan analyse vil iøvrigt kunne vise sig nyttig også på helt andre fronter; det kan således formodes, at taxonomiens stilling blandt de biologiske discipliner også rent politiskt ville nyde godt af, om der som for disse kunne henvises til et velformuleret teoretisk arbejdsgrundlag.

ANDERS MUNK

Synpunkter på karroofloran

Sydafrikas karroo-områden hyser en flora, som i sammansättning, ursprung och historia skiljer sig markant från kapfloran och den tempererade skogsfloran. Karroofloran har en vidsträckt utbredning i Sydafrikas inland och i nordväst längs kusten upp i Sydvästafrika. De mest typiska och välkända karroo-områdena är Great Karroo, Little Karroo och Ceres-Calvinia Karroo.

Särskilt Little Karroo är bekant för sin rikedom på intressanta suckulenter, framförallt tillhörande *Crassulaceae, Asclepiadaceae* tribus *Stapelieae*, och *Mesembryanthemaceae*. Endemismen är påfallande, och t.o.m. endemiska släkten förekommer, t.ex. *Gibbaeum* (c. 30 arter), *Rhinephyllum* (9 arter) och *Muiria* (2 arter). Andra släkten har ett markerat centrum i Little Karroo, t.ex. *Glottiphyllum* (c. 50 arter).

Endemism, artbildning och differentiering inom lokala populationer kan med fördel studeras inom begränsade karroo-områden. Ett sådant område är Vanrhynsdorp Karroo, även kallat Kners Vlakte, norr om Olifants River's nedre del. Området är flackt, c. 8 sv. mil långt och brett, och till största delen täckt av mäktiga sandlager. Här och var förekommer emellertid fasta fläckar av kvartsitgrus, ibland i samband med smärre kopjes, åsar eller stenryggar. Dessa isolerade lokaler hyser en rik och särpräglad flora av framförallt små suckulenter. Endemrikedomen är mycket stor. Inte mindre än fem endemiska släkten förekommer inom detta begränsade område, samtliga tillhörande *Mesembryanthemaceae: Argyroderma* (c. 50 arter), *Oophytum* (3 arter), *Dactylopsis* (2 arter), *Antimima* (1 art) och *Maughaniella* (1 art).

Inom området är de lokala populationerna ofta helt små, ibland blott ett hundratal individ eller ännu färre. Några exempel på morfologisk differentiering inom småpopulationer kan nämnas.

Av den endemiska *Othonna hallii* är två populationer kända, belägna ungefär en halvmil från varandra, och vardera bestående av något hundratal individ. Populationerna skiljer sig något i flera karaktärer, t.ex. bladstorlek, suckulensgrad, bladtandning, korgstorlek, och strålblommornas längd.

Ett liknande exempel finns inom en ännu obeskriven *Chrysanthemum*-art.

Det monotypiska släktet *Maughaniella* är känt från ett par lokaler. I en population har samtliga individ (under gynnsamma år, t.ex. 1962, omkring ett 100-tal, ofta säkerligen färre) avvikande färg på staminodierna. I övrigt överensstämmer populationen morfologiskt helt med den närmast belägna, några km därifrån. En slumpmässig fixering av en icke adaptiv karaktär förefaller föreligga.

Släktet *Oophytum*, slutligen, har tre populationer, som betraktas som skilda arter. Skillnaderna är dock relativt obetydliga. *O. oviforme* har rosa blommor, *O. nanum* skiljer sig främst genom sin litenhet, och *O. nordenstamii* har större, vita blommor.

Kvartsitgruslokalerna inom Vanrhynsdorp Karroo uppvisar knappast några klimatiska eller edafiska skillnader. Därför är området väl lämpat för studier av differentiering inom små isolerade populationer, eller den evolutionsmekanism, som benämnts »Sewall Wright-effekt» eller »genetic drift».

BERTIL NORDENSTAM

Populationsstudier inom Nigella arvensis-gruppen

Förf. har undersökt kromosommorfologin hos fyra egeiska arter av *Nigella*, nämligen *N. fumariifolia* Kotschy, *N. degenii* Vierh., *N. cretica* Mill. och *N. aristata* S.&S. Arterna har samma diploida kromosomtal, 2n=12, och likartade karyotyper. Fem par metacentriska till submetacentriska och ett par nästan telocentriska kromosomer förekommer. Skillnader mellan arterna har dock påvisats, t.ex. i antal och läge av sekundära konstriktioner.

N. fumariifolia skiljer sig cytologiskt från de övriga undersökta arterna genom det stora antalet sekundära konstriktioner. Alla sex kromosomparen kan identifieras.

N. degenii uppvisar ofta kraftigt kontraherade metafasplattor. Två par satelliter förekommer, samt en sekundär konstriktion i den lilla subtelocentriska kromosomen.

N. cretica är morfologiskt mycket lik *N. degenii*, men cytologiskt något olik. Två par satelliter förekommer.

N. aristata är mycket variabel, både i yttre morfologi och kromosommorfologi. Till karyotypen liknar den *N. degenii*, men dessa båda arter är klart skilda morfologiskt. Fem populationer av *N. aristata* från olika egeiska öar utvaldes för en särskilt noggrann cytologisk undersökning. I flera fall påvisades signifikanta skillnader. En planta, som var strukturheterozygot i satellitregionen i kromosom 2, självbefruktades och avkomman studerades. I denna var de olika satellittyperna fördelade enligt det väntade förhållandet 1 : 2 : 1.

De fyra undersökta arterna är uppenbarligen normalt självbefruktare, men i flera fall har utförda korsningar givit god frösättning. Populationer från olika egeiska öar är i de flesta fall effektivt isolerade. Slumpvisa förändringar i genfrekvenser och frekvenser av strukturellt olika kromosomtyper beroende på fluktuationer i populationsstorlek har förmodligen spelat en viktig roll för den morfologiska och cytologiska differentieringen inom *N. aristata*.

ARNE STRID

Litteratur

STRID, A. 1965. Studies in the Aegean Flora VII. Chromosome Morphology in the Nigella arvensis Complex. — Bot. Notiser 118: 2.

Statistiska synpunkter på spridning

Växtgeografiska diskussioner om långspridning avslutas ofta med antagandet, att någon gång kan genom en kombination av gynnsamma omständigheter diasporer spridas över stora avstånd, komma att hamna i en lämplig miljö och där ge upphov till nya individ.

Även om man accepterar en sådan möjlighet innebär detta inte att en lyckad kolonisation skett. Det kan nämligen matematisk-statistiskt visas, att i biotoper med stabiliserade växtsamhällen kommer avkomman till sådana enstaka kolonisatörer i de allra flesta fall att elimineras i följande generationer på grund av rena slumpfaktorer.

Detta ger en rimlig förklaring till att havsarmar på endast någon el. några få mils bredd ger en effektiv isolering (även för växter med relativt lättspridda diasporer) i områden, som under lång tid haft förhållandevis stabila miljöförhållanden. Som exempel kan nämnas isoleringen mellan olika öar i vissa ögrupper (bl.a. Hawaii, Galapagos, Kanarieöarna och de egeiska öarna).

Det bör betonas att det matematisk-statistiska resonemanget endast kan tillämpas på relativt stabila miljöer och därför ej appliceras på sådana problemställningar som invandringen av den skandinaviska floran efter istiden eller kolonisation av biotoper, vilka starkt förändrats eller nyskapats av människan.

HANS RUNEMARK

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Kompletteringar av föreliggande och uppgifter avseende nästa förteckning mottas tacksamt av undertecknad.

The bibliography comprises the scientific botanical literature printed in 1964 in Sweden, as well as such papers published by Swedish authors in foreign countries. Additions to previous lists are marked out with an asterisk. The year of publishing is put down only to these additions. Popular science and book reviews as a rule are not included in the list.

Starkare förkortningar — Shorter abbreviations

AAS: Acta Agriculturae Scandinavica, Stockholm.
ACS: Acta Chemica Scandinavica, Köbenhavn (tr. i Helsinki).
AHG: Agri Hortique Genetica, Landskrona.
BN: Botaniska Notiser, Lund.
ECR: Experimental Cell Research, New York (tr. i Uppsala).
GP: Grana Palynologica, Stockholm.
Her.: Hereditas, Lund.
PP: Physiologia Plantarum, Köbenhavn (tr. i Lund).
SBT: Svensk Botanisk Tidskrift, Stockholm.
TIBC: Tenth International Botanical Congress. Abstracts of papers. Edinburgh.

Morfologi. Anatomi. Embryologi — Morphology. Anatomy. Embryology

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21. MALKOFF, D. B., and BUETOW, D. E.: Ultrastructural changes during carbon starvation in Euglena gracilis. ECR 35, 58—68.
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Se även nr. 268, 442, 522.

ARNE H. HOLMQVIST
Botaniska Museet, Lund

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Litteratur

VOISIN, ANDRÉ: Ueber die Verbindung der Gesundheit des modernen Menschen mit der Gesundheit des Bodens. — Arbeitsgem. f. Forschung des Landes Nordrhein-Westfalen. Heft 108. 1962. 51 sid. (hela häftet 98 sid.) Pris DM. 8.25.

Publikationen är ett av de mera välunderbyggda försöken att upplysa om nu rådande brukningsmetoders avigsidor och vänder sig lika mycket till växtfysiologen, växtodlaren och marklärefackmannen som till läkaren, födoämnesspecialisten och den dietetiskt engagerade. I centrum för utredningen står åkermarken och dess grödor med avseende på deras inverkan på kreaturens och människans hälsa. Dessutom ägnas dricksvattnet viss uppmärksamhet. För att eliminera misstankar skall framhållas, att det inte rör sig om en biodynamisk kampskrift, men VOISIN tar på ett sakligt sätt givetvis ställning även till detta ämne.

Vår moderna tid har i motsats till gångna perioder möjligheter att förebygga jordtrötthet betingad av växtnäringsämnesbrist, främst då spårämnesbrist. På grund av kvävets starkt produktionsmängdökande verkan uppstår i åkerjorden ett större behov av spårnäringsämnen, som i många jordar inte kan tillfredsställas utan gödsling med mikroelement.

Kapitlet om kräftsjukdomar (i synnerhet deras frekvenskartor) verkar inte lika klart och lättförståeligt som t.ex. avsnittet struma, dels därför att man efterlyser en jämförelse med jordartskartor och dels därför att uppgifter om odlingstekniken i resp. områden saknas. Av speciellt intresse är att märgstamkål under vissa förhållanden kan innehålla en strumaframkallande faktor som övergår i mjölken, att kalk är ett antagonistämne till jod på så sätt att ökad kalknärvaro leder till sköldkörteluppsvällning efter jodfattig utfodring och slutligen att den kväveform fodret är odlat på påverkar jodhalten i sköldkörteln: nitratkväve sänker den relativa jodhalten, medan ammoniakkväve ej har någon jodsänkande effekt.

Likaså finns en antagonism mellan kväve och koppar såtillvida att ökad eller långvarig hög kvävegödsling medför kopparbrist hos betesdjuren, vilken kompenseras med 7 kg/hektar kopparsulfat (=1 ppm per 20 cm matjordsdjup).

Med nu rådande gödslingsnormer tillför vi för mycket NPK och kalk i förhållande till magnesium. Som följder utpekas betestetani, trombos och phlebitits (undertecknads anmärkning: även för tidig bladfällning hos fruktträd vållas oftast av magnesiumbrist). Påståendena ledsagas av försöksresultat och illustrationsmaterial.

Förf. framhåller övertygande dels nödvändigheten av en förbättrad lantbruksgödsling, där även spårämnesbehovet fullt tillgodoses, och dels betydelsen av biologisk kvalitetsundersökning av födoämnena. Uppnående av biologisk kvalitet behöver inte innebära nedsatt kvantitativ avkastning, ifall vi går in för en mera vetenskapligt än industriellt grundad gödsling.

Skriften vore värd att översättas till svenska.

HELLMUT MERKER

Notiser

Doktorsdisputation. Fil. lic. VOLKMAR STOY försvarade den 30 okt. 1965 vid Lunds Universitet avhandlingen »Photosynthesis, Respiration, and Carbohydrate Accumulation in Spring Wheat in Relation to Yield».

Forskningsanslag. Jordbrukets forskningsråd har vid sammanträde den 27 okt. 1965 utdelat bl.a. följande anslag: till hortonom T. JOHNSSON, Alnarp, 9.000 kr. för studier över sambandet mellan kväveupptagningen och blomknoppsbildningen samt fruktutvecklingen hos päronträd; till docent A. KYLIN, Stockholm, 12.000 kr. för isolering och karaktärisering av Na^+-aktiverade ATP-aser i betor; till docent A. NILSSON, Uppsala, 5.700 kr. för studier rörande de växtöstrogena ämnenas metabolism vid C.S.I.R.O.:s laboratorium i Perth, Australien, samt till laborator H. ZECH, Uppsala, 10.304 kr. för undersökningar över reproduktionsprocessen hos växtvirus.

Insamlingar i Ecuador. Intendent BENKT SPARRE, Riksmuseets bot. avd., Stockholm 50, meddelar: Begagnande mig av det nu utdelade Regnellska resestipendiet ämnar jag under 1966, troligtvis i september, avresa till Ecuador. Uppehållet där kommer att omfatta ca. ett år och såväl regnskogs- som högfjällsområdet kommer att besökas. Om det utan men för mitt eget program visar sig möjligt, är jag gärna villig att åtaga mig diverse specialinsamlingar inom begränsad grupp — fixeringar, fröinsamling, anatomiprover, pollen, mindre vattenprover, o.d. Någon större extra utrustning för detta insamlingsarbete kan tyvärr ej medtagas. Förslag och förfrågningar mottagas t.o.m. april månads utgång. Endast undantagsvis kan jag senare ta upp beställningar, då planeringen då måste vara i det närmaste slutförd.

Nordisk förening för taxonomisk botanik. Anmälan om medlemskap kan göras till föreningens svenska ombud, prof. H. WEIMARCK, Institutionen för systematisk botanik, Lund. Årsavgiften (10 kr.) kan insättas å föreningens postgirokonto 53 12 88.

Utmärkelse. Prof. HENNING WEIMARCK, Lund, har av Fysiografiska Sällskapet i Lund tilldelats Linnépriset i botanik för sin år 1963 utgivna »Skånes flora».

Professors namn. Professors namn har tillagts universitetslektorn vid Göteborgs universitet, docent GUNNAR DEGELIUS, avd. föreståndaren vid Sveriges Utsädesförening i Svalöv, docent ARNE HAGBERG, samt föreståndaren för institutet för växtförädling av frukt och bär i Balsgård, docent NILS NYBOM.

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