BOTANISKA NOTISER

FÖR ÅR 1954

UTGIVNA AV

LUNDS BOTANISKA FÖRENING

REDIGERADE AV

TYCHO NORLINDH

TIDSKRIFTEN GRUNDAD 1839

DISTRIBUTÖR:
C. W. K. GLEERUP, FÖRLAG, LUND

Utgivningstider:

Häfte 1, sid. 1—64, den 5 april
Häfte 2, sid. 65—206, den 22 juni
Häfte 3, sid. 207—242, den 20 sept.
Häfte 4, sid. 243—480, den 30 dec.

LUND 1954
CARL BLOMS BOKTRYCKERI A.-B.

INNEHÅLLSFÖRTECKNING.

Lunds Botaniska Förening.

Litteratur.

ARTFÖRTECKNING.

Nedanstående förteckning upptager endast sådana arter, som blivit i något avseende utförligare eller mera speciellt behandlade. Nya arter eller former angives med fetstil. * betecknar, att avbildning, k att karta förekommer.

BOTANISKA NOTISER 1954, HÄFTE 1. LUND

Revisions of some Pliocene charophyte gyrogonites.

By HENNING HORN AF RANTZIEN.

In connection with an investigation of some gyrogonites from the Austrian Pliocene, the morphology and systematic affinities of which will be discussed in another paper, the writer has examined the records of Pliocene charophytes in the literature. Though no material has been available for comparison of most of these species, some rather informative figures and descriptions allowed generic re-identifications on the basis of the literature alone. As these imply considerable extensions of the geological ranges of some genera, and as the Pliocene charophyte floras are but little known, some short notes may be motivated.

In view of the many interesting problems connected with Paleogene and still older charophytes, it is hardly surprising that most studies of gyrogonites are more or less exclusively devoted to these forms. Neogene charophytes, on the other hand, have received relatively little notice. This refers particularly to the Pliocene and somewhat less to the Miocene gyrogonites. The neglect of the Pliocene species may in some degree have been caused by a statement by J. GROVES (1924, p. 84): »In some of the Pliocene and Pleistocene beds *Chara*-fruits are abundant, but, as might be expected, these resemble for the most part those of species common and widely distributed at the present day.» This statement may be true of at least parts of the Pleistocene, though with the reservation that few gyrogonites of that age have been critically studied. With regard to the Pliocene, on the other hand, and particularly to its lower parts, it seems somewhat exaggerated. Present observations seem to indicate that the charophyte floras of the Pliocene, though extremely fragmentarily known, differ rather strongly from the charophyte floras of today, and that no Pliocene gyrogonite can — at least for the present — be identified with any living species. This is perhaps also only what might be expected, considering the comparatively short period of existence of most species of fossil charophytes known in any great detail (MÄDLER 1953 a, p. 65), a fact that is rather important to their evaluation as stratigraphic fossils.

GROVES' check-list of fossil charophytes from 1933 enumerates only three species of gyrogonites ascribed to Pliocene deposits. Two of them, identified with still existing species, viz. *Chara connivens* SALZMANN ex BRAUN, *Nitellopsis obtusa* (DESVAUX) GROVES, were reported by GROVES (1924, p. 84, 88) from the Cromer Forest Bed of Norfolk, England; this deposit is for the present time considered Lower Pleistocene (KIRCHHEIMER 1940, p. 159, BADEN-POWELL 1950, p. 10, WOLDSTEDT 1950, p. 111), however, and the two Cromerian species have for that reason been omitted from the list of Pliocene charophytes at the end of this paper. The third species in GROVES' catalogue, *Chara zoberbieri,* had been described by v. FRITSCH (1885, p. 424) from the Rippersroda deposits of Thuringia, Germany, of Middle Pliocene (Reuverian) age (KIRCHHEIMER, op.c., p. 150). Three charophyte species were reported from the Pliocene deposits of Sinkiang by LU (1946, p. 273—277). The most noteworthy contribution so far in this field was recently made by PAPP (1951), who reported nine forms — among them five previously undescribed species — from the Austrian Pliocene. He has supplemented his account of these forms by drawings, which allow detailed comparisons with other known types of gyrogonites.

Before discussing the Pliocene gyrogonites, an introductory observation seems necessary. This concerns the circumstance that all Pliocene gyrogonites have been ascribed to *Chara,* while the comments in this paper indicate that some of them cannot possibly be included in that genus, and that none of the others can with absolute certainty be referred to it. It should be remembered in this connection, however, that the three types of fossil gyrogonites originally referred to *Chara* (BRONGNIART 1822, p. 320—322) comprise two species (*C. medicaginula, C. helicteres*) which definitely do not belong to that genus, while the generic identity of the third (*C. lemani*) has not been possible to establish with any certainty. Later students have generally adopted this usage, and apart from a few deviating types — the Kosmogyreae distinguished by STACHE 1889, the trochilisks and sycidiads studied by KARPINSKY 1906, the *Clavator* discovered by REID & GROVES 1916, and BELL'S *Palaeochara acadica* of 1922 — all fossil gyrogonites have been referred to *Chara,* even in GROVES' catalogue of 1933. PIA'S attempt (1927, p. 89) to refer all free gyrogonites except the *Kosmogyreae* and

Palaeochara to the organ-genus *Gyrogonites* [LAMARCK 1804, p. 356] LAMARCK 1822, p. 614 — once established for »*Chara*» *medicaginula* — met with no success and has been criticizised (PECK 1941, p. 289, RÁSKY 1945, p. 29, MÄDLER 1952, p. 3). The establishment of the name *Aclistochara* (PECK 1937, p. 86) for a type of gyrogonite deviating from present-day *Chara* in systematically important features (MÄDLER 1952, p. 7), and the segregation of some other genera of gyrogonites — *Sphaerochara* and *Obtusochara* — has led to a more differentiated outlook on the system of the Charophyta (MÄDLER 1952, p. 14—15; further discussed and commented upon by MÄDLER 1953 a, p. 63—65 and 1953 b, p. 474 ff.; cf. PECK 1953, p. 224—225). An inclusion of fossil charophytes in these new genera has accordingly not been possible until the last few years. The reference of all gyrogonites to the genus *Chara* — still adhered to by some students of this group — is rather a general designation of fossil charophytes than a reference to any particular generic group. This also implies that a re-examination of previously described types of gyrogonites will necessitate several generic transfers and new combinations.

Professor OLOF H. SELLING, Sc.D., has read the manuscript of this paper and has suggested several improvements. The writer is indebted to him for much help and encouragement.

Aclistochara, Sphaerochara, and Kosmogyra in the Pliocene.

1. *Aclistochara nana* (LU) H. AF R.

Aclistochara nana (LU) H. AF R., n. comb. (fig. 1 a—c).

Chara nana LU 1946, p. 276, fig. 2: 3 a—c.

»Oogonia small, elongate-subovoid in shape, tapering steadily and regularly to the apex and gradually to the somewhat obtuse bases with the greatest transverse diameter above mid-height. Length measuring about 715 μ, breadth 455 μ. Spiral-cells showing 11—12 convolutions, smooth, convex, with the sutures in broad and deep furrows. Width of the spiral-cells variable, measuring about 65 μ at the upper-half portion and 48 μ near the base. Equatorial angle about 15°. Tips pronounced, faintly swollen, giving rise to a distinct, slightly projecting rosette.» (LU l.c.).

Occurrence: »at Kizil-Ming-Oi . . ., about 8 km north of Kucha and 1/2 km east of the Kucha-Bai motor road», Sinkiang. — Kucha Formation (=Kuchar Group of NORIN 1935 b and 1941), Middle Bed (=Series B of NORIN 1935 a, p. 80, 1935 b, p. 340 ff.). On the age of the latter CHANEY 1935, p. 97 writes: »It is clear that it can be referred to the Pliocene on the basis of its structure and lithology, and that the flora is related in kind and in climatic implications to Pliocene floras in Asia and in western North America. While the possibility must be considered that it may be as young as the Pleistocene, the evidence now at hand favours the reference of this flora to the Pliocene». NORIN (1941, p. 186) considers this bed »probably Pliocene».

The figures and descriptions of the apical regions of these gyrogonites show beyond any doubt that they should be referred to *Aclistochara,* as defined by present students of this group. In *A. nana* the spiral cells narrow in the periphery of the apical pole, but expand abruptly in the apical centre. This is a distinctive of one of the types referred to *Aclistochara* (see p. 9). Species of *Aclistochara* have usually a flat apical region, a character which was included in the diagnosis of the genus (PECK 1937, p. 86). As gyrogonites gradually tapering towards the summit, but provided with the apical structure characteristic of *Aclistochara,* have been encountered now and then (see e.g. MÄDLER 1952, Taf. B, fig. 29), this character seems less reliable from a systematic point of view.

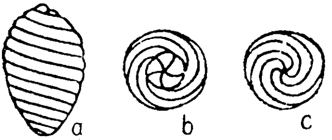


Fig. 1. *Aclistochara nana* (LU) H. AF R. Sinkiang: 8 km N of Kucha (Kuchar Group, Series B; Pliocene). — a: gyrogonite in lateral view; b: apical view; c: basal view. — After LU 1946, fig. 2: 3 a—c. — All fig. approx. 25/1.

Chara nana has been compared by LU (op.c., p. 277) with *C. escheri* UNGER (1850, p. 34) and *C. elegans* DOLLFUS & FRITEL (1920, p. 255). As figured by DOLLFUS & FRITEL (op.c., fig. 17), *C. elegans* does not belong to any of the types usually referred to *Aclistochara,* and is also in other respects rather different from *A. nana.* Whether the latter is distinct from some of the forms included in *C. escheri* seems more questionable, however. *C. escheri* — as usually interpreted — evidently comprises rather different forms, some of which belong to the Aclistochareae. As the taxonomy and variation of *C. escheri* is not well understood, and its typification not adequately investigated, a comparison with *A. nana* is difficult.

Our knowledge of the *Aclistochara* type of gyrogonites is of comparatively recent date.

PECK (1937, p. 86—90) united a group of seven species from the Upper Jurassic Morrison formation of Wyoming to a new genus, *Aclistochara,* defining them as comprising gyrogonites whose spiral cells »ascend to a truncated summit where they terminate without meeting in the center, leaving a conspicuous opening into the interior of each oogonium». From various Lower Cretaceous formations of U.S.A., PECK (1941, p. 290—292) described two additional species, but according to MÄDLER (1952, p. 8) one of these, *A. mundula,* probably belongs to the Clavatoraceae. In the same year, RÁSKY described *A. staubi* from the Lower Miocene of Hungary (RÁSKY 1941, p. 300) — up to the present the youngest recorded gyrogonites referable to these morphological types. Nine more species of the same genus were established by RÁSKY (1945, p. 40—46) from other Hungarian Middle Cretaceous, Paleocene, Eocene, and Oligocene deposits. An Eocene type of gyrogonite of this morphological group has been recorded from Peru (PECK & REKER 1947, p. 5), and four additional forms from the Eocene of U.S.A. (PECK & REKER 1948, p. 87—89). Some occurrences of *Aclistochara* from the Paleocene (BELL 1949, p. 36) and Lower Cretaceous (LORANGER 1951, p. 2357) of Alberta, Canada, have also been reported; the latter paper includes a description of a new species. HORN AF RANTZIEN (1951, p. 672—673) listed four species of *Aclistochara* from South America, one of them previously described as a *Chara,* and RÁSKY (1952, p. 43) gave a new record from the Eocene-Oligocene of Hungary. Fourteen new forms of *Aclistochara* were described by MÄDLER (1952, p. 18—30) from the Kimmeridge of NW Germany, eight of which were given specific rank. Two gyrogonite forms of *Aclistochara* type have finally been described by HORN AF RANTZIEN (1953, p. 6—7, 1954, in the press) from the Middle Triassic (Keuper or Muschelkalk) of South Sweden. The geological range of the morphological types of gyrogonites referred to *Aclistochara* is accordingly known to comprise the Middle Triassic, Upper Jurassic, Lower Cretaceous, the whole of the Paleogene, and the Lower Miocene. The present species widens this range also to the Pliocene.

It may be added that a still older record of *Aclistochara* than the Triassic exists, though this — apparently on account of some uncertainty attached to it — is not generally included when stating the range of this genus. This record refers to the discovery of a number of gyrogonites in a marine shale (Cherokee) of the Pennsylvanian of Missouri, U.S.A., described by PECK (1934 a, p. 54) as *Gyrogonites moreyi.* PECK's description and discussion, which is of considerable interest, is quoted *in extenso* below (his figures are reproduced here as fig. 2 a—e):

»*Gyrogonites moreyi,* n.sp. (Plate 1, figures 1—3, 5, 6.)

Oogonium subovate to ovate-rotundate, ranging from .3 to .4 mm. in height, higher than wide, greatest transverse diameter at or usually below mid-height. Spiral ridges intercellular, fairly broad, making a little more than one complete turn around the oogonium. At the center of each ridge is a fine furrow marking the lateral contact of the cells. The furrows separating the ridges are approximately equal to the ridges in width.

Occurrence. — Cherokee (Pennsylvanian) shale about thirtyfive feet above the Bevier coal at the Brick Plant, Columbia, Missouri; ? Winterset (Pennsylvanian) from Quarry at Swope Parkway and Prospect, Kansas City, Missouri; ? Waubaunsee (Pennsylvanian) near Manhattan, Kansas.

Holotypes and Paratypes. — Catalog numbers 31007—3, 31007—4, University of Missouri.

Approximately one hundred specimens of *G. moreyi* have been collected from the Cherokee by Mr. John Roberts and Mr. Philip Morey. They differ slightly in the length-width ratio, as is shown in the accompanying illustrations.

A single specimen has been collected from the Winterset limestone and another from the Waubaunsee formation. These forms are too poorly preserved to permit specific identifications and I am tentatively referring them to *G. moreyi.*»

Three years later, when establishing the genus *Aclistochara,* PECK (1937, p. 87) noted: »Species of charophyte oogonia that should be referred to *Aclistochara* are as follows: . . .; *Gyrogonites moreyi* Peck, Pennsylvanian, Missouri (Peck, 1934, p. 50, figs. 1—3, 5, 6).» In 1949, »about 50 specimens of *Chara moreyi* (Peck)» were reported from the Pennsylvanian of Iowa, U.S.A., »recovered from the Higginsville limestone member of the Ft. Scott formation exposed near Madrid in the N.E. 1/4, sec. 33, T. 82 N., R. 26 W.» (THOMAS 1949, p. 233).

Owing to some morphological similarities — not extending to the apical pole, however — between *G. moreyi* PECK and a Middle Triassic species of *Praechara,* the former was briefly discussed by HORN AF RANTZIEN (1954, in the press). Although it was pointed out there that according to PECK (1937) *G. moreyi* should be referred to *Aclistochara,* it was not included in the geological range of this genus. The reason was the somewhat incomplete correspondence between the holotype of *G. moreyi,* as figured in apical view by PECK (1934 a, pl. p. 50, fig. 2; this paper, fig. 2 b), and the holotype of *Aclistochara bransoni* — type of the genus — in summit view as reproduced by PECK (1937, pl. 14, fig. 9). It seems also rather difficult to refer the apical arrangement of *G. moreyi* to any of the three principal apical types of *Aclistochara* discussed below (p. 9). Apart from this, it was noted that the figures show rather large variations in shape, numbers of convolutions, etc.

The differences between *G. moreyi* and the aforesaid forms of *Aclistochara* may be due to heavy retouching or imperfect photographic reproductions of the former, and no inferences can be drawn from the figures alone regarding the possible systematic significance of these differences. It seems however, that we have better defer the inclusion of the Pennsylvanian record in the geological range of *Aclistochara* until the type material of *G. moreyi* has been re-examined.

The morphological interpretations of the *Aclistochara* gyrogonites have varied greatly. At the original establishment of this genus, the flattened apical region and the large apical opening were considered diagnostic, and motivating the generic distinction (PECK 1937, p. 86).

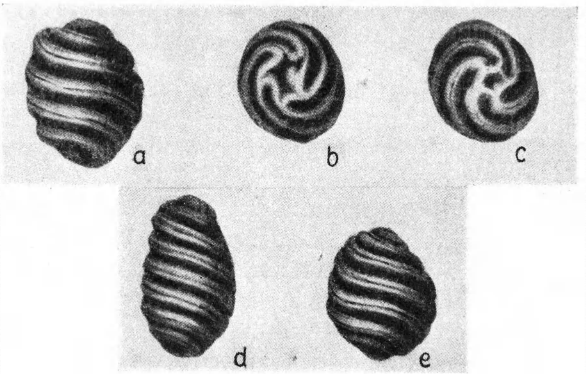


Fig. 2. *Gyrogonites moreyi* PECK (*Aclistochara moreyi* (PECK) PECK). U.S.A., Missouri: Columbia (Cherokee shale; Pennsylvanian). — a: holotype, gyrogonite in lateral view; b: holotype, apical view; c: holotype, basal view; d: paratype, lateral view; e: paratype, lateral view. — After PECK 1934 a, pl. (unnumb. in p. 50), fig. 1—3, 5, 6. — All fig. 54/1.

HARRIS (1939, p. 77—78) regarded the large apical hole as a less reliable feature, possibly due to the apex being accidentally broken off; this was also observed in a *Clavator grovesi* gyrogonite. HARRIS' statement has been discussed by RÁSKY (1945, p. 41) who stressed the distinctness of the large apical opening, and noted that HARRIS' observation »eher beweist, dass der Gyrogonit von *Clavator grovesi,* der auch in einer Abbildung gebracht wird (Plate X, Fig. 10), nichts anderes ist, als der einer *Aclistochara*-Art.»

The diagnosis of *Aclistochara* was amended by PECK (1941, p. 290). He defined the genus as comprising gyrogonites whose summit regions were characterized by »five calcified coronula cells resting on their distal extremities or, in the absence of coronula cells, indentations showing their former presence». The term »calcified coronula cells» apparently indicated the swelling of the spiral cell-tips in the apical centre, observed in several previously described species (see e.g. HEER 1855, Taf. IV, SCHIMPER 1870—1872, pl. V, DOLLFUS & FRITEL 1920, fig. 1—23). The breaking off of these »calcified coronula cells» exposed the large opening originally believed diagnostic of *Aclistochara*. However, the coronula cells of fossil and recent charophytes are not usually calcified (REID & GROVES 1921, p. 181, GROVES 1925, p. 12, 1926, p. 165, 1933, p. 3, RAO & RAO 1939, p. 2, RÁSKY 1941, p. 297) and such summit expansions — interpreted e.g. by DOLLFUS & FRITEL (1920, p. 254) as »vestiges de la coronule» — were therefore considered terminal expansions of the spiral cells (GROVES 1933, p. 3).

Real calcified coronula cells occur according to PECK (1934 b, p. 91—92) and CROFT (1952, p. 209) in some of the trochilisks (*Trochiliscus* subg. *Karpinskya*). A calcified coronula has moreover been recorded in *Chara sausari* from the Indian Intertrappeans (SAHNI & RAO 1943, p. 215 ff.).

With regard to these terminal structures, RÁSKY was able, however, to confirm PECK's record as to the presence of the »klar erkennbaren 5 Coronula-Zellen» in three Hungarian species of *Aclistochara* (RÁSKY 1945, p. 41). Some years later, PECK & REKER (1947, p. 5) reviewed on the base of large collections the characters of *Aclistochara* with the following comments: »We are unable to prove that the five collar-like nodes on the summits of the oogonia are separate from the calcareous spirals as true coronula cells should be. We are also unable to prove that the five nodes are simply terminal expansions of the regular spirals. We do find that the combination of characters, including . . . the presence of summit nodes (coronula cells) on well-preserved specimens, allows us to differentiate readily the one group of oogonia from the other group . . .». PECK (1953, p. 210, cf. also p. 221) maintains that in *Aclistochara* »coronula cells or evidence of their former presence are preserved». MASLOV (1947, p. 88) and PAPP (1951, p. 279), who — judging by the illustrations — seem to have dealt with forms close to the general concept of *Aclistochara,* apparently consider these structures terminal extensions of the spiral cells. MASLOV (l.c.) uses the expression »the base of coronule»; PAPP designates these structures »Krönchengestell» (op.c., p. 283 ff.).

MÄDLER (1952, p. 6—7, 1953 b, p. 478) has contributed much to an understanding of the apical structures of gyrogonites referred to *Aclistochara.* He denies that the terminal expansions can be calcified coronula cells. He furthermore stresses the systematic importance of a character found in some types of *Aclistochara* gyrogonites, viz. the decrease in width and weak calcification of the spiral cells in the apex periphery which forms a grooved, weak zone, along which the whole apical region is sometimes broken off, resulting in the large apical opening observed by PECK in 1937. MÄDLER (1953 b, p. 478) writes:

> »Das ist biologisch nicht ohne Bedeutung. Die rezenten Charophyten keimen so, dass das Würzelchen und der Vorkeim durch die Spitze des Gipfels hindurchstossen. Das dürfte bei den *Aclistochara*-Arten, bei denen die Spitze oft sogar durch Kalkablagerung verfestigt ist, nicht möglich gewesen sein . . . Es hat vielmehr den Anschein, als ob hier bei der Keimung der Oospore durch den inneren Quellungsdruck das ganze Gipfelstück herausgesprengt wurde. Dieser Umstand lässt es geraten erscheinen, die *Aclistochara*-Arten nicht zu der Unterfamilie der *Chareae* zu ziehen, sondern dafür eine besondere Unterfamilie *Aclistochareae* aufzustellen . . .»

Equally important is MÄDLER's observation that the gyrogonites referred to *Aclistochara* comprise some types of rather different apical structures. Some gyrogonites of this group are thus characterized by the narrowing of the spiral cells in the apical periphery, described above, and by the resultant formation of a peripheral, narrow, weakly calcified zone, along which the whole strongly calcified summit hood may break away, leaving a very large opening (MÄDLER 1952, Abb. 1 c—d, 1953 b, Abb. 17 c—d). *A. staubi* RÁSKY (1941, Taf. VII, fig. 2 a) appears to be a good representative of this type of apical structure. In other species of gyrogonites the walls of the spiral cells are reinforced towards the apical pole, become abruptly weaker near to their tips, and again reinforced in the tips themselves, the hood being mostly sunk below the surface of the other lime-shell (MÄDLER 1952, Abb. 1 b, 1953 b, Abb. 17 b). In that case a somewhat smaller part of the apical hood has probably been broken off at the germination. *A. thörensis* MÄDLER (1952, Taf. B, fig. 8) may serve as a typical example. A third type (MÄDLER 1952, Abb. 1 a, 1953 b, Abb. 17 a) seems to differ in principle from the others. In this type there is a rather small apical opening, the hood of which — if any — has not yet been observed. This apical orifice is delimited by the usually somewhat swollen tips of the spiral cells. There is, however, no distinct narrowing — nor any particularly weak calcification — of the spiral cells of the apex periphery, and germination may have taken place without any partial breaking off of the lime-shell. This structure is met with in several older forms, viz. *A. kimmeridgensis* MÄDLER (1952, Taf. B, fig. 13). MÄDLER (1953 b, p. 478) points out that these differences might be used for the further differentiation of the genus. Intergradations of the three types described are, however, rather common.

As defined by present students of this group, the genus *Aclistochara* is a somewhat heterogeneous assemblage of forms (MÄDLER 1952, p. 7). This does not refer only to the varying structures of the apical poles, but also to the considerable variations in size and shape of the gyrogonites, which are probably greater than in any other genus of charophytes. It should furthermore be remembered that gyrogonites in which the apical structures described above are combined with various types of tubercular decoration are known from the North American Eocene (PECK & REKER 1948, p. 88—89); if the tuberculate forms without such apical structures are segregated from other fossil gyrogonites — the genera *Kosmogyra* and *Kosmogyrina* of the Kosmogyreae — the tuberculate Aclistochareae should either be removed from that subfamily entirely, or perhaps better — as proposed by MÄDLER (1952, p. 8—9, 1953 b, p. 479) — form a separate genus within it. It should finally be noted that gyrogonites provided with the apical structures characterizing the Aclistochareae are rather widely distributed stratigraphically (see p. 5—6); they are among the most persistent of all morphological types of gyrogonites. The fossil species of charophytes so far investigated usually appear to have existed only for a short time (MÄDLER 1953 a, p. 65), and the investigations of the last few years seem to indicate that this apparently also applies to the genera, though of course to a less extent. The exceptionally wide stratigraphic range of *Aclistochara* may have something to do with the morphological heterogeneity observed within it. The writer's observations seem to point to different though overlapping stratigraphic ranges of distribution of the various types of apical structures of *Aclistochara* gyrogonites described by MÄDLER. This would moreover support the heterogeneous impression of this group.

Judging by the illustrations, several gyrogonites ascribed to various species of *Chara* seem to be provided with the apical structures considered characteristic of the Aclistochareae. A few of them were transferred in the first description of *Aclistochara* (PECK 1937, p. 87), and some other similar cases were mentioned by MÄDLER (1952, p. 9). An examination of the published figures of gyrogonites reveals a considerable number of such instances. Illustrations in HEER (1855, Taf. IV), SCHIMPER (1870—1872, pl. V), DOLLFUS & FRITEL (1920, fig. 1—23), REID & GROVES (1921, pl. IV—VI), and RAO & RAO (1939, pl. I—III) — to take but a few examples — are particularly informative in this respect. As gyrogonites of types referable to the Aclistochareae have often been confused with forms of entirely different apical structure, and original materials sometimes are mixtures of various forms, a general transfer to *Aclistochara* of forms like those illustrated in the papers cited above is rather useless without a check-up of the type material in each individual case.

2. *Aclistochara sinkiangensis* (LU) H. AF R.

Aclistochara sinkiangensis (LU) H. AF R., n. comb. (fig. 3 a—c).

Chara sinkiangensis LU 1945, p. 34, pl. I, fig. 1 a—c.

[As regards *Chara sinkiangensis* LU 1946, p. 274, see below].

»Oogonium large, obovoid in shape, swollen at the middle, with the sides converging rapidly from the greatest diameter to the somewhat obtuse base and gradually to the truncate, slightly depressed and broad apex. Length ranging from 1125 μ to 1280 μ, breadth 935—1060 μ. Spiral-cells showing 8—9 convolutions, smooth, convex, with the sutures in broad and deep furrows. Width of these cells uniform, measuring about 130—160 μ. Equatorial angle about 16—18°. Tips of the spiral cells at the apex slightly depressed, giving rise to a remarkable rosette.» (LU 1945, p. 34).

Occurrence: about 20 km N of Kucha, Sinkiang (acc. to LU 1946, p. 274; the first, brief record of this locality, LU 1945, p. 33, reads »near Kucha»). —

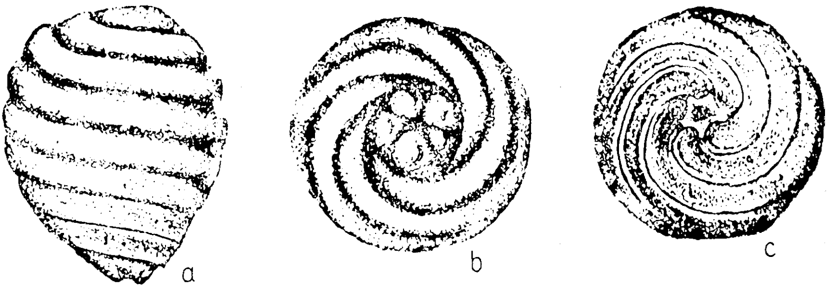


Fig. 3. *Aclistochara sinkiangensis* (Lu) H. af R. Sinkiang: 20 km N of Kucha (Kuchar Group, Series C; Cretaceous—Lower Tertiary). — a: gyrogonite in lateral view; b: apical view; c: basal view. — After Lu 1945, pl. I, fig. 1 a—c. — All fig. 32/1.

Kucha Formation (=Kuchar Group of Norin 1935 b and 1941), Lower Bed (=Series C of Norin 1935 a, p. 77—78, 1935 b, p. 340—341), being »of Cretaceous or possibly Lower Tertiary age» (Norin 1941, p. 186).

Furthermore reported (Lu 1946, p. 273—274) from »at Kizil-Ming-Oi . . ., about 8 km north of Kucha and 1/2 km east of the Kucha-Bai motor road», Sinkiang. — Kucha Formation (=Kuchar Group of Norin 1935 b and 1941), Middle Bed (=Series B of Norin 1935 a, p. 80, 1935 b, p. 340 ff.), which is acc. to Chaney 1935, p. 97 and Norin 1941, p. 186 of Pliocene age. — Regarding the age determination of the Series B, see notes p. 3—4.

This species — which, according to the descriptions and figures is doubtless referable to *Aclistochara* as defined by present students — was described from Pre-Pliocene deposits. It is included in this review because of its supposed occurrence in Pliocene beds of the Kuchar Group. Of its affinities, Lu (1945, p. 34) writes: »this new species is similar to *Chara meriani* Unger from the Miocene and Oligocene of Europe in the size and shape, but is distinguished from the latter by its truncate and very broad apex.» Judging from Lu 1945, pl. I, fig. 1 b, this paper fig. 3 b, the apical structure of *A. sinkiangensis* may largely correspond to that of the *A. staubi* type (cf. p. 9).

The gyrogonites from the Pliocene Series B of the Kuchar Group were never formally described, but only a reference made to the Cretaceous or Early Tertiary specimens described as *A. sinkiangensis*.

Considering the apparently considerable difference in age between the Series B and C of the Kuchar Group according to Norin (1941, p. 186) and the brief existence of the species of fossil charophytes so far investigated (Mädler 1953 a, p. 65), it seems less probable that the Pliocene gyrogonites referred to *Chara sinkiangensis* by Lu (1946) should be conspecific with the Cretaceous — Lower Tertiary specimens described under that name by LU (1945). Gyrogonites of the same general type as *A. sinkiangensis* were not rare in the Tertiary. LU's determinations show that such forms are apparently represented in the Pliocene of Sinkiang too. A re-deposition by riverine action of older deposits containing gyrogonites, which would explain the presence of the Cretaceous — Lower Tertiary *A. sinkiangensis* in Pliocene strata, should also be considered, but seems in this case less probable; this question is dealt with at some length under *Kosmogyra nodosa* (p. 16—18). Summarizing the evidence relating to the Pliocene specimens referred by LU (1946) to *Chara sinkiangensis*, it might be said that although gyrogonites of the same general morphological type may be expected in strata of this age, the identity of these Pliocene specimens with the type material of *A. sinkiangensis* remains to be proved.

3. *Kosmogyra nodosa* (LU) H. AF R.

Kosmogyra nodosa (LU) H. AF R., n. comb. (fig. 4 a—d).

Chara nodosa LU 1946, p. 275, fig. 2: 1 a—c, 2.

»Oogonia large, ovoid in shape, with sides converging rapidly from the greatest transverse diameter at mid-height toward the apical portion and regularly to the somewhat truncate base. Length about 1080 μ; breadth varies from 840 μ to 715 μ. Spiral-cells showing 14—15 convolutions, flat or occasionally sligthly concave, decorated with rounded tubercles at nearly regular intervals and with the sutures in convex, very narrow, but distinct ridges. The width of these cells is uniform, measuring about 76 μ, with an equatorial angle of 8°—9°. Apex unknown. Base narrow, truncate, projecting slightly to the proximal end.» (LU l.c.).

Occurrence: »at Kizil-Ming-Oi . . ., about 8 km north of Kucha and ½ km east of the Kucha-Bai motor road», Sinkiang. — Kucha Formation (=Kuchar Group of NORIN 1935 b and 1941), Middle Bed (=Series B of NORIN 1935 a, p. 80, 1935 b, p. 340 ff.), which is acc. to CHANEY 1935, p. 97 and NORIN 1941, p. 186 of Pliocene age. — Regarding the age determination of the Series B, see notes p. 3—4.

According to our present knowledge and the system of the Charophyta adopted by MÄDLER (1952, 1953 a & b; cf. PECK 1953), gyrogonites with tubercular decoration in which the tubercles are cellular, i.e. situated along the middle of the spiral cells, should be referred to the genus *Kosmogyra* STACHE (1889, p. 130). This genus was first described from the Paleocene, and similar forms have later been found in various Eocene and Oligocene deposits; there is also a single record from the Miocene (Sarmatian) of Hungary (RÁSKY 1941, p. 302). In the latest surveys the range of *Kosmogyra* is stated »Paläozän bis Eozän» (MÄD-

LER 1953 a, p. 64) or »Unt.-Mittl. Tertiär» (MÄDLER 1953 b, p. 483). The Pliocene specimens described by LU (1946) extend the geological range of this type of gyrogonite, and are therefore included in this discussion.

LU (op.c., p. 276) has compared the present species with the Lower Tertiary *Kosmogyra vasiformis* (REID & GROVES) PIA, to which it is rather similar in general shape. The latter — though varying in size — seems always to be considerably smaller and provided with fewer convolutions; judging by the original material of *K. vasiformis* — as figured by REID & GROVES (1921, pl. IV, fig. 13—15) — the arrangement of the tubercles differs in some degree from that of *K. nodosa*. This also applies to the gyrogonites which RAO & RAO (1939, p. 6, pl. I, fig. 5, pl. II, fig. 5 a—c) with some hesitation referred to REID & GROVES' species.

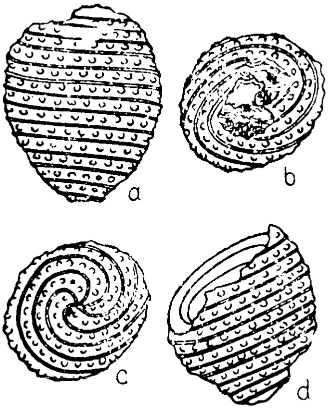


Fig. 4. *Kosmogyra nodosa* (LU) H. AF R. Sinkiang: 8 km N of Kucha (Kuchar Group, Series B; Pliocene). — a: the best preserved gyrogonite in lateral view; b: apical view; c: basal view; d: another specimen, lateral view. — After LU 1946, fig. 2: 1 a—c, 2. — All fig. approx. 25/1.

The nature of the tubercular decoration and the systematic position and affinities of these gyrogonites have been discussed repeatedly. Although some plausible explanations and important points have been brought out in the discussion, the problem still seems unsettled, at least partly. The writer wishes to stress that his reference of *Chara nodosa* to *Kosmogyra* does not mean that he has taken up a definite attitude to the rather intricate question whether a systematic distinction of so ornamented gyrogonites is tenable or not. The material necessary for that is not available. But it appears to be of some interest to point out that specimens of this particular type, which are especially characteristic of some Paleogene deposits, may have occurred up to the end of the Tertiary, a fact with some possible bearing on the morphological and systematical interpretation of these forms.

The present state of our knowledge of tuberculate gyrogonites will appear from the following brief summary.

Kosmogyra, described by STACHE (1889, p. 130), was made to include the large, spherical gyrogonites with tubercular decoration and flat or convex spiral cells occurring abundantly in some beds of the Middle »Liburnian Formation» (STACHE op.c., p. 86) which is considered equivalent to the Montian of the Paleocene (see e.g. EDWARDS 1932, p. 215). STACHE (op.c., p. 130) also established the genus *Kosmogyrella,* similar to *Kosmogyra,* but with concave spiral cells; both genera were included in the new subfamily *Kosmogyreae.* The latter division was adopted by MÄDLER (1952, p. 15, 1953 b, p. 483; see also PECK 1953, p. 225), but *Kosmogyrella* STACHE was dropped, and the new genus *Kosmogyrina* was established for gyrogonites with intercellular tubercular decorations (MÄDLER 1952, p. 5—6, 1953 b, p. 479).

Tuberculate gyrogonites were, however, known before STACHE established *Kosmogyra.* Such forms had been described by LYELL (1826, p. 94), HEER (1859, p. 150), and WATELET (1866, p. 54—56), and had been included in the genus *Chara.*

In 1913, TUZSON described a tuberculate type of gyrogonite as *Characeites verrucosa* (TUZSON 1913, p. 209). More or less similar specimens were by DOLLFUS & FRITEL (1920, p. 248—252) and by REID & GROVES (1921, p. 184—186) ascribed to *Chara.* However, in his survey of the fossil charophytes, PIA (1927, p. 90) referred all tuberculate gyrogonites — except two species of *Kosmogyrella* — to STACHE's *Kosmogyra.* This was amended to comprise not only the original spherical, but also the more or less oval types. PIA moreover included in *Kosmogyra* the Jurassic *Chara bleicheri* (SAPORTA 1873, p. 214), a form which, however, according to PECK & REKER (1947, p. 4, 1948, p. 85) belongs to the Clavatoraceae. GROVES (1933) again limited *Kosmogyra* to the original Liburnian species of STACHE, and listed the others under the genera in which they had been originally described. In recent years, gyrogonites of tubercular decoration have either been described as or referred to species of *Chara* (RAO & RAO 1939, p. 5—6, LU 1946, p. 275, PECK & REKER 1947, p. 4, 1948, p. 87), or included in *Kosmogyra* (RÁSKY 1941, p. 302—303, 1945, p. 46—52, 1952, p. 41—43). PECK & REKER (1948, p. 87—89) have proved that intercellular as well as cellular tubercular decorations occur in some species of *Aclistochara,* and MÄDLER has (1952, p. 6) referred a *Chara* species of RÁSKY (1945, p. 37) with intercellular tubercles to the new genus *Kosmogyrina.*

Opinions differ rather widely regarding the morphological interpretation of this kind of decoration. While for instance STACHE (1889, p. 130) considered the presence of tubercles sufficient to motivate the establishment of a new subfamily and new genera, DOLLFUS & FRITEL (1920, p. 247—249) included tuberculate and non-tuberculate forms in the same species, thus regarding tubercular decorations as not being important enough even for the delimitation of species. SCOURFIELD (in REID & GROVES 1921, p. 185) considered the tubercles of »*Chara*» *vasiformis* to be of organic origin, developed within the spiral cells, and REID & GROVES (op.c., p. 182) noted that no corresponding structure had been observed in recent »oospores». GROVES (1933, p. 41) left the matter open, noting that the tubercles, at least in some cases, »may merely represent an interrupted incrustation», a view »supported by the occurrence on a living species (*Chara delicatula*, Ag.) of an interrupted calcareous incrustation closely resembling the supposed tubercles on some of the fossils.» But GROVES also pointed out that »on the other hand, in many of the species enumerated below, the prominences are so evenly spaced, so symmetrical, and so definite in shape, as to seem to preclude the possibility of their being merely due to external incrustation.» With regard to some types of gyrogonites, RÁSKY (1941, p. 303) stressed that »die Verzierungen und Erhebungen der Spiralzellen waren derart gleichmässig verteilt und so regelmässig ausgebildet, dass ich es für ausgeschlossen halte, dass es sich dabei nur um Vorgänge der äusseren Rindenbildung handeln solle.» HORN AF RANTZIEN (1951, p. 664) noted that although the stage of growth may be responsible for some variation in tubercular arrangement in individual gyrogonites, and although the presence of tubercles may not be reliable evidence in the specific identification of a small specimen sample, the tendency to form tubercles seems to be of at least some systematic importance. PECK, who has considerable experience of tuberculate gyrogonites in North American deposits, holds an entirely different opinion, put forward in 1948 (PECK & REKER 1948, p. 88). These authors state that »tubercles may have little if any systematic value in the classification of the charophytes», and PECK (1953, p. 221) concludes »that the tubercles may or may not be present on a species and that, if present, they may be represented by varying degrees of prominence», and that »they [PECK & REKER] therefore included *Kosmogyra* as a synonym of *Chara*.» MÄDLER, on the other hand, considered »die Knoten eine taxonomische Besonderheit, die es rechtfertigt, der Gattung *Kosmogyra* eine besondere Unterfamilie *Kosmogyreae* in der Familie der *Characeae* einzuräumen» (MÄDLER 1953 b, p. 478). MÄDLER furthermore put forward two alternative interpretations of the nature of the tubercles. One postulates the existence of a hypothetical lamella situated in the inner wall of the spiral cell, a lamella which secretes calcium carbonate in the form of papillae at regular distances (MÄDLER 1952, p. 11). The other interpretation is that not only the walls of the spiral cells but also their nuclei — of which there are several in each cell — are calcified, and that the tubercles are formed by the latter (MÄDLER 1953 b, p. 478).

The occurrence and state of preservation of *K. nodosa* show some interesting points. The matrix is described by LU (op.c., p. 274) as »one piece of pale grey calcareous sandstone crowded with numerous oogonia; . . . among 94 specimens studied 67 are referred to *Chara sinkiangensis,* 25 belong to *C. nana* (sp. nov.) and two specimens belong to *C. nodosa* (sp. nov.).» Two pages later on, he gives the additional information that »this form is represented by only two incomplete crushed specimens. The cross-section along equator is oval and not circular as in other species from the Kucha Formation.»

It has been pointed out that the state of preservation and relative abundance of gyrogonites in a deposit may sometimes supply some information regarding the sedimentation conditions of this deposit (HORN AF RANTZIEN 1953, p. 8—10, 1954, in the press). This has been investigated in respect of alternating marine and lacustrine sediments. In most — possibly in all cases — the presence of gyrogonites in a marine sediment thus indicates a marine re-deposition of fresh-water sediments.

Re-deposition of gyrogonites might also be caused by running water, however, In that case, the gyrogonites of some riverine deposits might have been primarily deposited in an older geological environment. As far as the writer knows, however, no published accounts of occurrences of gyrogonites in riverine sediments have interpreted them as older than the matrix. It seems, nevertheless, that this question ought to be considered as a possible explanation of some remarkable records of types of gyrogonites outside their known geological range.

When considering a possible re-deposition of gyrogonites, there are two circumstances relating to their state of preservation and relative abundance that might conceivably affect the decision. One is when the gyrogonites are superficially corroded or otherwise fragmentary and broken up. This may be a result of weathering and transport from the original place of sedimentation, or may simply be due to unfavourable geological conditions for the preservation of the sometimes fragile gyrogonites during or after fossilization. The other is when in a large material from a comparatively small and structurally homogeneous piece of matrix, indicating uniform sedimentary conditions, some species are abundantly represented, while others are only found in single specimens. Observations on recent charophytes, and studies of some occurrences of their fossil forms the vegetative parts of which are also preserved — e.g. in the British Purbeck strata (HARRIS 1939) and in the »Liburnian Formation» at

Trieste (STACHE 1889) — prove that charophytes mostly grow in associations containing one or a few species only; the »oospores» of these will then be found in the sediment in considerable abundance. Exceptions occur of course, especially when changing environmental conditions cause some species to disappear and others are close on their tracks. As a rule, however, one particular patch is during a given space of time inhabited by only one or a few species of charophytes.

If, consequently, the frequencies of different types of gyrogonites occurring in a riverine deposit differ rather widely; if moreover the most sparsely represented kinds of gyrogonites appear to be in a somewhat weathered, corroded, broken up, and fragmentary condition; and if finally these gyrogonites are of types common in much older deposits but not found in rocks contemporary with that which is examined, it would seem that the possibility of a re-deposition should be considered. This does of course not imply that all such occurrences necessarily are re-depositions.

In the case of *Kosmogyra nodosa,* some circumstances indicate the possibility of re-deposition. *K. nodosa* is of a morphological type characteristic of the Lower Tertiary, and besides the two Sinkiang specimens there is only one more Neogene record of this genus, viz. from the Hungarian Miocene, in which according to RÁSKY (1941, p. 302) »ein seitlich stark zusammengedrücktes und beschädigtes Exemplar» was found. From LU's description it is furthermore clear that he found only two specimens of the *Kosmogyra*-type in a piece of matrix crowded with oogonia — a very small number in comparison with the frequencies (67 and 25) of the two accompanying types of gyrogonites — and these two specimens were moreover »incomplete» and »crushed».

As mentioned above, LU (op.c., p. 274) determined the fossil horizon of the Pliocene specimens as »equivalent, both in lithology and in stratigraphic position, to bed B of Norin», i.e. the Series B of the Kuchar Group. NORIN (1935 b, p. 341—342, and 1941, p. 186—187) described the composition of this bed as follows:

»Lithologically the Pliocene sediments are very similar to those which are being deposited in the Tarim basin today, with the exception that strata, which can be interpreted as fossil sand dunes have not been identified. In all the regions mentioned the sediments are developed in similar fine-grained facies suggesting a quietely proceeding sedimentation by rivers, which often changed their course. According to Chaney the sediments are characterized by a flora of the same general type as the vegetation, which at present time covers the shore zone of the large rivers and the swamps of the Tarim basin . . . From the evidence of the sediments and their flora we can get a rough idea about the principal geographic features of the Tarim basin during the Pliocene. It was then as it is now a large, drainageless continental basin with its deepest part in the east. The rivers from the surrounding higher land deposited their silt and sand forming wide flood plains and deltas, which soon transformed the basin into the immense flat plain, which it is today.» (NORIN 1935 b).

»The middle division, Series B, consists of gray, cream-coloured, and yellowish, indurated silt and silty sandstones with a thickness exceeding 500 m. A striking feature is the scarcity of red coloured or coarse-grained sediments. Lithologically, these sediments are very similar to those which are being deposited in the basin by the Tarim River system today. Fossil plants occur in abundance at several levels but only few species are represented. In a large collection made at the ruins of Qizil-ming-öi, west of Kuchar, CHANEY (1935) identified *Carex* sp., *Nuphar bohlini, Populus norini, Spirea sinkianga,* and *Typha* sp. This flora has, according to CHANEY, a Pliocene aspect. It represents a vegetation of the same general type as fringes the large water courses and the swamps of the Tarim Basin in present time, and suggests a climate only slightly more humid than the present.» (NORIN 1941).

The locality of *Kosmogyra nodosa* seems to be very near, or almost identical with, that in which the above-mentioned macrofossils were found. The lithological aspect of the sediment is evidently riverine material slowly accumulated in the deeper parts of a large basin.

Summarizing the above discussion of a possible re-deposition of the *Kosmogyra nodosa* gyrogonites, one explanation of their presence — which is somewhat surprising in view of the scarcity of the *Kosmogyra* type of gyrogonite in Neogene strata — might be that they were originally laid down in older deposits, perhaps the Lower Tertiary rocks of the Kuchar C Series, and subsequently freed from this first environment by erosion, and carried by running water to their present location in the Pliocene sediments.

It must be emphasized, however, that this theory, although supported by some observations on the material, will naturally be very difficult definitely to prove, particularly as no comparable observations on gyrogonites from other strata have been made. In cases like the present, it seems, however, important to bear in mind the possibility of re-deposition as an eventual source of error in discussing instances where gyrogonites are used as stratigraphic markers.

Nothing is known of the lithological conditions of the sediment in which the single *Kosmogyra* specimen from the Miocene of Pécs, Hungary, was found. The sparse information on this find precludes any statement as to whether it can be explained in the same or any similar way.

4. *Sphaerochara globosaforma* (PAPP) H. AF R.

Sphaerochara globosaforma (PAPP) H. AF R., n. comb. (fig. 5 a—c).

Chara globosaforma PAPP 1951, p. 282, Taf. 1, fig. 2 a—c.

»Gehäuse kugelig, in der Seitenansicht zehn Spiralwindungen zeigend; die Basis zeigt ein sehr kleines, fünfeckiges Loch, zu welchem die Spiralkämme mit einem deutlichen Knick hinziehen. An der Oberseite laufen die Spiralwindungen zusammen, ohne dass ein Krönchengestell zur Ausbildung käme. In der Seitenansicht erscheinen die Flanken der Spiralwindungen schwach konkav, die Nahtlinie ist etwas eingesenkt, was in der Seitenansicht sichtbar wird.» (PAPP op.c., p. 283).

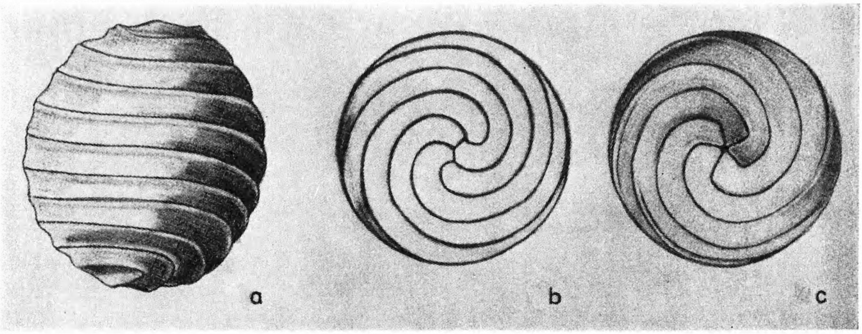


Fig. 5. *Sphaerochara globosaforma* (PAPP) H. AF R. Austria: Nieder-Österreich, Leobersdorf (Pliocene, Pannonian, Zone D). — a: holotype, gyrogonite in lateral view; b: holotype, apical view; c: holotype, basal view. — After PAPP 1951, Taf. 1, fig. 2 a—c. — All fig. approx. 33/1.

Occurrence: Ziegelei Polsterer, Leobersdorf, Nieder-Österreich, Austria. — Pliocene, Pannonian, Zone D (regarding the subdivisions of the Pannonian in the Vienna Basin, see PAPP 1948, p. 123 ff., and JANOSCHEK 1951, p. 599—610).

In 1925, GROVES, describing a new species of *Chara, C. brewsterensis,* from the Cretaceous of Texas, remarked that »these large broadly-ellipsoid fruits with more or less truncate extremities probably do not belong to the genus *Chara* as in its present restricted sense» (GROVES 1925, p. 13). A few years later GROVES (1933, p. 4) pointed out that »some of the fossil types . . . clearly do not belong to Chara, notably the large spherical type of the Upper Eocene and Oligocene Beds, of which C. medicaginula may be taken as the type.» A generic segregation of such gyrogonites from *Chara* thus seemed motivated, but was complicated by the fact that the typification and taxonomy of these large and spherical, often widely distributed forms of the Lower Tertiary were not well understood. As figured by some students, e.g. by DOLLFUS & FRITEL 1920, *Chara medicaginula* and *C. helicteres* — to take two of the most abundant forms — doubtless include gyrogonites with the apical structures characteristic of *Aclistochara,* but other gyrogonites that are neither referable to *Chara* s.str., nor to *Aclistochara* are also ascribed to the same species. As interpreted in later papers, many of these previously described species of gyrogonites are probably not conspecific with their types.

Spherical gyrogonites »vom Gipfelbau der Chareae und von ± kugeliger Gestalt ohne Verzierungen» were segregated by MÄDLER (1952,

p. 6), who referred these forms to the new genus *Sphaerochara*. The Upper Oligocene *Chara hirmeri* RÁSKY (1945, p. 36, Taf. I, Abb. 10—12) was selected as the genotype, and the above-mentioned *Chara brewsterensis* GROVES (1925, p. 12, fig. 1) and *C. perlata* PECK & REKER (1947, p. 3, pl. p. 2, fig. 19—21) as additional species. In a review of the stratigraphy of fossil charophytes, MÄDLER (1953 a, Taf. 1) indicated the distribution of these three species (Cretaceous and Oligocene). A gyrogonite of *Sphaerochara*, not specifically described, has recently been reported from the Middle Trias; in size and shape this comes rather close to the genotype (HORN AF RANTZIEN 1953, p. 7, 1954, in the press).

Besides of their spherical or very broadly oval shapes, the gyrogonites of *Sphaerochara* type are also characterized by the structures of their apical poles. The apical tips of the spiral cells are not at all, or very slightly, expanded, and turn together either into a point (*S. perlata* (PECK & REKER) MÄDLER, as figured by PECK & REKER 1947, pl. p. 2, fig. 19), or along a short broken line (the Middle Triassic *Sphaerochara* sp. acc. to HORN AF RANTZIEN 1954, in the press, or *S. brewsterensis* (GROVES) MÄDLER, as figured by GROVES 1925, fig. 1 b). One character relating to the calcification of the spiral cells has been pointed out by MÄDLER (1952, p. 11, Abb. 3 h—i), viz. that the spiral cells are hollow, though sometimes filled up with calcite, so that only a very small pore or slit is left of the original lumen. A possible explanation of this kind of structure, which was also observed and described by GROVES (1920, p. 126, fig. 1) and MASLOV (1947, p. 88, fig. 1), is that the calcite is excreted from the whole inner parietal surface of the spiral cell, while in other gyrogonites only the inner and lateral walls take part in the formation of the lime-shell. Although this feature may prove characteristic of the *Sphaerochara* species, similar phenomena have also been observed in gyrogonites whose apical structure conforms to that of the Aclistochareae (GROVES op.c., MASLOV op.c.). There is also a third character, which may possibly be of some use. The equatorial angles — i.e. the angles at which the enveloping cells cut the equator — of the so far known species of *Sphaerochara* are more acute than in other gyrogonites, except in some spherical species of the Aclistochareae and some of the Kosmogyreae (HORN AF RANTZIEN 1954, in the press).

Gyrogonites of *Sphaerochara* are apparently not particularly frequent, even if several more no doubt remain to be described. They seem at any rate to be less abundant than for instance forms referable to the Aclistochareae.

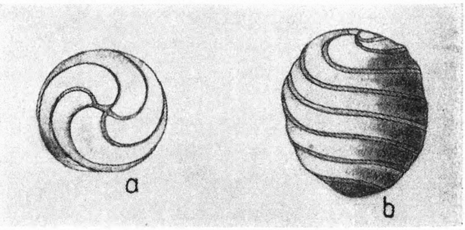


Fig. 6. *Sphaerochara rollei* (UNGER) H. AF R. Austria: Steiermark, Thal near Gratz (Miocene, Helvetian ?). — a: gyrogonite in apical view; b: lateral view. — After UNGER 1858, Taf. I, fig. 19—20. — Fig. 24/1.

In view of the few known instances of the occurrence of such forms, the present record from the Pliocene is of some interest. Only one specimen of *Chara globosaforma* is known, but according to the figures (PAPP 1951, Taf. 1, fig. 2 a—c), this seems to be very well preserved and fairly characteristic. The gyrogonite is figured as subspherical, the spiral cells as slightly convex or rather as flat, and the equatorial angle as between 5° and 10°; the tips of the spiral cells, which are not swollen, appear to unite at the apex into a short, broken line. As figured and described by PAPP, *Chara globosaforma* is doubtless referable to *Sphaerochara*, and is the latest known record of that genus.

As pointed out by PAPP (op.c., p. 282), *S. globosaforma* is rather similar to *Chara rollei* UNGER from the Miocene of Austria. This latter species is of some interest in this connection, and might for that reason be briefly discussed.

The type locality of *C. rollei* is the Castle of Thal in the vicinity of Gratz, Steiermark, Austria, and the type stratum Miocene beds, which with some doubt are ascribed to the Helvetian. The formal description (UNGER in ROLLE 1856, p. 546; cf. UNGER 1858, p. 9) reads:

»Ch. fructu elliptico. infra truncato (0.84 mm. longo, 0.76 mm. lato) valvis spiralibus a latere visis 7 concavis, commissura cristatis, basi intime conducatis, apice absque verrucis terminatis. — Terra lignitum ad castellum Thal prope Graecium, Stiriae.»

Figures of the original material (UNGER 1858, Taf. I, fig. 19—21; this paper, fig. 6 a—b) show the following features. In lateral view (UNGER op.c., fig. 19; this paper, fig. 6 b) the gyrogonite is of almost spherical shape. The upward directed pole — believed by UNGER to be the apical one — is slightly protruding, while the downward directed pole is more rounded. Judging by the figure, however, this should not be described as truncate. The spiral cells have 7 flat or slightly convex convolutions at a rather acute angle to the equator (in the separate, more magnified fig. 21 of the same paper the convolutions are reproduced as slightly concave). Fig. 20 (fig. 6 a of this paper) represents the same specimen from its lower, broader pole, which by UNGER is interpreted as the basal end. The tips of the enveloping cells are not united in a pore, but along a short broken line.

UNGER's figures and descriptions caused SCHIMPER (1869, p. 227) to say »M. Unger a pris le sommet pour la base, et c'est aussi dans ce sens qu'il a fait représenter ce fruit», and GROVES (1933, p. 29) also points out that »Unger evidently mistook the apex for the base». None of these authors gave any reasons for their opinions, but they are apparently quite right, for if the arrangement of the spiral cell-tips is correctly drawn in UNGER 1858, Taf. I, fig. 20 (this paper, fig. 6 a), the pole illustrated cannot be basal, but must be apical.[1] In another paper (HORN AF RANTZIEN 1954, in the press) the writer has attempted a brief survey of the various types of apical and basal arrangements met with in fossil gyrogonites and recent »oospores». Despite some variations the bases are in principle alike in one point, viz. in the presence of a small central pore, usually pentagonal, of less varying size than the apical orifice. In the living oogonium, this central basal pore was filled by an uncalcified basal cell. The basal tips of the enveloping cells, on the other hand, are never, as far as we know, meeting along a short broken line.

The spherical shape of the gyrogonite, and its apical structure, where the unexpanded spiral cell-tips meet along a broken line, show that *C. rollei* UNGER should be referred to *Sphaerochara*. Its citation and synonymy should be:

Sphaerochara rollei (UNGER) H. AF R., n. comb. (fig. 6 a—b).

Chara Rollei UNGER in ROLLE 1856, p. 546; UNGER 1858, p. 9, Taf. 1, fig. 19—21; SCHIMPER 1869, p. 227; GROVES 1933, p. 29; PAPP 1951, p. 283.

Gyrogonites Rollei PIA 1927, p. 90.

Our knowledge of the variations of *S. rollei* and *S. globosaforma* is not complete enough to show whether the two are sufficiently distinct to be maintained as separate species. The differences are, anyway, apparently small. *S. globosaforma* is larger (polar axis 1050 μ, largest equatorial diameter 900 μ) and ten convolutions are according to PAPP (op.c., p. 283) visible in lateral view (if also the partly visible convolutions at the poles are included, the specimen figured by PAPP, op.c., Taf. 1, fig. 2 a, has eleven convolutions). According to UNGER (1858, p. 9), *S. rollei* is 840 μ long and 760 μ at the equator; it has seven convolutions in lateral view. — *S. rollei* extends the range of the *Sphaerochara* gyrogonites also to the Miocene.

In this connection it might be of interest to note that the variations in the so far known gyrogonites of the *Sphaerochara* type are comparatively small, mostly variations in size. The Oligocene *S. hirmeri* is a rather small form, its polar axis being 500—550 μ and largest equatorial diameter 460—550 μ. It is of regular spherical shape, and its spiral cells, with 10—11 convolutions, cut the equator at a very acute angle

---

[1] For that reason, fig. 19 of UNGER op.c. has been reversed in fig. 6 b of this paper, the apical end thus pointing upwards, according to the general usage when figuring gyrogonites.

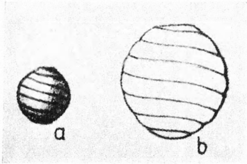


Fig. 7. »*Chara*» *granulifera* HEER. Switzerland: Kt. Vaud, Paudex and Belmont (to which of these localities the specimens figured are to be ascribed is unknown) (Miocene, Aquitanian ?). — a: gyrogonite in lateral view; b: lateral view. — After HEER 1855, Taf. IV, fig. 8 a—b. — a: 15/1; b: approx. 30/1.

(< 5°). It is not known whether the apical tips of its enveloping cells unite at a point or along a short line. The undescribed Triassic species is close to the genotype, but still smaller (polar axis c. 450 μ, largest equatorial diameter c. 460 μ), and shows 12 flat, cellular convolutions. Its equatorial angle is about 8°, and the apical cell-tips unite along a short broken line. This Triassic specimen belongs to the rather few known instances of gyrogonites whose equatorial widths exceed their lengths. This is still more pronounced in the apparently rather distinct *S. perlata* from the Cretaceous of Peru (polar axis 780 μ, largest equatorial diameter 810 μ). *S. perlata* differs from all other known species of *Sphaerochara* in being clearly truncate above and provided with high, rather narrow intercellular ridges; its convolutions — 7 or 8 in number — are accordingly concave. Apically, the spiral cells unite at a point. The Cretaceous *S. brewsterensis* from Texas belongs to the same size-group, but it is very broadly ovoid rather than spherical (polar axis c. 750 μ, largest equatorial diameter 650—675 μ). There are 12—13 flat or slightly convex, cellular convolutions at an acute equatorial angle; as figured by GROVES (1925, fig. 1 b), its spiral cells unite apically at a point. The Miocene *S. rollei* is slightly larger than *S. brewsterensis,* but otherwise of similar shape; as described by UNGER, the principal differences are: fewer convolutions (7), less convex spirals, and the apical cell-tips meeting in a broken line. The Pliocene *S. globosaforma* is the largest known species of *Sphaerochara.* It is similar to *S. rollei,* but larger, and more convolutions are visible.

In this connection it may be noted that another Miocene type of gyrogonite, *Chara granulifera* HEER (1855, p. 27), might possibly, according to the description (»Ch. fructu globoso, minimo, obtuso, spiris a latere visis, 7—8, planis, rarius convexiusculis») and illustrations (HEER op.c., Taf. IV, fig. 8 a—b, reproduced in SCHIMPER 1870—1872, as pl. V, fig. 47, and in this paper as fig. 7 a—b), have to be referred to *Sphaerochara,* but absence of adequate information on its apical pole structure makes this question difficult to decide without access to the type material. It has been reported from deposits in Switzerland and Alsace ascribed to the Aquitanian.

List of Pliocene Charophyta.

Besides the four species revised and discussed above, there are records of some more Pliocene charophytes, most of which have recently been published in a paper by PAPP (1951) on the Neogene gyrogonites of Austria. They have all been ascribed to the genus *Chara*. Several probably belong to other genera, but in most cases the information available does not permit their definitely referred to any particular organ-genus. For the sake of convenience, the Pliocene charophyte species known to the writer are listed below in alphabetical order.

1. *Aclistochara nana* (LU) H. AF R. See p. 3.

2. *Aclistochara sinkiangensis* (LU) H. AF R. See p. 10.

3. *Chara escheri* BRAUN ex UNGER.

Chara Escheri »ALEX. BRAUN *Manusc.*» UNGER 1850, p. 34.
Gyrogonites Escheri PIA 1927, p. 90.

For synonymy and illustrations up to 1933, see GROVES 1933, p. 17. Later contributions: PAPP 1951, p. 287, Taf. 3, fig. 11—14; CROFT 1952, p. 212, pl. 19, fig. 21—28, text-fig. 7 A, C.

Pliocene occurrences: Burgau, Burgenland, Austria (Pannonian, Zone D, acc. to PAPP l.c.). — Eichkogel at Mödling, Nieder-Österreich, Austria (Pannonian, Zone H, acc. to PAPP op.c., p. 288). — As to the subdivisions of the Pannonian in the Vienna Basin, see PAPP 1948, p. 123 ff. and JANOSCHEK 1951, p. 599—610. — For Pre-Pliocene records (ascribed to the Oligocene — Miocene), see references in GROVES l.c. and PAPP 1951, p. 287.

C. escheri — a common, widely distributed type of gyrogonite — is complex and ill-defined. Some gyrogonites ascribed to this species doubtless belong to the Aclistochareae, others may possibly be referred to *Chara* s.str. One of the forms referred to this species has been studied in detail by CROFT (l.c).

4. *Chara longovata* PAPP.

Chara longovata PAPP 1951, p. 289, Taf. 3, fig. 17—18.

Pliocene occurrence: Delsenbachgasse, Vienna, Austria (Pannonian, Zone E, acc. to PAPP l.c.). — Regarding the Pannonian subdivisions, see *C. escheri*.

This is a fairly characteristic type of gyrogonite, oblong or subcylindrical with more or less truncate poles and 13—14 narrow, convex, flat or slightly concave convolutions. Its polar axis is 500—600 μ long, its largest equatorial diameter 350 μ. More or less similar gyrogonites have been described from older deposits, e.g. *Aclistochara minima* MÄDLER (1952, p. 21, Taf. A, fig. 30—35) of the Kimmeridge, *A. jonesi* PECK and *A. elongata* PECK of the Morrison (PECK 1937, p. 88—89, pl. 14, fig. 12—15, 24—25), *A. cylindrica* PECK (1941, p. 291, pl. 42, fig. 38—39, 41—44) of the Draney and the Bear River of the Lower Cretaceous, and *Chara tornata* REID & GROVES and *C. subcylindrica* REID & GROVES of the Upper Eocene (REID & GROVES 1921, p. 187, pl. V, fig. 1—5). *C. longovata* differs in a number of characters from the gyrogonites mentioned above, however. In the general shape it also shows some resemblance to the »oospores» of some recent species of *Chara* s.str., which have less pointed poles than is usual in the genus, e.g. *C. aculeolata* KÜTZING ex REICHENB. (*C. polycantha* BRAUN ex LEONH.). *C. longovata* may belong to the types usually referred to the Aclistochareae, but its systematical position cannot be ascertained without access to the type material.

5. *Chara majoriformis* PAPP.

Chara majoriformis PAPP 1951, p. 282, Taf. 1, fig. 1.
Pliocene occurrence: Eichkogel at Mödling, Nieder-Österreich, Austria (Pannonian, Zone H, acc. to PAPP l.c.). — Regarding the Pannonian subdivisions, see *C. escheri*.

Two specimens of an almost spherical, very large gyrogonite (polar axis 1370 μ) were found by PAPP among *Chara meriani*. From PAPP's description they appear to have the apical structure characteristic of the Aclistochareae, though this question cannot be settled with certainty. PAPP points out that they may be allied to *C. meriani*.

6. *Chara meriani* BRAUN ex UNGER.

Chara Meriani »ALEX. BRAUN *Manusc.*» UNGER 1850, p. 34.
Chara meriani meriani PAPP 1951, p. 283, Taf. 1, fig. 3, 4 a—c.
Gyrogonites Meriani PIA 1927, p. 90.
A list of synonyms and illustrations is given by GROVES 1933, p. 25—26. Later contributions: MASLOV 1947, p. 81, 88, fig. 7—11; PAPP l.c.
Pliocene occurrences: Ziegelei and Sandgrube, Leobersdorf, Nieder-Österreich, Austria (Pannonian, Zone C). — Götzendorf, Moosbrunn, Nieder-Österreich, Austria (Pannonian, Zone F). — Mödling, Eichkogel, Nieder-Österreich, Austria (Pannonian, Zone H). — Tihany, Öcs, Hungary (Pannonian, »obere Congerienschichten»). All references acc. to PAPP op.c., p. 284. — Regarding the Pannonian subdivisions, see *C. escheri*. — For Pre-Pliocene records (ascribed to the Oligocene—Miocene) see references in GROVES 1933, p. 26, and moreover MASLOV op.c., p. 90, PAPP l.c.

The remarks as to the imperfect knowledge of the taxonomy of *C. escheri* also apply to this species. Pliocene specimens — as figured by PAPP — have apical characters which might motivate their inclusion in the Aclistochareae as defined by MÄDLER (1952).

7. *Chara meriani* ssp. *minoritesta* PAPP.

Chara meriani minoritesta PAPP 1951, p. 284, Taf. 2, fig. 5—6.
Pliocene occurrence: Mödling, Eichkogel, Nieder-Österreich, Austria (Pannonian, Zone H, acc. to PAPP l.c.). — Regarding the Pannonian subdivisions, see *C. escheri.*

These gyrogonites are slightly smaller (polar axis 1010 µ) than those of *C. meriani meriani* of PAPP 1951, p. 284 (polar axis 1300 µ). They were found in association with the latter.

8. *Chara multispira* PAPP.

Chara multispira PAPP 1951, p. 289, Taf. 3, fig. 16.
Pliocene occurrence: Delsenbachgasse, Vienna, Austria (Pannonian, Zone E, acc. to PAPP l.c.). — Regarding the Pannonian subdivisions, see *C. escheri.*

A broadly ovoid type of gyrogonite, polar axis, c. 550 µ, with 13 slightly convex, narrow, cellular convolutions. The rather truncate apical pole, as figured by PAPP, might indicate some affinity with the Aclistochareae, or with *Obtusochara* among the Chareae, but definite evidence is lacking.

9. *Chara spirocarinata* PAPP.

Chara spirocarinata PAPP 1951, p. 285, Taf. 2, fig. 8 a—b.
Pliocene occurrence: Mödling, Eichkogel, Nieder-Österreich, Austria (Pannonian, Zone H, acc. to PAPP l.c.). — Regarding the Pannonian subdivisions, see *C. escheri.*

As described and figured by PAPP, *C. spirocarinata* doubtless belongs to the Aclistochareae as defined by MÄDLER (1952). The structure of its apical pole is diagnostic. Owing to its somewhat doubtful distinctness as a species, no formal transfer to the Aclistochareae has so far been considered desirable.

10. *Chara stiriaca* UNGER.

Chara stiriaca UNGER in ROLLE 1860, p. 49, Taf. IV, fig. 6.
Gyrogonites stiriacus PIA 1927, p. 90.

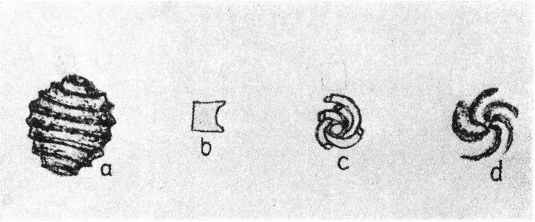


Fig. 8. »*Chara*» *zoberbieri* v. FRITSCH. Germany: Thuringia, Rippersroda (Pliocene, Reuverian). — a: gyrogonite »von der Seite»; b: »ungefährer Umriss des Durchschnittes eines der Spiralbänder»; c: »Obertheil der Frucht von innen gesehen. Scheibe unter der Coronula»; d: »Unteres Ende von aussen.» After v. FRITSCH 1885, Taf. XXVI, fig. 2—5. — a, c, d: approx. 20/1; 6: approx. 40/1.

References in GROVES 1933; p. 31; see furthermore PAPP 1951, p. 285, Taf. 2, fig. 7 a—b.

Pliocene occurrence: »Pannon, Ziegelei Polsterer bei Leobersdorf (Zone D nach Papp) ein Exemplar (Bestimmung unsicher)» (PAPP l.c.).

C. stiriaca (described from Hundsdorf in Steiermark, Austria; Miocene) seems a fairly characteristic species. As figured by UNGER (l.c.) and PAPP (l.c.) it might possibly be referred to the Aclistochareae, in which case it would be allied to the species of *Aclistochara* characterized by very narrow apical openings (cf. MÄDLER 1952, Abb. 1 a, 1953 b, Abb. 17 a), i.e. of the apical type of *A. kimmeridgensis*.

11. *Chara zoberbieri* v. FRITSCH.

Chara Zoberbieri v. FRITSCH 1885, p. 424, Taf. XXVI, fig. 2—5; this paper fig. 8 a—d.

Gyrogonites Zoberbieri PIA 1927, p. 90.

»Kleine fast kugelige Früchte von 0,62—0,65 Millimeter Länge, 0,55—0,56 Millimeter Breite. Die zusammengerollten 5 Valven gehen je 1 ¹/₂ mal um die Spore, so dass mann von aussen 8 Rippen sieht, die der Verbindung je zweier, mit erhöhten Rändern an einander stossenden (also aussen ausgehöhlten) Spiralschalen entsprechen. Zwischen je zweien der Spiralbänder wird die feine Trennungslinie unter dem Mikroskop sichtbar. Die Coronula scheint auf einer kreisrunden, von innen sichtbar werdenden Scheibe gestanden zu haben.» (v. FRITSCH l.c.).

References in GROVES 1933, p. 37.

Pliocene occurrence: Rippersroda, at »der zahmen Gera», Thuringia, Germany (v. FRITSCH l.c.). Acc. to KIRCHHEIMER (1940, p. 150) this deposit is Middle Pliocene (Reuverian).

The description and figures cannot be used for a reference of this species to any of the Tertiary genera of fossil charophytes. Its almost spherical shape, and the description of its apical pole, do not appear to conform very well to the corresponding features of *Chara* s.str. gyrogonites. Its ascription to that genus is accordingly open to doubt. It may belong to the Aclistochareae or to *Sphaerochara* according to the definitions of these groups of gyrogonites, but this cannot be decided without examining the type material.

v. FRITSCH has compared the gyrogonites of *C. zoberbieri* with the smaller and more oblong-oval *Chara sadleri* UNGER of the Ödenburg Miocene (cf. UNGER 1850, p. 36, 1852, p. 81, pl. 25, fig. 7—9).

Also another type of gyrogonite is mentioned from the Rippersroda deposits (v. FRITSCH op.c., p. 425). This differs considerably from *C. zoberbieri,* but as it has not been specifically described it has not been separately listed in the present paper.

12. ***Kosmogyra nodosa*** (LU) H. AF R. See p. 12.

13. ***Sphaerochara globosa*** (PAPP) H. AF R. See p. 18.

Summary.

In connection with a survey of the records of charophyte gyrogonites in Pliocene deposits (p. 24—28), some revisions have been made on the basis of descriptions and illustrations of various species.

1) *Chara nana* LU from the Pliocene Bed B of the Kuchar Group of Sinkiang belongs to the genus *Aclistochara* as defined by present students of this group, and the new combination *Aclistochara nana* (LU) H. AF R. is made. *Chara sinkiangensis* LU from the lower Bed C (Cretaceous—Lower Tertiary) of the Kuchar Group, with a doubtful record also from the Pliocene Bed B of the same group, also belongs to this genus (*Aclistochara sinkiangensis* (LU) H. AF R., n.comb.). With regard to further Pliocene occurrences of the Aclistochareae, it is noted that *Chara spirocarinata* PAPP (Pannonian, Austria) doubtless belongs to this group, as probably also *Chara stiriaca* UNGER (Austrian Miocene, a doubtful record from the Austrian Pliocene). New nomenclatural combinations of the two latter species have not been made. The diagnostic characters of *Aclistochara* and their morphological interpretations are briefly reviewed. *Aclistochara* is a rather heterogeneous assemblage of forms that ought to be divided further. The stratigraphic distribution of this group is wide, and includes the Middle Trias, Upper Jurassic, Cretaceous, and most of the Tertiary up to the Lower Miocene; the present paper shows that some species also occur in the Pliocene. Some records from the Pennsylvanian ascribed to *Aclistochara* are also discussed; the affinities of these Pennsylvanian remains seem still doubtful, however.

2) The gyrogonites of tubercular decoration, referred to the Kosmogyreae, and found in the Paleocene—Miocene, are also represented in the Pliocene, *Chara nodosa* LU from the Pliocene Bed B of the Kuchar Group of Sinkiang being doubtless referable to that group (*Kosmogyra nodosa* (LU) H. AF R., n. comb.). The Kosmogyreae are surveyed, and the nature of their tubercular decoration discussed. As regards the isolated finds of tuberculate gyrogonites from the Miocene (Sarmatian) and the Pliocene, the possibility of interpreting them by a re-deposition of older deposits by river action is discussed. Even though there is no conclusive evidence of re-deposition, Miocene and Pliocene finds of tuberculate gyrogonites may be explained in this way, in which case the primary occurrences of these gyrogonites would be Paleogene.

3) A spherical gyrogonite from the Austrian Pliocene (Pannonian), *Chara globosaforma* PAPP, should — as described and figured — be referred to the genus *Sphaerochara* (*S. globosaforma* (PAPP) H. AF R., n. comb.). Species referred to *Sphaerochara* and their morphology are discussed. The present species is compared with other forms of the same genus, and also with *Chara rollei* UNGER (Miocene of Austria). According to the illustrations published, the latter species should be referred to *Sphaerochara* as *S. rollei* (UNGER) H. AF R., n. comb. A further Miocene type of gyrogonite, *Chara granulifera* HEER, might possibly also be included in the same genus, but its systematical position can only be settled by an examination of the type material. Forms referable to *Sphaerochara* are known from the Middle Trias, Cretaceous, and Oligocene; species discussed in this paper widen the geological range of this genus to include also the Miocene and the Pliocene.

Paleobotanical Department, Riksmuseum,
Stockholm 50, Sweden, November 1953.

Literature cited.

BADEN-POWELL, D. F. W., 1950: The Pliocene-Pleistocene Boundary in the British Deposits. — Int. Geol. Congr., Rep. 18th Sess., IX: 8—10. London.

BELL, W. A., 1922: A New Genus of Characeae and New Merostomata from the Coal Measures of Nova Scotia. — Trans. Roy. Soc. Canada, ser. 3, 16: 159—167, pl. 1. Ottawa.

— 1949: Upper Cretaceous and Paleocene Floras of Western Alberta. — Geol. Surv. Bull. Canada, 13: i—v, 1—231, 2 tab. (unnumb. p. 17, 29—35), pl. I—LXVII. Ottawa.

BRONGNIART, ADOLPHE, 1822: Sur la classification et la distribution des végétaux fossiles en général, et sur ceux des terrains de sédiment supérieur en particulier. — Mém. Mus. d'Hist. Nat., 8: 203—240, 297—348, pl. I (12)—VI (17). Paris.

CHANEY, RALPH W., 1935: The Kucha Flora in relation to the physical conditions in Central Asia during the Late Tertiary. — Jubilee Vol. Sven Hedin, Geogr. Ann., XVII: 75—105, tab. 1—2, fig. 1—11, pl. I—III. Stockholm.

CROFT, W. N., 1952: A new Trochiliscus (Charophyta) from the Downtonian of

Podolia. — Bull. Brit. Mus. (Nat. Hist.), Geol., I (7): 189—220, fig. 1—7, pl. 18—19. London.

Dollfus, G.-F., & Fritel, P.-H., 1920: Catalogue raisonné des Characées fossiles du Bassin de Paris. — Bull. Soc. Géol. France, sér. 4, XIX (1919): 243—261, fig. 1—23 (24 fig.; fig. nr 18 occurring twice), 1 tab. (unnumb. p. 261). Paris.

Edwards, W. N. 1932: Lower Eocene Plants from Istria. — Ann. Mag. Nat. Hist., ser. 10, X: 213—216, pl. X. London.

Fritsch, K. v., 1885: Das Pliocän im Thalgebiete der zahmen Gera in Thüringen. — Jahrb. Kön. Preuss. geol. Landesanst. u. Bergakad. zu Berlin f.d. J. 1844: 389—437, 1 fig. (unnumb. p. 391), Taf. XXIII—XXVI. Berlin.

Groves, James, 1920: A Curious Fossil Charophyte Fruit. — Geol. Mag., LVII: 126—127, fig. 1. London.

— [J. G.], 1924: A sketch of the geological history of the Charophyta. — In: James Groves & George Russell Bullock-Webster, The British Charophyta, II: 72—90, fig. 26—31, pl. 45. Ray Soc., London.

— 1925: Fossil Charophyte-fruits from Texas. — Amer. Jour. Sci., ser. 5, 10: 12—14, fig. 1—3. New Haven, Conn.

— 1926: Charophyta. — In: Eleanor Mary Reid & Marjorie Elizabeth Jane Chandler, The Bembridge Flora (Brit. Mus. Cat. Cain. Pl., I): 165—173, fig. 16—20, pl. XII. London.

— 1933: Charophyta. — Fossilium Catalogus, II Plantae, ed. W. Jongmans, 19: 1—74. Berlin.

Groves, James, & Bullock-Webster, George Russell, 1924: The British Charophyta, II Chareae. i—xii, 1—129, fig. 26—31, pl. 22—45. Ray Soc., London.

Harris, Thomas Maxwell, 1939: British Purbeck Charophyta. i—ix, 1—83, fig. 1—16, pl. I—XVII. Brit. Mus. (Nat. Hist.), London.

Heer, O., 1855: Flora Tertiaria Helvetiae. I. i—vi, 1—117, Taf. I—L. Wintherthur.

— 1859: Flora Tertiaria Helvetiae. III. i—vi, 1—378, Taf. CI—CLVI, map. Wintherthur.

Horn af Rantzien, Henning, 1951: On the Fossil Charophyta of Latin America. — Sv. Bot. Tidskr., 45 (4): 658—677. Uppsala.

— 1953: De geologiska resultaten från borrningarna vid Höllviken. Del VI: Charophyta from the Middle Trias of the boring Höllviken II. Preliminary account. — S.G.U. Årsb. 47 (1953) (4) (Ser. C, N:o 533): 1—16, Tab. I, pl. I. Stockholm.

— 1954: Middle Triassic Charophyta of South Sweden. — Opera Botanica, I (2): 1—83, fig. 1—3, Tab. I—III, pl. I—VII. Lund. (In the press)

Janoschek, Robert, 1951: Das Inneralpine Wiener Becken. — In: Geologie von Österreich, 2. Aufl. herausgeg. v. F. X. Schaffer: 525—693, Abb. 1—8, Taf. I—II, 1 Tab. (unnumb. p. 607). Wien.

Karpinsky, A., 1906: Die Trochilisken. — Mém. Com. Géol. St. Pétersb., n.s., 27: i—viii, 1—86 (Russian), 87—166 (German), fig. 1—59, pl. I—III. St. Pétersbourg.

Kirchheimer, Franz, 1940: Flora und Gliederung des Pliocäns in Mitteleuropa. — Zentralbl. f. Min., etc., Abt. B (1940), 5: 141—152, 1 tab. Stuttgart.

LAMARCK, [J. B. A. P. MONET DE], An XIII [1804]: Suite des Mémoires sur les Fossiles des environs de Paris. — Ann. Mus. Nat. d'Hist. Nat., V: 349—357. Paris.

— 1822: Histoire naturelle des animaux sans vertèbres, VII: 1—711. Paris.

LORANGER, D. M., 1951: Useful Blairmore Microfossil Zone in Central and Southern Alberta, Canada. — Bull. Amer. Ass. Petrol. Geol., 35 (11): 2348—2367, fig. 1—3, pl. 1—3. Menasha, Wis.

LU, YEN-HAO, 1945: The Charophyta from the Kucha Formation near Kucha, Sinkiang. — Bull. Geol. Soc. China, XXIV (1944) (1—2): 33—36, pl. I. Pehpei.

— 1946: Additional Note on the Charophyta from the Kucha Formation of Sinkiang. — Ibid., XXV (1945) (1—4): 273—277, fig. 1—2. Peiping.

LYELL, CHARLES, 1826: On a recent Formation of Freshwater Limestone in Forfarshire, and on some recent Deposits of Freshwater Marl; with a Comparison of recent with ancient Freshwater Formations; and an Appendix on the Gyrogonite or Seed-vessel of the Chara. — Trans. Geol. Soc., ser. 2, II (I): 73—96. pl. X—XIII. London.

MASLOV, V. P., 1947: Materials for the Investigation of Fossil Algae of the USSR. Fossil Chara — their Importance, Anatomy and the Methods of their Study. — Bull. Soc. Nat. Moscow, 52 (Sér. Géol., 22, 3): 73—90, fig. 1—15. Moscow. (In Russian; Engl. Summ. p. 87—90.)

MÄDLER, KARL, 1952: Charophyten aus dem Nordwestdeutschen Kimmeridge. — Geol. Jahrb., 67: 1—46, Abb. 1—8, Taf. A—B. Hannover.

— 1953 a: Fossile Charophyten als Zeitmarken. — Erdöl und Kohle, 6: 63—65, Taf. I. Hamburg.

— 1953 b: Ein neues System der fossilen Charophyten. — Flora, 140: 474—484, Abb. 1—17. Jena.

NORIN, ERIK, 1935 a: [Written communication of May 18, 1934]. In: RALPH W. CHANEY, The Kucha Flora in relation to the physical conditions in Central Asia during the Late Tertiary. — Jubilee Vol. Sven Hedin, Geogr. Ann., XVII: 77—82. Stockholm.

— 1935 b: Tertiary of the Tarim Basin. — Bull. Geol. Soc. China, XIV (3): 337—347. Peiping.

— 1941: Geologic Reconnaissances in the Chinese T'ien-shan. — Rep. Sino-Swedish Exped., III. Geol., 6: i—xii, 1—229, fig. 1—33, pl. I—XXIII, pl. at the end of vol. A—D (maps and sections). Stockholm.

PAPP, A., 1948: Fauna und Gliederung der Congerienschichten des Pannons im Wiener Becken. — Anz. d. Österr. Akad. d. Wiss., 85. Jahrg. (11): 123—134, Tab. 1. Wien.

— 1951: Charophytenreste aus dem Jungtertiär Österreichs. — Sitz. Ber. Österr. Akad. Wiss., Math.-naturw. Kl., Abt. I, 160 (3—4): 279—293, Abb. 1, Taf. 1—4. Wien.

PECK, RAYMOND E., 1934 a: Late Paleozoic and Early Mesozoic Charophyta. — Amer. Jour. Sci., 5th ser., XXVII (157): 49—55, pl. (unnumb.) p. 50. New Haven, Conn.

— 1934 b: The North American Trochiliscids, Paleozoic Charophyta. — Jour. Paleont., 8 (2): 83—119, fig. 1—2, pl. 9—13. Menasha, Wis.

— 1937: Morrison Charophyta from Wyoming. — Ibid., 11 (2): 83—90, pl. 14. Menasha, Wis.

— 1941: Lower Cretaceous Rocky Mountain nonmarine microfossils. — Ibid., 15 (3): 285—304, pl. 42—44. Menasha, Wis.

— 1953: Fossil Charophytes. — The Bot. Review, 19 (4): 209—227. Lancaster, Pa.

PECK, RAYMOND E., & REKER, CARL C., 1947: Cretaceous and Lower Cenozoic Charophyta from Peru. — Amer. Mus. Novit., 1369: 1—6, fig. 1—27. New York, N.Y.

— 1948: Eocene Charophyta from North America. — Jour. Paleont., 22 (1): 85—90, pl. 21. Menasha, Wis.

PIA, JULIUS, 1927: Thallophyta. In: MAX HIRMER, Handbuch der Paläobotanik, I: 31—136, fig. 14—129. München & Berlin.

RAO, K. SRIPADA & RAO, S. R. NARAYANA, 1939: The Fossil Charophyta of the Deccan Inter-Trappeans near Rajahmundry (India). — Mem. Geol. Surv. India, n.s., XXIX (2): i—ii, 1—14, pl. I—III. Calcutta.

RÁSKY, KLÁRA, 1941: Über die Früchte fossiler Chara-Arten aus der Tiefbohrung Nr. II im Stadtwäldchen von Budapest und aus den Bohrungen auf Trinkwasser in Pécs. — Földtani Közlöny, LXXI (7—12): 297—305, Taf. VII. Budapest.

— 1945: Fossile Charophyten-Früchte aus Ungarn. — Ungar. Naturwiss. Mus. Naturwiss. Monogr., II: 1—74, pl. I—III, 1 map. Budapest.

— 1952: Dunántúli fosszilis Charophyta-termések (A Dunántúl eocén-kori Charophyta terméseinek monografikus feldolgozásához). — Rapport Annuel de l'Inst. Géol. de Hongrie, 1949: 41—46, 1 pl. (unnumb.) p. 44. Budapest. (French Summ. p. 46: Fruits fossiles de Charophyta en Dunántul (Transdanubie); Russ. Summ. p. 46).

REID, CLEMENT, & GROVES, JAMES, 1916: Preliminary Report on the Purbeck Characeae. — Proc. Roy. Soc., B, 89: 252—256, pl. 8. London.

— 1921: The Charophyta of the Lower Headon Beds of Hordle (Hordwell) Cliffs (South Hampshire). — Quart. Jour. Geol. Soc., LXXVII (3): 175—192, pl. IV—VI. London.

ROLLE, FRIEDRICH, 1856: Die tertiären und diluvialen Ablagerungen in der Gegend zwischen Gratz, Köflach, Schwanberg und Ehrenhausen in Steiermark. — Jahrb. K.—K. Geol. Reichsanst. Wien, VII. Jahrg. (3: V): 535—602, 7 fig. (unnumb.). Wien.

— 1860: Die Lignit-Ablagerung des Beckens von Schönstein in Unter-Steiermark und ihre Fossilien. Nebst einem Anhange »die Pflanzenreste der Lignit-Ablagerung von Schönstein», von dem w. M. der kais. Akademie Dr. FRANZ UNGER. — Sitz. Ber. K. Akad. Wiss., Math.-naturw. Cl., XLI (13): 7—52, 2 fig. (unnumb.) p. 13 & 20, 2 tab. (unnumb.) p. 23 & 24—25, Taf. I—V. Wien.

SAHNI, B., & RAO, S. R. NARAYANA, 1943: On Chara sausari sp. nov., a Chara (sensu stricto) from the Intertrappean Cherts at Sausar in the Deccan. — Proc. Nat. Acad. Sci. Ind., 13 (3): 215—223, fig. 1—8. Allahabad.

SAPORTA, [L. C. J. G.] Le Comte DE, 1873: Plantes Jurassiques. I. Algues, Equisetacées, Characées, Fougères. In: Paléontologie Française, 2e Série, Végétaux. Texte: 1—506. Paris.

SCHIMPER, W. PH., 1869: Traité de Paléontologie Végétale ou la flore du monde primitif dans ses rapports avec les formations géologiques et la flore du monde actuel. T. I: 1—740. Paris.

— 1870—1872: Traité de Paléontologie Végétale ou la flore du monde primitif dans ses rapports avec les formations géologiques et la flore du monde actuel. Atlas. p. 1—46, pl. I—CX. Paris.

STACHE, GUIDO, 1889: Die Liburnische Stufe und deren Grenz-Horizonte. Eine Studie über die Schichtenfolgen der cretacisch-eocenen oder protocänen Landbildungsperiode im Bereiche der Küstenländer von Österreich-Ungarn. Erste Abtheilung. Geologische Übersicht und Beschreibung der Faunen- und Florenreste. — Abh. K. K. Geol. Reichsanst., XIII (1): 1—170, Taf. I—VI, 1 map. Wien.

THOMAS, LEO A., 1949: Pennsylvanian Charophyta in Iowa. — Proc. Iowa Acad. Sci., 56: 233. Cedar Rapids, Iowa.

TROLL, OSKAR Ritter VON, 1907: Die pontischen Ablagerungen von Leobersdorf und ihre Fauna. — Jahrb. d. K.—K. Geol. Reichsanst., LVII (1907) (1—2): 33—90, Tab. (unnumb.) p. 82—85, Taf. II. Wien.

TUZSON, J., 1914: Beiträge zur fossilen Flora Ungarns. (Additamenta ad Floram Fossilem Hungariae III). — Jahrb. K. Ungar. Geol. Reichsanst., XXI (8): 233—261, pl. XIII—XXI. Budapest.

UNGER, F., 1850: Genera et Species Plantarum Fossilium. i—xl, 1—627. Vindobonae.

— 1856: see ROLLE, FRIEDRICH 1856.

— 1858: Über fossile Pflanzen des Süsswasser-Kalkes und Quarzes. — Denkschr. Akad. Wien, Math.-naturw. Cl., XIV: 1—12, Taf. I—III. Wien.

— 1860: Die Pflanzenreste der Lignit-Ablagerung von Schönstein in Unter-Steiermark. In: FRIEDRICH ROLLE, Die Lignit-Ablagerung des Beckens von Schönstein in Unter-Steiermark und ihre Fossilien. — Sitz. Ber. K. Akad. Wiss., Math.-naturw. Cl., XLI (13): 47—52, Taf. IV—V. Wien.

WATELET, AD., 1866: Description des Plantes Fossiles du Bassin de Paris. i—ii, 1—264, with Atlas: 1—30, pl. 1—60. Paris.

WOLDSTEDT, PAUL, 1950: Die Grenze Pliozän-Pleistozän in Europa. — Int. Geol. Congr., Rep. 18th Sess., IX: 108—114. London.

BOTANISKA NOTISER 1954, HÄFTE 1. LUND

The distribution of Pseudoperonospora erodii (Fuck.) Wilson in Skåne (Scania), South Sweden.

By ARNE GUSTAVSSON.

(Meddelanden från Lunds Botaniska Museum nr. 107.)

In an earlier paper (GUSTAVSSON, 1953) I mentioned some collections of this fungus from the autumn of 1952. Then I found it in five localities in South Sweden, which was rather interesting as it had not earlier been reported from our country.

GÄUMANN (1923) gave the distribution of the fungus on *Erodium cicutarium* (L.) L'Hér. as the following countries: Germany, Austria, Denmark and Russia. Moreover DENNIS (DENNIS and WAKEFIELD, 1946) reported a finding from England. In a personal communication to me he wrote that he had not seen the fungus since then, but that it »is a very inconspicious fungus and may be more plentiful than the records suggest».

During the summer and autumn of 1953 I was also interested in *Pseudoperonospora erodii* and tried to clarify its distribution in Skåne. The investigation has indicated that this fungus, not earlier known from Sweden, seems to be rather common in Skåne. DENNIS is undoubtedly right when he says that the fungus is difficult to discover, but it forms so characteristic spots on the leaves of the host that with a little practice it is rather easily detected. The spots are often numerous but, as a rule, rather small. Their colour changes from faint greenish yellow to dark red. The attacks are often weak, but sometimes a great part of the underside of the leaves is covered by the dense greyish violet felt formed by the conidiophores.

As is seen from the map (fig. 1), I have found the fungus in many places in Skåne. The small intervals here and there are probably not due to the absence of the fungus in these places. They are more likely

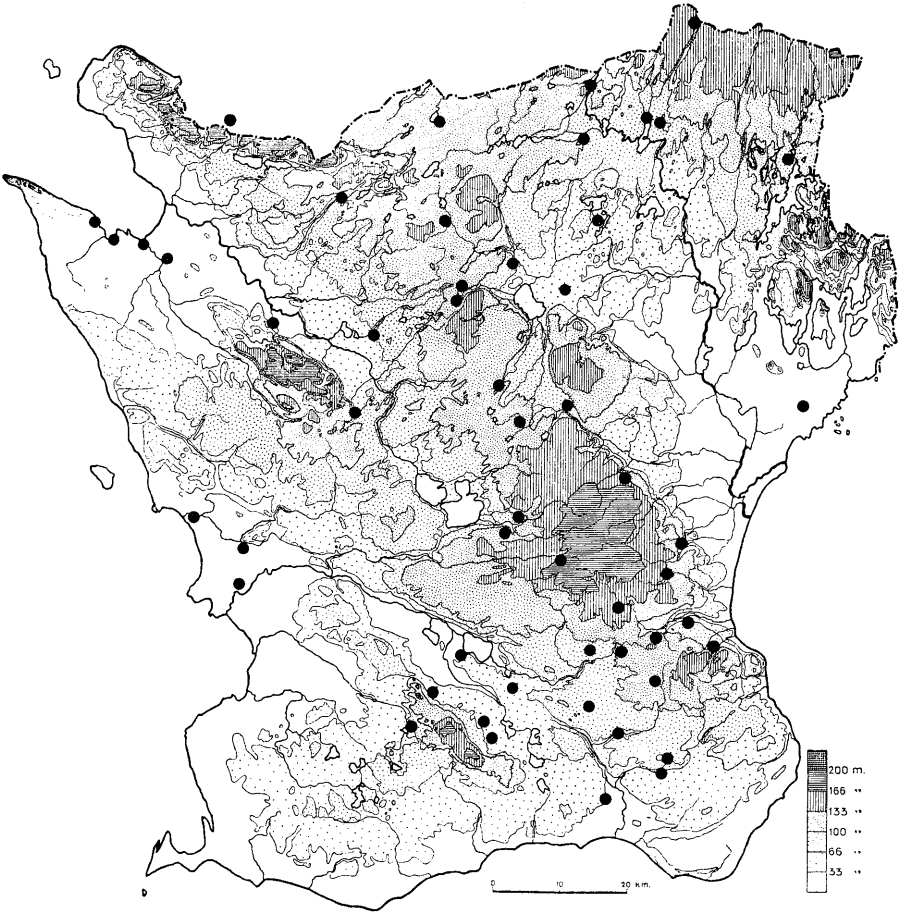


Fig. 1. Map of the distribution of *Pseudoperonospora erodii* in Skåne.

to be regarded as gaps in the investigation. As all these are not very extensive, I believe that they have no greater importance.

This fungus is not mentioned in the list of the micromycetes of Skåne that was published by HAMMARLUND in 1932. It seems rather curious that HAMMARLUND, who had worked on the list for several years, quite overlooked this species. However, this shows how easily such a fungus may escape notice. It may be very difficult to discover the first time, but after this it may be found more frequently.

The appearance of the conidiophores has been treated by both GÄUMANN and DENNIS, therefore only a photograph of a conidiophore (fig. 2) is included here.

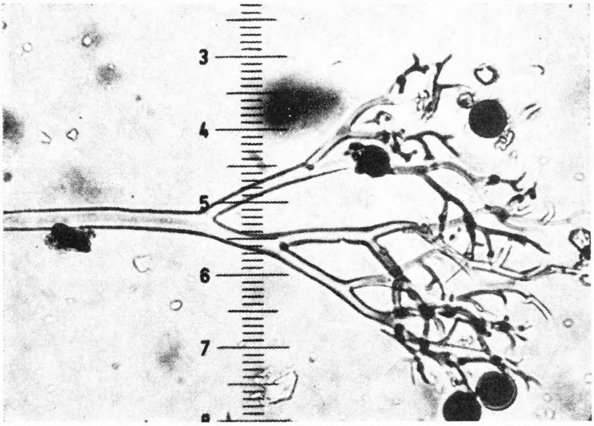


Fig. 2. Conidiophore from *Pseudoperonospora erodii.* 8×40. Ten divisions of the scale correspond to about 42 μ. From collection no. 3748: Tryde, 300 m. northwest of the church, field. 22/9 1953.

The conidia are as a rule somewhat ovoid or almost circular. In order to determine the variation between different localities I have measured 100 conidia from each of 20 collections according to the method employed in my earlier investigation (GUSTAVSSON, 1953). The average values thus obtained have been placed into a coordinate system (fig. 3). As may be seen from this, the variation in length and breadth is rather great. The average length varies between 21.9 and 24.6 μ with a rather marked concentration of the points between 22.5 and 23.5 μ. The average breadth lies between 18.9 and 21.9 μ. Most of the points are concentrated in this case between 20.0 and 21.5 μ. The quotient of length divided by breadth varies between 1.08 and 1.18. Almost half of these values lies between 1.08 and 1.11.

In my last paper I discussed some of the conceivable causes of this variation. I mentioned there as possible factors, in addition to the natural variation, the humidity and the temperature of the air with reference to GÄUMANN among others. Furthermore, the age of the condia may perhaps have a certain influence on the results; younger conidia may give lower values than older ones. Too old conidia may also change the result somewhat; especially those of old collections where many conidia often are destroyed and perhaps impossible to measure.

Finally, I will mention a cause of error, which is surely of very little importance but still may be worth mentioning. Many times it is difficult to decide whether a certain conidium really lies under the cover glass in such a position that the real length and breadth are measured. If a conidium lies inclined, this is rather easily seen, but it cannot be detected whether the conidium is standing on edge. When the conidia are long

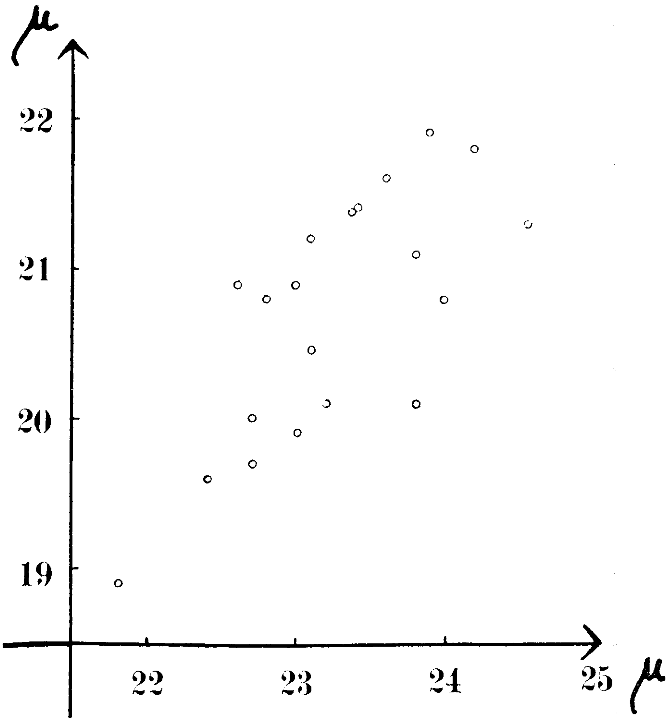


Fig. 3. Diagram over the size of the conidia in 20 collections of *Pseudoperonospora erodii.*

and narrow, this possibility is probably rather slight, but when, as is the case with *Pseudoperonospora erodii,* they are almost globular, the possibility must be much greater. The average length and consequently also the quotient will then be a little too small.

Several authors, when describing new species of this and related genera, have measured conidia from a single collection and then given very exact statements about the average length and breadth of the conidia. As the variation between different collections of the same fungus can be as great as this little investigation shows (fig. 3), this method should not be used. It would be better to give only approximate maximum and minimum values for the measurements.

This variation between different collections has also been shown by HOLM (1946), who placed values from several collections into a coordinate system in the same manner as described here. He had been working with several species of *Plasmopara* and tried to show that it may be possible to separate them in this way. As I have material from only a single species of *Pseudoperonospora,* I cannot carry out a similar investigation. However, later on I hope I shall be able to make the same type of study with some species of the related genus *Peronospora.*

References.

DENNIS, R. W. G. and WAKEFIELD, E. M. 1946. New or Interesting British Fungi. — Trans. Brit. Myc. Soc., XXIX, p. 153. Cambridge.

GUSTAVSSON, A. 1953. Some species of the genera *Peronospora* and *Pseudoperonospora* new to Sweden. — Bot. Not.: 1, pp. 48—64. Lund.

GÄUMANN, E. 1923. Beiträge zu einer Monographie der Gattung *Peronospora* Corda. — Beitr. z. Krypt. - fl. d. Schweiz. V: 4, pp. 100—101. Zürich.

HAMMARLUND, C. 1932. Beiträge zur Kenntnis der Mikromycetenflora der Provinz Skåne (Schonen). — Ark. f. Bot., 25 A, N:o 3. Stockholm.

HOLM, L. 1946. On the Variation of the Conidia in *Plasmopara Umbelliferarum* (Casp.) Schroet. in Relation to Different Hosts. — Sv. Bot. Tidskr.: 40, pp. 55—62. Stockholm.

BOTANISKA NOTISER 1954, HÄFTE 1. LUND

On Neohodgsonia H. Perss., the new hepatic genus from New Zealand and Tristan da Cunha.

By HERMAN PERSSON.

Five years ago, I received for determination from Professor G. E. DU RIETZ of Uppsala a collection of bryophytes from his journey in New Zealand in 1926—1927. Among them was a specimen of *Marchantiales* which was immediately recognized as representing a new genus. I made inquiries about this plant and, through the kindness of Mrs. E. A. HODGSON, I got in touch with Mr. K. W. ALLISON, one of the most successful collectors in New Zealand. He had not collected this hepatic himself but had some material from certain other localities. He was kind enough to send me part of this — rather scanty — material, mainly dried specimens.

Later I surprisingly found that the new genus was represented from several localities in a collection brought home from Tristan da Cunha by the Norwegian expedition in 1937—1938 under the leadership of Dr. E. CHRISTOPHERSEN [the Tristan plant (fig. 2), which is at least nearly related to the New Zealand, will be dealt with by Dr. S. ARNELL in his work on the hepatic collections of the Norwegian expedition].

Due to special circumstances the new genus was preliminarily published, without any illustrations, under the name of *Hodgsonia* in December, 1953 (PERSSON 1953). Unfortunately I had overlooked that the name of *Hodgsonia* had been used some 100 years ago for a genus of phanerogams. In a brief correction I published the name of *Neohodgsonia* for this genus (PERSSON 1954).

Since these publications are less accessible, it seems appropriate to publish here a somewhat extended description of *Neohodgsonia.* A serie of photographs will be added. For a more detailed description the reader is referred to a forthcoming paper, based on fresh material, by Miss E. CAMPBELL, Palmerston North, N.Z.

The new genus has been named for Mrs. E. A. HODGSON, Wairoa, the wellknown New Zealand hepaticologist.

Neohodgsonia H. PERSS. (*Marchantiaceae*)

Neohodgsonia H. PERSS., Correction, Stockholm 14.I.1954. — Syn.: *Hodgsonia* H. PERSS., Stockholm 22.XII.1953, non HOOK. f. et THOMS. in Proc. Linn. Soc. ii. (1853) 257, non. F. MUELL. Fragm. ii. (1860).

Polyoica (monoica et dioica). Thallus habitu staturaque generi Marchantiae simillimus. Stratum anticum altum, cavernosum. Stomata composita, cellulis 4—6, triseriatis cincta. Squamae posticae uniseriales. Pedunculus carpocephali 5—12-capsulus, ex apice frondis, sulco uno rhizophoro, superne bis bifurcatus, ramulis carpocephalo capsulis 2—3 ferentibus vel modo bifurcatus, carpocephalo bilobato lobisque iterum bilobatis, utrisque capsula una instructis. Capsula ovoidea, in sinuum caverniformem inclusa, pariete ventrali cuius rimis longitudinalibus disrumpet. Elateres c. 400 μ, bispiri. Pedunculus masculinus dioicus ex apice frondis, monoicus ex parte mediano thalli, prope pedunculum carpocephali ortus. Scyphuli formam posituramque iis Marchantiae similes.

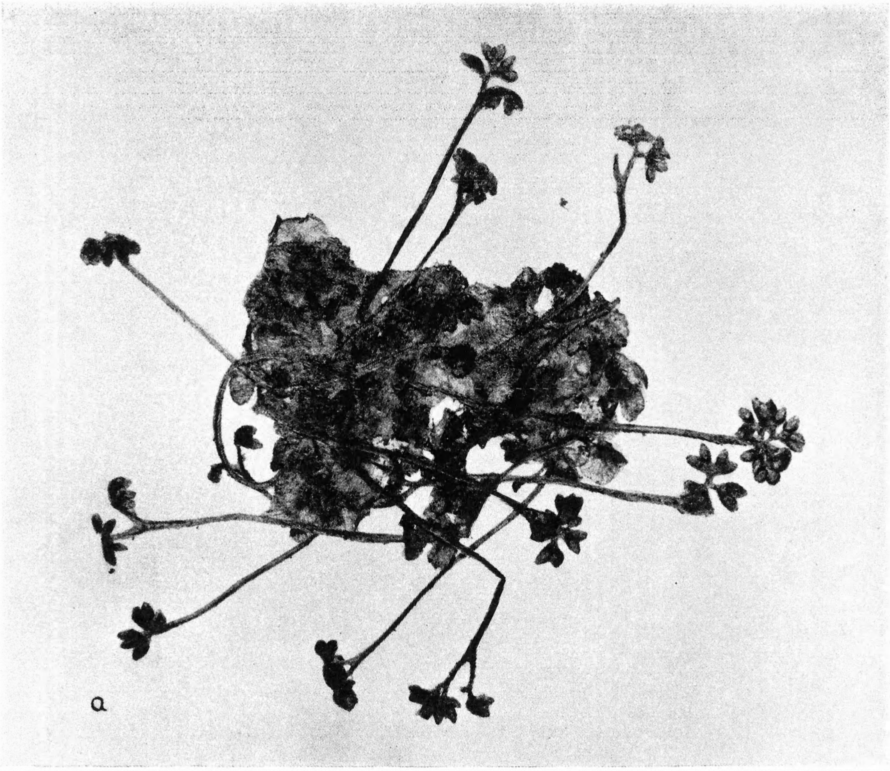
Species singula adhuc nota, Novae Zeelandiae.

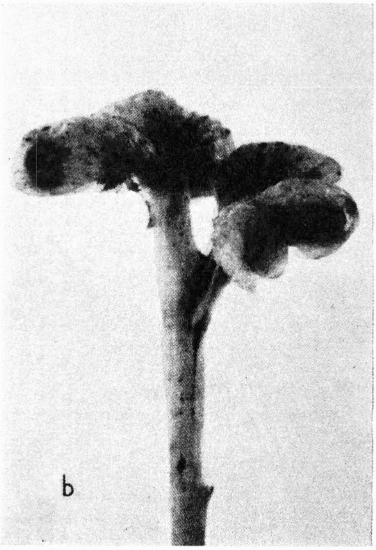
Neohodgsonia mirabilis H. PERSS.

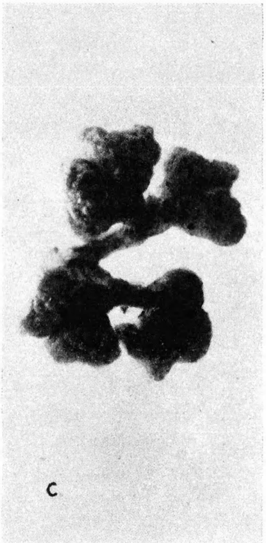
Neohodgsonia mirabilis H. PERSS., Correction, Stockholm 14.I.1954. — Syn.: *Hodgsonia mirabilis* H. PERSS., Stockholm 22.XII.1953.

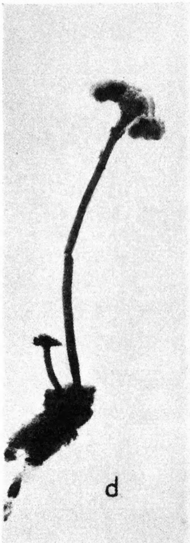
Thallus c. 3 cm longus, c. 0,8 cm latus, iterum bifurcatus, apice breviter incisus, tenuiter reticulatus. Costa c. sextam partem diametrum thalli metientem, sensim in alas attenuata, ventro parum prominens, rhizoideis numerosis vel latis, parietibus tenuibus vel valde angustioribus, parietibus crassis praedita. Stratum anticum altum cavernosum, cavernis bi- vel subtristratis. Stomata composita, triseriatis cincta, serie utraque cellulis 4(—6), poro externo magno, c. 45 μ longo, aperto, inferno subquadrato. Cellulae epidermidis ubique leptodermes, c. 30—40×60—90 μ. Squamae posticae mediocres, uniseriales, oblongae ovatae

Fig. 1. *Neohodgsonia mirabilis* H. PERSS. a: part of the type from New Zealand, Doubtful Sound, G. E. & G. DU RIETZ 2035: 1. Dried. 1/1. — b: upper part of a female receptacle seen side-face, New Zealand, Mt Holdsworth, N. S. BUTLER 2583. Alcohol. 5/1. — c: female receptacle seen from above, do. — d: thallus with female (the longer one) and male receptacle, do. Dried. 1/1 (all: material in Herb. Palaeobot. Dept., Swedish Museum of Natural History, Stockholm). — Photo: K. E. SAMUELSSON.


a


b


c


d

— lingulatae, obtusae — subacutae, integerrimae vel leviter crenulatae, non appendiculatae, secus marginem costae collocatae. Alae tenuissimae pellucidae, ventro plumiformiter cristulatae, cristulis rubro-brunneis, intus cavernis stomatophoris praeditae et inter eas canalibus latis, 75—200 µ diametro (etiam costa canalibus similibus instructa), succo rubro-brunneo saepeque corporibus ± ovoideis rubro-brunneis, c. 30 µ longis completis (corporibus oleiferis?). Pedunculus carpocephali 5—12-capsulus, ex apice frondis ortus, pallidus, plerumque 2—5 cm longus, squamae minores ovoideae — lanceolatae, subacutae sparse vestitus, sulco uno rhizophoro supra medium pedunculi bifurcato institutus (latere opposito sulci strato cavernoso, cavernis uniserialibus), superne bis bifurcatus, ramulis carpocephalo triangulari, capsulis 2—3 ferentibus vel modo bifurcatus, carpocephalo bilobato lobisque iterum bilobatis, utrisque capsula una instructis. Carpocephalus dorso grosse verrucosus, strato cavernoso vestitus, cavernis stomatophoris, sat magnis numerosis, ventro strato tenui bicellulari, basi corona squamarum parvarum ornatus. Capsula ovoidea, parietum incrassatio nodulosa et incompletiter semiannulata, in sinum caverniformem inclusa pariete ventrali cuius rimis longitudinalibus disrumpet. Sporae rubro-brunneae, angulato-globosae, c. 17—23 µ diametro, ± glabrae, sat late alatae. Elateres c. 400 µ longi, bispiri. Pedunculus masculinus c. 1 cm longus, dioicus ex apice frondis, monoicus ex parte mediano thalli, prope pedunculum carpocephali ortus. Capitulum masculinum parvum, disciforme, fere circulare, margine lato tenuissimo, pori canalium antheridiorum dorsales. Scyphuli (quod continent ignotum est) rari, 2—2,5 mm diametro, formam posituramque iis generi Marchantiae similes, lobati, margine ciliato-denticulato.

New Zealand: South Island, Fiord Bot. Distr., Doubful Sound, track from Wilmot Pass to Deep Cove, montane forest belt, March 1, 1927, G. Einar & Greta Du Rietz 2035: 1 (Type in Herb. Palaeobot. Dept., Swedish Museum of Natural History, Stockholm); South Island, Head of Lake Manapouri, January 8, 1947, G. Simpson (Herb. K. W. Allison H 891). North Island, Tararua Mts, near Table Top, in water course north of Field Hut, c. 2,600 ft., January 1, 1934, V. L. Zotov 7485; North Island, Tararua Mts, Mt Holdsworth, on a forest bank, c. 3,000 ft., March 18, 1950, N. S. Butler 2583.

This striking hepatic is at a glance characterized by the female organs: the stalk of the receptacle is twice bifurcated (sometimes the branches of the first order may be undivided). This is unlike everything so far known in *Marchantiales*. Interesting is that the number of the involucres (and capsules), 5—12, corresponds well with conditions in *Marchantia*.

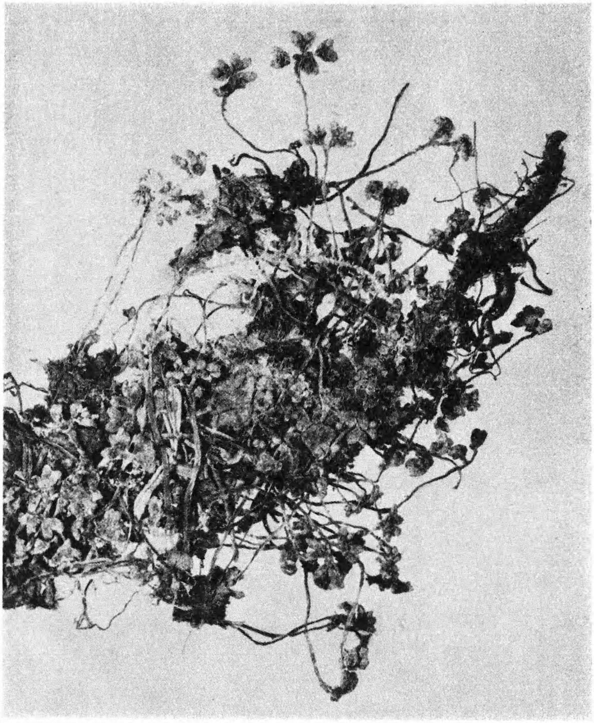


Fig. 2. *Neohodgsonia* spec. from Tristan da Cunha, forest W. of 3rd gulch, 550—600 m. alt., January 8, 1938, E. CHRISTOPHERSEN & Y. MEJLAND 930. Dried. 1/1 (material in Herb. Palaeobot. Dept., Swedish Museum of Natural History, Stockholm). — Photo: K. E. SAMUELSSON.

The stalk of the female receptacles has one [by *Marchantia* 2(—4)] rhizoid furrows. The carpocephalus is coarsely tuberculate in a manner resembling, e.g., several *Fimbriaria* species (Fig. 1: b and c).

The thallus, which varies as to size, is not unlike that of *Marchantia* but differs above all by its very soft structure. This is partly due to the fact that the epidermal cells (and most other cells too) are fragile and thin-walled, and partly to the unusually rich development of the air-chamber layer. Interesting are the big brownish channels, which, on the ventral side of the thallus, are visible to the naked eye. Noticable is also that the upper surface of the thallus which has large areolae forming a distinct network, is not plain as in *Marchantia* and most other *Marchantiales* but uneven. This is due to the fact that the areolae are somewhat bulging and somewhat resemble conditions in some *Marchantiales* such as *Clevea* and *Sauteria* and — yet more pronounced — *Exorrmotheca*.

The pores are of the barrel type. The cup-shaped cupules are rather similar to those in *Marchantia*. The ventral scales are arranged in only one row on each side (in *Marchantia* typically three rows).

The systematic position of *Neohodgsonia* is not easy to settle. This would need detailed investigations of fixed material. No doubt it is closely related to the family *Marchantiaceae* DUM. (1829) emend. K. MÜLL. (1940), where I have provisionally placed it. The bifurcated carpocephalus makes a primitive impression. It appears possible that *Neohodgsonia* represents a branch from the phylum leading to *Marchantia.*

From a phytogeographical point of view it is interesting that *Neohodgsonia* occurs in Tristan da Cunha as well as in New Zealand.

Literature.

PERSSON, H., (1953). Hodgsonia nov. gen. (Hepaticae). — Stockholm.
— (1954). Correction. — Stockholm.

BOTANISKA NOTISER 1954, HÄFTE 1. LUND

Zur Problematik der »Steppenböden».

Von E. SCHLICHTING.

Institut für Pflanzenernährung und Bodenkunde der Universität Kiel.

In der bodenkundlichen und pflanzensoziologischen Literatur sind Steppen- und steppenartige Böden bzw. Pflanzengesellschaften mehrfach beschrieben worden. Dabei hat es sich nicht nur um Böden der heutigen Steppen gehandelt, sondern man hat darüber hinaus Böden mit bestimmter Genese bzw. Ökologie darunter verstanden wissen wollen. Wo sich also heutiges Klima und Vorkommen von »Steppenböden» bzw. Steppenpflanzengesellschaften nicht in Einklang bringen liessen, war man gezwungen, die Ausprägung des Bodenprofils in frühere Zeiten zu verlegen bzw. die Pflanzengesellschaften als Reliktformen aufzufassen. Es ist zweifelhaft, ob man damit in allen Fällen das Richtige tat.

Als erstes sei die Frage erörtert, ob es überhaupt zweckmässig ist, den Begriff »Steppenboden» zu verwenden. Das ist im Wesentlichen ein Nomenklaturproblem. In der Bodenkunde wird heute fast allgemein anerkannt, dass man zur Klassifizierung bodeneigene Merkmale benutzen sollte.[1] Dagegen verstösst die Bezeichnung »Steppenboden». Sie ist überdies als Bodentypenbegriff nicht spezifisch, denn in den Steppen finden wir verschiedene, gut gegeneinander abgrenzbare Formen, wie Sierosem, Burosem, Kastanosem und Tschernosem (KUBIENA, 1953). Auf der anderen Seite ist die Gleichsetzung von Böden mit AC-Profil und Steppenböden (WALDHEIM, 1947, S. 73) nicht gerechtfertigt, da auch solche Böden ein AC-Profil haben, die man nicht zu den Böden der Steppen rechnen darf (z.B. Ranker und Rendzina). — Meist hat man wohl mit »Steppenboden» den Tschernosem (die Schwarzerde) und mit

---

[1] Eine Einteilung nach den Faktoren der Bodenbildung, wie sie besonders von STREMME und seinen Schülern geübt wird, ist anfechtbar, weil bislang keine systematischen quantitativen Untersuchungen über die relative Bedeutung der einzelnen Faktoren vorliegen (vgl. JENNY, 1941).

»steppenartig veränderten» Böden schwarzerdeähnliche Bildungen gemeint (z.B. STREMME, 1936).

Die Berechtigung der Bezeichnung »steppenartig» oder schwarzerdeartig für bestimmte Bodenformen des humiden Klimabereichs wird bei Abwesenheit von Steppenpflanzengesellschaften meist aus der Tatsache hergeleitet, dass diese Böden über mehr oder minder kalkreichem Muttergestein ähnlich dunkle und z.T. auch ähnlich mächtige A-Horizonte haben wie die Schwarzerden. Darin sind sie aber auch den Rendzinen und mehr noch gewissen Pararendzinen ähnlich. In der Literatur ist schon mehrfach auf die Verbindung zwischen Schwarzerden und Rendzinen hingewiesen worden (z.B. STEBUTT, 1930). Weil früher das Primat des Klimas unter den Faktoren der Bodenbildung postuliert wurde, stellte man die Schwarzerde quasi als den Normalfall und die Rendzina als den (intrazonalen) Sonderfall hin. Logischerweise sollte aber zur Klassifizierung und Namengebung das gemeinsame (bodeneigene) Merkmal benutzt werden, das die stärkste Differenzierung gegenüber anderen Formen ausdrückt (vgl. SCHLICHTING, 1953 a), in diesem Fall also der mehr oder minder hohe Kalkgehalt. So sieht KUBIENA (1948) die Schwarzerde auch als Mullpararendzina der Steppe an und belässt ihr lediglich aus historischen und Zweckmässigkeitsgründen ihre Eigenstellung. Das umgekehrte Vorgehen, die Rendzina als Kalksteinschwarzerde zu bezeichnen (STREMME, o. J.), verstösst gegen die von uns erhobene Forderung. Für die oben erwähnten Böden sollte man also statt der Bezeichnungen »steppenartig» oder schwarzerdeartig den Namen rendzinaähnlich bzw. Pararendzina wählen.

Dieses Vorgehen ist sicherlich dort gerechtfertigt, wo auch floristisch keine Beweise für eine rezente oder subfossile Steppenvegetation mehr beizubringen sind (z.B. auf Fehmarn, vgl. SCHLICHTING, 1953 b). Wie verhält es sich aber dort, wo Pflanzensoziologen ausserhalb des Steppengebietes »steppenartige» Gesellschaften kartieren: kann man diese Böden als schwarzerdeartig bezeichnen? Eine sichere Deutung solcher Schwarzerden ist nur in den Fällen möglich, wo sowohl eindeutig der Nachweis geführt wird, dass diese Pflanzengesellschaften Relikte einer echten Steppenvegetation sind, als auch der Charakter der Bodenprofile die ehemalige Schwarzerdenatur erkennen lässt.

Aus der Pflanzengesellschaft allein die Bezeichnung für einen Boden abzuleiten, ist so lange unsicher, wie nicht erwiesen ist, dass diese Gesellschaft spezifisch für eine bestimmte Bodenform ist. Zwar steht auch heute noch eine einwandfreie Definition des Begriffes »Steppe» aus (BRAUN-BLANQUET, 1951, S. 554), aber für unsere Zwecke mag genügen, sie als Landschaftsform in einem semiariden, kalttemperierten Klima anzusprechen, deren Böden die geringen Niederschlagsmengen bis zu einem gewissen Grade in ihren oberen Lagen zu speichern vermögen (LUNDEGÅRDH, 1949, S. 240). Sind aber die Steppenpflanzen durch diese Standortsverhältnisse so eindeutig charakterisiert, dass umgekehrt alle Böden mit solchen Pflanzengesellschaften als »Steppenböden» bezeichnet werden können? Diese Frage lässt sich z.T. bereits durch ihre Umkehrung beantworten: Wenn »Steppenpflanzen»-Gesellschaften auch ausserhalb der Steppe vorkommen, so kann das auch als Beweis dafür angesehen werden, dass sie nicht spezifisch für diese sind, hier also ihren Namen zu Unrecht tragen. Doch bedarf dieser Schluss noch der Erläuterung.

Der Zeigerwert einer Pflanzengesellschaft ist um so sicherer, je besser ihre Ökologie bekannt ist. Die Feststellung, dass sich Ökologie und floristische Gruppierung der Gesellschaft zueinander verhalten wie die noch recht wenig bekannte Ursache zur sichtbaren Wirkung (BRAUN-BLANQUET, l.c., S. 554), klingt wenig ermutigend. Wenn aber die Beziehung zwischen Pflanzensoziologie und Bodenkunde aus dem empirischen Bereich in den kausalen verlagert werden soll, muss die Ökologie in den Mittelpunkt gerückt werden. Wir wollen dabei analog zu unserem Vorgehen bei der Besprechung der Beziehungen zwischen gewissen Rendzinen und Tschernosemen die gemeinsamen Merkmale von Kalk- und Steppenpflanzen ihren Unterschieden gegenüberstellen (wobei wir uns z.T. an die eingehenden Untersuchungen von WALDHEIM in Schonen anlehnen).

Kalk- und Steppenpflanzen sind angepasst an einen hohen Elektrolytgehalt der Bodenlösung, in der im Gegensatz zu derjenigen von Marsch- und Alkaliböden die Erdalkalikarbonate und -sulfate über die Alkalihalogenide dominieren. Der hohe Ca- und Mg-Gehalt der Rendzinen und Tschernoseme bewirkt gleichzeitig hohe pH-Werte und damit z.B. eine geringere Anlieferung von Mn und Fe. Es ist auch zu vermuten, dass solche Pflanzen empfindlich gegen grössere Al-Mengen sind.

Anpassung an hohen Elektrolytgehalt der Bodenlösung bedeutet aber auch, dass die Pflanzen einen hohen osmotischen Druck aufbringen, um genügend Wasser aufnehmen zu können, oder einen geringen Wasserbedarf haben müssen. Im Jahresdurchschnitt betrachtet gleicht der Wasserhaushalt der Rendzinen und Pararendzinen im humiden Klima sehr dem des Tschernosems, und zwar um so mehr, je geringer der Tongehalt (und die Verwitterungstiefe) und je steiler die Hanglage ist (am stärksten ausgeprägt bei Süd-Exposition). Wir haben es hier also mit einem Faktorenersatz (vgl. BACH, 1950): trockenes Grossklima — geringe Wasserkapazität zu tun. Die Mergelrendzinen und -pararendzinen im humiden Klima versorgen dagegen dank ihrer hohen Wasserkapazität ihre Pflanzen gut mit Wasser (sie sind daher natürliche Waldstandorte).

Überblickt man diese Verhältnisse, so wird man WALDHEIM (l.c.) in seiner Feststellung zustimmen müssen, dass die Steppenvegetation im weitesten Sinne eine Kalkflora sei. Besonders die Kalktrockenpflanzen und die Steppenpflanzen sind als homologe Gesellschaften aufzufassen. Das Differenzialmerkmal (Anpassung an das Grossklima durch kurze Entwicklungszeit) ist nur den Steppenpflanzen eigen. Daher schlägt Verf. vor, sie ökologisch nur als Sondergruppe der Kalkpflanzen zu betrachten (vielleicht gelingt es einmal, diese Gesellschaften auch pflanzensoziologisch schärfer zu umgrenzen als es bisher der Fall war). Damit entfiele die Berechtigung, die »steppenartigen» Gesellschaften im humiden Klimagebiet noch weiter als solche und die betreffenden Böden als »Steppenböden» zu bezeichnen. Es sind vielmehr Kalktrockenrasengesellschaften (wie sie in der pflanzensoziologischen Literatur auch schon vielfach genannt werden) und Rendzinen bzw. Pararendzinen.

Für die betreffenden Böden in Schonen bemerkt WALDHEIM selbst, dass sie mehr an die Rendzinen als an die eigentlichen Steppenböden erinnerten; nennt sie aber trotzdem »Steppenböden». Verf. hatte Gelegenheit, mehrere der von WALDHEIM beschriebenen Profile aufzunehmen. Ein schwarzerdeartiger Charakter war in keinem Fall festzustellen, es handelte sich vielmehr um trockene mullartige Pararendzinen, z.T. um Ranker.

Zusammenfassend lässt sich feststellen, dass Steppenpflanzengesellschaften und Kalktrockenrasengesellschaften ebenso als homologe Formationen aufgefasst werden können wie Schwarzerde und Pararendzina. Der Name »Steppenpflanzen» sollte daher auf die Pflanzen der Steppen beschränkt bleiben und entsprechend der Name »Steppenböden» auf die Böden der Steppen.

Literatur.

BACH, R. 1950. Die Standorte jurassischer Buchenwaldgesellschaften mit besonderer Berücksichtigung der Böden (Humuskarbonatböden und Rendzinen). — Ber. Schweiz. Botan. Ges. *60,* 51—152.

BRAUN-BLANQUET, J. 1951. Pflanzensoziologie 2. Aufl. — Springer-Wien.

JENNY, H. 1941. Factors of Soil Formation. — Mc Graw-Hill Book Company, New York u. London.

KUBIENA, W. L. 1948. Entwicklungslehre des Bodens. — Springer-Wien.

— 1953. Bestimmungsbuch und Systematik der Böden Europas. — Enke-Stuttgart.

LUNDEGÅRDH, H. 1949. Klima und Boden in ihrer Wirkung auf das Pflanzenleben, 3. Aufl. — Fischer-Jena.

SCHLICHTING, E., 1953 a. Soil properties and soil classification. — Soils and Fertilizers *16,* 414—415.

— 1953 b, Die Böden der Insel Fehmarn. — Schr. Naturwiss. Verein Schl. Holst. *26,* 176—187.

STEBUTT, A. 1930. Lehrbuch der allgemeinen Bodenkunde. — Borntraeger-Berlin.

STREMME, H. 1936. Die Böden des Deutschen Reiches und der Freien Stadt Danzig. — Petermanns Mittlg. Erg. heft 226.

— o. J. Die Böden der Deutschen Demokratischen Republik. — Deutscher Zentralverlag-Berlin.

WALDHEIM, S. 1947. Kleinmoosgesellschaften und Bodenverhältnisse in Schonen. — Bot. Not., Suppl. Vol. 1: 1.

Botaniska Notiser 1954, Häfte 1. Lund

Smärre uppsatser och meddelanden.

Oedipodium Griffithianum (Dicks.) Schwaegr. funnen i Dalarna.

Under ett par sommarveckor 1951 hade jag förmånen att åtfölja lektor Folke Lundberg, Kungälv, på en bilfärd, som berörde stora delar av Dalarna. Min exkursionskamrat ägnade sitt huvudintresse åt planktonundersökningar men deltog flitigt och med stor framgång i det bryologiska fältarbetet.

Under bestigningen av den i Idre sn belägna Städjan (1,130 m) den 6 juli fann Lundberg i en liten klippskreva på östsidan av stortoppen en mossa, som frapperade honom. Till min överraskning kunde jag konstatera, att det var en av våra sällsyntaste och samtidigt egendomligaste bladmossor, den för Dalarna nya *Oedipodium Griffithianum*. Det visade sig sedermera att den förekom riklikt på liknande ståndorter i närheten.

Lokalen var belägen på ca 1,000 m:s höjd och utgjordes av små hålor och skrevor i den sparagmitformation, som uppbygger fjället. Topografien här på stortoppens östsida är brant. Som vanligt växte *Oedipodium* ej direkt på berget utan på ett jordlager. Den om en levermossa starkt påminnande, nästan ärggröna mossan bildade ofta små mattor på botten av hålorna. I regel var den steril men väl utvecklade frukter anträffades också. Den övriga vegetationen var, som vanligt då det gäller *Oedipodium*, sparsam och artfattig. Den utgjordes endast av dåligt utvecklade former av *Ditrichum homomallum* koll., *Lophozia alpestris* och *Webera nutans*.

Oedipodium Griffithianum, som får räknas till de kalkskygga mossorna, är enda arten av sitt släkte. Detta anses oftast bilda en egen familj, *Oedipodiaceae*, men förs ej sällan, på ungefär lika goda grunder, till familjen *Splachnaceae*. Ej blott till sitt utseende och byggnad är det en högst märklig art, även dess i hög grad splittrade utbredning förtjänar uppmärksamhet: Storbritannien, Skandinavien, Grönland (såväl v. som o.kusten), Alaska (Kodiak-ön) och Falklandsöarna (där den 1907 upptäcktes av T. G. Halle och C. Skottsberg). En utbredning påminnande om denna uppvisar levermossan *Gymnomitrium crenulatum*: Storbritannien, Norge (*Ilex*-regionen), Alaska och Sydgeorgien, den är emellertid, till skillnad från *Oedipodium*, utpräglat kustbunden. Bägge måste räknas till de oceaniska mossorna, för *Oedipodium* särskilt utmärkande skulle vara den stora amplituden vad temperaturfordringarna beträffar. I det fallet påminner den starkt om den oceaniska-suboceaniska levermossan *Anastrepta orcadensis*, som vi dagen innan i vackra tuvor anträffade på 800 m:s höjd å Storfjället i Transtrand sn (den är i Sverige ungefär lika sällsynt som *Oedipodium*; i Dalarna var den förut tagen på en lokal i Idre sn. Totalutbredning: Europa, Färöarna, Himalaya, Kina, Japan, Alaska och Hawaii).

I Skandinavien har *Oedipodium* sin huvudutbredning inom *Ilex*-regionen i Norge, där den ej kan sägas vara sällsynt och där den ofta växer vid havets nivå. Märkligt är därför att den så ofta förekommer i fjällen och här ej sällan, även fertil, på hög nivå. I Norge är den funnen på ett flertal lokaler i olika fjällområden, samtliga söder om Trondheimsfjorden, och når på Gausta en höjd av 1,550 m. I Sverige var den då MÖLLER 1936 gjorde sin sammanställning känd från en lokal i vardera Härjedalen, Jämtland samt de fyra sydligaste lappmarkerna och dessutom från en lokal i låglandet: Partille i Göteborgs-trakten. Härtill kan, förutom lokalen på Städjan, läggas följande nya lokaler: Jämtland. Hallen sn, Dromskåran, ca 1,000 m, st., 15 juli, 1944, OLAV GJAEREVOLL samt Lycksele lappmark. Tärna sn, Brantfjället, klyfta mellan stenblock på toppen, ca 1,000 m, st., 15 juli, 1946, A. HÜLPHERS. Högst når *Oedipodium* i Sverige på Storsola i Sylmassivet, där den tagits på 1,300 m:s höjd. I Finland är den endast känd från Nord-Saana i Kilpisjärvi-området. Den intressanta arten förtjänar att eftersökas, förvisso är den endast funnen på en ringa bråkdel av sina förekomster.

HERMAN PERSSON.

Växtanteckningar från trakten kring Torne träsk sommaren 1952.

Under tiden 27.6.—23.8. 1952 arbetade jag vid Abisko Naturvetenskapliga station med insamling av växter till en botanisk trädgård i Björkliden. Härvid iakttogs många intressanta och för trakten nya eller sällsynta arter, vilka kanske kan vara av intresse. Som framgår av listan är de flesta iakttagna på kulturpåverkad mark i Björkliden eller intill järnvägen. Vid angivande av lokaler har den flygfotogrammetriska sommarkartan »Abisko, Björkliden, Riksgränsen» använts.

Equisetum hiemale×*variegatum* (*E. trachyodon*). Mellan bv.-stugan vid Tornehamn och Pesujärvi i fjällbjörkskogen på 500 m ö.h.

Deschampsia atropurpurea (WG.) SCHEELE. Allmän på V-sidan av Kuokel (550 m ö.h.).

Phippsia algida (SOL.) R. BR. Allmän på Jebrentjåkko på 1.050 m ö.h. tillsammans med *Ranunculus glacialis*. L och *Saxifraga tenuis*. (WG.) H. SM.

Agropyron mutabile. DROB., T. VEST. I fjällbjörkskogen på Nuoljatunneln tillsammans med *A. caninum*. (L.) PB.

Carex rufina DREJ. Översilad, ± blottad eller mossbevuxen grusmark på V-sidan av Kuokel på 500 m ö.h. omkring den 15.8. tillsammans med *Koenigia islandica* L, vilken är en stor sällsynthet i trakten. Arterna växte tämligen allmänt tillsammans på flera lokaler utefter samma sträckning av småsjöar från Vadvetjåkko till Björkstugan.

Chamorchis alpina (L.) L. C. RICH. Tämligen allmän ovan trädgränsen på N-sluttningen av Nuolja (600 m ö.h.) samt på skifferhäll Ö. Pesujärvi. På det sistnämnda stället växte arten tillsammans med *Erigeron unalaschkense* (DC.) Vierh.

Gymnadenia conopsea (L.) R. BR. och *f. alba.* I *Scirpus cæspitosus* — kärr N. Björkliden. Här växte även *Orchis maculata.* L. De båda arterna förekom rikligt tillsammans. Trots ivrigt sökande kunde inte något hybridliknande exemplar upptäckas.

Polygonatum verticillatum (L.) ALL. I fjällbjörkskogen vid Jebrenjåkkstugan 1951.

Salix herbacea×*polaris.* Vid fallen i Ridonjira, Nuolja 1951.

Silene Cucubalus WIB. Björkliden samt jv-vallen S. därom.

Thalictrum alpinum L. Ljusgrön form vid Rallarkyrkogården, Tornehamn (=lokalen för *Cardamine amara* L.)

Ranunculus auricomus L. Björkliden.

Rorippa islandica (OEDER) BORB. Lokal som föregående!

Fragaria vesca L. Lokal som nästföregående på jv.-vallen!

Potentilla nivea L. Snoritjåkko (925 m ö.h.) och NV-sidan av Låktatjåkko.

P. norvegica L. Björkliden.

Alchemilla alpina L. Klippan mellan skidlinbanan och Kåppasjåkk, Björkliden.

Trifolium spadiceum L. Jv-bron över Rakkasjåkk, Björkliden.

Polygala Amarella CR. Lokal som föregående samt slänten vid bv.-stugan vid Tornehamn, vilket torde vara Sveriges nordligaste lokal för arten.

Hippuris vulgaris L. Liten göl mellan Pålnoviken och Njuoraätno (»Lerälven») tillsammans med *Utricularia vulgaris* L.

Heracleum Sphondylium L. *ssp. sibiricum.* (L.) AHLFV. Björkliden samt jv.-vallen N och S därom i enstaka exemplar.

Primula stricta HORN. Stranden av Torne träsk vid Djupviken och Abisko Östra samt vid Silverfallet i Rakkasjåkk.

Myosotis silvatica EHRH. *ssp. frigida.* T. VEST. *f. alba.* N. Rallarkyrkogården, Tornehamn.

M. arvensis (L.) HILL. Björkliden.

Prunella vulgaris L. Gångstig vid Lugnet, N. Björkliden.

Veronica serpyllifolia L. Björkliden.

Plantago major L. Nuoljatunneln, Lugnet och Björkliden samt jv.-vallen.

P. media L. Lokal som föregående!

Antennaria alpina (L.) GÆRTN. ♂. 6 exemplar den 21.7. på SV-sluttningen av Jebrentjåkko (950 m ö.h.) på snölegemark. Här växte rikligt med honindivider av arten samt *A. dioeca.* (L.) GÆRTN., ♂ och ♀.

Anthemis tinctoria L. Björkliden (troligen nordligaste lokalen i Sverige.)

INGVAR NORDIN, Västerås.

Växtanteckningar från trakten kring Vemdalen, Härjedalen sommaren 1950.

I början av juli 1950 deltog jag i ett av Sveriges Fältbiologiska Ungdomsförening arrangerat läger i NO-delen av Härjedalen och intilliggande delar av Jämtland. De besökta fjällen visade sig vara mycket karga och fattiga, och endast från Sånfjället noterades några mer krävande arter. Listan upptar de intressantaste fynden under en tiodagars vistelse.

Cryptogramma crispa (L.) R. BR. 1 exemplar nära toppen på N. Skalsfjället.
Matteuccia Struthiopteris (L.) TOD. Fuktig fjällbjörkskog på N-sluttningen av Varggransfjället.
Listera cordata (L.) R. BR. Tämligen allmän vid Skorvdals- och Skalsfjällen. Även sedd på N-sluttningen av Sånfjället tillsammans med *Coeloglossum viride* (L.) HARTM.
Corallorhiza trifida CHÂT. Enstaka exemplar här och var, bland annat vid Varggrans-, Hög- och Sånfjällen.
Thalictrum simplex L. Stranden av Vikarsjön, Hedeviken.
Viola montana L. Bäckravin mellan Skalsfjällen.
Epilobium lactiflorum HAUSSKN. Fjällbäck mellan Skalsfjällen, tillsammans med *E. Hornemanni.* RCHB.
Moneses uniflora (L.) A. GR. Enstaka exemplar på S-sidan av N. Skalsfjället.
Loiseleuria procumbens (L.) DESV. På skiffermark vid en fjällbäck på NO-sidan av Sånfjället samt nära toppen på Oxsjövålen (Jmt.).
Cassiope hypnoides (L.) D. DON. Fjällbäck på NO-sidan av Sånfjället.
Arctostaphylos alpina (L.) SPRENG. Lokal som föregående samt på Oxsjövålen och i fjällbjörkskogen på N-sluttningen av Högfjället.
Diapensia lapponica L. Lokal som *Cassiope*!
Gentianella Amarella (L.) H. SM. Röjans jv.-station (Jmt.).
Bartsia alpina L. Tämligen allmän på lågäng på S-sidan av Vikarsjön tillsammans med *Pedicularis Sceptrum-Carolinum* L., vilken även sågs vid Oxsjön (Jmt.).
Taraxacum nævosum. DT. Vägkant vid Vemdalsskalets pensionat den 14.7.
T. spectabile DT. Lokal som föregående den 11.7.
T. boreum DT. Fuktig gräsmark nära Vemdalsskalets pensionat den 14.7. Arten är endast uppgiven för Norge. Bestämningarna av maskrosorna har utförts av fil. dr GUSTAF HAGLUND.

INGVAR NORDIN, Västerås.

Nya växtlokaler för kärlväxter i Jämtland.

Nedanstående växtfynd har gjorts vid korta besök i Jämtland 1948—1952, sistnämnda år tillsammans med docent B. HYLMÖ och kamrer P. OLROG. Växtlokalerna finnes icke angivna i LANGEs Jämtlandsflora, HULTÉNs atlas eller HYLANDERs nya flora.

Art- och lokalförteckning:

Cystopteris fragilis (L.) BERNH. *ssp. alpina* (WULF.) HARTM. Frostviken: bäckravin på Raudeks ostsida i sent framsmält skreva. Reg. alp. Ny för Jämtland.
Cystopteris fragilis (L.) BERNH. *ssp. dickieana* (SIM) HYL. Frostviken: Hylla på Fågelbergets sydbrant. Reg. silv. Ny för norra Jämtland.
Botrychium lanceolatum (S. G. GMEL.) ÅNGSTR. Stugun: Borglunda på torrbacke invid landsvägen, 1 ex.
Calamagrostis canescens (WEB.) ROTH×*epigeios* (L.) ROTH. Stugun: Fredrikslund på grusås mot älven. Ny för Jämtland.

Carex Bigelowii TORR.×*rufina* DREJ. Åre: Skurudalsbergen och Blåhammaren i reg. alp. tillsammans med föräldraarterna. Ståndorterna intermediära mellan föräldraarternas. Hybriden iakttogs på ett tiotal lokaler och återfinnes säkerligen i detta område på de flesta ställen, där *rufina* växer. Bestämningen har confirmerats av fru ELSA NYHOLM, som undersökt bladanatomien. Hybriden har icke angivits tidigare från Jämtland.

Carex atrata L.×*norvegica* RETZ. Åre: Gräslifjäll, reg. alp.

Luzula pallescens SW. Frostviken: Fågelbergets brantsida på klipphyllor i reg. silv.

Chamorchis alpina (L.) L. C. RICH. Åre: Skurudalshöjdens västsida, reg. alp. riklig.

Saxifraga adscendens L. Frostviken: På Raudek i reg. alp. förekommer rikligt en form med rosafärgade blommor, som enligt fil. dr TH. LANGE av honom aldrig iakttagits i Jämtland.

Myricaria germanica (L.) DESV. Åre: Sandrevlar i Handölan ca 5 km ovanför Handöl.

Bjuv i januari 1954.

K. E. FLINCK.

A Note on the Viability of Aseptic Moss Cultures.

In microbiology, methods have been worked out, e.g. lyophilization and treatment with mineral oil, which make it possible to preserve cultures of fungi and bacteria aseptic and alive for a long period of time without the trouble of repeated transfers. In the case of mosses, which are more rarely studied in pure culture, the question of preservation has probably not so often been encountered. To bryologists and physiologists interested in studies of that sort, however, the following observations may be of some value.

About twelve years ago I isolated a number of moss species from spores or gamophyte shoots (FRIES 1942) and grew them in sterile culture under various conditions. In order to keep these cultures alive as long as possible without transfer to a new medium I kept the stock-cultures on agar in so-called Freudenreich flasks (Fig. 1). The moss-studies were discontinued in 1943, and since then no further transfers of the stock-cultures were made. However, when ten years had passed I thought it might be interesting to establish whether any of the cultures was still living.

During these ten years the flasks had been placed in a laboratory window, facing east. The temperature of the room had varied between 18° C and 22° C, but especially in the summer mornings the strong sun-light may have raised the temperature of the flasks considerably.

Each one of these 50 ml Freudenreich flasks contained 10 ml of a nutrient medium solidified with 1.5 % agar, representing a slanting surface on which the moss was growing. The medium consisted of: KNO_3 1.2 g., $Ca(NO_3)_2$ 0.12 g., K_2HPO_4 0.12 g., $MgSO_4 \cdot 7\,H_2O$ 0.24 g., and $FeCl_3$ traces, per litre of distilled water. Gas exchange occurred through the narrow tube at the top of the flask and probably also to a certain degree through the ground joint be-

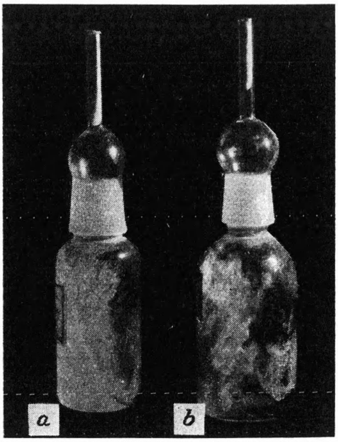


Fig. 1. Two cultures of *Hylocomium squarrosum* on agar in Freudenreich flasks. Age of the cultures, one year (a) and eleven years (b). Half natural size.

tween the cap and the basal part of the flask. Since the diameter as well as the length of the top tube differed rather much from one flask to another the rate of evaporation varied correspondingly.

In September 1952 the medium appeared completely dry in most flasks, and the protonema and gamophyte shoots were white or brownish. In none of these cases any further growth was observed from the samples transferred to fresh agar medium. Nine flasks, however, still contained water and in six of them the moss proved to be living and capable of developing new shoots when transferred to the new culture flask. These six species were, *Funaria hygrometrica, Ceratodon purpureus, Hylocomium squarrosum, Mnium undulatum, Mnium pseudo-punctatum,* and *Aulacomnium palustre.* The three non-viable cultures, viz. *Leptobryum pyriforme, Hylocomium triquetrum,* and a duplicate of *Funaria hygrometrica,* contained less water than the others.

In no case the new protonema and the shoots developing from the inocula on the fresh medium showed any signs of damage or degeneration. Thus it appears that growing moss cultures can be maintained without any drawbacks for at least ten years in Freudenreich flasks, provided the evaporation is not permitted to proceed too far.

Institute of Physiological Botany, University of Uppsala, February 23, 1954.

NILS FRIES.

Literature.

FRIES, N. 1942. Eine Methode zur Erzielung absoluter Reinkulturen von Laubmoosen. — Bot. Not. 1942. Lund.

Från Lunds Botaniska Förenings förhandlingar 1953.

Den 12 februari. Laborator TORE LEVRING, Göteborg, höll föredrag om »Befruktningen hos fucaceerna och ulvaceerna».

Inledningsvis redogjorde föredragshållaren för befruktningsförloppet hos fucaceerna samt för gameternas byggnad. Bl.a. hade påvisats, att spermatozoiderna voro omgivna av ett tunt geléhölje av fucoidin.

Ytan hos mogna, obefruktade ägg består av följande lager: ytterst ett skiktat geléhölje, äggmembranen, lipoproteinmembranen samt innerst ett kortikalskikt. Efter befruktningen framträder snabbt en befruktningsmembran, som är tvåskiktad. Det inre skiktet är starkt negativt dubbelbrytande och innehåller bl.a. cellulosa och fucoidin. Det yttre består av äggmembranen jämte återstoden av gelého̊ljet. I kortikallagret, som levererar väggmaterial efter befruktningen, har polysackaridsulfat (fucoidin) frigjorts.

Föredragshållaren visade sedan en av honom upptagen film, som illustrerade fortplantningsorganens och gameternas byggnad samt befruktningsförloppet hos fucaceerna.

Till slut visades en färgfilm om generationsväxlingen hos *Ulva lactuca*, varvid föredragshållaren lämnade en kort redogörelse för gameternas och zoosporernas byggnad samt deras reaktionssätt vid fortplantningen.

Den 9 mars. Valdes Professor GÖTE TURESSON, Ultuna, till föreningens hedersledamot.

Uppläste Docent OVE ALMBORN revisionsberättelser för 1952 års räkenskaper. Full ansvarsfrihet beviljades tacksamt räkenskapsförarna.

Höll Dr KÄTHE SEIDEL från Hydrobiologische Anstalt der Max-Planck-Gesellschaft in Plön (Holstein) föredrag över ämnet »*Scirpus lacustris*. Wert und Auswertung».

Dr SEIDEL talade om sävens förekomst och användning nu och i äldre tider. Redan de gamla grekerna kände till konsten att fläta föremål av säven. Föredragshållaren nämnde, vilken utomordentligt stor nytta folk i alla världsdelar haft och ha av säven. Bl.a. gavs som exempel att de kända balsabåtarna på Titicaca-sjön ofta är utrustade med segel flätade av sävstrån.

Under Dr SEIDELs ledning bedrives i Nordtyskland sedan flera år tillbaka ett omfattande arbete för att utforska sävens användbarhet. Den har bl.a. i fråga om äggvite-, kali- och fosfathalt visat sig överträffa både majs och lupin, varför den är ett högvärdigt foder. Kompostjord av *Scirpus lacustris* har visat sig utomordentligt värdefull. Odling av grönsaker och blommor på dylik jord har framkallat verkliga jätteformer.

Säven är en förträfflig sandbindare och har under senare tid även börjat planteras som strandskydd. Då den även bildar kraftig rothumus söker man genom »Binsenkultur» vid Nord- och Östersjökusterna vinna mark för åkerbruk.

Den 20 april. Firade föreningen sitt 95-årsjubileum.

Föreningens stipendium ur Jubileumsfonden, kr. 200: —, tilldelades Fru ELSA NYHOLM för exkursioner i Torne Lappmark. Ur Svante Murbecks fond tilldelades Amanuens BENGT ULF kr. 382: 50 som bidrag till studieresa till Zürich samt till fotografiutrustning.

Som nytt namn på Botaniska Notisers Supplement bestämdes »Opera Botanica».

I ett hälsningstal hyllade ordf. den nyvalde hedersledamoten, Professor GÖTE TURESSON, som därefter höll föredrag över ämnet »*Hieracium pilosella,* kromosomtal och utbredning».

Kvällens andra föredrag över experimentellt taxonomiska undersökningar hos *Poa* hölls av Professor T. G. TUTIN från Leicester, England.

Den tetraploida *Poa annua* med 28 kromosomer skulle enligt ett förmodande av Prof. NANNFELDT vara en kombination av de båda arterna *P. supina* och *infirma.*

Föredragshållaren hade prövat denna hypotes. *P. annua,* korsad med *supina,* gav en triploid med 7 bivalenter och 7 univalenter i meios. Samma resultat erhölls då *annua* korsades med *infirma.* Korsning av *supina* och *infirma* gav mest sterila, diploida hybrider, men också enstaka tetraploida med relativt normal meios. Kombinationen överensstämde med *P. annua,* varmed Prof. NANNFELDTS hypotes var bekräftad.

Födelseplatsen förlade Prof. TUTIN till västra medelhavskusterna där de båda föräldraarterna finnas icke alltför långt ifrån varandra.

Den 17 maj. Föreningens vårexkursion hade anordnats i samarbete med Hälsingborgs Botaniska Förening och Föreningen Landskronatraktens Natur.

Första målet var Ålabodarna där Försöksledare ARVID NILSSON, Landskrona, visade lokalerna för den sällsynta *Orobanche major,* varav vinterståndare fanns kvar, och *Equisetum telmateia.*

Vid Gea-gården i Åvarp berättar Lektor HERVID VALLIN, Hälsingborg, om den säregna omgivningen, den enbevuxna fäladsmarken.

Exkursionen fortsatte därefter under ledning av Folkskollärare PER MÅRTENSON, Hälsingborg, till Hallabäcken och en i närheten av denna belägen äng med bl.a. *Orchis mascula, Gagea spathacea* och *Thalictrum aquilegifolium.* Nästa etappmål var en ängsbokskog vid Söderåsen där huvudattraktionen var den nordligast kända lokalen för *Petasites albus.* För ängsbokskogen typiska arter kunde studeras: *Lathyrus vernus, Rumex sanguineus, Carex silvatica* och *Lathraea sqaumaria.* En god uppfattning om kontrasten mellan denna bördiga bokskog och sådan på urbergsmorän fick deltagarna en stund senare, då ett bokbestånd uppe på Söderåsen besöktes. Här var floran mycket fattigare och utmärktes av bl.a. *Deschampsia flexuosa, Galium saxatile* och *Trientalis europaea.*

Uppe på Söderåsen besöktes även ett fattigkärr liksom en lokal för *Blechnum spicant* i närheten av länsgränsen.

Den 5 juli. Sommarexkursion till Møns Klint under ledning av Professor THORVALD SÖRENSEN, Köpenhamn.

Kring det gamla godset Liselund sågs rikliga bestånd av *Bromus Benekeni* och *B. ramosus, Circaea lutetiana* och *Rumex sanguineus* liksom förvildade exemplar av *Daphne laureola.*

Efter besök vid Lilleklint, där buskvegetationen på branterna huvudsakligen utgjordes av *Hippophaë,* gick resan till Jydelejet där *Epipactis atrorubens, Orchis ustulata* och *purpurea* studerades. Møn är känt för sin rikedom på orkideer och i skogen kring Store Klint fick deltagarna tillfälle se två stora sällsyntheter: *Cephalanthera rubra* och *C. Damasonium.* Stort intresse tilldrog sig även de frodiga bestånden av jättefräken, *Equisetum telmateia.*

Slutligen förevisade Prof. SÖRENSEN Høvblegebackarna. Detta skoglösa parti i sydvästra hörnet av Klinteskoven uppvisar en egendomlig vegetation. Karakteristiska arter voro: *Linum austriacum, Onobrychis viciifolia, Sanguisorba minor* ssp. *muricata* och *Reseda lutea.* På dessa till synes mycket torra backar växte även *Parnassia palustris.*

Den 4 oktober. Svampexkursion till Eriksdal, Röddinge, Lyckås och Löderup under ledning av Fröken MAJA-LENA NILSSON, Ystad.

Den 6 oktober. Höll Fil. mag. HENRY RUFELT föredrag om »Auxiner och geotropism».

Efter en kort genomgång av termer och definitioner i anslutning till de geotropiska fenomenen gav föredragshållaren en kort överblick av den nuvarande uppfattningen av den ortogeotropiska reaktionens förlopp enligt WENT-CHOLODNYS auxinteori.

Mag. RUFELT hade genom att tillföra auxin och antiauxin till rötter av lin och vete försökt variera deras naturliga auxinhalter och genom att studera deras reaktioner under dessa förhållanden försökt klargöra problemen. Under försökens gång hade vissa resultat framkommit, som kunde förklaras med existensen av en reaktion, som motverkar den normala positiva reaktionen. Denna negativa reaktion har tidigare påvisats av LUNDEGÅRDH. Det visade sig att denna reaktion påverkas av ett använt antiauxin, p-klorfenoxi-isosmörsyra medan den däremot tycks vara okänslig för indolylättiksyra. Precis motsatta förhållanden visade sig gälla för den normala positiva reaktionen, som kan förskjutas med IAA men är okänslig för PCIB. Följaktligen tycks IAA och PCIB icke vara direkta antagonister utan får antagas inverka på olika system i rötterna.

Ämneslärare CHARLES REIMER, Alnarp, demonstrerade CARL SCHILDBACKS Holzbibliothek varav en samling på 200 band tillhör Alnarps trädgårdsinstitut.

Den 13 november. Val av styrelse för kommande verksamhetsår förrättades. Den nya styrelsen fick följande sammansättning: Ordf. Fil. dr ASTA ALMESTRAND, omval; v. ordf. Docent HEMMING VIRGIN, nyval; sekr. Amanuens LENNART ELIASSON, nyval; v. sekr. Amanuens ROLF DAHLGREN, nyval; styrelseledamöter utan särskild funktion, Proff. HANS BURSTRÖM och HENNING WEIMARCK samt Direktör K. E. FLINCK, omval; revisorer, Lektor OSCAR PALMGREN, nyval och Docent OVE ALMBORN, omval; rev.suppl., Docent BERTIL HYLMÖ och Assistent ANDERS KYLIN, omval.

Professor HUGO OSVALD, Uppsala, höll föredrag över ämnet: »Myrar på Nya Zeeland».

Föredragshållaren redogjorde för resultat och intryck från en resa 1951 i syfte att studera kärrmarkerna på Nya Zeeland, att söka parallellisera dem med myrar och kärr på norra halvklotet samt att bistå vid planeringen av deras skötsel och uppodling.

Myrarna behandlades i olika kategorier alltefter artsammansättningen:

Podocarpus-skogarna representerade en näringsrik kärrmarkstyp med snabb förmultning och relativt ringa torvlager. Underskiktet utgjordes ofta av *Cordyline*.

Phormium tenax-kärren hade ringare men dock relativt god näringstillförsel. Här växte också bl.a. *Carex* och *Blechnum* men även *Cordyline*.

Ännu näringsfattigare myrar hade *Cladium teretifolium* som karaktärsväxt.

De nyzeeländska kärrmarkerna uppvisade en rad för oss ovanliga egenskaper. Artsammansättningen var helt främmande. Icke många släkten och ännu färre arter voro gemensamma med de nordeuropeiska myrarnas.

Myrarna uppvisade aldrig några täckande mattor av *Sphagnum,* delvis kanske beroende på de ofta förekommande bränderna, som syntes ingå som en normal faktor i mossarnas regenerationsförlopp. En typisk egenskap för de nyzeeländska myrarna var vidare frånvaron av laggar.

Den 15 december. Ett stipendium på 100: — kronor ur fonden »Gertrud Jönssons Minne» tilldelades fil. stud. GERTRUD NILSSON.

Fil. mag. HENRY RUFELT uppläste revisionsberättelse för årets växtbyte. Full ansvarsfrihet för bytesföreståndaren föreslogs och beviljades.

Efter livlig diskussion beslöt föreningen att fr.o.m. 1954 höja medlemsavgiften till 18: — kr. (för studerande till 12: — kr.).

Amanuens BENGT ULF höll föredrag över »Vegetationen i Kungsmarken».

Områdets historia kan följas sedan lång tid tillbaka. Den från dammen i ungefär östlig riktning löpande gärdesgården har bevisligen existerats sedan 1600-talets slut, troligen längre. Området norr om denna gärdesgård har under hela denna tid varit betesmark, medan området söder därom varit slåtteräng fram till omkring 1900 och först därefter betats. Det geologiska underlaget på ömse sidor om gärdesgården är detsamma. Vegetationen visar emellertid stora olikheter på de båda sidorna. Den norra delen består av en mager, tuvig äng med kraftigt inslag av *Carex*-arter och på tuvorna *Cirsium acaule,* medan den södra delen utgöres av en betydligt rikare äng med kraftig gräsväxt och ett stort inslag av diverse örter, som äro mycket sällsynta på norra området och ofta t.o.m. saknas där.

Dessa skillnader i vegetationen kunna knappast bero på något annat än olika behandling under mycket lång tid. Vegetationsanalyser i fasta provytor utförda av amanuens ULF under sommaren 1952 ge exakt besked om olikheterna i vegetationen. Bottenskiktet är svagt utvecklat på båda sidor.

Avkastningsförsök utförda under sommaren 1953 visa, att det södra området ger ungefär dubbelt så mycket hö per m^2 som det norra.

BO PETERSON.

Botaniska Notiser 1954, Häfte 1. Lund

Litteratur.

K. Myrbäck, Enzymatische Katalyse. — de Gruyter & Co, Berlin 1953. — 181 S.

I handböcker i växtfysiologi förekommer i allmänhet kortfattade enzymkemiska framställningar, begränsade till den förhållandevis ofullständiga bild man har av växternas enzymkemi. I speciallitteraturen stöter man däremot allt oftare på hänvisningar till den bättre kända animaliska och mikrobiella enzymkemin, och växtfysiologen i gemen blir tvungen att konsultera biokemiska handböcker. Det finns också magnifika sådana, inte minst av prof. Myrbäcks hand. Man hälsar dock med tillfredsställelse föreliggande volym av samme rutinerade handboksförfattare, som en koncentrerad och lätthanterlig uppslagsbok, vilken som referensverk för icke-specialister har påtagliga fördelar framför de stora verken. — Boken börjar med ca 40 sidor »Allgemeine Chemie der Enzyme», som kan rekommenderas som kursläsning i växtfysiologi. Huvuddelen, som behandlar de speciella enzymen, är inte endast en mycket detaljrik katalog över enzym, deras struktur, förekomst och verkningssätt, utan den ger också en sammanfattande bild av de viktigaste respirationssystemen. — Man får också ett klart och korrekt intryck av hur litet man vet om de speciellt växtfysiologiska processernas, särskilt assimilationsförloppens enzymkemi; det man vet kunde därför ha kommit fram tydligare. Så saknar man hänvisningar till den — låt vara ofullständigt kända — enzymatiska omsättningen av auxin, och molybdenkatalysen av nitratreduktionen. — Förf. har fått in en otrolig mängd fakta på bokens 180 sidor och framställningen är överskådlig. Verket kan rekommenderas alla växtfysiologer. Det ringa omfånget gör dessutom, att man vågar hoppas på nya upplagor, så att boken inte föråldras, utan utvecklas i takt med det livaktiga ämne, som den behandlar.

Hans Burström.

A. W. Haupt: Plant Morphology. Mc Graw-Hill Book Co., New York, Toronto, London 1953. 464 s., $ 8.

Handböcker i växtmorfologi kunna vara upplagda på mycket olika sätt. Haupts Plant Morphology är en speciell morfologi, som behandlar olika växtgrupper var för sig, varvid huvudparten av framställningen ägnas åt kryptogamerna. För varje ordning skildras byggnad och fortplantning, antingen för hela ordningen eller för vissa typiska släkten. Framställningen belyses av talrika goda illustrationer, av vilka de flesta äro original. Det är en mängd fakta, som på detta sätt bli framlagda, och åtskilliga av dem ha blivit kända genom nyare undersökningar. För att nämna ett exempel så uppgiver förf. beträffande

Equisetums protallier, att de ej äro dioika, som förut antagits och ofta alltjämt uppgives, utan att de typiskt äro monoika; dock utvecklas anteridier och arkegonier på olika tid, och dåligt utvecklade protallier bära ibland endast anteridier, vilket gett upphov till den gamla uppfattningen. Förf. lägger stor vikt vid fylogenetiska förhållanden; slutkapitlet i boken behandlar utvecklingen inom växtriket, olika utvecklingstendenser och utvecklingsserier, och även i den mera speciella behandlingen söker förf. klargöra de utvecklingslinjer, som finnas.

Beträffande förf:s systematiska indelning observerar man, att de behandlade flagellaterna delas upp i fyra olika klasser, vilket säkerligen är motiverat med hänsyn till gruppens heterogena natur. Å andra sidan räknas conjugaterna endast som en ordning under *Chlorophyceae,* en anordning som kanske är mera diskutabel. Till svamparna föras även klasserna *Schizomycetes* och *Myxomycetes.* F.ö. lägger man märke till att bland levermossorna *Sphaerocarpales* urskiljes som en särskild ordning bredvid *Marchantiales, Jungermanniales* och *Anthocerotales,* och att bland pteridofyterna förf. i likhet med vissa andra systematiker sammanför *Psilotales* med *Psilophytales* till klassen *Psilophytinae.* Det senare motiveras morfologiskt med antagandet, att sporangierna hos *Psilotales* äro terminala på dikotomiskt anordnade grenar, alltså en likhet med arrangemanget hos *Psilophytales.* Bland gymnospermerna föras alltjämt *Ephedra, Gnetum* och *Welwitschia* till samma ordning, trots deras stora olikheter, och man saknar här i övrigt hänvisningar till FLORINS undersökningar; tydligen har förf. ej utnyttjat dessa, vilket medfört en del oriktiga uppgifter och antaganden beträffande fylogenien. För angiospermernas del ges en allmänt morfologisk framställning, varvid bl.a. olika embryologiska typer få en förtjänstfull behandling — förf. har på denna punkt samarbetat med P. MAHESHWARI —, och de viktigare ordningarna anföras även, dock mycket summariskt, mest i form av en uppräkning av deras karakteristika.

Framställningen i HAUPTS morfologi är klar och lättillgänglig; särskilt för den som undervisar i någon del av det behandlade ämnet utgör boken en värdefull källa, som kompletterar andra framställningar, genom sina talrika sakuppgifter och även genom sitt rikhaltiga och belysande illustrationsmaterial.

H. HJELMQVIST.

Notiser.

Docentförordnande. Till docent i växtfysiologi vid Lantbrukshögskolan har förordnats fil. dr IVAR EKDAHL.

Utmärkelse. Letterstedtska författarpriset har av K. Vetenskapsakademien utdelats till professor CARL SKOTTSBERG för arbetet: »The vegetation of the Juan Fernandez Islands».

Uppdrag i utlandet. Professor ÅKE GUSTAFSSON, Statens Skogsforskningsinstitut, har av universitetet i Algier kallats att under jan.—mars 1954 därstädes bedriva forskning och hanleda avancerade yngre forskare i genetik och allmän biologi. — Professor HENNING WEIMARCK har genom British Council mottagit en inbjudan från Department of Botany vid universitetet i Leicester till föreläsningar. Avsikten är att knyta kontakt med andra botaniska institut.

Forskningsanslag. Statens naturvetenskapliga forskningsråd har i december 1953 utdelat följande anslag till botanisk forskning: Till fil. lic. O. ANDERSSON 1.800 kr. för avslutande undersökningar av den svenska ädellövskogens storsvampar; till Botaniska sällskapet, Stockholm, 3.500 kr. för utforskande av Stockholms-traktens moss- och lavflora; till fil. dr G. ERDTMAN 6.200 kr. för bestridande av kostnader för det palynologiska laboratoriet i Bromma; till fil. lic. O. HEDBERG 8.300 kr. för studier av den afroalpina florans uppkomst och utveckling; till laborator A. LEVAN 18.500 kr. för studier över yttre faktorers inverkan på cytologiska förhållanden; till professor H. LUNDEGÅRDH 7.250 kr. för instrumentanskaffning för växtfysiologiska undersökningar; till fil. lic. M. MATELL 3.050 kr. för fortsatta arbeten över syntetiska tillväxtämnen med asymmetrisk byggnad; till fil. kand. ULLA REGNELL 800 kr. för bestämning av mikrofossil i två sedimentkärnor ur Albatrossexpeditionens Atlantmaterial; till professor C. SKOTTSBERG 613:50 kr. för ytterligare framställningskostnader för två vegetationskartor över Juan Fernandez-öarna; till professor VIVI TÄCKHOLM 6.000 kr. för botaniska studier i Genève och Kew för fullföljande av del 4 av »Flora of Egypt».

Från Magnus Bergvalls stiftelse ha bl.a. följande anslag utdelats: Till fil. lic. S. Björkman 2.000 kr. för cyto-taxonomiska undersökningar inom släktet *Agrostis*; till fil. lic. L. EHRENBERG 10.000 kr. för forskningar rörande fruktträdens vintervila; till fil. dr I. GRANHALL 12.000 kr. för undersökningar av sambandet mellan vintervila, köldhärdighet och strålningskänslighet hos knoppar och frön av fruktträd; till agr. lic. P. E. NILSSON 8.000 kr. för undersökning rörande relationerna mellan växten och markens mikrobflora; till docent HEDDA NORDENSKIÖLD 4.500 kr. för genetiska studier över artbildningsproblemet inom släktet LUZULA; till laborator W. RODHE 7.000 kr. för undersökning av fytoplanktonproduktionen i sjön Erken.

K. Lantbruksakademien har vid sin högtidssammankomst den 28 jan. 1954 utdelat bl.a. 4.000 kr. till agr. lic. S. BINGEFORS för fortsatta undersökningar angående ärftlighetsförhållandena hos rödklöver med hänsyn till resistensen mot stjälknematod m.m.; 2.220 kr. till docent E. ÅKERBERG och agr. lic. S. Bingefors för undersökningar rörande fröbildningen hos *Medicago falcata* och hos hybriden mellan *M. falcata* och *sativa*; 1.000 kr. till agr. lic. J. MAC KEY för fortsatta undersökningar rörande röntgeninducerade mutationer i vete.

K. Vetenskapsakademien har i februari 1954 från Krokska fonden utdelat 500 kr. till fil. lic. O. RUNE för en inventering av serpentinfloran i nordvästra Lule Lappmark; 500 kr. till fil. mag. TORD INGMAR för undersökning av myrområdet »Floran» i norra Uppland; från H. E. Johanssons fond lektor E. ALMQUIST 1.200 kr. för hieraciologiska fält undersökningar. Det Letterstedtska understödet för maktpåliggande undersökningar utdelades av akademien till fil. lic. L. EHRENBEG för undersökningar över kemiska effekter av joniserande strålning m.m.

Från Konung Gustaf VI Adolfs 70-årsfond för svensk kultur har utdelats bl.a. 4.000 kr. till fil. lic. E. WIKBERG för undersökningar över biokemiska mutationer hos svampar.

Bland de anslag, som under år 1953 utdelats från Knut och Alice Wallenbergs stiftelse, märkes ett anslag på 24.650 kr. till professor H. BURSTRÖMS undersökningar vid botaniska laboratoriet i Lund över tillväxtämnen och deras verkningar i rötter; ett anslag på 41.000 kr. till fil. dr G. ERDTMAN för forskningar vid det palynologiska laboratoriet i Bromma och utrustning av laboratoriets nya lokaler.

Upprop.

Finnes någon, som kan stå till tjänst med fotos (från växtplatsen) av *Botrychium simplex, B. matricariifolium* och *B. virginianum,* ombedes han eller hon godhetsfullt sätta sig i förbindelse med Civiling. HJ. HYLANDER, Alamedan 22, Karlskrona, likaledes om 2 (helst 3) ark kunna anskaffas av vardera *Rubus arcticus* f. *leuciticus, R. arcticus×idæus, R. Chamæmorus* f. *schizopetalus, R. idæus* f. *subviridis, R. Sprengelii×Wahlbergii, R. polyanthemus* v. *sericeus, R. cæsius×plicatus* och *R. gothicus* v. *eriocarpus*. Byte med andra växter kan event. ordnas.

HJ. HYLANDER.

BOTANISKA NOTISER 1954, HÄFTE 2. LUND

Pollen Morphology and Plant Taxonomy.[1]

By G. ERDTMAN.

With illustrations based on the author's originals, by ANNA-LISA NILSSON.

Introduction. Pollenmorphological characters have often been used in the taxonomy of the angiosperms, particularly in the Acanthaceae (by LINDAU and others), Bignoniaceae (URBAN), Bromeliaceae (MEZ), Convolvulaceae (HALLIER), Gentianaceae (GILG), Orchidaceae (REICHENBACH fil.), Phytolaccaceae (WALTER), Podostemaceae (WARMING), Portulacaceae (FRANZ), etc. A broad and comprehensive treatment of the subject was presented in 1935 by ROGER P. WODEHOUSE in his book »Pollen Grains». There followed, in 1952, the treatment given by the present author in »Pollen Morphology and Plant Taxonomy. Part I. Angiosperms.»

It is essentially on this book of 1952, and on results accumulated after its publication that today's report is based. The Palynological Laboratory, Stockholm, possesses a collection of approximately 16,000 pollen and spore slides from about 14,000 different species. With this material at hand it has been possible to outline a more detailed morphological classification of the pollen grains than has previously been done. The occurrence of the individual pollen types has been followed throughout the angiosperms as well as the gymnosperms, ferns, and the main groups of mosses. Some groups have been mapped in great palynological detail. Others belong to realms of which little or nothing is known. A wider knowledge can only be attained if a much greater number of plants is investigated. Furthermore, we must strive to improve the techniques employed. Ordinary microscopes do not usually reveal too many details of small pollen grains and spores. Here, studies

---

[1] Rapport général, colloque »Palynologie et Systématique», commun aux sections Taxinomie générale et Palynologie, VIII^{e} Congrès International de Botanique, Paris, Juillet 1954.

of ultra-thin sections by means of the electron microscope open up a new line of approach (AFZELIUS, ERDTMAN, SJÖSTRAND 1954).

Until palynology will have acquired a broader and safer foundation, many taxonomical indications provided by pollen morphology must be taken with reservation. However, these indications will gain in conclusiveness when supported by anatomy, cytology, and so forth. On the whole, taxonomy can only gain by considerations of any description — macroscopical, microscopical, and ultramicroscopical.

Monocotyledons and Dicotyledons. Early Angiosperms. In conformity with other botanical evidence, palynological facts as we know them do not support the existence of a sharp demarcation line between monocotyledonous and dicotyledonous plants. Monocotyledonoid characters occur in the Annonaceae, Calycanthaceae, Canellaceae, Chloranthaceae, Degeneriaceae, Eupomatiaceae, Himantandraceae, Magnoliaceae, Monimiaceae, Myristicaceae, Nymphaeaceae, Piperaceae, Saururaceae, and possibly also in a few other dicotyledonous families. On the other hand, some monocotyledonous plants exhibit certain dicotyledonoid characters: there are, for instance, pollen grains with three, or more, rounded apertures in the Alismataceae, Amaryllidaceae (*Phlebocarya* and other members of the Hypoxidoideae-Conostylideae), Araceae (*Anthurium*), and Bromeliaceae (*Aechmea*). The Eriocaulaceae have »spiraperturate» grains of a type very similar to that found in some dicotyledonous plants, etc.

Pollen grains with composite apertures, where the inner part of the aperture has not the same outline as that of the outer part, have only been encountered in the typical dicotyledons, and the same applies to long, meridional apertures (colpi) and long apertures (rugae) uniformly distributed over the pollen grain surface.

From a morphological point of view the apertures of the pollen grains of the monocotyledons and the monocotyledonoid dicotyledons seem to be more »primitive» than the apertures of the pollen grains of many dicotyledons. Paleontological records leave us in uncertanty as to which pollen types — dicotyledonoid or monocotyledonoid — were the first to appear. Tricolpate pollen grains of a type similar to pollen grains in certain dicotyledons of our days have been found in rhaeto-liassic beds. In some grains, not all the colpi are of the same length. The same feature is met with, in present-day plants, in the Cercidiphyllaceae, Eucommiaceae, and Hamamelidaceae (*Distylium guatemalense*). (Finds of alleged dicotyledonous pollen grains have also been made in Pre-

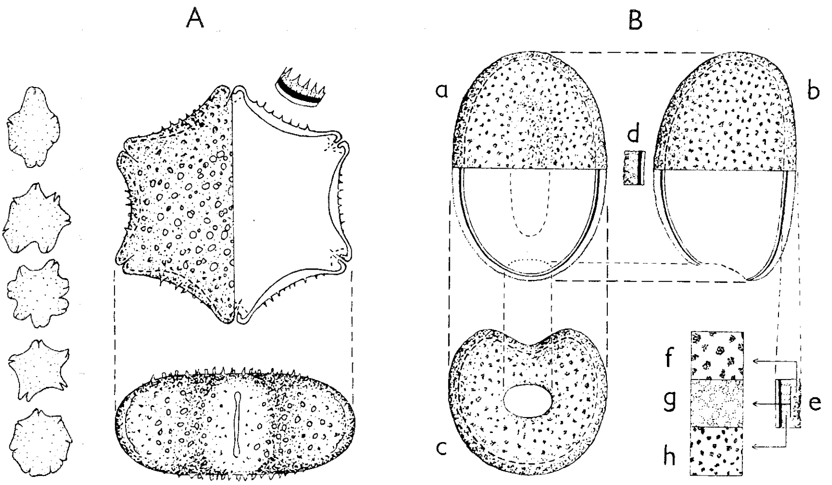


Fig. 1. A, *Trisyngyne codonandra* (Fagaceae); pollen grain in polar and equatorial view (×1000); to the left ± aberrant pollen grains (×250). — B, *Carludovica palmata* (Cyclanthaceae); a, polar view (groove-bearing, non-aperturiferous face up); b, longitudinal equatorial view (the equator — not indicated in the figure — at right angles to the vertical demarcation line between the sectioned and the non-sectioned part of the exine); c, transverse equatorial view (surface, aperturiferous end of the pollen grain; a—c ×1000); d and e, exine stratification (×2000); f—h, LO-analysis: exine pattern at high (f), medium (g), and low (h) focus.

jurassic strata. The most sensational find of this kind, by NAUMOVA, is that of porate grains — slightly similar to those in *Alnus* or *Myriophyllum* — in Carboniferous layers in Russia.)

Dicotyledonous pollen grains with composite apertures appear in Cretaceous beds. The rhaeto-liassic pollen grains just mentioned sometimes show signs of having faintly composite apertures. Also, there are indications of an occurrence of dicotyledonous pollen grains with composite apertures in still older layers; but this needs further confirmation.

As to the history of certain dicotyledonous plants it is interesting to note that Tertiary or even Cretaceous pollen grains of the same type as in the modern New Guinean and New Caledonian species of *Nothofagus* have been found in Australia by Dr. COOKSON and New Zealand by Dr. COUPER. It may be added that male specimens of some New-Caledonian trees, *Trisyngyne,* were once referred to the Euphorbiaceae by BAILLON. Female specimens have now been found and, in consequence, *Trisyngyne* has been referred to the Fagaceae by BAUMANN-BODENHEIM. A mere glance at their pollen grains is sufficient to reveal that they are of the same type as in *Nothofagus,* more precisely of that special subtype of which the oldest geological finds were made (Fig. 1 A).

The earliest appearance of pollen grains of a monocotyledonous pollen type cannot be established until a safe distinction between the pollen grains of monocotyledons and those of certain gymnosperms — members of the Bennettitales, etc. — can be made.

Steno- and Eurypalynous Families. Some angiosperm families are stenopalynous — more or less uniform pollen-morphologically — while others are eurypalynous, i.e., characterized by a more or less great array of pollen types, different in size, shape, aperture, exine stratification, etc.

The stenopalynous families are, as a rule, very natural. This is exemplified by the Asclepiadaceae, Cruciferae, Eriocaulaceae, Gramineae, Gyrostemonaceae, Meliaceae, Myrtaceae, and Sapotaceae. In addition, the Labiatae, Lauraceae, Rhamnaceae, and Thymelaeaceae may equally be called stenopalynous. One may add the Chenopodiaceae, Ericaceae, and Umbelliferae, but it must be remembered that pollen grains similar to those in these families are also found in related groups, such as the Amaranthaceae, Epacridaceae, and Araliaceae.

The thick-walled pollen grains in the Gyrostemonaceae have no counterpart in other plants. Incidentally, this is one of the reasons for classifying this small Australian family as a unit of its own, while it was earlier united with the Phytolaccaceae.

The prevalence of a stenopalynous condition does not always preclude the application of certain palynological data to taxonomical problems. Thus, among the Umbelliferae the Echinophoreae are characterized by bilateral, 2-aperturate grains, whereas, as far as is known, the rest of the family has radiosymmetric grains with three apertures. In the Labiatae, again, some genera have 3-, others 6-aperturate grains. Attention has been drawn to the fact that the 3-aperturate grains seem to be shed in a 2-nucleate, the 6-colpate in a 3-nucleate stage. Nevertheless, further examples illustrating the apparent coincidence of cytological and pollenmorphological data are desirable.

The eurypalynous families are more frequent. Some of them, e.g. the Oenotheraceae and the Chlaenaceae, are to some extent »stenomorphic». This may sound paradoxical. The oenotheraceous pollen grains are generally 3-aperturate and spherical or more or less flattened. The chlaenaceous grains are always united in tetrads. According to the wide variation as to size, aperture shape, and exine stratification these

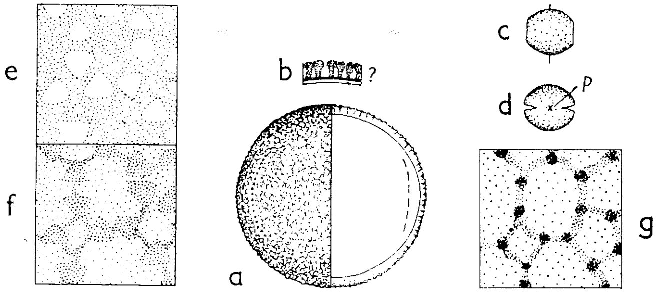


Fig. 2. *Callitriche verna*; a, lateral view, surface (left) and section (right; the section does not reach the aperture; ×1000); b, exine stratification (×2000); e—g, LO-analysis, pattern at high (e), medium (f), and low (g) focus.

families can, however, be aptly styled eurypalynous. Other distinctly eurypalynous families include the Acanthaceae, Amaryllidaceae, Araceae, Bignoniaceae, Compositae, Euphorbiaceae, Flacourtiaceae, Geraniaceae, Guttiferae, Icacinaceae, Leguminosae (partly at least), Liliaceae, Linaceae, Loganiaceae, Santalaceae, Olacaceae, Saxifragaceae, Sterculiaceae, and Verbenaceae.

Some of these families are very natural, others are clearly heterogeneous, at least in some measure. In the first case there is no reason to advocate a splitting of the families, not even for families such as the Leguminosae, which are cumbersome to deal with on account of their large size.

The Achariaceae, Euphorbiaceae, Loganiaceae, Saxifragaceae, and Sterculiaceae typify more or less heterogeneous assemblages. In many euphorbiaceous plants the pollen grains are »crotonoid», i.e. provided with a characteristic exine pattern similar to that in *Croton, Jatropha, Manihot,* and other genera. Outside the Euphorbiaceae crotonoid grains have been found, for instance, in the Callitrichaceae (Fig. 2) — a fact which strengthens the old assumption of a relationship with the Euphorbiaceae — and furthermore in several buxaceous genera and in the Thymelaeaceae. The characters the Thymelaeaceae and the crotonoid members of the Euphorbiaceae have in common have not, it seems, been duly stressed in the past. Other euphorbiaceous plants (*Micrantheum, Pseudanthus* etc.), once united by AGARDH into a special family, the Micrantheaceae, have spinuliferous grains similar to those in *Petalostigma*. The non-crotonoid grains in *Euphorbia* and many other genera are slightly similar to those in the Tiliaceae and other families.

On insufficient taxonomical evidence several rare plants have been lumped together with the Saxifragaceae during the lapse of the years. Hunters for misplaced plants meet no difficulty here in tracking down their prey. Several of these plants had to remain in the Saxifragaceae, for the scarcity of material available made it difficult to revaluate their systematic position. In spite of the unpromising nature of the subject a palynologist can often extract information from scanty and otherwise fairly useless fragments of herbarium specimens. In this way it is possible to suggest the removal of several genera from the Saxifragaceae. Flower fragments of *Berenice arguta* (Réunion) most unexpectedly yielded typically campanulaceous pollen grains. A reinvestigation of the macroscopical features of this plant supported its reference to the Campanulaceae. A rare species, from New Guinea, *Kania eugenioides*, type of a special subfamily (Kanioideae), has pollen grains of distinctly myrtaceous character. *Kania* has also been investigated by Dr. METCALFE, Kew. Without knowing anything about the pollen morphology in *Kania*, he found sundry anatomical facts pointing towards the Myrtaceae. This coincidence no doubt powerfully supports the legitimacy of transferring *Kania* to that family to which, by its general habit alone (as indicated by the specific name *eugenioides*), this plant bears such a marked resemblance.

At Morogoro in the Tanganyika Territory Dr. EGGELING recently found a plant (EGGELING no. 6442) whose classification by means of ordinary macroscopical characters was difficult. After a palynological investigation of an antheriferous flower fragment, and without knowing anything about the plant, except the country of origin, it was suggested that its relatives should be sought (cf. Fig. 3), in the first place, in or near two monotypical genera usually referred to the Saxifragaceae, viz. *Montinia* (South Africa) and *Grevea* (Madagascar). Mr. MILNE-REDHEAD, in charge of the plant at Kew, followed this suggestion. »EGGELING no. 6442» will thus join the African flora as a new species of *Grevea*, and this genus, together with *Montinia*, will later perhaps be referred to a new family of dicotyledonous plants.

Choristylis is placed by ENGLER in Saxifragaceae-Escallonioideae-Forgesieae, a tribe which, besides *Choristylis*, consists of the monotypical genus *Forgesia*. BENTHAM and HOOKER place *Choristylis* in the vicinity of *Itea*. Some botanists classify the latter genus as a family of its own. The pollen type in *Itea* is exceedingly rare. The occurrence of the same pollen type in *Choristylis*, and in no other saxifragaceous plants, thus forms an argument in favour of the idea expressed by

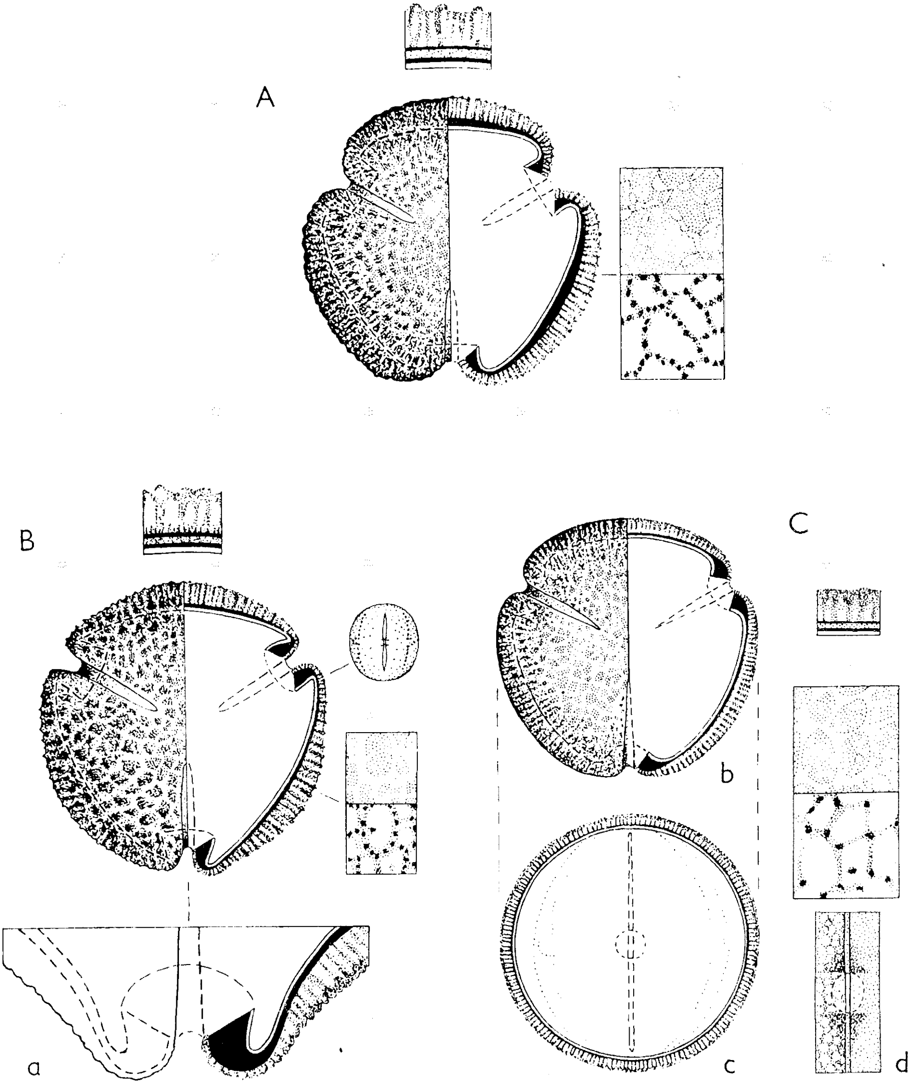


Fig. 3. Pollen morphology in *Grevea* and *Montinia* (×1000). — A, »EGGELING no. 6442» (×1000). — B, *Grevea madagascariensis*; a, aperture and exine stratification (×2000). — C, *Montinia caryophyllacea*; b, polar view, surface (left) and section (right); c, equatorial view (section; b, c ×1000); d, aperture (detail; ×2000).

BENTHAM and HOOKER. The pollen grains in *Forgesia* are quite different from those in *Itea.*

In the Sterculiaceae, several genera, e.g. *Fremontia,* have pollen grains similar to those in the Bombacaceae. *Pterospermum, Dombeya, Eriolaena* and related genera have grains of a malvaceous habit. Those in *Craigia* are distinctly tiliaceous. Pollen morphology thus brings out the vagueness of family demarcations within Malvales.

Subfamilies. The bearing of pollen morphology on splitting the angiosperm families into subfamilies has been dealt with to some length in »Pollen Morphology and Plant Taxonomy». Let me only mention here that pollen morphology in the Hydrocharitaceae supports a transfer, suggested by Dr. DANDY, of *Enhalus* from the Thalassioideae to Vallisnerioideae. Pollen morphology makes possible an outline of different groups within the Lecythidaceae and the Rapateaceae. It is, furthermore, not in harmony with the conventional subdivisions of the Tiliaceae. *Tilia* occupies an isolated position within the present Tilioideae. Pollen-morphological and other characters suggest a closer relationship between *Tilia* and the *Brownlowia* group. According to METCALFE and CHALK the wood anatomy of the simaroubaceous subfamilies Irvingioideae and Kirkioideae may possibly support the ranking of these groups as distinct families, if this were indicated on other morphological grounds. Pollen morphology provides the additional indication. The pollen grains in *Kirkia acuminata, K. pubescens,* and *K. wilmsii* are thus of a singular type and so are, though in a less striking manner, the pollen grains in *Irvingia* and *Klaineodoxa.*

The subfamilies in the Ulmaceae (Celtidoideae and Ulmoideae) are fairly well defined also pollen-morphologically. *Zelkova* (subfamily Celtidoideae), however, has pollen grains of the *Ulmus* type. In addition, other characters are common to *Zelkova* and the Ulmoideae: the style is excentric in both and central in the rest of the family.

The Asclepiadaceae would be palynologically homogeneous if the Periplocoideae were referred to the Apocynaceae. The subfamily Moronoboideae, of the Guttiferae, possibly merits the rank of a special family. In the case of the Magnoliaceae sensu lato and the Olacaceae pollen-morphological data can rightly be adduced in favour of their splitting into smaller units.

Genera incertae sedis. *Emblingia calceoliflora,* a rare plant from Western Australia, was referred by F. MUELLER to the Capparidaceae.

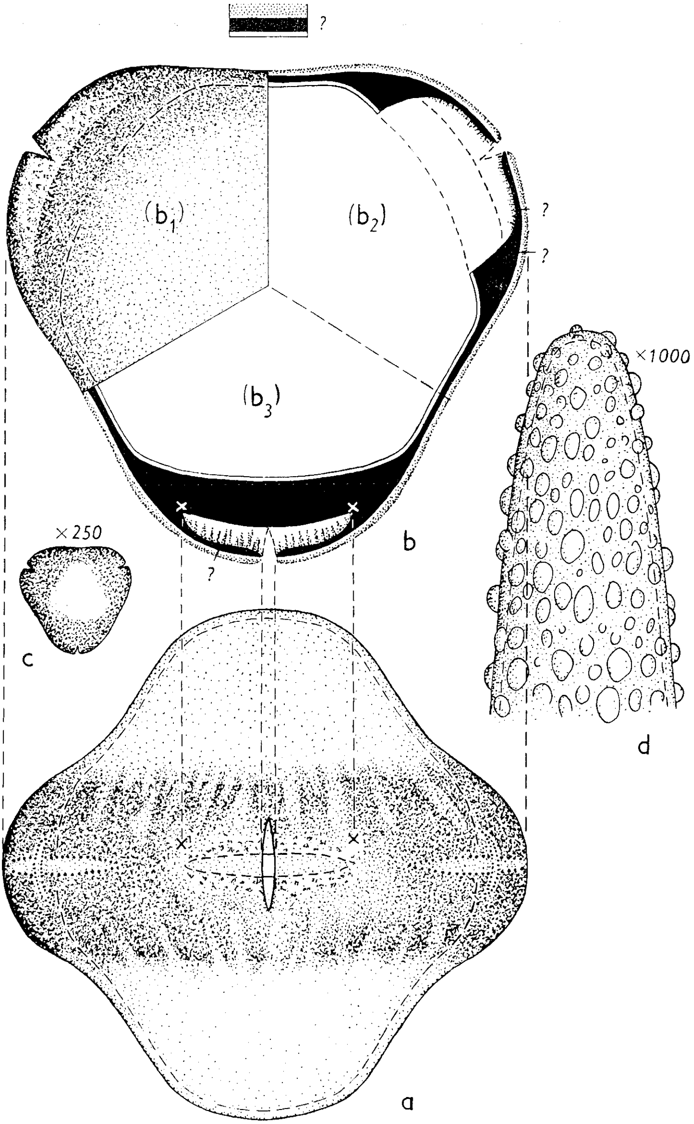


Fig. 4. *Emblingia calceoliflora* (Greenough River, W. Australia; F. MUELLER Oct. 1877, herb. Melbourne), a, equatorial view; b, polar view (b_1 surface, b_2 equatorial cross section, b_3 subequatorial cross section); c, young grain (polar view; ×250); d, part of hair. — a, b, d ×1000.

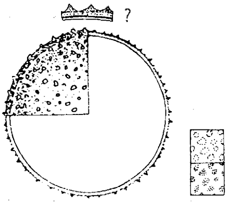


Fig. 5. *Hanguana malayana* (syn. *Susum anthelminthicum*). ×1000.

The large pollen grains (Fig. 4) are, however, widely different from the small grains usually found in this family, nor are they quite similar to any other pollen grains so far described. In the microscopical slides of *Emblingia* the pollen grains are interspersed with small hairs of the same type as those generally found in pollen slides of polygalaceous plants. Suspicion has thus been aroused and the suggestion made that *Emblingia* should be referred to the Polygalaceae — which would mean a considerable widening of the morphological range of this family — or to a special family at the side of it.

Another slightly dubious capparidaceous genus, *Pentadiplandra,* has sometimes been referred to the Pentadiplandraceae, of an uncertain position. Pollen morphology corroborates its retention within the Capparidaceae.

Sphenostemon is a New Caledonian genus, provisionally, though for insufficient reasons, referred to the Aquifoliaceae. It might be worth while the investigate whether or not the similarity between the strange pollen grains in this genus and those in *Idenburgia* (or *Nouhuysia*), another genus of uncertain taxonomic position from New Guinea, is taxonomically significant.

Simmondsia deviates from the rest of the Buxaceae. Its pollen grain details are similar to those in certain Centrospermae. According to VAN TIEGHEM, *Simmondsia* forms a family of its own not far from the Aizoaceae-Tetragonieae.

Hanguana malayana (syn. *Susum anthelminthicum*) differs from *Flagellaria* and *Joinvillea* both in pollen morphology (Fig. 5) and epidermis structure and should probably not be referred to the Flagellariaceae. ENDLICHER more than a century ago referred it to the Xerotideae.

Thorelia, a little-known genus from south-eastern Asia, has once tentatively been placed in the Lythraceae. Pollen morphology, as well as an anatomical investigation by Dr. METCALFE, tends to show that it should be referred to the Myrtaceae. The same applies to *Heteropyxis* and *Psiloxylon.*

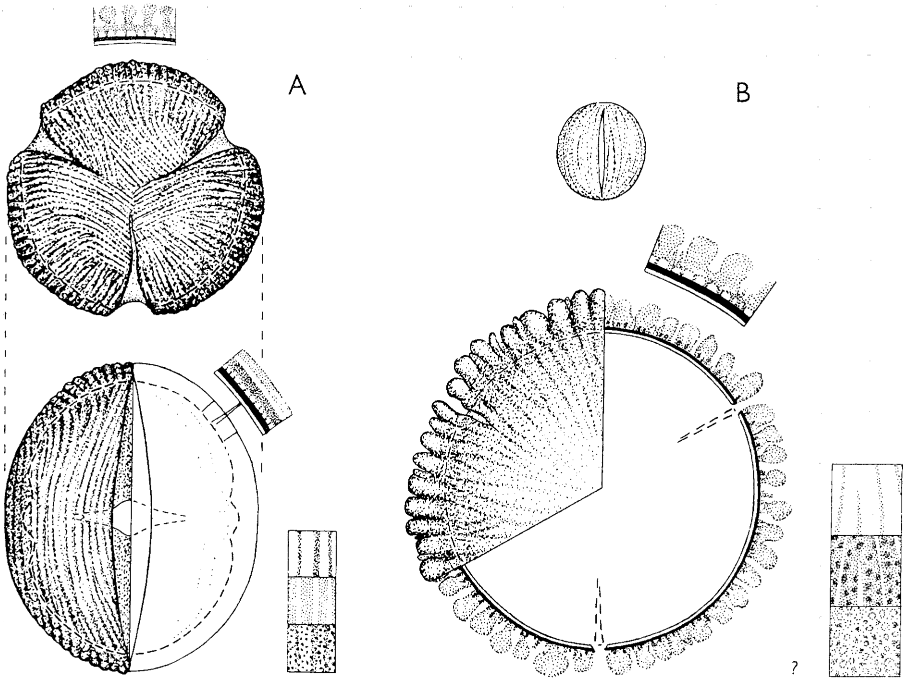


Fig. 6. A, *Duckeodendron cestroides.* — B, *Datura arborea.* ×1000.

It is impossible to retain *Trapella* in the Pedaliaceae. A special family, Trapellaceae, has been suggested, but it remains to be seen if this is really the best solution of the problem.

Canotia holacantha is referred to the Koeberliniaceae by METCALFE and CHALK. Its pollen grains, however, are not very similar to those in *Koeberlinia spinosa.* An affinity to the Capparidaceae, Hypericaceae, Rosaceae, Rutaceae, and Saxifragaceae has also been suggested. On the whole the pollen grains in *Canotia* seem to be more similar to those in certain celastraceous genera than to those in any of the families mentioned. Nor are the pollen-morphological indications in accord with the anatomical ones in *Duckeodendron cestroides.* This plant was primarily referred to the Solanaceae. This is corroborated by pollen morphology (Fig. 6), since the grains are similar to those in several solanaceous plants, e.g. *Cestrum smithii* and *Datura suaveolens.* Later *Duckeodendron* was referred by KUHLMANN to a special family, the Duckeodendraceae. According to METCALFE and CHALK *Duckeodendron* does not fit well in the Solanaceae. RECORD found the wood resembling that in some

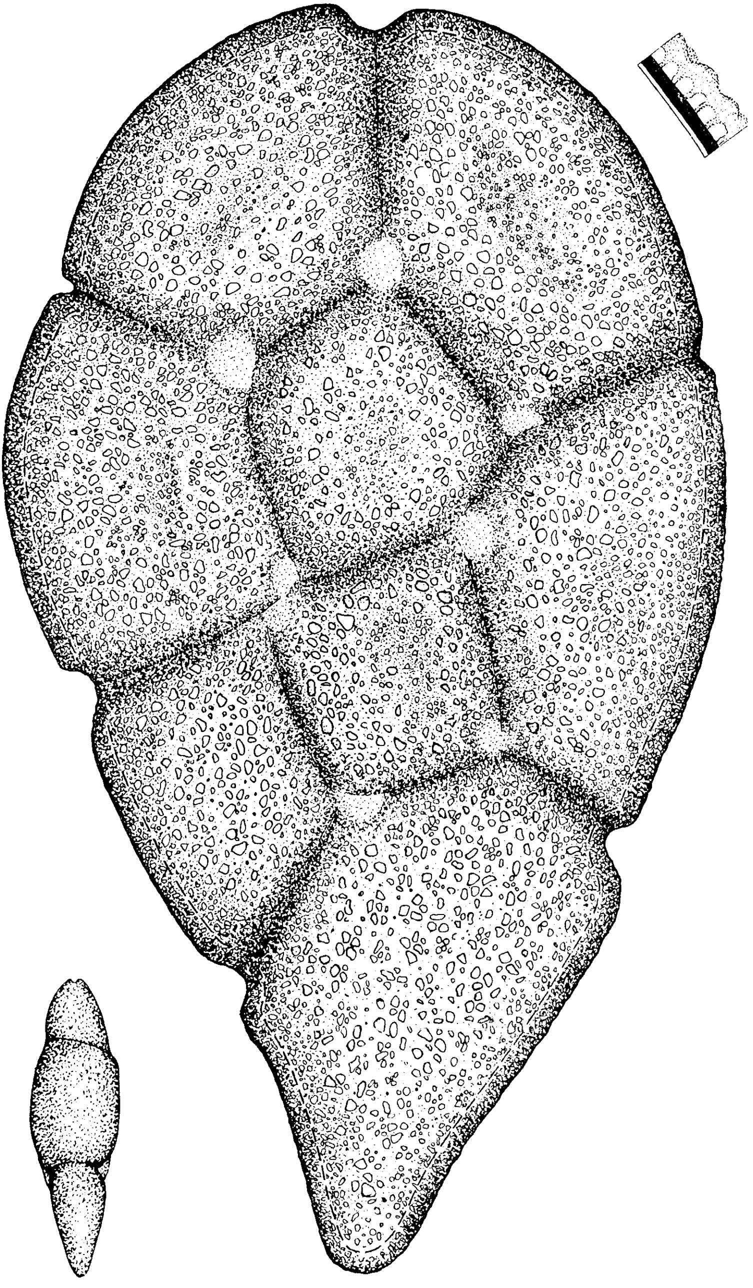


Fig. 7. *Calliandra californica,* octad (×1000). Detail figure: octad in lateral view (×250).

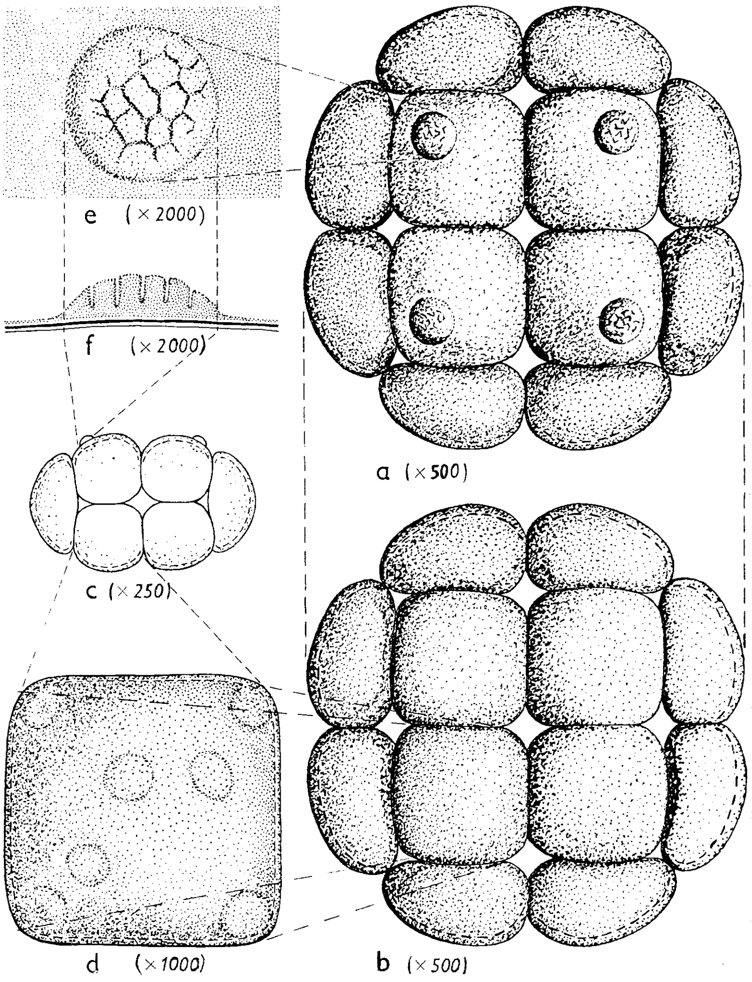


Fig. 8. *Calliandra portoricensis,* morphological analysis of polyad.

of the Apocynaceae. The apocynaceous pollen grains, however, are different from those in *Duckeodendron.*

Curiously enough, pollen grains of the very isolated, supposedly saxifragaceous genus *Roussea* have some characters in common with the rare, almost unique pollen type met with in *Ribes.*

Brachypodandra chevalieri, a recently described tree from French Indo-China, has been referred to the Tiliaceae. This is not supported by pollen morphology. Parallel cases are offered by *Platyspermation*

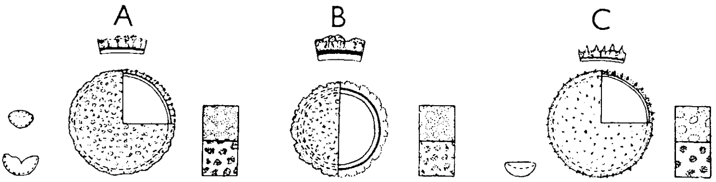


Fig. 9. A, *Gnetum venosum*. — B, *G. africanum*. — C, *G. montanum*. ×1000.

crassifolium, a New Caledonian tree which cannot be placed in the Myrtaceae, and *Oceanopapaver neocaledonicum* which certainly finds no safe refuge among the Papaveraceae.

In concluding what had necessarily to be an extremely cursory sketch of some genera of a more or less uncertain systematic position, let me add one or two remarks on some supposedly caprifoliaceous genera, *Alseuosmia, Memecylanthus,* and *Pachydiscus.* These genera are confined to a part of the world — New Caledonia and New Zealand — widely separated from the main distributional area of the family. Their pollen grains are different from those of the rest of the family. This no doubt corroborates a comment made by SCHLECHTER that these genera might in reality not belong to the Caprifoliaceae.

New Families. Withdrawal of Families. Pollen-morphological characters can be adduced in support of the establishment of new families, such as the Ctenolophonaceae, Dioncophyllaceae, Gyrostemonaceae, Hydrocaryaceae, Pentaphragmataceae, Siphonodontaceae, and Winteraceae. They can equally be adduced — in fact, this has already been done in several cases — in favour of an amalgamation of poorly justified families with other families. Thus, the Diclidantheraceae have been referred to the Polygalaceae and the Lacistemaceae to the Flacourtiaceae. By the same token, *Adoxa* should probably be referred to the Caprifoliaceae (or Sambucaceae), *Dysphania* to the Chenopodiaceae, *Thurnia* to the Juncaceae to mention only a few examples. Other more or less »shaky» families include the Buxaceae, Crypteroniaceae, Empetraceae, Eucryphiaceae, Fumariaceae, Gomortegaceae, Grubbiaceae, Hippocrateaceae, Julianiaceae (there are several points suggesting a relationship between *Juliania* and *Pistacia*), Martyniaceae, Nolanaceae, Octoknemataceae, Sargentodoxaceae, Sparganiaceae, etc.

Genera. *Gagea, Banksia,* and *Cobaea* are examples of stenopalynous genera. In conformity with most monocotyledons, *Gagea* has pollen

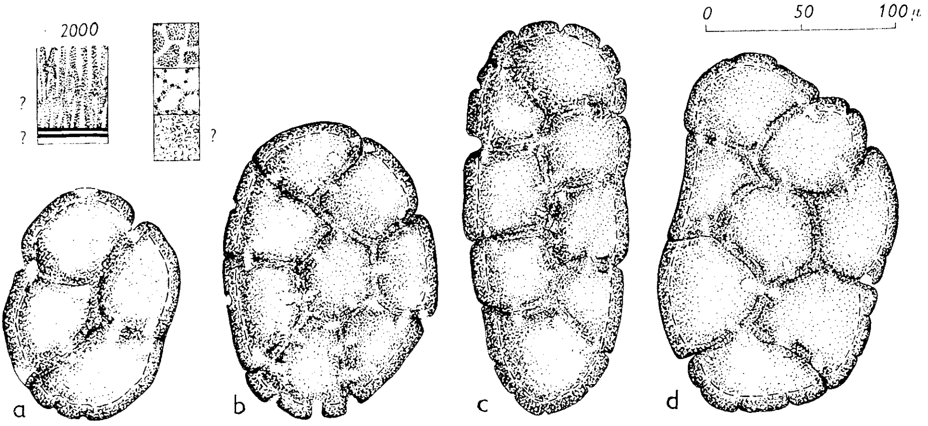


Fig. 16. *Leschenaultia longiloba*; a, tetrad; b–d, octads. ×250.

grains with a distal furrow. The wide range in size of the grains is of interest to cytology and palynology alike. The bilateral, 2-aperturate pollen grains in *Banksia,* indistinguishable from those in *Dryandra,* vary in size from 18 to 82 μ, in terms of longest diameter. In the spherical, polyaperturate grains in *Cobaea* the corresponding figures are approximately 100 to 200.

Anemone, Symplocos, and *Alangium* are eurypalynous. The pollen grains in *Anemone* have either three to numerous meridional furrows, or furrows or pores uniformly distributed over the entire exine surface. Some species have »spir-aperturate» grains — with apertures more or less similar to a spiral. The distribution of the different aperture types within the genus is taxonomically important.

The apertural and sporodermal variations found in the pollen grains of *Symplocos* and *Alangium* likewise seem to have taxonomical significance and may be adduced in favour of splitting these genera if indicated by other characters as well. Cf. also *Calliandra* (Fig. 7 and 8).

Pollen morphology has been instrumental in the inevitable splitting, into several genera, of *Polygonum*. Moreover, pollen morphology indicates the advisability of splitting *Abelia* into two separate genera: the section *Euabelia* has pollen grains of the same type as those in *Linnaea, Kolkwitzia, Symphoricarpus,* etc., whereas the section *Zabelia* has grains of a distinctly different type which is absent in other caprifoliaceous plants. Pollen-morphological features, combined with other characters, furthermore indicate the necessity of restricting the cyclanthaceous genus *Carludovica* to *Carludovica palmata,* the type species of the genus (Fig. 1 B). The pollen grains in *Cunonia capensis,* the only African species of the genus, are different from those in the species in New Guinea and New Caledonia.

Material at hand would seem to show that pollen studies will be instrumental in taxonomic revisions of several large and difficult genera such as *Centaurea, Gilia, Matisia, Oenothera, Pandanus,* and others.

In *Macrolobium,* another large genus, there is a slight, though constant and reliable, difference between the pollen grains from the African species and those from the South American species. In optical cross section, the superficial exine ridges in the South American species are more or less angular to square or rectangular with the longest sides perpendicular to the general exine surface. In the African species, the upper part of the ridges is more or less rounded. Thus, by means of pollen grain characters alone, it is possible to decide whether a *Macrolobium* specimen comes from Africa or from America. On the other hand, there is no visible difference between the pollen grains in the African species of *Macrolobium* sensu stricto and those in the species transferred to *Gilbertiodendron* and *Pellegriniodendron.*

MARKGRAF divides *Gnetum* into two sections, *Gnemonomorphi* and *Cylindrostachys.* The former is subdivided into *Eugnemones* (Asiatic), *Micrognemones* (African, Fig. 9 B), and *Araeognemones* (American, Fig. 9 A). Each subdivision has a special pollen type. The pollen type in the *Eugnemones* is similar to or identical with that in *Cylindrostachys* (Fig. 9 C).

In every young science, and palynology is one of them, it is particularly important to exercise great care to avoid hasty conclusions. There are many pitfalls in the path of palynology. For instance, the pollen grains in *Salix* are, as a rule, long and narrow and provided with three furrows, while in the closely related *Populus* they are spherical and without distinct apertures. The pollen grains in *Larix* and *Pseudotsuga* have no air-sacs, but those in related genera have. The pollen grains in *Leschenaultia* are strikingly different from those in other goodeniaceous genera. They are united in tetrads, in one species (*Leschenaultia longiloba*) often even in polyads (Fig. 10).

This does not necessarily imply that in some cases pollen morphology runs parallel to recognized taxonomic characters, while in other cases it does not. It may thus be possible to bridge the pollen-morphological gaps between *Salix* and *Populus,* or between *Larix* and *Cedrus.* The occurrence of tetrads and polyads in *Leschenaultia* is not more remarkable than is, for instance, the mixed occurrence of monads, tetrads, and polyads in the Mimosoideae. But even now, and fortunately, many mysteries remain unsolved. They are one of the many incentives that stimulate continued palynological research.

BOTANISKA NOTISER 1954, HÄFTE 2. LUND

Palynology: Aspects and Prospects. III.

Edited by G. ERDTMAN.

The previous parts of »Palynology: Aspects and Prospects» were published in Svensk Botanisk Tidskrift, Vol. 42, pp. 467—483, 1948, and Vol. 45, pp. 233—256, 1951. The present part deals with palynology in France, Russia, and North America.

For several reasons palynological research work in France will attract particular attention this year. Thus, at the 8th International Botanical Congress to convene in Paris in July, palynology will, for the first time, be represented by a section of its own. In cooperation with some of her colleagues the secretary of the section, Dr. M. VAN CAMPO, briefly reviews below the French institutions and scholars engaged or interested in palynological research work (p. 000). These notes are followed by some lines devoted to the memory of Professor G. DUBOIS, who has been active in France for 30 years in the field of pollen statistics (p. 000). A summary, by Professor G. LEMÉE, of the main results of pollen-statistical investigations in France will presumably appear in a forthcoming part of »Aspects and Prospects».

The chapter »Palynology in Russia» consists of two papers. One of them, by Mme TCHIGOURIAEVA, deals with the pollen grains in *Ephedra* and suggested precursors to this pollen type. In the other paper, O. GORODKOV discusses pollen grains, including pollen grains of *Artemisia,* from Quaternary strata in the Kotelny Island, one of the New Siberian islands. These papers have been translated at the C.E.D.P. (Centre d'Études et de Documentation Paléontologiques, 3 Place Valhubert, Paris V^{e}). The Bulletin Trimestriel d'Information edited by this agency lists the titles of a number of other Russian papers on palynology now available in French translation.

The notes on palynology in North America (p. 98) are a mere enumeration of the papers read at two palynological symposia held in the U.S.A. in 1953. Nevertheless, they convey, in a nutshell, an idea of the scope, trends, and results of the palynological research work carried out in Canada, the United States, and Mexico.

La Palynologie en France.

Exposé Générale.

Par M. VAN CAMPO.

Les recherches sur les pollens sont faites surtout dans la région parisienne et à Strasbourg.

A Paris, le laboratoire du Professeur P. DEFLANDRE et le laboratoire de Palynologie du Muséum d'Histoire Naturelle ont à leur actif des recherches sur la morphologie des pollens fossiles et vivants. Les palynologistes connaissent surtout P. DEFLANDRE par ses belles découvertes de pollens dans les silex. Il a bien voulu nous communiquer les indications suivantes sur les travaux en cours dans son laboratoire:

»Parmi les travaux qui sont à l'actif du Laboratoire de Micropaléontologie de l'Ecole Pratique des Hautes études, 96 boulevard Raspail Paris VI, on signalera tout d'abord un Mémoire de L. VALENSI (Poitiers): microfossiles des silex du Jurassique moyen. Ce Mémoire, qui a servi de Thése de Doctorat, paraît dans les Mémoires de la Société Géologique de France, T. XXXII, N° 68 (1954), surtout consacré aux Dinoflagellés et aux Hystrichosphères, il mentionne aussi des pollens et des spores, qui sont figurés mais non encore identifiés avec précision.

JEAN DEUNFF (Rennes) poursuit ses recherches sur les microorganismes planctoniques des roches primaires de Bretagne (Hystrichosphères du Silurien et éventuelles spores du Dévonien). Il a déja publié une note préliminaire sur ce sujet (C. R. Acad. Sc. T. 233, 1951, p. 321).

Madame M. DEFLANDRE-RIGAUD (Paris), dans un programme général d'étude des Silex crétacés de France et d'Union française a examiné des silex du Sénonien supérieur du Bassin parisien, dont elle a déterminé les microfossiles, en particulier les Hystrichosphères; une note sera publiée très prochainement sur ce sujet.»

Le Laboratoire de Palynologie, installé au Muséum d'Histoire Naturelle, 61 rue de Buffon, Paris V, a été organisé de la façon suivante: à coté des appareils nécéssaires aux analyses polliniques nous avons constitué des collections et des fichiers.

Les collections des pollens de Conifères comprennent actuellement environ 1600 préparations; les études entreprises sur ces pollens ont pour but une description détaillée de l'exine pouvant étayer des recherches de systématique et de phylogénie. Les pollens des Abiétacées, des Taxodiacées, des Cupressacées ont été examinés avec soin, des recherches sur les pollens des Araucariacées sont en cours. Pour les Coniférales, la tendance actuelle est sans conteste de faire jouer aux grains de pollen vivants et fossiles un grand rôle dans la classification et en 1950, dans un fascicule de son traité sur les Gymnospermes, H. GAUSSEN n'hésite pas à commencer son chapitre sur la classification des Coniférales par un tableau séparant les Taxines des Podocarpines et des Pinoïdines d'après leurs grains de pollen. Nous sommes particulièrement convaincus que les pollens doivent être de moins en moins négligés dans les classifications, nous suivons en cela le courant qui se dessine depuis quelques années, nous pensons que les pollens peuvent être des indicateurs de l'évolution de premier choix se différenciant en cela de nombreux autres organes de la plante beaucoup plus sensibles aux conditions du milieu.

La collection des pollens de l'Herbier de France est en cours de réalisation, les pollens sont montés par la méthode de R. P. WODEHOUSE, l'auteur n'ignore pas les critiques que l'on peut faire à cette technique, mais les préparations sont faites très rapidement et dans l'état actuel des moyens du laboratoire nous sommes partis de l'idée suivante: mieux vaut une collection imparfaite qui existe qu'une collection parfaite qui n'existe pas, nous montrant en cela fidèle disciple de notre Maître H. GAUSSEN qui a écrit: »un ouvrage imparfait qui paraît vaut mieux qu'un ouvrage parfait qui ne paraît pas». Toutefois lorsque de jeunes chercheurs travaillent au laboratoire, nous leur apprenons les techniques que nous avons eu le privilège d'appliquer en Suède lors d'un stage dans le Laboratoire de Palynologie de Bromma.

Outre les collections nous sommes entrain de constituer ces instruments de travail indispensables que sont les fichiers. Deux fichiers illustrés sont en cours d'organisation, les fiches portent une reproduction des dessins ou des microphotographies de pollens ou de spores choisis pour leur qualité ainsi qu'une indication du livre ou de l'article dont ils ont été extraits ou bien des microphotographies ou des dessins inédits. L'idéal serait qu'à chacune de ces fiches corresponde une préparation, actuellement nous avons plus de fiches que de préparations. Ces fiches sont d'un grand secours pour faire une première détermination des pollens et des spores trouvés dans les préparations, notre souci constant a été de mettre à la disposition du plus grand nombre possible de chercheurs un instrument qui leur évite les premiers écueils de l'analyse pollinique et leur permette de faire rapidement du travail utile. Ce fichier se manipule au moyen d'index colorés donnant les modalités indiquées sur les fiches perforées des laboratoires du J. IVERSEN et K. FAEGRI.

Un deuxième fichier comprend les reproductions des mêmes fiches classées par ordre alphabétique des familles et destiné plutot aux recherches de systématique, un fichier annexe de petites fiches ordinaires classées par ordre alphabétique des genres permet de trouver rapidement les collections et dans les fichiers les documents concernant une espèce donnée.

Un fichier illustré classé par ordre alphabétique des genres existe au Centre de Documentation du Muséum.

Le fichier bibliographique est pour une grande part la reproduction de celui du Laboratoire de Palynologie de Bromma.

Ces fichiers sont entrepris avec l'appui du Centre de Documentation du Muséum dirigé par le Professeur J. ROGER qui a bien voulu nous donner les precisions suivantes:

L'organisation de la documentation palynologique en France.

C'est essentiellement de l'organisation méthodique de cette documentation, dans le cadre du Centre d'Etudes et de Documentation Paléontologiques du Muséum National d'Histoire Naturelle (3 Place Valhubert Paris V) que nous voulons parler. La coordination de la bibliographie et de l'ensemble de la documentation relative aux spores et pollens étant un exemple caractéristique du fonctionnement du C.E.D.P., il est indispensable de dire au préalable quelques mots de cet organisme.

Les principes fondamentaux ayant présidé à la mise en place de ce centre d'information sont les suivants: grouper à l'échelle internationale, sans porter préjudice aux organisme existants, les renseignements et informations de toutes natures relatives à la paléontologie et, en même temps, réunir les renseignements fournis par d'autres disciplines, géologie au sens large, biologie, techniques de laboratoire etc. . . . que la recherche paléontologique utilise.

Pratiquement la première source d'informations est fournie par la bibliographie, par les articles et ouvrages, au fur et à mesure de leur parution. La première tâche du C. E. D. P. est donc le dépouillement méthodique et accéléré du maximum de littérature. Dépouillement méthodique, c'est à dire que non seulement les titres sont mis sur fiches et classés suivant un double système (alphabétique et matières), mais les catégories de la systématique sont aussi mises sur fiches (signalétiques et, dans toute la mesure du possible, aussi fiches illustrées). Dépouillement accéléré, c'est à dire suivant un rythme hebdomadaire.

Comme complément à cette première base il a fallu, évidemment, prévoir la possibilité de diffuser toute la documentation. A cette tâche essentielle s'ajoutent encore: un service de recherches d'ouvrages et périodiques difficiles à obtenir normalement, un service de traductions étendu aux langues d'alphabet non latin, etc.

Cette documentation est méthodiquement établie et, en principe, complète depuis 1940. Pour divers secteurs, en raison de l'existence dans le cadre des chercheurs scientifiques du C.E.D.P. ou du Muséum, d'un ou plusieurs spécialistes qualifiés, il a été possible d'élaborer plus complètement la documentation et de l'étendre de façon exhaustive, notamment aux années antérieures à 1940.

La paléobotanique en général et la palynologie en particulier représentent précisément l'un de ces secteurs.

Dans le domaine palynologique, grâce à l'activité de Mme VAN CAMPO, la réalisation de la section telle que nous l'entendons, fut en grande partie effectuée au moment de la première réunion de la Commission Internationale de Palynologie à Paris le 18 Septembre 1953.

G. ERDTMAN, Président de cette Commission, a soutenu l'idée d'une centralisation, au C.E.D.P., de la documentation palynologique, étant entendu que, comme de coutume, elle continuerait à se faire également à son laboratoire de Bromma pour les tirages à part.

Trois mesures importantes furent proposées par le Prof. ERDTMAN et furent adoptées:

1. Communication au C.E.D.P. du vaste fichier palynologique complet réuni à Bromma. Ce fichier est maintenant incorporé à la documentation du C.E.D.P. et comporte environ 4500 références.
2. Appel adressé aux palynologistes pour que, continuant d'adresser leurs publications au laboratoire de Bromma, ils en assurent en même temps le service au C.E.D.P.
3. A l'avenir la bibliographie annuelle palynologique sera réunie au C.E.D.P. et sa publication se fera dans Grana Palynologica.

Après ces rappels nous pouvons tracer les grandes lignes de la documentation palynologiques existant au C.E.D.P.

1. Bibliographie. Outre le fichier général du C.E.D.P., par ordre alphabétique des auteurs, il existe un fichier spécifiquement palynologique, complet, classé suivant le plan de la bibliographie palynologique

de G. ERDTMAN. Evidemment les références nouvelles viennent chaque semaine s'y ajouter. Signalons que cet ensemble peut, non seulement être consulté sur place, mais qu'il peut être diffusé en totalité ou partie sous forme de copie sur papier héliographique.

2. Systématique des spores et pollens. Des fichiers signalétiques et des fichiers illustrés lui sont réservés.

a. Fichiers signalétiques. L'un comprend les genres (et toutes les catégories supra-spécifiques) dans l'ordre alphabétique. Un autre donne dans l'ordre alphabétique également les noms d'espèces. Dans un troisième fichier les espèces sont groupées suivant la classification.

b. Fichiers illustrés. Ils comprennent des fiches du format 185×245 mm. portant la figuration des spores et pollens et, en outre, leur description. Un jeu de fiches illustrées est classé par ordre alphabétique des genres.

3. La bibliothèque palynologique de tirages à part est en voie de constitution. Outre les grands services qu'elle rend pour la consultation sur place, elle permet d'obtenir dans un temps plus court la réalisation des microfilms d'articles qui sont demandés.

4. Le palynologiste peut encore faire appel aux autres moyens d'information du C.E.D.P. par exemple il est souvent très utile de pouvoir trouver des références sur la stratigraphie, la sédimentation, les techniques de laboratoire, etc. . . . Il faut signaler aussi le lot de traductions existant déja et qui s'accroit sans cesse.

Il apparaît donc que la centralisation réalisée, sans nuire à l'originalité des travaux de chacun, produit déja d'heureux effets. Elle diminue les pertes de temps qui résultent de la recherche des informations, et des difficultés d'accès à la documentation. De plus, par la collaboration ainsi établie, par le dépouillement méthodique des publications périodiques, on peut réaliser une documentation sans lacunes.

L'ampleur des résultats que peut donner une telle organisation ne pourra d'ailleurs être appréciée que dans un avenir de quelques années. Une active persévérance sera certes nécessaire.

Peu d'études ont été faites en France sur les pollens atmosphériques en liaison avec les études médicales. Sur le rhume des foins, les phénomènes allergiques sont étudiés par le Docteur HALPERN dans son service de l'hopital Broussais; cette année vont être entreprises des études systématiques sur la richesse en pollens de l'atmosphère parisienne.

Pour ce qui concerne l'étude des pollens liée à l'apiculture Monsieur J. LOUVEAUX a bien voulu donner le texte suivant:

»Différents travaux sur le pollen sont actuellement poursuivis à la Station de Recherches Apicoles de Bures-sur Yvette (Seine-et-Oise).» Deux directions principales sont suivies:

1. Analyses polliniques de miels français. Ce travail est conduit par les méthodes d'analyse pollinique des miels telles qu'elles ont été définies par la Commission de Botanique Apicole de l'U.I.S.B. en 1952. 630 miels environ ont été analysés, en provenance de toutes les régions de France mais plus spécialement de la région parisienne. Plusieurs dizaines de miels étrangers ont été en outre examinés pour servir de controle en matière de repression des fraudes. Le but du travail est d'arriver à pouvoir caractériser les différents miels français quant à leur origine géographique et d'établir les liaisons existant entre la flore locale et la composition du miel. Un mémoire sur les résultats obtenus jusqu'ici est en cours de rédaction.

2. Etudes sur la récolté et l'utilisation du pollen par les abeilles. Ce travail est conduit à l'aide de trappes à pollens, un article sur ce sujet est en cours de publication.

Des études sont également faites à la Station de Bures sur la valeur alimentaire du pollen et sur ses propriétés biologiques.

Des analyses polliniques de miels sont faites également à Nice par M. BARBIER (Laboratoire de recherches apicoles des Services Vétérinaires), par M. BALDENSPERGER (Centre de diagnostic de Guebwiller, Haut-Rhin), ainsi que par le Dr. MOREAUX de la Faculté des Sciences de Nancy.

Madame C. SOSA-BOURDOUIL (Laboratoire de Génétique du Centre National de la Recherche Scientifique, Gif-sur-Yvette, Seine-et-Oise) a entrepris des recherches sur la composition biochimique des pollens dans ses rapports avec la physiologie et la génétique, sur la stérilité et les déficiences des pollens, sur la composition comparée des pollens et des spores et enfin sur la composition des pollens et la systematique.

Des analyses polliniques, afférentes aux recherches pétrolifères, ont été entreprises par M. C. SITTLER, Institut Français du Pétrole, 4 place Bir-Hakeim, Rueil-Malmaison, Seine-et-Oise.

Les recherches des spores dans les charbons avaient été pratiquées à Lille, elles sont actuellement poursuivies, accessoirement d'ailleurs, par M. B. ALPERN, Centre d'Etudes et de Recherches des Charbonnages de France, Verneuil, Oise.

Les laboratoires d'analyse pollinique de Strasbourg sont spécialisés dans l'étude des tourbes et des sédiments quaternaires. Le Professeur

G. DUBOIS avait fondé au laboratoire de Géologie et de Paléontologie de la Faculté des Sciences, 1 rue Blessig à Strasbourg, un centre d'analyses polliniques, il était aidé dans ses travaux par Madame DUBOIS.

Le Professeur G. LEMÉE de l'Institut de Botanique de la Faculté des Sciences, rue de l'Université, à Strasbourg, a pratiqué l'analyse pollinique en phytosociologue averti.

Il nous semble très important de signaler que, cette année, pour la première fois en France, l'attention des étudiants en Sorbonne est largement attirée sur l'importance des pollens pour la systématique végétale dans le cours du Professeur M. CHADEFAUD.

Nous terminerons par un souhait, le VIIIème Congrés International de Botanique comprend une section de Palynologie; d'autre part pendant le Congrès, la Commission internationale de Palynologie poursuivra ses travaux sous la présidence du G. ERDTMAN, nous avons l'espoir que les Palynologistes assisteront nombreux aux séances et que leurs discussions contribueront à faire progresser cette science, jeune encore, qui promet d'enrichir considérablement le domaine de la Botanique.

Georges Dubois *10.9. 1890, †2.10. 1953.

Par J. SITTLER-BECKER et J. SAUVAGE.

GEORGES DUBOIS naquit à Armentières (Nord). Après avoir été élève du Lycée de Lille, il poursuivit à l'Université de cette ville des études de médecine et de sciences naturelles. Au cours de ses années lilloises, GEORGES DUBOIS fut l'élève des géologues J. GOSSELET, encore actif, et surtout de CH. BARROIS, ainsi que des palébotanistes CHARLES et PAUL BERTRAND.

Le 1er avril 1928 la Faculté des Sciences de Strasbourg le désigna pour occuper la chaire de Géologie et de Paléontologie. En 1934, succédant à M. E. DE MARGERIE, GEORGES DUBOIS devint Président du Service de la Carte Géologique d'Alsace et de Lorraine.

Le nombre de ses publications s'élèvent à 261. Elles se rapportent pour la plupart à l'étude des terrains quaternaires, à la connaissance de la tourbe et de l'histoire forestière mise en évidence par l'analyse pollinique.

Il a montré que la classification des lignes de rivages, proposée par DEPÉRET, pouvait s'appliquer, pour les lignes les plus basses, à la région nord de la France. Preuve a été faite, par corrélations stratigraphiques, qu'après la dernière ligne de rivage suspendue, le niveau de l'Océan s'était abaissé eustatiquement pendant la poussée glaciaire würmienne, puis était remonté, également eustatiquement, lors de la dernière des glaciations terminales (transgression flandrienne).

Il a synchronisé, toujours par la Paléontologie stratigraphique, cette transgression flandrienne avec les multiples mouvements transgressifs et régressifs des détroits danois et de la Baltique, établissant que ces évènements étaient dus à l'interférence de la transgression flandrienne et du soulèvement local isostatique épiglaciaire et postglaciaire du Massif scandinave. Il fut le premier en France qui appliqua aux phénomènes flandriens la géochronologie postglaciaire de DE GEER.

La nécessité de coordonner les évènements flandriens les plus récents amenèrent GEORGES DUBOIS à s'intéresser aux analyses polliniques des tourbes en appliquant la méthode de VON POST et LAGERHEIM. Grâce à l'incessante collaboration de Mme DUBOIS, il a pu faire depuis 1934 un nombre considérable d'analyses polliniques et établir l'existence en notre pays de deux types d'histoire forestière fort différents dans leurs détails, bien que synchronisables, celui des régions montagneuses et celui des régions de plaines. Une école d'analyse pollinique, dans laquelle travaillérent 15 de ses élèves, fut crée à Strasbourg.

Pendant la guerre de 1939 le Professeur et Mme DUBOIS étudièrent les les dépôts tourbeux du Massif-Central, et c'est à leur base, dans des niveaux argileux, que furent déterminées les variations climatiques de l'oscillation allerödienne. Actuellement l'histoire de multiples régions (Flandres, Bretagne, Bassin parisien, Ardennes, Plaine d'Alsace, Vosges, Jura, Alpes, Massif-Central) a été établie par l'analyse pollinique.

GEORGES DUBOIS était un naturaliste, doué d'un don d'observation et d'une mémoire remarquable. Il aimait la perfection dans le travail et avait le même souci de culture générale, musicale, littéraire et artistique.

Sa parole évocatrice, son enseignement clair, agrémenté d'anecdotes amusantes, son enthousiasme surtout ont suscité bien des vocations de botanistes et géologues. Il nous sera impossible de parcourir l'Alsace, sans le revoir par la pensée, vêtu d'un loden brun, chaussé de gros souliers à clous, son marteau de géologue à la main et suivi d'une troupe joyeuse.

GEORGES DUBOIS participa, début septembre 1943, au Congrès de l'INQUA à Rome et à Pise. Il y fit une communication synthétisant les résultats palynologiques obtenus par son école.

Revenu en France, il assista le 18 septembre à la première réunion de la Commission Internationale de Palynologie qui se tenait à Paris et où il devait représenter son pays.

La Palynologie en Russie.

1. Paysages pléistocènes peri-glaciaires en Asie du Nord.[1]

Par B. N. GORODKOV.

Il existe parmi les paléographes des désaccords sur les représentations des paysages périglaciaires des grandes glaciations du Pléistocène. L'opinion dominante est que, à la limite des glaciers, ou au voisinage

---

[1] Comptes rendus de l'Académie des Sciences de l'URSS, 1948, t. 61, no. 3, p. 513—516. Trad. PIETRESSON DE SAINT AUBIN (Centre d'Études et de Documentation Paléontologiques, No 143).

direct des toundras préglaciaires, existaient des »steppes périglaciaires», des »steppes loessiques froides» et même des déserts rappelant ceux de la Mongolie actuelle, c'est-à-dire des paysages préglaciaires essentiellement différents des paysages arctiques contemporains (2, 4).

Les partisans d'une succession de zones de paysages différente de celle d'aujord'hui pour les époques glaciaires, appuient leur opinion non seulement sur les conditions climatiques nettement continentales dans la bande périglaciaire, mais aussi sur la présence dans les dépôts de pollens de végétaux steppiques, en particulier d'absinthe et de carotte. Bien des paléobotanistes ont soutenu l'existence des »steppes périglaciaires» par l'analyse de la flore actuelle de l'Arctique, où ils ont trouvé des végétaux de disjonction dite arcto-steppique (1, 9).

Les partisans de la sucession normale des zones de paysage au Pléistocène soutiennent que les aires de végétation arcto-steppiques ont été instituées d'après des erreurs: les analyses des restes fossiles d'âge glaciaire témoignent de toundras périglaciaires, et non de steppes (3, 8).

En 1927, B. N. GORODKOV et E. S. KOROTKIEVITCH ont rapporté de l'île Kotelny (archipel de la Nouvelle Sibérie) un échantillon minéral et organique de pollens de 21.5 l. d'eau, obtenu par dégel de glaces fossiles (pétrifiées).

Cette glace a été extraite d'un affleurement de rivage peu élevé, à l'embouchure de la rivière Katalinka sur la rive nord ouest de l'île, au voisinage de collines basses constituées de calcaire Paléozoique. La glace pétrifiée se trouve ici, comme cela est particulier aux glaces fossiles des îles de la Nouvelle Sibérie, traversée de veines épaisses de couches loessiformes et recouverte d'une couche de limon loessiforme de 40—60 cm d'épaisseur.

La répartition égale des pollens dans la glace, les petites bulles d'air, qu'elle contient, étant elle même très compacte, témoignent d'une provenance d'un ancien névé. Le pollen sec détaché s'élève à 85 g. environ.

R. V. FEDOROVA a procédé à l'analyse des nombreux pollens et spores, séparés du substratum mince et poudreux, renfermant aussi pas mal de restes de petits végétaux. Sur 664 grains polliniques, 4 % représentaient du pollen arboréen, 80 % du pollen non arboréen, et 16 % des spores. Une partie des pollens proviennent des couches antéquaternaires, de large étendue sur l'île Kotelny. Parmi les pollens arboréens prédominent ceux de *Pinus sibirica* et de *P. silvestris,* les autres appartenant à *Picea, Betula, Alnus.* Ce pollen provient sans conteste d'un transport éloigné.

Les couches de couverture contenaient beaucoup plus de pollens arboréens ce qui s'explique par le voisinage des loess à l'epoque de la fusion intense des glaces pétrifiées, particulièrement dans le cours de la période chaude optimum postglaciaire. Outre les pollens, ces dépôts contenaient des fragments de radicelles indéterminés, et d'autres tissus végétaux.

Le pollen non arboréen de la glace se composait pour 52 % d'*Artemisia* et pour 35 % de graminées; parmi les autres pollens, en partie indéterminable, on relève Chenopodiaceae, Caryophyllaceae, Ericaceae. On n'a pas signalé de pollens de *Salix* et de *Carex* ni d'arbres feuillus, malgré les excellentes conditions de conservation dans la glace. Parmi les spores prédominaient nettement celles de mousses proprement dites, mais on en a vu aussi quelques unes d'hépatiques, de fougères et de sphaignes.

Dans la flore actuelle de l'île Kotelny, contenant environ 75 espèces de plantes vasculaires, nous ne rencontrons absolument aucun représentant des *Artemisia* et Chenopodiaceae. Parmi les saules, *Salix polaris* est très commun; parmi les Cyperaceae on trouve deux espèces d'*Eriophorum*. Parmi les mousses, abondantes au sud de l'île, on trouve des sphaignes. Les graminées sont universelles. Ainsi, la végétation de début de la dernière époque glaciaire, dans la région de l'île Kotelny différait de celle des déserts polaires de ce même temps.

La seule analyse pollinique ne peut donner des résultats suffisants pour reconstituer les paysages, mais elle y est d'un grand secours, en présence d'autres restes fossiles, dégagés de la pétrification glaciaire pulvérisée, par R. V. FEDOROVA et E. S. KOROTKIEVITCH. Parmi de très nombreux débris de feuilles de graminées et de mousses proprement dites (familles des Amblystegiaceae, Bryaceae, etc.), nous avons déterminé quelques fleurs bien conservées de graminées: *Atropis angustata* V. Kreez., et *Deschampsia* aff. *brevifolia* R. Br. La première prospère actuellement parmi les glaces de la Nouvelle Zemble et de la terre François-Joseph, dans les déserts polaires du Taïmyr nord et de l'île Kotelny. Elle occupe des emplacements froids, découverts, presque dépourvus de neige. L'habitat local des *Deschampsia* est semblable. A ces espèces arctiques typiques se rattachent des mousses de substratum calcaire, *Barbula* aff. *rigidula* Mitt. (déterminées par L. I. SAVITCH). On a rencontré également des enveloppes feuilles externes d'inflorescences d'*Artemisia* aff. *borealis* Pall. Tous ces restes se distinguent des végétaux actuels par des dimensions un peu plus faibles ce qui témoigne d'un climat plus rude. Il y a correspondance entre les pollens prédominants et les débris microscopiques.

Parmi les autres gisements de la zone des déserts polaires, nous connaissons bien, grâce à des recherches appropriées, celui de l'île Wrangel. A la différence des îles de la Nouvelle Sibérie, cette île n'a pas été atteinte par la glaciation, c'est pourquoi l'on rencontre dans sa flore et dans sa faune un grand nombre de formes interglaciaires. On compte sur l'île Wrangel environ 170 espèces vasculaires, malgré des étés plus froids que ceux de l'île Kotelny. Parmi cette végétation quatre absinthes des déserts polaires sont assez communes. Sur les rochers de l'île Henriette, voisine de celle de la Nouvelle Sibérie, on n'a trouvé jusqu'à ce jour qu'une seule absinthe (*Artemisia henriettae* Krasch.) voisine de *A. borealis*. Il est permis de supposer qu'à la fin de la dernière période interglaciaire la végétation était la même dans la région de Kotelny et de Wrangel, mais la glaciation ultérieure l'a en partie anéantie et a crée une différence floristique entre les zones désertiques polaires de ces deux îles.

D'après l'analyse des inclusions parmi les glaces pétrifiées de l'île Kotelny, nous arrivons aux conclusions suivantes sur les conditions géographiques de la Iakoutie septentrionale au début de la dernière époque glaciaire, conclusions correspondant jusqu'à un certain point aux reconstitutions de E. VON TOLL (10).

Le glacier de la plaine Iakoute est resté immobile, dans une très grande mesure, aux stades les plus anciens de son développement; il en est résulté dans les points de relief bas des accumulations d'apports neigeux qui se sont transformés en névé et ont formé à leur base des ensembles de glaces pétrifiées.

Au moment où s'accomplissait cette accumulation de névé, il existait encore de vastes surfaces polaires désertiques, probablement sur les hauteurs peu enneigées. Ces surfaces montraient une flore voisine de la flore actuelle des déserts polaires dans les lieux non atteints par la glaciation; elles étaient comme aujourd'hui, privées de végétation arboréenne sur au moins 50 $^0/_0$ de leur étendue. La végétation des déserts polaires du Pleistocène recevait l'été des pollens des surfaces de névés et glaciaires, et l'hiver, ces déserts recevaient pas mal de poussières minérales et organiques, comme le font maintenant les glaces riveraines de la mer auprès des îles de Nouvelle Sibérie (5).

Les limons loessiformes, largement, développées dans la Iakoutie du nord, sont surtout d'origine éolienne. Ils se sont auccumulés dans les glaces de névé. Le secteur actuel des glaces mortes des îles de la Nouvelle Sibérie représente le paysage du Pleistocène tardif, alors que l'ancienne glaciation générale cédait du terrain. La fonte des glaces mortes appelait l'accumulation en surface de couches loessiques. Ces couches »toundrasiennes» étaient ravinées par des torrents: elles s'amoncelaient et se réamoncelaient dans les dépressions, formant des veines minérales contenant des restes d'animaux quaternaires. Plus tard des inclusions plus puissantes de couche loessiformes remaniées commencèrent à se faire remarquer en surface, recouvrant des pétrifications glaciaires, et se redèposaient de nouveau, constituant des variétés de couches loessiformes distinctes par leur composition minérale.

Les paysages des régions bordières glaciaires de la Iakoutie, et, probablement, aussi des autres régions périglaciaires du Pleistocène représentaient des déserts polaires et des toundras, et non pas des steppes. Plus au sud, ils se chargaient graduellement de loess.

En conclusion des considérations sur l'appartenance végétale des pollens de Chenopodiaceae dans les apports préglaciaires, on a estimé qu'ils constituaient, de même que ceux d'*Artemisia,* un argument en faveur des steppes périglaciaires. SAKS (7) a publié des analyses polliniques des dépôts de glaciation maximum au nord de la Sibérie occidentale, où il signale des pollens d'ombellifères, et NIKITINE (6) a communiqué des déterminations de semences de Chenopodiaceae, dont quelques unes plus méridionales que celles de la dépression Sibérienne, mais à peu prês de même âge. Ces semences appartenaient à *Chenopodium album, C. glaucum, C. polyspermum* et *C. rubrum.* Ce sont des espèces courantes de rivages qui aujourd'hui prospèrent sur les alluvions récentes du loess de la dépression Sibérienne occidentale. Elles devaient être très communes sur les berges des torrents fluvioglaciaires au Pléistocène, sans présenter avec les steppes le moindre rapport.

Bibliographie.

1. DAVRENKO, Manuel de Véget. de l'URSS, 1, 1938, p. 235.
2. GERASIMOV et MARKOV, Trav. Inst. géogr. Acad. Sci. URSS, 33, 1939.
3. GORODKOV, Botan. Soviet., no. 6—7, 41, 1939.
4. GRIGORIEV, Com. étude des forces nat. de l'Union, Acad. Sci. URSS, Matériaux, no. 80, 1930, p. 43—104.
5. KOLTSCHAK, Bull. Acad. Sci. Imp., sér. 8, sect. 26: 1, 1909.
6. NIKITINE, Tr. Inst. biol. Univ. de Tomsk, 5, 143, 1938.
7. SAKS, Traité de geol. minière appliquée, 22, 1946.
8. SOUKATCHEV, Manuel de végét. de l'URSS, 1, p. 183, 1938.
9. STEFFEN, Beih. Bot. Zentralbl., Abt. B, 5: 141, 1938.
10. VON TOLL, Bull. Soc. imp. géogr., 32, no. 1, 1897.

2. Structure du pollen des Gnétales.[1]

Par A. A. TCHIGOURIAEVA.

Il existe différentes thèses sur la position phylogénique des Gnétales, et dans le système leur place n'est pas encore bien nette. Ainsi par exemple, KOZO-POLIANSKII (5), ainsi que d'autres auteurs, estime que l'*Ephedra* est un descendant des Conifères, *Welwitschia,* descendant des Bennettitales, tandis que *Gnetum* provient d'un Angiosperme voisin du groupe des Santalacées. KOZO-POLIANSKII (6, 7) fait descendre l'*Ephedra* des Cordaïtes, ainsi que les Conifères, tandis qu'-il considère *Welwitschia* et *Gnetum* comme des représentants des Santalacées. HEINTZE rapporte les Gnétales aux Polygalales.

Depuis quelques années on se sert aussi des caractères morphologiques du pollen pour des questions de phylogénie (2, 4, 6 etc.).

Sans m'arrêter en détail à la description du pollen des Gnétales, que l'on peut trouver dans un certain nombre d'ouvrages (1, 6, 9), remarquons seulement que le pollen des trois genres de Gnétales est différent. L'Ephèdre et *Welwitschia* sont plus près entre eux que de *Gnetum.* Le pollen de *Gnetum* est sphérique et porte des épines; le pollen d'*Ephedra* et de *Welwitschia* porte des sillons et des côtes, grâce auxquels »le grain peut changer de forme et de dimensions sans déchirure de l'enveloppe».

D'après KOZO-POLIANSKII, le pollen d'*Ephedra* et de *Welwitschia* est hautement spécialisé.

Dans les dépôts du Permien supérieur et du Trias inférieur du Préoural méridional, nous avons rencontré des grains de pollen qui permettent de faire quelques hypothèses sur l'origine des Gnétales.

Le trait caractéristique des grains de pollen trouvés est l'existence de facettes, leur caractère sillonné, et certains possèdent des sacs à air — »ailés» (Fig. 1, 2, 4, 5, 6), les autres portent des sacs à air réduits (Fig. 3, 7, 9) et les troisièmes n'en possèdent pas du tout (Fig. 8, 10).

Ces grains appartenaient probablement à des Conifères du Permien. Le caractère sillonné des grains de pollen est de toute évidence une adaptation aux conditions xérophytes. Les sillons donnaient de l'élasticité et permettaient le changement de forme du grain sans abimer l'enveloppe, lorsque les conditions d'humidité changeaient [analogie avec les grains de pollen de l'*Ephedra* et de *Welwitschia* (6)].

---

[1] Dokl. Ak. N. S.S.S.R. (1949), t. 65, No 4, p. 555—557. Trad. S. KETCHIAN (Centre d'Études et de Documentation Paléontologiques, No 768).

Cette interprétation concorde avec ce que les grains de pollen du type conifère avec un corps sillonné se rencontrent seulement dans les dépôts permiens et peut-être dans les dépôts du Trias inférieur, tandis que pour l'Europe un certain nombre d'auteurs (KRICHTOFOVITCH etc.), indiquent un caractère chaud, sec du climat et un caractère xérophyte de la végétation. Il est évident que cette xérophytisation ne pouvait pas ne pas de faire sentir aussi sur la morphologie du pollen. Les formes initiales de ces Conifères à grains de pollen sillonés étaient probablement les grains de pollen de Cordaïtes à un sac à air, entourant le corps du grain. La cause d'une telle hypothèse est la présence de formes chez lesquelles on trouve des traces d'ailes rondes (Fig. 2, 3, 5).

Le lien des Conifères avec les Cordaïtes, basé sur la morphologie, s'établit par l'intermédiaire du genre Permien *Walchia,* ayant des grains de pollen à un seul sac à air.

La présence de formes intermédiaires (Fig. 3, 7, 9) entre les formes »ailées» (Fig. 1, 2, 4, 5, 6) et les formes »nues» (Fig. 8, 10) montre que des formes »ailées», sillonnées, ont donné naissance aux formes »nues». Nous avons déjà remarqué un fait analogue pour les Conifères sur un matériel plus vaste.

Les formes sillonnées pourraient être les formes initiales pour les grains de pollen de l'*Ephedra* et, en particulier, de *Welwitschia.*

Cette hypothèse se fonde sur les faits suivants:

1) Analogie du caractère des sillons chez les formes permiennes fossiles trouvées et les grains de pollen actuels de l'*Ephedra* et de *Welwitschia.*

2) L'étude des grains de pollen de l'*Ephedra,* de *Welwitschia,* après la préparation habituelle par attaque par alcali à 10 % a montré que l'enveloppe de beaucoup de grains de *Welwitschia* a formé une sorte de gradins à l'endroit correspondant aux sacs à air — aux ailes de nos formes fossiles (Fig. 12, 13, 14, 15). Tandis que les grains de pollen d'*Ephedra* de différentes éspèces, étudiés en grande quantité et provenant de nombreuses régions géographiques du monde, n'ont pas manifesté cette propriété, ce qui montre dans une certaine mesure leur plus grande différence par rapport à nos formes initiales »ailées» que les grains de pollen de *Welwitschia.*

3) L'adaptation actuelle de l'*Ephedra* et de *Welwitschia* à un habitat xérophyte est également un »écho» de leur passé lointain.

Comme nous l'avons indiqué plus haut, les grains de pollen sillonnés des Conifères se rapportent au Permien, avec un climat chaud et sec.

Ainsi, le point de vue de KOZO-POLIANSKII, d'après lequel l'*Ephedra*

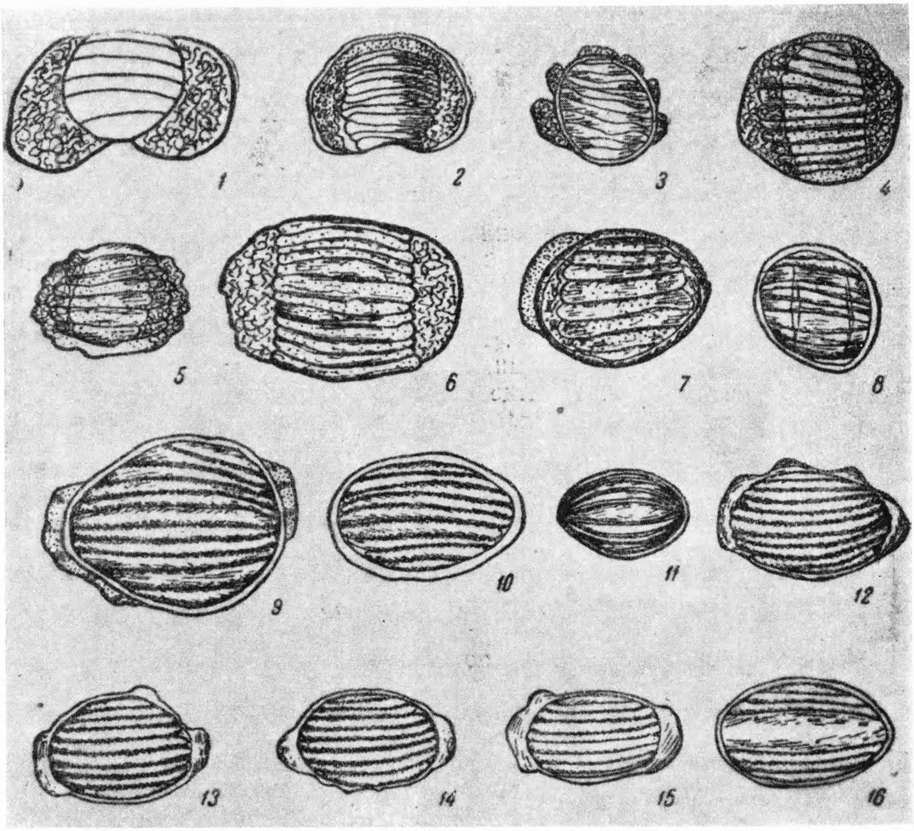


Fig. 1—10: grains de pollen fossiles, rencontrés dans les dépôts permiens et du Trias supérieur (?) du Préoural du Sud. Fig. 11: Pollen actuel d'*Ephedra foliata*. Fig. 12—16: Grains de pollen de *Welwitschia*. — Dessinés à la chambre claire d'Abbe, grossisement environ 600 fois. La structure des sacs est schématique.

est un descendant des *Cordaïtes,* de même que les Conifères, se confirme par nos trouvailles de pollen.

En ce qui concerne l'origine de *Welwitschia,* il y a divergence.

Par la morphologie du pollen, *Welwitschia* et *Ephedra* sont voisins et nous pensons que les formes permiennes sillonnées »ailées» pourraient être les formes initiales pour les grains de pollen de *Welwitschia,* tandis que Kozo-Polianskii éstime à priori que *Welwitschia* est né de *Gnetum,* et que tous deux sont des représentants des Santalacées.

Malheureusement parmi les Santalacées nous n'avions à notre disposition que des grains de pollen des genres *Viscum, Thesium,* à épines (analogie avec *Gnetum*), mais à trois pores. Par conséquent, d'après la morphologie du pollen, il est difficile de rapporter le *Gnetum* (et encore moins le *Welwitschia*) aux Santalacées.

Le pollen des Polygalales a principalement le type silloné (analogie avec l'*Ephedra*), mais il est aussi polyporate, de sorte qu'il nous semble impossible de rapporter toutes les Gnétales aux Polygalales (HEINTZE), en se basant sur la morphologie du pollen.

La communication de ces quelques données a été faite dans le but d'attirer l'attention des chercheurs sur ce genre de trouvailles de pollens fossiles, qui par la suite peuvent constituter des données précieuses sur la phylogénèse de ce groupe original et combler la lacune de leurs annales géologiques, car d'après l'avis de A. N. KRICHTOFOVITCH les anciennes indications sur les Conifères sont peu vraisemblables; par exemple des déterminations comme *Gnetopsis,* qui sont probablement des Cycadofilicales du Carbonifère supérieur, *Ephedrites,* déterminés comme provenant du Jurassique, du Crétacé, etc.

Par la même occasion j'exprime ma grande reconnaissance au Professeur B. M. KOZO-POLIANSKII pour ses indications précieuses.

Littérature citée.

ERDTMAN, G. 1943. An Introduction to Pollen Analysis. Verdoorn, New Ser. Pl. Sci. Books 12. Waltham, Mass.

KOUPRIANOVA, L. A. 1940. La botanique soviétique, No 3.

— 1945. La botanique soviétique, 13, No 3.

— 1948. Travaux de l'Inst. bot. Ac. des Sci. URSS, sér. 1, No 7.

KOZO-POLIANSKII, B. M. 1922. Introduction à la systématique phylogénique des plantes supérieures.

— 1945. Succès de la biologie moderne, 19, No 1.

— 1947. D. Ak. N., 56, no 3.

KRICHTOFOVITCH, A. M. 1941. Paléobotanique.

Palynological Conferences in the USA 1953.

A. Palynology Symposium, Yale University 21 February.

CAIN, STANLEY A. (University of Michigan): The Use of Size-Frequency in the Determination of Species of Pollen.

Illustrations from some of the genera will show cases in which the technique appears to be useful and other instances where it is inadequate alone, or even useless.

GRAYSON, JOHN (University of Michigan): A Size-Frequency Study of Fossil *Pinus* Pollen from Lake Bottom Sediments of the George Reserve Southeastern Michigan.

DAHL, EILIF (Botanical Museum, University, Oslo, Norway): Climatological Interpretation of Postglacial Pollen and Microfossil Records.

FREY, DAVID G. (Indiana University): Wisconsin and post-Wisconsin Palynology of Eastern North Carolina.

BUTLER, PATRICK (Harvard University): Pollen Studies of Small Swamp, Cape Cod, and of the Barnstable Marsh, Cape Cod.

DONALDSON, ALAN (University of Massachusetts): Plant Microfossil Study of a Cape Cod, Massachusetts Peat Bog.

IGNATIUS, HEIKKI (Yale University): Lateglacial and Postglacial History in North-Central Quebec—Ontario, Canada.

Studies of lake sediments and peat bogs reveal the following sequence: (1) Lateglacial tundra characterized by non-arboreal pollen and a high alder frequency. The large amount of pine pollen in this zone is considered to be due mainly to long distance transportation. (2) The postglacial sequence in Ontario consists of (a) basal spruce zone, followed by (b) very high pine maximum, and (c) reappearance of spruce. Birch increases after the culmination of pine. The postglacial sequence in northern Quebec does not show a well developed pine zone; instead birch has a high maximum in the middle of this sequence.

WILSON, L. R. (University of Massachusetts): Peat Studies of Northeastern Ontario.

LEOPOLD, ESTELLA (Yale University): Current Pollen Studies in Certain River Terraces of Northeast Wyoming.

BENNINGHOFF, WILLIAM S. (U. S. Geological Survey): Pollen of an Interglacial Lignite from Seward Peninsula, Alaska.

LIVINGSTONE, DANIEL (Yale University): Some Pollen Diagrams from Northern Alaska.

HEUSSER, CALVIN J. (Yale University): Additional Pollen Profiles from Southeastern Alaska.

WOLFE, MARGARET K. and E. S. BARGHOORN (Harvard University): Fossil Maize from the Valley of Mexico.

CLISBY K. H., F. FOREMAN and L. ZEEVAERT (Oberlin College and Mexico City): Fossil Pollen and Stratigraphy from Two Deep Cores under the City of Mexico.

The purpose of this paper is to record the close correlation of the pollen profile with the stratigraphy and the water holding capacity of the sediments in two 70-meter cores under the City of Mexico. Diagrams are presented which show percentage of pollen genera, total pollen population, gross sedimentary phases and geotechnical properties. Throughout the cores, pine is the dominant tree genus, but reaches its maxima during shallow water phases of the lake. Oak and alder increase during the deeper water phases. Fir seems to indicate cooler temperatures rather than just higher precipitation. Genera such as maize and spruce are infrequent in the profile but must be considered.

Taxodium and microcoquinas of ostracods appear in association with each other. Diatoms and sponge spicules are noted in frequency of appearance. Rapid deposition and volcanic activity obscure or destroy the pollen.

HAMILTON, RICHARD (University of Massachusetts): Plant Microfossil Studies of an Arkansas Wilcox (Eocene) Coal.

LE BLANC, ARTHUR (University of Massachusetts): Plant Microfossil Studies of the Rockport, Texas Project of the A.P.I.

BARGHOORN, ELSO S. (Harvard University): Pollen and Spores of the Brandon Lignite and their Paleoecological Significance.

BARGHOORN, ELSO S. (Harvard University): Some Recent Work on Fossil Soils from the Piedmont of South Carolina.

BENNINGHOFF, WILLIAM S.: Some Applications of Palynology to the Earth Sciences in Alaska.

Techniques involving fossil pollen are being applied to diverse researches in Alaskan geochronology and geobotany. Results of these pollen studies are occasionally ambiguous and commonly less positive than results of corresponding studies in temperate latitudes. The deposition and history of pollen-bearing sediments in boreal regions account for some obstacles of the method. Further problems are imposed upon the method and interpretation of results by the nature of the floras, ecological characteristics of boreal vegetation, and geological processes of frost climates. It is suggested that the most promising approach for palynology in the North is that of working toward the reconstruction of local vegetation at stratigraphic horizons, to add this total environment, then the application of these extrapolated results to geologic and biotic chronologies. Palynology promises little success in the production of independent vegetation chronologies for regions of boreal forest or tundra.

B. Second National Pollen Conference, December 28—29.

Joint Session of AAAS, Section G-Botanical Sciences, and the Ecological Society of America.

FOREMAN, FRED (Oberlin College): Studies of Mexican Profiles, I: Textural and Petrographic Analyses.

CLISBY, KATHRYN (Oberlin College): Studies of Mexican Profiles, II: Pollen Profiles.

ELLIS, WADE (Oberlin College): Studies of Mexican Profiles, III: Statistical Analyses.

BARGHOORN, ELSO S. and WOLFE, MARGARET K. (Biological Laboratories, Harvard University) and CLISBY, KATHRYN (Oberlin College): Studies of Mexican Profiles, V: Fossil Maize in the Valley of Mexico.

MANGLESDORF, PAUL C. (Botanical Museum, Harvard University): Variations in Pollen of Maize and Its Relatives.

Round-table Discussion: Interrelations of Palynology and other Disciplines.

COURTEMANCHE, ALBERT (service de Biogéographie, University of Montreal) and POTZGER, JOHN E. (Butler University): Bog Study Expedition by Plane Across the Laurentian Shield: A Kodachrome Record.

POTZGER, JOHN E. (Butler University) and COURTEMANCHE, ALBERT (Service de Biogéographie, University of Montreal): A series of Bogs Across Quebec from the St. Lawrence Valley to James Bay.

CAIN, STANLEY A. (University of Michigan): Studies on Pollen Representation, I: Spectra from Moss Polsters in Relation to Forest Types in Central Quebec.

GRAYSON, JOHN (University of Michigan): Studies of Pollen Representation, II: Spectra from Moss Polsters in Relation to Forest Types in Eastern Quebec.

POLUNIN, NICHOLAS (Harvard University): Arctic Aerobiology: Pollen Grains, etc., Observed on Sticky Slides Exposed in Various Regions in 1950.

HEUSSER, CALVIN J. (American Geographical Society, New York): Palynology of the Taku Glacier Snow Cover, Alaska, and its Significance in the Determination of Glacier Regimen.

BUTLER, PATRICK (Biological Laboratories, Harvard University): Palynological Studies of the Barnstable Marsh, Cape Cod, Massachusetts.

Round-table Discussion: Problems of Profile Interpretation.

WILSON, L. R. (University of Massachusetts): The Value of Plant Microfossils in Ancient Strandline Studies.

GERARD, ROBERT (McGill University): A Method for Pollen Sampling in Permafrost.

CAIN, STANLEY A. (University of Michigan): Further Studies on Size-Frequency Characteristics of Conifer Pollen.

CRANWELL SMITH, LUCY (Cambridge, Massachusetts): *Nothofagus*: Its Living and Fossil Pollen.

TRAVERSE, ALFRED (U.S. Bureau of Mines, Grand Forks, North Dakota): The Application of Palynological Methods to Investigations of Tertiary Coals.

BLAKESLEE, ALBERT F. (Smith College): The Use of Pollen in Genetic Studies.

Round-table Discussion: Problems of Palynological Techniques.

BOTANISKA NOTISER 1954, HÄFTE 2. LUND

On Pollen Grains and Dinoflagellate Cysts in the Firth of Gullmarn, SW. Sweden.

By G. ERDTMAN.

Marine sediments at the south-western coast of Sweden have repeatedly been the subject of pollen-statistical investigations (ERDTMAN 1921, HALDEN 1922 etc.). The present paper contains some data on the number of pollen grains and spores which settle in different seasons, after traversing the sea water, in the sedimentogeneous zone at the sea bottom. They further include some observations on dinoflagellate cysts and other »hystrichosphaeroid» bodies. The investigations were carried out from 1947 to 1949 and during part of the summer of 1952 at the Marine Research Laboratory at Bornö. Bornö is a small island situated in the inner part of the Firth of Gullmarn, about 75 km NNW of Gothenburg.

The finding of pollen grains — including pollen grains of several kinds of herbs — in abyssal sediment cores obtained by Dr. B. KULLENBERG during Professor HANS PETTERSSON's oceanographic reconnaissance work in the Mediterranean in 1947 (cf. LARSSON and ERDTMAN in PETTERSSON 1948) provided a stimulus for the present paper. Another reason for undertaking the investigation was the desire to present, if possible, some data illustrating the annual amount of pollen grains and spores settling through the waters. The investigation was made possible thanks to the good offices of Professor PETTERSSON, whom I wish to thank for valuable suggestions and substantial aid. My thanks are further due to Dr. JERLOW and Dr. KOCZY for various suggestions, as well as to Professor T. BRAARUD, Oslo, Dr. ASTRID CLEVE-EULER, Uppsala, Dr. H. HÖGLUND, Lysekil, Professor H. KUFFERATH, Brussels, and Dr. O. WETZEL, Eutin, for ready assistance in the identification of plancton organisms.

Following a suggestion of Dr. KOCZY, the settling material (pollen

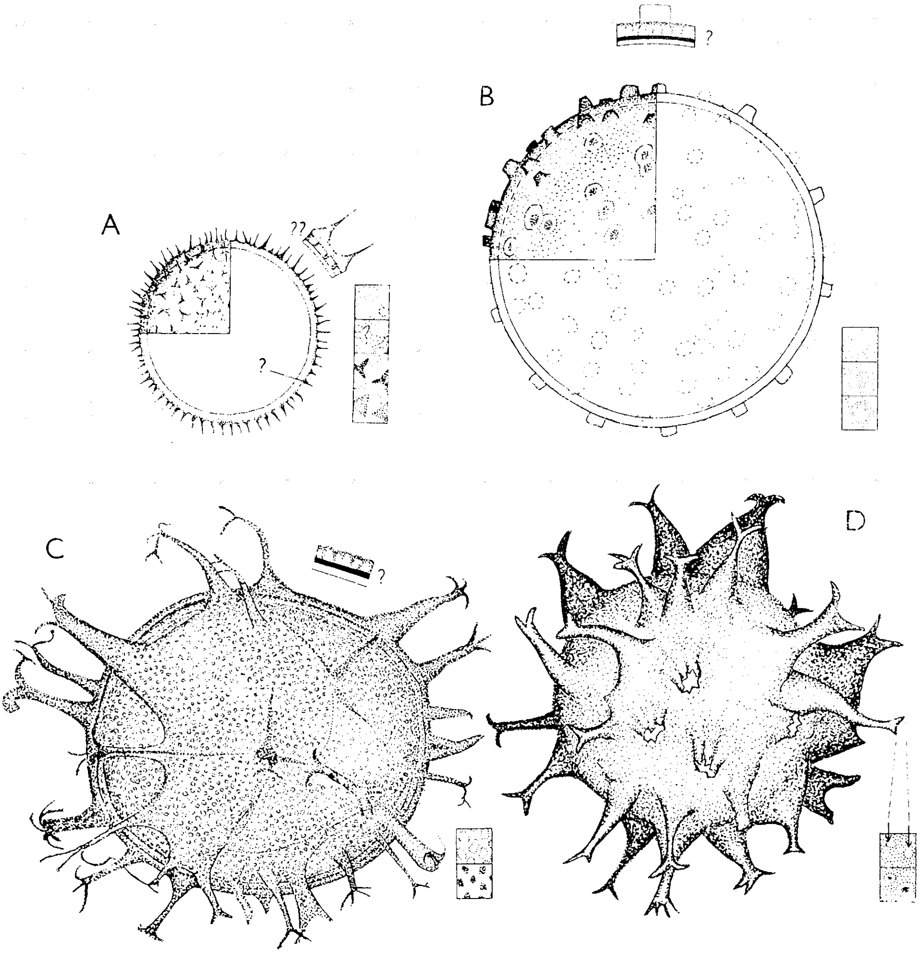


Fig. 1. A, *Protoceratium reticulatum* (BRAARUD det.); June 1952; fixed in formaline; smaller and provided with shorter spines than the cysts described by BRAARUD (1945; N.B.: the line from the lower query should end at the inner contour line of the cyst wall. — B, cf. *Peridinium triquetrum* (BRAARUD det.); June 5—August 1, 1949; *Hystrichosphaera* cf. *furcata* (O. WETZEL det.) was encountered in the same sample. — C, »Probably not a dinoflagellate cyst» (BRAARUD); Sept. 1—Oct. 7, 1948. — D, »Probably a dinoflagellate cyst» (BRAARUD); June 1—July 7, 1949. × 1000.

grains, spores, etc.) was collected in corked flasks without bottom and an inside diameter of 95 mm fixed upside down 15 metres below mean sea level and 22 metres off the precipitous shore. The total depth at this place amounts to 30 metres. The difference between high and low water levels is practically negligible.

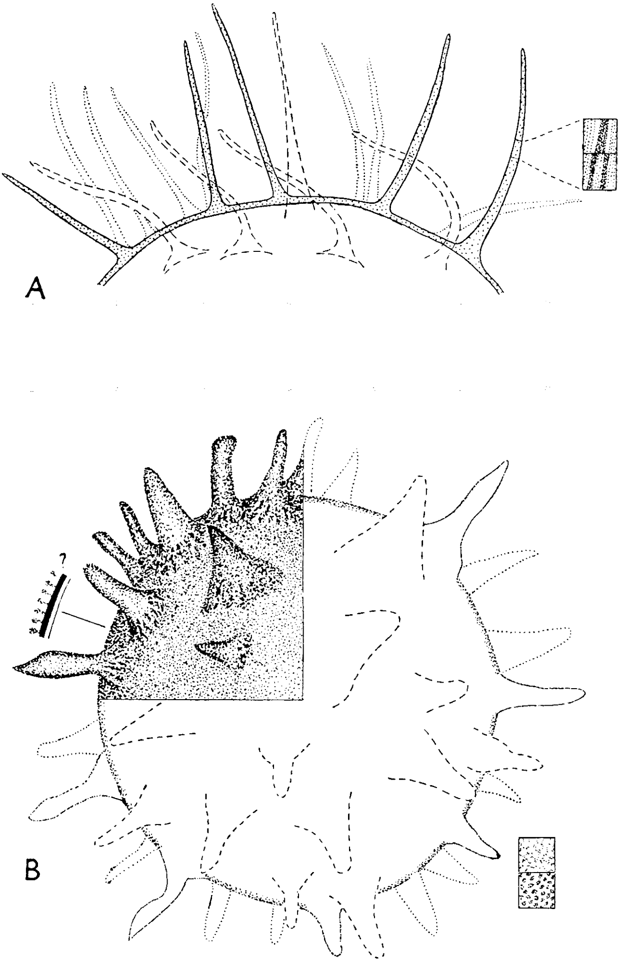


Fig. 2. A, Part of a »dinoflagellate cyst?» (BRAARUD det.); May 4—June 4, 1948. — B, cf. *Goniaulax polyedra* (BRAARUD det.); Sept. 1—Oct. 7, 1948. ×1000.

The flasks were generally exchanged monthly, the sediment condensed by centrifuging and subjected to chemical treatment (as a rule with H_2F_2, followed by acetolysis). The total amount of the pollen grains was calculated in the same way as described by ERDTMAN 1937 (cf. also ERDTMAN 1943, p. 183, lines 11—22 from below).

Bornö is densely forested, chiefly by mixed pine-spruce-forest with some admixture of birch, oak, alder, and beech, etc. Data on the flora and vegetational history of this part of Sweden have recently been published by H. FRIES (1945) and M. FRIES (1951).

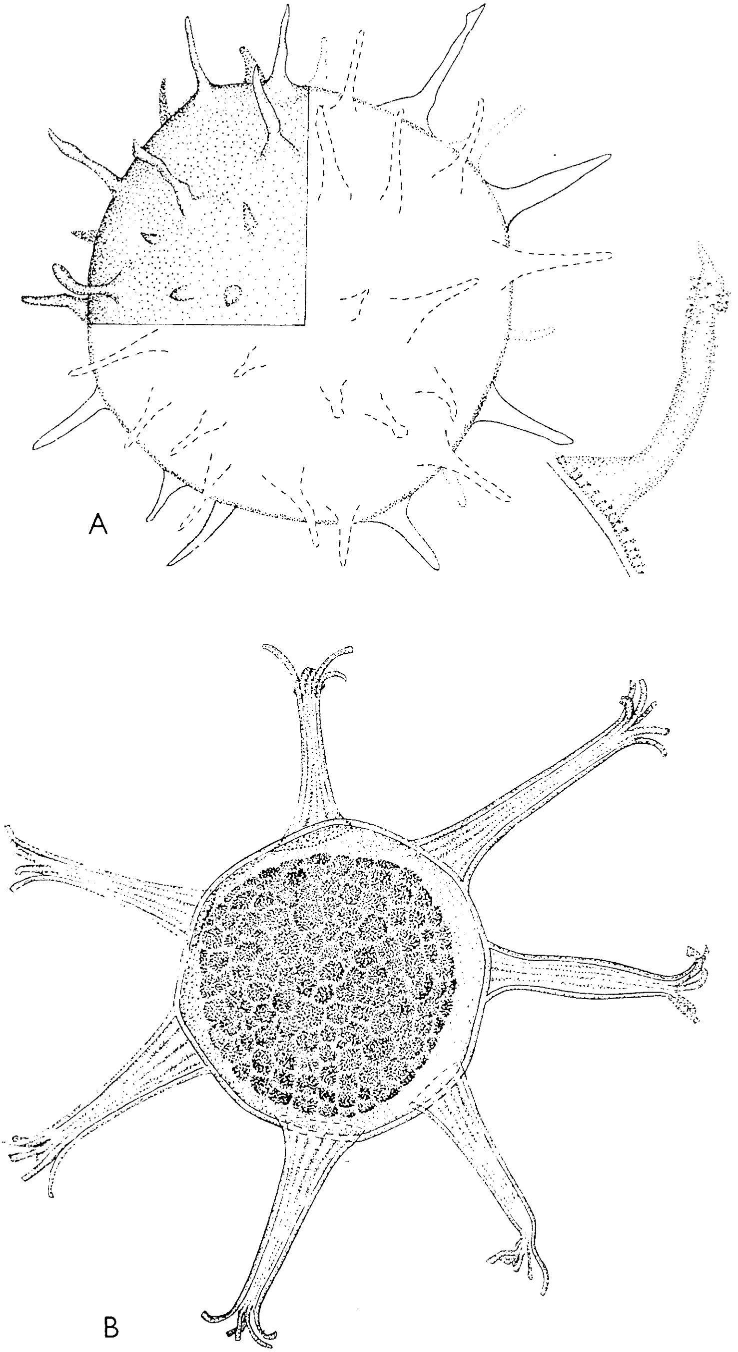


Fig. 3. A, *Goniaulax polyedra* (Braarud det.); Sept. 1—Oct. 7, 1948; cf. Fig. 1, p. 191, in Eisenack 1951! — B, *Hexasterias problematica* (A. Cleve-Euler det.); May 4—June 11, 1948; specimen with seven arms (fixed in formaline). ×1000.

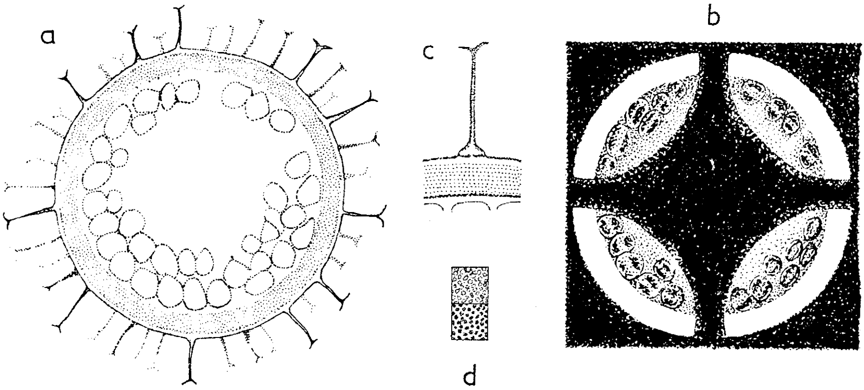


Fig. 4. »Probably a dinoflagellate cyst» (BRAARUD); July 1952; fixed in formaline; b: same as a (crossed polars). a, b × 1000; c ×2000.

Tab. 1. Tree and shrub spores collected in the Firth of Gullmarn 1947—1949. (Technique, see p. 104, 105.)

	Number of days	Σ spores	Σ spores per sq. cm	Σ spores per sq. cm and day	*Alnus*	*Betula*	*Carpinus*	*Fagus*	*Fraxinus*	*Picea*	*Pinus*	*Quercus*	*Tilia cordata*	*Ulmus*	*Corylus*	*Juniperus*	*Populus*	*Salix*	Σ tree and shrub spores
Sept. 1947	—	295	—	—	18	63	—	2	1	14	122	4	1	1	5	1	—	1	233
Oct. 1947	—	347	—	—	28	56	—	—	—	19	118	17	+	1	6	10	1?	1	257
10.11—15.12 47	—	361	—	—	16	61	—	1	—	21	159	18	2	—	5	6	—	—	289
15.12 47—16.1 48	—	377	—	—	37	55	—	2	2	16	114	15	—	—	10	13	1?	1	266
20.5—3.6 48	14	428	896	64	2	107	—	6	—	42	163	22	—	—	—	65	—	1	408
3.6—13.7	40	179	1,600	40	5	42	—	—	—	20	40	7	—	—	2	4	—	—	120
13.7—2.8	20	117	420	21	4	22	—	—	—	9.5	11.5	2	1	—	—	—	—	—	50
2.8—1.9	30	196	585	19.5	12	41	—	2	—	22	46	5	1	1	2	3	—	—	135
1.9—7.10	36	151	166	4.6	13	66	—	—	—	4	18	4	1	—	4	—	—	—	110
7.10—15.11	39	122	324	8.3	17	41	—	+	—	6.5	27.5	6	1	1	1	2	1?	—	104
15.11—28.12	43	144	159	3.7	12	43	—	—	2	6	28	8	—	1	—	—	—	—	100
28.12—6.2 49	40	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6.2 49—2.3 49	24	237	48	2	16	42	1	1	—	12	120	7	1	—	8	4	—	—	212
2.3—16.3	14	142	42	3	6	49	—	1	1	5	33	4	—	1	7	2	—	—	109
16.3—1.4	16	100	16	1	9	20	—	—	—	11	33	4	—	—	2	2	—	1	82
1.4—4.5	33	230	396	12	26	37	2	2	7	46	6	6	1	7	6	1	2	1	150
4.5—1.6	28	200	3,696	132	2	6	—	—	2	2	152	11	—	—	—	18	—	—	193
1.6—5.7	34	119	1,360	40	3	4	—	—	—	—	73	1	—	—	—	6	1?	—	88
5.7—1.8 49	27	227	486	18	4	15	—	—	—	7	83	4	—	1	2	3	—	1	120

Tab. 2. Non-tree and non-shrub spores collected in the

	Number of days	Σ spores	Σ spores per sq. cm	Σ spores per sq. cm and day	*Caryophyllaceae*	*Chenopodiaceae*	*Compositae*				*Cruciferae*	*Cyperaceae*	*Ericales*	*Gramineae spont.*	*Gramineae cult.*
							Artemisia	*Centaurea cyanus*	*Liguliflorae*	Others					
Sept. 1947	—	295	—	—	—	4	5	—	3	2	—	—	11	10	1
Oct. 1947	—	347	—	—	1	8	2	1	1	2	—	1	10	15	4
10.11—15.12 47	—	361	—	—	1	4	1	1	3	—	—	2	8	18	5
15.12 47—16.1 48	—	377	—	—	1	4	1	—	3	—	—	2	5	23	6
20.5—3.6 1948	14	428	896	64	—	—	1?	—	1	—	—	2	1	2	—
3.6—13.7	40	179	1,600	40	—	1	—	1	—	—	—	—	3	28	3
13.7—2.8	20	117	420	21	—	—	28	—	—	1	1	—	3	16	3
2.8—1.9	30	196	585	19.5	—	3	8	—	—	1	—	—	23	6	+
1.9—7.10	36	151	166	4.6	—	7	1	—	1	1	—	—	7	11	1
7.10—15.11	39	122	324	8.3	—	2	—	—	1	—	—	—	1	5	—
15.11—28.12	43	144	159	3.7	—	6	—	—	1	—	—	2	8	6	1
28.12—6.2 49	40	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6.2 49—2.3 49	24	237	48	2	—	1	1	1	2	—	—	—	—	7	3
2.3—16.3	14	142	42	3	—	—	—	—	1	—	—	—	5	6	1
16.3—1.4	16	100	16	1	1	1	—	—	—	—	—	1	3	2	1
1.4—4.5	33	230	396	12	—	2	—	—	2	7	—	4	9	12	11
4.5—1.6	28	200	3,696	132	—	—	—	—	—	—	—	2	—	1	—
1.6—5.7	34	119	1,360	40	—	—	—	—	—	—	—	—	—	10	4
5.7—1.8 49	27	227	486	18	—	—	1	—	1	2	1	—	—	62	8

The results of the pollen- and sporestatistical investigations appear from Tab. 1—2. In one year (August 1948 to July 1949) about 520.000 pollen grains and spores passed the sea water and sedimented in the flasks (intake area 71 cm^2). A horizontal square area, 1×1 mm, thus receives about 73 pollen grains and spores per year. The lowest number of pollen grains and spores was collected in February and March 1949 (1—3 per sq. cm and day), and the highest number in May 1949 (about 132 per sq. cm and day). The firth was frozen from December 29, 1948 to February 5, 1949. No observations were made during this period.

The tables give the absolute numbers of pollen grains in trees (*Alnus—Ulmus*), shrubs (*Corylus—Salix*), herbs (*Caryophyllaceae—Urticaceae*), ferns and mosses (*Athyrium—Sphagnum*). The relative frequencies can be calculated from the sums given in the tables.

The alder pollen frequency reaches a maximum in April; pine pollen predominates in June; the *Artemisia, Rumex,* and *Gramineae* pollen maxima occur in July, that of *Ericales* tetrads in August.

Firth of Gullmarn 1947—49. (Technique, see p. 104, 105.)

				Rosac.												Lyco-pod.							
Leguminosae	*Plantago*	*Ranunculaceae*	*Rhamnus*	*Filipend. ulm.*	Others	*Rubiac. (Galium)*	*Rumex*	*Ruppia*	*Spargan.* and/or *Typha*	*Umbelliferae*	*Urticaceae*	*Athyr. f.-fem.*	*Dryopt. f.-mas*	*Dryopt. phegopt.*	*Equisetum*	*Selago*	Others	*Polypodium*	*Pteridium*	*Sphagnum*	Unidentified	Σ non-tree and non-shrub spores	Σ tree and shrub spores
—	1	—	—	—	—	—	4	—	—	—	—	3	—	1	1	—	—	—	2	2	12	62	233
1	+	—	1	1	—	—	2	2	1	—	—	—	1	1	—	—	1	1	—	5	27	90	257
—	—	1	—	—	—	—	4	—	—	—	1	3	1	—	—	—	1	1	—	4	23	72	289
—	1	2	—	—	—	—	3	1	—	—	1	1	1	1	—	1	—	—	—	8	46	111	266
—	1?	—	—	1	—	—	2	—	—	—	—	—	—	—	1	—	—	—	—	1	7	20	408
—	—	—	—	—	1	—	7	—	—	—	—	—	—	—	—	—	—	—	—	—	15	59	120
—	4	—	—	—	—	—	5	—	—	—	—	—	—	—	—	—	—	—	—	—	6	67	50
—	5	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	12	61	135
—	1	—	—	—	—	—	5	—	—	—	—	1	—	—	—	—	—	1	2	1	7	41	110
—	—	—	—	—	—	—	2	—	—	2	—	—	—	—	—	—	—	—	—	—	5	18	104
1	2	1	—	1	—	—	2	—	—	1	—	—	1	—	—	—	1	—	—	—	10	44	100
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	2	—	1	—	—	2	—	—	—	—	—	—	1	—	—	1	3	25	212
—	2	—	—	—	4	—	2	—	—	—	—	—	1	—	1	—	—	1	—	2	7	33	109
—	1	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	6	18	82
1	1	2	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	1	—	2	26	80	150
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	7	193
—	1	—	—	—	—	—	9	—	—	—	—	—	—	—	—	—	—	—	—	—	7	31	88
—	—	1	—	—	1	1	16	1	—	—	—	1	—	—	—	—	—	—	—	—	11	107	120

Pollen grains of *Ruppia* were encountered three times (in July, October, and December). Even late in the year (October—December) the pollen grains and spores traversing the water are practically of the same kind as those of earlier seasons, though their number is considerably smaller. In all probability, these pollen grains originally settled on land and were later swept into the sea by strong winds.

In connection with the pollen-statistical investigation of the samples stray observations on »hystrichosphaeridoid» organisms were made. Some of these (cf. Figs. 1—4) have been identified by Professor T. BRAARUD. Resting spores of *Goniaulax polyedra* (cf. further NORDLI 1951) were very common in some samples. Thus in the sediment sample collected in September and the first week of October 1948 their frequency was about 66 times that of the pollen grains. In other words, the total »palynological population» of the sea water (dinoflagellate cysts, pollen grains, and spores) was, in those autumn weeks, about twice as large as during the spring pollen maximum recorded in May.

In the three last weeks of October and the first week of November the average number of *Goniaulax* cysts was only about three times that of the pollen grains.

The walls, or at least their outer part, of the »hystrichosphaeridoid» organisms (including the dinoflagellate cysts) have several features in common with the sclerine of the pollen grains and spores, such as their resistance to acetolysis and to treatment with hydrofluoric acid. Their fine details can be illustrated, just as in pollen grains, by means of palynograms, etc.

Fresh »hystrichosphaeridoids», when fixed in formaline, often exhibit various greenish, yellowish, sometimes even faintly reddish shades. The contents observed in fresh specimens of *Hexasterias problematica* (cf. Fig. 3 B) would seem to suggest that these organisms are phytogeneous.

Generally speaking many hystrichosphaeridoid organisms have several traces in common with certain dinoflagellate cysts. There is need for further dinoflagellate studies on the lines of those undertaken by BRAARUD (1945) to give us better insight into the actual relationships between dinoflagellate cysts on the one hand, and the more or less heterogeneous group of »hystrichosphaeridoid organisms» on the other. Literature on the latter subject has recently been compiled [ERDTMAN in Geol. Fören. Stockh. Förhandl. 1949 (p. 76), 1950 (p. 37), 1951 (p. 107), 1952 (p. 31), 1954 (p. 26)].

The fact that living hystrichosphaeridoid organisms have been found in the waters of the Firth of Gullmarn proves — what has earlier been emphasized on several occasions (ERDTMAN 1950; cf. also Svensk Bot. Tidskr. p. 55, 1949) — that the occurrence of such organisms in postglacial sediments etc. does not necessarily imply an admixture of allochthonous elements from older, hystrichosphaeridoidiferous strata.

Goniaulacoid cysts also occur in abyssal sediments from the Mediterranean, collected by Professor HANS PETTERSSON. This was pointed out by the present author in a paper read in September, 1953, at the third I.N.Q.U.A. Congress (Pisa), and it was then suggested that investigations should be undertaken into the occurrence and frequency of some types, at least the most distinct ones. Will it be possible to use, to some extent at least, hystrichosphaerids and hystrichosphaeridoid organisms in the same way as pollen grains and spores in peats and lacustrine sediments? If this can be done, marine sediments poor in pollen grains, or lacking them altogether, would, nevertheless, be accessible to micropalaeontological investigations similar to pollen statistics.

Literature.

BRAARUD, T. 1945. Morphological Observations on Marine Dinoflagellate Cultures. — Avh. Norske Vidensk.-Akad. I. Mat.-Naturv. Kl. 1944. No. 11.

EISENACK, A. 1951. Über Hystrichosphaerideen und anderen Kleinformen aus baltischem Silur und Kambrium. — Senckenbergiana 32: 187—204.

ERDTMAN, G. 1921. Pollenanalytische Untersuchungen von Torfmooren und marinen Sedimenten in Südwest-Schweden. — Ark. f. Bot., Bd. 17, No. 10.

— 1943. An Introduction to Pollen Analysis. — Waltham, Mass.

— 1948. See PETTERSSON 1948.

— 1950. Fynd av *Hystrichosphaera furcata* i Gullmarn. — Geol. Fören. Stockh. Förhandl.

FRIES, H. 1945. Göteborgs och Bohus läns fanerogamer och ormbunkar. Göteborg.

FRIES, M. 1951. Pollenanalytiska vittnesbörd om senkvartär vegetationsutveckling, särskilt skogshistoria, i nordvästra Götaland. — Thesis, Uppsala.

HALDEN, B. E. 1922. Tvänne intramarina torvbildningar i norra Halland jämte äldre och nyare synpunkter på saltvattensdiatomacéerna. — Sveriges Geol. Unders., Ser. C. No. 310.

LARSSON, C. 1948. See PETTERSSON 1948.

NORDLI, E. 1951. Resting spores in *Goniaulax polyedra* Stein. — Nytt Mag. f. Naturvidensk., Bd. 88.

PASTIELS, A. 1945. Étude histochimique des coques d'Hystrichosphères. — Bull. Mus. Hist. nat. Belg. 21 (17).

PETTERSSON, H. 1948. Three Sediment Cores from the Tyrrhenian Sea. — Göteb. Vet.- och Vitterh.Samh. Handl., 6. Följden, Ser. B, Bd. 5, No. 13.

BOTANISKA NOTISER 1954, HÄFTE 2. LUND

On the Occurrence of Pediastrum in Tertiary Strata in the Isle of Wight.

By O. BORGE (†) and G. ERDTMAN.

In the October issue of the American Journal of Science for 1953 (Vol. 251, pp. 753—760) L. R. WILSON and W. S. HOFFMEISTER described four new species of *Pediastrum* from the Lower Formation (Paleogene) of southern Sumatra. The authors state, among other things, that until the Sumatra discovery *Pediastrum* was not known in the fossil state earlier than Pleistocene.

This statement must be challenged. For, in 1935, the junior author found well preserved *Pediastrum* coenobia in a layer with *Chara* among the Headon beds in the Isle of Wight. These beds are Oligocene or possibly Eocene (cf. CHATWIN, C. P., Guide to Geological Excursion to the Isle of Man and the Mainland opposite; Geological Survey Centenary, London 1935; p. 20). A notice on this matter was included in a paper read at the combined meeting of the Geobotanical and Palaeobotanical Sections, VIth International Botanical Congress, Amsterdam, September 5, 1935. The paper in question (»New Methods in Pollen Analysis») was published in Svensk Botanisk Tidskrift in 1936 (Vol. 36, pp. 154—164). It concludes as follows:

> »In its botanical application pollen analysis should not be restricted solely to tracing the history of the forest trees but should be used, also, to trace the history of all plants whose pollen can be indubitably identified. Nor does the idea apply to pollen analysis of Quaternary deposits alone. The older deposits present a wealth of similar problems. Of these only one may be mentioned here: the origin and history of the Angiosperms. A few weeks ago I collected some rock samples in the Isle of Wight and on the mainland opposite, ranging in age from Oligocene to Upper Jurassic times. Treating these samples by the methods just mentioned it was possible, in some cases at least, to isolate pollen and spores in great profusion in addition to such delicate things as coenobia of *Pediastrum* etc. Consequently it does not seem unreasonable to hope that pollen analysis of suitable samples of Cretaceous and Jurassic material etc.,

will contribute to the elucidation of the profoundly important problem relating to the origin and early history of the Angiosperms.»[1]

In a letter dated August 9, 1935, the senior author gave a detailed report on the *Pediastrum* coenobia from the Headon beds. They were all found to belong to the still existing, common species *Pediastrum boryanum* (f. *typicum*). He also made a collocation of the finds of the same species in Late Quaternary deposits in Sweden [cf., for instance, papers by LAGERHEIM (1902, 1903), VON POST (1903 and 1909), HOLST (1906), WITTE (1906), SERNANDER (1910), HALDEN (1917), SUNDELIN (1917), and ERDTMAN (1921), listed in »Literature on Palynology» by G. ERDTMAN].

Dr. O. BORGE, a generous and unconventional scientist, well known for his papers on microscopical algae, died in 1938. His careful examination of the fossil *Pediastrum* coenobia from the Isle of Wight provided an impetus for writing the present note.

Palynological Laboratory, Bromma, December 1953.

---

[1] At that time there were, in fact, special reasons for stressing the future importance of micropalaeontology in tracing the early history of the Angiosperms. Thus, the junior author in July 1935 discovered stray pollen grains of a dicotyledonous type in another deposit in the Isle of Wight, viz. the »Dirt Bed» (Middle Purbeck, Upper Jurassic strata). For certain reasons these findings were never published. The discovery of a large juglandoid pollen grain (diameter 70 μ) was, however, mentioned incidentally in an interview published in the Swedish newspaper Svenska Dagbladet, April 3, 1938. Notes on these grains, camera lucida drawings etc. are preserved in the archive of the Palynological Laboratory, Bromma. The microscope slides were not sealed and so became spoiled.

BOTANISKA NOTISER 1954, HÄFTE 2. LUND

Bau und Form von Sporotrapoidites illingensis n. gen. et sp. sporomorpharum.[1]

Von W. KLAUS.
Geologische Bundesanstalt, Wien.

Gross ist die Zahl bisher bekannter fossiler Mikrosporen aus verschiedenen Ländern und Straten. Gross ist die Zahl der hiefür nach verschiedenen Gesichtspunkten eingeführten Namen. Noch grösser können die Schwierigkeiten sein, fossile Mikrosporen mit den jetzt bekannten zu identifizieren. Der Grund hiefür scheint klar. Die älteren, wenn auch kurzen, aber für den Stand vor etwa 30 Jahren klaren Beschreibungen und Abbildungen stammen aus der Pionierzeit der Mikrofossilbestandsaufnahme. Obwohl damals kaum geahnt werden konnte welche Formenfülle sich nach Fortsetzung dieser Arbeiten kundtun würde, haben einzelne Autoren schon Typuspräparate angefertigt und immer wieder gefordert, in der klaren Erkenntnis, dass an einem so kleinen und in seinem Bau oft so komplizierten Objekt wie einer Mikrospore fortgesetzte Schlussfolgerungen nur auf einer konstanten Basis — dem Typuspräparat — aufgebaut werden könnten. Die Wirren der Zeit mögen es mit sich bringen, dass man bei Bestimmungsfragen zur Zeit nicht in allen Fällen auf die alten Typen zurückgreifen kann. Bei manchen neueren Arbeiten steht ihr Umfang in umgekehrtem Verhältnis zur angegebenen Zahl von Typuspräparaten, d.h. dass die grosse Zahl der angeführten, vielleicht neuen Sporomorphen wohl geeignet ist unser Interesse in Anspruch zu nehmen, nicht aber zu eindeutigen Entscheidungen bei Bestimmungen herangezogen werden kann.

Dabei betonen doch alle konsequent-palynologisch arbeitenden Forscher immer wieder die Notwendigkeit der paläontologischen Sporenbearbeitung, worunter hier die morphographische Bearbeitung von Sporenformen auf Grund von Typuspräparaten verstanden wird. R. POTO-

---

[1] Palynographica (No. 1). Morphographic studies of recent and fossil spores edited by G. ERDTMAN and W. KLAUS, International Commission on Palynology.

NIÉ hat seit Jahren immer wieder die Typuspräparation gefordert und Sporenmonographien empfohlen, die Notwendigkeit hiefür aus seiner Erfahrung ableitend. G. ERDTMAN hat für rezente und auch fossile Sporen an Hand von detaillierten Palynogrammen die Richtung zu klaren Darstellungen gewiesen. Auch KIRCHHEIMER sagt (1950, S. 156): »Man sollte . . . durch grundlegende Untersuchungen den zu weiteren Schlussfolgerungen berechtigenden Kredit des Verfahrens schaffen.»

Herkunft des Untersuchungsmateriales. Das Sediment, aus welchem die hier beschriebene Sporenform in mehreren Exemplaren präpariert werden konnte, stammt aus einer Braunkohlengrube des Hausruck in Oberösterreich. Die Hausruckbraunkohlen liegen in den kohleführenden Süsswasserschichten Oberösterreichs. Sie wurden der oberen Süsswassermolasse (Ober-Miozän) zugerechnet. Seit dem Zahnfund von *Hipparion gracile* KAUP gelten Teile der Hausruckflöze (Wolfsegg, Oberflöz) als sicheres Unter-Pliozän (E. THENIUS 1952). Stratigraphisch tiefere Anteile (westlicher Hausruck), aus welchen die hier beschriebene Sporomorphe stammt, könnten dem Ober-Miozän angehören.

Die Probe wurde im Illing, wo zwei Flözbänke, etwa 1.5 m mächtig im Tiefbau abgebaut werden, von Doz. Dr. H. ZAPFE im Jahre 1950 aus dem dünnen Zwischenmittel in der Unter-Bank, Heissler-Stollen, Streichendstrecke, entnommen und freundlichst zur palynologischen Untersuchung zur Verfügung gestellt. Die Sedimentprobe und das aufbereitete Sporenkonzentrat sind unter No. »1 H» in der Sammlung der Geologischen Bundesanstalt in Wien aufbewahrt.

Lithologische Beschaffenheit des Sedimentes. Humoser plastischer Ton. In bergfeuchtem Zustand von graubrauner Farbe, mitunter mit einem leicht rosaroten Anflug. Keine Schichtung. Die Probe wurde einige Zentimeter über Oberkante des unteren Kohlenblattes der Flöz-Unterbank entnommen.

Isolationsmethode. Das Sediment wurde mit Flussäure und Salzsäure zuerst vom anorganischen Anteil befreit. Der organische Rückstand ergab nach Chlorierung und Azetolyse und Aufnahme in Glyzeringelatine sehr klare Präparate, welche vorwiegend pflanzliche Mikrosporen enthalten. Holz- und Kutikularreste sind sehr selten.

Erhaltungszustand der Exinen. Mikrosporen sind vorwiegend körperlich-dreidimensional erhalten, Korrosion und Desorganisation so gut wie nicht feststellbar. Zu morphographischen Studien sind die Sporen dieser Probe besonders gut geeignet — bei alpinen Braunkohlen eine ausgesprochene Seltenheit. Die Azetolyse bewirkt wohl eine Quellung der Exinen in der Grössenordnung von etwa 10—20 %. Sie hat sich, abgesehen von den hervorgerufenen sehr kontrastreichen Braun- bis Gelbfarbwerten, die eine Detailuntersuchung sehr erleichtern, zum Studium der Exinenstratifizierung und des Aperturen-Baues — das wäre besonders zu betonen — auch an Jungtertiärmaterial als ganz hervorragend geeignet erwiesen. Es liegt heute Veranlassung vor, auf diesen letzteren Punkt besonders hinzuweisen, denn Kontrollversuche mit Wasserstoffsuperoxyd, Natriumperborat und Kalilauge haben ergeben, dass diese Methoden wohl weniger kostspielig und zeitraubend sind, aber für genauere morphographische Untersuchungen wegen der starken Aufhellung, der teilweise auftretenden Korrosion der Exinen und besonders wegen der hiebei relativ undeutlichen Aperturenbaues sehr viel zu wünschen übrig lassen.

Palynokoïnum der Probe. Die beschriebene Sporomorphe kommt in folgender Vergesellschaftung (Palynokoïnum, R. POTONIÉ 1951) in Einzelexemplaren, die sich prozentuell nicht erfassen lassen, vor:

Sequoioipollenites polyformosus THIERG.	sehr selten
Taxodioipollenites sp.	häufig
Sciadopitys-pollenites serratus R. POT. & VEN.	selten
Tsugaepollenites macroserratus WOLFF (*major*)	selten
Tsugaepollenites macroserratus WOLFF (*minor*)	selten
Tsugaepollenites igniculus major et *minor* R. POT.	selten
Pinuspollenites labdacus minor R. POT.	häufig
Pinuspollenites labdacus major R. POT.	häufig
Piceaepollenites microalatus minor R. POT.	sehr häufig
Piceaepollenites microalatus major R. POT.	selten
Piceaepollenites alatus R. POT.	selten
Abiespollenites absolutus THIERG.	häufig
Cedroipollenites sp.	sehr selten
Platysaccus libellus (R. POT.)	sehr selten
Laricoipollenites magnus R. POT.	sehr selten
Caryapollenites simplex R. POT.	selten
Pterocaryapollenites stellatus R. POT.	selten
Juglandoipollenites (aff. *regia* und *cinerea*)	sehr selten
Liquidambarpollenites stigmosus R. POT.	selten
Tiliapollenites instructus R. POT.	sehr selten
Tiliapollenites indubitabilis R. POT.	selten
Diverse salicoide Pollenformen	selten
Quercoipollenites henrici R. POT.	häufig

Pollenites laesus R. POT.	selten
Quercoipollenites microhenrici R. POT.	häufig
Weitere quercoide Pollenformen	selten
Cupuliferoipollenites liblarensis POT. TH.	selten
Cupuliferoipollenites villensis THOMSON	sehr selten
Castaneoipollenites exactus R. POT.	sehr selten
Cornaceoipollenites parmularius R. POT.	sehr selten
Symplocoipollenites clarensis et subspec. THIERG.	sehr selten
Symplocoipollenites triangulus R. POT.	sehr selten
Sapotaceoipollenites sp.	sehr selten
Sambucoipollenites sp.	sehr selten
Ilicoipollenites iliacus R. POT.	sehr selten
Ilicoipollenites margaritatus R. POT.	sehr selten
Ilicoipollenites propinquus R. POT.	sehr selten
Ericaceoipollenites ericius R. POT.	sehr selten
Ericaceoipollenites roboreus R. POT.	sehr selten
Pollenites oculis noctis THIERG.	sehr selten
Pollenites brühlensis THOMSON	sehr selten
Fagoipollenites sp.	häufig
Ulmoidites undulosus WOLFF	häufig
Zelkowoidites sp.	selten
Pollenites cf. *willrathae* R. POT.	sehr selten
Nyssoipollenites rodderensis THIERG.	sehr selten
Nyssapollenites accessorius R. POT.	häufig
Nyssapollenites analepticus R. POT.	selten
Nyssoipollenites dispar R. POT.	häufig
Araliaceoipollenites edmundi et subsp. R. POT.	selten
Rhooipollenites sp.	selten
Diverse *Gramineae*	sehr selten
Compositoipollenites (cf. *Liguliflorae*)	selten
Myriophylloide Exinen	sehr selten
Caprifolioide Exinen	sehr selten
Potamogetonoide Exinen	sehr selten
Lemnoide Exinen	selten
Trapoide Exinen	sehr selten
Ovoidites ligneolus R. POT.	sehr selten
Tetraporina NAUMOWA sp.	sehr selten
Engelhardtioipollenites microcoryphaeus R. POT.	sehr selten
Betulaceoipollenites bituitus R. POT.	häufig
Myricaceoipollenites sp.	selten
Alnuspollenites metaplasmus und ähnl. sp.	häufig
Carpinoide Exinen	selten
Sporites primarius WOLFF	sehr selten
Polypodiaceae-sporites haardtii R. POT. & VEN.	sehr selten
Polypodiaceae-sporites cf. *speciosus* R. POT.	sehr selten

Präparat-Belegmaterial (Typen). Diagnose, Beschreibung von Bau und Form, die Mehrzahl der Mikrophotos und das Palynogramm dieser Arbeit beziehen sich auf das Holotypuspräparat. Weitere Exinen dienten dem Studium der Variationen. Die Sporomorphen liegen als Einzelkornpräparate in der Sammlung des Verfassers an der Geologischen Bundesanstalt in Wien auf, und zwar unter folgenden Nummern: Holotypus, Einzelkornpräparat (»EKP») 112. Weitere Exinen: EKP 27, 44, 111, 113, 115, 117, 118, 130.

Auch ist damit erneut gezeigt, dass die dauernde Erhaltung fossiler Mikrosporen möglich ist. An sich wäre es unnötig, dies zu erwähnen. Wenn aber einzelne Autoren dieser, allerdings nicht ganz bequemen Methodik unter Anführung von Art. 18 der Nomenklaturregeln (1935) aus dem Wege gehen, so erscheint eine Stellungnahme angezeigt. In Art. 18 heisst es: »Ist ein dauernder Erhaltungszustand eines Exemplares oder eines Präparates unmöglich, so wird die Anwendung des Namens einer Art oder einer Unterabteilung einer Art durch die ursprüngliche Beschreibung oder Abbildung bestimmt.» Die Möglichkeit der dauernden Erhaltung einer Spore beweisen auch die alten noch gut erhaltenen Sporenpräparate von EHRENBERG und FISCHER.

Wir sind daher nicht der Ansicht, dass man bei der Aufstellung neuer nomenklatorischer Einheiten auf Typenpräparate verzichten darf. Die Anfertigung eines Typuspräparates im Nachhinein, d.h. nach erfolgter Publikation, erachten wir nicht oder nur beschränkt gültig, da keine Gewähr gegeben ist, dass es sich bei dem Präparat tatsächlich um das gleiche Individuum handelt, das seinerzeit zur Festlegung des Typus photographiert oder beschrieben wurde.

Zur Darstellungsmethode. Ein Körper ist ein dreidimensionales Objekt — auch rezente und fossile Mikrosporen. Dargestellt werden sie flächenhaft, d.h. durch Projektion in die Tafelebene. Nicht eine, sondern drei (bei radialsymmetrischen Formen zwei) ausgewählte Projektionsbilder geben über die räumliche Beschaffenheit des Körpers Auskunft. Wenn man sicher der hiefür vorteilhaften Methoden der darstellenden Geometrie bedienen will, wird der Körper auf drei aufeinander senkrecht stehende Ebenen projiziert, die Projektionsbilder in die Tafelebene geklappt und dann als Aufriss (π_2), Grundriss (π_1), Kreuz- und Seitenriss (π_3) bezeichnet.

Folgerichtig benötigen wir also auch von jeder Mikrospore der Übersicht halber drei Bilder um ihre dreidimensionale Ausdehnung zu erfassen. Besonders sinnvoll erscheint dieses Verfahren, wenn es sich um die Darstellung von räumlich gut erhaltenen Sporen handelt. Stratigraphisch ältere Sporen sind dagegen sehr oft plattgedrückt, sodass eines der Projektionsbilder nicht viel mehr als einen Strich erkennen lassen wird. Aber auch das ist nicht ganz ohne Interesse, denn daraus geht dann am besten die plattgedrückte Form hervor.

In Tafel I ist versuchsweise die untersuchte Spore in Aufriss (Fig. 1), Kreuzriss (Fig. 2) und Grundriss (Fig. 3) photographiert worden. Dazu wurde das Holotypus-Exemplar unter dem Mikroskop in erwärmter, leichter beweglicher Glyceringelatine in die ausgewählten Lagen gebracht und photographiert.

Um einem einheitlichen und damit vergleichbaren Vergrösserungsmasstab gerecht zu werden, ist in Tafel I sowohl der Holotypus als auch die weiteren Sporenformen in 500-facher Vergrösserung abgebildet.

Die Detailaufnahmen von Tafel V und VI wurden mit einem Immersionsobjektiv num. Ap. 1.25 hergestellt und sind im Masstab 1 : 1000 wiedergegeben. Die gerade Zahl 1000 ermöglicht eine einfache Umrechnung der Grössenmasse von mm in μ (1 mm = 1 μ). Natürlich geht diese Vergrösserung auch auf Kosten der Tiefenschärfe. Da es hier aber auf die Wiedergabe von Skulptur und Strukturdetails ankommt und ausserdem die Abbildungen der Tafel I die gleiche Spore nur halb so stark vergrössert bringt, glauben wir diesem Nachteil nicht zu grosse Bedeutung beimessen zu müssen. Wenn es in manchen Fällen notwendig war, bei den Aufnahmen die Kondensorblende mehr als zwei Drittel zu verengen, sind an stärker lichtbrechenden Konturen, wie z.B. in Taf. I Fig. 3, 7, 8, in Taf. III Fig. 3—6, 8, 10, in Taf. IV Fig. 1—3, 6, 7, 9, 10, in Taf. V Fig. 1, 3, 4, 7, 8 und in Taf. VI Fig. 1—5 an den Exinenrändern ein bis mehrere Beugungsstreifen entstanden.

Erkenntnisse, welche am Holotypus durch subjektive Beobachtung gewonnen und soweit als eben möglich durch die vielleicht etwas objektivere photographische Wiedergabe zum Teil festgehalten werden konnten, wurden neben der Beschreibung in Art eines Palynogrammes zur graphischen Darstellung gebracht. ERDTMAN hat diese klare Darstellungsweise eingeführt. Ich bin in dieser Arbeit bemüht seinen wertvollen Beispielen nachzukommen. Dabei bin ich mir wohl bewusst, dass das Palynogramm ebenso wie die Beschreibung die subjektive Auffassung des Verfassers über den Bau der Sporomorphe darlegt, nur vielleicht in etwas bündigerer Form, als dies in einer Beschreibung allein geschehen kann. Die Vergrösserung der Hauptfigur im Palynogramm ist 2150-fach, der Polansicht links unten etwa 540-fach, der idealisierte Exinenschnitt (Fig. f) 4300-fach. Die Art dieser Darstellungsweisen soll den Werdegang des Studiums vom Holotypus-Individuum zur Beschreibung veranschaulichen.

Sporotrapoidites nov. gen. sporomorpharum.

Genotypus: *Sporotrapoidites illingensis* n.sp. Taf. I, Fig. 1—3.

Diplotypus: Einzelkornpräparat Nr. 112, Sammlung Klaus, Geologische Bundesanstalt, Wien.

Derivatio nominis: Wegen der morphograpischen Ähnlichkeit des Sporenbaues der rezenten Gattung *Trapa* (Näheres vgl. unten).

Diagnose: Prolate bis suboblate Mikrosporen mit einem in Polansicht ± dreieckig bis runden, in Äquatorialansicht linsenförmig bis runden »Zentralkörper». Dieser ist den Meridionalrichtungen folgend von meist drei Exinenkrausen umgeben, welche sich an zwei gegenüberliegenden Polen unter einem Winkel von etwa 120 Grad zusammenschliessen. Im Äquator sind von den Krausen ± umhüllt in der Regel drei sich meridional erstreckende ± kurze, schmale Aperturen vorhanden an welchen noch weitere Differenzierungen auftreten können. Die Exine ist aus mindestens zwei Lamellen aufgebaut. An einem Pol kann eine Y-Marke vorhanden sein.

Bemerkungen: Sporen deren Meridionalkrausen sich abgelöst haben, sind an den charakteristischen Ablösungsstellen ausser den weiteren Merkmalen als zu dieser Gattung gehörig zu erkennen (vgl. Taf. I Fig. 7, 8, Taf. VI Fig. 4—6). Zuweilen sind auch nur zwei Meridionalkrausen ausgebildet (vgl. Taf. I Fig. 9).

Die Festlegung des Namens erfolgte u.a. unter Berücksichtigung der Vorschläge ERDTMANS (1947), der mehrfachen Hinweise R. POTONIÉS (1952 u.s.w.), der Berichte über Empfehlungen des III. Karbon-Kongresses von Heerlen 1951 (vgl. DIJKSTRA 1952) und der Besprechungen auf der Tagung der Paläontologischen Gesellschaft in Trier 1951. Wir sind bei der Benennung etwa nach folgenden Gesichtspunkten vorgegangen:

1. Gegenstand der Untersuchungen ist eine fossile Sporomorphe aus dem Tertiär. Hiefür wurde, um eine Sporengattung möglichst treffend zu charakterisieren, sowohl von ERDTMAN (1947) als auch R. POTONIÉ (1952) vorgeschlagen, den morphographischen Vergleich durch Hinweis auf die Gestalt bekannter rezenter Sporomorphen anzudeuten, wie z.B. »*Fagidites*» oder »*Fagoipollenites*». ERDTMAN betont, ganz unserer Auffassung entsprechend: »Nichts sei hiermit gesagt oder angenommen betreffend irgend eine mögliche Verwandschaft zwischen *Fagus* und der oder den Ursprungspflanzen der in Frage stehenden Sporomorphen. Missverständnisse würden vermieden durch die klare Definition des rein morphologischen Charakters.» Das angenähert na-

türliche System R. POTONIÉs ist, wie er selbst folgerichtig sagt, in Wahrheit ein künstliches.

Demzufolge soll im Formgattungsnamen unserer Sporomorphe der Name *Trapa* vorkommen unter Hinweis auf ausschliesslich morphologisch ähnliche Exinenbauverhältnisse innerhalb der rezenten Gattung *Trapa.*

2. Weiters soll hier betont werden, dass es sich lediglich um ähnliche und nicht identische Exinenkonstruktionen handelt. Für solche Hinweise sah ERDTMAN 1947 die Endung -id, R. POTONIÉ 1951 -oid oder -oi vor. Eine »trapoide» Exine ist somit jenen innerhalb der rezenten Gattung *Trapa* ähnlich.

3. Damit sogleich ersichtlich ist, dass es sich um eine fossile Spore oder Pollenexine handelt, sollte nach R. POTONIÉ (1952) die Sporomorphe die Endung »*-sporites*» oder »*-pollenites*» erhalten. Abgesehen von der Konformität mit paläobotanischen Gepflogenheiten — wie z.B. *-phyllum, -xylon, -pteris* u.s.w. zu sagen — ist dies wohl notwendig, um dem Paläontologen zu zeigen, dass das genannte Fossil unter den Gesichtspunkten der Bestimmung dispergierter Sporen und den damit verknüpften Schwierigkeiten zu betrachten ist und sich z.B. in den Fossillisten einer bestimmten Fundstelle deutlich von den anderen genannten Fossilien abhebt.

Ob wir nun *-sporites* oder *-pollenites* als Suffix hinzufügen, wäre im Einzelfalle zu entscheiden. In Grenzfällen wird das auch morphographisch nicht ganz einfach sein. Daher meinen wir zunächst grundsätzlich für alle dispergierten Sporen, wobei Pollenexinen generell als Mikrosporenexinen angesprochen werden, die Bezeichnung »*-sporites*» wählen zu sollen. Unsere Sporen-Formgattung müsste demnach »*Trapoisporites*» heissen. Nach IBRAHIM (1933) könnte man allerdings auf Grund des Vokales »*-i-*» vor *-sporites* an eine Spore mit Y-Marke denken. Dieser Eindruck sollte aber bei unserer Sporomorphe nicht aufkommen. Versuchsweise soll daher die Silbe »*spor(o)*» vor den morphographischen Vergleichsnamen gesetzt werden. Unsere Formgattung müsste dann heissen:

Sporo-	*trap-*	*oid-*	*ites*
Spore, s. lat., Sporomorphe, Sporengestalt	*Trapa*	ähnlich	fossil

Damit ist der Fossilfund nicht nur als Spore s. lat. gekennzeichnet sondern die Prefix »*Sporo-*» soll gleichzeitig an »sporomorpha» erinnern, was besagen soll, dass es sich lediglich um einen Hinweise der Gestalt und nicht notwendigerweise der botanischen Verwandschaft handelt. Auf die eventuelle Möglichkeit statt *Sporotrapoidites* »*Sporotrapoites*» zu schreiben sei hingewiesen.

Diese Art der Benennung will das künstliche (angenähert natürliche) System, wie es sich besonders im jüngeren Tertiär öfters mit Vorteil verwenden lässt, auf den ersten Blick kenntlich machen.

Das ausgesprochen künstliche System, wie z.B. das der paläozoischen *Sporites,* wird dagegen nach wie vor die Endung »*-sporites*» aufweisen können und sich dadurch vom künstlichen System jüngerer Formationen, dem rezente Sporenkonstruktionstypen zum Vergleich zur Verfügung stehen, unterscheiden.

Um bei der erstmaligen Benennung zu betonen, dass es sich um Sporenformgenera und -spezies handelt, sei »sporomorpharum »der Kennzeichnung »nov. gen.» angefügt. In diesem Zusammenhang ergibt sich die Frage, wie man zunächst rezente Sporomorphen unbekannter Herkunft nennen sollte (z.B. Formen unter den Sporomorphen, die an einem Moospolster oder Flechtenthallus haften). In diesem Falle könnte man ähnlich verfahren, wie wir es hier für fossile Sporomorphen vorschlagen. Würde es sich z.B. um eine Sporomorphe handeln, die in ihrem Bau ähnlich den Exinen der Gattung *Trapa* ist, so könnte man von einer »trapoiden» Sporomorphe (»*Sporotrapoides*») sprechen.

Unterschiede gegenüber anderen ähnlichen Sporengattungen: Der beschriebene Sporentypus ist so differenziert, dass eine Verwechslungsmöglichkeit mit bisher bekannten Sporengattungen nicht gegeben erscheint. Anlass zu Bestimmungsschwierigkeiten könnten höchstens Sporenfragmente geben. Wenn man auf solche eine Bestimmung überhaupt aufbauen will, wird man auf Form der Kolpen, vielleicht auch auf das feinreticuliert erscheinenden Exinenfeld, dem ursprünglich die Meridionalkrausen aufgelagert waren, achten:

Folgend wird die fossile Sporen-Formspezies dieser Gattung beschrieben:

Sporotrapoidites illingensis n.sp. sporomorpharum.

Holotypus: *Sporotrapoidites illingensis* n.sp., Taf. I Fig. 1—3, Taf. II Fig. 1—10, Taf. III Fig. 1—10, Taf. IV Fig. 1—3, Taf. V Fig. 1. Einzelkornpräparat 112, Geologische Bundesanstalt, Wien.

Derivatio nominis: Nach dem Fundort »Illing» Bergbau in Oberösterreich.

Locus typicus: Zwischenmittel in der Unterbank des Heisslerstollens, Streichendstrecke, Illing, Hausruck-Kohlen, Oberösterreich.

Stratum typicum: Jungtertiär (Obermiozän—Unterpliozän).

Diagnose: Mikrosporen deren »Zentralkörper» in Polansicht (π_1; Taf. I Fig. 3, Taf. V Fig. 1) rund bis ± dreieckig und von drei Exinenkrausen meridional umschlossen ist. Diese treffen sich in den Polen und schliessen dort einen Winkel von 120 Grad ein. In Äquatoransicht (π_2, π_3; Taf. I Fig. 1, 2, Taf. II, Taf. III, Taf. IV Fig. 1—3) Zentralkörper rund bis linsenförmig. Die aufgelagerten Exinenkrausen verleihen der Spore ± spindelförmige Gestalt. Drei zusammengesetzte Äquatorialaperturen, von Exinenteilen der Krausen umschlossen. Über ein kurzes, schmales Intexinen-Os von meridionaler Erstreckung wölbt sich die Exoexine so vor, dass ein die Os-Form fortsetzendes Vestibulum entsteht, das in Äquatoransicht (π_3) etwa halbkreisförmig von basalen Anteilen der Isolierschicht (Bacula) umschlossen wird. Den äusseren Abschluss der Apertur bildet je eine streng äquatorial ausgerichtete kleine Quer-Ruga der Exoexine welche in Seitenansicht (π_3) bis zum zentrifugalen Rand der Vestibulumbegrenzung eingreift. Exoexinenstruktur der seitlichen Vestibulumbegrenzung englumig unregelmässig reticuliert, feiner als die sonstige Krausendifferenzierung der Exoexine. Exine aus mindestens zwei Lamellen aufgebaut. Glatte Intexine, baculate Exoexine mit Isolierschicht (Basis der Bacula in den Krausen und Aperturen teilweise miteinander verschmolzen) und Exolamelle. Flächenansicht der Exine (LO-Analysis): Englumiges Infrareticulum am Zentralkörper, stark gedehnte und verzerrte Infrastruktur in den Meridionalkrausen.

	P	E	K (vgl. S. 124)
Grösse (Holotypus; vgl. Taf. 1:1—3)	72 μ	56 μ	55 μ
Variation:			
Minimum	62 μ	41 μ	38 μ
Maximum	81 μ	63 μ	59 μ

Farbe: Nach Azetolyse Zentralkörper braun, Krausen und Aperturen hellgelb.

Detailbeschreibung. Polarität: Gut erhaltene Exinen isopolar (ERDTMAN 1952), d.h. die Äquatorebene teilt die Exine in zwei gleiche Hälften. An einer nicht voll entwickelten Sporomorphe des gleichen Präparates (Taf. I Fig. 6, Taf. VI Fig. 1—2) ist der proximale Pol durch eine schwach angedeutete Y-Marke kenntlich. Der gegenüberliegende distale Pol lässt keine solche Bildung erkennen (Taf. VI Fig. 3).

Symmetrie: Radialsymmetrisch (WODEHOUSE 1935). Eine dreizählige Hauptachse (Polachse) steht senkrecht auf die Äquatorebene und schneidet diese im Zentrum. Drei Symmetrieebenen, senkrecht zur Äquatorebene durch das Zentrum gelegt, repräsentieren die Ebenen der Meridionalkrausen und schneiden sich unter einem Winkel von 120 Grad.

Bei dem Korn der Taf. I Fig. 6 und Taf. VI Fig. 1, 2 schliessen die Y-Strahlen mit den Krausenebenen eine Winkel von 60 Grad ein.

Gestalt: Äquatoransicht (Aufriss π_2 und Kreuzriss π_3): vgl. Taf. I Fig. 1, 2, Taf. II, Taf. III, Taf. IV Fig. 1—3.

a) Gesamtansicht (einschl. Meridionalkrausen): Subprolat (subspheroidal; Verhältnis P/E×100=129).

[Index pollinis Lg/Lt, +(IVERSEN & TROELS-SMITH)=1.29 (1.33—0.75)].

Variation der Gestalt (76 gemessene Exinen):

	suboblat	spheroidal	subprolat	prolat
Gesamtkorn	—	10	22	6
Ohne Krause	10	24	3	1

Polansicht (Grundriss π_1); Vgl. Taf. I Fig. 3, Taf. V Fig. 1.

Der Grundriss des Exinenkörpers ohne Krausen hat die Form eines gleichseitigen sphärischen Dreieckes, dessen Ecken abgerundet erscheinen.

Variationen: Die Dreieckseiten können je nach Quellungszustand stark konvex ausgebaucht, ± gerade verlaufend oder in selteneren Fällen auch konkav eingedellt sein. So weist zum Beispiel die vielleicht abnormal entwickelte Form der Taf. I Fig. 6, Taf. VI Fig. 1—3, stärker konvex gewölbte Seiten auf als normal ausgebildete Formen (Holotypus). Grössere Formen hingegen sind oft durch konkave Seiten (Taf. V Fig. 2—4) gekennzeichnet. Die Meridionalkrausen reichen über den Umriss (Ambitus, ERDTMAN 1952) des Zentralkörper ± weit hinaus, und zwar in folgendem Verhältnis:

Holotypus: Zentrum bis Zentralkörperkontur 17 μ, Zentralkörperkontur bis äusserste Begrenzung der Krause 15 μ.

Verhältnis a/b×100=110 (Vgl. Taf. I Fig. 3).

Variation: Bei einer grösseren Zahl von Formen greift die Krause nicht so weit über die Zentralkörperkontur hinaus. Das oben angegebene Verhältnis ist z.B. bei Einzelkornpräparat No. 111 207, No. 117 164, No 27 110.

Grösse: MA, Spora magna (ERDTMAN 1952); vgl. Taf. I Fig. 1—3. Die Masse sind im Anschluss an die Speziesdiagnose gegeben. Ausser den zwei Dimensionen P (Polachse) und E (Äquatorbreite) ist hier noch die dritte Dimension, welche zur Definition eines Körpers erforderlich ist, angegeben und zwar K (Kreuzriss). K muss sich nicht mit E decken.

Aperturen (Vgl. ausser den Photodarstellungen das Palynogramm): Tricryptocolporat, angulaperturat (Vgl. ERDTMAN l.c.).

Wo die Meridionalkrausen die Äquatorebene schneiden liegen symmetrisch angeordnet die drei kompliziert gebauten, zusammengesetzten Aperturen.

a) Intexinenanteil der Apertur (Nexinenapertur).

Die Intexine des Zentralkörpers weist drei enge Ora auf. Verhältnis Os-Breite zu Länge wie etwa 1 : 15 (Taf. IV Fig. 8).

Länge eines Os (Taf. IV Fig. 1—3), Holotyp 13 μ; variiert bis 18 μ.

Breite eines Os (Taf. V Fig. 1), Holotyp etwa 1.0 μ; variiert bis 2 μ (Taf. I Fig. 5, Taf. IV Fig. 8).

Die polwärts weisenden Enden des Os sind abgerundet. Vgl. Taf. I Fig. 2, 5; Taf. IV Fig. 1, 2, 3, 8, Taf. VII Fig. a.

b) Exoexinenanteil der Apertur (Sexinenapertur; vgl. Taf. VII Fig. a, b, c, e und Hauptfigur.)

Unmittelbar um die Ränder des Os löst sich etwa in gleicher Distanz von diesen der Exoexinenanteil von der Intexine ab und wölbt sich in Richtung der Meridionalkrausenebene vor. Die Vergrösserung des Exoexinenkolpenraumes — das Vestibulum — zeigt in ausgewählten Schnitten Taf. VII Fig. b, e und Hauptfigur. Als Grundlage dienten hiefür auch die Photos Taf. II Fig. 1—5, 8, 9; Taf. III Fig. 1, 2, 5, 7, 8, 9, Taf. IV Fig. 1—3, 5—9, 11, Taf. V Fig. 1, 3, 8. In π_3 (Kreuzriss) ist die seitliche Begrenzung des Kolpenraumes durch die halbkreisförmige Kontur der basalen Verschmelzung der Bacula ersichtlich (Taf. IV Fig. 1—3).

Die Breite des Vestibulums übertrifft nicht wesentlich die des Os (Palynogramm Taf. VII Fig. b, e; Photos Taf. II Fig. 8; Taf. III Fig. 7; Taf. IV Fig. 9; Taf. V Fig. 1, 3).

Die Apertur endet zentrifugal mit einer Äquatorialeinschnürung der Exoexine. Das Vestibulum schliesst sich in zentrifugaler Richtung nicht vollkommen. Wo die Endosexinenkontur des Vestibulums von der Äquatorebene geschnitten wird ist die Ektosexine stark reduziert, was zur Bildung einer kleinen äquatorialen Einschnürung führt (Vgl. Taf. VII, Hauptfigur und Fig c. Weiters Phot. Taf. II Fig. 6, 7, 8; Taf. IV Fig. 1, 3, Taf. V Fig. 6.). Wo die Kerbe der Einschnürung (Seitenansicht π_3) mit der endosexinösen Vestibulumbegrenzung zusammentrifft ist die dünnste Stelle der Exine. An dieser Stelle fragmentieren Exinen der untersuchten Probe am häufigsten (Vgl. Taf. V Fig. 6).

Exinen-Bau. Am Holotypus und weiteren Formen scheint sich folgender Exinenaufbau ableiten zu lassen:

Intexine (Nexine, Endexine); Palynogramm Taf. VII Fig. e, f, g. Photos: Taf. II, Fig. 3—5; Taf. III Fig. 1; Taf. IV Fig. 1, 2, 11; Taf. V Fig. 1, 4, 7, 8; Taf. VI Fig. 5.

Die innerste Lamelle des Kornes, die Intexine (im Palynogramm schwarz gezeichnet) baut den »Zentralkörper» auf und gibt ihm die suboblate Gestalt. Nach Azetolyse ist sie braun gefärbt, jedenfalls etwas dunkler als die exoexinösen Meridionalkrausen. Sie erscheint bei Ap. 1.25 glatt, stärker lichtbrechend als die Sexine; Dicke etwa 1.5 μ (Palynogramm Fig. e).

An den Orarändern ist die Intexine etwas aufgebogen. Die in den Photos manchmal recht zahlreich erscheinenden Beugungsstreifen, sind keine Lamellen. Vielmehr entsprechen sie der Becke'schen Linie und geben daher je nach ihrer Bewegungsrichtung beim Heben und Senken des Objektives lediglich den Grad der Lichtbrechung gegenüber dem Einbettungsmedium an.

Exoexine (Sexine, Ektexine). Bauprinzip: An die Intexine schliesst sich die Isolierschicht mit Exolamelle (R. POTONIÉ 1934; Endosexine+Ectosexine nach ERDTMAN 1952). Je nach Lage am Sporenkörper ist die Exoexine verschieden differenziert.

Flächen zwischen den Krausen (Vgl. Palynogramm Taf. VII, Hauptfig. und

Fig. e; Photos: Taf. II Fig. 2—5, Taf. III Fig. 1, Taf. IV Fig. 3, 11): Exoexine etwa 1.5 μ dick, aus Isolierschicht und Exolamelle bestehend. Die Pila (bzw. piloide Bildungen) schliessen sich mit ihren Capita so eng zusammen, dass diese eine geschlossene Lamelle ergeben (Exolamelle, Tegillum, Tectum). Die Bacula (Stäbchen) der Isolierschicht sind sehr kurz (0.1—0.3 μ), verbreitern sich und digitieren mitunter an der Basis, dem Übergang zur Intexine (Nexine). Stellenweise verschmelzen sie. Die Oberfläche der Exolamelle erscheint, entsprechend der Wölbung der Capita, leicht gewellt.

LO-Analyse (Vgl. ERDTMAN 1952): In Flächenansicht gibt sich bei Hocheinstellung (Ap. 1.25) ein engmaschiges, sehr zartes Reticulum zu erkennen (Lumina etwa 0.5—0.8 μ). Lumina dunkel, Muri hell. Bei Tieferstellung des Tubus tritt Umkehr der Aufhellung ein, die Konturen bleiben etwa die gleichen.

Bau der Meridionalkrausen ausserhalb der Aperturen: Die Krausen sind Abhebungen der Exoexine unter starker Vergrösserung und Dehnung der Pila. Die Basen der Bacula schliessen sich zu einer ± geschlossenen Lamelle (Vgl. Palynogramm) von welcher die Bacula unter enormer Verlängerung etwa 20 μ zentrifugal an den Meridionalgrenzen der Krausen (Taf. VI Fig. 6) beiderseits emporstreben und in den stark vergrösserten und verdickten Capita endigen. Diese reihen sich in meridionaler Richtung lose aneinander. In der Fläche senkrecht dazu, also in der Tangentialebene zu den äussersten Krausenbegrenzungen, sind die Exoexinenelemente dagegen sehr schwach ausgebildet und dienen der Verbindung der beiden meridional verlaufenden Capita-Reihen einer Krause (Vgl. die Hauptfigur des Palynogrammes, Mitte; Taf. II Fig. 6—10, Taf. IV Fig. 5—8; Taf. V Fig. 1, 2, 5). Das schmale Feld dazwischen ist in Flächenansicht fein retikuliert. Die Höhe der Krausen vergrössert sich gegen die Pole zu, während ihre Breite abnimmt. An den Polen schliessen sich die Krausen unter einem Winkel von 120 Grad zusammen. Ebenso vereinigen sich in den Polen ihre Hohlräume; sie sind dort etwa 2 μ breit und 20 μ hoch (Taf. III Fig. 3, 4, Taf. IV Fig. 2, 10).

Exoexine der Aperturen: Die Fusslamelle der Isolierschicht, durch Fusion der Bacula-Basen entstanden, hebt sich parallel zum intexinösen Os-Rand ab und bildet das Vestibulum. Über dem Vestibulum sind die Bacula stark verkürzt. Am stärksten ist dies direkt im Äquator der Fall, wodurch es zur Entstehung der Einschnürungen kommt.

Erhaltungszustände und Variationen der beschriebenen Sporomorphe: Die Meridionalkrausen sind in ihrer zentrifugalen Ausdehnung oft stärker reduziert, besonders in der Region der Aperturen wo sich das Vestibulum oft nur undeutlich abzeichnet. Auch die kleine äquatoriale Einschnürung fehlt mitunter. Die Krausen können abgerissen sein (Taf. I Fig. 7, 8, Taf. VI Fig. 4—6). An solchen Exinen sind besonders gut die Ansatzstellen der Krausen zu sehen.

In der Sedimentprobe des Holotypus fand sich eine Spore welche von dem hier beschriebenen typischen Bau etwas abweicht. Die Spore ist kleiner, die Krausen sind stark reduziert und an einem Pol ist eine, wenn auch nicht sehr deutliche Y-Marke erkennbar (Taf. I Fig. 6, Taf. VI Fig. 1—3). Wie Y-Strahlen verlaufen nicht parallel zu den Krausen, sondern schneiden deren Seiten senkrecht. Zwischen zwei Y-Strahlen verläuft somit eine Krause und daher auch eine Apertur. Das ist weiter nicht erstaunlich, denn es ist das Bauprinzip der Angiospermen-Pollenexinen. Wir haben ganz ähnliche Verhältnisse ja auch z.B. bei den Ericaceae. Das hat R. POTONIÉ schon 1934 und auch andere Botaniker erkannt und daher mit vollem Recht die Area contagionis als Homologie der Keimstellen betrachtet. Ähnliche Verhältnisse findet ERDTMAN (1943) an jungen Pollenexinen von *Trapa natans* (S. 46 Fig. 223).

Es fand sich auch eine Exine von dicolporatem Bau welche auf Grund ihrer sonstigen Merkmale zur Gattung *Sporotrapoidites* zu stellen wäre (Taf. I Fig. 9). Ein einziger Krausenkranz umgibt meridional das Korn.

Vergleich mit bekannten ähnlichen Sporenformen. Über fossile Sporenexinen aus präquartären Schichten, welche unserer Gattung nahestehen, berichtet MTCHEDLICHVILI (1953). Sie wurden in Ober-Kreide und Tertiärschichten West-Sibiriens, in einer Tertiärprobe aus Ost-Sibirien und im Quartär von Leningrad gefunden und mit der rezenten Gattung *Trapa* identifiziert. Der Bau unseres Typus stimmt im Wesentlichen mit den dort geschilderten charakteristischen Merkmalen überein. Unsere Sporomorphe weicht nur insoferne ab, als die zentrifugalen Teile der Apertur-Exoexine nicht durchbrochen sind und an der Krausenvereinigung der Pole kein schwach ausgebildetes Dreieckfeld sichtbar ist. Das sind aber Unterschiede, welche man höchstens die Bedeutung von Form-Spezies beimessen könnte.

Da es sich in unserer Arbeit ausschliesslich um eine morphographische Charakterisierung der Sporomorphe handelt, wird sie nicht der Gattung *Trapa* direkt eingeordnet — wie dies MTCHEDLICHVILI handhabt — sondern durch Form-Spezies und Form-Genus festgelegt.

Aus dem Interglazial und Spätquartär sind Pollenexinen der Gattung *Trapa* wiederholt erwähnt (zum ersten Mal in Schweden von ASSARSSON 1927, wo sich auch zwei Abbildungen finden).

Botanische Zugehörigkeit. ERDTMAN hat sich mehrfach (1943, 1952) mit Bau und Form der Pollenkörner von *Trapa natans* beschäftigt. Der allgemeine, sehr bezeichnende Aufbau stimmt mit dem unserer tertiären Sporengattung annähernd überein. Unsere Sporenformspezies unterscheidet sich durch die äquatoriale Einschnürung und den in Polansicht zentrifugal einheitlich geschlossenen Krausenrand. Die Zeichnung ERDTMANS 1943 (Taf. XIII Fig. 223) zeigt dagegen eine Aufspaltung der Krausenränder. Aber es handelt sich dort um ein unreifes Korn. Weitere wesentliche Angaben über die Konstruktion rezenter *Trapa*-Exinen finden sich bei GIBELLI und FERRERO (1895) und MTCHEDLICHVILI 1953 [*Trapa astrachanica* (FLER) VINTER, Fig. 1 a, b, c].

Man kommt zu dem Schluss, dass die hier beschriebene Sporomorphe grosse Ähnlichkeit mit solchen der rezenten *Trapa*-Arten aufweist (vielleicht im Range einer Formgattung), in Details aber doch abweicht. Morphographische Studien der Pollenexinen von verschiedenen rezenten Arten der Gattung *Trapa* würden weitere Vergleiche erleichtern.

Resümee. Aus der jungtertiären Braunkohlenlagerstätte des Hausruck in Oberösterreich wird eine Sporenform morphographisch untersucht. Von der mikroskopischen Beobachtung des Holotypus-Exemplares ausgehend wird an Hand von Photoserien verschiedener Orientierung der Versuch unternommen, Bau und Form der Sporomorphe zu rekonstruieren (Palynogramm) und durch Diagnose und Detailbeschreibung die Auffassung des Verfassers darüber darzulegen. Morphographisch bestehen Ähnlichkeiten gegenüber Pollenformen der lebenden Gattung *Trapa*. Der Holotypus und weitere Sporomorphen dieser Art sind unter angegebenen Nummern als Einzelkornpräparate in der Sammlung der Geologischen Bundesanstalt, Wien aufbewahrt.

Literatur.

ASSARSSON, G., 1927: Fossilt pollen av *Trapa natans*. Geol. Fören. Förhandl. Bd. 49. Stockholm.

BERTSCH, K. 1942: Lehrbuch der Pollenanalyse. Stuttgart.

DIJKSTRA, S. I. 1952: Palynology at the »Troisième Congrès de Stratigraphie et de Géologie Carbonifère» at Heerlen 25—30 June, 1951. Svensk bot. Tidskr. Bd. 42.

ERDTMAN, G. 1943: An Introduction to Pollen Analysis. Waltham (2nd print, 1954).

— 1947: Suggestions for the classification of fossil and recent pollen grains and spores. Svensk bot. Tidskr. Bd. 41.

— 1952: Pollen Morphology and Plant Taxonomy. I. Angiosperms. Stockholm.

FAEGRI, K. and IVERSEN, J. 1950: Textbook of modern pollen analysis. Copenhagen 1950.

GIBELLI, G. und FERRERO, F. 1895: Ricerche di anatomia e morfologia intorno allo sviluppo del fiore e del frutto della *Trapa natans*. Malpighia 9: 379—437.

International Rules of Botanical Nomenclature (1935). — Brittonia, Vol. 6 (1947).

IVERSEN, J. und TROELS-SMITH, J., 1950: Pollenmorfologiske definitioner og typer. Danm. Geol. Unders. IV, 3, Nr. 8. Copenhagen.

KLAUS, W. 1953: Zur Einzelpräparation fossiler Sporomorphen. Mikroskopie Bd. 8, H. 1/2. Wien.

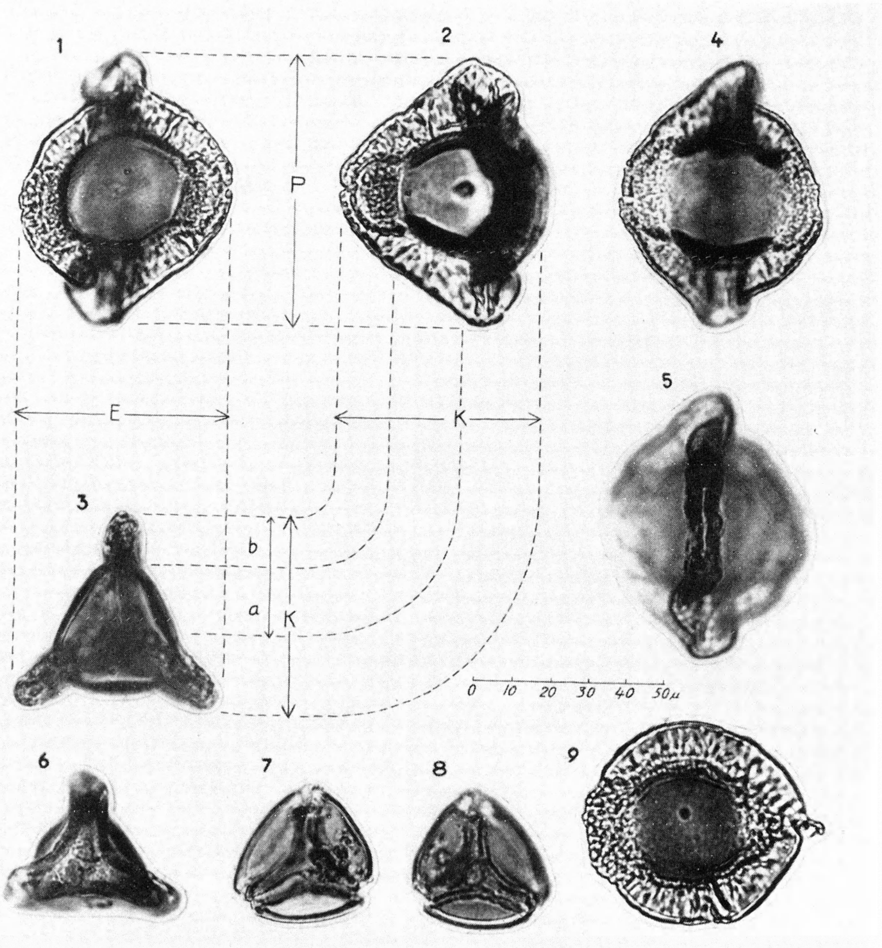
KIRCHHEIMER, F. 1950: Mikrofossilien aus Salzablagerungen des Tertiärs. Palaeontographica 90 B. Stuttgart.

MTCHEDLICHVILI, N. D. 1953: Au sujet du pollen du genre *Trapa* L. Dokl. Akad. Nauk. SSSR. E 90, No 4, p. 659—662, 2 Fig.

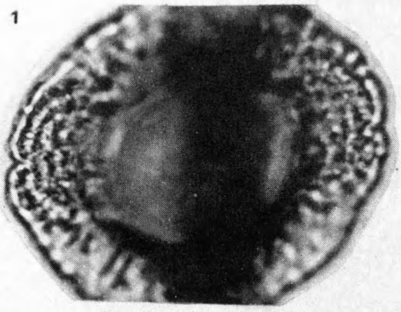
POTONIÉ, R. 1934: Zur Mikrobotanik der Kohlen und ihrer Verwandten I. Zur Morphologie der fossilen Pollen und Sporen. Arb. Inst. Paläobot. Bd. 4.

— 1951: Revision stratigraphisch wichtiger Sporomorphen des mitteleuropäischen Tertiärs. Palaeontographica 91 B.

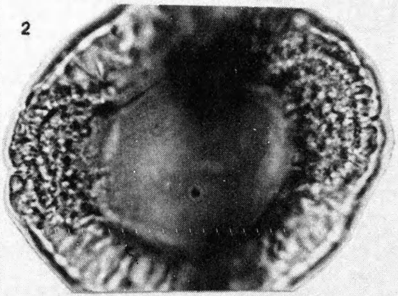
— 1952: Zur Systematik isolierter Sporen fossiler Pflanzen. Bemerkungen zu den Besprechungen auf der Tagung der Paläont. Ges. in Trier 1951. Svensk bot. Tidskr. Bd. 42.


1
2
4
P
E
K
5
3
b
a
K
0 10 20 30 40 50μ
6
7
8
9

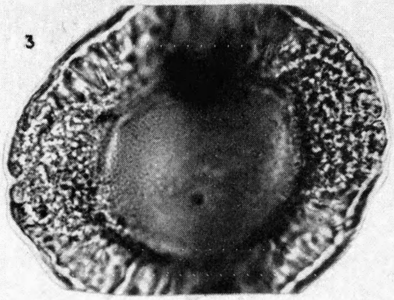
1



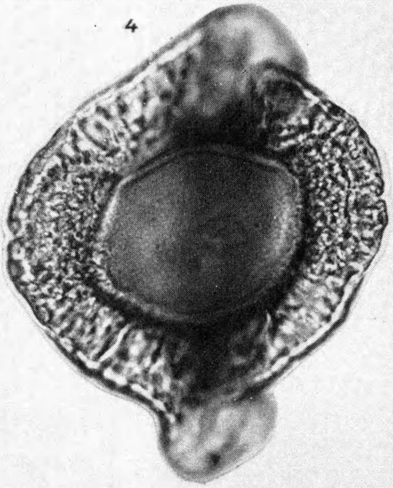
2



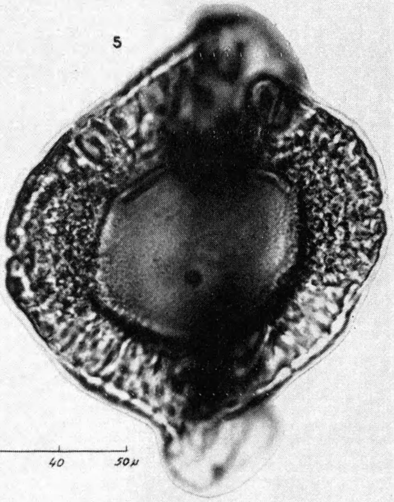
3

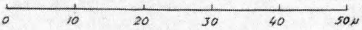


4



5

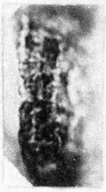




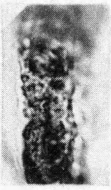
6

7

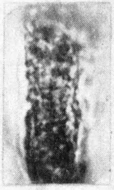
8



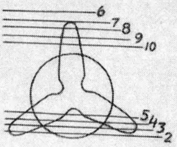
9



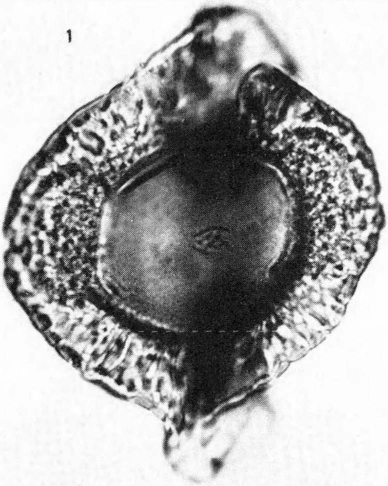
10



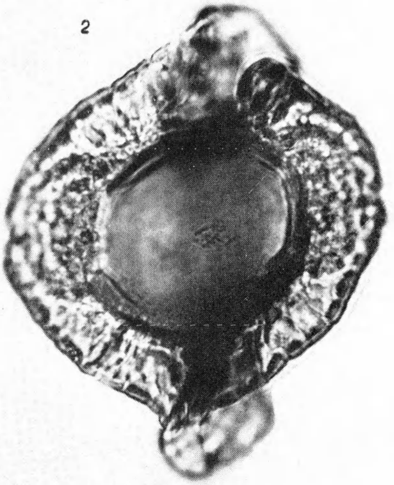
11



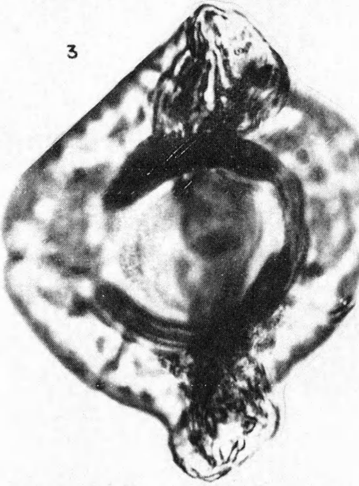
1



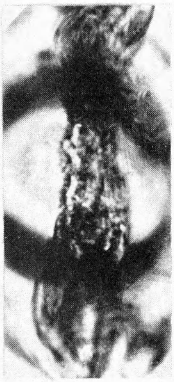
2



3



4



5

6

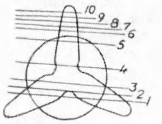
7

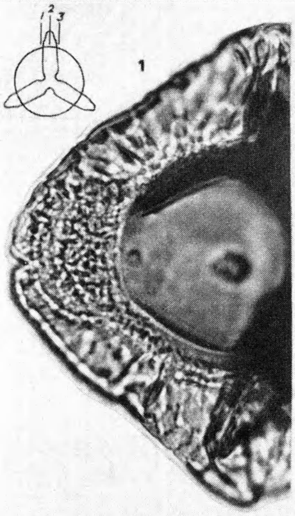
8

9

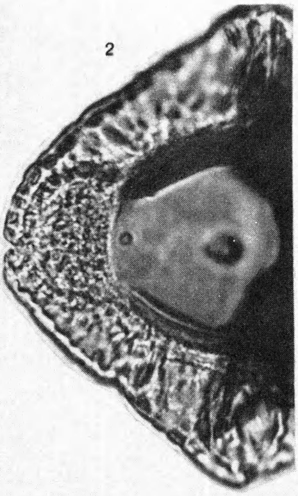
10

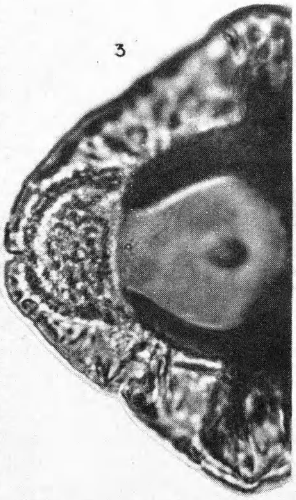
11





1

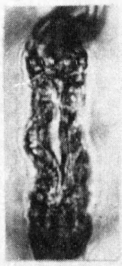

2

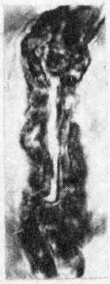

3

4

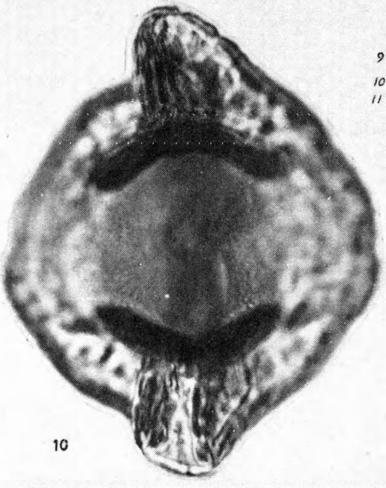

5

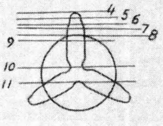

6

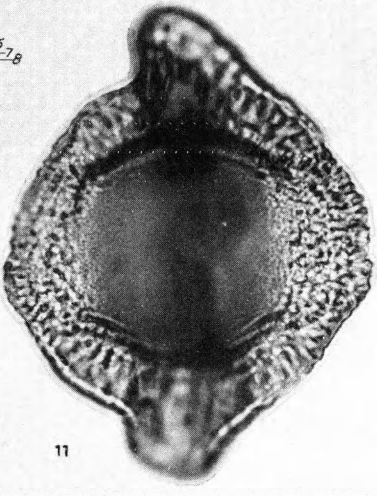

7


8


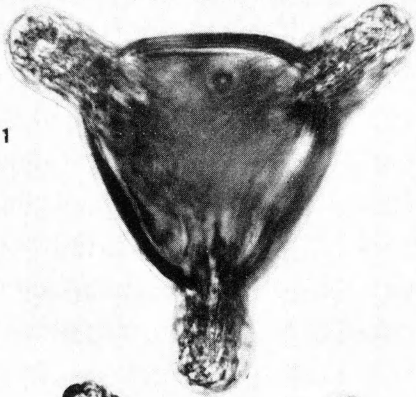
9



10




11

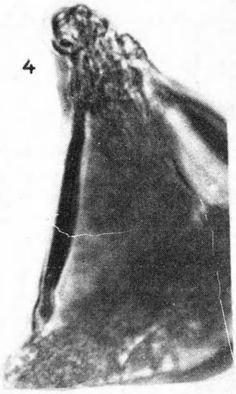
1



2

3

4

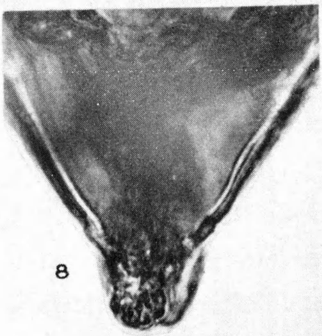


5

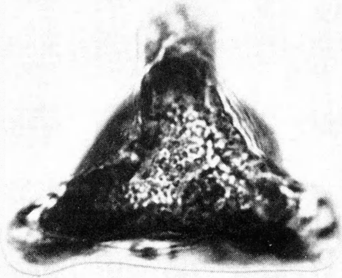
6

7

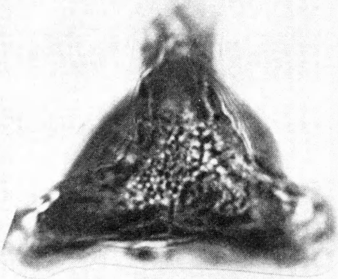
8



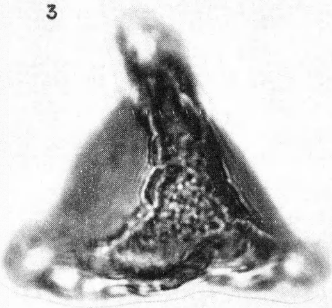
1



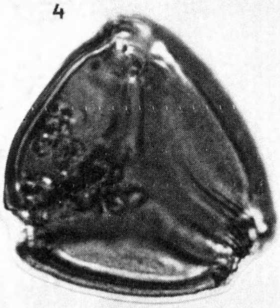
2



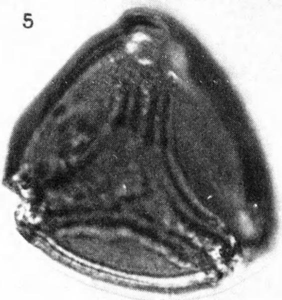
3



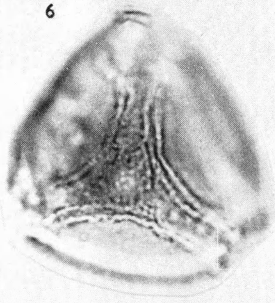
4

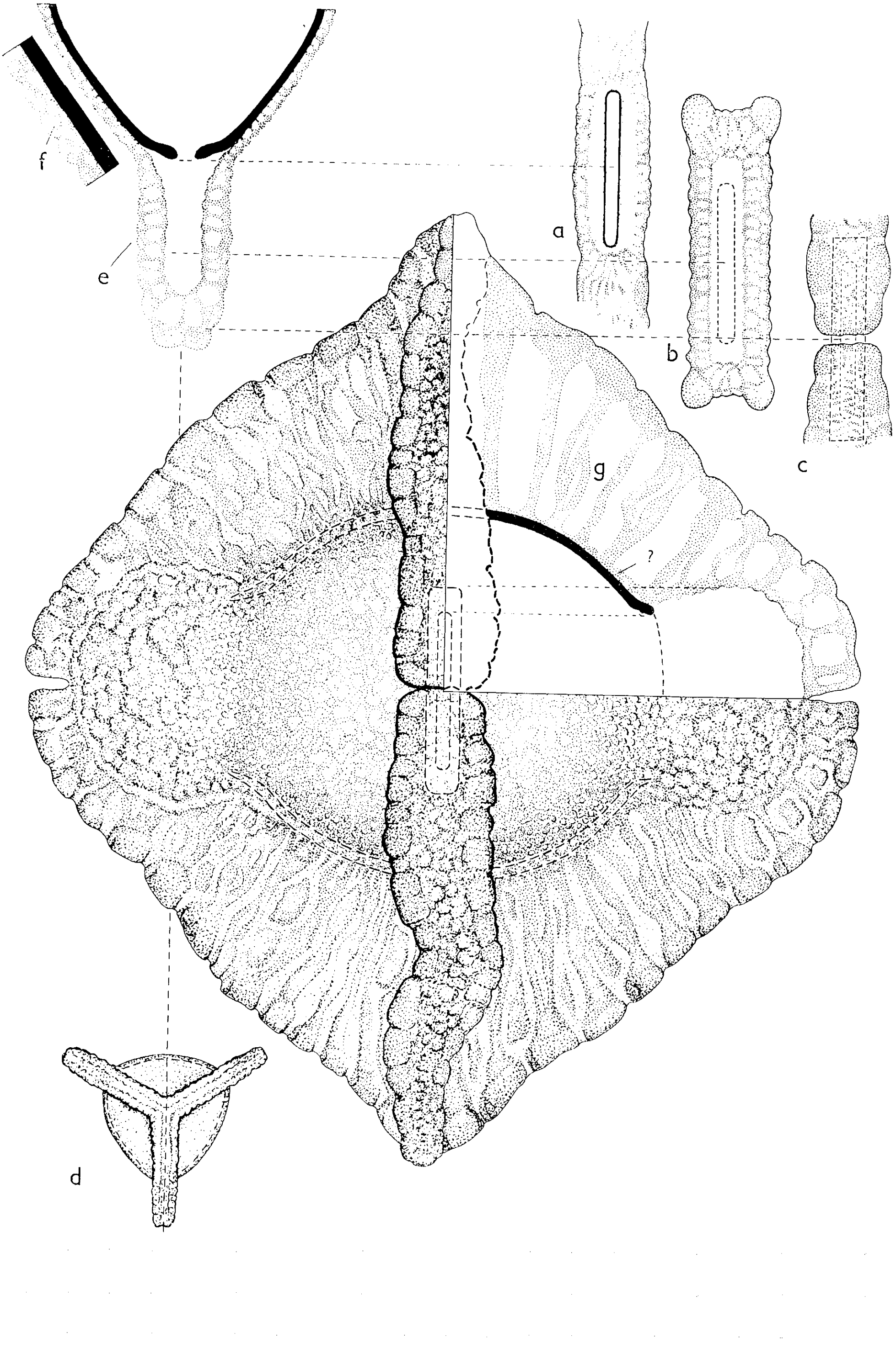


5



6




f
e
a
b
c
g
?
d

POTONIÉ, R., THOMSON, P., THIERGART, F., 1950: Zur Nomenklatur der neogenen Sporomorphae (Pollen und Sporen). Geol. Jb. Bd. 65.

WODEHOUSE, R. P. 1935: Pollen grains, their structure, identification and significance in science and medicine. New York and London.

Tafelerklärung.

Alle Photos wurden vom Verfasser hergestellt und stammen von unretuschierten Negativen.

EKP = Einzelkornpräparat aus der Sammlung des Verfassers.

Aufbewahrung: Geologische Bundesanstalt, Wien.

Tafel I. Übersicht (500 ×).

Fig. 1.	Holotypus, Aufriss	EKP 112
2.	Holotypus, Kreuzriss	EKP 112
3.	Holotypus, Grundriss	EKP 112
4.	Aufriss, Vestibulum-Einstellung	EKP 27
5.	Aufriss, Kolpus-Einstellung	EKP 27
6.	Form mit Y-Marke	EKP 117
7.	Zentralkörper ohne Krause, Foc. A.	EKP 118
8.	Zentralkörper ohne Krause, Foc. B (hoch)	EKP 118
9.	Dicolpates Korn	EKP 116

Tafel II. Detailaufnahmen (900 ×).

Focus-Einstellung: Vgl. Skizze rechts unten.

Fig. 1.	Einstellung vor dem Aperturrand	EKP 112
2.	Einstellung linke Kontur scharf	EKP 112
3.	Einstellung Ornamentation Zentralkörper	EKP 112
4.	Einstellung rechte Kontur scharf	EKP 112
5.	Einstellung Intexinenbegrenzung und Vestibulum und Krausenornamentation	EKP 112
6.	Apertur von vorne (π_2), vor Ruga	EKP 112
7.	Querruga wird scharf	EKP 112
8.	Vestibulum-Innekontur erscheint	EKP 112
9.	Ruga wird unscharft. Innere Vestibulum-Kontur	EKP 112
10.	Scharfeinstellung im Exoexinenaperturfeld	EKP 112

Tafel III. (Fortsetzung von II).

Vgl. bezüglich Einstellung Skizze rechts unten.

Fig. 1.	Auflagerung der Krausenbasis auf Intexine, Krausenornamentation.	EKP 112
2.	Krause polwärts scharf	EKP 112
3.	Pole scharf. Vertikallumen der Krausen sichtbar	EKP 112
4.	Kolpusansatz von Innen. Polkrausenlumen scharf	EKP 112
5.	Beginn des Vestibulum-Innraumes	EKP 112

6.	Apertur von Innen	EKP 112
7.	Apertur von Innen. Seitl. innere Vestibulumgrenze	EKP 112
8.	Verbreiterung des Vestibularraumes. Äquatorialer lichter Fleck deutet Lage der Ruga an	EKP 112
9, 10.	Einstellung gegen Vestibulum-Ende	EKP 112

Tafel IV (900 ×).

Vgl. bezüglich Einstellung Skizze. (Die Skizze sollte um 90° nach links gedreht werden).

Fig. 1.	Kreuzriss. Apertur-Seitenansicht. Einstellung auf Krausenrand	EKP 112
2.	Einstellung auf Ornamentation des Vestibulum	EKP 112
3.	Exinenornamentation in Gegend des Intexinenkolpus	EKP 112
4.	Apertur von vorne. Ruga undeutlich	EKP 27
5.	Beginn des Vestibulum	EKP 27
6.	Fortsetzung	EKP 27
7.	Intexinen-Os zeichnet sich ab	EKP 27
8.	Einstellung auf Intexinen-Os	EKP 27
9.	Optischer Vestibulum-Schnitt von Zentrum des Kornes aufgenommen	EKP 27
10.	Einstellung auf Polkrausen	EKP 27
11.	Einstellung auf Intexinenkontur	EKP 27

Tafel V.

Grundrisse (Polansicht; 1000 ×).

Fig. 1.	Holotypus. Einstellung auf Äquatorebene	EKP 112
2.	Einstellung auf Krausenpol	EKP 111
3.	Einstellung auf Äquatorebene. Exoexinenablösung zur Apertur	EKP 111
4.	Einstellung auf Äquatorebene. Exoexinenablösung zur Apertur	EKP 111
5.	Einstellung auf Krausentangentialfläche und Pol	EKP 111
6.	Fragmentation der Apertur in der Ruga	EKP 113
7.	Exoexinenablösung in der Apertur (lateral)	EKP 111
8.	Exinenlamellen in Kolpusregion	EKP 111

Tafel VI.

Polansichten (1000 ×).

Fig. 1.	Abnormal entwickletes Korn. Proximal. Pol mit Y-Marke	EKP 117
2.	Abnormal entwickletes Korn. Proximal. Pol mit Y-Marke	EKP 117
3.	Abnormal entwickletes Korn. Distal. Pol ohne Y-Marke	EKP 117
4.	Zentralkörper ohne Krause. Lamellen Tiefeinst. Polansicht.	EKP 118
5.	Dto. Hocheinstellung	EKP 118
6.	Dto. Einstellung auf Krausenablösungsfläche	EKP 118

Tafel VII.

Palynogramm (Hauptfigur 2150 ×). ANNA-LISA NILSSON delin.

Hauptfigur: Drei Viertel voll ausgezeichnet, oberes rechtes Viertel Schnitt.

a. Schnitt in Höhe Intexinen-Os (Schnittfläche senkrecht zur Krausenebene).

b. Parallelschnitt hierzu durch Vestibulum.

c. Parallelschnitt hierzu durch Ruga.
d. Polansicht (540 ×).
e. Äquatorialschnitt durch Zentralkörper und Apertur (halbseitig gez.).
f. Exinenschnitt am Zentralkörper (4300 ×).
g. Schnitt durch die Krause in Krausenebene.

BOTANISKA NOTISER 1954, HÄFTE 2. LUND

Märkligare nytillskott till den svenska kärlväxtfloran sedan 1920.

AV NILS HYLANDER.

När jag satt den tidsgräns bakåt som rubriken anger, så har detta inte skett på en slump. När det gäller den svenska kärlväxtflorans utforskande, kan man med goda skäl dra en gräns ungefär vid åren 1920—21. 1920 utgav NORDSTEDT sin sammanställning Prima loca plantarum suecicarum, som kan sägas ge en summarisk sammanfattning av vad som dittills var känt av i Sverige funna kärlväxtarter. Ungefär vid denna tid börjar också GUNNAR SAMUELSSON publicera sina Floristiska fragment, varmed han visar hur förbluffande mycket som alltjämt stod att finna av nyheter inom detta område redan på grundval av det föreliggande herbariematerialet för en specialist med tillräckligt skarp blick och tillräcklig kännedom om litteraturen och floran i andra europeiska länder. De blevo också en stark stimulans för fortsatta floristiska fältstudier och inledde den mycket aktiva period inom svensk fanerogamfloristik, som de senaste decennierna utgöra.

Ämnet bereder emellertid av andra orsaker svårigheter både i fråga om avgränsning och disposition. För det första kan man fråga: vad är »märkligare»? — ja vad menas i detta sammanhang med nytt? Gör man en jämförelse mellan artbeståndet i de två på varandra följande upplagorna av Lunds Botaniska Förenings kärlväxtförteckning 1917 och 1941, finner man antalet i Sverige som konstant vildväxande funna arter — alltså sådana som stå med vanlig, ej kursiv stil — ökat betydligt. Jämför man 1917 års förteckning inte med 1941 års utan med den allra sista artlistan över området, ÅSKELL och DORIS LÖVES kromosomtalslista, blir skillnaden ännu mera markerad, men samtidigt blir det också klart, vari en del av denna tillökning av artantalet egentligen består, nämligen i en uppvärdering av åtskilliga underarter och varieteter till självständiga arter, utan att dessa enheters avgränsning i och för sig ändrats; i något annat hänseende innebära alltså dessa fall intet nytillskott till floran. Det saknas emellertid inte exempel på den motsatta ytterligheten, när de nya arterna inte bara sakna motsvarighet i den äldre förteckningen utan t.o.m. urskilts från det nordiska floraområdet, ev. just från Sverige, som för vetenskapen nya arter. I de fall, där detta gäller — och de förekomma huvudsakligen i den Löveska listan — är det dock utan undantag fråga om mer eller mindre kritiska växter, och knappast i ett enda fall har de nya arternas arträtt blivit oomstridd.

Det är inte om sådana fall — sådana på sin höjd som underarter värderbara »arter» som *Pyrola norvegica, Myosotis praecox* och *serotina* och *Atriplex praecox* eller »kromosomarter» som *Anthoxanthum alpinum* och *Rumex tenuifolius* — som jag här skall tala. En enda sådan nyurskild nordisk art skall jag dock i förbigående nämna, nämligen den av Bruun 1938 beskrivna *Primula scandinavica.* Denna står *P. farinosa* nära men är väl skild från denna, även (som Bruun visat) i vissa finare morfologiska detaljer, såsom »farina»-kornens storlek, och inte bara genom de olikheter, man redan tidigare iakttagit i fråga om kronans form och färg, fodrets typ etc. och genom vilka den närmar sig den brittiska *P. scotica.* I likhet med denna, med vilken den hos oss tidigare identifierats, men i motsats till *farinosa,* är *P. scandinavica* monomorf i blommorna, d.v.s. alla blommor ha samma typ av ståndare och pistill; från både *farinosa* och *scotica* avviker den genom kromosomtalet. I själva verket är detta den egentliga skillnaden gentemot äkta *P. scotica,* de morfologiska olikheter som Bruun framdragit (märkets form, antalet stänglar pr individ) äro näppeligen genomgående, och engelska forskare synas nu föga benägna att godta *scandinavica* som stälvständig art. Vidare undersökningar synas vara påkallade, innan man tar definitiv ställning till frågan om dess arträtt, vilken i viss mån komplicerats, sedan helt nyligen engelska forskare konstaterat, att även inom *P. farinosa* s. str. olika kromosomtal finnas inom Sveriges område.

Jag skall f.ö. inskränka mig till ett antal fall, lite mer än ett tjog, av så att säga hederliga, »goda» arter, som nästan alla för länge sedan, i flertalet fall för mer än hundra år sedan, erhållit sina namn men som först under de senaste 30 åren kunna sägas ha blivit enrollerade i den svenska floran. Detta betyder inte — som ganska självfallet är, eftersom jag hela tiden skall inskränka mig till arter, som man kan kalla inhemska eller i ett par fall, där det gäller kulturmarksarter, vitt spridda och stabiliserade arter — att dessa nyheter skulle ha kommit in i landet först under denna period. Men en del av dem ha först under denna tid verkligen blivit funna på svenska lokaler, dit de kommit för årtionden eller århundraden, ja, en del för årtusenden sedan. Detta är den ena kategorin av »nya arter». Den andra, som ur en synpunkt kanske erbjuder ännu mer intresse, nämligen för den som är intresserad av hur en vetenskaplig upptäckt görs, utgörs av sådana fall, där växterna i själva verket länge varit kända eller, tydligare uttryckt, där det sen länge funnits material av växterna från Sverige men där detta material aldrig blivit riktigt identifierat till arten — vad som här hänt, är alltså, att ur det gamla materialet en art dragits fram, som man förut ej räknat med som svensk.

Det är emellertid den förstnämnda kategorin, som väcker den största sensationen och som ensam understundom rentav kan få äran att delges den stora allmänheten genom tidningarna. Detta är inte förvånansvärt: fynd av denna typ innebära ofta även för botanisterna av facket något fullständigt oväntat, arterna i fråga äro ej sällan mycket distinkta och i och för sig remarkabla, och det slumpmässiga momentet, som ger krydda åt nyheten, ökas stundom av att finnaren är en kanske inte alls vidare botaniskt bevandrad person. Vi ha under de allra sista åren fått ett par sådana tillskott, och ett fall bara för ett par år sen illustrerar det sagda på ett mycket typiskt sätt. Den 10 mars 1951 meddelade de svenska tidningarna, att en göteborgsk skolpojke i en sjö i Värmland funnit en för Sverige ny blomväxt, nämligen *Elisma natans*. Fyndet hade gjorts i den lilla sjön Vålungen i Långseruds s:n sommaren 1950 men hade först nyligen blivit bekant genom att exemplaret blivit lämnat till granskning hos dr CARL BLOM i Göteborg. Arten, vars släktskap och växtsätt båda antydas av det svenska namnet flytsvalting, är ju eljest mycket karakteristisk: den är visserligen ganska nära besläktad med det egentliga svaltingsläktet, *Alisma*, och liknar detta i kalkens typ, men skottsystemet är mycket olika, uppbyggt som det är av en trådfin, på bottnen krypande och vid noderna vidfäst stjälk; varje nod bär dessutom en krans av 3 små fjällika blad, av vilka 2 stödja var sin ensamma blomma, som medelst ett långt fint skaft exponeras på vattenytan, medan ur det tredje bladets veck utgår en knippa likaledes långskaftade blad med den lilla ovala skivan flytande på ytan.

Det svenska fyndet av *Elisma natans* — eller, som man väl hädanefter är tvungen att kalla den, *Luronium natans* — är inte orimligt men dock mycket oväntat. I Norden har arten sen länge ett litet snävt begränsat område i västra Jylland. Men så upptäcktes den 1923 helt oväntat i Alnsjöen nära Oslo, en liten mager skogssjö, där den vid närmare efterforskning 1926 befanns växa i ymnighet och enligt LID 1949 tycktes täcka hela bottnen. Förekomsten beskrevs först (1930) av HOLMBOE.

vilken som sannolikaste förklaring angav en tillfällig spridning med fåglar; att det inte var fråga om någon avsiktlig utplantering eller någon annan antropokor spridning syntes av sjöns läge och andra omständigheter tydligt. Att den svenska förekomsten måste härledas från en fågeltransport från Norge, kan det väl knappast råda någon tvekan om, helst som flytsvaltingen där verkligen naturaliserats och uppenbarligen befinner sig i spridning: 1949 kunde nämligen LID meddela en ny fyndort, strax intill den första, och dessutom omtala, att arten utbrett sig rikligt i en sjö, där HOLMBOE 1929 planterat ut den. Artens totalutbredning sträcker sig genom Västeuropa från Spanien till Storbritannien och österut genom Tyskland, enligt uppgift ända till Polen. Högeligen remarkabelt är, att den också en gång, en enda, blivit funnen på Java.

Fåglarnas medverkan vid spridningen av växtdiasporer är ju sen länge mycket uppmärksammad och har ju framför allt ofta framhållits, när det gällt att förklara från en arts huvudutbredning starkt disjunkta förekomster, t.ex. den baltiska förekomsten av *Silene viscosa* eller förekomsten på Ölands alvar av den sydosteuropeiska *Plantago tenuiflora*. Det andra spridningssätt, som brukar anföras som förklaring till dylika oväntade fynd, i fall när en reliktförekomst verkar utesluten, är anemokori, spridning med vinden. Ettdera av dessa agens, och kanske då snarast vinden, får väl göras ansvarigt, som också finnaren själv framhållit, för det närmast före i tiden liggande nytillskottet till den inhemska svenska kärlväxtfloran, och det med tanke på artens säregna utseende och sydliga natur kanske mest remarkabla under långliga tider, nämligen den lilla ormbunken *Ceterach officinarum*. Släktet, som omfattar bara några få närstående arter, är nära besläktat med *Asplenium* — vår art kallades av LINNÉ *Asplenium ceterach* — men är lätt att känna igen på att den smala, enkelt pardelade skivan på undersidan är täckt av brett triangulära fjäll, vilka som mycket unga äro färglösa men snart nog anta en skimrande gulröd färg — härav namnet kattguldbräken, varunder *Ceterach officinarum* uppenbarar sig i HULTÉNS atlas. Ett i mitt tycke bättre namn är mjältbräken, bildat efter artens tyska namn Milzfarn och syftande på dess forna medicinska användning liksom släktnamnet *Asplenium*.

Arten är en klippväxt med utbredning från Brittiska öarna över Frankrike och Pyreneiska halvön ner till Marocko och vidare österut genom hela Mediterranområdet i Europa och Afrika samt Mindre Asien, Palestina och Kaukasus ända till Centralasien. I det inre Europa går den med en smal utlöpare från väster in i mellersta Tyskland; dessutom finns (eller fanns) den på en fyndort i Polen som antropokor, nämligen på fästningsmurarna vid Grudsiatz (f.d. Graudenz) nära Gdansk (f.d. Danzig). Även den nordligaste av dessa lokaler är ju emellertid så pass avlägsen, att man inte hade anledning att vänta sig arten i Norden. Som så ofta i fråga om sydliga arter, var det Gotland, som visade sig äga den; lokalen, östsidan av Grogarnsberget i Östergarn på öns östra sida, blev funnen 29 juni 1948 av en läroverkslärare i Örebro, GÖSTA NYHLÉN. Här växer arten sparsamt men dock i flera tuvor, både större och helt små, i »horisontella sprickor och grottor i kalkklipporna» på så låg höjd över havet, att fyndorten, som dess finnare påpekar i sin redogörelse i Botaniska Notiser 1949, måste ha varit dränkt av havet åtminstone under Ancylus-tid och troligast även under Litorina-tid. Om en relikt förekomst kan det alltså, säger han, inte rimligen vara fråga; fågelspridning skulle däremot kunna tänkas, eftersom växtplatsen var bebodd av skogsduvor, likaså spridning av sporer med vinden från en mellaneuropeisk lokal. Men att härom bevisa något är ännu ogörligt och kommer väl att så förbli.

Den motsatta tolkningen, alltså en relikt förekomst och ej en (eljest väl tekniskt möjlig) recent vindspridning vill BENGT PETTERSSON däremot ge åt en liknande starkt disjunkt gotländsk förekomst av en syd- och mellaneuropeisk växt, där han själv var den lycklige upptäckaren och som han för några år sedan väckte storsensation med hos sina kolleger, nämligen *Orchis Spitzelii*. PETTERSSON fann denna art den 4 juni 1939 i Halls socken på Gotland och kunde därmed, som han själv skriver i sin redogörelse för fyndet i festskriften för CARL SKOTTSBERG 1940, jämnt 140 år efter WAHLENBERGS på sin tid lika märkliga fynd av *Orchis palustris* »på Gotland påvisa en representant för en artgrupp av släktet *Orchis* som till denna dag varit okänd i Sverige, ja i hela norra och mellersta Europa norr om Schwarzwald». Den står bland svenska arter närmast *O. mascula* men skiljs lätt genom brunaktig överläpp och framför allt genom konisk, nedåtriktad, inte nedåt bredare och uppåtböjd sporre. Efter det PETTERSSON gjort sitt fynd visade det sig också, att arten i själva verket insamlats redan 1914 på Gotland av dr. E. TH. FRIES i Visby, som visserligen kallat den *mascula* men på etiketten till sitt exemplar anmärkt skillnaden i blomfärg. PETTERSSONS förmodan, att arten skulle stå att finna på flera lokaler på ön, har också visat sig riktig. När han 1951 (i ROSVALL & PETTERSSON: Gotlands orkidéer) meddelade en karta över de gotländska fyndorterna, hade dessas antal stigit till 11. I alla fallen, inkl. det ursprungliga, är lokalen av överraskande trivial karaktär, i de flesta nära överensstämmande med den första, som utgjordes av en torr och mager, mjölonrik tallskog strax intill kusten. Han påpekar emellertid, att lokalklimatet och markförhållandena på dessa ståndorter måste anses ganska bra stämma överens med de förhållanden, som äro kända för artens förekomster i Alperna; på det hela taget är den, så vitt man vet, en kalkväxt. Dessa båda omständigheter ge ju en viss förklaring till dess trivsel på Gotland, där den enligt honom måste anses vara av gammalt datum — som redan antalet lokaler antyder — trots att den så länge undgått upptäckt; detta i sin tur kan förklaras inte bara med ståndorternas triviala karaktär, som inte inbjudit till eftersökning av rara orkidéer, men även därmed att arten endast under den ganska korta blomningstiden sticker av tillräckligt från *mascula*. På det hela taget är arten ganska polymorf, vilket står i samband med att den har en så splittrad utbredning; med undantag för Gotland och ett par öar vid Dalmatiens kust är den rent montan (mestadels högmontan). Mera talrika äro dess lokaler endast i Alperna och på nordvästra Balkanhalvön; härifrån går den över Balkan till Mindre Asien, där ett par fyndorter äro kända, liksom en enda är bekant från Spanien och en från Marocko.

Ett tredje spridningssätt — alltså utöver fågel- och vindspridning — nämligen med havsströmmar ligger väl närmast till hands att anta för en tredje remarkabel sydsvensk novitet, vars upptäckt dock ligger ungefär 25 år tillbaka i tiden, nämligen umbellaten *Oenanthe Lachenalii*, funnen 1927 av dåvarande skolpojken, nu lasarettsläkaren NILS SÖDERSTRÖM, som själv publicerade sitt fynd i Svensk Bot. Tidskrift 1930. Fyndorten var en holme i Blekinge, i närheten av Ronneby, men egendomligt nog — som finnaren påpekar — ligger den inte ute i yttersta havsbandet utan långt in i skyddat läge. Därför ställer han sig skeptisk mot att den skulle förts hit av havsströmmar från sina närmaste baltiska förekomster, som ligga på tyska nordkusten — arten finns nämligen, så vitt man vet, inte på Bornholm, fastän HULTÉN i sin atlas råkat pricka in några lokaler för den där — utan han vill snarare tro, att den lilla Blekingeförekomsten är en rest av en tidigare större utbredning. Detta kan synas djärvt men får nog inte utan vidare avspisas, särskilt när man tänker på vad som hänt med en annan havsstrandsumbellat, nämligen *Ligusticum scoticum*. Denna var i Sverige känd blott från Västkusten intill det JOHAN ERIKSON 1927 just i Blekinge fann den i ett enda litet ex.; och nu har den, åtskilliga år senare, visats äga en inte så oansenlig förekomst i Hälsingland, med strödda sparsamma utposter (men får väl snarast tolka förhållandet på det sättet) i Gästrikland och nordligaste Uppland. Hur som helst, en spontan förekomst är det säkert fråga om när det gäller *Oenanthe Lachenalii* i Blekinge — som en anmärkningsvärd omständighet påpekade SÖDERSTRÖM, att den växte tillsammans med *Juncus maritimus*, som eljest inte fanns i närheten. Inom Norden finns *O. Lachenalii* f.ö. blott i Danmark men där på ganska många håll, dels kring Limfjorden, dels vid kusten i sydöstra Jylland, Fyn, Langeland, Falster och Sjælland.

Ytterligare några arter, som tillhöra havsstränderna eller deras närmaste omgivningar, ha under nu ifrågavarande tid upptäckts som nya för Sverige, flertalet i de sydligaste landskapen. För det allra märkligaste — och i sanning högst remarkabla — av dessa har säreget nog aldrig givits någon ordentlig redogörelse i litteraturen utan endast korta notiser, och vad som är känt om fyndomständigheterna har traderats muntligen. Vad jag syftar på är NILS DAHLBECKS fynd sommaren 1944 av *Scutellaria minor* nära Torekov i nordvästligaste Skåne. Det var enligt finnarens egen relation beroende på en blandning av slump och nyfikenhet, att det gjordes: hade han inte behövt stiga av sin cykel för att öppna en grind, när han for över strandängen, och hade han inte samtidigt varit nog nyfiken att begagna tillfället att titta efter, om det möjligen kunde finnas något sevärt i någon av de små pölar med vitmossa kring, som funnos i närheten som svackor i ängen, så hade den oansenliga växten förblivit oupptäckt — för hur lång tid är svårt att säga, ty det har senare visat sig, att den faktiskt finns på ytterligare åtm. ett par liknande lokaler i samma trakt, detta enligt STEN SELANDER, som ägnat sig åt en del detaljerad florautforskning av området under några somrar. Detta tyder ju på att det i varje fall inte är fråga om någon så alldeles recent förekomst; att den undgått upptäckt är inte så mycket att undra över, om man känner dess obetydlighet — den gör verkligen, åtm. i fråga om svenska ex., skäl för epitetet *minor,* ty den blir inte många cm hög, och dess blommor med sin ganska blekt violettskära krona äro också små och föga iögonenfallande. Ståndorten är väl inte heller av den typ, att den ofta efterforskas. Den torde motsvara vad som är normalt för arten inom dess egentliga utbredningsområde, som är m.l.m. atlantiskt och mot norr sträcker sig upp till Storbritannien och nordvästra Tyskland. Man kan alltså inte säga, att *Scutellaria minor* var någon växt, som man var inriktad på att finna, inte någon av de där arterna, som man i första hand satte på listan över växter som borde efterspanas.

Det kan däremot med större eller mindre rätt sägas om de tre återstående havsstrandsarterna inom denna grupp av nyheter. Två av dem äro bottniska och sedan länge bekanta från Finlands-sidan. Den ena är *Hippuris tetraphylla,* den andra *Rumex fennicus* — eller, som man nog måste kalla den, *R. pseudonatronatus. Hippuris tetraphylla* hade visserligen flera gånger förut blivit rapporterad som svensk, från helt olika trakter av östkusten, men uppenbart med orätt eller åtm. utan säkra bevis, och det första säkra fyndet kom först 1930, då den blev funnen nära Umeå av dåvarande skolgossen, numera botanik-licentiaten LENNART HOLM. — *Rumex pseudonatronatus* blev konstaterad som svensk något tidigare, nämligen 1922, då disponenten STEN GRAPENGIESSER fann den vid stranden av Holmöarna, också i närheten av Umeå. Här ha sedan flera fyndställen blivit funna och publicerade av TH. ARWIDSSON, och dessutom har ett litet område blivit funnet för den i Haparanda skärgård. Hur pass konstant den är på sina fyndställen och i Sverige på det hela taget, vet man väl mycket lite om — den är ju även i Finland lite rörlig av sig; som stabiliserad får man nog ändå räkna den även på svenska sidan.

Detta är däremot mycket tvivelaktigt i fråga om art nr 3, som i motsats till de båda föregående tillhör västkusten, nämligen sandmållan, *Atriplex sabulosa,* tidigare mera bekant som *A. maritima* eller *A. farinosa.* Den har ju redan tidigare figurerat från Sverige men endast i egenskap av adventiv, f.ö. blott med få och gamla fynd. Om någon antropokor tillförsel kan det tydligen inte gärna vara tal i fråga om det fynd, som motiverar dess upptagande i min översikt, nämligen det som GUNNAR DEGELIUS 1943 gjorde på Nordkoster i Bohuslän i ett enda exemplar; som ju arten är ettårig, är det alltså ganska ovisst om den alltjämt lever kvar i vår flora. Å andra sidan kan det mycket väl tänkas, att den förr eller senare skall visa sig ha gjort en ny och mera lyckad kolonisation, på samma sätt som tycks ha skett under de allra sista årtiondena på norska sydkusten, enligt vad som skildrats av HOLMBOE och NORDHAGEN; härifrån måste ju med all rimlighet framstöten mot Bohuslän ha utgått. Denna norska expansion — man kanske får använda detta uttryck, eftersom gamla ex. tyda på att arten haft smärre spontana förekomster i området sen långt tillbaka — är i sin tur dock ganska anmärkningsvärd, ty det är från artens norska område en ganska avsevärd sträcka ner till dess egentliga sammanhängande utbredningsområde.[1] Sandmållan är nämligen en art som hör hemma på stränderna av Atlanten och Nordsjön från Frankrike upp till England och västra Jylland; där är den känd från ett tjugotal lokaler upp till norra Vendsyssel. Överallt växer den som i Skandinavien i fin sand.

Flertalet nya arter av denna grupp tillhöra emellertid, som naturligt

---

[1] Sedan ovanstående skrivits har IVAR SEGELBERG i Svensk Bot. Tidskr. 48: 1 (1954) meddelat, att han hösten 1953 funnit »ett hundratal individ» av arten på havsstranden vid Åsa i Ölmevalla s:n i Halland.

är, fjällen. De flesta höra till den så att säga väntade kategorien, d.v.s. sådana som tidigare varit kända från Norge och i många fall även Östfennoskandia. För inte mindre än 4 av dessa står den oförlikneligt skarpsynte HARRY SMITH, nämligen *Draba crassifolia, Stellaria longipes* (eller *S. crassipes,* om man accepterar HULTÉNS uppdelning av denna artgrupp) — vardera funnen på 2 lokaler i Torne lappmark 1920 — samt *Ranunculus sulphureus* på Pesisvare vid Abisko 1925 och slutligen 1933 den först hos HEDBERG 1952 publicerade *Armeria sibirica* eller, som den väl bör heta, *A. scabra,* från det högst märkvärdiga och växtrika fjället Pältsa i Torne lappmarks allra nordligaste kil, vilken sistnämnda art visserligen redan tidigare angetts som svensk men med orätt. För en annan av de nya fjällarterna, nämligen *Gentianella aurea,* fanns det däremot tidigare hederliga svenska belägg, men de härstammade från en förekomst vid Abisko, där arten väl utan något tvivel kommit in från Norge, närmare bestämt med hö någonstans från Narviks-kusten, där den är vanlig på strandängarna. Men 1929 fann GUNNAR BJÖRKMAN — också en av de loögda — arten som otvivelaktigt indigen fjällväxt på Tjårgesvare i Lule lappmark; han har närmare berättat därom i sin avhandling om floran i Stora Sjöfallets nationalpark 10 år senare. Sist i skaran av dessa nya men mer eller mindre väntade fjällväxter kommer så 1935 *Carex holostoma,* funnen av AXEL NYGREN vid Riksgränsen, nätt och jämnt innanför gränsen mot Norge.

Men även fjällen ha för några år sedan givit en art av samma överraskande slag som t.ex. *Orchis Spitzelii* och vetenskapligt väl av nästan ännu större intresse, nämligen den tidigare på Europas fastland blott från Kanin nos kända *Potentilla emarginata* eller, som man nog måste kalla den, *P. hyparctica.* Det var STEN SELANDER som 1941 gjorde detta högst oväntade fynd på krönet av fjället Stalotjåkko i Virihaure-området i Lule lappmark, c. 1.300 m ö.h.; fyndet var desto hedersammare som växten var i frukt. Följande år kunde han dock beskåda och samla den i blommande skick, och hans färdkamrat CARL SKOTTSBERG fann den på en andra lokal på fjället. Ytterligare 2 år senare fann SELANDER och OLOF RUNE den på det närbelägna fjället Jeknafo, där den på 1.400 m höjd t.o.m. var ganska riklig. Enligt SELANDER synes arten i Lule lappmark ha mycket speciella fordringar på sina ståndorter: »dessa utgörs», säger han, »av branta, blåsiga höjdkammar inom översta delen av regio alpina media, där snöbetäckningen under vintern måste vara högst obetydlig, och är på ett undantag när [SKOTTSBERGS lokal] belägna på fjällens lovartssidor åt väster och söder. . . . Marken består av vittrat kalkhaltigt skiffergrus» med gles koloniartad vegetation, där artens mycket kraftiga jordstammar fästa den tillräckligt kraftigt för att den skall kunna uthärda den starka uppfrysningen. Artens utbredning är högarktiskt cirkumpolär; att den i den nordiska fjällkedjan skulle finnas just i Lule lappmark kan, som SELANDER säger, synas ganska oväntat, men i själva verket hyser, som han samtidigt framhåller, detta stora kompakta högfjällsmassiv en ganska enastående uppsättning av typiska »övervintrare», däribland 15 av Sveriges 22 västarktiska arter — bl.a., på ett par hundra m:s avstånd från *Potentilla, Draba crassifolia.* Att *Potentilla hyparctica* här måste räknas som en interglacial relikt, en »övervintrare», kan det näppeligen råda något tvivel om.

Med den sista art jag nu skall skildra inom de »nyupptäcktas» grupp måste vi emellertid återvända till Sydsverige, närmare bestämt till Gotland. Samtidigt kan den arten sägas bilda en övergång till nästa grupp, den man skulle kunna kalla de nyavslöjades grupp — ty fyndet gjordes inte i naturen utan i herbariet. Den intresserar mig speciellt, eftersom det är den enda novitet jag själv kunnat bidra med — men fyndet, alltså den ursprungliga insamlingen av exemplaren, gjordes inte av mig. Min s.k. upptäckt var så tillvida lön för ett avsiktligt letande, som att jag gjorde den när jag gick igenom Uppsala-herbariets svenska material av *Veronica triphylla* på jakt efter en annan art, *V. Dillenii* (eller *V. campestris*), som med hänsyn till sin förekomst ganska långt norrut i Tyskland rimligen kunde tänkas växa i Sydsverige och för vilken ett högst obskyrt svenskt fynd spökat i litteraturen. Jag fann den inte, vare sig då eller senare, men i stället en kollekt från Visby, samlad 1896 av K. JOHANSSON och kallad »*V. triphylla* cum f. *nana*», vilken jag såg vara en för Sverige ny art; vid genomgång av det allmänna herbariet visade den sig vara den av ALLIONI 1785 beskrivna *V. praecox.* När jag för säkerhets skull även granskade vårt nordiska material av *V. arvensis,* låg även där (under namnet *V. arvensis* f. *serrata*) ett likaså av K. JOHANSSON på Gotland — närmare bestämt i Hejdeby 1906 — samlat ark av *V. praecox.* I själva verket står arten morfologiskt tämligen mitt emellan dessa båda arter, fast den åt båda hållen är mycket väl skild genom bladens, kapselns och frönas form — det är inte på något sätt en kritisk art utan en mycket hederlig, fristående och föga variabel art. Om blommorna kunde jag inte få mycken föreställning på de avslöjade herbarieexemplaren, av vilka det ena arket upptog ex. i frö, det andra ytterst små, bara några få cm höga ex., som just börjat blomma. Det intressanta var nu emellertid framför allt, att det redan av uppgifterna på etiketterna enligt min mening var tydligt fråga om spontana förekomster på kalkklippmark. Detta bekräftades också snart nog: följande år fann BENGT PETTERSSON arten väl inte på någon av de gamla lokalerna men på en ny gotländsk lokal av utpräglad alvarkaraktär, och 2 år senare kunde den skarpsynte NILS ALBERTSON upptäcka den på två alvarlokaler på Öland, där senare ytterligare en lokal blivit funnen av Ölandsflorans egen monograf, RIKARD STERNER. Att denne dittills kunnat förbise den har en mycket enkel förklaring i att arten är utomordentligt tidig (ALBERTSON samlade den i blom siste april) och sedan snabbt försvinner. Men uppenbart är även — efter ALBERTSONs och STERNERs noggranna undersökningar av dess ståndortsförhållanden på Öland, där den förgäves eftersökts på stora alvaret — att dess krav äro mycket speciella och att den både är och kommer att förbli en stor sällsynthet. Omöjligt skulle väl emellertid, som ALBERTSON framhåller, inte vara, att arten skulle stå att finna inom Skånes sandområden; i så fall skulle man få en viss bekräftelse på en gammal uppgift om att den skulle ha samlats i Torup i östra Skåne, vilken ELIAS FRIES meddelat på grundval av ett gammalt herbarieexemplar från 1700-talet. På detta sätt, som sandväxt, förekommer *V. praecox* i England, där den först på 1930-talet blev funnen i torra halvkultursamhällen med m.l.m. utpräglad sandhedsvegetation, likaså i Tyskland, delvis i samhällen av mera påtaglig spontan karaktär. Längre söderut blir den ånyo klippväxt, och även så långt norrut som i Kyffhäuser-området vid Rhen har den en sådan förekomst på kalkberg.

På en del av sina lokaler, bl.a. i England, uppträder den tillsammans med en växt, med vilken den både växtgeografiskt och i fråga om sin svenska upptäcktshistoria visar påtagliga likheter, nämligen alvarkösan, *Apera interrupta*. Att en småväxt *Apera*-form förekom ute på Ölands alvar som en normal konstituent var sen länge bekant, och redan ELIAS FRIES gav den en särskild varietetsbeteckning under *A. spica-venti*: var. *pygmaea*, vilken behölls ännu av HOLMBERG i första häftet av hans flora 1922. 2 år senare visade den utomordentlige artsystematikern TYCHO VESTERGREN, att den i själva verket inte alls var någon form av *A. spica-venti* utan identisk med en annan linnaeansk art, *A. interrupta* (beskriven av LINNÉ som *Agrostis interrupta* 1759). Utöver habituella kännetecken, speciellt den smala vippan, som även i kultur förblir konstant, skiljs denna från *A. spica-venti*, åkerkösan, genom sina ytterst korta ståndarknappar. I Sverige finns alvarkösan dels, uppenbarligen mycket sällsynt, på Gotland, dels vida spridd på Ölands alvarmarker; ja, VESTERGREN skriver, att »det är troligt, att Ölands södra alvar är den enda plats på vår jord, där den kan betraktas som allmän». Utanför

Sverige förekommer arten huvudsakligen på »sandfält, vägkanter, åkrar och liknande ställen med öppen vegetation, t.o.m. murar»; i södra mediterranområdet möter man den som bergväxt. Utanför Europa, där den f.ö. går upp till södra Skottland, södra Holland och två lokaler i Tyskland (i Köln- och Hildesheims-trakten), är den med säkerhet bara känd från en lokal i Transkaukasien och från Atlas.

Ytterligare två goda men länge bortglömda eller missförstådda gräsarter ha under denna period blivit utredda och påvisade som svenska, nämligen *Poa supina* och *Glyceria declinata*. Namnet *Poa supina* hade ju tidigare förekommit i svenska floror, exv. hos NEUMAN 1901, fast det som betecknats så egentligen bara varit kraftigt färgade modifikationer av *Poa annua* — säreget nog ligger dock i Uppsala-herbariet en kollekt av verklig *supina* samlad av ELIAS FRIES och bestämd till denna, vilket dock aldrig ledde till att FRIES definitivt accepterade arten. Definitivt urskild som en egen, väl skild art med avsevärd utbredning inom Sverige blev *Poa supina* först på 1930-talet genom J. A. NANNFELDT. Denne hade under sina *Poa*-forskningar visserligen fäst sig vid en del utländskt herbariematerial, kallat *P. supina* och avvikande från det vanliga vitgröet genom förlängda, krypande skottaxlar, men någon klarhet om att här förelåg en artskild typ fann han ej förrän han sett en uppgift i HARALD LINDBERGS bok Itinera mediterranea, att *P. supina* skulle skilja sig från *P. annua* genom mycket längre ståndarknappar. Då väcktes emellertid NANNFELDTS nyfikenhet på allvar, och han kunde strax konstatera, att denna karaktär stämde genomgående för utländsk *supina* och även att svenska exemplar, som han tidigare funnit ha samma skottsystem, också hade långa ståndarknappar och alltså borde räknas till *P. supina*. Närmare granskning gav ju också vid handen, att denna skilde sig även i andra detaljer, exv. vippformen, från *P. annua*. Detta blev ännu tydligare, när levande material blev tillgängligt för studium — och sådant levererades prompt, när våren efter upptäckten kom, av Uppsala-botanisterna. *Poa supinas* favorittillhåll äro väl trampade skogsstigar och parkgångar o.d. — jag har därför döpt den till trampgröe — n.b. om de äro mullrika, men gärna också kring uthus, på ladugårdsbackar, beten etc.; på sandig mark söker man den i regel förgäves. På det hela taget är arten europeisk-nordafrikansk, men NANNFELDT har också påvisat den från Sibirien och Himalaja. I Sverige är den — med skenbara eller verkliga ojämnheter i utbredningen — funnen upp till Jämtland (och på en lokal i Torne Lappmark) och är i många landskap traktvis helt vanlig. I de övriga nordiska länderna är den alltjämt förvånansvärt litet samlad: från Norge är den, bortsett från ett gammalt fynd vid Oslo, bara känd från några lokaler i Sör- och Nord-Tröndelag i nära anslutning till de jämtländska förekomsterna, från Danmark bara från Bornholm; i Finland, där den kunde väntas vara ganska spridd, med tanke på artens ymnighet i Uppland, har den först helt nyligen blivit påvisad, nämligen från ett par ställen i Eckerö på Åland. Härtill måste emellertid påpekas, att trampgröet måste sökas under våren och försommaren — denna art har nämligen gentemot den när som helst under året blommande *annua* den markerade olikheten, att den blommar bara en kort och avgränsad period och sen snabbt mognar och sprider sitt frö, varpå strået vissnar. Dess hybrid med *annua*, som nästan alltid finns, när arterna — såsom ofta sker — växa tillsammans, håller däremot långt därefter på med sin resultatlösa blomning och kan långt in på högsommarn påträffas med sina karakteristiska utspretande blomfjäll, mellan vilka de smala och alldeles hopskrumpna ståndarknapparna sticka ut; steriliteten sammanhänger med den av NANNFELDT fastställda skillnaden i kromosomtal mellan arterna.

Även *Glyceria declinata*, som man skulle kunna kalla blågrönt mannagräs — med tanke på dess bladfärg och i anslutning till de förut existerande namnen på samarterna *fluitans* och *plicata*, resp. vanligt och skånskt mannagräs — skiljer sig, som engelska botanister nyligen visat, i sitt kromosomtal från sina närmaste släktingar, de just nämnda arterna, med vilka den länge varit förblandad. *G. declinata* har nämligen somatiskt 20 kromosomer, de båda övriga 40. Över huvud taget var det genom engelska botanister som arten på 1930-talet så att säga återupptäcktes och även dess yttre morfologiska, från de övriga arternas väl markerade karaktär ånyo påpekades. Den är uppenbarligen ej alls sällsynt i Storbritannien, och på det hela taget är den så vitt man vet västeuropeisk: efter vad jag själv sett i herbarier går den från Portugal över västra Frankrike, västra Tyskland och Danmark upp till södra Norge. Beskriven blev den från Normandie av BRÉBISSON 1859, och dess förnedring var alltså inte så lång som den redan 1804 beskrivna *Poa supinas* men å andra sidan djupare — den förhållandevis inskränkta utbredningen kan väl kanske andragas som en förmildrande omständighet. Det är dock möjligt, att denna sträcker sig längre in i Mellaneuropa, om nämligen den av WIMMER & GRABOWSKI från Schlesien beskrivna *G. fluitans* f. *pumila* verkligen hör hit; detta verkar av beskrivningen att döma i varje fall inte omöjligt. Faktum är emellertid, att detta namn senare i Sverige använts för att beteckna exemplar som verkligen tillhöra *G. declinata*, t.ex. hos HOLMBERG 1926, ja, att HOLMBERG själv samlat sådana och spritt dem under detta namn. Det besynnerliga är nu, att den beskrivning han ger i andra häftet av sin flora av denna f. *pumila* just framhäver de båda viktigaste karaktärer, genom vilka *declinata* skiljer sig från *fluitans,* nämligen de korta ståndarknapparna — en karaktär gemensam med *plicata* — och den även från den sistnämnda avvikande uppflikningen av ytterblomfjällets spets i tre (eller fem) korta uddar. Han tillägger: växer på uttorkade ställen; småaxen likna dem hos *G. plicata.* Det sistnämnda är riktigt, och i många fall är det just med denna som *declinata* förväxlats hos oss, men första delen av meningen, jämte första delen av beskrivningen av f. *pumila,* nämligen såsom lågväxt, 10—20 cm hög, nedliggande — uppstigande med kort, axlik vippa, stämmer inte genomgående; tydligen hade HOLMBERG ej stött på arten i andra än dessa magra modifikationer. Det var emellertid på sådana exemplar i Uppsala-herbariet som arten till slut (1948) av den gästande unge engelske botanisten MAX WALTERS fastställdes som svensk. Bilden av både arten och dess utbredning ändrades emellertid snabbt, när W. och jag fortsatte herbarieundersökningen: de få lokalerna mångdubblades, och arten framställde sig i väl utbildat och då mycket prydligt skick i samma ögonblick vi genomgingo materialet i Göteborgs botaniska trädgårds herbarium. Det visade sig, att den — nästan uteslutande på 1930-talet — inom Göteborgs och Bohus' län samlats på inte mindre än 28 lokaler, delvis i källdrag i skalbankar, men genomgående bestämts till *plicata.* Till större delen låg den därifrån i magnifika exemplar med ofta $^1/_2$ m höga strån och dm-långa rika vippor. Redan inom en vecka kunde vi f.ö. genom den påpasslige NILS ALBERTSONS hjälp få levande exemplar från ett nytt område för m.l.m. riklig förekomst, nämligen Falköpings-trakten i Västergötland. Dess älsklingstillhåll voro här enligt ALBERTSON gyttjiga, helst rikligt kotrampade och naturligtvis även -gödslade vattningspölar, dammkanter eller kärriga betesmarker o.d. Jag har senare själv i Skåne haft tillfälle att finna den och försöka diska den något så när ren på en sådan lokal; den var förvisso ej av sådan natur, att man där letade efter snygga exemplar till sitt herbarium, och detta växesätt och därav följande oskönhet är naturligtvis främsta anledningen till att arten så litet uppmärksammats i Sverige. Under de senaste åren ha åtskilliga nya fyndorter kommit till från Skåne, i vars slättbygder den torde vara ganska vanlig, men till sin utbredningstyp är arten alltjämt inom Sverige sydlig och västlig, med den mot öster längst framskjutna fyndorten i Gustav Adolf i Västergötland, strax intill Smålandsgränsen V om Jönköping. Den är nu också, särskilt genom STÖRMERS undersökningar, känd från några lokaler vid Norges sydkust.

Hela denna upptäcktshistoria, åtm. den svenska delen därav, påminner i högsta grad om en annan arts, där också en gästande utlänning gjorde upptäckten. Vad jag åsyftar är *Alchemilla* eller hellre *Aphanes microcarpa,* vars förekomst i Sverige fastställdes av den tyske *Alchemilla*-specialisten WERNER ROTHMALER vid hans besök i Stockholm 1937. Till min skam måste jag erkänna, att jag skulle ha gjort upptäckten själv, om jag haft lite mera nyfikenhet — jag hade nämligen sett ROTHMALERs strax förut publicerade monografi över gruppen och ett ögonblick reflekterat över möjligheten att *A. microcarpa* kanske skulle kunna finnas även i Sverige; men eftersom den i Europa gällde som rent mediterran (och därutöver endast var känd från östra Nordamerika) slog jag tyvärr bort tanken igen. När ROTHMALER på sommaren kom till Stockholm och G. SAMUELSSON uppmanade honom att gå igenom Riksmuseets svenska *Aphanes*-material hade han emellertid under fortsatt herbariearbete funnit material från Böhmen, Bulgarien och Frankrike och från 5 lokaler i Tyskland. En del av de nordligare fynden voro dock, enligt vad ROTHMALER ansåg, av recent antropokor natur och att *A. microcarpa* skulle visa sig vara en inom vissa trakter av Sydsverige rentav ganska vanlig art, fanns det ingenting som tydde på. Så visade sig emellertid vara fallet — genom våra gemensamma herbariegranskningar kunde vi fastställa den från mellan 60 och 70 svenska lokaler. Utbredningsbilden, inlagd på en karta, blev i princip ej mycket olik bilden för den reviderade *A. arvensis* s. str., och i inte mindre än 30 fall funnos arterna samlade och uppfästade tillsammans från samma lokal. Icke i något fall hade dock insamlaren på något sätt antytt något om en sådan blandning, trots att de båda arterna i själva verket ej bereda några som helst bestämningssvårigheter, när de — som nästan alltid är fallet — ha utvecklade blommor. Trots det så ofta gemensamma uppträdandet fanns det dock vissa tecken som tydde på en viss ekologisk olikhet — så föreföll *microcarpa* avgjort vanligare än *arvensis* i Blekinge, medan på Gotland *arvensis* var tämligen allmän men *microcarpa* blott samlad på 5 lokaler. Att sådana olikheter verkligen existera visades några år senare i ett vackert arbete av den dansk-isländske forskaren GUÐJÓNSON över de båda arternas förekomst i Danmark.

När jag nämnde *Aphanes*-arternas samförekomst, så är ju denna en egendomlighet som dock ej alldeles saknar paralleller — jag kan erinra om *Lamium*-arterna av *purpureum*-gruppen som exempel, men det är ett annat fall som jag i förbigående speciellt ville fästa uppmärksamheten på, nämligen *Geranium bohemicum* och *G. lanuginosum.* Den sistnämnda kan ju också ha skäl att bli nämnd i denna översikt, eftersom dess rätta identifiering faller inom den nu ifrågavarande tidsperioden. Det var nämligen hösten 1932 som jag på ett sammanträde i Botaniska sektionen av Naturvetenskapliga studentsällskapet i Uppsala kunde meddela, att den växt ERIK ALMQUIST 1916 på material från Småland och Södermanland beskrivit som *G. bohemicum* ssp. *deprehensum,* i själva verket var identisk med den från Sydfrankrike tidigare beskrivna *G. Perreymondii* SHUTTLEW., vilken i sin tur snart nog blivit identifierad med den redan 1784 av LAMARCK från »Numidien» beskrivna *G. lanuginosum.* Jag genomgick också åtkomliga herbarier och fann några förut obeaktade svenska fynd av denna, men mera hade jag inte tid och tillfälle att ägna mig åt saken, som i stället togs upp av K. V. O. DAHLGREN, vilken redan tidigare sysslat med de båda arterna och framställt den fullständigt sterila hybriden mellan dem. Han publicerade 1943 resultaten av sin nya undersökning i en mångsidig uppsats, som också avsåg att stimulera växtsamlare att meddela nya fynd. Detta lyckades också i viss mån: ett par år senare kunde DAHLGREN redovisa 6 nya lokaler för *lanuginosum,* 1948 ytterligare 2, och senare ha ännu ett par kommit till. Detta är procentuellt inte så litet: sammanlagt känner man arten alltjämt bara från något över 20 lokaler eller lokalgrupper. Bortsett från 1 lokal i Dalsland och 2 nära varandra i nordöstra Västergötland — den förra anmärkningsvärt nog alldeles intill Vänern, de senare alldeles vid Vättern — falla alla inom östkustprovinserna och med bara några få undantag alldeles intill kusten. Den sydligaste ligger i mellersta Kalmar län, den nordligaste Ö om Uppsala. Äldsta fyndet är gjort redan 1813 och ganska anmärkningsvärt: på etiketten har nämligen finnaren, den som characéspecialist kände lektor WALLMAN, antecknat: »Af denna besynnerliga *Geranium* hvars petala äro hela, fann jag allenast tvenne specimina. Till *pusillum* kan den väl knappast föras, men ännu mindre till *bohemicum* i hvars sällskap den växt?» Skillnaden i kronbladen är nu föga påfallande gentemot *bohemicum,* men eljes äro olikheterna både talrika och påtagliga, dels i bladformen (kuriöst nog tydligast på hjärtbladen), dels i märkenas färg: hos *bohemicum* grönggrå, hos *lanuginosum* bjärt röd, och framför allt i frönas färg och ytstruktur.

Enligt vad man vet om arternas uppträdande i Sverige, är deras ekologi fullkomligt densamma, de äro — som framgår av namnen svedjenäva för *bohemicum* och brandnäva, bildat av LINDMAN, för *lanuginosum* — båda antrakofiler, som komma fram på brännfläckar men också stundom visa sig på obränd mark, som blivit starkt uppvärmd av solen.

Och åtminstone på en avsevärd del av *lanuginosum*-lokalerna har denna vuxit tillsammans med *bohemicum* men, som det tycks, alltid sparsammare än denna. Detta samuppträdande är desto mera säreget som arterna i sin totalutbredning äro starkt olika: *bohemicum* är nämligen utanför Sverige, sydöstra Norge och södra Finland östeuropeisk med några få och strödda lokaler även i mellersta Europa, *lanuginosum* däremot är utanför Sverige rent mediterran med sina nordligaste fyndorter i dep. Var i sydöstra Frankrike och f.ö. känd från Algeriet, Marocko, södra Frankrike, Italien, Korsika, Sicilien och Grekland. Dess förekomst i Sverige är ju därför högst överraskande, eftersom denna måste vara av gammalt datum; »det lönar sig», säger DAHLGREN, »nog ganska litet att spekulera om sättet för dess invandring». Kanske det, men någon mera problematisk växt ur invandringshistorisk synpunkt ha vi knappt i vår flora; i varje fall bör den ju definitivt slå ihjäl den teori, som särskilt HEINTZE lanserat, att *G. bohemicum* inkommit till Sverige med finnråg i slutet av 1500-talet och början av 1600-talet eller i samband med svedjebrukets spridande genom invandrare från Finland. *G. lanuginosum* väntar alltjämt på att bli funnen i Finland.

*Glyceria declinata*s och *Aphanes microcarpa*s svenska upptäcktshistoria har på allra sista tiden fått en parallell, där upptäckten av en för Sverige ny art grundar sig på direkt efterforskning. Också i detta fall liksom i fråga om *Glyceria declinata* var det en engelsman som först kunde rapportera den som svensk på grundval av gammalt herbariematerial, och även i detta fall är det fråga om en för länge sen beskriven men senare feltolkad, d.v.s. ej rätt uppskattad art. Det gäller den art, som med ett av mig kombinerat namn kallas *Rorippa microphylla* men som från början beskrevs — redan 1830 av BOENNINGHAUSEN hos REICHENBACH — som *Nasturtium microphyllum*. Det är en art, som otvivelaktigt står nära *Rorippa nasturtium-aquaticum* eller — som de flesta engelsmän alltjämt synas vilja kalla den — *Nasturtium officinale,* och den avviker liksom denna från våra övriga *Rorippa*-arter genom vita blommor. Från *R. nasturtium-aquaticum* skiljer den sig emellertid genom mycket långa och smala skidor med fröna ordnade nästan i en rad, inte i två tydliga rader som hos *nasturtium-aquaticum*. Det närmare studiet av denna *Rorippa*-grupp påbörjades av den mycket framstående engelska cytotaxonomen IRENE MANTON, som 1935 kunde meddela, att vad hon kallade *Nasturtium officinale* visat sig omfatta två i fråga om fruktformen skilda typer med olika kromosomtal, somatiskt resp. 32 och 64. Av den lågkromosomiga och kortfruktiga typen hade hon sett exemplar bl.a. från Skåne, av den högkromosomiga och långfruktiga bl.a. från Danmark. Ett par år senare fullföljdes undersökningen av professor MANTON i samarbete med hennes landsman HOWARD, och därvid upphöjdes den högkromosomiga typen till egen art, som (med hänsyftning på de enradiga skidorna) kallades *N. uniseriatum,* medan namnet *N. officinale* behölls för den lågkromosomiga. Nu kunde de emellertid stödja den förras arträtt även på en karaktär av inte bara kvantitativ utan mera kvalitativ art: de visade nämligen, att fröna hos *uniseriatum* hade en mycket tätare nätmönstring än *officinale.* Denna karaktär är i själva verket mycket lätt att se även på ganska unga frön; och frön utvecklas hos båda arterna mycket snabbt efter blomningen. Därigenom är också den redan i miss MANTONS första arbete omtalade, i naturen funna hybriden mellan arterna mycket påfallande: den är nämligen så gott som fullständigt steril. Eftersom den, under antagande av att arterna äro resp. di- och tetraploida, är triploid, är ju detta visserligen endast vad man kunde vänta, men M. & H. visade, att detta inte är hela saken liksom att den i naturen förekommande tetraploiden inte är en ur *officinale* uppkommen autotetraploid. Med kolchicinmetoden kunde de nämligen ur diploid *officinale* framställa en autotetraploid, men denna visade sig ej alls ha *uniseriatums* karaktärer vare sig i frukt eller frön — den var helt enkelt en förstorad *officinale.* Men till på köpet visade sig den hybrid de framställde mellan denna, i fråga om frösättningen med stamarten jämngoda tetraploid och i naturen funnen *uniseriatum* lika steril som den triploida hybriden.

Redan efter miss MANTONS första arbete granskade jag Uppsala-herbariets nordiska material av *Rorippa nasturtium-aquaticum* men utan fullständig framgång. Sedan arbetet nr 2 med den utmärkta frökaraktären kommit, upptog jag undersökningen på nytt, denna gång även av övriga nordiska herbarier och med bättre lycka. Jag ansåg mig därvid också kunna identifiera den nya arten med BOENNINGHAUSENS gamla *Nasturtium microphyllum* — ett namn som understundom använts av svenska florister och växtsamlare för särskilt magra exemplar av *nasturtium-aquaticum* — men innan jag hann publicera min studie, meddelades samma slutsats av en botanist i Kew, H. K. AIRY-SHAW. Samtidigt gav denne också en översikt av denna arts utbredning, som befanns vara tämligen kosmopolitisk, och kunde därvid också meddela ett fynd av den vid Visby enligt ett ex. i Kew-herbariet. Här samlades arten åtskilliga gånger under tiden 1861—1882, men alla exemplaren härstamma uppenbarligen från en och samma fläck, nämligen Gamla hamnen i Visby, och allt tyder på att det här varit fråga om en enda förekomst, kanske en enda klon, som kommit in en enda gång men funnit en viss trevnad; med all sannolikhet är det fråga om en adventivförekomst, väl troligen med barlast. I själva verket fanns vid början av min undersökning i herbarierna inte ett enda exemplar därutöver, alltså inte något verkligt inhemskt, av *microphylla* från Sverige — allt material av gruppen från fastlandet hörde till *nasturtium-aquaticum*, alltså den kortfruktiga, diploida arten. Detta är desto säregnare som en genomgång av det danska herbariematerialet visade, att i detta land tvärtom allting hörde till *microphylla* — så när som på en enda kollekt av *nasturtium-aquaticum*. Men innan min undersökning avslutats inlöpte ett skånskt ark, som visade sig vara *microphylla*, samlat 1944 av NILS ALBERTSON på en från andra sammanhang botaniskt välbekant lokal nära Lund, Fågelsång. Jag har senare själv besökt denna lokal och sett den frodas rikligen.

Från Gotland låg emellertid inte så lite material under namnet *nasturtium-aquaticum* eller liknande från ett par andra lokaler. Vad voro då dessa exemplar? Ja, de hade redan från början gjort mig besvär, men sedan jag småningom lärt känna de båda arternas karaktärer bättre, tvekade jag inte om bestämningen: det var den nyss nämnda hybriden mellan dem. Den synes numera tyvärr vara mindre riklig än förr men har åtminstone för blott ett par år sen ännu haft en ganska riklig fyndlokal, vid Lummelunda N om Visby, ty därifrån har inte bara SAMUELSSONS exsickatverk fått sitt som *R. nasturtium-aquaticum* distribuerade material, utan när den sistnämnda skulle sättas in som en av de nytillkomna arterna på en färgplansch i andra upplagan av Vilda växter i Norden, kom just denna förekomst att bli utvald. Denna bild är tydlig nog att visa de karakteristiska, helt felslagna frukterna. Hur den gotländska förekomsten av hybriden skall förklaras, är inte så lätt att avgöra, med tanke på att den åtminstone tidvis tydligen omfattat mer än ett vattensystem, men särskilt därför att man inte kan påvisa något samband mellan denna och Visby-förekomsten av *microphylla* och att den andra av föräldraarterna, *nasturtium-aquaticum,* aldrig blivit samlad på ön! Jag kan inte förstå annat än att hybriden som sådan, antingen i form av ett frö eller en skottbit kommit in med någon återflyttande vattenfågel från fjärran land, funnit sig väl tillrätta och sedan, kanske med liknande hjälp men väl delvis genom vattendrift, spritt sig vidare. Hybriden är från flera håll i England känd som ymnigt växande i floder utan föräldrarnas sällskap, och man har ju f.ö. även andra exempel inom släktet på att vegetativ förökning och spridning spelar en stor roll inte bara i fråga om arter utan även i fråga om vissa sterila hybrider, som trots sin felslående frösättning äro väl i stånd att sprida sig och uppträda som »föräldralösa».

Jag tänkte avsluta denna exposé med en art, som i motsats till de nyss nämnda visar, hur en sen länge känd växt under långliga tider kan få vänta på ett giltigt artnamn. Det gäller en av de *Epipactis*-arter av *latifolia*-gruppen, som NANNFELDT i en uppsats i Botaniska Notiser 1946 meddelade som nya för den nordiska floran, nämligen den som redan 1780 avbildades på ett träffande sätt i Flora Danica men senare ömsom förblandades med olika icke-nordiska arter, ömsom — när den alls uppmärksammades — räknades som en form av *latifolia,* tills den av NANNFELDT identifierades med en strax förut från Persien beskriven art, *E. persica,* med vilken emellertid även den ännu senare beskrivna *E. Troodi* från Cypern skulle vara identisk, liksom en från England, närmare bestämt ön Wight, ungefär samtidigt beskriven art, *E. vectensis.* Just i Storbritannien ha under de senaste decennierna en hel rad av varandra närstående, huvudsakligen genom minutiösa blomkaraktärer skilda typer beskrivits som nya arter, vilka samtliga, så vitt hittills känt, ha en ganska liten utbredning, i flertalet fall inskränkt till Storbritannien. Det kunde ju därför synas överraskande, att just denna, av NANNFELDT som en extrem kalkväxt (med svenska lokaler på Gotland och Öland, i Skåne och Östergötland samt flerstädes i östra Jylland och de danska öarna) avslöjade växt skulle äga en så vid utbredning, då den visserligen hos oss ej är svår att skilja från *latifolia* men vid jämförelse med de nämnda brittiska typerna inte intar någon markerad morfologisk särställning. Fortsatta studier av en av de brittiska *Epipactis*-forskarna, D. P. YOUNG, ha också visat, att såväl *E. persica* som *E. Troodi* äro var för sig skilda arter, och att ej heller *E. vectensis* stämmer nog väl med den nordiska växten för att lämpligen kunna förenas med denna. I själva verket är enligt YOUNGS iakttagelser — publicerade i Botaniska Notiser 1953 — den sistnämnda ej känd utanför Sverige och Danmark; han ger den — med tanke på dess långdragna upptäcktshistoria — här namnet *E. confusa.* Samtidigt korrigerar han en annan av NANNFELDTS identifieringar; denne hade nämligen i sin uppsats från Danmark som nya angett även den redan 1828 beskrivna och från många håll i Västeuropa kända *E. purpurata* (även kallad *E. sessilifolia*) men dessutom en av de förut som engelska endemer ansedda arterna av sent datum, nämligen *E. leptochila.* YOUNG kunde nu påvisa, att denna sistnämnda verkligen växer i Danmark — men att den av NANNFELDT så benämnda växten var en av de många formerna av den polymorfa *E. phyllanthes,* ett gammalt bortglömt namn, som YOUNG upptagit som sammelbeteckning för ett komplex av närstående, av vissa författare som artskilda uppfattade, former med m.l.m. utpräglad självbefruktning. Över huvud taget sammanhänger denna bildning av m.l.m. skarpt avgränsade »småarter» inom denna grupp med en m.l.m. genomförd övergång från den normala korsbefruktningen till självbefruktning; de morfologiska skiljekaraktärerna hänföra sig också i stor utsträckning till könsdelarnas byggnad. Exemplet är ett av flera från senare år, där en revision resulterat i påvisandet av en för Sverige eller floraområdet ny art men där denna utredning i sin tur snart fått revideras med avseende på nomenklaturen, därför att den första identifieringen varit oriktig. Detta sammanhänger med att dessa utredningar i större och större utsträckning rört sig med kritiska grupper, som erbjuda svårigheter både genom de obetydliga eller svårgripbara karaktärerna och i avseende på den litteratur vari de förut behandlats. Men på sådana fall skall jag, som jag i inledningen nämnde, här ej gå in — det synes just lämpligt att sluta med *Epipactis confusa,* som ur en synpunkt sett måste räknas som kritisk, ur en annan som en av de »hederliga» arterna.

Viktigare litteratur.

ALBERTSON, N. 1944: *Veronica praecox* All. funnen på Öland. — Bot. Not. 1944, s. 459—464.

ARWIDSSON, TH. 1931: Växtgeografiska notiser från Norrland III—IV. — Bot. Not. 1931, s. 355—374.

BJÖRKMAN, G. 1939: Kärlväxtfloran inom Stora Sjöfallets nationalpark jämte angränsande delar av norra Lule Lappmark. — K. Sv. Vet. akad. Avhandl. i naturskyddsärenden N:o 2. 224 s.

BJÖRKMAN, S. O. 1947: *Ligusticum scoticum* L. funnen i Hälsingland. — Svensk Bot. Tidskr. 41, s. 187—189.

BRUUN, H. G. 1938: Studies on heterostyled plants. 2. *Primula scandinavica* nov. sp., endemic in Scandinavia. — Ib. 32, s. 249—260.

CEDERGREN, KERSTIN 1945: *Ligusticum scoticum* L. anträffad i Gästrikland. — Ib. 39, s. 304—310.

DAHLGREN, K. V. O. 1943: Svedjenävan (*Geranium bohemicum*) och brandnävan (*Geranium lanuginosum*). — Ib. 37, s. 127—160.

— 1945: Nya meddelanden om *Geranium bohemicum* och *Geranium lanuginosum.* — Bot. Not. 1945, s. 381—389.

— 1948: Nya lokaler för *Geranium lanuginosum* Lam. i Mellansverige . . . — Svensk Bot. Tidskr. 42, s. 178—180.

DEGELIUS, G. 1944: *Atriplex sabulosa* Rouy, en västeuropeisk art, anträffad spontan i Sverige. — Ib. 38, s. 122—123.

FÖRTECKNING öfver Skandinaviens växter utg. af Lunds Botaniska Förening. 1. Kärlväxter. 2. uppl. — Lund 1917. 120 s.

Förteckning över Skandinaviens växter utg. av Lunds Botaniska Förening. 1. Kärlväxter. 3 uppl., utarbetad av Nils Hylander. — Lund 1941. VI+197 s.

Hedberg, O. 1952: List of Vascular Plants, =Chap. 4, s. 74—115, av Hedberg, O., Mårtensson, O. & Rudberg, S.: Botanical Investigations in the Pältsa Region of Northernmost Sweden. — Bot. Not. Suppl. 3: 2. 209 s.

Holm, O. 1935: Ett par växtfynd i Västerbotten. [2.] *Hippuris tetraphylla* L. fil. — Svensk Bot. Tidskr. 29, s. 367.

Holmboe, J. 1930: Spredte bidrag till Norges flora. I. 6. *Elisma natans* (L.) Buchenau ved Oslo, ny for Norge. — Nyt Mag. for Naturvid. 68, s. 136—143.

Hultén, E. 1943: *Stellaria longipes* Goldie and its allies. — Bot. Not. 1943, s. 251—270.

— 1950: Atlas över växternas utbredning i Norden. Fanerogamer och ormbunksväxter. — Stockholm. 512 s.

Hylander, N. 1941: En för Sverige ny spontan *Veronica*-art, *V. praecox* All. — Svensk Bot. Tidskr. 35, s. 296—306.

— 1950: *Rorippa microphylla* i Sverige och Danmark. — Bot. Not. 1950, s. 1—13.

— & Rothmaler, W. 1937: Om *Aphanes microcarpa* (Boiss. et Reut.) Rothm., en hittills förbisedd svensk växt, och dess förhållande till *A. arvensis* L. — Svensk Bot. Tidskr. 31, s. 411—424.

Lid, J. 1950: Nye plantefunn 1945—1949. — Blyttia 8, s. 41—53.

Löve, Á. & Doris 1948: Chromosome numbers of Northern plant species. — Reykjavík. 131 s.

Nannfeldt, J. A. 1935: *Poa supina* Schrad. i Sverige och dess hittills förbisedda hybrid med *P. annua* L. — Bot. Not. 1935, s. 1—16.

— 1937: Om *Poa supinas* utbredning i Norden. — Ib. 1937, s. 258—265.

— 1946: Tre för Norden nya *Epipactis*-arter, *E. persica* Hausskn., *E. leptochila* (Godf.) Godf. och *E. purpurata* Sm. — Ib. 1946, s. 1—28.

Nordstedt, O. 1920: Prima loca plantarum suecicarum eller Första litteraturuppgift om de i Sverige funna vilda eller förvildade kärlväxterna. — Bil. till Bot. Not. 1920. IV+91 s.

Nygren, A. 1936: *Carex holostoma* Drejer, en för Sverige ny fanerogam, funnen i Torne lappmark. — Svensk Bot. Tidskr. 30, s. 137—153.

Nyhlén, G. 1949: *Ceterach officinarum,* en för Skandinavien ny ormbunke. — Bot. Not. 1949, s. 395—402.

Pettersson, B. 1940: *Orchis Spitzelii* Sauter var. *gotlandica* n. var. Nyupptäckt gotländsk representant för sydeuropeisk bergsflora. — Acta Phytogeogr. Suec. 13, s. 162—185.

Rosvall, S. & Pettersson, B. 1951: Gotlands orkidéer. — Stockholm. 108 s.+20 pl.

Selander, S. 1942: *Potentilla emarginata* Pursh i Sverige. — Bot. Not. 1942, s. 69—74.

— 1945: Ny svensk förekomst av *Potentilla emarginata* Pursh. — Ib. 1945, s. 164—166.

Söderström, N. 1930: *Oenanthe Lachenalii* i Sverige. — Svensk Bot. Tidskr. 24, s. 139.

Vestergren, T. 1924: *Apera interrupta* (L.) PB. (*Agrostis interrupta* L.), en sydlig xeroterm på Ölands och Gotlands hällmarker. — Ib. 18, s. 469—486.

Walters, S. M. 1948: *Glyceria declinata* Bréb., en förbisedd nordisk art. — Bot. Not. 1948, s. 430—440.

Young, D. P. 1953: Autogamous *Epipactis* in Scandinavia. — Ib. 1953, s. 253—270.

BOTANISKA NOTISER 1954, HÄFTE 2. LUND

Studies on Bacterial Nutrition.

I. Utilisation of Different Sugars or Mixtures of Sugars by Three Soft Rot Bacteria.

By M. K. TOLBA, D.I.C., Ph. D. (London) and S. S. GHANEM, M. Sc. (Cairo).
From the Botany Department, Faculty of Science, Cairo University, Egypt.

I. Introduction.

Bacterial soft rots of the fleshy tissues of plant, in particular storage tissue, have been the subject of investigation for many years and has been ascribed to a number of bacteria which are closely similar in their morphology and staining reactions. HARDING and MORSE (7) compared some 43 strains of soft rot bacteria and claimed that these bacteria should be recognised as but varieties of one organism, *Bacillus carotovorus,* now known as *Bacterium carotovorum* or *Erwinia carotovora.* Subsequent researches by other investigators (LEECH [8], BONDE [1]) have all tended to strengthen the view of the identity of soft rot bacteria. In Britain, up to the present, three separate species have been recognised, viz. *Bacterium carotovorum* (Jones) Lehmann and Neumann, *B. phytophthorum* (Appel) Burgwitz and *B. aroideae* (Townsend) Stapp.

In a trial to settle this controversial state of affairs with regards the relationship between the three bacteria, it was thought advisable to tackle the problem from the point of view of the utilisation, by the above three bacteria, of different sugars when used as carbon sources either singly or in mixture. The monosaccharides glucose, fructose and galactose and the disaccharides sucrose and lactose were used.

The similarity or dissimilarity of the behaviour of the three organisms on such sugar media may help in formulating a clear view as to whether they should be recognised as but strains of one and the same organism or three separate species.

II. Materials and Methods.

The organisms used in this investigation were as follows:

1. *Bacterium aroideae,* Dowson, 66.
2. *Bacterium carotovorum,* Jones.
3. *Bacterium phytophthorum,* Appel.

The three cultures were kindly supplied by the Plant Bacteriological Laboratory of the Imperial College of Science and Technology, London.

In this series of experiments a basal medium of the following constitution was prepared:

Asparagin	10	grams
$MgSO_4 \cdot 7\,H_2O$	2.5	»
KH_2PO_4	5	»
Distilled water to	500	ml.

The different sugars were dissolved separately in sterile distilled water at the rate of 4 %. Equal volumes of the different sugars or mixtures of sugars and the basal medium were mixed. The full culture media so obtained were distributed into a series of sterile 150 ml. conical flasks at the rate of 10 ml. per flask and inoculated at the rate of 0.2 ml. of a suspension of each of the three bacteria under test in sterile distilled water. The flasks were then incubated at 25° C for 48 hours during which the sugar concentrations of the different media were estimated at 24 hour intervals.

The methods used for sugar analysis of the media were those given by SAÏD (11).

III. Experimental Results.

1. Sugar Utilisation by *B. aroideae, B. carotovorum* and *B. phytophthorum* Subcultured in Media Containing 2 % Sucrose, Glucose, Fructose or a Mixture of Glucose and Fructose.

A. *Analysis of the Media.*

The results of the analysis of the media for their sugar-contents are presented in Figs. 1—6.

a. *B. aroideae*: The fall in the concentration of sugars in all the media was proceeding at different rates during the first and second 24 hours, being much higher during the former than the latter. Considering the first period of 24 hours the concentration dropped most

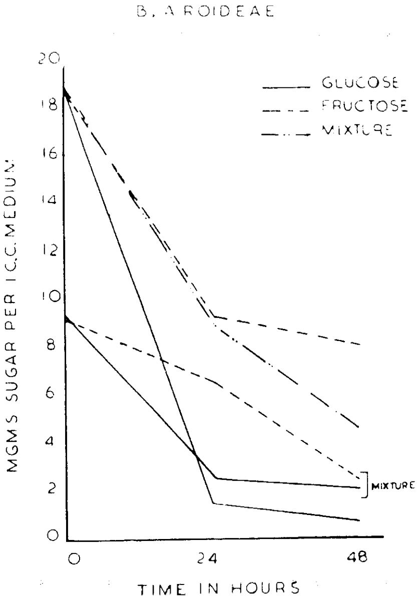


Fig. 1. Sugar concentration of media containing glucose, fructose or a mixture of glucose and fructose and inoculated with *B. aroideae* (mgms glucose per I ml. medium).

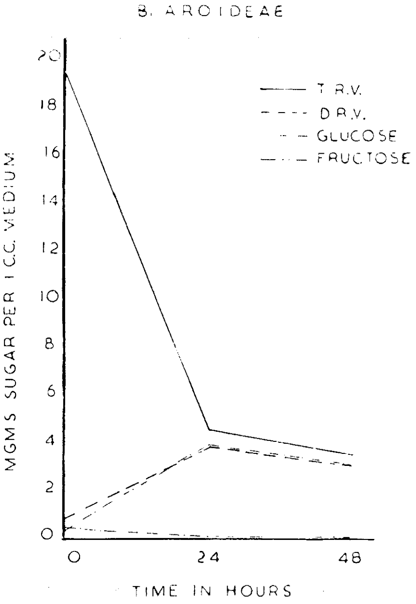


Fig. 2. Sugar concentration of media containing sucrose and inoculated with *B. aroideae* (mgms glucose per 1 ml. medium). — T.R.V.=Total Reducing Value. — D.R.V.=Direct Reducing Value.

rapidly in case of glucose followed by sucrose, with no material difference between the drop of concentration in media containing fructose or a mixture of glucose and fructose. Along the whole experimental period the order of drop in concentration of sugar from the different media was as follows: glucose > sucrose > mixture of glucose and fructose > fructose.

It is interesting to note further that the glucose fraction disappeared from its mixture with fructose much faster than the fructose component during the first 24 hours while the rate of disappearance of the two components of the mixture was, more or less, the same by the end of the experimental period.

b. *B. carotovorum*: The fall in the concentration of sugar in all the media was proceeding in almost the same manner, being much faster during the first than the second 24 hours. No substantial difference was observed between the rates of disappearance of the different sugars from their media during the whole experimental period.

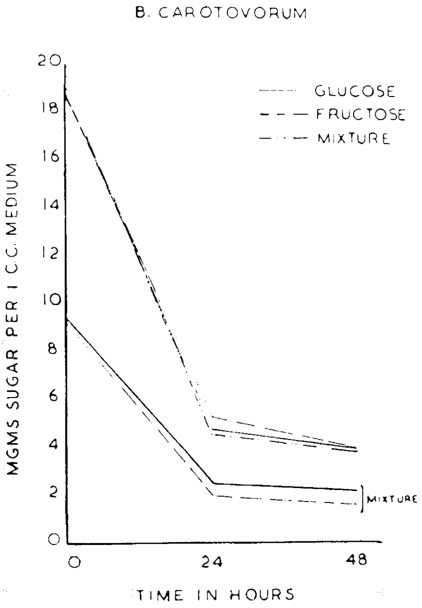


Fig. 3. Sugar concentration of media containing glucose, fructose or a mixture of glucose and fructose and inoculated with *B. carotovorum* (mgms glucose per 1 ml. medium).

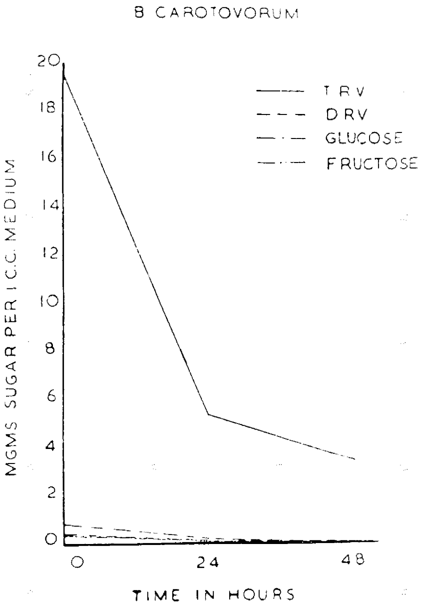


Fig. 4. Sugar concentration of media containing sucrose and inoculated with *B. carotovorum* (mgms glucose per 1 ml. medium). — T.R.V.=Total Reducing Value. — D.R.V.=Direct Reducing Value.

It is worth mentioning, however, that the rate of disappearance of the fructose component from the media containing glucose and fructose was slightly higher than that of glucose during the whole experimental period.

c. *B. phytophthorum*: The fall in concentration of sugar in all media was proceeding, on the whole, at different but fairly steady rates. The sugar concentrations dropped rather rapidly in case of sucrose and glucose media, with a much slower rate of disappearance of sugar from media containing a mixture of glucose and fructose or fructose alone.

From the above discussion it can be seen that *B. aroideae* prefers glucose to fructose and in a mixture of both it starts utilising glucose until the medium is almost depleted of it and then, only, it starts making use of appreciable amounts of fructose. *B. carotovorum*, on the other hand, utilises almost equal amounts of fructose and glucose when supplied to it separately. In a mixture of the two sugars it attacks both sugars at almost the same rate, probably, with a very slight preference

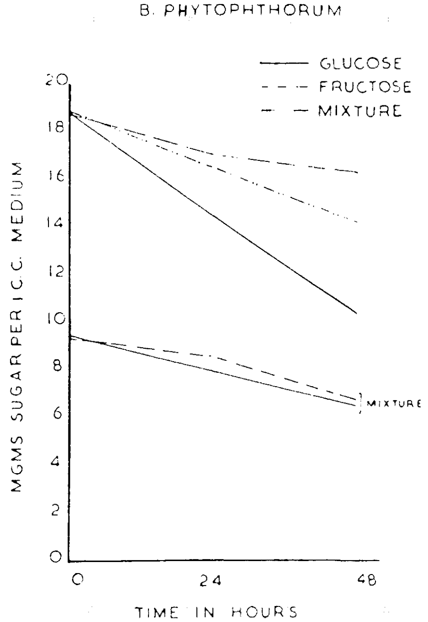


Fig. 5. Sugar concentration of media containing glucose, fructose or a mixture of glucose and fructose and inoculated with *B. phytophthorum* (mgms glucose per 1 ml. medium).

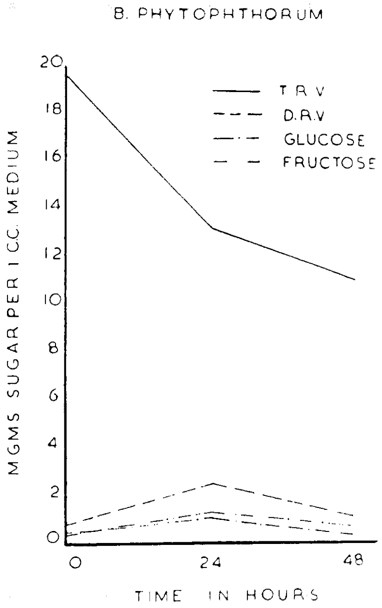


Fig. 6. Sugar concentration of media containing sucrose and inoculated with *B. phytophthorum* (mgms glucose per 1 ml. medium). — T.R.V.=Total Reducing Value. — D.R.V.=Direct Reducing Value.

of fructose to glucose. *B. phytophthorum* prefers glucose to fructose whether supplied separately or in a mixture.

B. *Sucrose Inversion by the Three Bacteria.*

The total sucrose inversion was calculated by SAÏD (l.c.), in his sugar feeding experiments, as the sum of sugar uptake by the tissue and direct reducing value of the corresponding medium. In this investigation the amount of sucrose inverted was calculated as the sum of the sugar utilised by the organism and the direct reducing value of the corresponding medium and presented in Table 1.

The results in Table 1 show that sucrose undergoes rapid hydrolysis by *B. aroideae,* a slower rate of hydrolysis is exhibited by *B. phytophthorum,* especially during the second 24 hours. Culture media inoculated with *B. carotovorum* failed completely to reveal any trace of reducing

Table 1. **Total Sucrose Inversion by *B. aroideae* and *B. phytophthorum***
(expressed as mgms glucose per ml. medium).

Organism	Age of culture in hours	
	24	48
B. aroideae	18.06	18.29
B. phytophthorum	8.05	8.77

sugars throughout the whole experimental period. In order to reach a fair judgement about this peculiar behaviour of *B. carotovorum* the organism was inoculated into culture media containing different concentrations of sucrose, namely, 1 %, 2 %, 3 %, 4 % and 5 %, incubated at 25° C and the culture media analysed for their contents of reducing sugars after 24, 48 and 96 hours. The results obtained failed again to reveal the presence of any reducing sugars in the different media.

Another trial was made in which the organism was inoculated into a culture medium containing 2 % sucrose and the medium tested for the presence of invert sugar after 3, 6, 9 and 24 hours from inoculation. The results of the above experiment, as presented in Table 2, show that the rate of sucrose inversion by *B. carotovorum* slightly exceeds the rate of utilisation during the early hours of growth. This result, though not very conclusive, yet, judging by what happens in the other two bacteria, may be taken as a supporting evidence of the conclusion that *B. carotovorum* hydrolyses sucrose before taking it up.

Table 2. **Direct Reducing Values of Medium Inoculated with *B. carotovorum* at Different Intervals from the Time of Inoculation**
(expressed as mgms glucose per ml. medium).

Age of Culture in Hours	Direct Reducing Value of the Medium
0 (Initials)	0.36
3	0.53
6	0.50
9	0.41
24	0.00

To test whether or not the enzyme concerned with sucrose inversion by the three bacteria is excreted into the external medium, the organisms were inoculated into 2 % sucrose culture media, incubated for 24 hours and analysed for their direct reducing values. The media, freed from

Table 3. **Analysis of Maltose and Raffinose Culture Media at Different Intervals from Inoculation with the three Bacteria**
(expressed as mgms glucose per ml. medium).

Organism	Age of culture in hours	Sugar in the culture medium			
		Maltose			Raffinose
		D.R.V.	T.R.V.	$\frac{\text{D.R.V.}}{\text{T.R.V.}}$	D.R.V.
B. aroideae	0	8.18	16.37	50 %	0.00
	24	6.73	13.39	51 %	2.95
B. carotovorum	0	8.18	16.37	50 %	0.00
	3	7.96	16.03	49.7 %	1.09
	6	7.80	15.94	49.0 %	0.92
	9	7.64	15.69	48.7 %	0.76
	24	6.94	14.03	49.4 %	0.00
B. phytophthorum	0	8.18	16.37	50.0 %	0.00
	24	7.79	15.69	49.6 %	0.95

their bacterial contents, were then reincubated for another 24 hours and again analysed for their contents of reducing sugars. The results obtained showed no difference in the direct reducing values of the media between the first and second 24 hours, thus indicating that the enzyme was not secreted into the external medium.

To test for the nature of the enzyme concerned with the breakdown of sucrose, the three bacteria were inoculatd into culture media containing 2 % maltose or the fructoside raffinose. The media were analysed for their direct and total reducing values in case of maltose and for direct reducing value only in case of raffinose during a period of 24 hours. The results are presented in Table 3.

The results in Table 3 show that raffinose undergoes hydrolysis by the three bacteria and the rate of breakdown is faster than the rate of utilisation, thus reducing sugars appear in the external medium. *B. carotovorum,* again as in the case of sucrose media failed completely to reveal any trace of reducing sugars at the end of 24 hours, but the rate of hydrolysis of raffinose exceeds the rate of utilisation during the early hours of growth.

Maltose is utilised to a rather small extent by the three bacteria. Estimation of the direct reducing values of maltose in the initial samples showed that this value amounts to 50 % of the total reducing value of the sugar. This value did not show any appreciable variations at the end of 24 hours in case of the three bacteria. This result can be explained on the basis of either that maltose is hydrolysed and the hydrolysis products are used up as soon as they are formed or that it is taken up by the three bacteria as such without hydrolysis.

2. Sugar Utilisation by *B. aroideae, B. carotovorum* and *B. phytophthorum* Subcultured in Media Containing 2 % Lactose, Glucose, Galactose or a Mixture of Glucose and Galactose.

A. *Analysis of the Media.*

The results of the analysis of the media are presented graphically in Figs. 7—10. These results show that the fall in the concentration of sugars in all the media inoculated with each of the three bacteria was proceeding at different rates in the first and second 24 hours, being, in almost all cases, higher in the former than the latter. Throughout the whole experimental period the drop in concentration of sugar was highest in media containing glucose or a mixture of glucose and galactose.

It is interesting to note that the glucose fraction disappeared from its mixture with galactose much faster than the galactose component in case of *B. aroideae. B. phytophthorum* and *B. carotovorum* show much less pronounced differences in the rates of disappearance of the two sugars than *B. aroideae.*

Estimation of the direct reducing value of lactose in the initial samples showed that this value amounts to 56.9 % of the total reducing value of the sugar. This value did not show any appreciable variations during the whole experimental period in case of the three bacteria. This result can be explained on the basis of either that lactose is taken up by the three bacteria as such without hydrolysis or, that it is hydrolysed and the hydrolysis products are used up as soon as they are formed.

When the three bacteria were inoculated into culture media containing different concentrations of lactose, namely, 2, 3, and 4 % and the media were analysed for their direct and total reducing values at various time intervals, the ratio of direct to total reducing values was, in all instances, ranging between 55.2 % and 56.0 %. This result, together with similar results reported by several investigators with higher plants and fungi, support the view that lactose is taken up unhydrolysed.

The above results, thus, show that the highest amount of sugar utilised by the three bacteria was from glucose and the least from lactose containing media. They also show that glucose is preferentially utilised by the three bacteria from its mixture with galactose. This fact is more pronounced in case of *B. aroideae* than the other two organisms.

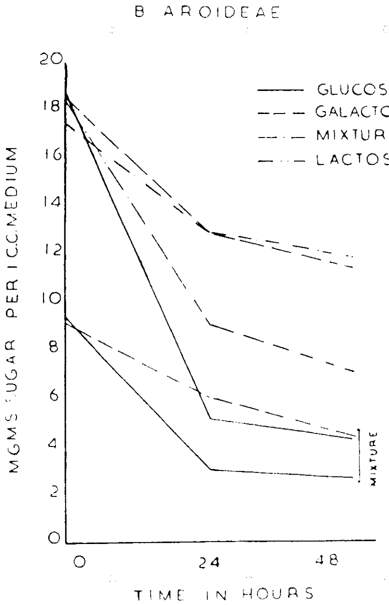


Fig. 7. Sugar concentration of media inoculated with *B. aroideae* (mgms glucose per 1 ml. medium).

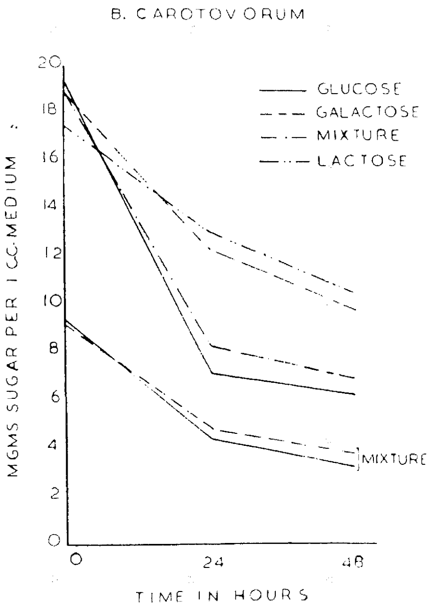


Fig. 8. Sugar concentration of media inoculated with *B. carotovorum* (mgms glucose per 1 ml. medium).

IV. Discussion.

From the foregoing experiments the following points have been observed:

1. *Utilisation of Different Sugars by the Three Bacteria.*

The experiments reported in this investigation involved the utilisation of six different sugars by the three bacteria. Throughout the whole work the three bacteria utilised, at different rates, all the sugars used whether mono- or disaccharides. *B. aroideae* and *B. phytophthorum* utilised more glucose than fructose from their media when the sugars were supplied separately. *B. carotovorum* did not show such behaviour. When glucose and fructose were supplied in a mixture to the three bacteria *B. aroideae* and *B. phytophthorum* showed preferential utilisation of glucose, at least at a certain stage of the experimental period, while *B. carotovorum* used up slightly more fructose than glucose throughout. Presence of fructose with glucose in the mixture significantly reduced the rate of utilisation of the latter sugar by *B. phytophthorum*. Such

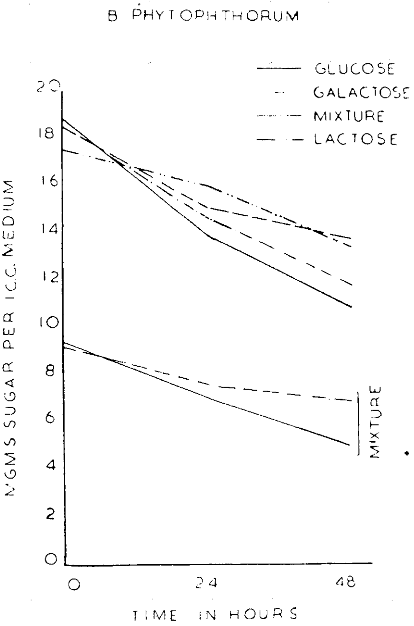


Fig. 9. Sugar concentration of media inoculated with *B. phytophthorum* (mgms glucose per 1 ml. medium).

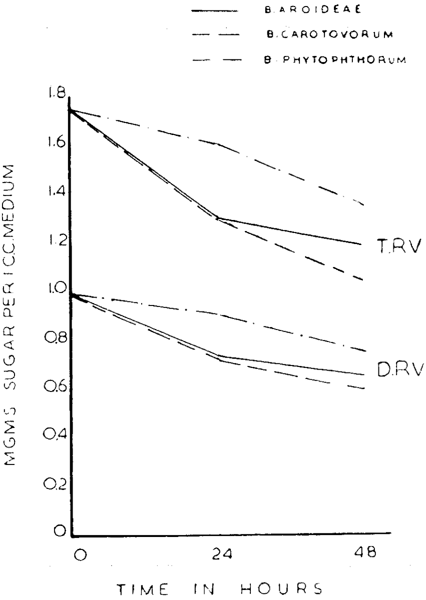


Fig. 10. Direct Reducing Values (D.R.V.) and Total Reducing Values (T.R.V.) of lactose media inoculated with *B. aroideae, B. carotovorum* and *B. phytophthorum* (mgms glucose per 1 ml. medium).

effect was not observed in case of the other two organisms. The three bacteria utilised more glucose than galactose when supplied separately or in mixture.

Sucrose was hydrolysed into glucose and fructose before it is used up by the three bacteria while lactose and maltose are, most probably, taken up as such without hydrolysis.

Sucrose was the best disaccharide utilised while maltose was the least and lactose occupied an intermediate position.

2. *Sucrose Inversion in the Culture Media by the Three Bacteria.*

It has long been known that when sucrose was supplied in the culture media of plant tissues it was always broken down in the external medium at the protoplasmic surfaces of the plant tissues and some of the products of the sucrose breakdown are subsequently absorbed (Rob-

BINS (10), GAWADI (6), SAÏD (11), BURSTRÖM (2), DORMER and STREET (3) and STREET and LOWE (13)). Owing to the fact that the rate of sugar uptake is always less than the rate of sucrose breakdown in the external media, reducing sugars usually appear in these sucrose media.

GAWADI (l.c.), SAÏD (l.c.) and BURSTRÖM (l.c.) suggested that the sucrose breakdown in the culture media of plant tissues was brought about by means of invertase enzyme centres situated at the protoplasmic surfaces of the plant tissue. The possibility that invertase enzyme was excreted by the plant tissues into their external media was refuted by the fact that when these tissues were removed, the cultural media showed no hydrolytic power on sucrose (SAÏD (l.c.)). This fact is substantiated by the results obtained in the present investigation when sucrose culture media freed from their bacterial contents failed completely to reveal any hydrolytic power on sucrose.

SAÏD (l.c.) and NAGUIB (9) suggested that the invertase centres of the protoplasmic surfaces were all of the fructofuranosidase type and not α-glucosidase type. DORMER and STREET (l.c.) and STREET and LOWE (l.c.) postulated that sucrose breakdown in the media of their excised plant roots was by means of specific phosphorylase enzyme. This phosphorylase enzyme has been found in bacterial sources by DOUDOROFF, KAPLAN and HASSID (5) and DOUDOROFF (4).

In this investigation the three bacteria under test readily hydrolysed sucrose and utilised appreciable amounts of its hydrolytic products. Maltose, on the other hand, was utilised to a very small extent when compared with sucrose and no trace of reducing sugars was revealed in the external media containing maltose. The ratio of direct reducing value (D.R.V) to total reducing value (T.R.V.) in such media was, more or less, 50 %. This indicates that maltose is, most probably, taken up as such without hydrolysis. It may, thus, be postulated that the enzyme concerned with sucrose hydrolysis is not of the α-glucosidase type, lest it should have broken down maltose in a, more or less, similar way to sucrose.

The possibility was still there that the enzyme concerned with sucrose inversion is a specific sucrose phosphorylase, but the fact that the three bacteria hydrolysed the fructoside raffinose in their culture media verified the view held by Saïd and his co-workers, namely, that the invertase enzyme responsible for sucrose hydrolysis is of the fructofuranosidase type.

V. Summary.

1. The utilisation of different sugars or mixtures of sugars, when present as carbon sources in the culture media, by *B. aroideae, B. carotovorum* and *B. phytophthorum* was studied.

2. The three bacteria utilised, at different rates, all sugars used in this investigation. *B. aroideae* and *B. phytophthorum* preferentially utilised glucose from its mixture with fructose.The glucose fraction disappeared from its mixture with galactose much faster than the galactose component in case of *B. aroideae. B. carotovorum* and *B. phytophthorum. B. carotovorum* and *B. phytophthorum* when inoculated into the media induced much less pronounced differences in the rates of disappearance of the two sugars than *B. aroideae.*

3. Sucrose is hydrolysed into glucose and fructose before it is used up by the three bacteria while lactose and maltose are, most probably, taken up as such without hydrolysis. The enzyme concerned with sucrose inversion is, in all probability, of the fructofuranosidase type.

4. The results of the present investigation tend to strengthen the view that the three bacterial organisms should be recognised as three separate species.

Acknowledgements. — The authors are greatly indebted to Prof. H. Saïd and Dr. H. Fawzy, of the Botany Department, Faculty of Science, Cairo University, for their illuminating discussions and criticisms.

Literature cited.

1. Bonde, R. 1939. Comparative studies of the bacteria associated with potato blackleg and seed piece decay. — Phytopath. 29, 831.
2. Burström, H. 1941. Studies on the carbohydrate nutrition of roots. — Ann. Agr. Coll. Sweden, 9, 264.
3. Dormer, K. J., and Street, H. E. 1949. The carbohydrate nutrition of tomato roots. — Ann. Bot. N.S., 13, 199.
4. Doudoroff, M. 1943. Studies on the phosphorolysis of sucrose. Jour. Biol. Chem., 151, 351—61.
5. Doudoroff, M., Kaplan, H. M., and Hassid, W. Z. 1943. Phosphorolysis and synthesis of sucrose with a bacterial preparation. — Jour. Biol. Chem. CXLVIII, 65—75.
6. Gawadi, A. G. H. 1935. Studies on carbohydrate metabolism in the roots of Daucus carota. — Ph. D. thesis, Cambridge.
7. Harding, H. A., and Morse, W. J. 1909. Bull. Ver. Agric. Exp. Sta., 147, Pt. 1. (c.f.) Manual of Bacterial Diseases by W. I. Dowson, London 1949.
8. Leach, J. G. 1930. The identity of the potato blackleg pathogene. — Phytopath. 20, 743—751.
9. Naguib, M. I. 1952. Some studies of the carbohydrate metabolism of carrot root slices. — Ph. D. thesis, Cairo.
10. Robbins, W. J. 1918. Direct assimilation of organic carbon by Ceratodon purpureus. — Bot. Gaz., 65, 543—551.

11. Saïd, H. 1937. Carbohydrate and nitrogen metabolism in the roots of Daucus carota. — Ph. D. Thesis, Cambridge university.
12. Saïd, H. 1941. Researches in plant metabolism. I. Respiration and sugar absorption by storage organs in relation to tissue and thickness of tissue slices. — Bull. Fac. Sci., Fouad I Univ., Cairo, 22, 31.
13. Street, H. E., and Lowe, J. S. 1950. The carbohydrate nutrition. II. The mechanism of sucrose absorption by excised roots. — Ann. Bot. N.S., 55, 307.

BOTANISKA NOTISER 1954, HÄFTE 2. LUND

A new Genus and a new Species among the Desmids.

By ROLF GRÖNBLAD and PAAVO KALLIO.

1. Taxonomical Notes.

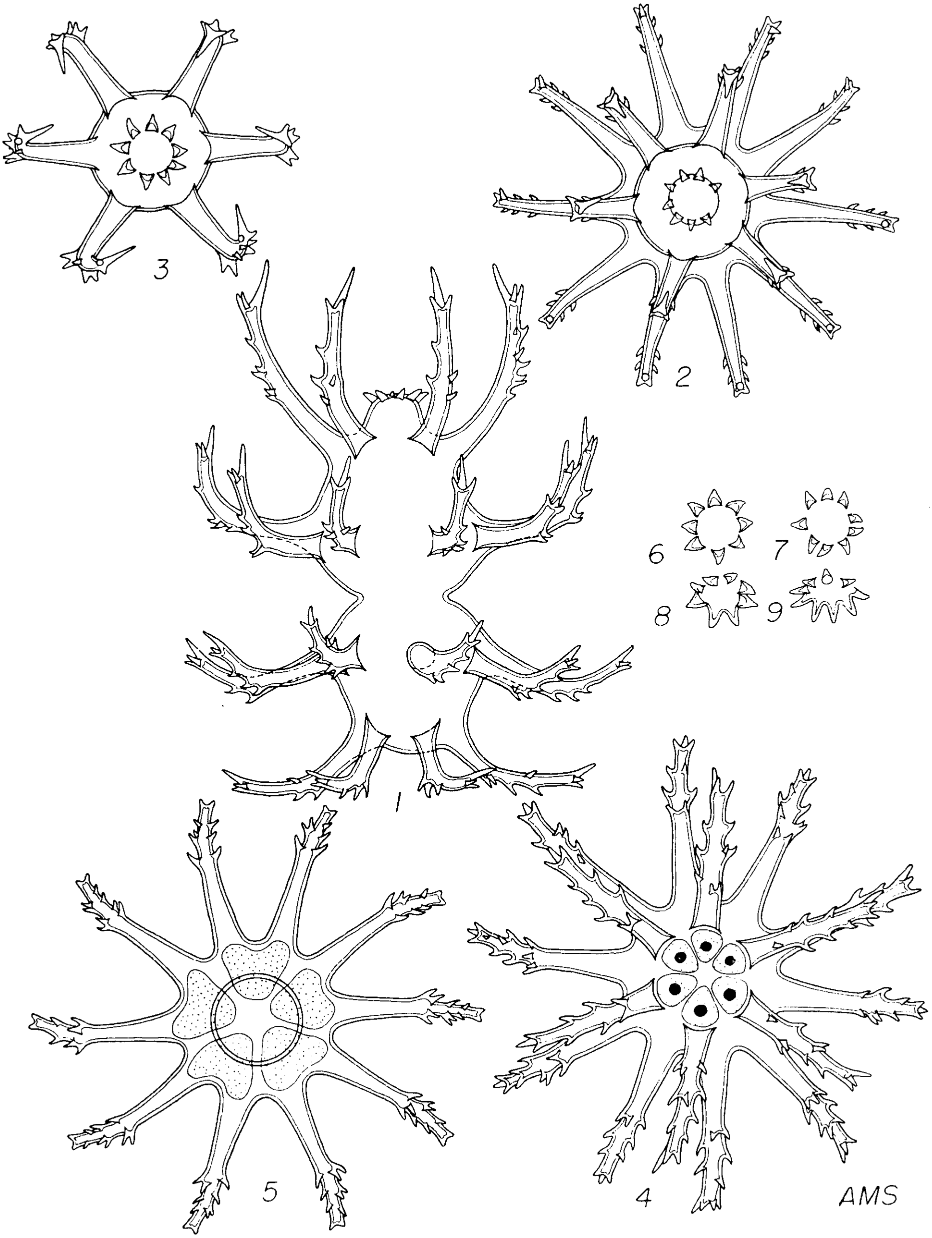
By ROLF GRÖNBLAD.

Through the kindness of my friend Mr. ARTHUR M. SCOTT (New Orleans, U.S.A.) I have the honour to publish the description of a very remarkable new Desmid which was found by Mr. SCOTT in material sent to him from Brazil by Dr. HARALD SIOLI of Belém. The algae were collected by means of a plankton-net from Lago da Boca do Igarapé Mentai on the Arapiuns River, which is a tributary of the Rio Tapajos, which joins the Amazon a short distance above Santarem.

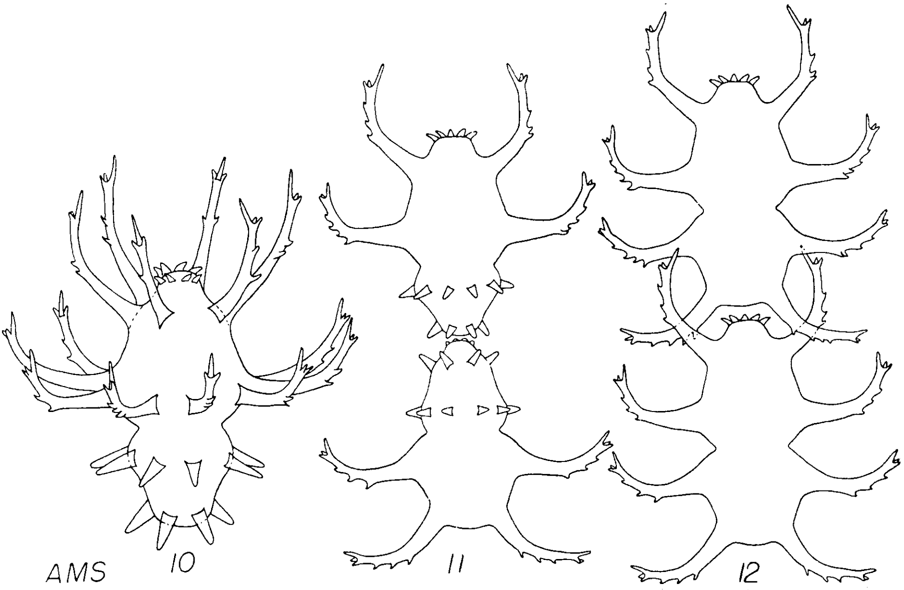
The new alga is at once distinguished from all Desmids hitherto known by having the two semicells different in shape. Thus the cell is asymmetrical while both semicells are symmetrically built, the shape of these bearing some resemblance to certain species of *Staurastrum*. In other words: to see that the alga really is a Desmid we only have to imagine both semicells like each other; then there would be something not very unlike a species of *Staurastrum*.

Scottia GRÖNBLAD, nov. gen.

Descriptio generis: Cellulae maiores, medio sinu late aperto profunde constrictae; semicellulis inter se dissimilibus: una apice valde protruso, corona apicali dentium 8 vel 9 instructa, superior nominetur; altera apice late rotundato, laevi inferior nominetur. Habitus semicellularum subovatus a basi inflata versus apicem angustior; in utraque semicellula corona brachiorum 6 subapicalis alteraque corona brachiorum 10 superisthmialis loco plurimum inflato insidentium sunt. Brachia omnia semicellulae superioris sursum curvata, at brachia semicellulae inferioris quoque in directionem eandem (=sursum) curvata sunt; brachia omnia cava, non solida, spinis nonnullis in loco maximae curvaturae sitis, in finem tricuspidatam exeuntia, cuspidibus interioribus duplo longioribus. Cellula a vertice visa circularis brachiis 10 in parte terminali



Figs. 1—9. *Scottia mira* Grönbl. 1. Front view. 2. Vertical view of upper semicell. The figure shows 8 teeth in the corona, with a space for a ninth tooth, which was not present. 3. Vertical view of another upper semicell, with the lower whorl of processes omitted. 4. Basal view of lower semicell, seen from underneath. 5. Ventral view of lower semicell, seen from the isthmus; the lowest whorl of six processes is omitted. 6—9. Vertical views of apical coronae, with 8 and 9 teeth. The figures are drawn to a magnification of about 385. All of them are from different specimens.



Figs. 10—12. *Scottia mira* GRÖNBL. 10. Slightly tilted front view, showing a fully developed upper semicell with an attached partially developed lower semicell. 11, 12. Diagrams showing supposed sequence of cell-division. — About 325×.

denticulatis e margine radiatim exeuntibus; intra marginem brachiis 6 similibus et in centro dentibus 8—9 in circulo ordinatis; circulus in semicellula inferiore deest. Ceterum membrana laevi. Massa chlorophyllacea admodum dubia, ut videtur, laminis longitudinalibus 5 aut 6 in centro inter se non adhaerentibus; nucleis amylaceis (ut videtur) singulis in unaquaque lamina; (cf. GRÖNBL., Desm. Brasil. Tab. X, Fig. 200); e laminis lamellae subtilissimae in brachiis exeuntes.

Descriptio speciei, quae ***Scottia mira,*** nov. spec. nominetur, idem est ac descriptio generis. Dimensiones: long sine proc. 108—128, long. c. pr. 159—189, lat. sine proc. 50—57, lat. c. pr. 132—159, isthm. 27—34 μ.

Cells large, at the middle divided into two semicells by means of a widely open, deep constriction. Semicells not alike: the one with an apical corona of 8 or 9 teeth we may call the upper, the other one with a rounded smooth apex we call the lower one. (These terms are quite arbitrarily chosen only for the reason that they just »look so», and because we have to call them by different names.) Both semicells are somewhat obovate with an inflated basis tapering towards the apices; they have a whorl of 6 processes just below the apex, which in the upper semicell is strongly protruded, in the lower widely rounded. Another whorl of 10 processes is to be found — also in both semicells — near the isthmus, inserted at the most inflated point. In the upper semicell all processes are strongly curved upwards and in the lower semicell the processes are also curved, but not so strongly, in the same direction towards the upper semicell (»in the wrong direction»). All processes are hollow and furnished with a few acute spines on the outer margin at the region of their greatest curvature, and all processes terminate in three slightly divergent spines, of which the inner one is twice as long as the other two. Vertical view circular, at the outer margin with 10 radiating processes which are denticulated at their ends; inside the margins with 6 similar processes and in the central area with 8—9 teeth arranged in a circle; this latter lacking in the vertical view of the lower semicell. Between the processes the cell-wall is smooth. (This does not mean that there should be no pores.) The shape of the chromatophores we have not been able to establish as to their details, but it seems that there are 6 or 5 axile longitudinal »laminae» or »bundles» from which pairs of fine extensions go into the processes of the lower whorl and single extensions into those of the upper whorl. The number of the pyrenoids is not known, but in vertical view there sometimes can be seen one pyrenoid in each lamella, which are not connected at the central longitudinal axis.

There is only one species known of this new genus with the characteristics of the genus. This species may be called *Scottia mira,* nova sp.

Dimensions of the cell: length without processes 108—128, with proc. 159—189, width without pr. 50—57, with pr. 132—159, isthm. 27—34 μ.

Habitat: Lago da Boca do Igarapé Mentai; approximate location 2° 38′ S. lat., 55° 34′ W. long. In a straight line it is about 85 km from Santarem, in the direction W 15° S, or a course of 255°. 'Igarapé' is a native (Tupí Indian) word meaning literally 'boat-way' which is used, only in this part of lower Amazonia, to designate any stream, even some which would be considered good-sized rivers in Europe. The Ig. Mentai is a tributary which flows into the south bank of the Rio Arapiuns a short distance below the confluence of the Rio Maró and Rio Aruã, whose junction forms the Rio Arapiuns. The latter in turn flows into the Rio Tapajós a short distance above its junction with the Amazon River.

The 'Lago da Boca' of the Ig. Mentai is not a true lake, but a lake-like widening and deepening of the stream bed just at the point where it joins the Rio Arapiuns. This phenomenon ('Fluss-See' or 'Mündungsbucht') occurs on many of the small and large rivers in this region; its cause is not known, but may be due to a local sinking of the earth's crust. In the case of the Ig. Mentai, the 'Lago' is about 2 km. long, 500 m. wide, and 5.50 m. deep in the dry season; in the rainy season it is somewhat deeper but not much larger, because of the fairly steep banks. The stream itself, just

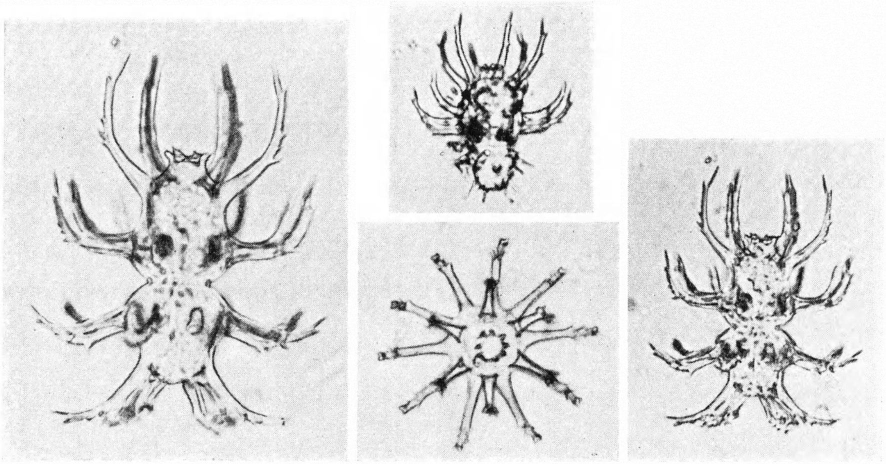


Fig. 13. *Scottia mira* GRÖNBL. — Photomicrographs: A. M. SCOTT.

above the enlargement, is 10—15 m. wide and about 1 m. deep, with a flow of perhaps 1 m./second. The stream discharge, therefore, is so much smaller than the volume of water in the lake that there is no appreciable current in the latter. Perhaps for this reason, the lake plankton, principally zooplankton, is much more abundant than that of the stream. The lake water is brownish in colour, and has a pH of 4.5; this rather high acidity is a characteristic of most of the rivers in the region.

Mr. SCOTT tells me that he believes he has once seen this alga in one of his samples from Florida, U.S.A. But it was so mixed up with debris and looked so strange that he did not recognize it as being a Desmid.

Collector of the material: Dr. phil. HARALD SIOLI, Belém, Brazil. Collected September 15th 1953.

Type specimens are kept in the collections of Mr. A. M. SCOTT. Material has been sent to Professor G. W. PRESCOTT, to Dr. phil. W. KRIEGER and to the present writer. Dr. phil. PAAVO KALLIO also has at his disposal specimens of the type collection.

All drawings were made by Mr. SCOTT, who wishes to thank Mrs. DOROTHY PERINE for her assistance in inking his pencil drawings.

In conclusion I wish to thank Dr. HANNAH CROASDALE for kind assistance in writing the Latin diagnosis. Also I have to thank my friend Dr. phil. PAAVO KALLIO for his very interesting contribution to the problem of symmetry.

2. Cytological Discussion and Survey of Symmetry and Polarity in the Desmids.

By PAAVO KALLIO.

The desmids possess a very characteristic structural feature, the highly developed symmetry of the cells. Taxonomists have long been aware of this, but the origin of the symmetry, its dependence on the nucleus and on the special structural characteristics of the cytoplasm have only recently become objects of study (WARIS 1950, KALLIO 1951, 1953, 1954).

The symmetry relationships are best known for several species of the genus *Micrasterias*. These algae are normally both bipolarly and bilaterally symmetrical (cf. WARIS). The former type of symmetry means that the semicells are mirror images of each other; this symmetry is disturbed only within the limits of the total phenovariation. A vertical plane bisecting the polar lobes along the major axis divides the cell bilaterally into two identical halves.

Owing to the fact that the two semicells are formed at different times, it is possible that environmental conditions prevailing when the daughter semicell is developing may affect its structure in such a way that it differs from its parent semicell. It is known that the shape of the semicell is very sensitive to such environmental changes and forms morphologically more or less asymmetrical have been encountered both in nature and in cultures. In addition to changes in environmental conditions, also genotypic mutations may lead to bipolar asymmetry. Such asymmetrical forms have actually been found only in laboratory cultures, but there is no doubt that they also exist in nature. The best examples of bipolar asymmetry due to changes in the nucleus have been encountered in artificial experiments planned to induce polyploid forms. Centrifugation, continued illumination and other procedures (KALLIO 1951, 1953 b) may be used to produce polyploid forms. In these transformations an intermediate form is produced in which the parent semicell is of normal size (haploid) and the new semicell is definitely larger (diploid) in size. Several other mutations with asymmetrical features have also been observed in the genus *Micrasterias* (KALLIO 1954). In these cases the dichotypical (asymmetrical) intermediate cell form is a transient one. Until quite recently no Desmid species was known in which bipolar asymmetry is an inherited property.

Bilateral asymmetry may also occur sometimes in abnormal environmental conditions, but in most cases such forms may be considered phenovariations. There are, however, species with normal inherited asymmetry among the Desmids, e.g. in the Genus *Closterium.* More important in this connection is, however, that asymmetrical forms have been artificially produced whose asymmetry is transferred to the progeny. Examples of these asymmetric forms are the uniradiate forms of *Micrasterias thomasiana* var. *notata* (WARIS 1951, KALLIO 1951) and *M. rotata* var. *evoluta* (KALLIO 1951, see Fig. 1).

A theory of the genetic origin of the bilateral asymmetry has been proposed (WARIS and KALLIO) which is based on the following cytoplasmic characteristics. The cytoplasm contains a small number of self-duplicating plasmatic framework units which are in some degree independent of each other. The number of such units in normal biradiate *Micrasterias* cells is three. This number may, however, be artificially altered, either diminished or increased. In the uniradiate cells one of the structural units of the cell, viz. one corresponding to the side lobe complex or wing (cf. KALLIO 1954), is lacking, and the cell continues to develop with only two structural axes and produces a clone like it with constant properties. The difference between the uniradiate and normal biradiate strains is purely plasmatic since both forms have the same nuclear constitution.

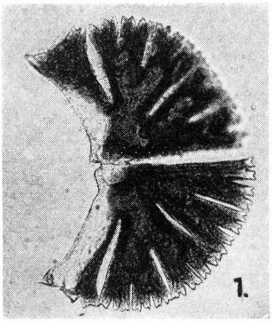
The diploid cell of *M. thomasiana* has also two forms or facies (cf. TEILING, 1950), the triradiate and the quadriradiate forms (Figs. 3 and 4). The diploid form of *M. rotata* var. *evoluta* is normally biradiate, but a triradiate form may also be produced which is in some degree constant (KALLIO 1954). In all known cases where the degree of radial symmetry has undergone a change, the change in the number of plasmatic structural units has involved the side lobe axis. A change may, however, also occur in the number of polar lobes. This has been observed under the following conditions. A culture containing a diploid strain of *M. thomasiana* var. *notata* was badly infected by some species of *Protococcales* algae. The *Micrasterias* cells ceased to divide after a few cell divisions. In many of the cells the polar lobes were bifurcate, i.e. there were two polar lobes side by side. In some cells these two polar lobes were not completely separated at the base. Cells were also found in which the polar lobes of both semicells were bifurcate (Figs. 5—6). The cells were transferred to grow under normal optimal conditions as a pure culture in an »MS-solution» (WARIS 1953). The cells underwent division in the new environment and bifurcate polar lobes could be distinguished in many of the new semicells (Fig. 5). These bifurcate polar lobes were observed both in cells in which there was only one polar lobe in the mother semicell and in cells where also the mother semicell had a bifurcate polar lobe. When the cells divided the second time, however, the latter type of cell produced only bifurcated polar lobe semicells and the cells with normal polar lobes semicells with normal polar lobes. After several divisions, however, all new semicells formed were normal.

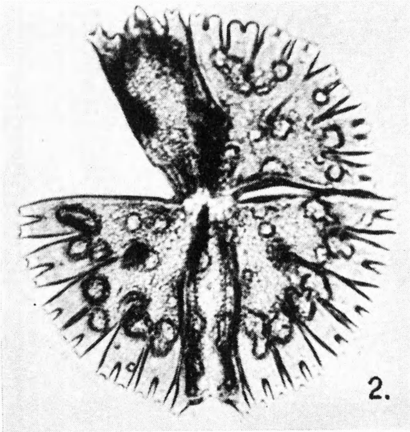
These cases may have involved some sort of plasmatic continuity which is related to the so-called dauermodifications. It is also possible that these forms are the result of a toxic reaction which has become evident only in the polar lobes. Thus it seems that the different plasmatic units differ in their reaction to external influences (cf. KALLIO 1951).

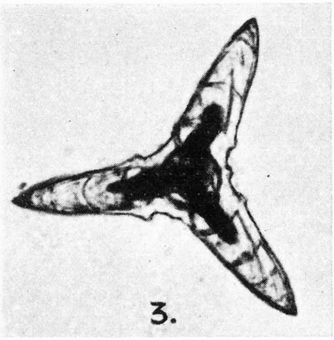
It has been assumed that the plasmatic structural units (axes) in the *Micrasterias* cell are as long as the cell itself. In each cell division all the axes are severed at the isthmus and each half of the structural unit forms a new half which is its mirror image. This autocatalytic reproduction is one of the major processes involved in cell reproduction.

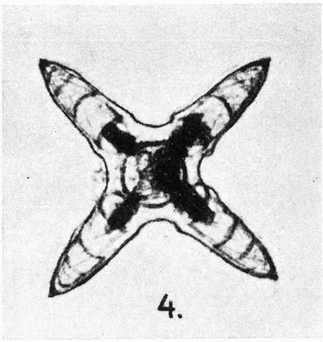
The series of observations to be described below illustrate a phenomenon which shows the significance of the mother cell for the development of the new semicell. In Fig. 7 a *Micrasterias thomasiana* var. *notata* cell is shown. This cell was produced from a cell in which a wall of some kind had appeared at the base of one of the side lobes (at the point to which the arrow points) during a centrifugation experiment. The chloroplast in the side lobe in question first turned brown and later became colourless; the visible structure of the cytoplasm differed from the normal. When the cell divided, two cells were formed, one of which was normal in all respects, but the semicells in the other cell were abnormal as shown in Fig. 7. In the new semicell there is seen a colourless area symmetrically situated with respect to the abnormal colourless side lobe in the mother semicell. After the next division the symmetrical colourless area was still present in both new semicells, but the new semicells formed in the third division were normal in appearance.

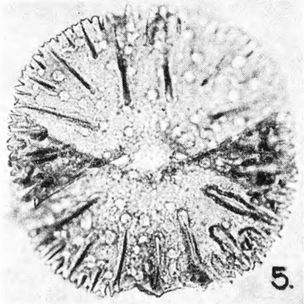
All the phenomena described above justify the conclusion that there exists a cytoplasmic self-perpetuating mechanism in the *Micrasterias* cell. In each cell division all the cytoplasmic structural units duplicate themselves, or, to use the term introduced by HUGO DE VRIES, »intracellular pangenesis» occurs. The duplication is controlled by the nucleus, i.e. the number of plasmatic units is to a large degree dependent on the

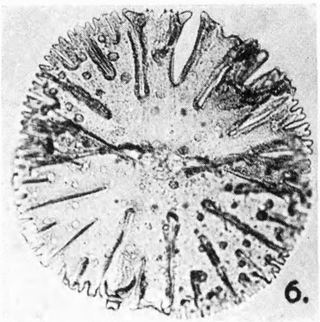

1.

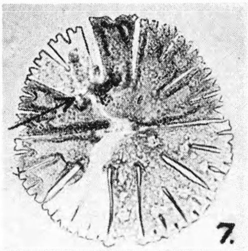

2.


3.


4.


5.


6.


7.

Figs. 1—7. 1. A constant bilaterally asymmetric form, the uniradiate fac. of *Micrasterias thomasiana* ARCH. var. *notata* (NORDST.) GRÖNBLAD. Living cell. 2. *Micrasterias rotata* (GREV.) RALFS. var. *evoluta* TURNER. A dichotypical form with an uniradiate and a biradiate semicell. Living cell. 3 and 4. Triradiate and quadriradiate facies of the diploid form of *Micrasterias thomasiana* ARCH. Dead cells seen from the end. 5 and 6. *Micrasterias thomasiana* ARCH. var. *notata* (NORDST.) GRÖNBLAD, diploid form with bifurcate polar lobes. Living cells. 7. *Micrasterias thomasiana* ARCH. var. *notata* (NORDST.) GRÖNBLAD. See text.

nuclear effect (as shown by the haploid and diploid forms of *M. thomasiana* ARCH.). On the other hand, however, the mechanism of plasmatic duplication in some cases functions to some extent independent of the nuclear influence (compare, e.g. the uniradiate and biradiate haploid forms of *M. thomasiana* var. *notata*).

The phenomena described have revealed some features of plasmatic duplication as encountered in the Desmids. The relation between cytoplasmic structure and nuclear effect is also reflected in the following observations. When compared with the characteristics of normal cells, variations in cell structure may be caused both by changes in the nucleus as well as by changes in the cytoplasm, e.g. the shape of the side lobes in the diploid (biradiate) and the haploid (uniradiate) cells of *M. thomasiana* var. *notata*. In principle the autocatalytic reproduction of plasmastructural units is similar to chromosome and gene division and to the division of protofibrils described by MONNÉ (1948). The former process does not, however, take place on the (macro)molecular level, but involves large organised structural units.

For the present we have no convincing examples of the behaviour of cytoplasmic units in sexual reproduction. It should be possible to determine the individuality of the cytoplasmic units by cross-breeding two facies with identical nuclear constitutions. Such experiments have not been performed. There is, however, in the literature one observation which suggests such an occurrence. TURNER (1921) has reported the production of a triradiate and a quadriradiate cell from a single zygote of *Staurastrum Dickiei* var. *parallelum*. It is obvious that this occurrence may be attributed to genomic variation. The possibility should, however, be considered that the structural duality existing in the nucleus in the zygote phase in all probability also exists within the cytoplasm. GEITLER (1948, 1951 a, 1951 b) has observed plasmatic striation in *Eunotia* and has discussed a type of regular plasmastructural change accompanying sexual reproduction. Also these observations point to an independent behaviour of the cytoplasm in sexual reproduction.

The new genus *Scottia* described above differs clearly in its morphology from all other known Desmids. Its bipolar asymmetry is an inherited characteristic. The two semicells, »upper» and »lower», always differ in morphology, but when the cell divides, the upper semicell produces a semicell which has the features of the lower semicell, and vice versa. This provides a simple example of polarity in a cell. The differentiation and determination phenomena which are closely related can apparently be favourably studied in the species.

The work done on the *Micrasterias* species suggests a working hypothesis which may be of value in the study of polarity in the genus *Scottia*. The cytoplasmic structural units in the *Scottia* cell must differ in many respects from those in the *Micrasterias* cell. In the first place, in the *Scottia* cell there may be distinguished two symmetrical systems: one (upper) whorl with six and one (lower) with ten processes and an equal number of symmetry axes. In addition, there is an apical corona comprising 8—9 teeth and one can not ascribe any degree of radiation to the cell as a whole. Experimental studies can be expected to reveal a more complex system of plasmastructural units than that found in *Micrasterias*. Is it possible to change the degree of the two different whorls in the cell independently in ploidization experiments? Will the anucleate upper and lower semicells differ from each other, e.g. in analogous features as do the denucleate, uniradiate and biradiate *Micrasterias* cells (KALLIO 1950)?

Bipolar asymmetry presupposes asymmetry in the different plasmastructural units. When these units are severed, the halves formed do not produce new halves that are identical with the parent halves. The asymmetrical structural unit possesses the property that, when it is broken into two at the midpoint, both halves are capable of regenerating the original asymmetrical unit. If this is actually the case, it means that the problem of polarity has been moved to a lower level, from the protoplast level to the level of plasmastructural units. The ultimate solution must be transferred to the field of macromolecular systems.

I wish to thank Dr. phil. ROLF GRÖNBLAD for placing the material of *Scottia* at my disposal.

Literature cited.

GEITLER, LOTHAR, 1948: Die Differenzierung des Protoplasten der Diatomee Synedra. — Österr. Bot. Zeitschr. 95, 345—360.

— 1951: Prägame Plasmadifferenzierung und Kopulation von Eunotia flexuosa (Diatomeae). — Ibid. 98, 395—402.

— 1951 a: Zelldifferenzierung bei der Gametenbildung und Ablauf der Kopulation von Eunotia (Diatomeae). — Biol. Zbl. 70, 385—397.

KALLIO, PAAVO, 1951: The significance of nuclear quantity in the genus Micrasterias. — Ann. Bot. Soc. Zool.-Bot. Fenn. Vanamo 24, 1—111.

— 1953 a: On the morphogenetics of the desmids. — Bull. Torr. Bot. Club 80, 247—263.

— 1953 b: The effect of continued illumination on the desmids. Arch. Soc. Zool.-Bot. Fenn. Vanamo 8, 58—74.

— 1954: Morphogenetic studies in Micrasterias rotata (Grev.) Ralfs var. evoluta Turner (Desmidiaceae). — Arch. Soc. Zool.-Bot. Fenn. Vanamo 8, 118—122.

MONNÉ, LUDVIK, 1948: Functioning of the cytoplasm. — Adv. in Enzymology 8, 1—69.

TEILING, EINAR, 1950: Radiation of desmids, its origin and its consequences as regards taxonomy and nomenclature. — Bot. Not. 1950, 299—327.

TURNER, CHARLES, 1922: The life-history of Staurastrum Dickiei var. parallelum Nordst. — Proc. Linn. Soc. 1921—1922.

WARIS, HARRY, 1950 a: Cytophysiological studies on Micrasterias. I. Nuclear and cell division. — Physiologia Plantarum 3, 1—16.

— 1950 b: Cytophysiological studies on Micrasterias. II. The cytoplasmic framework and its mutation. — Ibid. 3, 236—246.

— 1951: Cytophysiological studies on Micrasterias. III. Factors influencing the development of enucleate cells. — Ibid. 4, 387—409.

— 1953: The significance for algae of chelating substances in the nutrient solution. — Ibid. 6, 538—543.

BOTANISKA NOTISER 1954, HÄFTE 2. LUND

Some Remarks on Fragilaria zasuminensis.

By ASTA LUNDH-ALMESTRAND.

In 1937 CABEJSZEKOWNA described a new species of *Fragilaria*: *F. zasuminensis*. According to HUBER-PESTALOZZI (1942) HUSTEDT doubts that it is a *Fragilaria*. He considers it to belong to an *Asterionella* species. CLEVE-EULER (1953) also includes it in *Asterionella gracillima* var. *Ralfsi*.

A closer study of a Scanian form, that undoubtedly belongs to *Fragilaria zasuminensis* CABEJSZ., indicates that the species in question should be included in the genus *Asterionella*. The only real difference between the Scanian and Polish form is the shape of the pseudoraphe. In the first-mentioned form no pseudoraphe was to be seen under the microscope, although the best avaible optics were used in collaboration with A. PREISLER, Malmö, whereas CABEJSZEKOWNA notes a distinct pseudoraphe. The frustule resembles on the whole those of *Asterionella formosa* and *gracillima* (Fig. 1). There are, e.g., also a row of black »dots» on the edge between the valve- and girdle-view, just as is the case in *Asterionella formosa,* observed in the same lakes. The dots would seem to be a kind of short spines. It differs, however, in some regards from the two *Asterionella* species:

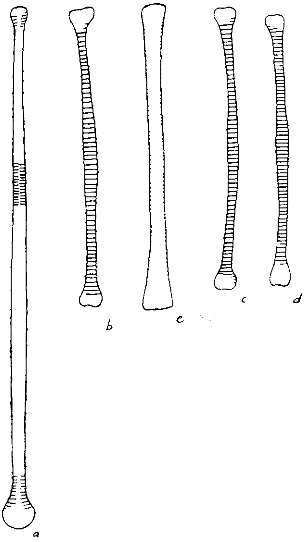


Fig. 1. a. *Asterionella formosa.* b—e. *A. zasuminensis* from the valve-view and girdle-view. Höjalen 12.8.1952. 1000×.

1. It apparently never forms characteristic stars like the other two *Asterionella* but chains (Fig. 2). The colony shape is somewhat suggestive of that of *Diatoma elongatum*.
2. The valve-view has another shape. It is

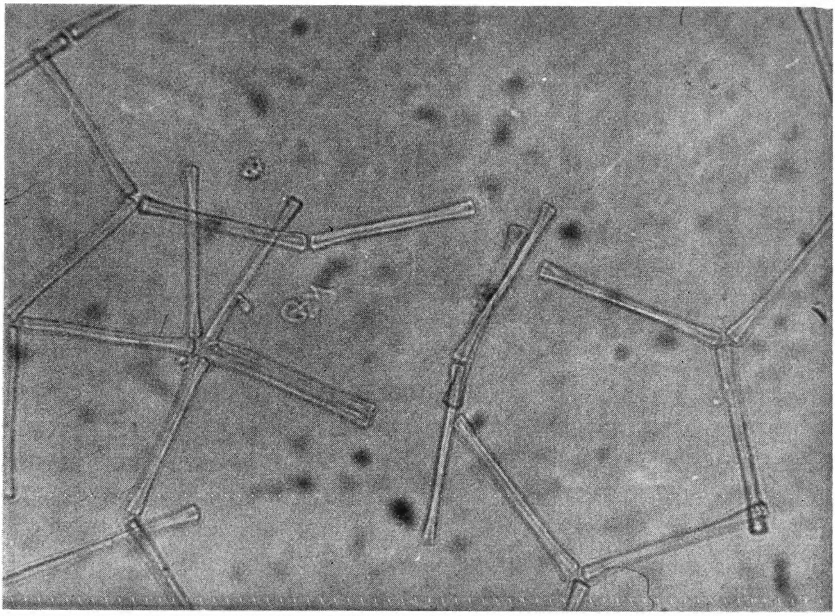


Fig. 2. *Asterionella zasuminensis*. Photomicrograph. Colony morphology. Lillsjön 12.8.1952. About 600×.

somewhat curved and the ends are rather flattened out with a slight concavity in the middle (Fig. 1 b—d and 3 b).

3. The length proportions are different in the lakes investigated by the author. In Höjalen *A. formosa* has a length of 60—70 μ and *F. zasuminensis* 35—45 μ (the same length records as CABEJSZEKOWNA has given).

4. *F. zasuminensis* has about 18—20 striae in 10 μ in the Scanian lakes. (In Poland CABEJSZEKOWNA states 16—20 in 10 μ.) *A. formosa* has in the same lakes considerably denser striae, about 25 in 10 μ.

The differences are so considerable, that it seems justifiable to describe the form as a distinct species. Then it should be called *Asterionella zasuminensis* (CABEJSZ.) nov. comb.

CLEVE-EULER includes *A. Ralfsi* W. SM. (SMITH 1856), *A.* (*formosa* v.?) *Ralfsi* GRUN. (Fig. 52: 2 in VAN HEURCK 1880—85) and *F. zasuminensis* CABEJSZ. in *A. gracillima* var. *Ralfsi* (W. SM.) A. CL., which can hardly be correct. According to descriptions and figures *A. Ralfsi* would seem to be very closely related to *A. gracillima*. HUSTEDT (1932) also includes it in this species. *Fragilaria zasuminensis,* however, differs appreciably, as is clear from the facts discussed above. CLEVE-EULER's figure 401 B

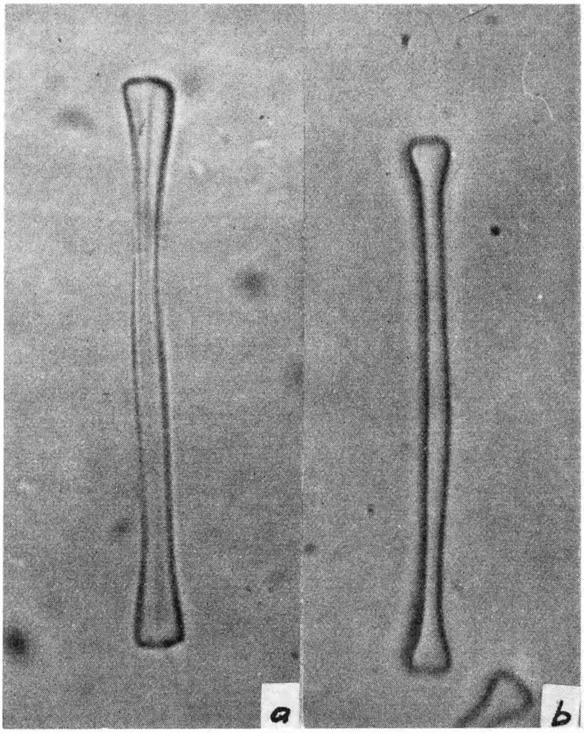


Fig. 3. *Asterionella zasuminensis.* Photomicrograph. a. Girdle-view b. Valve-view. Höjalen 12.8. 1952. About 1500×.

k (1953) resembles the latter and could thus belong to *F. zasuminensis*, but the valve-view is not depicted, and therefore no evidence can be obtained.

The distribution of *Asterionella zasuminensis* in Sweden is not known in detail. Teiling (1946) characterizes it as a »mässig selten» planktic form, occurring in lakes of different trophic types. In Scania it has so far been found by the author in plankton samples from the lakes Höjalen, Lillsjön and Gårsjön, all situated in the parish of Vittsjö. Lillsjön is close to Höjalen and runs off into this lake. The effluents of Höjalen and Gårsjön debouche into Oretorpssjön. All three lakes are characterized by clear, very brownish water poor in lime.

References.

Cabejszekowna, I., 1937. Fragilaria zasuminensis n. sp. dans le lac Zasuminskie en Polésie. — Archives d'Hydrobiologie et d'Ichtyologie. X: 4. Suwalki. (The paper in Polish, the summary in French.)

CLEVE-EULER, A., 1953. Die Diatomeen von Schweden und Finnland. — K. Sv. Vet.-ak. Handl. Fjärde serien. 4: 1. Stockholm.

HUBER-PESTALOZZI, G., 1942. Das Phytoplankton des Süsswassers. 2: 2. Diatomeen. Stuttgart.

HUSTEDT, F., 1932. Die Kieselalgen Deutschlands, Österreichs und der Schweiz. II: 2. — Rabenhorst's Kryptogamen-Flora. VII. Leipzig.

SMITH, W., 1856. A synopsis of the British Diatomaceae. II. London.

TEILING, E., 1946. Zur Phytoplanktonflora Schwedens. — Bot. Not. 1946 p. 61. Lund.

VAN HEURCK, H., 1880—85. Synopsis des diatomées de Belgique. Anvers.

BOTANISKA NOTISER 1954, HÄFTE 2. LUND

Bryologiska notiser.

AV OLLE MÅRTENSSON och ELSA TUFVESSON-NYHOLM.

III. Dicranella riparia (H. LINDB.) MÅRT. et NYH. n. comb.

I Societas pro Fauna et Flora Fennica anmälde H. LINDBERG den 5 mars 1898 en för vetenskapen ny art, *Oncophorus riparius*. Referatet från detta sammanträde (1900, p. 29) brukar i floror och handböcker anges som originalbeskrivning. *O. riparius* jämföres här med *O. wahlenbergii* BRID., »från hvilken den är lätt skild genom de styfva, uppåt—utåt riktade smala bladen och den med ring försedda kapseln». Nu lämnar emellertid LINDBERG något längre fram i samma årgång av tidskriften (p. 200) en latinsk diagnos, som — även om den i stort sett inte är utförligare än hans anmälan — hellre bör tagas som originalbeskrivning under det att den tidigare anmälan betraktas som nomen nudum. Beskrivningen lyder: »A congenibus, *Onc. virente* et *Onc. Wahlenbergii,* praecipue differt foliis rigidis, strictis basi non dilatatis, cellulis marginalibus 2-seriatis, capsula annulo instructa.—Isthmus karel., Valkjärvi, in ripa arenosa fluminis Vuoksen, prope pag. Pasuri, una cum. *Onc. Wahlenbergii, Polytricho *cubico, Amblysteg. adunco* etc.»

Existensen av den nybeskrivna arten tycks ha varit föga känd även bland nordiska bryologer. ARNELL och JENSEN lämna sålunda i sin Sarekflora (1910, pp. 182—184) en mycket utförlig diagnos av *Oncophorus hambergii* utan att LINDBERGS art på något sätt omnämnes vid diskussionen av den nya artens systematiska ställning.

Om vi följa *O. riparius*' vidare öden i floror och handböcker skola vi finna, att HAGEN (1915, p. 118) givit den varietets rang under *Kiaeria starkei* (WEB. & MOHR) HAG. Senare floraförfattare tyckas alla ha rönt inflytande från HAGEN och vi finna nu mossan som varietet under *Kiaeria blyttii* (SCHIMP.) BROTH. eller dess synonym *Dicranum blyttii* SCHIMP. *Oncophorus hambergii* upptages i regel som synonym till varieteten. MÖNKEMEYER (1927, p. 204), som troligen missuppfattat HAGEN, sätter den som synonym till *D. blyttii*. En sammanställning av synonymerna finnes nedan i sammanfattningen.

Då ARNELL och JENSEN, som ovan omtalats, lämnat en utförlig beskrivning av arten, vilja vi här endast nämna några få mera påfallande egenskaper. Bladen äro kort tillspetsade, upprätt utstående, med plana kanter. Nerven är något plattad och till sin byggnad överensstämmande med den hos släktet *Dicranella* SCHIMP. Ledarcellerna ligga sålunda ventralt, stereidband saknas eller är mycket svagt utvecklat på nervens ventrala sida; på dorsalsidan finnes däremot ett brett och väl utvecklat stereidband. Bladets cellvävnad är tämligen lucker, cellerna tilltaga något i storlek från bladkanten mot nerverna och från bladspetsen mot bladbasen. Differentierade bashörnceller saknas.

Släktet *Oncophorus* BRID. omfattande arterna *O. virens* (SW. ex HEDW.) BRID. och *O. wahlenbergii* BRID. har blad av annat utseende och byggnad. Nervens ledarceller ligga ungefär i bladets mitt, på dorsalsåväl som på ventralsidan förefinnes ett väl utvecklat stereidband; cellvävnaden i lamina är tämligen kompakt, bashörncellerna äro mer eller mindre tydligt differentierade.

I likhet med de båda nämnda *Oncophorus*-arterna är *Dicranella riparia* autoik. ARNELL och JENSEN anföra detta som ett skäl att föra sistnämnda art till släktet *Oncophorus*. Erfarenheten har emellertid visat att könet hos mossorna i många fall har underordnad systematisk betydelse. Sålunda äro arterna av släktet *Dicranella* — som vi anse även bör omfatta släktet *Anisothecium* MITT. — vanligen dioika men ett fåtal arter kunna vara både autoika och dioika.

Varför HAGEN fört arten till det av honom uppställda släktet *Kiaeria* och som varietet under *K. starkei* (WEB. & MOHR) HAG. är gåtfullt. Någon likhet med detta släkte utöver familjekaraktärerna förefinnes knappast. Bladens cellvävnad är helt annorlunda. *Kiaeria* står nära släktet *Dicranum* HEDW.; bladens cellstruktur påminner starkt om detta släkte.

H. LINDBERGS exemplar från originallokalen skiljer sig något från den typ som är känd från Skanderna. Den förra har sålunda något bredare nerv och bladkanten är längre ner dubbelskiktad. Andra olikheter ha ej iakttagits. Sporstorleken, peristomets och kapselns utseende förefalla vara lika.

Om artens ekologi veta vi just inte så mycket mer än att mossan företrädesvis växer på fuktig, sandig jord eller svämsand. De mossor den anträffats växande tillsammans med äro tämligen intetsägande och tyda inte på att några speciella krav beträffande substratet skulle föreligga.

Den finska lokalen ligger i barrskogsregionen under det att arten i Sverige och Norge endast är känd från Skandernas subalpina och lågalpina bälten.

Sverige: Lule lappmark: Sarek, Rapaätnos strand, björkregionen, 1902, ARNELL & JENSEN (Univers. Bot. Mus., Uppsala). Torne lappmark: Torneträsk-området, Maivattjåkko, vid bäck i lågalpina bältet, 1949, ELSA TUFVESSON-NYHOLM (Univers. Bot. Mus., Lund).

Finland: Isthmus karelicus: Valkjärvi, in ripa arenosa flum. Vuoksen, 15.VI. 1895, H. LINDBERG (Univers. Bot. Mus., Helsingfors).

Norge: Opland, riparia Slethavn, ad terram, 1220 m s.m., 15.VIII.1889, I. HAGEN (Det Kgl. Norske Vidensk. Selsk. Mus., Trondheim).

Litteratur.

ARNELL, H. W. & JENSEN, C., 1910: Die Moose des Sarekgebietes II & III. Naturwiss. Untersuch. des Sarekgebierges in Schwedisch-Lappland III Botanik. — Stockholm.

BROTHERUS, V. F., 1927: Die Laubmoose Fennoskandias. — Helsingfors.

JENSEN, C., 1939: Skandinaviens bladmossflora. — Köbenhavn.

HAGEN, I., 1915: Forarbejder til en norsk lövmosflora XX Dicranaceae. Kgl. Norske Vidensk. Selskl. Skrift. 1914 N:o 1. — Trondhjem.

LINDBERG, H., 1900: Trenne för den finska floran nya arter (pp. 28—29); latinsk diagnos i »Uebersicht der wichtigeren Mitteilungen», p. 200. — Medd. Soc. Fauna et Flora Fenn. XXIV. — Helsingfors.

MÖNKEMEYER, WILH., 1927: Die Laubmoose Europas in RABENHORSTS Kryptogamen-Flora, IV, Ergänzungsband. — Leipzig.

Summary.

In the present paper some problems concerning the taxonomy of that species which originally was described as *Oncophorus riparius* H. LINDB. are discussed. It is our opinion that these problems are best solved, when the species is referred to the genus *Dicranella* SCHIMP. The results may be summarized as follows:

Dicranella riparia (H. LINDB.) MÅRT. et NYH. nov. comb.

Synonyms: *Oncophorus riparius* H. LINDB., 1910, p. 29 (nom. nud.) and p. 200. — *Oncophorus hambergii* ARN. & C. JENS., 1910, pp. 182—184. — *Kiaeria starkei* (WEB. & MOHR) HAG. var. *riparia* (H. LINDB.) HAG., 1915, p. 118. — *Kiaeria blyttii* (SCHIMP.) BROTH. var. *riparia* (H. LINDB.) BROTH. 1923, p. 88. — *Dicranum blyttii* SCHIMP. var. *riparium* (H. LINDB.) MOENKEM., 1927, p. 205.

Dicranella riparia has been collected from alluvial sand or »bare», sandy soil. There are only four Fennoscandian localities. The Finnish original locality lies in the coniferous forest belt but the Swedish localities and the Norwegian one are situated in the subalpine and low-alpine belts of the Scandes.

BOTANISKA NOTISER 1954, HÄFTE 2. LUND

Om ullfloran vid Lackalänga i Skåne.

AV TH. LANGE, K. E. FLINCK och B. HYLMÖ.

I vårt land är ett områdes stationära flora vanligen mycket artfattig och snart genomgången, om ej svårare eller kritiska släkten tagas upp till observation. För den stora gruppen av amatörbotanister utgör inkomlingarna vid hamnar och på industritomter då ofta ett kärkommet tillskott, även om endast undantagsvis adventivfloran blir så artrik som vissa år vid Lackalänga. De genom kulturtransport tillfälligt inkomna arterna har utan tvivel också ett berättigat intresse. Många av dem har visat sig kunna hålla sig kvar i den nya omgivningen och så småningom komma att spela en betydande roll i vegetationen.

Vår nuvarande flora sammansättes till stor, ja kanske övervägande del av kulturspridda arter. Arternas utbredning och frekvens bestämmes säkerligen i stora delar av vårt land i mycket högre grad än man vanligen vill erkänna av människans kulturåtgärder. För vår tids liksom för kommande generationers botanister bör det vara av intresse att följa de främmande arternas inkörsportar och försök att på olika sätt naturalisera sig. HYLANDER (1953, sid. XI) anför i sin flora: »Denna grupp (antropokorerna) spelar en högst väsentlig roll framför allt i den vegetation av mer eller mindre klar halvkulturtyp, vars oerhörda utsträckning inom stora delar av vårt område man ofta synes mig ha allt för svårt att inse, med påföljd att man också är alltför obenägen att erkänna många sena, ofta mycket sena invandrares eller utkomlingars fullkomliga naturalisation och på ett stundom något romantiskt sätt låter omdömet om den vilda, stabila florans sammansättning i otillbörlig grad avgöras efter arternas 'inhemskhet'».

Utomlands har sedan länge flerstädes de starka och snabba förändringar som äger rum i florans sammansättning starkt uppmärksammats. I England diskuterades exempelvis nyligen på en konferens med 270 deltagande botanister detta problem (LOUSLEY 1953), varvid bl.a. pekades på de många nyinkomlingar, som under det sista århundradet naturaliserats på brittiska öarna. Inte minst ullfloran uppmärksammades därvid.

Kring Furulunds Yllefabrik i Lackalänga socken (numera Furulunds köping) har vid flera tillfällen en rik adventivflora iakttagits. Sålunda har artförteckningar över denna ullflora publicerats av BLOM (1929, 1933 och 1936), HYLMÖ (1947) och av PROBST (1949). Dessa adventivväxter har vissa år uppträtt synnerligen rikligt medan de andra år nästan helt saknats. Under åren 1949 och 1950 användes kardavfall från fabriken som utfyllnadsmaterial denna gång vid igenläggandet av ett gammalt sandtag, varvid ullfloran uppflammade i stor art- och individrikedom. Avfallet lades i metertjocka lager, ibland med ett tunt grusskikt ovanpå. Vid ullavfallets nedbrytning alstrades liksom hos stallgödsel under drivbänkar värme och den stegrade marktemperaturen synes ha gynnat de ofta värmekrävande inkomlingarnas trivsel. Redan i medio av maj kunde arter av bl.a. *Medicago, Bromus* och *Hordeum* insamlas i välutvecklade exemplar med mogna frukter.

Sannolikt är åtskilliga av ullväxterna kortdagsväxter, som först under höstens korta dagar får impuls till blombildning. Bland förmodade kortdagsväxter, vilka först blommat i oktober eller november, kan framhållas *Cynodon dactylon, Inula graveolens* och flera chenopodiaceér. Åtskilliga plantor hann överhuvud ej utvecklas till blomning och har ej kunnat bestämmas till art eller släkte.

Många inkomlingar uppträder endast i en generation. Andra utvecklar dock fullgott frö och har genom självsådd återkommit år efter år. Enstaka ullväxter har i Lackalänga fast fotfäste sedan åtminstone 20 år, men det stora flertalet nyinkomlingar försvinner efter ett eller ett par år då de har svårt att hävda sig i konkurrensen när området växer igen. Sannolikt hade fler arter kunnat klara sig om de erbjudits tillgång till öppen mark.

I nedanstående förteckning har för en del utsatts hemlandet. Representanter finnas från alla större ullproducerande områden, bl.a. Medelhavsländerna, Sydafrika, Australien, och Sydamerika. Särskilt Australien har släppt till många arter. Den ullspridda växtens hemland utgör dock inget säkert indicium på ullens ursprung. Många ullspridda arter har genom vår tids enorma handelsutbyte länder och världdelar emellan kommit att bli kosmopolitiska ogräs. Dessa vanligen torkresistenta arter utgör dominerande inslag i växtligheten på industritomter och i hamnområden i subtropiska länder och är där också allmänna ogräs i betesmarker och på uppodlad kulturmark. De stora fåruppfödningsländerna har ett stort antal gemensamma ogräs. Inte minst vanliga bland dessa är arter ursprungliga i länderna kring Medelhavet.

En annan grupp av ullinkomlingar till Lackalänga utgör de odlade foderväxterna. Intressantast är måhända *Trifolium subterraneum*, vars blomställningar efter blomningen gräver sig ned i marken. Inte minst i Australien och på Nya Zeeland är denna klöverart en omtyckt vallväxt. *Cynodon dactylon* är en allmänt odlad foderväxt, som också i många länder användes i trädgårdsgräsmattor. Omtyckta fodergräs är även *Eleusine indica, Setaria italica, Digitaria sanguinalis* och *Lolium rigidum*.

Blom (1929) har tidigare diskuterat ullflorans spridningsbiologi. Art och individrika är växter vilkas frukter eller frön har organ som lätt häftar vid fårens pälsar, t.ex. *Medicago, Erodium, Xanthium, Centaurea* liksom många gräsarter. Även frön av arter med saftiga frukter inkapslar sig lätt i pälsen, då fåret under sin vila spränger sönder dessa frukter (*Cucumis, Nicandra* och *Physalis*). Men även många glatta fröer häftar vid i fårens spillning i ullen (*Amaranthus, Sisymbrium* och *Brassica*).

Nedanstående lista upptar ca 150 arter, varav ej mindre än ca 60 är gräs. Med största sannolikhet har samtliga upptagna arter inkommit med ullen. Flera av arterna har ej tidigare insamlats i vårt land. I listan ingår även fynd gjorda av överste Carl-Axel Torén.

De ofta mycket svåra och tidskrävande artbestämningarna har till övervägande delen utförts av Lange. Fil. dr. Carl Blom och fil. dr. Erik Asplund har lämnat värdefull hjälp med detta arbete.

Gramineae

Andropogon pertusus Willd. (Australien)
Tragus racemosus (L.) All.
Eriochloa ramosa O. Kuntze (Australien)
Setaria viridis (L.) PB.
— *italica* (L.) PB.
Panicum miliaceum L.
— *dichotoniflorum* Michx.
Digitaria sanguinalis (L.) Scop. ssp. *vulgaris* Henr.
Echinochloa crus-galli (L.) PB.
Eragrostis megastachya (Koel.) Lk.
— *tef* (Zuccagni) Trotter (Afrika)
— *filiformis* (Thunb.) Nees (Sydafrika)
— *Brownii* Nees
— sp.
Eleusine indica (L.) Gaertn.
Dactyloctenium aegyptium (L.) Richt. v. *radulans* (R. Br.) Hack. (Australien)
Cynodon dactylon (L.) Pers.
Chloris divaricata R. Br. (Australien)
— *truncata* R. Br. (Australien)
— — v. *abbreviata* Thell.
— *virgata* Sw.
— *ventricosa* R. Br. v. *tenuis* Benth.
Diplachne uninervia (C. Presl) Parodi (Sydamerika)
Stipa aristiglumis F. v. M.
— *variabilis* Hughes
— *compressa* R. Br.
Lepturus incurvatus Trin.
Lolium temulentum L.
— *rigidum* Gaud.
Vulpia geniculata (L.) Lk

Vulpia bromoides (L.) S. F. Gray
— *myurus* (L.) C. C. Gmel.
— *megalura* (Nutt.) Rydb.
Lophochloa cristata (L.) Hyl.
Avena fatua L. ssp. *eufatua* Hyl.
Agrostis avenacea J. F. Gmel.
Polypogon monspeliensis (L.) Desf.
Gastridium ventricosum (Gouan) Sch. et Th.
Sporobolus Poiretii (R. et P.) Hitchc. (Australien)
— *Lindleyi* Benth. (Australien)
Triraphis mollis R. Br. (Australien)
Ehrharta longiflora Sw. (Sydafrika)
Phalaris angusta Nees
— *canariensis* L.
— *minor* Retz.
— *paradoxa* L.
Bromus catharticus Vahl (ev. f. *aristatus* (J. et W.) Aell. et Thell.)
— *rigidus* Roth
— *sterilis* (L.) Roth
— *tectorum* L.
— *madritensis* L.
— — v. *Delilei* Boiss.
— *rubens* L.
— *alopecuroides* Poir.
Danthonia semiannularis (Labille) R. Br. (Australien)
— *racemosa* R. Br. (Australien)
Anthosachne australasica Steud.
Hordeum jubatum L.
— *marinum* Huds.
— *murinum* L. ssp. *eumurinum* Briq.
— — ssp. *leporinum* (Lk) A. et G.
— *pubiflorum* Hook. fil. (Sydamerika)
— *compressum* Gris.
— *comosum* J. et C. Presl (Sydamerika)

Polygonaceae

Rumex Brownii Campd. (Australien)

Chenopodiaceae

Chenopodium pratericola Rydb.
— *ambrosioides* L. (Sydamerika)
— *cristatum* F. v. M. (Australien)
— *pumilio* R. Br. (Australien)
— — f. *glandulosum* (Moq.) Aell.
Chenopodium carinatum R. Br. v. *holopterum* Aell. (Australien)
— — v. *melanocarpum* Aell.
— *Bontei* Aell. (*carinatum*×*cristatum*)
— *giganteum* D. Don.
— *Probstii* Aell. (Australien)
— *auricomiforme* Murr. et Thell.
— *antarcticum* (Hook. f.) B. et H. (Patagonien)
— *myriocephalum* (Benth.) Aell. (Australien)
Atriplex tatarica L.
— *angulata* Benth. (Australien)
— *leptocarpa* F. v. M. (Australien)
Bassia quinquecuspis F. v. M. v. *villosa* Benth. (Australien)
Salsola kali L.
— *ruthenica* Iljin

Amaranthaceae

Alternanthera pungens H. B. K.
Amaranthus chlorostachys Willd. (Argentina)
— *retroflexus* L. (Nordamerika)
— *blitoides* S. Wats. v. *aragonensis* Sennen
— *Dinteri* Schinz v. *uncinatus* Thell.
— *Thunbergii* Moq. (Sydafrika)
— — f. *maculatus* Thell.

Aizoaceae

Mesembrianthemum crystallinum L. (Afrika)
— sp.

Caryophyllaceae

Silene gallica L.
Kohlrauschia prolifera (L.) Kunth

Papaveraceae

Argemone mexicana L. (Centralamerika)

Cruciferae

Brassica Tournefortii Gouan (individrik)
Diplotaxis tenuifolia (L.) DC.
— *muralis* (L.) DC.
Lepidium ruderale L.
— *graminifolium* L.

Subularia maritima (L.) DESV.
Sisymbrium altissimum L.
— *orientale* L. (individrik)

Leguminosae

Psoralea tenax LINDL. (Australien)
Scorpiurus sp.
Medicago arabica (L.) ALL.
— *hispida* GAERTN.
— — v. *denticulata* (WILLD.) URB.
— — v. *lappacea* (DESR.) BURN.
— *praecox* DC. (Medit.)
— *Schimperiana* HOCHST. (Sydafrika)
— *laciniata* (L.) MILL. (Sydeuropa, Afrika)
— — f. *integrifolia* GODR.
— *minima* L.
— — v. *recta* (DESF.) BURN. (Sydeuropa)
— *tribuloides* DESR.
Melilotus indicus ALL.
Trifolium angustifolium L. (Medit.)
— *subterraneum* L.
— *striatum* L.
— *tomentosum* L.

Oxalidaceae

Oxalis stricta L.

Geraniaceae

Erodium cicutarium (L.) L'HÉR. (mångformig)
— *moschatum* (L.) L'HÉR.
— *cygnorum* NEES (Australien)
— *Botrys* (CAV.) BERTOL. (Medit.)
— *Stephanianum* WILLD.
— *brachycarpum* (GODR.) THELL. (Amerika)

Malvaceae

Malva parviflora L. (Medit.)

Cucurbitaceae

Cucumis myriocarpus NAUD. (Sydafrika)

Onagraceae

Oenothera nocturna JACQ.

Lythraceae

Lythrum hyssopifolia L.

Umbelliferae

Caucalis lappula (WEB.) GRANDE
Ammi visnaga (L.) LAM. (Medit.)

Verbenaceae

Verbena bonariensis L.

Labiatae

Marrubium vulgare L.

Solanaceae

Nicandra physaloides (L.) GAERTN. (Sydamerika)
Physalis minima L. (Australien, tropik.)
Datura ferox L.
— *stramonium* L.
— *tatula* L. (Argentina)
Nicotiana glauca GRAHAM (Argentina)

Scrophulariaceae

Verbascum virgatum WITH.
— *phlomoides* L.

Plantaginaceae

Plantago coronopus L. ssp. *Cupani* (GUSS.) PILGER

Compositae

Calotis hispidula F. v. M. (Australien)
Vittadinia scabra DC.
Erigeron bonariense L.
Inula graveolens (L.) DESF.
Xanthium strumarium L.
— *spinosum* L.
Verbesina encelioides (CAV.) B. et H.
Bidens sp.
Centaurea solstitialis L.
— *melitensis* L.
Carthamus lanatus L.
Tagetes minutus L. (Sydamerika)
Schkuhria advena THELL. (Sydamerika)
Leontodon nudicaulis (L.) BANKS.
Chrysocoma tenuifolia BERGER (Sydafrika)
Felicia tenella (L.) DC. (Sydafrika)
Arctotheca calendula (L.) LEVYNS (Sydafrika)

Litteratur.

BLOM, C.: Ullfloran vid Lackalänga i Skåne. — Medd. Göteborgs Bot. Trädg. 5: 85, 1929.

— Bidrag till Skånes adventiv- och ruderatflora. — Bot. Not. 355, 1933.

— Bidrag till kännedom om Sveriges adventivflora. III. — Medd. Göteborgs Bot. Trädg. 11: 159, 1936.

HYLANDER, N.: Nordisk kärlväxtflora I. — Stockholm 1953.

HYLMÖ, B.: Notiser om ullfloran vid Lackalänga. — Bot. Not. 81, 1947.

LOUSLEY, J. E.: The changing flora of Britain. — London 1953. (Även i Nature 169: 1076, 1952.)

PROBST, R.: Woll-adventivflora Mitteleuropas. — Vogt-Schild, Solothurn. 1949.

BOTANISKA NOTISER 1954, HÄFTE 2. LUND

New Lichens.

By A. H. MAGNUSSON.

Lecidea (Biatora) curvula H. MAGN. n. sp.

Thallus verrucoso-diffractus, crassiusculus, fuscescenti-cinereus, verrucis minutis, irregularibus, dense contiguis, basi constrictis, KOH—, CaCl—, Pd—, hypothallo indistincto. Apothecia simplicia vel saepe conglomerata, atra, primum plana tenuiterque marginata, mox convexa, immarginata, subscabrida. Excipulum crassum, atrofuscum, uniforme, completum. Hypothecium crassum, incoloratum. Thecium superne late fuscoatrum, paraphysibus clavatis, superne pallide fuscis. Sporae octonae, oblongae, curvatae.

Poland: Sudeten, Heuscheuergebirge, Glatz. On perpendicular cliff of sandstone by the road Karlsberg—Wunschelberg, 630 m s. m., 1951. Z. TOBOLEWSKI.

The largest specimen seen 1.5 cm square, consisting of 0.3—0.5 mm broad, packed verrucae forming a 0.3—0.5 mm thick thallus, in the thickest part with deep and broad cracks but not forming real areolae. Apothecia dense, simple ones about 0.5 mm broad, rather plane and only slightly prominent, sometimes in 2—3 mm wide clusters, convex and more elevated above thallus surface. Sometimes abortive clusters are found without a limit between the single apothecia.

Thallus cortex about 10 μ thick, in KOH brown-grey, cells indistinct, 1—2 μ diam. Algae 7—10 μ large in a dense, 100 μ thick stratum. Medulla colourless in upper part, in lower part mixed with a dark ± granular stuff, hyphae densely intricate, 4 μ, thick-walled. — Apothecia about 0.3 mm deep. Exciple 50—65 μ thick all round and black-brown. Hypothecium to 120 μ deep at centre. Thecium about 70 μ tall, like hypothecium I—; upper 20—25 μ dark-brown, in KOH blackish blue-green like the exciple. Paraphyses in HNO_3 2 μ thick, apices pale brown for 6—8 μ, tips 3—4 μ thick, clavate. Spores 8.5—11 × 3.5—4.5 μ, more or less arcuate, especially when ripe.

The new species belongs to the *rivulosa-cyathoides*-group and has spores resembling those in *arcuatula* (ARN.) HUE or *recensa* STIRT. but has a different shape of the thallus, in the last two areolate, in *curvula* verrucose and thick with clustered, black apothecia. I have examined part of an apothecium in *recensa* (from. Brit. Museum) which has 0.8 mm broad, plane, black apothecia with a concolorous thin, prominent margin. The exciple very thick at base, brown-black. Thecium 75—85 μ tall, colourless-greyish, upper 15—20 μ black-brown. Hypothecium 50—70 μ, colourless. Thecium and hypothecium I+ blue, apices of asci very dark blue, tips of paraphyses 10—20 μ, very dark green-brown, contiguous in KOH, clavate, 4—5 μ. Spores 12—14 × 4—4.5 μ, in KOH thicker than in the Poland specimen. Apothecia KOH—, Pd—.

Catillaria (Biatorina) tavastiana H. MAGN. n. sp.

Thallus obscure viridi-cinereus, effusus, tenuis, continuus, rimosus, inaequalis vel verruculosus, KOH—, I—, CaCl—. Apothecia arcte adnata, minuta, atra, disco plano vel convexulo, margine primum tenui, mox depresso. Excipulum caerulescens. Hypothecium incoloratum. Thecium tenue, pallide caeruleo-viride, paraphysibus conglutinatis. Sporae octonae, uniseptatae, minutae, oblongae.

Finland. Tavastia austr.: Jämsänkoski, Kanhariovesi, on basal cortex of *Salix* on the bank, August 1952 (holotype); Padasjoki, Saksala, on the bank of lake Päijänne, August 1953, also on basal cortex of *Salix*, coll. ARVO KOSKINEN.

Thalli small, up to 3 × 2 cm, extenuated and very thin towards the circumference, uneven and thinly cracky but not distinctly areolate. Apothecia 0.3—0.5 mm wide, some larger ones irregularly convex, some more or less clustered. — Apothecia 0.15—0.25 mm thick without algae but lumps of 4—7 μ large algae seen below the exciple. This 35—50 μ thick below, thinning towards edge and often absent at centre, intensely dark bluish-green with radiating, conglutinate, indistinct hyphae. Hypothecium 35(50) μ thick, mainly colourless, sometimes lengthened downwards at centre. Thecium 50 μ tall, sordid, ± pale blue-green to surface, I ± blue, in HNO_3 violet red like the exciple but fainter. Asci about 35 × 12 μ, wall at top about 5 μ thick. Paraphyses firmly conglutinated, about 1.7 μ thick to the apices but indistinct also in KOH. Spores 10 × 3—3.5 μ, partly simple.

The new species is characterized by the somewhat thick thallus, the blue-green exciple, the pale hypothecium and the conglutinate paraphyses. At first glance it resembles *Lecidea euphorea.*

Lopadium saxicolum H. MAGN. n. sp.

Thallus tenuissimus, viridi-cinereus, subcontinuus vel evanescens. Apothecia crebra, majuscula, adpressa vel sessilia, fuscoatra, plana, margine crassiusculo, haud prominente, subpersistente. Excipulum crassum, sordide olivaceo-fuscum cum hypothecio crasso obscuriore confusum, KOH+ fuscorufescens. Thecium altum, pallidum, superne obscure olivaceum. Paraphyses simplices, apicem versus intricatae. Sporae octonae, pallidae, submuriformes, elongatae.

India. United Provinces: Dwarahat Almora 1948, P. N. MEHRA, on siliceous rock at 5500 ft.

Thallus at base of apothecia with 6—8 μ wide algae in large crowds, hyphal tissue with indistinct about 2 μ large cells and a few 2—3 μ thick, long-celled hyphae, KOH—, CaCl—. Apothecia 0.7—1 (1.2) mm wide, very dark brown to almost black, surface opaque, slightly rough, limitation of the margin to the disc often diffuse.

Apothecia 0.4—0.5 mm thick, the pale part 200 μ deep, CaCl+ brown-red. Exciple laterally 70—100 μ thick, sordid olive-brown with radiating hyphae obscured by minute granules and grading into 100—150 μ thick, darker brown-olive hypothecium, both paler in KOH and ± brown-red. Thecium 150—160 μ tall, pale, I+ dark blue; upper 10—18 μ dark olive (±brown), surface uneven. Paraphyses thin, 1 μ, simple except in upper 17 μ where they are densely intricate with constricted, subglobose joints. Asci 100—115 × 25 μ, I+ uniformly blue, wall 2—2.5 μ thick, at apices 3—3.5 μ. Spores 8, (25) 35—45 × 10 μ with about 7 transversal septa and one longitudinal one in the central part, cells 9—12, angular.

There are very few saxicolous species of *Lopadium* described, one from Paraguay: *bilimbioides* MÜLL. ARG. and one from Patagonia: *diffluens* NYL. but both have shorter spores.

Acarospora geophila H. MAGN. n. sp.

Thallus squamuloso-verrucosus, squamulae juniores minutae, verruciformes, rufofuscae, rotundae, laevigatae, squamae vetustiores majores, convexae, caesio- vel viridi-albescentes, partim irregulares, omnes late affixae, KOH—, CaCl—, Pd—, subtus fuscae. Apothecia saepius solitaria, in quavis areola vetusta immersa, mediocria, disco fuscoatro, concavo, margine thallode ±crasso elevato cincto. Thecium altum, paraphysibus superne fusco-clavatis. Sporae numerosae, minutae, globosae.

U. S. A. Washington: Grant Co., 1.5 miles N. of Burke, on soil under *Artemisia tridentata,* April 10, 1953, coll. R. DAUBENMIRE (53195), comm. ALBERT W. C. T. HERRE.

Squamules 0.7—1.5(2) mm diam., older ones contiguous or approaching, younger ones dispersed, warmly brown, smooth, convex, sterile or with young apothecia, the older ones larger and thicker, whitish or usually with a greenish cover, rarely smooth, mostly rough, shagreen-like. — A brown areola 0.75 × 0.4 mm in size. Its cortex 10—20 μ thick, diffuse, upper 5 μ dark red-brown, cells 2—3 μ in the colourless part, indistinct, but ± broad strands of hyphae are often seen far downwards. Algae 6—11 μ in a 50—70 μ thick, yellow-green stratum. Medulla ± nubilated, in KOH translucid, but with numerous remaining stone-particles. Lower side more or less brown.

Apothecia present in most rough squamules, solitary or occasionally 2(3), perhaps on account of concrescent areolae, disc 0.5—1 mm wide, black-brown, at first concave with prominent, faintly furrowed thallus margin, then plane with thin, smooth, hardly rising margin. — The edge of one, 0.8 × 0.4 mm large verruca, 100 μ broad, in upper 100 μ without algae, laterally with dense, 8—12(20) μ large algae inside the 15—20 μ thick, colourless cortex, exterior 5 μ red-brown, amorphous stratum 10—15 μ. Exciple 10—15 μ thick, colourless or indistinct. Hypothecium 20—25 μ, colourless, sometimes root-like lengthened at centre. Thecium 85—90 μ tall, colourless, I+ dark blue like the hypothecium to the algae; upper 5—8 μ dark brown-red, in HNO_3 ± sordid bright red. Paraphyses 1.7 μ thick, tips in KOH 3.5 μ with brown »cap». Asci easily bursting, 85 × 20—25 μ, wall mostly 3—3.5 μ thick. Spores probably about 100, 3—3.5(4) μ diam., globose.

The new species belongs to the Div. 2, *subglobosae* in my Monograph of *Acarospora* (p. 119) and is undoubtedly akin to *A. epilutescens* and *peltastica* ZAHLBR. But it is still more similar to *A. washingtonensis* H. MAGN. (in Ann. Crypt. Exot. 6: 46, 1933) which has a rather agreeing inner structure but higher thecium, 100—110 μ, partly ellipsoid spores, quite naked, larger and irregular squamules fastened to stone. A new locality for this species is Arizona: near Oraibi, coll. K. BARTLETT 1935 (comm. J. HEDRICK 1936).

A. geophila is an obvious species, especially on account of the surface cover in older squamules, which have a distinct greenish colour.

It seems to depend upon the 15—25 μ thick, gelatinous, colourless stratum, frequently interrupted which probably is the cause of the shagreen-like surface. On a note upon the label Dr HERRE had stated: cortex C+ red, but I have not been able to find a real colouring in the cortex with CaCl. Occasionally the dark brown surface takes on a more reddish colour, found also in HNO_3. Both naked and pruinose squamules were tested with a solution of CaCl giving a bright red colour in *Parm. subaurifera,* but without result.

Lecanora (Eulecanora) thallophila H. MAGN. n. sp.

Thallus horisontalis haud evolutus. Apothecia primum verrucas albidas supra thallum *Dermatocarpi* formantia, sensim in apothecia lecanorina evoluta, demum majuscula, basi valde constricta, subtus flavescentia, disco plano vel undulato dense albosuffuso, margine crasso prominente flexuoso cincto. Cortex apothecii crassus, cellulis mediocribus formatus. Thecium subtenue, superne fusco-fulvum. Sporae octonae, simplices, ellipsoideae.

U. S. A. Utah: San Juan Co., Devil's Canyon 1952, at 6300 ft. On *Dermatocarpon* cf. *miniatum* on dry exposed sandstone. Coll. SEVILLE FLOWERS, comm. JOHN W. THOMSON (s.n. *L. crenulata*).

Apothecia 1—3 mm wide, KOH—, mostly upon the edge of the lobes, at first thick, smooth, highly elevated, then flexuose-crenulate, margin slightly inflexed. — Apothecia 0.3—0.5 mm thick, lower cortex 50—70 μ thick, colourless except nubilated 15—18 μ, its cells 5—9 × 4—5 μ large, irregular, often perpendicularly stretched, oblong, with gelatinized walls, at edge narrower and nubilated. Medulla lax, easily torn, hyphae very loosely intricate, greyish nubilated. Algae 10—17 μ diam., stratum about 50 μ thick reaching the edge. Exciple 20—25 μ along base with parallel, gelatinized hyphae up to the edge. Hypothecium faintly developed. Thecium 70 μ tall, colourless, I+ dark blue; upper 8 μ brown-fulvous, dissolving in KOH or CaCl without coloration. Paraphyses 1—1.5 μ, simple apices not thickened, ending in a gelatinous cover of the thecium. Asci 45—50 × 10 μ, clavate. Spores 10—13 × 7—8 μ, wall thin. — Conidia unknown.

This lichen has only an outwordly similarity to *L. crenulata,* the structure especially of the cellular, thick cortex being quite different. It belongs perhaps to the *Hageni—albescens*-group but I have not been able to state a near relative of it from my keys of the genus. Till these intricate groups have been treated monographically it may be appropriate to give it a name. Most likely it has its affinities among the saxicolous species.

Lecanora (Eulecanora) wisconsinensis H. MAGN. n. sp.

Thallus viridiglaucus, dense verruculosus, latus, verruculis contiguis, granuliformibus, saepe valde irregularibus, verticaliter excrescentibus, KOH et Pd+ flavis. Apothecia numerosa, dispersa, majuscula, sessilia, ad basin valde constricta, disco rufo-testaceo vel testaceo-rufo, plano, margine glaucescente vel albicante, flexuoso, leviter prominente cincto, crystallos majusculos haud formantia. Paraphyses superne leviter incrassatae. Sporae octonae, simplices, mediocres, ellipsoideae.

Thallus surface very uneven, partly with contiguous low granules, 0.2—0.25 mm broad, partly with crowded, high to vertically lengthened granules, often constricted at base and ± packed. Apothecia 1—1.5 mm broad, soon plane with shining, furrowed margin, paler than the thallus, often ± whitish. — Apothecia 0.4—0.5 mm thick with the pale part to 250 μ deep. Margin 130 μ thick, algal stratum there about 100 μ continuing all round the base. Cortex 20—25 μ thick, colourless or ± greyish with intricate hyphae. Exciple 35—50 μ thick, not refracting but cellular. Hypothecium 100—150 μ deep, colourless with perpendicular hyphae. Thecium 70 μ tall, sligthly brownish upwards, I+ dark blue 100 μ deep; uppermost 3—5 μ red-brown, not inspersed. Paraphyses contiguous, also in KOH, apices only 2 μ thick. Spores 12—13 × 8.5 μ, ellipsoid or some subglobose.

U. S. A. Wisconsin: Marienette Co., near Pembine, on the bark of *Pinus strobus* at 1.5 mm height, 1952 W. L. CULBERSON (1418), Holotype. Same county near Wausaukee (1177). Conidia 17—20 × 0.5 μ, ± arcuate. Also near Peshtigo, still more coarsely granular with coarsely granular apothecia margins (1514). Lincoln Co., near Merill (1538) very small but typical. All collected by CULBERSON 1952 on *Pinus strobus*.

This new species in the *subfusca*-group is characterized by its coarsely granular thallus, large, often crenulate apothecia without large crystals in the algal stratum, and the yellow Pd-reaction in the thallus.

Lecanora subradiosa Nyl. v. *intermedia* H. MAGN.

Thallus flavescenti-griseus, crassus, verrucoso-subareolatus, verrucis perpendiculariter accrescentibus, basi constrictis, valde irregularibus compositisque, cortice KOH flavo, CaCl+ subcitrino. Apothecia numerosa, adpressa, valde irregularia, disco fusco-atro, saepius cinereo-pruinoso, CaCl+ citrino.

Poland. Sudeten, Eckstein bei Karlsberg. On perpendicular rock of sandstone, 820 m s.m. 1953 Z. TOBOLEWSKI.

The new variety is intermediate between the type and v. *caulescens* STNR [Lichenes in Ergebn. naturwiss. Reise Erdschias-Dagh (Klein Asien) 1907]. The verrucae grow in v. *caulescens* vertically to a height of 2 mm while branching and form 3—6 mm broad head-like growths. This form is issued in SUZA exs. 168 as v. *stipitans* SUZA (probably never published). The thallus is in v. *intermedia* only about 1 mm thick but the irregular verrucae show the tendency of lengthening vertically, are densely crowded and produce rather numerous apothecia. I possess in my herbarium a specimen: Kutak, Lich. Bohem. 526 from Krkonoše (Riesengebirge) collected in 1920 which is rather similar only differing in the almost black and immarginate apothecia.

Lecanora (Aspicilia) limitata H. MAGN. n. sp.

Thallus determinatus, cinereus vel albocinerascens, rimoso-areolatus, areolis planis vel centroversus interdum concavis, marginibus leviter prominentibus, areolis marginalibus tenuioribus, hypothallo obscuro limitatis, I—, KOH—, CaCl—, Pd—. Apothecia pauca vel in centro thalli numerosa, immersa, minuta, disco atro, saepe irregulari, leviter depresso, margine proprio haud evoluto. Thecium altum, paraphysibus superne ± moniliformibus. Sporae majusculae, ellipsoideae.

U. S. A. Wisconsin: Iowa Co., Blue Mounds, on chert boulders 1953, June 16, JOHN W. THOMSON (4237) s.n. *laevata* with *Physcia* sp. and *Caloplaca* sp. (cf. *festiva*).

Thallus forming ± orbicular areas, 1—2.5 cm diam., limited by a distinct, very dark, subfimbriate hypothallus on naked stone, areolae 0.5—1.0 mm wide, mostly angular, smooth or in older, perhaps overnourished parts with thick, raised edges or by pressure higher to irregularly verrucose. — Cortex 25 μ thick, ± grey, KOH+ translucid, hyphae perpendicular with 2—3 μ wide, rounded, thin-walled cells. Medulla grey, cellular, with much air, translucid in HNO_3.

Apothecia often lacking, in one individual dense, disc 0.3—0.5 (0.7) mm wide, irregularly rounded without prominent thallus margin. — Apothecia about 200 μ deep. No exciple developed. Hypothecium 50—90 μ high at centre, colourless. Thecium 115 μ high, I+ dark blue to the algae; upper 25 μ sordid blue-green, in KOH ± brown with a violet shade. Paraphyses in KOH constrictedly septate, in upper part ± branched with globose or broadly ellipsoid joints, 3 μ thick. Spores

6—8, 20—25 × 13—15 (17) μ, broadly ellipsoid. — Conidia 7—9 × 0.5 μ, straight.

L. limitata can not belong to *L. laevata* on account of its pale colour, shorter conidia and lacking KOH-reaction. After the description it comes near to *L. laxula,* but this species has verruculose, thicker thallus entirely covered by apothecia, larger cells in the thallus cortex, a distinct exciple and more densely moniliform par. etc.

Examined after FINK's Lichen flora U. S. A. the lichen seems to belong to *L. laevata* but his species limitation is too wide and he does not take the chemical reactions in consideration.

Buellia montana H. MAGN. n. sp.

Thallus tenuissimus, fusco-cinerascens vel viridi-cinereus, laevigatus. Apothecia adpressa, minuta, disco plano, atro, margine concolori, prominenti cincto. Excipulum extus obscure fuscum, intus pallidior. Hypothecium atrofuscum, crassum. Thecium mediocre, hyalinum, superne viridi-fuscum, apicibus paraphysarum capitatis. Sporae octonae, uniseptatae, fuscae, pariete septoque tenui.

India. United Provinces: Nainital, China Peak 1949, at 7000 ft, on cortex. P. N. MEHRA.

Thallus little conspicuous as a smooth film on the cortex, to 100 μ thick, I—, KOH—, CaCl—, Pd—. Cortex 10—15 μ, hyaline, cells 3—4 μ. Apothecia 0.5—0.7 mm, dense, sometimes contiguous. — Apothecia about 0.3 mm thick. Exciple laterally 60—70 μ with exterior 25 μ dark brown, cellular, cells 2.5—3 μ, thick-walled, isodiametric, inwards gradually paler, grading into black-brown hypothecium, 75—80 (100) μ thick. Thecium 75—80 (90) μ tall, hyaline, without oil, I+ dark blue; upper 12—15 μ green-brown. Paraphyses contiguous, simple, 1.5 μ, apices distinct, 3—4 μ, brown-capitate. Asci 65—80 × 18 μ, wall at apex 3.5—4 μ thick. Spores long enclosed and conglutinated, 20—25 × 10—12 μ, mostly old, not constricted.

The new species reminds of *B. Zahlbruckneri,* but this one has verrucose white thallus, KOH+ yellow and slightly smaller spores. *B. nubilioides* NYL. from Ceylon has only 0.35 mm large apothecia and 16—20 × 7—11 μ large spores. — *Rinodina conradi* with red-brown apothecia and 25—40 × 14—16 μ large, typical spores was present in one specimen.

Buellia schisticola H. MAGN. n. sp.

Thallus olivaceo-fuscus, effusus, subsquamuloso-areolatus, areolis laxe affixis, convexis, irregularibus, minutis. Apothecia sparsa, adpressa, minuta, disco atro, plano, primum tenuiter marginato, mox immarginato. Excipulum cum hypothecio atrofusco. Thecium mediocre, superne viridi-fuscum. Sporae octonae, uniseptatae, obscurae, minutae.

Italy. Liguria, inter Vesima et Arenzano, June 1951, C. SBARBARO (11), on schistose, siliceous rock.

Thallus covering several square cm, very uneven from the 0.4—1.0 mm large, irregularly shaped, mostly ± convex areolae, often with the edges free from the substratum and sublobate, underside pale; I—, KOH—, CaCl—, Pd—. Thallus 150—200 μ thick, cortex about 10 μ, mainly consisting of the olive-brown apices of hyphae with a 5—7 μ thick, continuous amorphous stratum above. Algae 8—12 μ diam., yellow-green, stratum 50—70 μ thick. Medulla colourless, its hyphae ± intricate.

Apothecia 0.3—0.5 mm wide, solitary or 2—3 concrescent, widely dispersed with innate base, superficial, 0.3 mm thick. Marginal exciple 20—25 μ thick, black-brown or rather pale brown, ± separated from the 70—100 μ thick black-brown hypothecium with its diffuse limitation. Thecium 75—85 μ tall, colourless, without oil, I+ dark blue; upper 10—15 μ dark green-brown. Paraphyses contiguous, 1.7 μ, apices 3.5—5 μ, capitate, green-brown with a brown »cap». Spores 12—14 × 7 μ, as young pale sordid green with distinct inner wall, as old entirely thin-walled, dark brown-green, hardly constricted at the septum.

Pycnidia forming very small, dark verrucae, especially in exterior parts of the thallus. Conidia 3—4 × 1 μ, straight.

An obvious species on account of the dark brown, irregular squamules, at first sight recalling a *Rhizocarpon* species. *Buellia subbadia* ANZI may be somewhat similar but is dark grey with black hypothallus and large spores, 15—18 μ long and often curved.

Koerberia biformis MASS., new to America.

In a collection of lichens obtained from Dr JOHN W. THOMSON, Wisconsin, there was an undetermined, puzzling specimen with large, blue-green algae and vermiform spores. It was collected in Arizona: Santa Rita Mts, Whitehouse canyon at 6900 ft on bark of *Arbutus arizonica* 1943 by R. A. DARROW (1686). Its whole structure placed it in *Placynthiaceae* according to the study by EILIF DAHL in Medd. om Grönland, Vol. 150, 2: 49, 1950. At last I found the solution: *Koerberia*, although the algae ought to be *Nostoc* (according to ZAHLBR. in Pflanzenfamilien). SERVIT has treated it in Hedwigia 74: 130, 1934 — where a good description is found — and places it into *Lichinaceae* that according to DAHL contains algae of *Calothrix*-type. Like myself SERVIT has found large algae up to 18 μ diam. and has found it impossible to retain it in *Collemataceae.*

In order to call attention to this species, now found in America, I will give a description of the above-mentioned specimen well agreeing with material from Europe in my herbarium. Thallus 1—2 cm large, olivaceous or sordid blue-green, thin, laciniate, loosely appressed to the crumbling substratum, lacinae 3—1 mm broad, irregularly incised with some parts only 0.1 mm broad, underside not darker. Thallus 70—100 μ thick, at the ends of lobes without distinct cortex. Exterior 40—50 μ with rather dense, bright blue-green algae, 8—12(15) μ large. At centre there is a 12—15 μ thick colourless stratum with longitudinal, thin hyphae and below it rounded or lengthened crowds, 25—35 μ large, of smaller 3—5 μ wide algae in inrolled chains (resembling *Nostoc*). In other parts the whole thallus is cellular with thin-walled 6—12 μ angular cells.

The apothecia are dense, biatorine, 0.4—0.5 mm wide, convex, immarginate, intensely brown-red, constricted at base. They are 0.25 mm thick with soon excluded exciple. In young apothecia it is 35—40 μ thick consisting of radiating hyphae widening outwards and there with distinct, 5—8 × 3—5 μ large, thin-walled cells. Rather numerous large algae are enclosed in the inner part. Hypothecium 50—70 μ high, pale yellowish red, cellular, cells about 2 μ. Thecium 70—80 μ tall, colourless, I+ dark blue; surface pale or brownish yellow. Paraphyses contiguous, simple, 1.7 μ to the apices. Asci about 35 × 7—10 μ, narrowly clavate. Spores 8, bacilliform, 25—30 × 1.5—1.8 μ, without visible septa, in the asci spirally contorted, as free either curved or contorted.

This apparently isolated but according to the new find widespread and old genus can not after the hitherto followed taxonomic principles remain within *Collemataceae*. But its proper, final place in the system must depend upon further studies of the structure in several genera with blue-green algae.

The find is interesting being the first (to my knowledge) outside Europe, where it is limited to a few localities north of the Mediterranean. Like several other finds (e.g. *Biatorella microhaema* NORM. in Uruguay) it shows that also rare lichens may have an unexpected, wide distribution.

The holotypes or at least part of the holotype are preserved in my herbarium.

Litteratur.

JOHN G. DONY, Flora of Bedfordshire. — The Corporation of Luton Museum and Art Gallery. Henry Burt & Son Ltd, Bedford, 1953. 532 p. Pris 42 s.

I den långa raden av engelska lokalfloror har en lucka blivit fylld i och med utgivandet av ovanstående arbete. Den enda tidigare existerande sammanställningen av floran inom hela grevskapet Bedfordshire daterar sig från 1798.

Bedfordshire, beläget ung. mellan Oxford och Cambridge, hör icke till de botaniskt mera intressanta grevskapen i England. Emellertid innehåller DONYS flora en hel del, som säkerligen kan vara av intresse även för svenska botanister. Speciellt då det stora kapitlet om »Natural Regions» med ganska ingående beskrivningar av ett stort antal växtsamhällen med uppgifter om särskilt de allmännare växternas frekvens.

Floran, som följer det för landskapsfloror sedvanliga schemat, inledes med en historik över Bedfordshires botaniska utforskande. I den långa raden av framstående botanister, som varit verksamma inom grevskapet, märkas bl.a. DRUCE, SAUNDERS och WILMOTT jämte ett flertal ur den nu verksamma staben vid Kew-herbariet.

Kortare översikter lämnas över områdets klimat och geologi liksom diskussioner över florans sammansättning och dess förhållande till angränsande distrikt. Den egentliga flora-delen omfattar ej endast kärlväxter utan även en del kryptogamgrupper. Vid behandlingen av de senare har författaren fått hjälp av specialister. Som brukligt i floror av denna typ lämnas uppgifter om ståndort, inhemskt namn, utbredning och tidigaste fynd för de olika arterna. Nomenklaturen, vad kärlväxterna beträffa, följer i det stora hela CLAPHAM, TUTIN and WARBURG, Flora of the British Isles (1952).

Jämte *Bunium bulbocastanum, Seseli libanotis* och *Hypochoeris maculata* från kalkområdena, nämner DONY bl.a. *Primula elatior, Ornithogalum pyrenaicum* och *Melampyrum cristatum* som de mera intressanta arterna inom grevskapet. I en särskild avdelning behandlas adventivväxterna. Av dessa äro 120 arter att hänföra till »ullfloran».

Ett 20-tal vegetationsbilder, några utbredningskartor samt ett topografiskt register komplettera framställningen.

BO PETERSON.

W. J. GARNETT: Freshwater microscopy. Constable & Co. Ltd. London. 1953. 300 p. Pris 30 s.

Boken omfattar en inledande del med beskrivning av insamlings- och mikroskoperingsteknik och en efterföljande klassifikationsdel med beskrivning av allmänt förekommande sötvattensväxter och -djur. Det zoologiska avsnittet behandlas givetvis inte i detta sammanhang.

Förf. diskuterar ganska ingående olika metoder och apparater för insamlingsarbetet. Han berör därvid detaljer, som för mera avancerade forskare synas självklara, men som behöva inpräntas i nybörjare, t.ex. nödvändigheten av att anteckna karakteristika beträffande insamlingslokalen redan vid besöket. Viktigt är också hans påpekande om de olika lokalmiljöer, som finnas t.o.m. i en liten damm. Dammarnas mikroorganismvärld ligger för övrigt förf. särskilt varmt om hjärtat.

Därefter redogör förf. för olika mikroskoptyper och vad de duga till. Han rekommenderar speciellt mörkfältsbelysningen, emedan denna kan framkalla en mångfald annars osynliga strukturer. I mörkfält kan man uppleva »the full beauty of microscopic aquatic life». Han tillhåller även sina läsare att rita, eftersom man då tvingas att lägga märke till detaljer. Han nämner även de nyaste hjälpmedlen, t.ex. reflekterande objektiv och faskontrast.

Alla tillbehör räknas omsorgsfullt upp, som äro oundgängliga vid detta slags mikroskoperingsarbete, pincetter, pipetter o.s.v. Detta är säkerligen nyttigt för nybörjare, som inte ha tillfälle att lära av mera erfarna forskare, men ibland går förf. kanske onödigt långt, som när han ingående beskriver handhavande av en pipett utan gummituta.

Den andra delen av boken vill underlätta bestämningen av de insamlade organismerna. Det största utrymmet ägnas bland växterna åt algerna. Förf. sammanför, när det gäller *Chlorophyceae,* alla habituellt närstående typer oberoende av deras genetiska släktskap, vilket är en god idé. Nybörjaren vet då, vad som finns att välja på vid bestämningen. De olika släktena beskrivas på ett lättfattligt och initierat sätt, och figurer komplettera beskrivningen. Inte minst intressant är redogörelsen för algernas ofta märkliga livscykel. Endast ett fåtal arter nämnas som exempel, men man hade nog önskat att i dessa fall de nu gängse namnen hade använts. På Pl. XII kallas t.ex. *Pinnularia*-arterna för *Navicula.*

Boken är utan tvekan synnerligen lämplig för nybörjare, som få många råd och tips. De uppmanas att begränsa sig och få också anvisning på lämpliga studieobjekt. Förf. skriver med en entusiasm, som måste smitta av sig på läsaren, och med sitt stora biologiska intresse kommer han nog att stimulera studiet av levande organismer, vilket skulle vara mycket värdefullt inom många alggrupper, inte minst bland diatomeerna.

ASTA LUNDH-ALMESTRAND.

Notiser.

Professors namn. Föreståndaren vid Palynologiska laboratoriet, Bromma, fil. dr GUNNAR ERDTMAN har av Kungl. Maj:t tilldelats professors namn.

Naturhistoriska riksmuseet. Till intendent vid Naturhistoriska riksmuseet i Stockholm har utnämnts fil. dr GUSTAF HAGLUND.

Vetenskapsakademiens Linnémedalj. Vid sammanträde den 14 april beslöt K. Vetenskapsakademien att utdela sin större Linnémedalj i silver till Mr HENRIK J. VOUGT, Pomona, Californien, för hans medverkan vid anskaffandet av den sektion av det californiska jätteexemplaret av *Sequoiadendron giganteum,* som staten California skänkt till Naturhistoriska riksmuseet.

Doktorsdisputation. Agron. lic. JAMES MAC KEY försvarade lördagen den 10 april 1954 i Ultuna en gradualavhandling med titeln: »Neutron and X-ray experiment in Wheat and a Revision of the Speltoid Problem.»

Forskningsanslag. K. Vetenskapsakademien har tillerkänt fil. lic. OLOF ANDERSSON det Lindahlska stipendiet på 8.000 kr. för slutredigering av en gradualavhandling om storsvamparna i södra Sveriges lövskogar.

Längmanska kulturfonden har till fil. lic. OLOF ANDERSSON utdelat 2.250 kr. för tryckning av tabellmaterial till hans doktorsavhandling »Studies in the Larger Fungi of Southern Deciduous Woods in Sweden».

Fonden för skoglig forskning har utdelat bl.a. följande anslag: till prof. ARTUR HÅKANSSON 1.000 kr. för undersökning av befruktning och embryobildning hos svensk tall och gran, till jägmästaren JAN LEKANDER 750 kr. för studier av granprovenienser i Tyskland och Danmark.

Vid Lunds universitet har ur C. E. O. Nordstedts fond utdelats till amanuens BENGT ULF 140 kr. som bidrag till en resa i botaniskt syfte till Öland och Falbygden och till prof. HENNING WEIMARCK 250 kr. som bidrag till en studieresa i England.

K. Fysiografiska sällskapet i Lund har utdelat bl.a. följande anslag: till fil. lic. OLOF ANDERSSON och HANS RUNEMARK 500 kr. för ritning och tryckning av en underlagskarta över Europa i skala 1/10, till fil. mag. ARNE GUSTAVSSON 1.000 kr. för fältundersäkningar över *Peronospora*-arterna i Skåne, till fil. kand. NILS MALMER 500 kr. för kostnader för provtagningsmaterial och resor i samband med en undersökning över vissa myrväxters halt av mineralnäringsämnen på olika ståndorter, till prof. HERIBERT NILSSON 800 kr. för artificiella bastarderingar i fjällen mellan typer av *Salix*-gruppen *Virescentes,* till laborator HUGO SJÖRS 120 kr. för kostnader för fosfat- och kalianalyser av naturliga humusjordar, till sektionen Skånes Flora 800 kr. för täckande av merkostnader vid undersökning av floran inom olika delar av Skåne.

Från Hierta-Retzius stipendiefond har utdelats bl.a. följande stipendier: till fil. dr INGVAR GRANHALL 2.000 kr. för undersökningar över inflytandet av fysiologiska faktorer på växtens känslighet för gamma- och neutronstrålning, till laborator AXEL NYGREN 2.000 kr. för undersökningar av inter- och intraspecifika bastarder inom släktet *Melandrium*, till docent GUNNAR HARLING 2.000 kr. för detaljteckningar till en monografi över familjen *Cyclanthaceae*, till docent MATS WÆRN 1.700 kr. för algologiska undersökningar vid Sveriges västkust.

Ur stiftelsen Lars Hiertas Minne har bl.a. lektor ALF LILJEFORS erhållit ett anslag på 400 kr. för att på Åland studera och insamla material av *Sorbus*-hybrider.

Från Knut och Alice Wallenbergs stiftelse har bl.a. utdelats 100.000 kr. till Uppsala universitet för restaurering av orangeribyggnaden i Linnéträdgården och 8.000 kr. till laborator WILHELM RODHE för undersökning av fytoplanktonproduktionen och dess betingelser i sjön Erken.

Corrections.

p. 82. Palynology: Aspects and Prospects. III., read IV.
p. 82, line 13, read p. 83.
p. 82, line 16, read p. 89.
p. 90, line 28, read 1953.

BOTANISKA NOTISER 1954, HÄFTE 3. LUND

Studies on Bacterial Nutrition.

II. Effect of some Micronutrient Elements on Respiration and Sugar Utilisation by Three Soft Rot Bacteria.

By M. K. TOLBA, D.I.C., Ph. D. (London) and S. S. GHANEM, M. Sc. (Cairo).
From the Botany Department, Faculty of Science, Cairo University, Egypt.

I. Introduction.

In a previous paper the authors (14) studied the utilisation of different sugars or mixtures of sugars by three closely related soft rot bacteria and found that they exhibited considerable differences in the utilisation of these sugars. In the present investigation the effect of some micronutrient elements on respiration and sugar utilisation by the same three soft rot bacteria is studied.

CALVERY (2) classified the trace elements into the following four groups:

1. Nutritive trace elements.
2. Non-nutritive and non-toxic trace elements.
3. Non-nutritive and toxic trace elements.
4. Miscellaneous trace elements.

The first group includes those elements which have been shown to play a definite role in biological oxidation. Among these the most important are cobalt, copper, iron, zinc and manganese. Iron is important in the growth of azotobacter when both combined nitrogen and atmospheric nitrogen are used [BURK (1)], and it is undoubtedly essential or stimulative for many other microorganisms. Specific examples are studies by REED and RICE (9), MC INTIRE, RICKER and PETERSON (5), STRØM (13), PAPPENHEIMER and JOHNSON (8), WARING and WERKMAN (15), YOUNG, BEGG and PENTZ (16), NORÉN (7) and several other investigators.

The function of the two elements copper and zinc in metabolic processes is properly catalytic. The effect of these elements on bacterial growth and metabolic activities have been studied by FOSTER and WAKSMAN (3), NORÉN (l. c.), MULDER (6), LEWIS (4) and many others.

II. Materials and Methods.

The organisms used in this investigation were as follows:

1. *Bacterium aroideae,* Dowson, 66.
2. *Bacterium carotovorum,* Jones.
3. *Bacterium phytophthorum,* Appel.

The three cultures were kindly supplied by the Plant Bacteriological Laboratory of the Imperial College of Science and Technology, London.

Is this series of experiments a basal medium of the following constitution was prepared:

Glucose	20	grams.
Asparagin	10	grams.
KH_2PO_4	5	grams.
$MgSO_4 \cdot 7H_2O$	2.5	grams.
Re-distilled water to	1.000	ml.

To aliquot samples of the basal medium so obtained $FeSO_4 \cdot 7H_2O$, $CuSO_4 \cdot 5H_2O$, and $ZnSO_4 \cdot 7H_2O$ were added to give the following concentrations of iron, copper and zinc respectively, expressed as p.p.m., 0, 10, 20, 50 and 100. In the preparation of the above culture media asparagin, $MgSO_4 \cdot 7H_2O$ and micronutrient element salts were purified according to STEINBERG's (12) method. Potassium dihydrogen phosphate was sterilised separately in view of the fact that it is easily precipitated by calcium carbonate. Glucose was dissolved separately in cold sterile distilled water to eliminate the possible decomposition of sugar during autoclaving. It was purified in the cold according to the aluminium hydroxide precipitation method given by SHU and JOHNSON (11).

The stock culture media so obtained were distributed into a series of sterile 150 ml. conical flasks at the rate of 10 ml. per flask. The media were then inoculated at the rate of 0.2 ml. per culture flask of a suspension of each of the three bacteria under test in sterile distilled water. The flasks were then incubated at 25° C for 48 hours during which respiration and sugar concentrations of the media were estimated at 24 hour intervals.

The methods used for sugar analysis were those given by SAÏD (10).

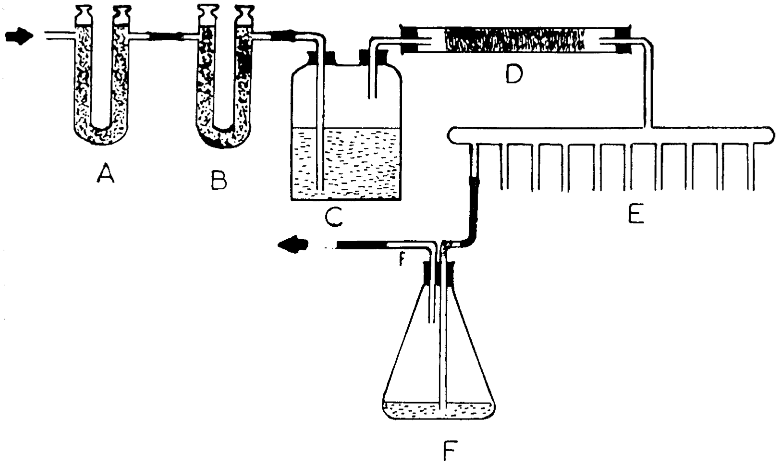


Fig. I. Apparatus used for the estimation of carbon dioxide output.

For the determination of carbon dioxide output a simple apparatus as shown in Fig. 1 was used. In any one experiment a current of air is first passed through two tubes of soda lime (A and B) to remove any carbon dioxide originally present. The current is then allowed to bubble through a tower (C) of barium hydroxide to which some drops of phenolphthalein are added. This tower serves to ensure the complete elimination of carbon dioxide from the air. The carbon dioxide-free air current is then passed through a glass tube (D) (1.5 cm. diameter and 15 cm. length) plugged with cotton, and sterilised before use. It serves as a cotton filter to ensure the sterility of the air current after passing through the Baryta solution. The carbon dioxide-free sterilised air then flows into a compound T tube (E) which subdivides it into as many divisions as there are cultural flasks (F). The air current passes through the cultural flasks for 30 minutes. When laden with carbon dioxide given off by the respiring bacteria air current passes out of the culture flask through the outlet (f) into a 250 ml. conical flask containing 50 ml. of, approximately, 0.5 N barium hydroxide.

The respiratory carbon dioxide given off by the bacteria during the experimental period is precipitated in the form of barium cabonate. The residual barium hydroxide is titrated against a standard HCl solution with phenolphthalein as an indicator. The difference between this value and that for a blank titration using the same quantity of barium hydroxide solution gives an estimation of the carbon dioxide in terms of the standard acid.

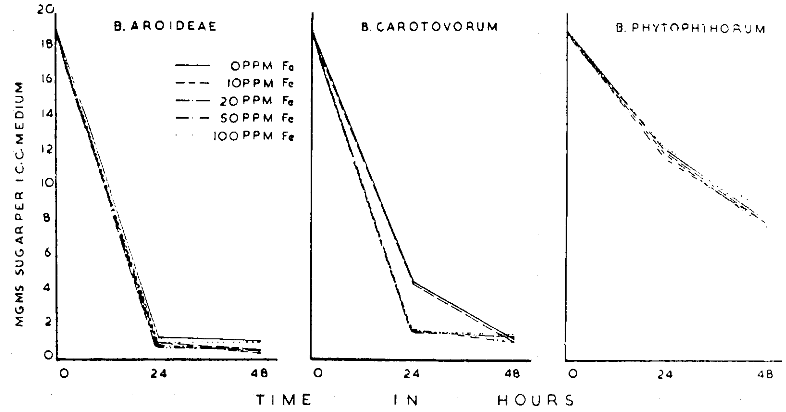


Fig. II. Sugar concentration of the different media inoculated with the three bacteria (mgms glucose per 1 ml. medium).

III. Discussion of Results.

1. *Effect of Iron on Respiration and Glucose Utilisation by B. aroideae, B. carotovorum, and B. phytophthorum.*

A. Utilisation of Sugar:

The results of the analysis of the media for their sugar contents are presented graphically in Fig. II. These results show that: The fall in concentration of glucose in all the media inoculated with *B. aroideae* was proceeding at different rates in the first and second 24 hours being much higher in the former than the latter, a fact which is explicable on the basis of the very small amounts of sugar left in the media at the end of 24 hours.

It is worthmentioning, however, that the organism failed completely to absorb any sugar from the medium containing 100 p.p.m. iron during the second 24 hours.

The same fact that the fall in concentration of glucose in the different culture media was much higher during the first than the second 24 hours was again observed in case of *B. carotovorum*. The disappearance of glucose from the media in case of this organism was much faster when iron was present in concentrations more than 10 p.p.m. during the first 24 hours. At the end of 48 hours these differences in the rates of disappearance of glucose from the different media were very much reduced.

The difference between the rate of disappearance of glucose during

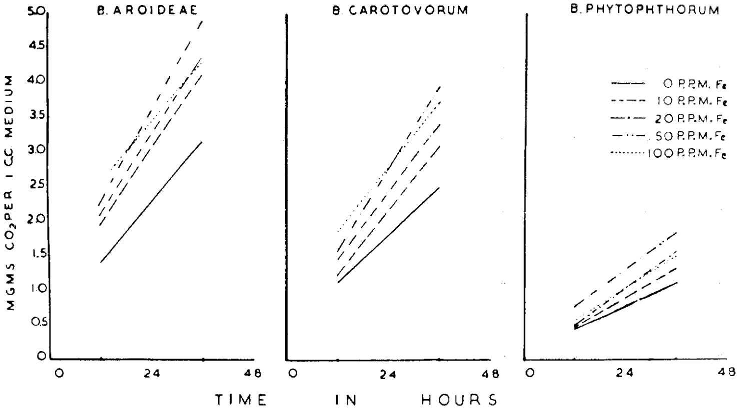


Fig. III. Carbon dioxide output by the three bacteria on the different culture media (mgms carbon dioxide per 1 ml. medium).

the first and second 24 hours was much less exaggerated in case of *B. phytophthorum* than the other two organisms. Presence of iron in different concentrations did not materially affect the rate of utilisation of glucose by this bacterium.

B. Carbon Dioxide Output:

The amounts of carbon dioxide output by the three bacteria in the different media at the end of 24 and 48 hours are presented in Fig. III. These results show that:

B. aroideae: The presence of iron in the medium increases the total carbon dioxide output at the end of 48 hours. The increase in the rate of respiration goes hand in hand with the increase in the concentration of iron, during the first 24 hours, while the carbon dioxide output during the second 24 hours increases with the increase in iron concentration up to 50 p.p.m. On the medium containing 100 p.p.m. iron the carbon dioxide output falls suddenly and reaches that from the control medium.

B. carotovorum: behaved in a, more or less, similar way to *B. aroideae* with a less marked depressive effect of the highest iron concentration on respiration during the second 24 hours.

B. phytophthorum: Carbon dioxide output by this organism increases slowly with increasing the concentration of iron in the medium throughout the whole experimental period up to a concentration of 50 p.p.m.

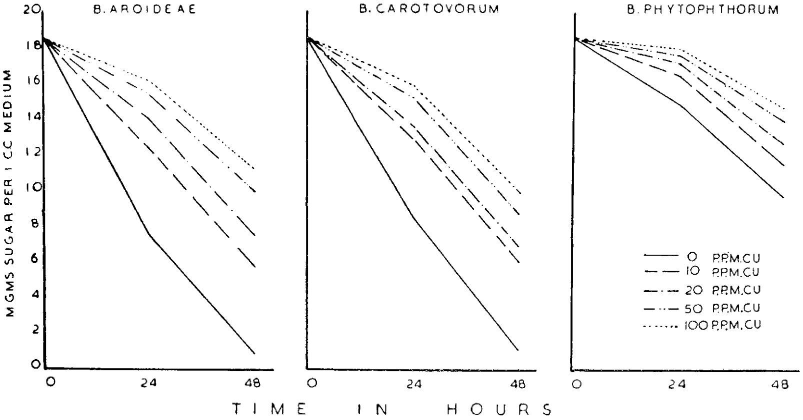


Fig. IV. Sugar concentration of the different media inoculated with the three bacteria (mgms glucose per 1 ml. medium).

followed by a decrease in the respiration rate on increasing the concentration of iron.

The highest carbon dioxide output by the three bacteria at the end of 48 hours is revealed on media containing 50 p.p.m. iron.

2. *Effect of Copper on Respiration and Glucose Utilisation by B. aroideae, B. carotovorum and B. phytophthorum.*

A. Utilisation of Sugar:

The results of the analysis of the media for their sugar-contents are presented graphicaly in Fig. IV. These results show that: The fall in concentration of glucose in the different media inoculated with *B. aroideae* and *B. carotovorum* was proceeding at different rates during the first and second 24 hours. In the control samples the rate of disappearance of glucose was higher in the first than the second 24 hours. The reverse statement holds true for the disappearance of sugar from media containing copper in its different concentrations. The high rate of sugar disappearance during the second 24 hours as compared with that of the first 24 hours was more pronounced when copper was present in its highest concentration, namely, 100 p.p.m.

On the whole, increasing the concentration of copper in the media induced a marked reduction in the rate of disappearance of sugar from the media inoculated with the above two organisms.

B. phytophthorum behaved in a, more or less, similar way to *B.*

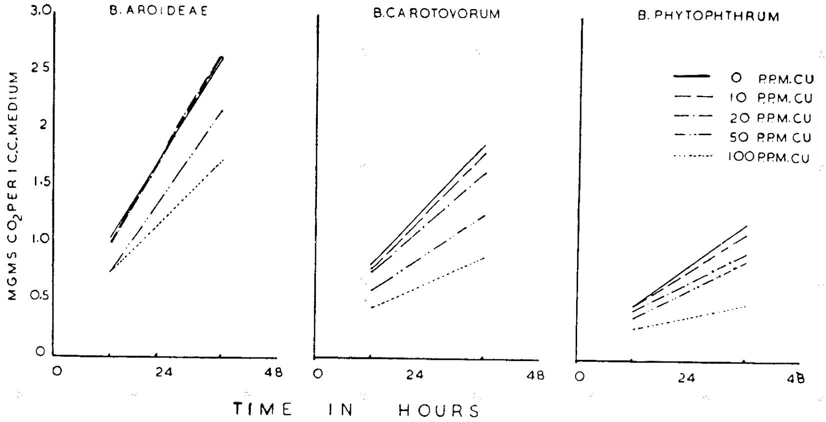


Fig. V. Carbon dioxide output by the three bacteria on the different culture media (mgms CO_2 per 1 ml. medium).

aroideae and *B. carotovorum* except for the fact that the rate of disappearance of glucose from the control samples was proceeding at a rather steady rate during the whole experimental period.

The above results show that the presence of copper markedly reduced the rate of utilisation of glucose by the three bacteria. Increasing the concentration of copper was accompanied by a steady decrease in the total amount of sugar utilised by the three bacterial organisms.

B. Carbon Dioxide Output:

The amounts of carbon dioxide output by the three bacteria in the different media at the end of 24 and 48 hours are presented in Fig. V. These results show that the presence of copper in concentrations of 10 and 20 p.p.m. did not materially affect the carbon dioxide output by the three bacteria throughout the whole experimental period when compared with that from the controls, while its presence in higher concentrations significantly reduced the rate of respiration. The latter effect was more pronounced in the media containing highest concentration of copper, namely, 100 p.p.m. in case of *B. aroideae* and *B. carotovorum* only.

3. *Effect of Zinc on Respiration and Glucose Utilisation by B. aroideae, B. carotovorum and B. phytophthorum.*

A. Utilisation of Sugar:

The results of the analysis of the media for their sugar contents are presented in Fig. VI. These results show that the fall in concentration

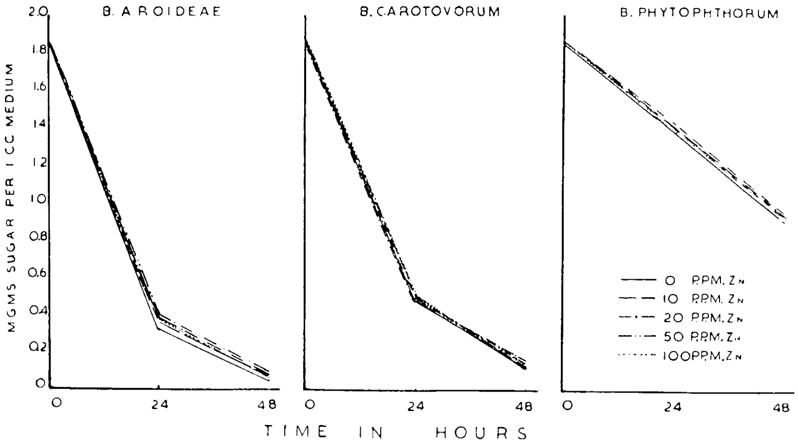


Fig. VI. Sugar concentration of the different media inoculated with the three bacteria (mgms glucose per 1 ml. medium).

of glucose in the different media inoculated with *B. aroideae* and *B. carotovorum* was proceeding at different rates during the first and second 24 hours, being much higher in the former than the latter. The disappearance of glucose from all the media inoculated with *B. phytophthorum* proceeded at rather steady rates during the whole experimental period.

On the whole, the presence of zinc in the medium in its different concentrations did not materially affect the rate of disappearance of sugar from media inoculated with the three bacteria.

The above results, therefore, show that the presence of zinc did not induce any substantial differences in the amounts of sugar utilised by the three bacteria during the whole experimental period when compared to the control samples except, probably, a slightly lower rate of sugar utilisation exhibited by *B. aroideae* in presence of zinc during the first 24 hours of the experiment.

B. Carbon Dioxide Output:

The results of the carbon dioxide output by the three bacteria in the different culture media are presented in Fig. VII. These results show that the presence of zinc in the medium did not materially affect the carbon dioxide output by the three bacteria throughout the whole experimental period when compared with that of the control samples.

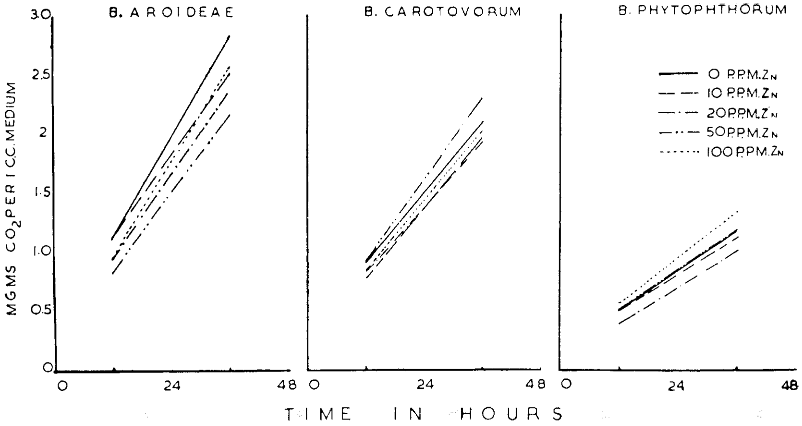


Fig. VII. Carbon dioxide output by the three bacteria on the different culture media (mgms carbon dioxide per 1 ml. medium).

IV. Summary of Conclusions.

1. The effect of the presence of iron, copper and zinc in different concentrations in the culture media on the respiration and utilisation of glucose by *B. aroideae*, *B. carotovorum* and *B. phytophthorum* was studied.

2. Presence of iron and zinc in different concentrations in the culture media did not materially affect the rate of glucose utilisation by the three bacteria while increasing the concentration of copper in the medium was accompanied by a drastic fall in the amount of sugar utilised from the different media by the three bacteria.

3. Presence of iron in the culture media significantly increased, while the presence of copper significantly decreased the rate of carbon dioxide output by the three bacterial organisms. Zinc did not seem to induce any appreciable effect on the rate of respiration exhibited by the three bacteria.

Literature Cited.

1. BURK, D., 1934. Azotase and nitrogenase in Azotobacter. — Ergeb. Enzymforsch., 3, 23.
2. CALVERY, H. O., 1942. Trace elements in foods. — Food. Res., 7, 313—31.
3. FOSTER, J. W., and WAKSMAN, S. A., 1939. The specific effect of zinc and other heavy metals on growth and fumaric acid production by Rhizopus. — Jour. Bact., 37, 599—617.

4. Lewis, J. C., 1942. A lactobacillus assay method for P-aminobenzoic acid. — Jour. Biol. Chem., 146, 441—450.
5. McIntire, F. C., Riker, A. J., and Peterson, W. H., 1941. The role of certain vitamins and metallic elements in the nutrition of the crowngall organism. — Jour. Bact., 42, 1—14.
6. Mulder, E. G., 1939. Über die Bedeutung des Kupfers für das Wachstum von Mikroorganismen und über eine mikrobiologische Methode zur Bestimmung des Pflanzen-verfügbaren Bodenkupfers. — Arch. Mikrobiol., 10, 72—86.
7. Norén, B., 1952. Studies on Myxobacteria. I. Growth conditions. — Svensk Bot. Tidskr. 46, 324.
8. Pappenheimer, A. M. Jr., and Johnson, S. J., 1936. Brit. Jour. exp. Path., 17, 335. — C. F. Bacterial Chemistry and Physiology; by I. R. Porter 1947.
9. Reed, G. B., and Rice, C. E., 1928. The action of iron and citrate in synthetic media for tubercle bacilli. — Jour. Bact., 16, 97—107.
10. Saïd, H., Carbohydrate and nitrogen metabolism in the roots of Daucus carota. — Ph. D. thesis, Cambridge.
11. Shu, P., and Johnson, M. J., 1948. The interdependance of medium constituents in citric acid production by submerged fermentation. — Jour. Bact., 56, 577—585.
12. Steinberg, R. A., 1919. A study of some factors in the chemical stimulation of the growth of Aspergillus niger. — Amer. Jour. Bot., 6, 330—372.
13. Strøm, A., 1935. The production of Dyphterea toxin. — A. S. Haakensen and Co., Oslo.
14. Tolba, M. K., and Ghanem, S. S., 1954. Studies on Bacterial Nutrition. I. Utilisation of Different Sugars or Mixtures of Sugars by Three Soft Rot Bacteria. — Bot. Notiser 1954, 154—166.
15. Waring, W. S., and Werkman, C. H., 1944. Iron deficiency in bacterial metabolism. — Arch. Biochem., 4, 75—87.
16. Young, E. G., Begg, R. W., and Pentz, E. I., 1944. The inorganic nutritional requirements of Echerichia coli. — Arch. Biochem., 5, 121—36.

BOTANISKA NOTISER 1954, HÄFTE 3. LUND

Einige Bemerkungen zu drei Aufsätzen von Fr. Hustedt.

Von R. W. KOLBE.

Paleobotaniska avdelningen, Naturhistoriska Riksmuseum, Stockholm 50.

Zu einigen Fragen der drei Aufsätze von FR. HUSTEDT (1945, 1952 und 1953, s. Literaturverzeichnis) soll nachstehend Stellung genommen werden. Ich werde diese Aufsätze nicht einzeln besprechen, sondern einige wichtige Punkte der genannten Arbeiten in 3 Gruppen zusammenfassen:

1. Zur Struktur der Diatomeen,
2. Zur Verwertbarkeit der durch das Elektronenmikroskop gewonnenen Erkenntnisse für die Taxonomie und
3. Zur Revision des Halobien-Systems.

1. Zur Struktur der Diatomeen.

Man kan HUSTEDT nur zustimmen, wenn er schreibt (1952, S. 301): »Mit Diskussionen über die Porengestalt besonders der *Pleurosigma*-Arten ist seit einem Jahrhundert viel Papier bedruckt worden, und immer noch scheint die Frage nicht endgültig gelöst zu sein». Ich möchte hinzufügen: es ist auch nur zu verständlich, dass diese Frage noch nicht so gelöst worden ist, dass alle Zweifel verstummen. Nach den mühevollen Untersuchungen der Diatomeenstrukturen, die seit einem Jahrhundert mit dem Lichtmikroskop angestellt wurden und die die allmähliche Verbesserung dieses Instruments und der Untersuchungsmethoden deutlich widerspiegeln, trat seit kurzem ein neues Instrument — das Elektronenmikroskop (nachstehend: Elmikr. abgekürzt) — an dessen Seite, mit neuen Eigenschaften, einer enorm gesteigerten Auflösungsfähigkeit und einer entsprechend erhöhten sog. »nützlichen Vergrösserung». Dass die mit Hilfe des neuen Instruments erhaltenen Resultate einer Skepsis seitens einiger Mikroskopiker begegnen, ist nicht nur verständlich, sondern auch für die Fragen über die Feinstrukturen nur nützlich. Indem wir die Punkte, bei denen die einerseits mit dem Lichtmikroskop, andrerseits mit dem Elmikr. gewonnenen Deutungen übereinstimmen, festlegen, über die strittigen Punkte diskutieren und u.U. durch neue Belege klären, können wir einer endgültigen Lösung der Fragen allmählich näherkommen. Dies kann am besten jeweils von Fall zu Fall geschehen und die Aufsätze von HUSTEDT (1945 u. 1952) bilden dazu einen willkommenen Anlass. Um nicht ins »Uferlose» zu geraten, will ich nachstehend alle allgemeinen Ueberlegungen möglichst vermeiden und nur auf die Hauptpunkte der Kritik HUSTEDTs eingehen, die die Kammerstruktur und den Bau der Poren einiger Diatomeen betreffen.

Kammerstruktur. Es scheint mir, dass hinsichtlich des Kammerbaus keine wesentlichen Divergenzen zwischen der Auffassung HUSTEDTs und der meinigen vorliegen. Nach beiden Auffassungen handelt es sich um Hohlgebilde, die durch Seitenwände voneinander abgegrenzt sind. Die eine Aussenwand (ob die biologisch äussere oder innere, ist für die Diskussion belanglos) ist durch eine Membran gebildet, die mit feinen bis feinsten Poren oder Poroiden versehen ist, die zuweilen hart an der Grenze der Auflösungsfähigkeit des Elmikr. stehen. Diese Membran wird von HUSTEDT »poroide Membran» oder »Schliesshaut», von mir (1951, S. 636) »Siebmembran» genannt. Die andere Aussenwand kann entweder ganz fehlen (»offene Kammern» nach KOLBE 1951) oder vorhanden sein und in diesem Falle einen ± grossen Porus tragen (»halbgeschlossene Kammern», KOLBE 1951), der von HUSTEDT als »innere Kammeröffnung» bezeichnet wird. Ich nenne diese Aussenwand »Porenmembran» (1951). Nach meinen Erfahrungen gehören die meisten Kammern, die dem hexagonalen Kammertypus entsprechen (aber nicht nur diese) dem halbgeschlossenen Kammertypus an, und hierzu gehören Arten von *Coscinodiscus, Triceratium, Biddulphia,* aber auch *Neidium, Achnanthes, Diploneis* und wahrscheinlich noch viele andere.

Der Bau der gröbsten Kammern lässt sich auch mit dem Lichtmikroskop deutlich nachweisen und die ausgezeichneten Stufenaufnahmen von HUSTEDT (1945, Taf. XIX, Fig. 2—7 — aber auch in seinen früheren Arbeiten, deren Zitate ich aus Platzersparnis unterlasse) sind objektive Beweise für die Gemeinsamkeit unserer Auffassungen. Vergleicht man diese Aufnahmen mit elektronenmikroskopischen Bildern, z.B. KOLBE 1948, Fig. 6, so ist deren Ähnlichkeit augenfällig.

Sie — d.h. die licht- und elektronenmikroskopischen Aufnahmen — ergänzen sich darin, dass

1. HUSTEDTs lichtmikroskopische Aufnahmen die räumlichen Verhältnisse durch die optischen Querschnitte nachweisen und nacheinander Siebmembran, Kammerquerschnitt und Porenmembran darstellen.[1] Infolge der grossen Tiefenschärfe des Elmikr. erscheinen bei meinen Aufnahmen dagegen Poren- und Siebmembran gleich scharf und ohne räumliche Wirkung.

2. Bei den lichtmikroskopischen Aufnahmen stehen selbst die groben Einzelheiten der *Triceratium*-membran bereits an der Grenze des Auflösungsvermögens des Lichtmikroskops und erscheinen daher unscharf; bei Formen mit feineren Einzelheiten sind diese lichtmikroskopisch nicht mehr auflösbar, und das dürfte für die meisten Kammern gelten. In Ergänzung hierzu sind bei den elektronenmikroskopischen Aufnahmen diese Einzelheiten noch scharf definiert.

In einem Punkt scheinen jedoch HUSTEDTs und meine Auffassungen auseinanderzugehen: dem Charakter der Porenmembran. HUSTEDT (1945, S. 318 — allerdings nur in dieser Arbeit) bestreitet, dass es sich bei der Porenmembran um eine besondere Membranschicht handelt. Dieser Behauptung widerspricht die Tatsache dass man bei reichlichen Material, z.B. von grob areolierten *Coscinodiscus*-Arten häufig Schalen sieht, bei denen entweder die Sieb- oder die Porenmembran abgesprengt ist. Ich habe in hunderten von Fällen sowohl einzelne, als auch mit der unverletzten Schale zusammenhängende Bruchstücke der Membranen von *Coscinodiscus nodulifer* gesehen und dabei beobachtet, dass es sich in einigen Fällen um zusammenhängende Stücke der Porenmembran, in anderen — der Siebmembran handelte. Auch *Coscinodiscus asteromphalus,* bei dem die Siebmembran ja sehr deutlich ist, zeigte in einigen Fällen das gleiche Verhalten. PERAGALLO (1897—1908, Taf. CXV, Fig. 12) zeichnet eine solche Ablösung und sicher hat HUSTEDT auch derartige Beobachtungen gemacht, ohne vielleicht darauf geachtet zu haben, dass viele der abgelösten Stücke zur Porenmembran gehörten. Wenn HUSTEDT an der zitierten Stelle schreibt: »Ebenso ergibt sich aus der Form der Kammerwände, dass man die durchlochte Wandfläche nicht etwa als eine besondere Wandschicht auffassen kann. Die Öffnungen sind lediglich die Folge der T-förmigen Erweiterung der Kammerwände, und der Begriff »Primärschicht» ist

---

[1] Die Kammern von HUSTEDTs Objekt, *Triceratium,* gehören auch dem halbgeschlossenen Typus an und zeigen, dass innerhalb derselben Gattung die Grösse des Porus der Porenmembran variiert — vgl. seine Figuren 4 und 6.

somit nur als Gegensatz zu den als sekundäre Bildungen aufzufassenden Kammerwänden zu verstehen», so kann man entgegnen, dass die Kammern ein zusammenhängendes Gebilde sind und dass man kaum einen prinzipiellen Unterschied zwischen deren einzelnen Teilen machen kann. Ob die Porenmembran als zusammenhängendes Gebilde erscheint oder nicht, dürfte im Wesentlichen von der Porengrösse abhängen. Nach meiner Auffassung ist eine Membran — zumindest in den Fällen, in denen sie sich als zusammenhängende Schicht abheben lässt —, als ein selbständiges Gebilde aufzufassen, unabhängig von dessen, uns noch gänzlich unbekannten Genesis.

Meiner Ansicht nach ist der Charakter der Porenmembran: ob sie nun als selbständige Schicht aufzufassen ist oder nicht, nur von untergeordneter Bedeutung. Wichtiger ist der andere Diskussionspunkt, die Frage nach der Natur der Schlitze (Poren) in den Kammern von *Pleurosigma, Gyrosigma* und wahrscheinlich bei den *Naviculae orthostichae,* die auch sonst Verwandtschaften mit den genannten Gattungen zeigen. HUSTEDT (1945 und 1952) bestreitet die Wirklichkeit dieser Gebilde und hält sie für Beugungsbilder. Seine Auffassung begründet HUSTEDT durch eine Reihe von theoretischen Argumenten. Von jedem seiner Argumente kann man sagen: es kann richtig sein, es kann aber auch eine andere Erklärung geben und ich könnte eine gleiche Reihe von Gegenargumenten anführen, von denen aber augenscheinlich das gleiche gesagt werden könnte. Eine Diskussion auf dieser Basis kann »uferlos» werden und führt auf ein Gebiet, das ein Biologe kaum mehr beherrschen kann; hierzu gehört die Frage, ob die Interferenz bei den extrem kleinen Wellenlängen des Elektronenstrahls überhaupt sichtbare Beugungsbilder hervorrufen kann. Diese Fragen dürften nur von Physikern entschieden werden und deren Entscheid wird den praktischen Mikroskopiker häufig nicht restlos befriedigen bezw. überzeugen. HUSTEDT (1945, S. 329) schreibt hierzu auch gewissemassen vorbeugend: »Eine Zurückweisung meiner Einwendungen mit Hilfe von physikalischen Gesetzen und mathematischen Formeln muss aber vom Standpunkt des Biologen abgelehnt werden, weil keine Gewähr dafür gegeben ist, dass die in Frage kommenden Gesetze restlos oder gänzlich fehlerfrei erkannt sind, und ausserden in der mikroskopischen Praxis sich manches anders ausnimmt als es der Theorie nach erscheinen dürfte.» Ich will mich auf den Standpunkt HUSTEDTS stellen, den Boden theoretischer Erwägungen verlassen und mich beschränken auf eine kritische Analyse der nebenstehenden elektronenmikroskopischen Aufnahme, und zwar nur von deren Teilen, bei denen der Einwand von

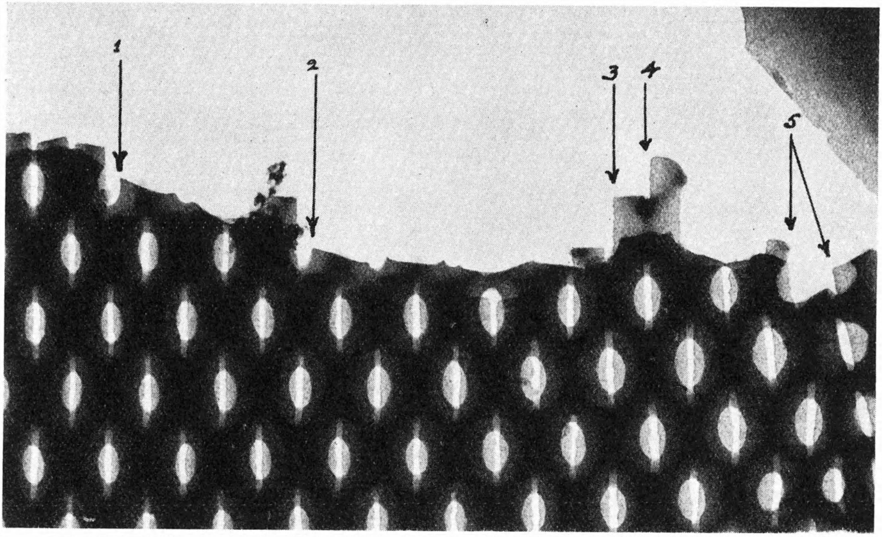


Fig. 1. *Pleurosigma aestuarii* BREB. Bruchstück einer Schale. Elektronenmikrosk. Aufnahme, nachvergrössert nach KOLBE 1951.

übereinanderliegenden Strukturen (die Beugungsbilder hervorrufen könnten) wegfallen muss.

Fig. 1 ist eine Nachvergrösserung meiner Aufnahme (KOLBE 1951, Fig. 1) einer Bruchkante von *Pleurosigma aestuarii* Breb. Der Bau der Kammern dieser Form (und verwandter Formen) ist meiner Auffassung nach stereometrisch vergleichbar mit einer Schachtel, deren durch die Seitenwände bedingter Querschnitt sechseckig ist. Die eine Ausenwand (Siebmembran) besitzt ein ovales Siebfeld[1] (»grosse Ellipse» nach HUSTEDT 1945, S. 328), die andere (Porenmembran) ist mit einem Porus in Gestalt eines relativ langen und schmalen Schlitzes versehen, dessen Realität HUSTEDT bestreitet.

Betrachtet man die abgebildete Bruchkante, so sieht man an einigen markierten Stellen Teile der Siebmembran (1, 2), als auch der Porenmembran (3, 4, 5) frei in den Raum hineinragen. An den mit 3 und 4 markierten Stellen sind die Ränder der Schlitze sehr deutlich abgebildet. Der Einwand von etwaigen Interferenzerscheinungen fällt infolge ihrer freien Lage ganz weg, auch ist es bezeichnend, dass die Schlitzränder etwas korrodiert sind und daher leicht gezackt erscheinen. Die

---

[1] Die zarten Siebfelder sind infolge langer Lagerung meines Materials in wässrigen Lösungen ganz aufgelöst und daher in der Aufnahme nicht sichtbar. Sie sind jedoch ausgezeichnet dargestellt bei HELMCKE u. KRIEGER (1953, Taf. 62).

gleiche Gezacktheit zeigen die Schlitzränder auch in den Teilen der aufnahme, in denen beide Membranen (Poren- und Siebmembran) übereinanderliegen und ein angebliches virtuelles Bild erzeugen könnten. Ein solches virtuelles Bild dürfte aber streng gradlinige und glatte Ränder aufweisen. Man sieht ferner, dass die Regelmässigkeit und gleichbleibende Länge der Schlitze, die HUSTEDT (1952, S. 296) als verdächtig auffiel, nicht grösser ist, als diejenige der Kammern (man beachte z.B. die unregelmässigen Kammern im rechten Teil des Bildes — 2 Reihe von rechts —, denen auch entsprechend anders orientierte und sogar gekrümmte Schlitze entsprechen). Schliesslich zeigt die Stelle 3 mit aller Deutlichkeit die Endigung eines Schlitzes am Knotenpunkt der Kammer-Seitenwände und dürfte die Annahme HUSTEDTS (ebenda) widerlegen, dass es sich um durchgehende Beugungs-Längslinien handelt.

Nach einer genauen und kritischen Betrachtung dieser Aufnahme glaube ich nicht, dass ein Zweifel an der Realität der Schlitze zu bestehen braucht und dass es keiner weiteren theoretischen Begründungen bedarf, um diese Auffassung zu stützen.

Die Aufnahme von HENDEY (KOLBE 1951, Taf. II, Fig. 3) ist augenscheinlich von einem frischen, wenig korrodierten Exemplar gemacht worden. Trotzdem dürfen die etwas zackigen Ränder einiger Schlitze, die auf dem Original deutlicher hervortreten, als auf der Autotypie, auf die Analogie dieser Strukturen auch bei *Navicula crucigera* (Grun.) Cl. schliessen lassen. Nach meiner Ueberzeugung werden weitere elektronenmikroskopische Untersuchungen auch bei vielen anderen Formen analoge Bildungen erschliessen.

2. Zur Verwertbarkeit der durch das Elektronenmikroskop gewonnenen Erkenntnisse für die Taxonomie.

HUSTEDT (1952, S. 300) verhält sich sehr skeptisch in bezug auf die Verwertbarkeit der durch das Elmikr. erschlossenen Einzelheiten für die Diatomeen-Systematik. Die Gründe, die er zugunsten seines Standpunktes anführt, sind:

1. Die Unsicherheit, ob eine aufgenommene Form — infolge der heute noch schwierigen elektronenmikroskopischen Technik — auch wirklich identisch ist mit der vorher im Material bestimmten. HUSTEDT bringt als Beispiel *Navicula subtilissima* Cl., für die ich auf Grund ihrer Feinstruktur eine Ueberführung in die Gattung *Anomoeoneis* befürwortete (KOLBE 1951, S. 641) und bezweifelt die richtige Bestimmung

der elektronenmikroskopisch aufgenommenen Form, die er für *Anomoeoneis exilis* hält, aus 2 Gründen:

a. Seine Nachmessung meiner Fig. 6 (KOLBE 1951) auf Grund der angegebenen Vergrösserungszahl ergab eine Streifendichte von etwa 33 Transapikalstreifen in 10 mμ, die für *Nav. subtilissima* zu grob ist. HUSTEDT ist aber ein Messfehler unterlaufen: die Vergrösserungszahl von 33 000 : 1 ist richtig, sie entspricht einem Masstab der Figur von 1 μ = 33 mm. Auf 33 mm kommen in Fig. 6 etwas über 4 Transapikalstreifen, was einer Streifendichte von etwa 40 in 10 μ bei dem Original entspricht. Bei meiner Fig. 5 ist dagegen die Vergrösserungszahl von 15 000 : 1 infolge eines Druckfehlers falsch angegeben: sie soll heissen 10 000 : 1; setzt man diese Zahl ein, so ergibt sich auch bei Fig. 5 die gleiche Streifendichte von etwa 40 in 10 μ.

b. Die Längsstreifen (nach HUSTEDT: Längsrippen) müssten auch im Lichtmikroskop sichtbar sein. Aus der el. mikr. Aufnahme Fig. 6 geht nicht hervor, dass es sich um Rippen handelt, sie müssten sonst als dunklere Stellen in der Aufnahme erscheinen. Ihre Breite schwankt zwischen etwa 0,2—0,3 μ, so dass es — besonders bei einer Membran von gleichbleibender Dicke — fraglich erscheint, ob sie im Lichtmikroskop sichtbar sind.

Im übrigen bin ich sicher, dass *Navicula subtilissima* bei der Aufnahme vorgelegen hat: diese Form ist im Originalmaterial relativ häufig, während *Anomoeoneis* nur in der Varietät *A. serians* var. *brachysira* selten vertreten war und keine Uebergangsformen gefunden werden konnten.

Zu Punkt 2 und 3 von HUSTEDTS Ausführungen möchte ich bemerken, dass es eine Frage ist, ob »der Membranbau der Diatomeen im Elektronenmikroskop viel einheitlicher ist, als es bei lichtmikroskopischer Betrachtung den Anschein hat, soweit der grundsätzliche Bau in Frage kommt.» (HUSTEDT 1952, S. 300). Das hängt m.E. nur davon ab, wie weit man den Begriff »grundsätzlicher Bau» fasst. In Einzelheiten ist der Feinbau der Diatomeenmembran überraschend vielfältig, vielleicht vielfältiger als die lichtmikroskopisch sichtbaren Strukturen, wie dies die vorzüglichen el. mikroskopischen Aufnahmen von HELMCKE u. KRIEGER (1953) eindrucksvoll zeigen.

Die vielen, teilweise klassischen lichtmikroskopischen Untersuchungen der Diatomeen schufen die Grundlage für das Verständnis des Baues ihrer Zellmembranen; trotzdem sind unsere Kenntnisse der feinsten, jenseits der Grenze der Auflösungsfähigkeit des Lichtmikroskops stehenden Strukturen noch gering. Die bisherigen Resultate der Elektronenmikroskopie führten zwar zu einer Vertiefung unserer Kenntnisse einiger morphologischen Einzelheiten der Diatomeenmembran, rüttelten aber in keiner Weise an dem Gebäude der Diatomeen-Systematik. Sie führten — taxonomisch gesprochen — nur zu Vorschlägen von geringen Verschiebungen der systematischen Stellung einiger Arten: ausser dem besprochenen Fall von *Navicula subtilissima* verweise ich auf *Navicula pelliculosa* (KOLBE u. GÖLZ 1943, S. 93) und *Stephanodiscus binderanus* (KOLBE 1948, S. 17). Was spätere Untersuchungen noch bringen werden, wissen wir nicht. Sollten — nach kritischer Sichtung — allmählich neue, für die Taxonomie wichtige Erkenntnisse daraus resultieren, so wird man sie — wohl oder übel — verwerten müssen. Wohin das führen kann und wird, ist ebenso unbekannt und braucht wohl heute nicht diskutiert zu werden.

Die theoretisch wichtige Frage, mit der HUSTEDT (1952, S. 301) seinen Aufsatz abschliesst, ist: wieweit sind wir berechtigt elektronenmikroskopisch abgebildete Strukturen als reelle Gebilde zu betrachten, bezw. wie weit sind wir Täuschungen durch Interferenzerscheinungen ausgesetzt? Diese Frage steht im Zusammenhang oder ist eine direkte Folge von HUSTEDTs Zweifel an der Wirklichkeit der Schlitze der *Pleurosigma*-Kammern. Ueber andere Fälle, bei denen eventuelle Täuschungen durch das Elektronenmikroskop vorliegen könnten, ist meines Wissens nicht berichtet worden. Durch meine Ausführungen glaube ich den Nachweis gebracht zu haben, dass die Schlitze der *Pleurosigma*-Membran reelle Gebilde darstellen. Damit wäre der bisher einzige Zweifelsfall aufgeklärt und es liegt kein Grund vor, das Elektronenmikroskop als ein weniger zuverlässiges Instrument zu halten, als das Lichtmikroskop und die mit dem ersteren erzielten Resultate a priori skeptisch zu betrachten.

3. Zur Revision des Halobiensystems.

In seiner »Revision des Halobien-Systems» schreibt HUSTEDT (1953, S. 515), dass mein System »nicht restlos befriedigt, auch wenn es eine verbreitete Anwendung gefunden hat, andrerseits aber auch abgelehnt wurde (THIENEMANN 1950, S. 112).» Um zu zeigen, wie diese »Ablehnung» aussieht, zitiere ich die angeführte kurze Stelle aus der Arbeit THIENEMANNS:

> »Berücksichtigt man alle biologischen Verhältnisse der Binnensalzstellen, so kann man vom NaCl-Oligotypus bis zu einem Gehalt von 1 ‰ sprechen, der Mesotypus erstreckt sich dann bis etwa 3 ‰, darüber hinaus kommt der Poly-

typus (KOLBE 1927, S. 112 zieht die Grenzen für Diatomeen etwas anders). Diese Grenzziehung wird deshalb so schwierig, da jedenfalls die tierischen Halobionten der Binnensalzgewässer nicht etwa an einen bestimmten Bereich des NaCl-Spektrums gebunden sind, sondern sich zum Teil euryplastisch durch den ganzen Bereich vom Ende des Oligotypus bis zum extremen Polytypus hindurchziehen. KOLBE nennt die Diatomeenformen, deren Entwicklungsoptimum und Verbreitungsgebiet im Polytypus liegen, Euhalobien; wir nennen sie lieber Polyhalobionte; es folgen die Mesohalobionten und die Oligohalobionten (wenn KOLBE seine Oligohalobien in halophile, indifferente und halophobe aufteilt, so können wir ihm nicht folgen: wir brauchen den Ausdruck halophile im Gegensatz zu halobionten und haloxene in anderem Sinne (vgl. S. 29—30)».

Wie ersichtlich, beschränkt sich THIENEMANN darauf zu konstatieren, dass die Grenzen zwischen dem Poly-, Meso- und Oligotypus von mir etwas anders gezogen wurden, als von ihm, dass er ferner den Begriff der halophilen Elemente in einem anderen Sinn gebraucht und daher mir darin nicht folgen kann.

Die Kritik meines Halobiensystems durch HUSTEDT richtet sich ausschliesslich gegen die »Unlogik» dieses Systems, »die darin besteht, dass innerhalb derselben Rangstufe eine Verschiebung des Einteilungs-Grundes vom Qualitativen zum Quantitativen eingetreten ist» (HUSTEDT 1953, S. 515). HUSTEDTs Kritik wäre auch durchaus berechtigt, wenn eine solche Verschiebung des Grundprinzips tatsächlich vorliegen würde. Dies ist aber nicht der Fall und die Grundlagen der Ueberlegungen HUSTEDTs beruhen auf einem Missverständnis bezw. seiner abweichenden Deutung meines Systems. Um es gleich vorweg zu nehmen: mein System der Halobien ruht — wie wohl alle formalen Systeme, die Milieuspektra verwenden — auf einer rein quantitativen Grundlage und zwar sowohl in den 3 Haupt-, wie in den 3 Untergruppen.

Bei der Aufstellung meines Halobiensystems lehnte ich mich an das in der Ökologie bewährte Prinzip der Unterteilung des Spektrums (NAUMANN) der ökologischen Typen, die durch einen veränderlichen Faktor bedingt werden, in 3 Abschnitte: den Poly-, Meso- und Oligotypus. Im gegebenen Fall (Abhängigkeit vom Salzgehalt des Biotops) ergaben sich mithin die 3 Hauptgruppen der Eu- (=Poly-), Meso- und Oligohalobien, die dem Salzgehalt des Biotops in abnehmender Salzkonzentration entsprechen. Bei der letzten Hauptgruppe, den Oligohalobien waren Unterteilungen erwünscht, da bekanntlich bei dieser Gruppe weitere ökologisch bedingte Fazies ± deutlich hervortreten. Ich unterteilte daher die Oligohalobien (wieder quantitativ nach abnehmender

Salzkonzentration des Biotops) in halophile — also Oligohalobien, die sich aber der nächsthöheren Hauptgruppe nähern —, indifferente und halophobe, die »Anpassungen an extrem geringe Salzmengen zeigen» (KOLBE 1932, S. 269). Gewiss könnte man die 3 letztgenannten Fazies auch als gleichberechtigte Gruppen neben die Hauptgruppen stellen; da jedoch diese 3 Fazies die Gesamtheit der Bewohner (Diatomeen) des Süsswassers ausmachen, ist es entschieden richtiger, sie als Unterabteilungen der Oligohalobien aufzufassen. Das System in dieser Form scheint mir die »natürlichen» Verhältnisse am besten darzustellen:

Seewasser — Euhalobien

Brackwasser — Mesohalobien

Süsswasser — Oligohalobien, unterteilt in halophile, indifferente und halophobe Formen. (Vgl. hierzu Textfig. 5 in KOLBE 1927, S. 114, die das Einteilungsprinzip erläutert).

Ich glaube, dass Inkonsequenz das Letzte ist, was man diesem System vorwerfen kann, wenn man sich von vornherein bewusst ist, dass es auf einer quantitativer Grundlage aufgebaut ist.

HUSTEDT geht in seiner Kritik von einer Reihe von Voraussetzungen bezw. Unterstellungen aus, die durchaus nicht zutreffen. Der Reihe nach sind es die folgenden:

1. Für die Euhalobien sei die Anwesenheit von NaCl erforderlich, aber ohne Rücksicht auf die Menge, so dass es sich hier um einen qualitativen Charakter handle. Wieso denn: ohne Rücksicht auf die Menge? Da die Euhalobien an der oberen Grenze des »natürlichen» NaCl-Spektrums stehen, ist die obere Grenze der Salzkonzentration für deren Wohnbereiche festgelegt und von der unteren Grenze der Salzkonzentration sind sie ebenso abhängig, wie die anderen Gruppen. Wären sie es nicht, so würden sie auch in anderen, niederen Bereichen des NaCl-Spektrums leben können. Der Begriff »Euhalobien» ist mithin ebenso quantitativ bedingt, wie die Definition der übrigen Gruppen.

2. Zu den Oligohalobien bemerkt HUSTEDT, dass ein geringer Salzgehalt ertragen werden kann, aber nicht erforderlich sei, dass es sich also auch hier um ein qualitatives Merkmal handle. Wir können — exakt gesprochen — für eine gegebene Form nur die Grenzen ihres Vorkommens in einem bestimmten Spektralbereich eines ökologischen Faktors feststellen, bestenfalls das Minimum, Optimum und Maximum der Konzentration für diesen von ihr bewohnten Spektralbereich. Dies gilt auch für den Bereich der niederen Salzkonzentrationen, also auch für die Gruppe der Oligohalobien. 1.)

Dass die Oligohalobien durch eine obere Grenze von der an höhere Konzentrationen angepassten Gruppen abgesondert werden, ergibt sich aus dem obigen Schema, ebenso, dass der Bereich der Mesohalobien als mittlere Gruppe durch eine obere und eine untere Grenze bedingt ist.

3. Bei den halophoben Arten unterstellt HUSTEDT, dass diese den Salzgehalt nicht nur nicht »erfordern», sondern ihn als entwicklungshindernd »ablehnen», daher sei auch dieses Merkmal ein qualitatives. HUSTEDT meint unter »Salzgehalt» augenscheinlich einen höheren Salzgehalt, denn absolut chlorfreie Gewässer gibt es in der Natur kaum und dass auch geringe Spuren eines Stoffes u.U. nicht ohne Wirkung auf einen Organismus sind, ist bekannt. Wenn HUSTEDT schreibt, dass die halophoben Diatomeen den (höheren?) Salzgehalt als entwicklungshindernd ablehnen, so kann man nur dagegenhalten, dass sie sich darin ebenso verhalten, wie Formen anderer Halobiengruppen: eine oligohalobe Form lehnt — um mit HUSTEDT zu reden — einen Standort mit höherem Salzgehalt als den für sie optimalen ebenso als entwicklungshindernd ab, wie eine euhalobe Form ein Gewässer mit geringerer Salzkonzentration. Im Grunde genommen meint HUSTEDT wohl ungefähr dasselbe, was durch mein System ausgedrückt ist: dass die halophoben Formen an die geringsten NaCl-Mengen angepasst sind. Das Wesentliche ist aber, dass obere (wenn auch relativ geringe) Salzkonzentrationen für ihren Wohnbereich bestimmend sind — dass mithin auch für sie das quantitative Moment ausschlaggebend ist, ebenso wie für die Euhalobien die unteren Konzentrationsgrenzen.

Ich fasse zusammen: das von mir vorgeschlagene System der Halobien umfasst den in der Natur am häufigsten vorkommenden Bereich des NaCl-Spektrums und ist auf rein quantitativer Grundlage aufgebaut.

Ein jedes Halobien-System berücksichtigt nur einen ökologischen Faktor und sagt nicht etwa aus, dass der Salzgehalt den einzigen ökologischen Faktor bei den Diatomeen darstellt. Es ist klar, dass — besonders die Oligohalobien — in ihrer Entwicklung von anderen, z.T. noch unbekannten Faktoren abhängig sind, wie z.B. viele Eunotien vom pH-Faktor, gewisse Nitzschien von der Trophiestufe u.s.w. Nur die Nebeneinanderstellung der optimalen Bereiche innerhalb der verschiedenen ökologischen Faktoren kann für eine Form ein Gesamtbild ihrer ökologischen Ansprüche ergeben.

Immerhin ist der Salzgehalt ein sehr wichtiger, augenfälliger und leicht ermittelbarer Faktor und gibt — selbst allein betrachtet — ein gewisses Bild über die Verteilung wesentlicher ökologischer Gruppen der Diatomeen.

Die von HUSTEDT vorgeschlagene Abänderung beruht in erster Linie darauf, ob ein Salzgehalt

1. unbedingt erforderlich,
2. nicht erforderlich ist oder
3. als entwicklungshindernd abgelehnt wird.

Der wichtigste Einwand gegen diesen Vorschlag ist, dass mit dem Faktor »Salzgehalt» operiert wird, ohne dass dieser Begriff einigermassen präzisiert wird. Ist der Salzgehalt eines eutrophen Sees von — sagen wir — 50 mg/l ein Gehalt, der nicht erforderlich ist? Bezw. ist der Cl-Gehalt eines Braunwassersees von 9,2 mg/l Cl (Rudträsket, mit überwiegend halophober Diatomeenflora) ein Gehalt der noch nicht abgelehnt wird und nicht berücksichtigt zu werden braucht? Das letztere ist nach den Erfahrungen schwedischer Limnologen nicht zulässig: der Cl-Gehalt von Süssgewässern ist meist auch ein Indikator für die Eutrophiestufe eines Gewässers und zwischen Hochmooren, die praktisch nur von Regenwasser gespeist werden und solchen, die Beziehungen zum Moorgrund haben (DU RIETZ, THUNMARK) bestehen trotz relativ geringer Unterschiede in den Cl-Zahlen (die sich in der Grössenordnung von wenigen mg/l bewegen) erhebliche floristische Verschiedenheiten. In ein auf quantitativer Grundlage ruhendes System lassen sich die Wohnbereiche auch innerhalb der niedrigsten NaCl-Konzentrationen einordnen.

Die von HUSTEDT vorgeschlagene Abänderung sieht — als logische Folge seines qualitativen Grundprinzips — das Zusammenlegen bezw. Einordnen der Euhalobien (bei HUSTEDT: Polyhalobien) und Mesohalobien in eine Hauptgruppe vor: die marinen und Brackwasserformen bilden zusammen die Gruppe der Euhalobien. Die halophoben Diatomeen, die nur eine rel. kleine Gruppe der Süsswasserdiatomeen darstellen, werden dagegen im Rang zu einer der 3 Hauptgruppen seines Systems erhoben. Gerade diese Gruppe ist — definitorisch gesehen — m.E. ganz unhaltbar in der Fassung von HUSTEDT. Es ist doch unmöglich festzustellen, ob und von welcher Grenze an ein »Salzgehalt» nicht erforderlich oder entwicklungshindernd ist, welches Merkmal nach HUSTEDTS Vorschlag den Unterschied zwischen Oligohalobien und halophoben Formen darstellt.

Es scheint mir ferner richtig, dass ein Halobiensystem sich an die 3 grossen Gewässertypen: Meer-, Brack- und Süsswasser anlehnt. Im System von HUSTEDT würden seine Hauptgruppen etwa den Gewässertypen: Salzwasser, Süsswasser und Moor- oder Gebirgswasser entsprechen.

HUSTEDT beklagt sich, dass bei Anwendung meines Systems Fehldeutungen vorkommen. Ich fürchte, dass dies bei jedem System (auch bei der Abänderung nach HUSTEDT) unvermeidlich ist denn. . . Irren ist menschlich. Gewiss ist die Wahl des Grundprinzips für ein ökologisches System bis zu einem gewissen Grad eine Ansichtssache — im vorliegenden Fall: quantitatives oder qualitatives Prinzip. Mir scheint das erstere exakter zu sein. Ich glaube — nach allem oben Ausgeführten nicht, dass mein System »aus logischen Gründen abgeändert werden muss» (HUSTEDT l.c., S. 518, gesperrt von mir).

Literatur.

HELMCKE, J.-G. und KRIEGER, W. 1953. Die Diatomeenschalen im elektronenmikroskopischen Bild. — Bild u. Forschung, Berlin.

HUSTEDT, F. 1945. Die Struktur der Diatomeen und die Bedeutung des Elektronenmikroskops für ihre Analyse. — Arch. f. Hydrobiologie, 41, 315.

— 1952. Die Struktur des Diatomeen und die Bedeutung des Elektronenmikroskops für ihre Analyse. II. — Arch. f. Hydrobiologie, 47, 295.

— 1953. Die Systematik der Diatomeen in ihren Beziehungen zur Geologie und Ökologie nebst einer Revision des Halobien-Systems. — Svensk Bot. Tidskr., 47, 509.

KOLBE, R. W. 1927. Zur Ökologie, Morphologie und Systematik der Brackwasser-Diatomeen. — Pflanzenforschung, 7.

— 1932. Grundlinien einer allgemeinen Ökologie der Diatomeen. — Ergebnisse d. Biologie, 8, 221.

— 1948. Elektronenmikroskopische Untersuchungen von Diatomeenmembranen. — Ark. f. Botanik, 33.

— 1951. Elektronenmikroskopische Untersuchungen von Diatomeenmembranen, II. — Svensk Bot. Tidskr., 45, 636.

KOLBE, R. W. und GÖLZ, E. 1943. Elektronenmikroskopische Diatomeenstudien. — Ber. Deutsch. Bot. Ges., 61, 91.

PERAGALLO, H. et M. 1897—1908. Diatomées marines de France etc. — Grez-sur-Loing.

THIENEMANN, A. 1950. Verbreitungsgeschichte der Süsswassertierwelt Europas. — Die Binnengewässer, 18.

BOTANISKA NOTISER 1954, HÄFTE 3. LUND

A Physiological Classification of »Shoot Auxins» and »Root Auxins» I.

By BERIT A. M. HANSEN.

Botanical Laboratory, Lund.

(Received June 14, 1954.)

Contents.

Introduction.

Numerous hormone-like growth-regulating compounds have been investigated from both theoretical and practical points of view. Many different kinds of plant materials and techniques have been used. These facts render comparisons difficult or unrealizable. Furthermore we do not know what is included in the concept »growth» which either comprehends total enlargement of a plant or a part of a plant (as in this paper), or is measured as cell elongation of an organ (e.g., the Avena-tests and the pea-test). Increases or decreases of growth can take place in physiologically different ways. Therefore comparisons not only between different works but even between different compounds may be uncertain. In order to overcome at least some of these difficulties the effects of a series of growth regulators (Table 1) have been investigated by a routine method. In connexion with that attention has been devoted even to morphological effects other than mere alterations of cell elongation. These have been referred to their physiological processes, and a proposal of an alteration of the growth terminology has been made based upon these results.

All except two of the compounds investigated have been prepared by Dr. NILS ÅKE JÖNSSON, Department of Organic Chemistry, the Royal Institute of Technology, Stockholm, Sweden. Hydratropic acid has been obtained from Prof. ARNE FREDGA, Department of Organic Chemistry, Uppsala University, Uppsala, Sweden, and decahydronaphthaleneacetic acid from Prof. H. VELDSTRA, N. V. Amsterdamsche Chininefabriek, Amsterdam, Netherlands. The writer wishes to express her appreciation to all of them.

Methods.

Seeds of Weibull's Eroica wheat were soaked for 24 hours in distilled water. The absence of heavy metals in all water was controlled by testing with dithizone. The seeds were then placed in Petri dishes on wet filter to germinate for two days without light and at 22° C. Well germinated plants with their first three adventitious roots 1—2 cm in length were planted on perforated cork bricks in beakers containing one litre of nutrient solution. This was renewed every day during the treatment, i.e., three days. Each beaker contained 45 wheat plants. The beakers were placed in a constant room with continuous artificial illumination, a temperature of 20.0—20.5° C, and a relative humidity of 23—40 per cent. The solution had the following composition $Ca(NO_3)_2$ $10^{-3}\,M$, $MgSO_4$ $5 \cdot 10^{-4}\,M$, KH_2PO_4 $10^{-3}\,M$, and H_3BO_3 $10^{-4}\,M$. The growth-regulating acids were used as water-soluble sodium salts and added to the nutrient solution. Two compounds, cyclohexyloxyacetic acid and α-cyclohexyloxypropionic acid were delivered and used as cyclohexylamine salts. A special test with cyclohexylaminohydrochloride showed that these ions did not cause

Table 1. ***List of compounds, tested in this investigation.*** **The numbers refer to the curves of activity in figures 6—21.**

cyclohexyloxyacetic acid = 1
phenylacetic acid = 2
phenoxyacetic acid = 3
2-methylphenoxyacetic acid = 4
2,4-dimethylphenoxyacetic acid = 5
2,6-dimethylphenoxyacetic acid = 6
2-chlorophenoxyacetic acid = 7
4-chlorophenoxyacetic acid = 8
2,4-dichlorophenoxyacetic acid (2,4-D) = 9
3,5-dichlorophenoxyacetic acid = 10
2,4,6-trichlorophenoxyacetic acid = 11
2-methyl-4-chlorophenoxyacetic acid (methoxone) = 12
2-methyl-6-chlorophenoxyacetic acid = 13
2-methyl-4,6-dichlorophenoxyacetic acid = 14
1-naphthaleneacetic acid = 15
3-indoleacetic acid = 16
6-chloro-3-indoleacetic acid = 17

α-cyclohexyloxypropionic acid = 18
α-phenylpropionic acid = 19
α-phenoxypropionic acid = 20
α-(2,4-dimethylphenoxy)propionic acid = 21
α-(2,6-dimethylphenoxy)propionic acid = 22
α-(4-chlorophenoxy)propionic acid = 23
α-(2,4-dichlorophenoxy)propionic acid = 24
α-(2,4,6-trichlorophenoxy)propionic acid = 25
α-3-indolepropionic acid = 26

α-cyclohexyloxyisobutyric acid = 27
α-phenylisobutyric acid = 28
α-phenoxyisobutyric acid = 29
α-(2-methylphenoxy)isobutyric acid = 30
α-(2,4-dimethylphenoxy)isobutyric acid = 31
α-(4-fluorophenoxy)isobutyric acid = 32
α-(4-chlorophenoxy)isobutyric acid = 33
α-(4-bromophenoxy)isobutyric acid = 34
α-(4-iodophenoxy)isobutyric acid = 35
α-(2,4-dichlorophenoxy)isobutyric acid = 36
α-(2,4,6-trichlorophenoxy)isobutyric acid = 37
α-(2-methyl-4,6-dichlorophenoxy)isobutyric acid = 38
α-3-indoleisobutyric acid = 39

decahydronaphthaleneacetic acid
cyclohexylaminohydrochloride

any growth activity. The pH in the fresh solutions amounted to 5.2 and after 24 hours it had increased to about 6.0. Solutions containing $10^{-4}\,M$ or more of a growth-regulating compound sometimes had a pH value higher than 5.2 and were then buffered with 0.1 M phosphoric acid to the pH of the control. According to the pK of these compounds this increase in pH is of no greater importance. The solutions were aerated the whole time. After three days the lengths of the first three roots and of their epidermal cells were measured and the morphological effects of the compound were studied macro- and microscopically. The root growth was measured as final root length minus initial root length. The number of roots in each concentration was 135. The lengths of twenty cells from each of ten roots, i.e., 200 cells representing one replicate of a series, were measured directly in a microscope without any staining. The cell number was calculated as the average root growth divided by the average cell length.

Root growth and cell numbers have been expressed in the diagrams as per cent of the control in order to overcome the possible variations of time between the different series. Cell lengths have been expressed in μ. All the values which determine the curves of the diagrams are averages between repetitions of the same test. 4 to 13 tests have been made with each compound.

This procedure includes one fault. Cell elongation in intact roots is not constant during the three days but increases (14). The cell lengths were measured in that part of the root, which grew out during the third day. Therefore the values of the cell length are high, compared with those of the root growth, and the calculated cell numbers will be low. In tests with growth substances which do not alter this time curve the values of cell number will

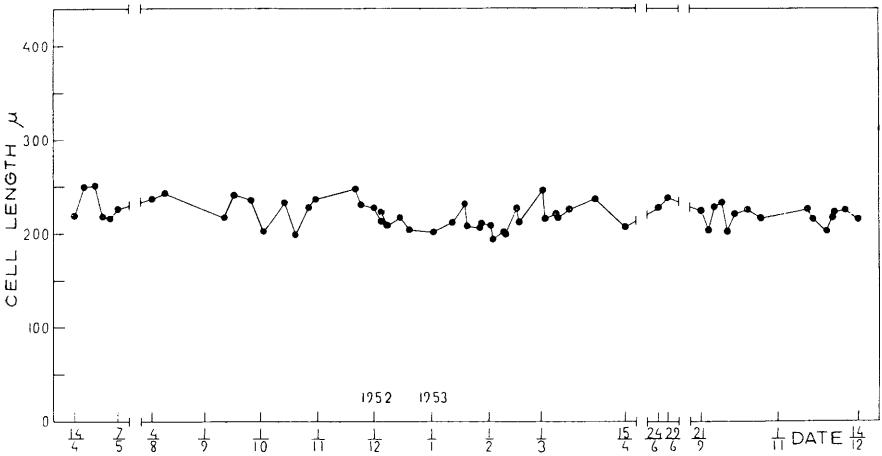


Fig. 1. *The variation of cell lengths in* μ *between the controls throughout the investigation period.* The variation is within 194 μ—251 μ.

be fairly correct, when expressed in per cent of the control. Closer studies of cell multiplication effects must include an investigation of eventual deviations from this normal time curve.

Results.

I. Growth Observations.

The growth-regulating compounds thus investigated influence the roots in different ways. They act upon their *cell elongation,* their *geotropic response,* the rate of *cell division* and, furthermore, they cause *toxic effects.* These different physiological phenomena will be described in the following together with some selected experiments.

1. Decreased Cell Elongation.

The length of epidermal cells from wheat roots cultured under conditions mentioned above is on an average 221 μ. The average values of the individual series vary from 194 μ to 251 μ (Fig. 1). The cell stretching period of such roots can be shortened by the addition of certain growth regulators. These may stop cell elongation when the cells are about 40 μ long without killing the plants.

The breadth of inhibited cells as well as their general appearance does not differ from the controls. During the entire experimental period the cell breadth has been about 20 μ.

As a consequence of inhibited elongation of epidermal cells root hairs are numerously developed. They may become longer than the hairs of the control roots. The roots will thus have a brush-like appearance.

Phenylacetic acid is an example of this type of growth compounds. The cell elongation of roots grown in a nutrient solution containing 10^{-6} *M* phenylacetic acid differs in no way from the control roots. Cell elongation of roots grown in 10^{-5} *M* phenylacetic acid is slightly inhibited. On three different occasions it has been measured as 178 μ, 169 μ and 191 μ. A stronger inhibition is produced by a 10^{-4} *M* solution. The cell lengths of two identical treatments were 121 μ and 138 μ. The roots are killed by a $3 \cdot 10^{-4}$ *M* solution (Fig. 6).

Often the plants survive even if their three first roots have been killed. As they still are nourished from their endosperms, they are able to form new roots. These new roots are highly insensitive to growth substances and the plants may therefore survive.

In rare cases the three first roots may adapt themselves to compounds which inhibit cell elongation in sublethal concentrations. When plants are transferred to a 10^{-4} *M* solution of phenylacetic acid, the cell elongation of their roots is highly inhibited during the first hours. Then cell elongation is increased until the solution is renewed. The fresh solution causes a new inhibition. Such a periodical variation will make it difficult to obtain good average values of cell lengths. This adaption or inactivation occurs, besides in solutions of phenylacetic acid, also in solutions of α-3-indoleacetic acid but not when any of the other substances are employed. This phenomenon has former by been observed when using flowing solutions and cannot be due to insufficient quantities of the substance (11).

Substances other than phenylacetic acid which inhibit cell elongation may act in weaker concentrations, but the morphological course of inhibition is the same as has been reported in the foregoing. According to the literature some compounds belonging to this group can under certain conditions give rise to a weakly increased cell elongation of roots in very dilute solutions. This phenomenon has not occurred in the present investigation.

2. Increased Cell Elongation.

As well as the cell elongation period can be shortened by the addition of certain growth regulators to the medium of the roots, it can also be lengthened by the addition of other similar compounds. Then the cell elongation continues beyond what is normal for untreated roots. The average cell length of roots treated in this manner may rise to about 390 μ before elongation is completed (Fig. 9).

The activity of α-phenoxyisobutyric acid first shown by BURSTÖM (14) exemplifies this. Cell elongation of roots grown in nutrient solution containing 10^{-6} *M* α-phenoxyisobutyric acid does not significantly differ from that of the controls. On two occasions it amounted to 264 μ and 224 μ. These lengths are almost within the variation of the controls which is 194—251 μ. The cell lengths of roots in 10^{-5} *M* phenoxyisobutyric acid in four identical treatments were 293 μ, 320 μ, 298 μ, and 302 μ. A $3 \cdot 10^{-5}$ *M* solution gave a length of 326 μ and 10^{-4} *M* gave 386 μ. A solution of $3 \cdot 10^{-4}$ *M* phenoxyisobutyric acid killed the roots. Even in such a high concentration as 10^{-4} *M,* when the root length becomes shorter than the controls, depending on the inhibition of cell division (Fig. 19), this cell stretching ability is thus maintained (Fig. 9). The elongated cells have their normal breadth and their general appearance corresponds to that of the controls. When cell elongation is promoted in this way, the length of the root hairs decreases. Often at maximal elongation no root hairs are formed whatsoever.

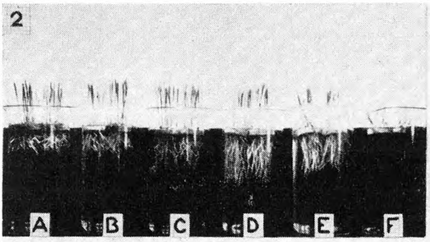
3. Antagonism.

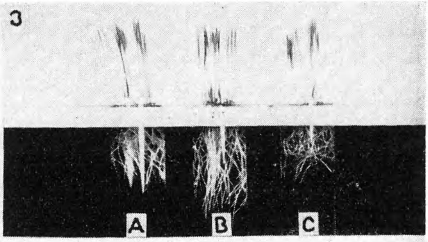
If roots grow in a nutrient solution containing both one compound which decreases and one which increases cell elongation, this growth will be intermediate (15). Moreover, if such an inhibiting or stimulating compound is added together with other compounds, which alone are inactive, the elongation effect of the first one can be weakened (34) (Fig. 14). However no growth effects other than elongation have been observed after such treatments. Other morphological observations which have been made are the same as those described under the headings of Decreased and Increased Cell Elongation.

4. Increased Positive Geotropism.

Variations in geotropic response of roots are also included in growth. Untreated roots growing in nutrient solution are positively geotropic. They are not straight, however, but grow irregularly in different directions. This may depend partly upon local disturbances of cell elongation which give rise to sudden crookings of the roots, although the roots grow downwards the whole time (Figs. 2 A, 3 A, 5 A).

The geotropic response of roots with a shortened period of cell elongation is about the same. No deviations have been observed.





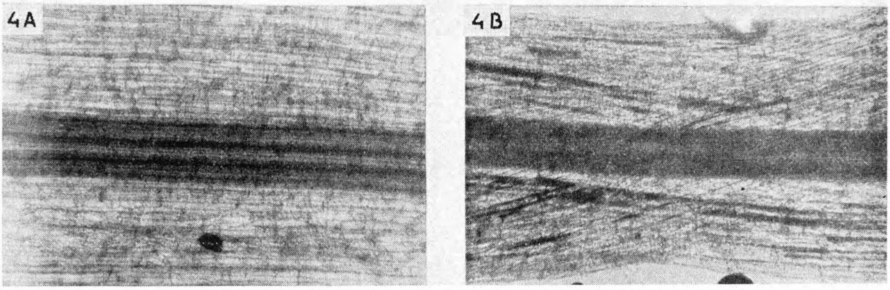


Fig. 2. *The growth action of α-(2-methyl-4,6-dichlorophenoxy)isobutyric acid, showing increased positive geotropism and toxicity.* 3-day-old plants. pH 5.2 at the start and 6.0 at the end of the experiment. *A*=control. $B = 10^{-8}\,M$ of the acid. No growth alterations. $C = 10^{-7}\,M$, $D = 10^{-6}\,M$, and $E = 10^{-5}\,M$. *C*-*E* show (i) increased root growth, depending on accelerated cell multiplication and cell elongation, (ii) increased positive geotropic response of the roots, and (iii) no shoot alterations. $F = 10^{-4}\,M$. Toxic effects. Roots have been killed and shoots are strongly inhibited.

Fig. 3. *The growth action of α-3-indoleisobutyric acid, showing »ageotropism».* *A*=control. $B = 10^{-6}\,M$ of the acid. Increased root length (159 per cent) and somewhat increased positive geotropism of the roots. $C = 10^{-5}\,M$. Increased root length (154 per cent) and »ageotropism», i.e., roots grow in all directions.

Fig. 4. *Spiralization of roots with increased positive geotropism.* *A*=control root with straight rows of epidermal cells. *B*=treated root with spiralized epidermal cell rows. The darker part in the centre is the stele.

Roots with promoted cell elongation but without any signs of toxicity deviate macroscopically from the controls. Their positive geotropic response increases as their cell length increases. Roots with maximal cell length grow almost vertically without the crookings which characterize the controls (Figs. 2 B—E, 3 B, 5 B). Such an increase of the positive geotropism has not been observed on roots with normal or inhibited cell elongation.

A detailed investigation of geotropism has been performed at this laboratory by Rufelt (43). He found a positive geotropic reaction in normal roots and another one which is antagonistic thereto. This coun-

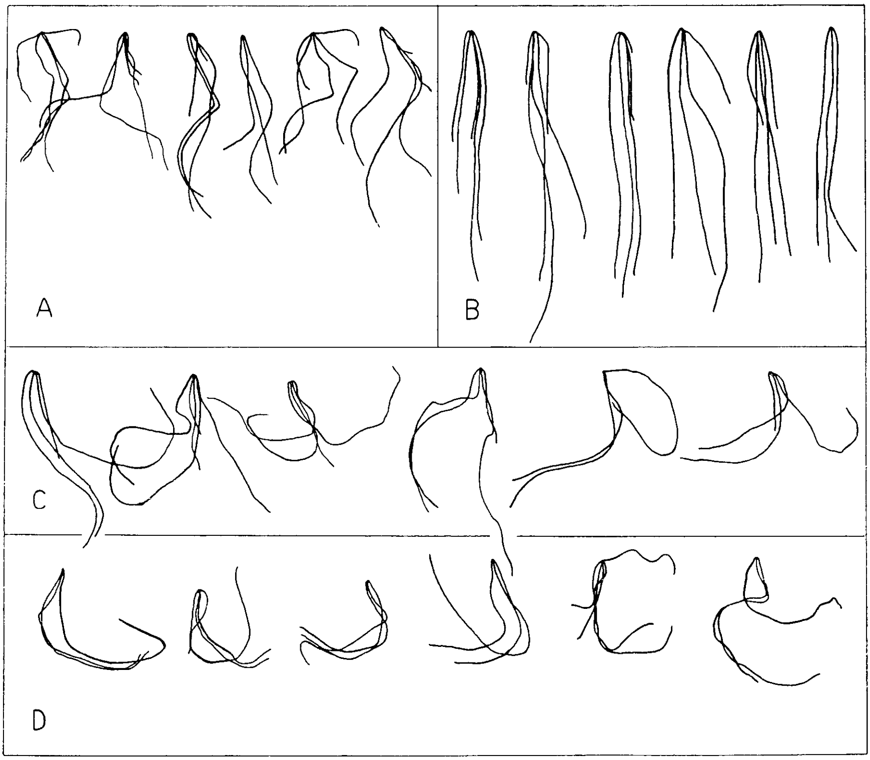


Fig. 5. *Different geotropic response of roots.* A = untreated roots. B—D = roots, treated with α-3-indoleisobutyric acid, $B = 3 \cdot 10^{-6}$ M, $C = 10^{-5}$ M, $D = 3 \cdot 10^{-5}$ M. A shows positive geotropic response of untreated roots. B shows increased positive geotropism, connected with increased cell elongation. C and to a greater extent D show »ageotropism», connected with incipient toxicity.

teraction is eliminated by α-(4-chlorophenoxy) isobutyric acid and the result will be more pronounced with roots exhibiting positive geotropism. This has also been observed here.

Often the increased positive geotropic response is correlated to a microscopic effect. The outer parts of the roots grow in spirals around their stele. Thus a row of epidermal cells is not straight as the controls (Fig. 4 A) but spiralized (Fig. 4 B).

5. »Ageotropism».

Some of the compounds which prolong the cell elongation period cause another geotropic effect. This is observed in high, weakly toxic concentrations when root length is decreasing much more than cell length, which even may increase (Fig. 15). It manifests itself as a loss of geotropic response of the roots. Thus the roots grow in all directions not irregularly wound as the controls but bent in smooth curves (Figs. 3 C, 5 C—D). They may even grow upwards and reach the surface of the nutrient solution. Thus B in figure 3 is 159 and C is 154 per cent of the control although the roots in C are so curled that they seem to be as short as the control.

The theoretical background of this phenomenon is not known. It is impossible to say, whether it is a real loss of geotropism or an increased negative geotropic reaction. The phenomenon has therefore been called »ageotropism» from a morphological point of view.

6. Cell Multiplication.

Cell elongation and cell multiplication may be independent of each other (12, 13). This has also been observed in the present investigation in some cases (Figs. 16—21). Elongation and multiplication may also be related to each other, either so that they change the bulk growth in the same direction or so that they counteract each other. A further analysis of the present material lends support to the notion that a relation between the two processes can exist.

Compounds which inhibit elongation also inhibit cell multiplication. An example of this is phenylacetic acid, the elongation effects of which have been reported above. A 10^{-6} M solution did not influence elongation or multiplication which amounted to 105 per cent. The average number of a control is 180 cells. A 10^{-5} M solution inhibited both processes. The cell numbers corresponding to the values for elongation amounted to 97, 67, and 89 per cent of their controls. A 10^{-4} M solution of the acid more strongly inhibited elongation and the corresponding cell numbers were 39 and 70 per cent. The variation of cell numbers in otherwise identical treatments are here consistently greater than the variation of cell elongation. This has even earlier been observed (12). However, *all the substances inhibiting cell elongation tested here, also inhibit cell multiplication* (Figs. 16, 17).

Compounds which promote cell elongation can also promote cell multiplication, which is exemplified by α-phenoxyisobutyric acid (see above). A 10^{-6} M solution had no effect on elongation or multiplication. The cell numbers amounted to 97 and 95 per cent. A 10^{-5} M solution of the acid promoted elongation and increased the rate of cell multiplication to 129, 105, 114, and 124 per cent respectively. The average cell number of roots in a $3 \cdot 10^{-5}$ M solution was 118 per cent.

Not every promotor of cell elongation increased cell multiplication (Figs. 18—20). Varying results have been obtained with different compounds and in different series of the same compounds, although, *none of them have significantly decreased the rate of cell multiplication.*

The foregoing results show how elongation and multiplication change the bulk growth in the same direction. How these two processes may counteract each other is exemplified by tests with sublethal concentrations of promotors of elongation. A 10^{-4} M solution of α-phenoxyisobutyric acid, which increased cell elongation to 185 per cent, strongly decreased the cell numbers which amounted to only 52 per cent of the control. A $3 \cdot 10^{-4}$ M solution of the acid was lethal.

All compounds when non-toxic either inhibit or promote cell multiplication or do not interfere with it at all. When they are used in so high concentrations that toxicity occurs cell multiplication is inhibited. It is impossible at this stage to decide whether inhibited cell multiplication caused by morphologically non-toxic concentrations of compounds which inhibit cell elongation is a separate process or the very first results of what here is called toxicity.

7. Toxicity.

All growth regulators tested here cause toxic effects in high concentrations, independent of the other morphological effects they may exert. The symptoms of toxicity do not appear in tests with low but active concentrations. When the concentration is increased they occur very suddenly and both shoot and root growth are inhibited. The leaves do not develop normally and the roots become thin and transparent. Root hairs evolve irregularly. The average cell elongation generally decreases but the variation of length of the individual cells increases. As has already been mentioned, cell division is strongly inhibited. In still stronger solutions all root growth is stopped and, if the plants cannot adapt themselves to the medium, they will die.

II. Connexions between the Different Growth Responses and the Chemical Structure of the Compounds.

There are connexions between the different growth observations related here and the chemical structures of the growth-regulating substances employed. According to the requirements for growth activity

Table 2. ***Structure of the compounds used.*** **Compounds marked with * have also been used with methylated or chlorinated rings. The asymmetric compounds are racemic.**

Acid chains	Ring systems ± oxygen bridge				
	cyclohexyloxy-	phenyl-	phenoxy-	1-naphthalene-	3-indole-
acetic acid	+	+	+ *	+	+ *
α-propionic acid...	+	+	+ *		+
α-isobutyric acid	+	+	+ *		+

laid down by KOEPFLI, THIMANN, and WENT (26), later evolved and discussed by many others the compounds consist of a ring system, even without double bonds, and a side chain, which ends with a carboxyl group (Table 2). The acids investigated here have all been α-substituted. In most cases there has been an oxygen atom between the ring and the acid chain. As rings cyclohexene, benzene, naphthalene, and indole have been used. The side chain has consisted of acetic, propionic, or isobutyric acid. The racemic form of the asymmetric substances has been employed. The phenoxyalkylcarboxylic acids have been substituted, i.e., halogenated or methylated in their *ortho-* and *para*-positions, and 3-indoleacetic acid has also been chlorinated. Some naphthalenealkylcarboxylic acids, lacking in table 2, will be reported in a separate paper in order to make the table more complete.

Definitions.

Auxins are generally defined as growth substances characterized by their capacity to induce elongation in shoot cells. If the concept auxin effect means influence upon certain groups of growth processes, the concept antiauxin effect should linguistically mean influence upon these or parallel processes which produce the opposite results. Therefore, in this paper the concept antiauxin is used for compounds which inhibit shoot cell elongation and stimulate root cell elongation without the presence of externally added auxins. This means that *antiauxins counteract the endogenous auxins of plants.* Later these concepts will be slightly altered, but for the time being they will be used in this sense.

Compounds which inhibit one or both of these two effects (auxin and antiauxin effects) but have no effect when added alone, are called *antagonists,* auxin antagonists or antiauxin antagonists. *They antagonize only externally added growth-active compounds.* Thus, for example, an auxin may be antagonist to another auxin (22, 44). Inactive compounds may be auxin antagonists as well as antiauxin antagonists (34, 69, this paper).

Of course nothing precludes an antiauxin from also being an antagonist (15). The antiauxin may counteract both endogenous auxins and externally added ones. Antagonist is a more comprehensive concept than antiauxin. The counteraction of an antagonist can be, e.g., inhibition of the absorption of an auxin or an antiauxin, or it may block the transport. *Thus it is not necessary that they interfere with growth reactions.*

However, the main problem has been to determine the effects of the synthetic compounds upon the *natural* growth of roots, i.e., their activity as auxins or antiauxins. When only their morphological activities have been noted and not their biochemical, the concept auxin and antiauxin are used from a morphological point of view. Whether the biochemical reactions which result in morphological auxin and antiauxin effects also are parallel but opposite reactions, so that the concept antiauxin can be applied even from this point of view, can not be inferred from this investigation. This may not necessarily be the case (43).

1—2. Cell Elongation.

The substances which have been tested here inhibit or promote cell elongation of wheat roots as has been previously described, or they are inactive. An account of this and the references in the literature which have been available to the author will be given.

Survey of the Literature.

The references in table 3 have been classified according to the different test methods, which are used in order to measure different kinds of elongation in plants. Growth tests which include growth phenomena other than elongation, e.g., initiation of roots, parthenocarpy, modification of organs, abscission, bud development, or seed germination have been placed in the last column. Growth substances which have been defined as auxins are marked off in italic type in the table. Compounds which have been defined as antiauxins, are marked off in bold-faced type, and inactive compounds in common type.

As is seen in the table the references from the literature agree fairly well. *Every compound which decreases root cell elongation in this paper is without exception called an auxin in the literature.* WEINTRAUB reports 2,4-D as an antagonist to indoleacetic acid (59). To what extent the growth-inhibiting compounds tested here belong to one or more groups

Table 3. ***Survey of the activity of the compounds, found in the literature and in the present study.*** **The references have been classified according to the different tests. Tests which not directly include cell elongation have been**

Compounds	Types of tests		
	Avena curvature	Avena cylinder	Pea curvatur
1. cyclohexyloxyacetic acid			
2. phenylacetic acid	*19, 50, 61*	*19, 36, 50, 51, 60, 61, 71*	*9, 19, 26, 50, 51, 6*
3. phenoxyacetic acid	*41*, 56	18, **25**, *36*, *41*, 56, 58	18, 41, 48, 54*,
4. 2-methylphenoxyacetic acid			
5. 2,4-dimethylphenoxyacetic acid			
6. 2,6-dimethylphenoxyacetic acid			
7. 2-chlorophenoxyacetic acid	*41, 56*	*18, 36, 41, 56, 58*	*18, 41, 48, 54, 5*
8. 4-chlorophenoxyacetic acid	*41, 56*	*18, 25, 36, 41, 56, 58*	*18, 41, 48, 54, 57*
9. 2,4-dichlorophenoxyacetic acid	*4, 18, 41, 56*	*6, 18, 32, 34, 35, 36* *41, 56, 57, 58, 71*	*18, 41, 42, 48,* *54, 58*
10. 3,5-dichlorophenoxyacetic acid		58	49, 58*
11. 2,4,6-trichlorophenoxyacetic acid		34, 36, 58	49*, 54, 57*, 58
12. 2-methyl-4-chlorophenoxyacetic acid	*18, 41, 56*	*18, 41, 56*	*18, 41*
13. 2-methyl-6-chlorophenoxyacetic acid			
14. 2-methyl-4,6-dichlorophenoxyacetic acid		20	
15. 1-naphthaleneacetic acid	*4, 5, 50, 61*	*50, 51, 60, 61, 71*	*26?, 42, 50, 51,* *54, 60, 61*
16. 3-indoleacetic acid	*4, 5, 19, 27,* *29, 47, 50, 61*	*6, 19, 34, 35, 36, 47* *50, 51, 60, 61, 71*	*9, 19, 24, 26, 42,* *49, 50, 51, 53, 60*
17. 6-chloro-3-indoleacetic acid			*24*
18. α-cyclohexyloxypropionic acid			
19. α-phenylpropionic acid			*26*
20. α-phenoxypropionic acid	*18, 41, 56*	*18, 25, 41, 56*	*18, 41*
21. α-(2,4-dimethylphenoxy)propionic acid			
22. α-(2,6-dimethylphenoxy)propionic acid			
23. α-(4-chlorophenoxy)propionic acid	*18, 41, 56*	*18, 41, 56*	*18, 41*
24. α-(2,4-dichlorophenoxy)propionic acid	*18, 41, 56*	*18, 41, 45, 56*	*18, 41, 45, 48*
25. α-(2,4,6-trichlorophenoxy)propionic acid			
26. α-3-indolepropionic acid	*27, 28*	*28*	*26*
27. α-cyclohexyloxyisobutyric acid			
28. α-phenylisobutyric acid			26, 62
29. α-phenoxyisobutyric acid	18, 41, 56	18, 41, 56	18, 41
30. α-(2-methylphenoxy)isobutyric acid			
31. α-(2,4-dimethylphenoxy)isobutyric acid			
32. α-(4-fluorophenoxy)isobutyric acid			
33. α-(4-chlorophenoxy)isobutyric acid	18, 41, 56	18, 35, 41, 56	18, 41
34. α-(4-bromophenoxy)isobutyric acid			
35. α-(4-iodophenoxy)isobutyric acid			
36. α-(2,4-dichlorophenoxy)isobutyric acid	18, 41, 56	18, 35, 41, 56	*18*
37. α-(2,4,6-trichlorophenoxy)isobutyric acid			
38. α-(2-methyl-4,6-dichlorophenoxy)isobutyric acid			
39. α-3-indoleisobutyric acid			

collected in the last column. Auxins (shoot auxins) have been marked off in italic type (*00*), antiauxins (root auxins) in bold-faced type (**00**), and inactive compounds in common type (00). Symbol: * = very weak activity.

	Types of tests				
	Pea cylinder	Root growth	Root cell elongation	Fig.	Other growth tests
1				**8**	
2	*51*	*10, 69, 70*		*6*	*38, 64, 66*
3		_3*_, **32**, 39, _52*_, 69, 70	15	**6**	18, **32**, 40, 41, 56, _63*_, _65*_
4		*52*		*6*	*22, 38*
5		*52*		*6*	*38, 63*
6				11	
7		*31, 52*		*6*	*18, 22, 31, 38, 40, 41, 56, 63, 65*
8		*31*, 52		*6*	*1, 18, 31, 38, 40, 41, 56, 63, 65*
9	*42*	*2, 3, 31, 32, 39, 52, 67, 68, 69, 70*		*6*	*1, 7, 8, 18, 23, 31, 32, 38, 40, 41, 46, 56, 59, 63, 65*
0		_31*_, *52*		**6**	31
1		_31*_, *52*		11	31, *38*, 63
2		*3, 52, 70*		*6*	*1, 7, 8, 18, 22, 38, 41, 46, 56*
3		*52*		13	*22*
4		52		11	**22**
5	*42, 51*	*10, 39, 67, 68, 70*	*10A, 15, 16, 17*	*6*	*23, 32, 38, 53, 63, 64, 66*
6	*42, 51*	*3, 10, 30, 32, 33, 39, 67, 68, 69, 70*	*11, 12*	*12*	*23, 24, 32, 33, 38, 43, 53, 64, 66*
7				*6*	*24*
8				**8**	
9		*10*		*7*	
0		*69, 70*	*15*	*7*	*18, 38, 40, 41, 56, 63*
1				*7*	*38, 63*
2				**7**	
3			*15*	*7*	*18, 38, 40, 41, 56, 63*
4		*70*	*15*	*7*	*18, 23, 38, 40, 41, 46, 56, 63*
5				**7**	46, 63
6		*10, 70*		*7*	*38*
7				**8**	
8		10		**9**	
9		**69, 70**	**14, 15, 17**	**9**	18, 40, 41, 56
0				**9**	
1				**9**	
2				**10**	
3			**10A, 12, 13, 14, 16**	**9, 10**	18, 40, 41, **43**, 56
4				**10**	
5				**10**	
6			**14**	**9**	18, 40, *41*, 56
7			**14**	**9**	
8				**9**	
9			**13, 14**	**9**	

of activity and — if the latter should be the case — the relations of these groups to each other are not to be discussed on the basis of the present investigation.

Among the compounds which promote root cell elongation and thus are called antiauxins, the following ones have not been found in the literature:

cyclohexyloxyacetic acid
α-(cyclohexyloxy)propionic acid
α-(cyclohexyloxy)isobutyric acid
α-(2,6-dimethylphenoxy)propionic acid
α-(2-methylphenoxy)isobutyric acid
α-(2,4-dimethylphenoxy)isobutyric acid

Figs. 6—11. *Root cell elongation activity in* μ. Cell elongation of control roots varies between 194 μ and 251 μ and is marked with horizontal lines. Compounds which inhibit normal elongation are auxins (shoot auxins), and those which increase cell elongation to more than 251 μ are antiauxins (root auxins).

Fig. 6. *Active acetic acids* (besides 3-indoleacetic acid).

2. phenylacetic acid
3. phenoxyacetic acid
4. 2-methylphenoxyacetic acid
5. 2,4-dimethylphenoxyacetic acid
7. 2-chlorophenoxyacetic acid
8. 4-chlorophenoxyacetic acid
9. 2,4-dichlorophenoxyacetic acid
10. 3,5-dichlorophenoxyacetic acid
12. 2-methyl-4-chlorophenoxyacetic acid
15. 1-naphthaleneacetic acid
17. 6-chloro-3-indoleacetic acid

Fig. 7. *Propionic acids.*

19. α-phenylpropionic acid
20. α-phenoxypropionic acid
21. α-(2,4-dimethylphenoxy)propionic acid
22. α-(2,6-dimethylphenoxy)propionic acid
23. α-(4-chlorophenoxy)propionic acid
24. α-(2,4-dichlorophenoxy)propionic acid
25. α-(2,4,6-trichlorophenoxy)propionic acid
26. α-3-indolepropionic acid

Fig. 8. *Cyclohexyloxy acids.*

1. cyclohexyloxyacetic acid
18. α-cyclohexyloxypropionic acid
27. α-cyclohexyloxyisobutyric acid

Fig. 9. *Isobutyric acids.*

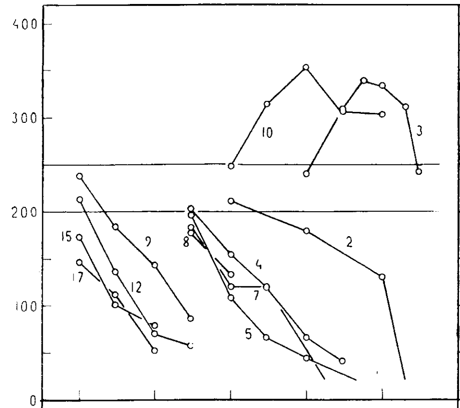
28. α-phenylisobutyric acid
29. α-phenoxyisobutyric acid
30. α-(2-methylphenoxy)isobutyric acid
31. α-(2,4-dimethylphenoxy)isobutyric acid
33. α-(4-chlorophenoxy)isobutyric acid
36. α-(2,4-dichlorophenoxy)isobutyric acid
37. α-(2,4,6-trichlorophenoxy)isobutyric acid
38. α-(2-methyl-4,6-dichlorophenoxy)-isobutyric acid
39. α-3-indoleisobutyric acid

Fig. 10. *Halogenated isobutyric acids.*

32. α-(4-fluorophenoxy)isobutyric acid
33. α-(4-chlorophenoxy)isobutyric acid
34. α-(4-bromophenoxy)isobutyric acid
35. α-(4-iodophenoxy)isobutyric acid

Fig. 11. *Inactive diorthosubstituted phenoxyacetic acids.*

6. 2,6-dimethylphenoxyacetic acid
11. 2,4,6-trichlorophenoxyacetic acid
14. 2-methyl-4,6-dichlorophenoxyacetic acid



g. 6.

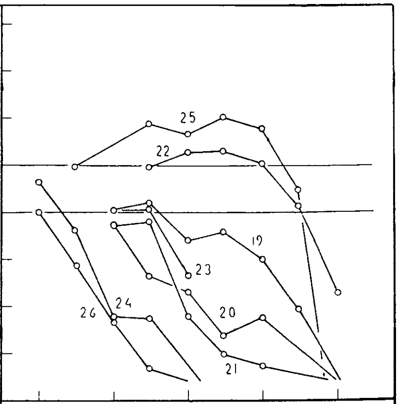
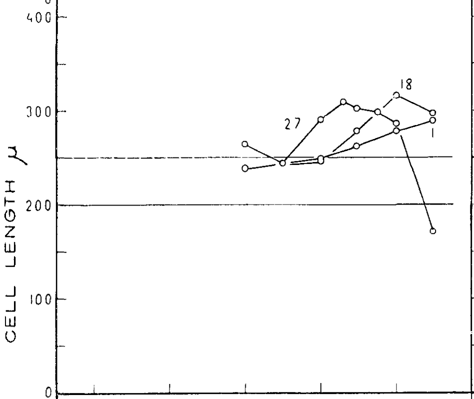


Fig. 7.



ig. 8.

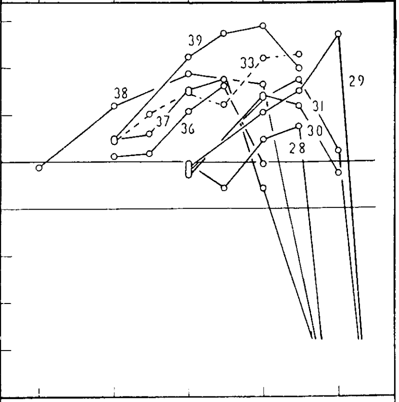
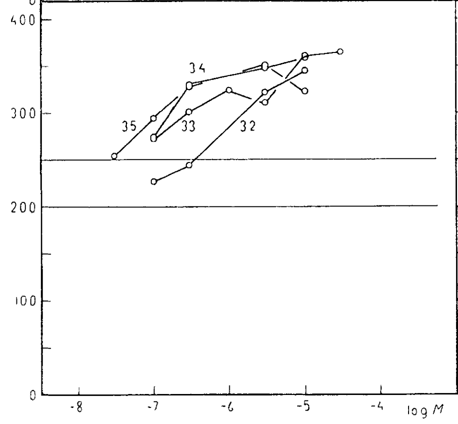


Fig. 9.



. 10.

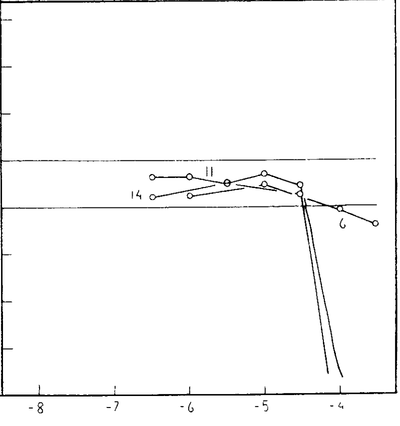


Fig. 11.

α-(4-fluorophenoxy)isobutyric acid
α-(4-bromophenoxy)isobutyric acid
α-(4-iodophenoxy)isobutyric acid
α-(2-methyl-4,6-dichlorophenoxy)isobutyric acid.

Cyclohexanealkylcarboxylic acids without the oxygen bridge have been tested and found inactive.

With regard to the experiences of the purity of growth substances, reservations must be made for the activity of α-(2,6-dimethylphenoxy) propionic acid. Its maximal cell elongation amounted to 117 per cent (control = 100 per cent), i.e., it is lower than that of all other antiauxins. The result is, nevertheless, fairly repeatable and does not depend upon irrelevant conditions. It is possible that the substance is inactive and that the sample used contained a certain percentage of antiauxins as impurities. According to the definitions established this acid will until further notice be called an antiauxin.

The following compounds, which have been found to be antiauxins in this investigation, have been tested earlier but with diverging results:

1. *Phenoxyacetic acid.* When used in shoot tests phenoxyacetic acid has been found either inactive (18, 41, 48, 56, 58) or a weak auxin (36, 41, 54, 63, 65). Twice an inhibiting activity has been observed (25, 32). In root tests phenoxyacetic acid has in most cases been found inactive (15, 39, 69, 70). AUDUS (3) has worked with inhibiting concentrations. These were high (30 p.p.m. and 100 p.p.m.) and it cannot be decided whether the inhibition is a mere auxin activity or a toxic inhibition which is caused even by antiauxins and otherwise inactive compounds. LINSER (32) has found a slight stimulating effect upon root growth. In this investigation a maximal cell elongation of 156 per cent was found (control = 100 per cent). Not even $3 \cdot 10^{-4}$ M acid caused inhibition of cell elongation (Fig. 6). Inhibition of root growth has been observed and it depended wholly upon decreased cell multiplication (Fig. 16). Therefore phenoxyacetic acid is classified as an antiauxin in this paper.

2. *3,5-dichlorophenoxyacetic acid.* This acid has been found inactive or practically inactive in shoot tests (49, 58). In root tests it is found to have inhibiting effects (31, 52). When studying epidermal cell elongation of wheat roots 3,5-dichlorophenoxyacetic acid acts in the same way as phenoxyacetic acid, i.e., as an antiauxin. Maximal cell elongation was 353 μ or 164 per cent (Fig. 6).

3. α-*(2,4,6-trichlorophenoxy)propionic acid* has been investigated by

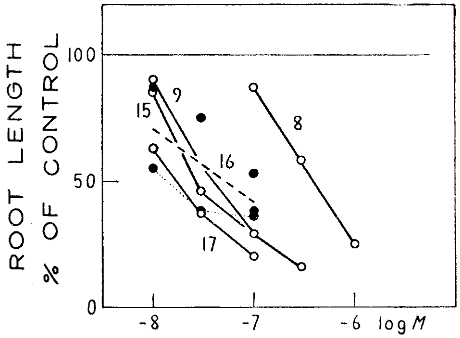


Fig. 12. *Root length inhibition, caused by 3-indoleacetic acid,* showing the great variation between different identical treatments, depending on adaptation. ○ = values of root length of plants, treated with substances 8, 9, 15, or 17, in per cent of the controls (control = 100). ● = values of root length of plants, treated with 3-indole-acetic acid. (......) represents treatments at the same occasion. The average curve has been drawn (- - -). The acid has about the same activity as substances 9, 15 and 17.

8. 4-chlorophenoxyacetic acid	16. 3-indoleacetic acid
9. 2,4-dichlorophenoxyacetic acid	17. 6-chloro-3-indoleacetic acid
15. 1-naphthaleneacetic acid	

SYNERHOLM and ZIMMERMAN in their tomato tests and it caused no cell elongation (46, 63). In the present investigation this acid was active as an antiauxin. It caused a maximal cell elongation of 301 μ or 134 per cent (Fig. 7).

4. *α-phenoxyisobutyric acids* have been found to be inactive in shoot tests (18, 26, 35, 41, 56, 62) except in one case. The physiologists at Wye found a very weak auxin activity when using α-(2,4-dichlorophenoxy)isobutyric acid (18, 41). In one case, in the root tests, α-phenylisobutyric acid is classified as not inhibiting (10). Nothing is said about possible positive effects. In all other cases the investigated isobutyric acids have been reported as antiauxins (10 A, 12, 13, 14, 15, 16, 17, 43, 69, 70) as is the case in this paper (Figs. 8—10).

Further Results.

The foregoing results led to further studies, mainly comparisons between the activity of the different compounds, and of the different parts of the compounds.

α. *Substitutions of the side chain.* — The acetic acids are thus either inhibitors or promotors. Phenoxyacetic acids may be inactivated by diorthosubstitutions of the ring. The propionic acids are also both inhibitors and promotors. The isobutyric acids are all promotors. Thus *the type of acid chain does not alone determine the qualitative effect of the substance.*

β. *Importance of the ring systems.* — An effect which may determine qualitative activity is saturation of the ring system. *The three acids with saturated rings,* i.e., cyclohexyloxyacetic acid, α-cyclohexyloxypropionic acid and α-cyclohexyloxyisobutyric acid, *promote cell elongation.* The saturated acetic acid has a very weak activity. The propionic acid is more active and the cyclohexyloxyisobutyric acid has about the same activity as phenoxyisobutyric acid (Fig. 8). It may be mentioned in this connexion that decahydronaphthaleneacetic acid has no such anti-auxin activity.

One factor which influences the quantitative activity of the growth substances is the size of their ring system. *The three 3-indolealkylcarboxylic acids are more active* (up to about 100 times) *than the unsubstituted phenyl- and phenoxyalkylcarboxylic ones,* either they inhibit or promote elongation (Figs. 7, 9, 12). The effects of 3-indoleacetic acid is not accounted for in figure 6 or figure 16, because of its adaptative ability. Only total root growth has been plotted in figure 12. Although the values are fluctuating, root growth is inhibited by 3-indoleacetic acid to about the same extent as by 1-naphthaleneacetic acid.

The phenylalkylcarboxylic acids all have weak activity. Both phenylpropionic and phenylisobutyric acid require higher concentrations than the corresponding phenoxysubstances in order to give the same effect (Figs. 7, 9). Phenylacetic acid is difficult to compare with phenoxyacetic acid this way as the former inhibits and the latter promotes cell elongation, nevertheless their activities are weak.

γ. *Substitutions of the ring system.* — Even *methylation* and *halogenation* of the rings influence the activity of the compounds. Two types of comparisons have been made, firstly the activity of different substitutions within each of the three acid groups, secondly the activity of correspondingly substituted acids.

γ_1. *Quantitative comparisons within each acid group.* — The activity of the substituted *phenoxyacetic acids* may be divided into *three groups* (Table 4 A). The figures in this and the following tables (5—8) should be only vertically compared. Each column represents one series.

To the first group belong 2-methyl-, 2,4-dimethyl-, and 4-chlorophenoxyacetic acid.

To the second group belong 2,4-dichlorophenoxyacetic acid (2,4-D)

Table 4 A—C. ***The elongation activity of substituted phenoxy- and indoleacetic acids.*** **The values are only vertically comparable. Control values = 194μ – 251μ (Fig. 1).**

Table 4 A. ***Phenoxyacetic acids.*** **Cell elongation in μ. The acids are divided into three groups: (I) weakly active, (II) highly active, and (III) inactive.**

Compounds	Molarity				
	$3 \cdot 10^{-7}$	$3 \cdot 10^{-7}$	$3 \cdot 10^{-7}$	10^{-6}	$3 \cdot 10^{-6}$
I					
2-methylphenoxyacetic acid		192	192		132
2,4-dimethylphenoxyacetic acid	234	180	177	108	
4-chlorophenoxyacetic acid	206	178	147	126	
II					
2,4-dichlorophenoxyacetic acid	106	81	75		
2-methyl-4-chlorophenoxyacetic acid		53	61		
III					
2-methyl-4,6-dichlorophenoxyacetic acid		216	206		226

Table 4 B. ***Further comparisons between 2,4-dichlorophenoxyacetic acid (2,4-D) and 2-methyl-4-chlorophenoxyacetic acid (methoxone).*** **Cell elongation in μ, showing methoxone as the more active inhibitor.**

Compounds	Molarity			
	10^{-8}	$3 \cdot 10^{-8}$	10^{-7}	$3 \cdot 10^{-7}$
2,4-dichlorophenoxyacetic acid *(2,4-D)*	238	184	166	80
2-methyl-4-chlorophenoxyacetic acid *(methoxone)*	213	136	70	56

Table 4 C. ***Indoleacetic acids.*** **Chlorination increases the activity of 3-indoleacetic acid.**

Compounds	Cell length in μ at *M*		Root growth in per cent of the controls at *M*			
	$3 \cdot 10^{-8}$	10^{-7}	10^{-8}	$3 \cdot 10^{-8}$	10^{-7}	10^{-7}
3-indoleacetic acid	196	196	87	75	38	53
6-chloro-3-indoleacetic acid	112	52	63	37	19	20

and 2-methyl-4-chlorophenoxyacetic acid (methoxone), both of which are more inhibiting than the others (Table 4 A, Fig. 6). Some tests have been made in order to investigate the differences between these two herbicides (Table 4 B). This has been done several times before by other physiologists (1, 3, 7, 8, 18, 38, 41, 46, 52, 56, 70). Their results are sometimes contradictory which may depend on different methods or plant material, on varying purity of the different samples, and also on

Table 5. ***The cell elongation activity of substituted α-phenoxypropionic acids.* Cell elongation in μ. The values are only vertically comparable. The acids are divided into two groups: (I) weakly active, and (II) highly active.**

Compounds	Molarity						
	10^{-7}	10^{-7}	$3 \cdot 10^{-7}$	10^{-6}	10^{-6}	10^{-6}	10^{-6}
I.							
α-phenoxypropionic acid	205	157		155	118	100	113
α-(2,4-dimethylphenoxy)propionic acid	198		207		94		91
α-(4-chlorophenoxy)propionic acid ..	202		203	187	135	97	113
II.							
α-(2,4-dichlorophenoxy)propionic acid	78	91	112				

what they include in the concept of hormonal effects. In this investigation methoxone inhibited elongation of epidermal cells of wheat roots more strongly than 2,4-D. Nevertheless total root growth was most inhibited by 2,4-D depending on decreased cell division.

To the third group belongs 2-methyl-4,6-dichlorophenoxyacetic acid, which is inactive alone (Table 4 A). Even the other three diorthosubstituted phenoxyacetic acids, i.e., 2,6-dimethyl-, 2-methyl-6-chloro-, and 2,4,6-trichlorophenoxyacetic acid belong to this group (Figs. 11, 13). Comparisons between 3-indoleacetic acid and 6-chloro-3-indoleacetic acid show that even this chlorination increases the ability of inhibiting cell elongation (Table 4 C) (24).

The *phenoxypropionic acids* may be classified in a similar way into *two groups*. Unsubstituted phenoxypropionic acid, 2,4-dimethyl-, and 4-chlorophenoxypropionic acid have about the same inhibiting activity upon cell elongation (Table 5, Fig. 7), whereas 2,4-dichlorophenoxypropionic acid is more strongly inhibiting. It is remarkable that 2,4,6-trichlorophenoxypropionic acid is neither an inhibitor, nor an inactive compound as the corresponding acetic acid, but promotes cell elongation (Fig. 7).

Methylated and halogenated *phenoxyisobutyric acids* promote cell elongation as does the phenoxyisobutyric acid itself. This acid and the 2-methyl-, and 2,4-dimethylphenoxyisobutyric acids have about the same activity (Table 6). When chlorinated, the activity is increased. The 4-chloro-, 2,4-dichloro-, 2,4,6-trichloro-, and 2-methyl-4,6-dichlorophenoxyisobutyric acids are exemples of this (Table 6, Fig. 9). These findings agree well with BURSTRÖM's (14). One chlorine increases the effect of α-phenoxyisobutyric acid while further chlorination causes no further increase. Thus the two diorthosubstituted phenoxyisobutyric

Table 6. ***The cell elongation activity of substituted α-phenoxyisobutyric acids.*** **The same plan as in table 5**

Compounds	Molarity		
	10^{-6}	10^{-6}	10^{-5}
I.			
α-phenoxyisobutyric acid	249	224	320
α-(2-methylphenoxy)isobutyric acid	223	236	
α-(2,4-dimethylphenoxy)isobutyric acid	247	248	319
II.			
α-(4-chlorophenoxy)isobutyric acid		324	
α-(2,4-dichlorophenoxy)isobutyric acid	288	304	
α-(2-methyl-4,6-dichlorophenoxy)isobutyric acid	317	326	

acids promote cell elongation as the diorthosubstituted propionic acids.

Even the effects of the other halogens, fluorine, bromine, and iodine in the *para*-position on the ring of α-phenoxyisobutyric acid have been studied (Fig. 10). These three acids behaved as the chlorinated one and were all antiauxins. Their activity ranged as follows: J>Br>Cl>F. *The larger the ring, the greater the activity.* This corresponds to the fact that the indole compounds are more active than the phenyl compounds.

γ_2. *Quantitative comparisons between correspondingly substituted acids.* — The activity of correspondingly substituted acids has also been compared. 2,4-dimethyl-, 4-chloro-, and 2,4-dichlorophenoxyacetic and α-phenoxypropionic acids have been used. *Their elongation-inhibiting ability is not significantly either qualitatively or quantitatively, when propionic acid has been used as side chain instead of acetic acid* (Table 7).

From what has been recorded in the foregoing it appears that *substitution in 2-, in 4-, or in 2,4-positions upon the ring may increase the activity of a growth regulator whether it is an inhibitor or a promotor.*

The increase in activity of 2,4-dimethylphenoxypropionic acid compared with phenoxypropionic acid (Fig. 7) is greater than that of 2,4-dimethylphenoxyisobutyric acid compared with phenoxyisobutyric acid (Fig. 9).

The increase in activity obtained by using 2,4-dimethylphenoxyacetic acid instead of 2-methylphenoxyacetic acid (Fig. 6) is greater than the increase obtained with 2,4-dimethylphenoxyisobutyric acid instead of 2-methylphenoxyisobutyric acid (Fig. 9).

Table 7. ***Comparison between correspondingly substituted phenoxyacetic and α-phenoxypropionic acids***, **showing that there is no difference in cell elongation activity between the corresponding acids. The same plan as in tables 5—6.**

Compounds	Molarity						
	$3 \cdot 10^{-7}$	$3 \cdot 10^{-7}$	10^{-6}	10^{-6}	10^{-6}	$3 \cdot 10^{-6}$	10^{-5}
2,4-dimethylphenoxyacetic acid	234	191		96	108	69	44
α-(2,4-dimethylphenoxy)propionic acid ..	207	173		96	91	30	37
4-chlorophenoxyacetic acid	206		139		126		
α-(4-chlorophenoxy)propionic acid	203		187		113		
2,4-dichlorophenoxyacetic acid	106						
α-(2,4-dichlorophenoxy)propionic acid ...	112						

The increase in activity of 2,4-dichlorophenoxyacetic acid compared with 4-chlorophenoxyacetic acid (Fig. 6) or the increase with 2,4-dichlorophenoxypropionic acid compared with 4-chlorophenoxypropionic acid (Fig. 7) are both significant, while there is no increase in activity of 2,4-dichlorophenoxyisobutyric acid compared with 4-chlorophenoxyisobutyric acid (Fig. 9).

The greatest quantitative difference in activity between two phenoxyacetic or α-phenoxypropionic acids is brought about when a 4-chlorinated acid is changed to a 2,4-dichlorinated one, but when using phenoxyisobutyric acids the greatest increase is found between the unsubstituted acid and the 4-chlorinated one. Thus the ring substitutions employed here give greater effects in phenoxyacetic and α-phenoxypropionic acids than in α-phenoxyisobutyric acids. This may depend upon the balance between the hydrophilic and lipophilic parts of the different molecules (53, 54).

3. Antagonism.

There is another group of compounds which has been investigated, the diorthosubstituted phenoxyacetic acids. In the literature (Table 3) 2,4,6-trichlorophenoxyacetic acid is classified either as inactive (31, 34, 36, 54, 57, 58, 63) or as an auxin (31, 38, 49, 52, 58); 2-methyl-4,6-dichlorophenoxyacetic acid is reported as inactive (20, 22, 52) and 2,6-dimethylphenoxyacetic acid has not been found in the literature. In this investigation these acids did not exhibit any activity other than toxicity. They do not influence cell elongation in non-toxic concentra-

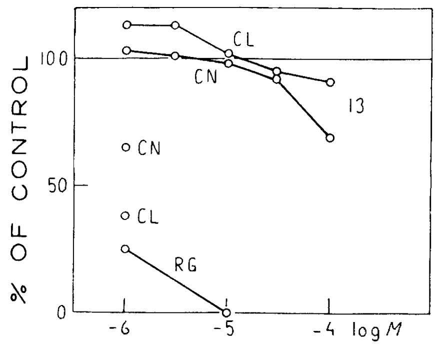


Fig 13. *The activity of impure and purified 2-methyl-6-chlorophenoxyacetic acid.* The strongly decreased values in the concentrations of $10^{-6}M$ and $10^{-5}M$ are results with the sample used by HANSEN (22). The two upper curves are results of a purified sample, showing no growth effects but only toxicity in a 10^{-4} M solution. RG=root growth. CL=cell length. CN=cell number.

tions. The cells elongate as control cells until the plants are poisoned and killed (Fig. 11).

The 2-methyl-6-chlorophenoxyacetic acid is classified as an auxin in the list of THOMPSON et al. (52). The author found in an earlier investigation of hers (22) that this acid was active in the same way as methoxone, i.e., it acted as an auxin. But in the present investigation the acid caused no growth effect but toxicity. When this was studied more closely it was found that the sample which was used in the former investigation still gave rise to auxin effects. When the test was repeated with a carefully purified sample from Dr. JÖNSSON, these auxin effects wholly disappeared (Fig. 13), and therefore they may be ascribed to impurities in the first sample. *Concerning cell elongation of wheat roots 2-methyl-6-chlorophenoxyacetic acid seems to be inactive.*

When a diorthosubstituted phenoxyacetic acid is added together with an auxin, the auxin-induced growth of Avena coleoptiles is competitively inhibited (34, 35). In the present study the inactive 2-methyl-4,6-dichlorophenoxyacetic acid has been added together with the antiauxin α-(2-methyl-4,6-dichlorophenoxy)isobutyric acid and the result was the same. This was also performed with another cultivation method with the same result. The antiauxin-induced cell elongation of wheat roots was inhibited by the acetic acid. Both acids were added in the same concentrations (Fig. 14). Because of these results *2-methyl-4,6-dichlorophenoxyacetic acid is called an antagonist against the corresponding α-isobutyric acid.*

The same test has been repeated with 2,4,6-trichlorophenoxyacetic acid which is inactive by itself and the antiauxin α-(2,4,6-trichlorophenoxy)propionic acid. The result was not the same as in the former experiment. The antiauxin activity of the propionic acid was not altered

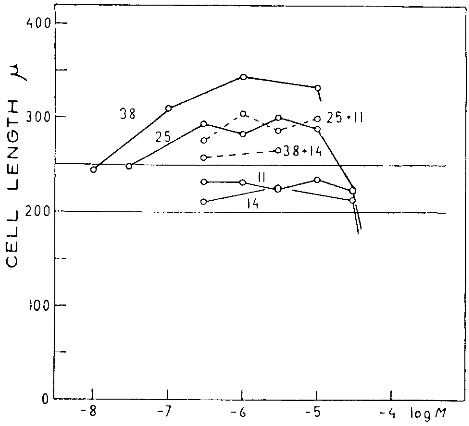


Fig. 14. *Inactive diorthosubstituted phenoxyacetic acid is antagonistic to the correspondingly substituted phenoxyisobutyric acid but not to the propionic acid* (which both are antiauxins = root auxins). In the mixed solutions (broken curves) the acids are used in equal concentrations. Cell elongation in μ.

11. 2,4,6-trichlorophenoxyacetic acid
14. 2-methyl-4,6-dichlorophenoxyacetic acid
25. α-(2,4,6-trichlorophenoxy)propionic acid
38. α-(2-methyl-4,6-dichlorophenoxy)-isobutyric acid

by the acetic acid. Therefore *2,4,6-trichlorophenoxyacetic acid is not an antagonist against the corresponding α-propionic acid.* Perhaps the results can be generalized to the extent that we are allowed to call diorthosubstituted acetic acids antagonists to elongation-promoting isobutyric acids but not to elongation-promoting propionic acids. But they are not antiauxin antagonists in general. The results give rise to doubts that these propionic and isobutyric acids are antiauxins of the same type. The shapes of the curves of the propionic and isobutyric acids are also different. The propionic acid curves lack a pronounced peak at an optimal concentration. It must also be kept in mind that these results are restricted to epidermal cell elongation of wheat roots.

4—5. Geotropisms.

The alterations of geotropism, which have been described under Growth Observations, are related to compounds which above has been defined as antiauxins.

Thus the three acetic acids, cyclohexyloxyacetic acid, phenoxyacetic acid and 3,5-dichlorophenoxyacetic acid, and two propionic acids. α-cyclohexyloxypropionic acid and α-(2,4,6-trichlorophenoxy)propionic acid caused increased positive geotropism. No such increase was caused by α-(2,6-dimethylphenoxy)propionic acid. Its maximal antiauxin activity was also less than the other antiauxins (Fig. 7). Finally all the thirteen α-isobutyric acids increased the positive geotropism of roots. Thus *increased positive geotropism appears in non-toxic concentrations and together with increased cell elongation.*

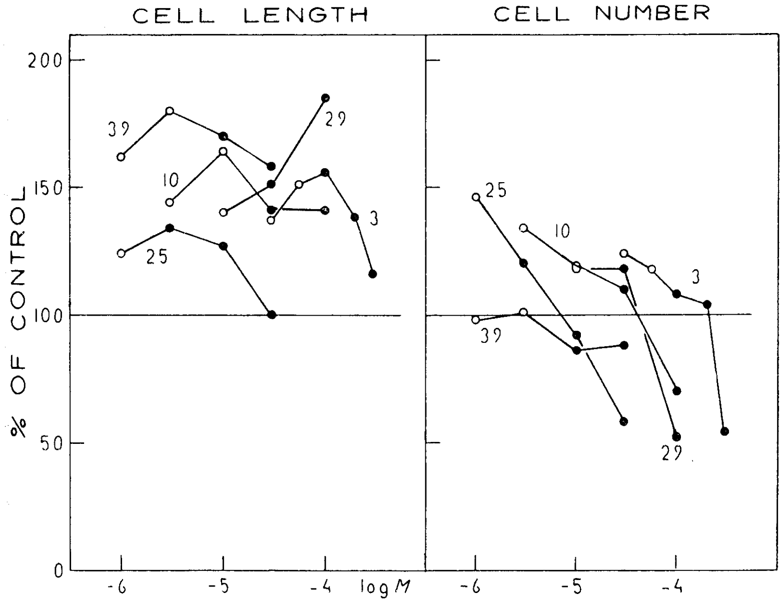


Fig. 15 A. Fig. 15 B.

Fig. 15. »*Ageotropism*». 15 A: cell elongation and 15 B: cell number of roots, treated with substances, causing »ageotropism». Values in per cent of the controls (control = 100). Cell elongation is accelerated, even if the maximum of the curve has been passed. The frequency of cell multiplication is rapidly sinking, indicating increasing toxicity. ○ = no »ageotropism». ● = »ageotropism».

3. phenoxyacetic acid
10. 3,5-dichlorophenoxyacetic acid
25. α-(2,4,6-trichlorophenoxy)propionic acid
29. α-phenoxyisobutyric acid
39. α-3-indoleisobutyric acid

Only some of the compounds which increase the positive geotropism are in higher concentrations able to cause »ageotropism» (Results I 5). Thus the cyclohexyloxyalkylcarboxylic acids are unable to do so. Among the aromatic compounds three unsubstituted ones, i.e., phenoxyacetic acid, α-phenoxyisobutyric acid, and α-3-indoleisobutyric acid cause loss of geotropism. Furthermore 3,5-dichlorophenoxyacetic acid and α-(2,4,6-trichlorophenoxy)propionic acid have this ability (but not α-(2,6-dimethylphenoxy)propionic acid!); α-phenylisobutyric acid and the substituted α-phenoxyisobutyric acids lack this activity. Thus *besides their effect on other physiological processes these five compounds first give rise to an increase of the positive geotropism of wheat roots, then cause »ageotropism»*.

A common quality of these compounds is their weak toxicity. As is seen in figure 15 A cell elongation of the roots is accelerated by the concentrations which cause ageotropism. This is the case even if the maximum of the curve has been passed. The frequency of cell division is, nevertheless, lower than cell elongation (calculated in per cent of the control values). Often it is less than the control and falls rapidly (Fig. 15 B). This phenomenon occurs when an antiauxin is used in toxic sublethal concentrations (Results I 6 and I 7).

6. Cell Multiplication.

In concentrations which do not cause visible toxic symptoms the acetic and α-propionic acids which are auxins (Table 3), inhibit cell multiplication (Fig. 16, 17). There are no differences in cell multiplication between 2,4-dimethylated phenoxyacetic and α-phenoxypropionic acids (Table 8). Chlorination of the ring system increases the effect of the acetic acids. The diorthosubstituted phenoxyacetic acids, which have no cell elongation activity, do not interfere with cell division until toxicity occurs (Fig. 21). The antiauxins, i.e., the cyclohexyloxyalkylcarboxylic acids (Fig. 18), phenoxy- and 3,5-dichlorophenoxyacetic acid (Fig. 16), α-(2,6-dimethylphenoxy)- and α-(2,4,6-trichlorophenoxy)-propionic acid (Fig. 17), α-phenylisobutyric acid and all the α-aryloxyisobutyric acids (Figs. 19, 20) either do not alter or they accelerate the rate of cell division. Finally all the growth substances tested here inhibit cell multiplication in toxic concentrations.

The ability to cause cell multiplication or increase the rate thereof is considered to be one of the qualities of an auxin.

Nevertheless in this investigation the antiauxins accelerate the rate of cell multiplication, while the auxins retard it. This will be discussed later.

Figs. 16—21. *Root cell multiplication activity* in per cent of the controls (control= 100). The auxins (shoot auxins) always decrease cell multiplication of roots, while the antiauxins (root auxins) do not decrease but even can increase cell multiplication in non-toxic concentrations.

Fig. 16. *Active acetic acids* (besides 3-indoleacetic acid). The same acids as in fig. 6.

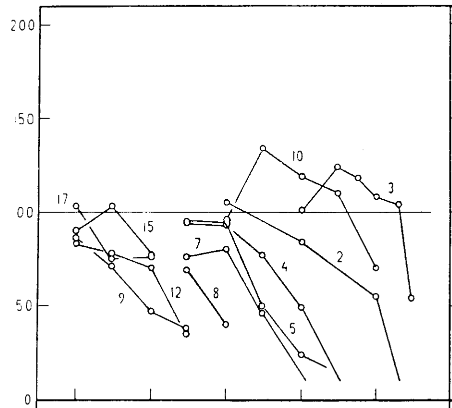
Fig. 17. *Propionic acids.* The same acids as in figure 7.

Fig. 18. *Cyclohexyloxy acids.* The same acids as in figure 8.

Fig. 19. *Isobutyric acids.* The same acids as in figure 9.

Fig. 20. *Halogenated isobutyric acids.* The same acids as in figure 10.

Fig. 21. *Inactive diorthosubstituted phenoxyacetic acids.* The same acids as in fig. 11.



. 16.

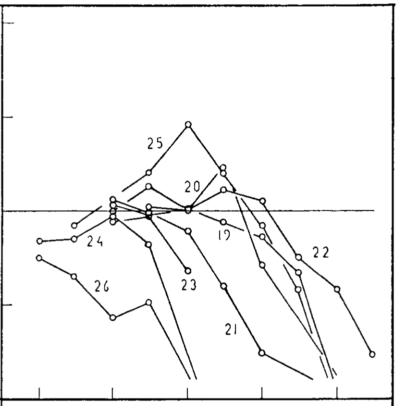
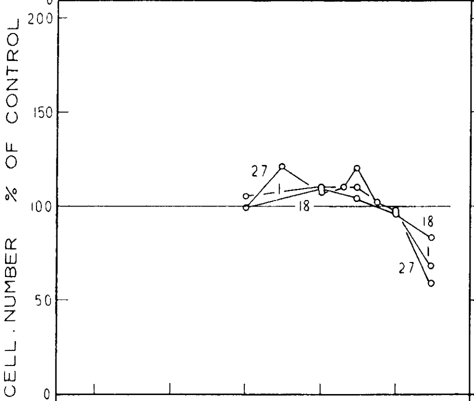


Fig. 17.



. 18.

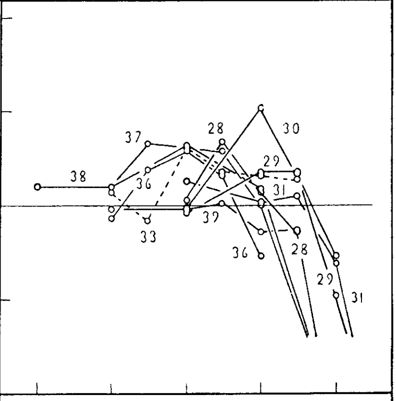
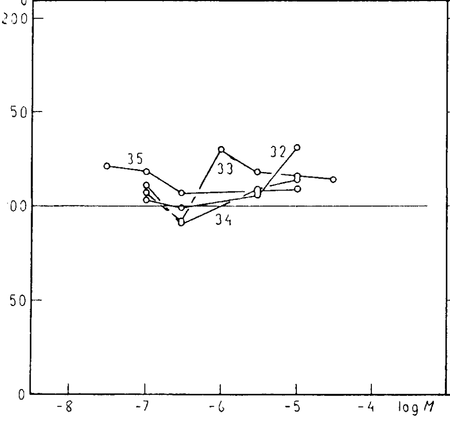


Fig. 19.



. 20.

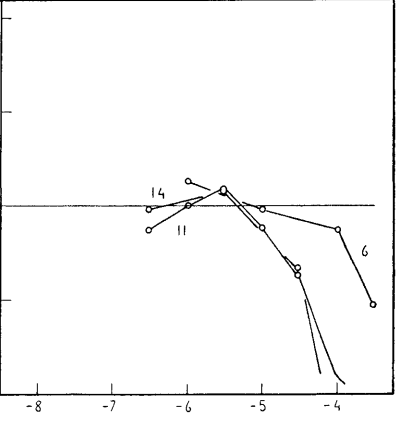


Fig. 21.

Table 8. ***Cell numbers of roots treated with correspondingly substituted phenoxyacetic and α-phenoxypropionic acids.*** **Chlorination (even with one chlorine) increases the inhibiting activity of the acetic acids.**

Compounds	Molarity						
	$3 \cdot 10^{-7}$	$3 \cdot 10^{-7}$	10^{-6}	10^{-6}	10^{-6}	$3 \cdot 10^{-6}$	10^{-5}
2,4-dimethylphenoxyacetic acid	215	173		215	187	132	43
α-(2,4-dimethylphenoxy)propionic acid	223	164		187	115	187	43
4-chlorophenoxyacetic acid	165		94		68		
α-(4-chlorophenoxy)propionic acid	211		143		117		
2,4-dichlorophenoxyacetic acid	102						
α-(2,4-dichlorophenoxy)propionic acid	170						

7. Toxicity.

The morphological phenomena which have been described above as indicating toxicity depend on the structure of the compound in so far that methylation and chlorination in 4- and 2,4-positions increase the toxicity which all these compounds exert. This increase is greater when using auxins than antiauxins (Table 9). When a phenoxyalkylcarboxylic acid is substituted in its 2,6-positions such an increase does not occur, if the compound is inactive as the acetic acids or an antiauxin as the propionic and isobutyric acids. Therefore this increase of toxicity can not only be dependent on some decomposition of the molecule. The 2,6-substituted compounds show that the structure of toxic growth regulators must fulfil the requirements for special growth processes, e.g., have auxin activity, in order to cause increased toxicity. It is hardly likely that this depends upon differences of the dissociation of the compounds (14). The problem is still very vague and undefined.

The toxic activity of antiauxins and their cell elongation activity do not seem to be related to each other. The cell elongation activity of α-phenoxyisobutyric acid is about 30 times weaker than that of α-3-indoleisobutyric acid while their toxicity is found within the same range of concentration (Fig. 9). Their elongation curves have quite a different appearance on account of this. The curve for α-phenoxyisobutyric is steep and has a marked maximal point, the curve for α-3-indoleisobutyric acid is less steep and that for α-(2,4,6-trichlorophenoxy)-propionic acid (Fig. 7) is horizontal within a certain range and has thus no maximum at all. The elongation activity of α-phenylisobutyric acid (Fig. 9) is very weak and its curve is soon interrupted by the great toxicity of the compound.

Table 9. ***Macroscopically visible toxic effects.*** Auxins (shoot auxins) are more toxic to roots than antiauxins (root auxins) or growth-inactive compounds. *Ortho-* and *para-*substitutions mostly increase the toxicity of the auxins. Symbols: 0 = non-toxic concentrations, + = toxic concentrations, † = lethal concentrations.

Compounds	Molarity									
	10^{-8}	$3 \cdot 10^{-8}$	10^{-7}	$3 \cdot 10^{-7}$	10^{-6}	$3 \cdot 10^{-6}$	10^{-5}	$3 \cdot 10^{-5}$	10^{-4}	$3 \cdot 10^{-4}$
Auxins:										
phenylacetic acid							0		0	†
2-methylphenoxyacetic acid						0	0	+		
2,4-dimethylphenoxyacetic acid					0	0	+			
2-chlorophenoxyacetic acid				0	0	+				
4-chlorophenoxyacetic acid				0	+					
2,4-dichlorophenoxyacetic acid			0	+						
2-methyl-4-chlorophenoxyacetic acid			0	+						
3-indoleacetic acid		+	+							
6-chloro-3-indoleacetic acid	0	0	+							
α-phenylpropionic acid							0	0	+	
α-phenoxypropionic acid					0		0	(+)		
α-(2,4-dimethylphenoxy)propionic acid				0	0					
α-(4-chlorophenoxy)propionic acid			0	0	(+)					
α-(2,4-dichlorophenoxy)propionic acid			0	0	+					
α-3-indolepropionic acid		0	0	+						
Antiauxins:										
cyclohexyloxyacetic acid							0		0	+
phenoxyacetic acid							0		0	+
3,5-dichlorophenoxyacetic acid					0		0	(+)	+	
α-cyclohexyloxypropionic acid							0		0	+
α-(2,6-dimethylphenoxy)propionic acid						0	0		+	
α-(2,4,6-trichlorophenoxy)propionic acid					0	0		+		
α-cyclohexyloxyisobutyric acid								0	0	+
α-phenylisobutyric acid							0	0	†	
α-phenoxyisobutyric acid							0	0	+	†
α-(2-methylphenoxy)isobutyric acid					0		0		+	
α-(2,4-dimethylphenoxy)isobutyric acid								0	0	†
α-(4-chlorophenoxy)isobutyric acid							0	0		
α-(2,4-dichlorophenoxy)isobutyric acid					0	0	+			
α-(2,4,6-trichlorophenoxy)isobutyric acid					0	0	(+)	+		
α-(2-methyl-4,6-dichlorophenoxy)isobutyric acid					0		0		†	
α-3-indoleisobutyric acid					0	0	(+)	(+)		
Inactive:										
2,6-dimethylphenoxyacetic acid							0		0	(+)
2,4,6-trichlorophenoxyacetic acid							0	+	†	
2-methyl-6-chlorophenoxyacetic acid							0	0	(+)	
2-methyl-4,6-dichlorophenoxyacetic acid						0		0	+	

Discussion.

I. Auxin Theories.

There are six more or less diverging theories of the problem structure—activity. These theories will not be compared here; only that which is relevant to each theory will be discussed. It should be kept in mind that the experimental methods upon the results of which these theories are based, are not uniform.

1. The present results support the structural requirements for activity given by KOEPFLI, THIMANN, and WENT (26) in so far that all auxins in this investigation fulfil these requirements, but they are not applicable to cell elongation activity in general. They do not hold good for cell elongation of roots, as the three cyclohexyloxyalkylcarboxylic acids are active, although lacking double bonds in the ring (they increase the grand period of cell elongation of roots). Moreover, a number of substances which fulfil their requirements for auxins have been found here to be either antiauxins or inactive. Antiauxins are phenoxyacetic acid, 3,5-dichlorophenoxyacetic acid, α-(2,6-dimethylphenoxy) propionic acid, α-(2,4,6-trichlorophenoxy)propionic acid and all the thirteen α-isobutyric acids. Inactive substances are the four diorthosubstituted phenoxyacetic acids.

This study has shown that there are other kinds of cell elongation activities among growth substances than auxin activity. They seem to have different structural requirements.

2. A physico-chemical theory of structure and activity has been evolved by VELDSTRA (53, 54). Later he has revised and discussed the results of other physiologists (55). The present author can not decide to what extent her results confirm or contradict his theories, when she has not studied the special physico-chemical qualities of the compounds used. However, VELDSTRA finds that it is not the structure of the entire molecule but a very special combination of active groups in that molecule that is of primary importance. The present results support this conclusion.

3. HANSCH and MUIR (20, 21, 36, 37) have found that certain growth-active substances can be inactivated by diorthosubstitution, and with this as a base they have laid down their two-point attachment theory. MCRAE and BONNER (34, 35) have tried to explain this theory kinetically and have included antiauxin activity and antagonism in the theory.

According to this theory diortho-substituted acids and α-arylisobytyric acids block auxin at either of the two attachment points by steric hindrance. But in this investigation the α-isobutyric acids counteract endogenous auxins while the diorthosubstituted acetic acids do not compete with them but with the α-isobutyric acids. This indicates that blocking of the ring and blocking of the side chain belong to different reactions. In this study the diorthosubstituted acetic acids have no influence upon root cell elongation and this corresponds with the results of HANSCH and MUIR. However, both the compounds phenoxyacetic acid and 3,5-dichlorophenoxyacetic acid, which according to the two-point attachment theory should be auxins as both their attachment points are free, are antiauxins. This theory does not explain why diorthosubstituted α-phenoxypropionic acids are antiauxins while corresponding acetic acids are inactive antagonists and nor why these acetic acids antagonize diorthosubstituted α-phenoxyisobutyric acids but not diorthosubstituted α-phenoxypropionic acids.

4. The *para*-theory of LEAPER and BISHOP (31) is not applicable to antiauxin activity as 3,5-, 2,6-, and 2,4,6-substituted antiauxins are not inactivated (Figs. 6, 7, 9).

5. The Wye school requires three receptor centres for activity, the two which are postulated under point 3 and moreover one at a hydrogen atom attached to the α-carbon atom (57). They have used several different tests and have found α-aryloxyisobutyric acids inactive in these tests (in exceptional cases a weak auxin activity has been observed). These compounds are active as antiauxins in our root cell elongation tests. Leaving this out of consideration other exceptions have been found. According even to the three-point attachment theory phenoxyacetic acid and 3,5-dichlorophenoxyacetic acid should be auxins, not antiauxins as here.

6. THIMANN has critically reviewed these thories (49) and found qualities in common. He explains the activity of a compound by the qualitites of the constituents of the molecule and their influence upon each other. He classifies 2,4,6-substituted phenoxyacetic acids as weak auxins and 3,5-dichlorophenoxyacetic acid as inactive. Thus the present results are not corresponding as the 2,4,6-substituted acids are inactive and the 3,5-substituted one is active as an antiauxin.

As is seen none of these theories can satisfactorily explain the present results. All six theories are founded on different shoot tests without attempts to identify growth phenomena which have been studied, i.e., elongation in all kinds of shoot tissues without considering the different growth processes which compose cell elongation (17). Some investigations have been based on total root growth or root cell elongation. As to cell multiplication, geotropism and other groups of growth processes they have been poorly studied.

It is remarkable that it is chiefly the activity of certain particular compounds, which does not agree with most of these theories. These compounds are above all phenoxyacetic acid, 3,5-dichlorophenoxyacetic acid and diorthosubstituted α-phenoxypropionic acids. Nevertheless these theories may all be of some value if the concept activity is restricted to auxin activity, defined as a promotion of shoot cell elongation. Similar but not identical laws may control the activity of root cell elongation. Auxins inhibit elongation of root cells. On the other hand compounds which accelerate elongation of root cells do not necessarily inhibit that of shoot cells (Table 3). There are compounds such as 3,5-dichlorophenoxyacetic acid and α-aryloxyisobutyric acids which are inactive on shoots and accelerate elongation of roots. When a compound is called active, the kind of activity should be stated. When it is said that only compounds with an unsaturated ring system are active, active means promoting growth of stems. In this investigation the three compounds which have a saturated ring system are active, i.e., they promote cell elongation of roots.

These different kinds of activity emphasize one point. It is necessary to try to solve the many problems of growth before the relation of structure — activity can be cleared up. VELDSTRA says (55): »The problem of structure — activity will not be completely solved as long as our knowledge of the nature of action is so much less than that of the structure».

Primarily morphological observations should be made and referred to their different physiological actions, and, when these are known and well defined, the structure of the compounds influencing each of these actions may be established. No further theory will be laid down here, but an attempt will be made to refer the growth observations, which have been carried out, to their physiological actions and some special relations will be discussed.

II. Physiological Actions and Their Interrelationships.

The seven growth observations can be referred to a few physiological groups of actions. These are auxin activity, antiauxin activity, antagonism and toxicity. *Auxin activity* includes decrease of cell elongation and cell multiplication in roots. *Antiauxin activity* includes increase of cell elongation, cell multiplication, and positive geotropism. *Antagonism* is the ability to retard or block these two kinds of actions and does not necessarily belong to the growth processes. This is underlined by the fact that antagonists sometimes act only upon externally added growth substances. *Toxicity* should, from a physiological point of view, be decomposing, destructive processes which do not belong to genuine growth processes, but it can not be separated from every growth action in this paper. Here it includes decreases of cell elongation and cell multiplication and perhaps also the »ageotropism».

This classification cannot simply be used due to the relations which exist between these groups of actions. Both auxin and antiauxin activity include cell elongation and cell multiplication of shoots and roots. The first problem which arises will then be the relations which exist between these kinds of elongation and multiplication.

Elongation—Multiplication.

Auxins promote cell elongation of shoots. If the constitution of the cells permits, they can also cause stimulation of mitosis and cell division. We can reason in the same way concerning the antiauxin activities as regards roots. But the increased cell number will only appear if no inhibiting factor is present (17). This may explain the variation of cell multiplication which has been described in Results I 6. The increase in cell elongation of roots will appear chronologically after the cell multiplication.

Multiplication and elongation should as a matter of principle be kept apart when growth is studied, as they represent two physiologically quite different processes. This principle is not invalidated by the fact that some growth compounds act upon both processes, but it is the reason why total root growth is no good measure of activity of growth substances.

Total root growth can apparently be stimulated only to a certain limit (200 per cent) by cooperation of multiplication and elongation depending on nutrition and other conditions. If cell multiplication is increased by an antiauxin (at a high nitrogen concentration as is used here), elongation can seemingly be substituted by multiplication (10 A, 17).

Acceleration of cell multiplication as well as of cell elongation is attributed to the auxin effects. The acceleration is changed to inhibition in roots depending on superoptimal concentration of natural auxin. When further auxin is added externally the elongation will be still strongly inhibited. The reported inhibition of multiplication cannot be distinguished from that type of inhibition, which is a sign of toxicity. It may be the very first symtom of toxicity. If this is the case the ability to stimulate cell multiplication will be a genuine quality of auxins. The compounds which here are classified as antiauxins should then be antiauxins only as regards elongation and auxins as regards multiplication. The definition of antiauxins has also been based only on the elongation activity of the compounds. If the same compound exerts a different influence upon the two processes, multiplication and elongation, this is another reason for differentiation until their definite relations have been classified.

This interpretation gives us a possibility of applying the growth terminology, now in use for shoot growth, even to root growth. Then *auxins can be called shoot auxins* and the compounds, which up to now have been called *antiauxins can be called root auxins. Shoot auxin increases elongation of shoot cells and root auxin increases elongation of root cells. Both accelerate cell multiplication in their respective organs,* if the conditions permit, and both increase the tensibility of the cell wall (17). *Thus shoot and root processes, which are morphologically alike, will be uniformly nominated.*

Nothing in this view is contradicted by the fact that shoot and root auxins antagonize each other in certain cases. This corresponds with the thought that there are two kinds of growth, which have much in common, but are not identical. Other supporting evidence is the influence of root auxins upon geotropism (cf. RUFELT 43). If there is one master reaction, influenced by additional factors (48), or if there are various equal reactions, cannot be definitely decided.

These lines of thought are limited by the fact that not even cell elongation and cell multiplication are single growth processes but two groups of processes. The different components, which contribute to each group must be isolated and defined before the growth concepts can be finally established. At the present stage, however, the concepts shoot and root auxin seem to be appropriate.

Shoot and Root Auxin Effects — Toxicity.

Another problem is the relations between, on the one hand, the growth effects of shoot and root auxins and, on the other hand, their toxicity. It has earlier been shown that both shoot and root auxins inhibit cell elongation and multiplication in toxic concentrations. They inhibit not only their respective organs, but shoot auxins inhibit both elongation and multiplication of roots and root auxins inhibit — when toxic — the growth of the shoots. The effects of shoot auxins on roots cannot be separated from toxicity. They increase the cell wall tensibility, which is a real auxin function (17) in the same concentrations as the inhibitions appear, which may be toxic signs depending upon overdosage.

The higher the concentration of a shoot auxin used in a root test, the shorter the grand period of root cell elongation. Finally elongation amounts only to about 40 μ. Further increase of concentration causes no further inhibition before lethal concentration is reached. Thus some elongation remains which is not affected by these compounds. There is a natural explanation to this. The volume of living dividing cells must be enlarged to a certain limit by swelling of the cell content, which may go on independently of the influence of growth compounds upon the cell elongation proper. When studying shoot auxin antagonism in root tests, e.g., the interaction between 2,4-D and an antagonist, it is inexpedient to supply 2,4-D in too high a concentration. If growth is reduced so much that only this independent growth remains (69, 71), the effect of the antagonist is computed relative to the residual growth, which probably does not imply any real elongation but actually a zero value.

Root auxin effects on roots can be separated fairly well from toxicity. The growth functions of unsubstituted root auxin appear in different concentration areas while their toxicity appears within the same high concentrations. Furthermore elongation and toxicity depend on ring substitutions in different ways. *The real growth effects are stimulating functions, while the toxic ones are inhibiting.*

One growth observation, »ageotropism», appeared only in toxic concentrations, preceeded by increased positive geotropism. A certain high concentration was required in order to give rise to this phenomenon. Perhaps it may only appear when using root auxins of weak toxicity. Other more toxic root auxins which increase the positive geotropical response may kill the plants before »ageotropism» appears. »Ageotropism» may also depend on the chemical structure of just those compounds which cause it. It can not be said whether »ageotropism» depends on an increase of a negative geotropic reaction or loss of the ability to react geotropically (cf. RUFELT).

Thus from the different functions only the two kinds of auxin effects and toxicity remain. The auxin types are *shoot auxin and root auxin, both stimulating elongation and multiplication in their different plant* *parts. The root auxins are furthermore able to increase the positive geotropism of roots.* All other observations can be referred to toxicity or to processes which are not real growth functions.

Summary.

The influence of about 40 compounds on the growth of wheat roots has been studied. Their effects appeared as decreased and increased cell elongation, antagonism against externally added growth substances, increased positive geotropism, »ageotropism», decreased and increased cell multiplication, and toxicity. These different morphological observations have been described separately and after a survey of the literature have been related to the structure of the different compounds. The agreement of these kinds of influence with six more or less divergent growth theories has been discussed. None of these theories wholly explains the results obtained. Yet all of them are valid to a certain extent if they are restricted to auxin activity in shoots.

The different morphological observations can be referred to some few real growth processes, and the growth active substances have been classified according to these. Real growth processes are increased cell elongation and cell multiplication, and, furthermore, increased positive geotropism. Decreased cell elongation and cell multiplication, antagonism, »ageotropism», and toxicity cannot without reservations be included in real growth. Auxins exert inhibiting effects in roots which have been interpreted as overdosage and cannot be separated with certainty from toxic inhibitions. Compounds hitherto classified as antiauxins, owing to their ability to counteract root inhibitions of auxins, have the same effects in roots as auxins in shoots. Antiauxins increase cell elongation and cell multiplication in roots, if conditions permit, and cause, furthermore, increased positive geotropism. Antagonists are compounds, which counteract the effects of externally added auxins or antiauxins, without having any real growth effects of their own.

According to these data the concept shoot auxin has been introduced instead of auxin and the concept root auxin instead of antiauxin. Thus processes in shoots and roots, which are morphologically alike, will be uniformly nominated.

References.

1. Allard, R. W., DeRose, H. R., Swanson, C. P. — Bot. Gaz. 107, 575. 1946.
2. Audus, L. J. — New Phytol. 48, 97. 1949.
3. — Shipton, M. E. — Physiol. Plant. 5, 430. 1952.
4. Avery, G. S., Berger, J., Shalucha, B. — Bot. Gaz. 104, 281. 1942.
5. — Burkholder, P. R., Creighton, H. B. — Amer. Jour. Bot. 24, 226. 1937.
6. Bentley, J. A. — Nature 165, 449. 1950.
7. Blackman, G. E. — Nature 155, 500. 1945.
8. — Holly, K., Roberts, H. A. — Symposia Soc. Exp. Biol. 3, 283, 1949.
9. Bonner, D. M. — Bot. Gaz. 100, 200. 1938.
10. Bonner, J., Koepfli, J. B. — Amer. Jour. Bot. 26, 557. 1939.

10 A. Bosemark, N. O. — Physiol. Plant. 7, 497. 1954.

11. BURSTRÖM, H. — Ann. Agr. Coll. Sweden 10, 209. 1942.
12. — — Physiol. Plant. 3, 277. 1950.
13. — — Physiol. Plant. 4, 199. 1951.
14. — — Physiol. Plant. 4, 470. 1951.
15. — — Physiol. Plant. 4, 641. 1951.
16. — — Physiol. Plant. 5, 391. 1952.
17. — — Physiol. Plant. 7, 548. 1954.
18. FAWCETT, C. H., OSBORNE, D. J., WAIN, R. L., WALKER, R. D. — Ann. Appl. Biol. 40, 232. 1953.
19. HAAGEN SMIT, A. J., WENT, F. W. — Proc. Kon. Ned. Akad. Wetensch., Amsterdam 38, 852. 1935.
20. HANSCH, C., MUIR, R. M. — Plant Physiol. 25, 389. 1950.
21. — — METZENBERG, R. L. — Plant Physiol. 26, 812. 1951.
22. HANSEN, B. A. M. — Physiol. Plant. 4, 667. 1951.
23. HITCHCOCK, A. E., ZIMMERMAN, P. W. — Contrib. Boyce Thompson Inst. 17, 35. 1952.
24. HOFFMANN, O. L., FOX, S. W., BULLOCK, M. W. — Jour. Biol. Chem. 196, 437. 1952.
25. INGESTAD, T., — Physiol. Plant. 6, 796. 1953.
26. KOEPFLI, J. B., THIMANN, K. V., WENT, F. W. — Jour. Biol. Chem. 122, 763. 1938.
27. KÖGL, F., KOSTERMANS D. G. F. R. — Z. Physiol. Chem. 235, 201. 1935.
28. — VERKAAIK, B. — Z. Physiol. Chem. 280, 167. 1944.
29. — HAAGEN SMIT, A. J., ERXLEBEN, H. — Z. Physiol. Chem. 288, 104. 1934.
30. LANE, R. H. — Amer. Jour. Bot. 23, 532. 1936.
31. LEAPER, J. M. F., BISHOP, J. R. — Bot. Gaz. 112, 250. 1951.
32. LINSER, H. — Pflanzenschutz-Ber. 1949, 131.
33. MARMER, D. R. — Amer. Jour. Bot. 24, 139. 1937.
34. McRAE, D. H., BONNER, J. — Plant Physiol. 27, 834. 1952.
35. — — — Physiol. Plant. 6, 485. 1953.
36. MUIR, R. M., HANSCH, C. H., GALLUP, A. H. — Plant Physiol. 24, 359. 1949.
37. — — — Plant Physiol. 26, 369. 1951.
38. NORMAN, A. G., WEINTRAUB, R. L. — Natl. Research Council Nat. Acad. Sci. (U.S.) Chem. Biol. Coordination Center, Pub. I Sympos. 46, 1951.
39. NUTMAN, P. S., THORNTON, H. G., QUASTEL, J. H. — Nature 155, 498. 1945.
40. OSBORNE, D. J., WAIN, R. L. — Proc. IInd Int. Congr. Crop Protection London 333, 1949.
41. — — — Science 114, 92. 1951.
42. VAN OVERBEEK, J., BLONDEAU, R., HORNE, V. — Plant Physiol. 26, 687. 1951.
43. RUFELT, H. — Physiol. Plant. 7, 141. 1954.
44. SKOOG, F., SCHNEIDER, C. L., MALAN, P. — Amer. Jour. Bot. 29, 568. 1952.
45. SMITH, M. S., WAIN, R. L., WIGHTMAN, F. — Ann. Appl. Biol. 39, 295. 1952.
46. SYNERHOLM, M. E., ZIMMERMAN, P. W. — Contrib. Boyce Thompson Inst. 14, 91. 1945.
47. THIMANN, K. V. — Proc. Kon. Ned. Akad. Wetensch. Amsterdam 38, 896. 1935.
48. — — Plant Growth Substances, 21 (F. Skoog, Ed., Madison, Wisc., 1951).
49. — — Plant Physiol. 27, 392. 1952.
50. — BONNER, J. — Physiol. Rev. 18, 524. 1938.
51. — SCHNEIDER, C. L. — Amer. Jour. Bot. 26, 328. 1939.

52. THOMPSON, H. E., SWANSON, C. P., NORMAN, A. G. — Bot. Gaz. 107, 476. 1946.
53. VELDSTRA, H. — Enzymologia 11, 97 and 137. 1944.
54. — — Biochim. et Biophys. Acta 3, 278. 1949.
55. — — Ann. Rev. Plant Physiol. 4, 151. 1953.
56. WAIN, R. L. — Jour. Sci. Food Agric. 2, 101. 1951.
57. — — Lectures, Monographs and Reports No. 2, 1953.
58. — WIGHTMAN, F. — Ann. Appl. Biol. 40, 244. 1953.
59. WEINTRAUB, R. L. — Agr. Food Chem. 1, 250. 1953.
60. WENT, F. W. — Proc. Kon. Ned. Akad. Wetensch. Amsterdam 42, 581. 1939.
61. — — Proc. Kon. Ned. Akad. Wetensch. Amsterdam 42, 731. 1939.
62. — — Arch. Biochem. 20, 131. 1949.
63. ZIMMERMAN, P. W. — Torreya 43, 98. 1943.
64. — HITCHCOCK, A. E. — Contrib. Boyce Thompson Inst. 8, 337. 1937.
65. — — — Contrib. Boyce Thompson Inst. 12, 321. 1942.
66. — WILCOXON, F. — Contrib. Boyce Thompson Inst. 7, 209. 1935.
67. ÅBERG, B. — Physiol. Plant. 3, 447. 1950.
68. — — Arkiv Kemi 3, 549. 1951.
69. — — Physiol. Plant. 5, 305. 1952.
70. — — Ann. Agr. Coll. Sweden 20, 241. 1954.
71. — KHALIL, A. — Ann. Agr. Coll. Sweden 20, 81. 1954.

BOTANISKA NOTISER 1954, HÄFTE 3. LUND

Diatomeen und einige andere Algen aus dem »de Hoek»-Reservat in Nord-Transvaal.

Von B. J. CHOLNOKY.
Universiteit van Pretoria.

Auf einer Exkursion mit dem Herrn Prof. Dr. R. KRAEUSEL aus Frankfurt a.M. hat Prof. Dr. H. G. SCHWEICKERDT (Pretoria) in dem »de Hoek»-Waldreservat in der Nähe des Debegeni-Wasserfalles im Zoutpans-Gebirge aus aërophytischen und halb-aërophytischen, saueren (pH=5,6) Standorten 17 Algen- und Moosproben gesammelt, von denen einige wichtige Aufschlüsse besonders über die Diatomeen-Gesellschaften ähnlicher, tropischer Standorte aus einer bisher gänzlich unbekannten Gebiete lieferte.

Die Proben, von denen nur eine die Bestimmung des pH's ermöglichte, waren die folgenden:

1. »Triefende, schattige, vertikale Felswand. Debegeni.» — Typisch halbaërophytisches Material, dessen Hauptmenge durch die Cyanophyta gebildet wird. In der so gebildeten gallertigen Masse lebt auch eine sehr individuenreiche Diatomeenassoziation und einige wenige Desmidiazeen.
2. »In stark fliessendem Wasser. Felsplatten mit Podostemonaceen. Debegeni.» — Zwischen den Stengeln und Blättern der Podostemonacee habe ich ausser einiger vegetativen *Spirogyra*-Fäden nur Diatomeen gesehen.
3. »Triefende Felsen. Schatten. Debegeni.» — Das Material wird durch ein lockeres Moosrasen gebildet, in welchem ausser der *Microchaete transvaalensis,* einer vegetativen *Oedogonium* sp., und einiger Chlorococcalen sehr viele Diatomeen vorkommen.
4. »Moosrasen auf einer kleinen Insel zwischen Gras. Debegeni.» — Das Material wird durch eine Jungermanniale gebildet, die sicher hauptsächlich submers leben musste, da sie aërophytische Elemente nur spurenweise, desto reichlicher aber die eines saueren, tropisch-subtropischen Baches beherbergt. Die anderen Algengruppen waren nur spärlich vertreten (pH=5,6).
5. »Auf feuchten Felsen und Holz in der Nähe des Wassers. Schatten.» — Eine Jungermanniale und eine Bryale bildet das Material, in welchem ich ausser unbestimmbaren Resten einer *Oscillatoria* nur eine reichliche Diatomeenflora feststellen konnte.

6. »Feuchter Moosrasen auf horizontaler Felsplatte. Schatten. Debegeni.» — Rasen einer Jungermanniale, in welchem einige Cyanophyten und eine arme Diatomeenflora zu beobachten war.

7. »In praller Sonne. Schnell fliessendes Wasser. Debegeni.» — Das Material wird durch eine rein vegetative, also unbestimmbare *Spirogyra* sp. gebildet, die nicht besonders viele Diatomeen beherbergt. Andere Algen habe ich nicht gesehen.

8. »Suid ingang tot Forestry-pad. Moosrasen im Schatten auf vertikalen Felsen im Walde.» — In diesem Rasen eines Laubmooses konnte ich nur wenige, hauptsächlich aerophytische Diatomeen beobachten.

9. »Baumrinde, Halbschatten, gelbbraun. Debegeni.» — Kleine Laubmoose und Flechten mit einer ziemlich reichlichen Diatomeenflora.

10. »Moosrasen. Debegeni. Epiphytisch auf einer Liane.» — Ein Moosrasen mit einer überraschend reichen Diatomeenflora, die vermuten lässt, dass der Standort zeitweise überschwemmt oder ausserordentlich nass wird.

11. »Zwischen Felsen. Schatten. *Selaginella.* Debegeni.» — Eine nur teilweise aërophytische Assoziation eines mit Laubmoosen gemengten *Selaginella*-Rasens.

12. »Moosrasen auf flachen (horizontalen) Felsen. Schatten. Debegeni.» — Die hier vorkommende Diatomeenassoziation ist sehr individuen- und formenarm, zeigt aber deutlich, dass sie nur teilweise autochton sein kann.

13. »Schattige Felsen. Debegeni-Wasserfall, ca. 8 m vom Wasser entfernt». — Ausser einer typisch tropisch-aërophytischen, formenarmen Diatomeenassoziation konnte ich keine andere Algen zwischen den Blättern der getrocknet angekommenen Moose entdecken.

14. »Auf den Brettwurzeln einer *Anthocleistra zambeziaca* (Loganiaceae). Debegeni.» — Trockener Moosrasen mit nur auffallend wenigen, wahrscheinlich hauptsächlich verschleppten Diatomeen, die man keinesfalls als eine autochtone Assoziation auffassen kann.

15. »Moosrasen. Epiphytisch auf Lianen. Debegeni.» — Ein getrockneter Moosrasen, der sicher öfters und für längere Zeit überschwemmt wurde, da sie nur wenige aërophytische, viel mehr aber die in den saueren, tropischen Bächen Afrikas häufige Diatomeen enthält. Ein teil der sehr reichlichen Diatomeenflora ist also sicher heterochton.

16. »Auf lebenden Baumstämmen, etwa 2 m über dem Boden. Nähe des Hotels Magoebaskloof. Oberste Baumgrenze. Schatten.» — Getrockneter Laubmoosrasen mit nur wenigen, aërophytischen Diatomeen.

17. »Moosrasen. Epiphytisch. Einem vertikalen Baumstamm entnommen. Nähe der obersten Baumgrenze. Magoebaskloof-Hotel.» — Eine noch ärmere aërophytische Assoziation in einem ebenfalls getrockneten Moosrasen.

Ich bemerke noch, dass die Proben 1—15 am 9. Dez. 1953 und die beiden letzten (16, 17) am 16. Jänner 1954 gesammelt wurden.

Es bedeutet für mich eine angenehme Pflicht, sowohl dem Herrn Prof. Dr. R. Kraeusel, besonders aber dem Herrn Prof. Dr. H. G. Schweickerdt für das Sammeln und die Überlassung der Materialen meinem aufrichtigen Dank auch auf dieser Stelle einen Ausdruck zu geben.

Die Thomasson-Analysen dieser Proben habe ich unterlassen, da sie kaum mit voller Berücksichtigung der Milieufaktoren gesammelt wurden und mir ausser dem einzigen pH keine andere hydrologische Angaben über die Fundorte zur Verfügung stehen. Die geschätzte Häufigkeit der gesehenen Formen habe ich nach den mit den oben angeführten Nummern angegebenen Standorten zwischen Klammern in der Aufzählung der gefundenen Formen angegeben, da ich eine tabellarische Zusammenstellung ähnlicher Schätzungen — die zwangsläufig sehr persönlich und von nebensächlichen Faktoren abhängig sein müssen, wodurch sie nur mit einem hohen Masse des Erkenntnisoptimismus miteinander vergleichbar sind — nicht nur überflüssig und kostspielig, aber auch irreführend halte. Die vollkommene Unbekanntheit dieses interessanten Gebietes lässt mir aber die ausführliche Aufzählung der gefundenen Formen, besonders die der seltenen und neuen, unerlässlich erscheinen.

Im Texte sind, wie gesagt, die Fundorte mit ihren Nummern angegeben, nach diesen stehen die von mir stets gebrauchten Andeutungen der geschätzten Häufigkeit (SH=sehr häufig, H=häufig, ZH=ziemlich häufig, NS=nicht selten).

Zuerst zähle ich die seltenen, wenig bekannten oder neuen Diatomeen-Formen auf. Diese sind:

Achnanthes inflata KG. f. **elatoides** n.f. — HUSTEDT (1937—39) hat auf den Sunda-Inseln die durch LEUDIGER-FORTMOREL beschriebene Form »*Navicula elata*» wieder aufgefunden und diese als Varietät zur *A. inflata* gestellt. Die Selbständigkeit der Varietät wird auch durch ihre Auxosporenbildung bestätigt (vgl. GEITLER 1932). In einem dieser Materialen habe ich eine Form der *A. inflata* gefunden, die, was ihre Umrisse betrifft, der var. *elata* ähnlich aber viel kleiner ist, da ihre Länge meistens nur 20—25 μ und die Breite 10—12 μ beträgt, d.i. auch unter den Abmessungen der typischen Form bleibt. Da ich aber in dem reichlichen Material auch einige Übergänge (Fig. 4) nach dem Typus gesehen habe, kann ich sie nur als Form beschreiben. — Fig. 1—4. — Fundort 5.

A. Kraeuselii n.sp. — Die raphenlose Schale dieser Art zeigt eine gewisse Ähnlichkeit mit der der *A. hungarica* GRUN., ihre Rhaphenschale ist aber grundsätzlich von letzterer verschieden, so dass ihre nächsten Verwandten wahrscheinlich unter andere *Achnanthes*-Arten zu suchen sind (etwa *A. radiosa* HUST., *A. Holstii* CL. usw.). Die Schalen sind linear-lanzettlich oder lanzettlich, niemals linear, die Schalenenden sind gleichmässig lanzettlich verschmälert und abgerundet, nicht vorgezogen. Länge 12—25 μ, Breite 4—6, meistens 5 μ. Rhaphenschale: die Zentralporen der Rhaphe stehen meistens mässig voneinander entfernt, Axialarea ziemlich breit, lanzettlich, in der Mitte nicht erweitert, die Streifung ist auch in der Mitte ununterbrochen. Die Streifen, von denen 18—20 in 10 μ sind und die an den Enden etwas enger stehen, verlaufen besonders auf den Schalenenden auffallend stark radial, sind fein und sehr undeutlich punktiert. Rhaphenlose Schale: Pseudorhaphe eng, nur in der Mitte etwas breiter, die Streifen sind schwach, meistens nur an den Schalenenden deutlich radial, sie sind aber auch hier auffallend minder divergent, als die der Rhaphenschale. Ihre Anzahl beträgt 16—18 in 10 μ, sie sind deutlich punktiert, mit etwa 20—22 Punkten in 10 μ. — Die Art widme ich dem Herrn Prof. Dr. R. KRAEUSEL aus Frankfurt a.M., der auf der de Hoek-Exkursion teilgenommen hatte und bei dem Sammeln der Proben behilflich war. — Fig. 5—10. — Fundorte 3, 4, 5 (NS), 7, 9 (NS), 10 (NS), 15 (NS).

A. Kraeuselii var. ***debegenica*** n. var. — In einem Materiale (15) habe ich neben den typischen *A. Kraeuselii*-Individuen auch viele Exemplare einer grösseren, robusteren Form gesehen, die etwa 30 μ lang und 6—7 μ breit, ausserdem aber auch in der Struktur ihrer Rhaphenschalen auffallend abweichend waren. So war bei diesen die lanzettliche Axialarea in der Mitte stark lanzettlich erweitert und waren einige Streifen neben dem Mittelknoten unregelmässig verkürzt. Da ich keinen Übergang zu dem Typus beobachten konnte, halte ich die Benennung dieser Formen notwendig. — Fig. 11, 12. — Fundort 15.

A. oblongella OESTR. — Nach HUSTEDT (1937—39, Bd. 15: 199) wäre die »Allgemeine Verbreitung» dieser Art »tropisches Asien». Auf Grund meiner Beobachtungen muss ich annehmen, dass sie in den Tropen viel allgemeiner verbreitet ist. Dass sie überall eine »Charakterform» fliessender Gewässer wäre, kann ich auf Grund der hier Untersuchten Fundorte nicht bestätigen. Die Angaben über die pH-Grenzen bei HUSTEDT (l.c.) kann ich kaum als stichhaltend annehmen, da sie auf floristischen Funden und nicht auf ökologischen Untersuchungen gegründet sind. Hier möchte ich noch bemerken, dass manche der gesehenen Exemplare stark unsymmetrisch waren (Fig. 17) und dass die Streifung der rhaphenlosen Schalen immer ± stark unregelmässig ist. — Fig. 13—17. Fundorte 2, 3, 4, 5 (NS), 7, 9, 11 (NS), 12.

A. pinnata HUST. — Die gesehenen vielen sehr typischen Exemplare entsprechen vollkommen den Zeichnungen HUSTEDTS in A. SCHM. Atl. T. 413, Fig. 45—54. Die Art kann demnach keinesfalls einer »Tiefenbiocönose» angehören, sie ist vielmehr eine Art saurer, O_2-reicher, tropisch-subtropischer Kleingewässer, die bei pH 8 sicher nicht lebend, vielmehr nur verschleppt oder subfossil angetroffen werden konnte. — Fundorte 10 (NS), 15 (ZH).

A. Woltereckii Hust. (in A. Schm. Atl. T. 410, Fig. 25—28). — Die Art kommt hier in wohl kurzen, sonst aber typischen Exemplaren vor. Die mittleren Transapikalstreifen der Rhaphenschale sind deutlich stärker lichtbrechend, vielleicht auch dicker, wie die übrigen. Die Breite der bandförmigen Mittelarea variiert ziemlich stark. — Fig. 18, 19. — Fundort 4.

Caloneis Chasei Cholnoky (1954 A). — Die Art kommt hier in ebenso typischen Exemplaren wie in den Vumba-Gebirgen und in der Nähe von Umtali vor, wodurch eine floristische Verwandtschaft dieser benachbarten Gebiete angedeutet wird. Ökologisch scheint sie ± stenotypisch azidophil, mesotherm und aërophil zu sein. — Fig. 20. — Fundorte 8, 15.

Cymbella Chasei Cholnoky (1954 A). — Unter den vielen normalen habe ich manchmal auch etwas dichter gestreifte Individuen gesehen. Das Vorkommen dieser Art ist wieder ein Beweis für die floristische Verwandtschaft der ähnlichen südrhodesischen und nordtransvaalschen Standorte. Der Variationsbereich der Art in diesen Fundorten wurde auf den Fig. 21—23 veranschaulicht. — Fundorte 1, 3, 5, 9, 10.

C. javanica Hust. — Hustedt (1937—39, Bd. 15: 424) versucht auch hier auf Grund, nach seiner eigenen Behauptung, »zerstreuter Funde» den pH-Bereich dieser Art festzustellen, seine Fundorte sind aber Bäche und ein Fischteich, die wahrscheinlich eine sehr heterochtone, teilweise subfossile Flora beherbergen, die kaum als eine Assoziation aufzufassen ist. Nach meinen bisherigen Beobachtungen in Südafrika (vgl. Cholnoky 1954 A, B und C, und besonders 1953 A) ist die Art etwas eurytypisch azidophil und stenotypisch mesotherm, die in tropisch-subtropischen Gebieten um pH 6 ihr Optimum findet. In manchen Standorten habe ich unter den sehr typischen auch längere (Länge bis 33 μ) und etwas dichter gestreifte (bis 13 Transapikalstreifen an der Dorsalseite in 10 μ) Individuen gesehen, die aber durch gleitende Übergänge an dem Typus gebunden waren. Krasske (1948) hatte auch ähnliche Varianten in Brasilien gefunden, der die Art in neutralen oder schwach basischen Gewässern ebenfalls nicht beobachten konnte. — Fundorte 1, 3, 4, 5 (NS), 10, 15 (NS).

C. Mesiana Cholnoky (1953 B und 1954 B). — Diese in saueren Gewässern (Leeufontein in Transvaal) entdeckte und in dem ebenfalls sauerem Mogol-Fluss in einer grösseren Form vorkommende Art ist in diesen Materialen in beiden Grössen vorhanden, die miteinander mit vollkommen allmählichen Übergängen verbunden sind. — Fig. 24. — Fundorte 3, 4.

C. raytonensis CHOLNOKY var. ***debegenica*** n. var. — Die hier gesehenen Formen weichen etwas von der typischen (CHOLNOKY 1953 B, 1954 C) ab, da sie meistens zu den kürzesten (Länge um 20 μ) und breitesten (Breite etwa 5 μ) gehören und ihre Streifung auch etwas gröber punktiert und weiter stehend ist (9—10 dorsale Transapikalstreifen in 10 μ). Vorläufig trenne ich diese Formen ab, da ich den Typus hier nicht auffinden konnte, da aber das manchmal isolierte Vorkommen einer Form keine Grundlage für die Benennung einer Varietät bilden kann, müsste man den obigen Varietäts-Namen im Falle des Auffindens einiger Übergänge einziehen. — Fig. 25. — Fundort 4.

C. turgidula GRUN. var. *Kappii* CHOLNOKY — vgl. CHOLNOKY 1953 A und 1954 C. Eine typische Form neutraler und schwach basischer Gewässer des südlichen Afrikas, die dementsprechend hier sehr selten, sicher nur verschleppt vorkommt. — Fundort 16.

Eunotia actinelloides n.sp. — HUSTEDT (1952) hat neuerdings die »rhaphidioiden» Diatomeen ausführlich behandelt, wobei auch mehrere neue tropische Arten aus Brasilien beschrieben wurden. Er versucht die Scheidung zwischen *Actinella* und *Eunotia* in der hetero- oder isopolen Natur der Apikalachse festzulegen. Die schwache Heteropolarität bei vielen tropischen Arten habe ich wiederholt hervorgehoben (CHOLNOKY 1953 B, 1954 A) und nach der Vermehrung ähnlicher Funde, wie z.B. *E. synedraeformis* HUST. (1952), *E. longissima* HUST. (1952), *E. Mesiana* CHOLNOKY (1953 B) und *E. Theronii* CHOLNOKY (1954 B), aber auch mehr oder minder deutlich asymmetrischer Formen der »gewöhnlichen» *Eunotia*-Typen (*E. rhomboidea* HUST. 1950) bin ich zu der Auffassung gezwungen, dass die Asymmetrie der Apikal-

---

Fig. 1—52. — 1—4 *Achnanthes inflata* KG. var. *elatoides* n. var. — 5—10 *A. Kraeuselii* n.sp. — 11, 12 *A. Kraeuselii* var. *debegenica* n. var. — 13—17 *A. oblongella* OESTR. — 18, 19 *A. Woltereckii* HUST. — 20 *Caloneis Chasei* CHOLNOKY — 21—23 *Cymbella Chasei* CHOLNOKY — 24 *C. Mesiana* CHOLNOKY — 25 *C. raytonensis* CHOLNOKY var. *debegenica* n. var. — 26 *Eunotia actinelloides* n.sp. — 27—31 *E. dissimilis* HUST. — 32 *E. fallax* A. CL. — 33 *E. fallax* var. *gracillima* KRASSKE — 34—35 *E. polydentula* BRUN. — 36 *E. porcellus* CHOLNOKY — 37—41 *E. Rabenhorstii* CL. var. *monodon* GRUN. — 42—45 *E. Rabenhorstii* var. *irregularis* n. var. — 46, 47 *E. Schweickerdtii* n.sp. — 48—50 *E. Siolii* HUST. — 51 *E. subaequalis* HUST. — 52 *E. tenella* (GRUN.) HUST. var. *densestriata* CHOLNOKY. — Vergr. 1330/1.

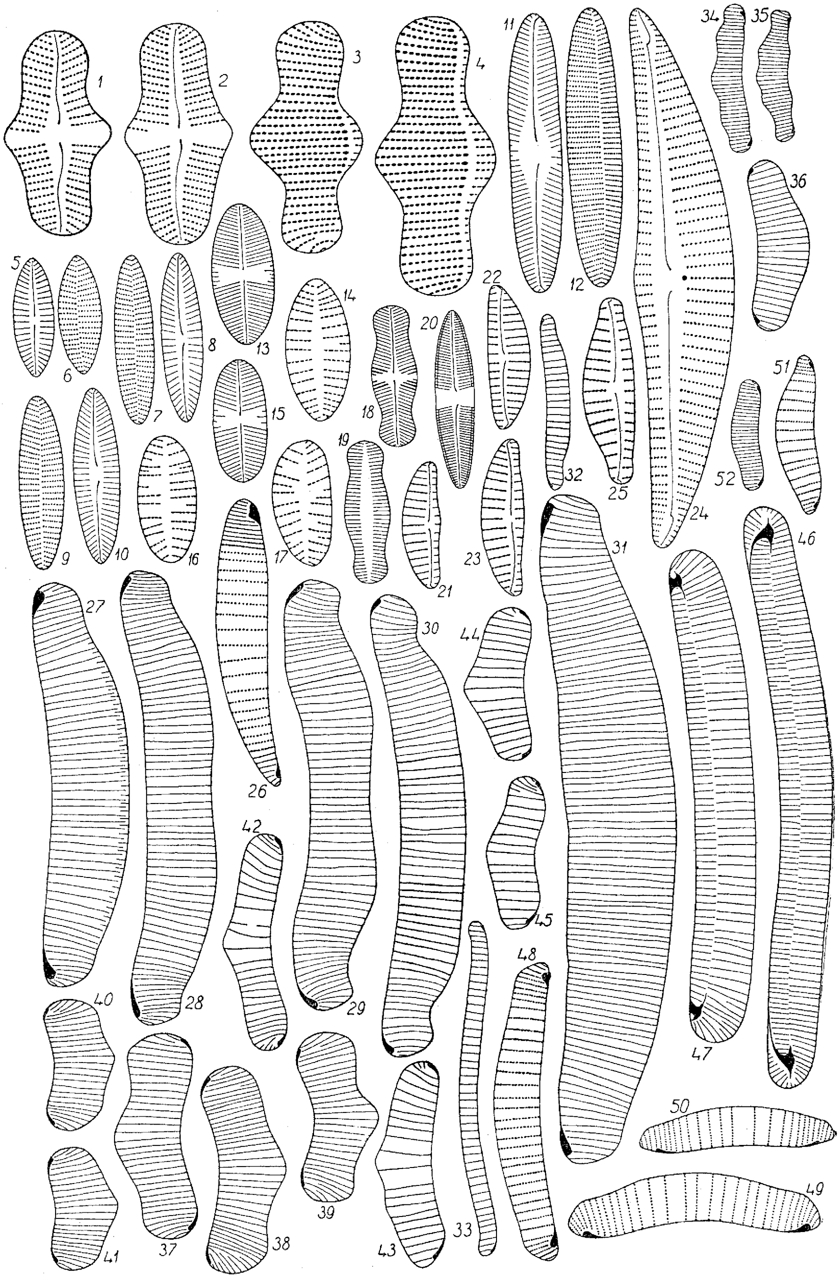

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52

Fig. 1—52.

achse kaum als generisches Unterscheidungsmerkmal gewählt werden kann. So finde ich es besser, die im Material 10 reichlich vorkommende, stark asymmetrische *Eunotia* nicht als *Actinella* zu beschreiben, da die zwei Genera früher oder später doch wieder vereinigt (oder aber andere Merkmale zu ihrer Unterscheidung gewählt) sein müssen werden. Die Apikalachse ist bei *E. actinelloides* stark heteropol, indem der eine Pol breit und gleichmässig, der andere spitzlich aber ebenfalls gleichmässig gerundet ist. Die Ventralseite der Schalen ist schwach und unregelmässig konkav, die Dorsalseite asymmetrisch konvex. Vor den Polen kommen keine Eindrückungen vor. Die Endknoten sind in den Ecken der Ventralseite deutlich asymmetrisch entwickelt, indem der des breiten Endes grösser, robuster ist. Die Länge der Schalen ist 25—35 μ, ihre Breite in der Mitte etwa 5 μ. Die Transapikalstreifen sind in der Mitte sehr unregelmässig gestellt, etwa 8 in 10 μ, deutlich punktiert, in der Nähe der Polen auffallend dichter (bis etwa 20 in 10 μ) und viel undeutlicher punktiert. — Fig. 26. — Fundort 10.

E. dissimilis HUST. (1937—39, Bd. XV: 164). — Neben den durch HUSTEDT (l.c. und A. SCHM. Atl. T. 382, Fig. 101, 102) gezeichneten Formen kommen in diesen reichlichen Materialen auch andere Varianten vor, von denen einige auf den Figuren dargestellt wurden. Ich habe Exemplare mit tiefer oder aber gar nicht eingedrückter Rückenlinie, aber auch andere, auffallend robuste, breite beobachtet, die mit vollkommen gleitenden Übergängen aneinander gebunden sind. Die Fig. 27 stellt ein Exemplar in einer etwas schiefer Lage dar, wodurch das Übergreifen der pleuralen Streifung sichtbar ist. In einigen der unten angeführten Materialen kommen überwiegend kleine Exemplare (Länge 45—50 μ, Breite etwa 8 μ) vor, die aber ebenfalls kaum als selbständige Formen aufzufassen sind. Ich möchte auf dieser Stelle auch auf dem sehr charakteristischen Verlauf der Transapikalstreifen in der Nähe der Polen aufmerksam machen. — Fig. 27—31. — Fundorte 3, 4 (NS), 5 (NS), 6, 9, 10 (NS), 11, 12, 15 (NS).

E. fallax A. CL. — Eine in der letzteren Zeit in tropischen Gewässern wiederholt gesehene Art, die ich auch in den benachbarten rhodesischen Gebirgen (vgl. CHOLNOKY 1954 A) beobachtet habe. — Fig. 32. — Fundort 9.

E. fallax var. *gracillima* KRASSKE. — Sie scheint ebenfalls in saueren Standorten der Tropen allgemein verbreitet zu sein (CHOLNOKY 1952, 1954 A). — Fig. 33. — Fundorte 1, 6.

E. mogolensis CHOLNOKY (1954 B). — Die Waterberge, wo die Art entdeckt wurde, sind nicht zu weit von diesen Standorten entfernt. In dem einzigen angeführten Material habe ich sehr typische Exemplare gesehen. — Fundort 9.

E. polydentula BRUN. — Eine bisher noch nur selten gesehene, in ähnlichen tropischen Standorten wahrscheinlich aber öfter vorkommende, stenotypisch azidophile und eurytypisch mesotherme Art, die als solche selbstverständlich »halophob» ist. — Fig. 34, 35. — Fundorte 5, 9.

E. porcellus CHOLNOKY (1953 B, 1954 A). In der letzteren Zeit habe ich diese kleine, charakteristische *Eunotia* bei pH 5—6 öfter in Südafrika gesehen. Die Figur stellt ein Exemplar mit etwas abweichenden Umrisslinien dar. — Fig. 36. — Fundorte 3, 10, 13.

E. Rabenhorstii CL. var. *monodon* GRUN. — Es ist sehr auffallend, dass die typische Form in tropischen Gewässern weder durch HUSTEDT (1937—39), noch durch KRASSKE (1948), noch durch mich (CHOLNOKY, 1954 A) aufgefunden wurde, demzufolge halte ich es sehr wahrscheinlich, dass in dieser »var. *monodon*» eine »gute», selbständige Spezies vorliegt, die nur durch gewisse zufällige Ähnlichkeit mit *E. Rabenhorstii* CL. verbunden wurde. Es wäre vielleicht besser, sie weiterhin als Spezies aufzufassen, in welchem Falle meiner Meinung nach die Benennung »*E. Grunowiana*» die richtigste sein könnte. Die reichlichen Funde sowohl hier als auch in Süd-Rhodesien beweisen, dass die Art azidophil bis azidobiontisch, meso- oder polytherm ist. Ich bemerke noch, dass ihre Schalen immer deutlich heteropol sind, die Asymmetrie der beiden Polen kommt zumindest in dem Verlauf der polaren Transapikalstreifen immer zum Ausdruck. Um die bisher noch nicht gut bekannte Variation der Art anzudeuten, habe ich auf den Fig. 37—41 einige der in den unten angeführten Materialen gesehenen Schalen dargestellt. — Fundorte 5, 6 (ZH), 8 (ZH), 10 (NS), 13 (NS), 15.

E. Rabenhorstii CL. var **irregularis** n. var. [oder vielleicht richtiger *E. Grunowiana* (GRUN.) var. *irregularis* n. var.]. — Die Form der Schalen ist meistens schlanker, als bei der vorhergehenden Art, die Apikalachse ist auch hier mehr oder minder heteropol. Die Asymmetrie kann manchmal so weit gehen, dass einseitige »sekundäre» Buckels auf der breiteren Hälfte der Schalen entstehen können (Fig. 43). Länge 15—25 μ, maximale Breite etwa 7 μ. Die Transapikalstreifen verlaufen sehr unregelmässig und stehen manchmal besonders stellenweise in der Schalenmitte bei längeren Exemplaren auffallend weit, 10—12, in einzelnen Fällen sogar 8—9 in 10 μ. An den Schalenenden ist die Streifung der typischen *E. Grunowiana* ähnlich. Ich habe einige Zweifel, ob diese Form mit dem Typus zu verbinden oder richtiger als selbständige Art aufzufassen wäre, da die Unterschiede in der Form und Struktur der Schalen zu weitgehend sind. Jedenfalls konnte ich keine Übergänge feststellen, obzwar in dem selben Material auch *E. Rabenhorstii* var. *monodon* (=*E. Grunowiana*) reichlich vertreten war. — Fig. 42—45. — Fundort 8 (NS).

E. Schweickerdtii n.sp. — Eine eigentümlich gebaute, sicher meso- oder polytherme (=»tropische») *Eunotia* aus der Verwandtschaft der *E. parallela* E., mit der sie aber nicht zu verbinden ist. Die Schalen der Art sind auch »wurstförmig», ihre Bauchseite ist aber nur schwach gekrümmt, mit der die Dorsallinie parallel verläuft. Die Enden sind breit und gleichmässig gerundet und ebenso wie bei *E. parallela,* nicht vorgezogen, nicht gestutzt oder auf einer Seite eingedrückt. Nur bei den längsten Exemplaren konnte ich eine kleine Unregelmässigkeit im Verlauf der Ventral- und Dorsallinie beobachten (Fig. 46), die aber auch bei diesen miteinander parallel bleiben. Länge 50—70 μ, Breite 6—7 μ. Den auffallendsten Unterschied zeigen die Endknoten, die nicht in den Ecken der ventralen Schalenenden zu finden, sondern sehr deutlich mehr nach der Mitte zu verschoben und auch mehr in der Mittellinie der Schalen gelagert sind. Mit dem Ventralrand sind sie durch einen Rhaphespalt(?) verbunden und ausserdem tragen sie ein eigenartiges Anhängsel in der annähernden Mittellinie der Schale, das sowohl polwärts als auch nach der Schalenmitte zu entwickelt ist. In der letzteren Richtung liegen diese stark lichtbrechenden und darum auffallenden Äste in der bekannten Längsleiste (»Pseudorhaphe»). Letztere ist in der ganzen Länge der Schalen gut entwickelt und verbindet die beiden Endknoten miteinander. Die »Pseudorhaphe» ist dadurch noch mehr auffallend, dass die Transapikalstreifen auf der ventralen Schalenhälfte etwas dichter stehen und nicht mit denen der Dorsalhälfte korrespondieren. Eine Pseudorhaphe ist allerdings auch bei *E. parallela* auf der Valvarseite sichtbar, sie ist aber viel mehr ventralwärts verschoben. Die bei *E. parallela* sehr regelmässige Streifung ist bei *E. Schweickerdtii* sehr unregelmässig. Die Anzahl der Transapikalstreifen ist auch bei *E. Schweickerdtii* etwa 14, auf der Dorsalseite meistens nur 10—12 (manchmal etwas dichter) in 10 μ, die auch in der Nähe der Polen nicht auffallend dichter werden. Eine wahrscheinlich noch mehr in dem Verwandtschaftskreis dieser Art gehörige *Eunotia* hat HUSTEDT (1952) aus Brasilien unter *E. curvula* HUST. beschrieben, mit der sie im Bau des Endknotens aber in keinen anderen morphologischen Merkmalen der Schale übereinstimmt. Hier bemerke ich noch, dass die scheinbare Verlängerung des Endknotens in polarer

Richtung auch bei *E. Schweickerdtii* ein länglicher Porus sein kann. — Die Art widme ich dem Herrn Prof. H. G. SCHWEICKERDT, dessen Eifer diese interessanten Materiale zu danken sind. — Fig. 46, 47. — Fundorte 3, 4.

E. similis HUST. — Diese Art habe ich in Afrika, allerdings nur in saueren Gewässern, sehr oft gesehen (vgl. CHOLNOKY 1953 B, 1954 A und C), die sich hier somit als eine für pH natürlich »empfindliche» Art erweist. Autochton kann sie natürlich keinesfalls bei pH 8 (!) vorkommen (vgl. HUSTEDT 1937—39). Wie es auf Grund meiner bisherigen Erfahrungen zu erwarten war, ist sie auch in einigen dieser Materialen eine der häufigsten *Eunotien.* — Fundorte 5 (ZH), 6 (H), 8, 10 (NS), 11 (ZH), 15 (ZH).

E. Siolii HUST. (1952). — Die Art ist in geeigneten Standorten in Afrika wahrscheinlich allgemein verbreitet (vgl. CHOLNOKY 1953 B) und sehr gut durch ihre Streifung und gestutzte Enden charakterisiert, die eine Verwechslung mit den kleineren Exemplaren der *E. subaequalis* HUST. ausschliesst. Um die Variabilität der Art in diesen Materialen festzulegen, habe ich drei der gesehenen Exemplare auf den Fig. 48—50 dargestellt. — Fundorte 10 (NS), 14, 15 (ZH).

E. subaequalis HUST. (1937—39 oder A. SCHM. Atl. T. 382, Fig. 5—10). — Ebenfalls eine der häufigsten *Eunotien* saurer südafrikanischer Gewässer (vgl. CHOLNOKY 1953 B, 1954 A und C). Ein auffallend kleines Exemplar aus dem Material 3, die auch sehr weit gestreift ist (Länge 16 μ, Breite 4,5 μ, etwa 10 Streifen in 10 μ) und doch nicht mit der vorhergehenden Art zu verwechseln ist, habe ich auf der Fig. 51 dargestellt und bemerke, dass sie mit gleitenden Übergängen an dem Typus gebunden war, so dass eine Benennung kaum in Frage kommen kann. — Fundorte 1 (NS), 2, 3 (ZH), 4 (SH), 5 (ZH), 6, 7, 9 (ZH), 10 (NS), 11, 12, 15.

E. tenella (GRUN.) HUST. var. *densestriata* CHOLNOKY (1953 B). — In einem dieser Materialen kommt diese kleine, in Transvaal entdeckte später aber auch in Rhodesien beobachtete (CHOLNOKY 1954 C) Varietät reichlich vor, von denen ein kleines Exemplar auf der Fig. 52 dargestellt wurde. — Fundort 4 (NS).

E. Tschirchiana O. M. — In dem unten angeführten einzigen Standort kommt diese Art in sehr typischen Exemplaren in einer mässig grossen Anzahl vor, so dass angesichts des Fundortes und des Vorkommens eine Verschleppung nicht ausgeschlossen ist, und so könnte sie hypothetisch aus einem Kleingewässer mit einem hohen pH hierher gelangt sein. Ohne einer eingehenden ökologischen Untersuchung kann ich aber den »ökologischen Charakter» dieser Art noch keinesfalls als bekannt annehmen, da sie hier sicher in einer saueren Umgebung in einer weiterhin typisch azidophilen Assoziation vorkommt. Der neueste Fund HUSTEDTS (1953) aus der Oase Gafsa in Tunis ist floristisch wohl sehr wertvoll, kann aber die Frage der Ökologie dieser nur selten gesehenen Art doch nicht entscheiden, da z.B. nicht einmal das pH des Oasenteiches bekannt ist und da in der Liste der im Teiche gefundenen Flora auch *Anomoeoneis brachysira* (BRÉB.) CL. vorkommt (und bei HUSTEDT kann sicher keine Sprache von einer Verwechslung bei der Identifikation sein), die auch durch HUSTEDT (z.B. 1937—39, Bd. 15: 219) selbst als »stenotop» »in Beziehung auf dem pH-Wert» bezeichnet wurde, die eine »Massenentwicklung» um pH 5,5 zeigt, ist die Annahme vollkommen berechtigt, dass in diesem Oasenteich zumindest ein Teil der gefundenen Diatomeen heterochton ist. Solange man aber mit nur einer »Sammelprobe» arbeitet, die für floristische Entdeckungen sehr gut geeignet sein kann, ist es mehr als gewagt, über Ökologie zu sprechen. — Fig. 53, 54. — Fundort 15.

E. valida HUST. — Die gesehenen Exemplare sind wohl schlank, sie bleiben aber auch in dieser Hinsicht in den Rahmen der HUSTEDTschen Diagnose. Die Form und die auffallend starke Verkieselung der Schalen schliessen eine Verwechslung mit anderen Arten aus. *E. valida* habe ich übrigens auch in den benachbarten Vumba-Bergen Süd-Rhodesiens aufgefunden (CHOLNOKY 1954 A), so dass sie in entsprechenden Fundorten des südlichen Afrikas wahrscheinlich mehr verbreitet ist. — Fig. 55. — Fundort 1.

E. vumbae CHOLNOKY (1954 A). — Ebenfalls ein Beweis für die Beziehungen dieser Standorte mit den südrhodesischen, wo die Art in den Vumba-Bergen entdeckt wurde. Allerdings sind die hier gesehenen Exemplare im Durchschnitt kleiner, manchmal kaum 15 μ lang, die sonst aber sehr typisch und der ursprünglichen Diagnose entsprechend sind. — Fig. 56—58. — Fundorte 6, 8.

Frustulia Chasei CHOLNOKY (1954 A). — Diese in der Umgebung von Umtali in Südrhodesien entdeckte Art kommt zerstreut auch in Nord-Transvaal vor. — Fig. 59. — Fundorte 3, 4.

Gomphonema Clevei FRICKE (= *G. brachyneura* O. M.). — Die Art ist in Afrika eine charakteristiche Form neutraler und schwach alkalischer Gewässer, in welchen sie eine grosse Variabilität zeigt. Die Behauptung HUSTEDTS (1937—39), nach welcher die Art auf den Sunda-Inseln eine grössere Variabilität zeigen sollte, ist sicher etwas verfrüht, da die Diatomeenflora von Afrika grösstenteils auch heute noch als unbekannt gelten muss, obzwar eben *G. Clevei* zu den wenigen Arten gehört, die auch die älteren Autoren mitgeteilt haben (ausser O. MÜLLER 1905 auch FRITSCH und RICH 1925, ERLANDSSON 1928, RICH 1937 usw.), die Zuverlässlichkeit dieser Angaben ist aber wahrscheinlich nur im Falle O. MÜLLERS und ERLANDSSONS gesichert (vgl. auch CHOLNOKY 1954 C). Ich finde die Art neuerdings regelmässig in allen neutralen und schwach alkalischen Gewässern, besonders in Bächen vor, wo sie eine Variabilität zeigt, die der auf den Sunda-Inseln ähnlich ist. Da die Art zwischen pH 7—7,5 das Optimum erreicht, ist ihr spärliches, wahrscheinlich auch heterochtones Auftreten in den hier untersuchten Materialen gut verständlich. — Fundorte 3, 4, 7.

G. javanicum HUST. (1937—39). — Die Art ist auf Grund der Diagnose HUSTEDTs sehr leicht von dem *G. parvulum* und seine Formen zu trennen, desto mehr, da die Gallertporen am Fusspol bei *G. javanicum* sehr deutlich sichtbar und die Transapikalstreifen auch nicht *parvulum*-artig fein, aber robuster, obzwar ebenfalls undeutlich punktiert sind. Die Variabilität der Art ist in diesen Standorten ziemlich gross, zwischen den sehr vielen typischen Exemplaren kommen einzelne mit gar nicht oder kaum vorgezogenen Kopfenden vor. Die Übergänge sind ganz allmählich. Ökologisch kann man die Art vorläufig gar nicht charakterisieren, da man so etwas auf Grund spärlicher rein floristischer Angaben, in welchen stillschweigend aber sehr optimistisch angenommen wird, dass die Art in allen Fundorten wirklich leben und sich normal vermehren konnte, keinesfalls leisten kann. Diese Funde hier lassen das Vorkommen bei pH 6,8 auf Bali (Danau Bratan) doch nicht so ganz unnatürlich erscheinen (vgl. HUSTEDT l.c., Bd. XV: 435). — Fig. 60—63. — Fundorte 1, 3 (H) 10, 15.

Navicula adnata HUST. — Die in dem unten angeführten Material gesehenen wenigen Exemplare sind etwas dichter gestreift (auch in der Mitte bis 18 Streifen in 10 μ), wie es in der Diagnose HUSTEDTS (1937—39, Bd. XV: 264) angegeben wurde. Die Form der Schalen stimmt besser mit der Diagnose (l.c.) und Zeichnungen l.c., T. XIX, Fig. 16, 17, als mit den Abbildungen in A. SCHM. Atl. T. 400, Fig. 6—9 überein, ich halte es aber wahrscheinlich, dass hier nur eine phänotypische Variation vorliegt. Auf Grund der gesehenen wenigen Exemplare konnte ich diese Frage keinesfalls entscheiden. Nach HUSTEDT wäre sie eine alkaliphile Aërophyt, obzwar seine Fundortenliste meistens Moospolster angibt, wo das pH auch im Falle niedrig sein kann, wenn die Umgebung alkalisch ist. Dieser Standort 4 mit seinen *Eunotia sub-*

aequalis-, E. tenella var. *densestriata-* und *Frustulia rhomboides*-Mengen kann kaum als alkalisch gelten. — Fig. 64. — Fundort 4.

N. brekkaensis PETERSEN. — Es ist seit den Untersuchungen HUSTEDTS (1937—39) bekannt, dass in den Tropen meistens die langen Exemplare der Art überwiegen, unter denen in diesen Standorten auch ungewöhnlich lange beobachtet werden konnten (z.B. Länge 41 μ, Breite 4 μ, Fig. 65). Ich muss es aber bemerken, dass hier in manchen Standorten (z.B. 13) unter den normalen auch viele echt »isländisch» kleine (vgl. PETERSEN 1928) zu beobachten waren, die mit gleitenden Übergängen zu den in den Tropen typischen Formen gebunden waren. — Fundorte 10 (NS), 12, 13 (SH), 14, 15 (NS).

N. cymbelliformis n.sp. — Die Art steht vielleicht der *N. kuripanensis* HUST. und der *N. cryptocephaloides* HUST. am nähesten. Die Form der Schalen ist am meisten der *N. cryptocephaloides* ähnlich, lanzettlich, an den Polen deutlich vorgezogen, aber viel schlanker, da sie bei einer Länge von 30—35 μ nur etwa 5 μ breit ist. Die Form der Schale macht eine Verbindung mit *N. kuripanensis* ebenfalls unmöglich, obzwar die Streifung, zumindest was ihre Dichte betrifft, besser mit letzterer übereinstimmt, da bei *N. cymbelliformis* ziemlich konstant 20 Transapikalstreifen in der Mitte der Schalen auf 10 μ fallen, die aber hier auch nach den Polen zu nur unbedeutend enger werden. Die Axialarea ist auch abweichend, da sie nicht so eng, vielmehr, besonders bei einzelnen Exemplaren (Fig. 67) deutlich lanzettlich ist. Die Streifen stehen in der Mitte der Schalen parallel oder sehr schwach radial, und bleiben auch in der Nähe der Polen schwach radial. Die Zentralporen der Rhapheäste stehen mässig weit voneinander entfernt. Der Endknoten ist gut entwickelt und das Endspalten der Rhaphe deutlich, die Rhaphespalten selbst gerade und auch in der Nähe des Mittelknotens kaum gekrümmt. Einen weiteren auffallenden Unterschied bilden die um den Mittelknoten sehr unregelmässig verkürzten Transapikalstreifen, wodurch aber doch keine deutlich abgesetzte Zentralarea gebildet wird. — Fig. 66, 67. — Fundort 1.

N. debegenica n.sp. — In dem unten angeführten Material habe ich mehrere Exemplare einer *Navicula* beobachtet, die meiner Meinung nach der Gruppe der »*Naviculae minusculae*» angehören muss, die sich aber mit keinem der mir bekannten Vertreter dieser Gruppe verbinden lässt. Die Schalen sind in der mittleren $^1/_3$ ihrer Länge linear, in den polwärts liegenden dritteln keilförmig zugespitzt und abgerundet, nicht vorgezogen. Die Schalen sind auch viel grösser, um die Art mit etwa *N. minuscula* GRUN. verbinden zu können, und da die Valven keine Depressionen zeigen, ist eine Verbindung mit *N. Krasskei* HUST. ebensowenig möglich. Länge 18—20 μ, Breite 5—6 μ, die Variationsbreite der Art ist aber mit diesen Angaben kaum erschöpft, da ich in dem Material nicht besonders viele Exemplare gesehen habe. Die Rhaphe ist gerade, fadenförmig, Zentralporen mässig weit gestellt. Die Streifen konnte ich in Monobromnaphtalin-Präparaten in Phasenkontrast nur in dem mittleren Abschnitt etwas deutlicher auflösen, sie sind sicher mehr als 42—44 in 10 μ. Die Grenzen der auch in der Mitte nicht erweiterten Axialarea sind immer deutlich sichtbar. Hier bemerke ich noch, dass die Punktierung der Streifen auf den Figuren den wirklichen Verhältnissen nicht entspricht und ist nur eine technische Darstellung der unsicherer Sichtbarkeit. — Fig. 68. — Fundort 10.

N. Hambergii HUST. (1937—39; A. SCHM. Atl. T. 400, Fig. 12—15 unter *N. quadripartita* HUST.; über die Systematik und Synonymik der Art s. HUSTEDT 1943: 281). — Die gesehenen Exemplare waren manchmal nur 12 μ lang. Die Polen der kleinsten Schalen sind kaum vorgezogen. Manche grosse Exemplare haben auch eine von den oben angeführten Zeichnungen HUSTEDTs abweichende Form gezeigt, da aber alle diese Varianten mit gleitenden Übergängen an dem Typus gebunden sind und wahrscheinlich auch zu dem normalen Formwechsel der Art gehören, ist eine Benennung überflüssig. Einige der gesehenen abweichenden Formen habe ich auf den Fig. 72—75 dargestellt. — Fundorte 1 (NS), 3, 15.

N. invicta HUST. (1937—39, auch in A. SCHM. Atl. T. 402, Fig. 63) erscheint mir eine mehr allgemein verbreitete Bewohnerin der saueren, O_2-reichen Kleingewässern der tropischen Gebirge dieses Gebiets zu sein, da ich sie auch in den benachbarten südrhodesischen Vumba-Bergen auf ähnlichen Standorten nachweisen konnte (vgl. CHOLNOKY 1954 A). — Fig. 76, 77. — Fundorte 10, 15.

N. Kotschyi GRUN. — Die Art scheint in O_2-reichen, saueren Kleingewässern und »aërophytischen» Standorten auch in den Tropen allgemein verbreitet zu sein (vgl. CHOLNOKY 1952). Die Meinung HUSTEDTS (1937—39) über die Ökologie der Art — die eigentlich sich selbst widerspricht, erweckt den Eindruck, dass bei dem, wahrscheinlich kolorimetrischen, Messen des pH der aktuelle Zustand am Tage registriert wurde, wobei in Kleingewässern durch das Assimilations-O_2 das pH selbst mit 2,0 höher ausfallen kann. Bei Quellen mit erneutem Wasser kann sich dieser Fehler viel minder gelten lassen. MESSIKOMMER (1942) hat die Art übrigens auch nur bei niedrigem pH gefunden. — Fig. 78. — Fundort 6 (H).

N. Kraeuselii n.sp. — Die Art gehört in der Gruppe der »*Naviculae mesoleiae*» und ist morphologisch wohl noch am meisten mit der *N. Voigtii* MEISTER (1932) verwandt, mit der sie aber keinesfalls zu verbinden ist. Abgesehen von der gänzlich abweichenden Struktur der Schalen, konnte ich mich über die Selbständigkeit dieser Art auch durch Vergleichung überzeugen, da ich die echte *N. Voigtii* in der letzteren Zeit in Südafrika, auf einem wohl unerwarteten Standort, auffinden konnte. Die Schalen der *N. Kraeuselii* sind breitlanzettlich mit immer deutlich vorgezogenen Enden. Ihre Länge variiert zwischen 45—90 μ, die Breite 18—28 μ. Die Rhaphespalten sind ± S-förmig gebogen, die Zentralporen nach der einen Seite abgebogen. Die Endspalten sind in Schalenansicht nur teilweise sichtbar, da die grösste Hälfte des bogenförmigen Spaltens in der Pleuralseite liegt. Sie zeigen mit ihren konvexen Seiten in dieselbe Richtung, in welcher die Zentralporen abgebogen sind. Die Axialarea ist lanzettlich, transapikal asymmetrisch, in der Mitte durch eine eigenartige Verkürzung der Streifen transapikal ± stark erweitert und durch die letzten, grösseren, stärker lichtbrechenden Punkte der Transapikalstreifen, die von den übrigen Punkten durch einen grösseren Abstand geschieden sind, gesäumt. Die Transapikalstreifen sind in der Mitte radial, in der Nähe der Polen stark radial, in der Mitte etwa 11—12, etwas weiter polwärts 12—13 und in der Nähe der Polen 13—15 in 10 μ, grob punktiert, in der Mitte der Schalen etwa 16—18 Punkte in 10 μ. Am Schalenrande ist der erste Punkt der Streifen länglich, strichförmig und auffallend gross, die den Schalenrand selbst, besonders bei grösseren Exemplaren deutlich sichtbar, nicht erreichen und auch von den übrigen Punkten der Streifen ebenfalls durch eine regelmässige, ziemlich breite, dem Schalenrand parallele Leiste getrennt werden. Bei sehr vielen Exemplaren habe ich auch unregelmässig zwischengeschobene kürzere Streifen gesehen, die am Schalenrande die schon beschriebene Struktur aufweisen und nach der Mitte zu mit den normal langen zu verschmelzen scheinen. Die

---

Fig. 53—89. — 53, 54 *Eunotia Tschirchiana* O. M. — 55 *E. valida* HUST. — 56—58 *E. vumbae* CHOLNOKY — 59 *Frustulia Chasei* CHOLNOKY — 60—63 *Gomphonema javanicum* HUST. — 64 *Navicula adnata* HUST. — 65 *N. brekkaënsis* PETERSEN — 66, 67 *N. cymbelliformis* n.sp. — 68 *N. debegenica* n.sp. — 69—71 *N. lapidosa* KRASSKE — 72—75 *N. Hambergi* HUST. — 76, 77 *N. invicta* HUST. — 78 *N. Kotschyi* GRUN. — 79, 80 *N. Kraeuselii* n.sp. — 81 *N. seminuloides* HUST. — 82, 83 *N. Thienemannii* HUST. var. *africana* n. var. — 84, 85 *N. tridentula* KRASSKE — 86 *Pinnularia borealis* E. var. *rhodesica* CHOLNOKY — 87 *P. brasiliensis* HUST. var. *debegenica* n. var. — 88 *P. caloneiformis* HUST. — 89 *P. debegenica* n. sp. — Vergr. 1330/1.

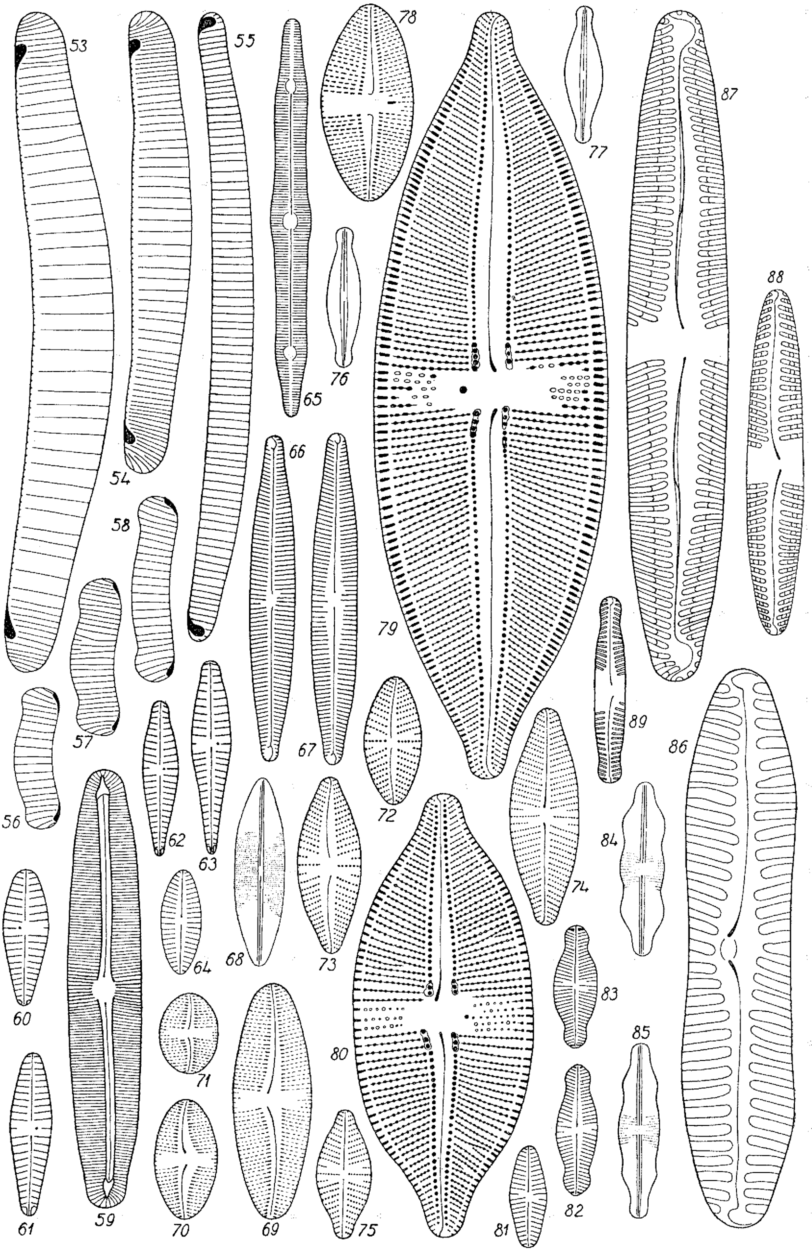

53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89

Fig. 53—89.

mittleren Streifen sind unregelmässig verkürzt, wobei einzelne Poren der Streifen normal, die übrigen nur schattenhaft, wahrscheinlich minder tief entwickelt sind. In der Richtung des mittelsten Streifens auf einer Seite der Zentralarea befindet sich ein deutlicher Porus, der manchmal durch einen grösseren (Fig. 79), in anderen Fällen nur durch einen unbedeutenden Abstand (Fig. 80) von den schattenhaft entwickelten letzten Poren des mittleren Streifens getrennt sind. Die Punkte, die die Axialarea begleiten, sind in der Nähe des Zentralknotens durch eine weitere Aushöhlung des Zellwandes miteinander verbunden, wobei aber ihre Individualität erhalten bleibt. — Die Art benenne ich, als Andenken an seiner Afrika-Reise, in welcher er auch die Gelegenheit zum Sammeln dieser Materialen geschaffen hat, zu Ehren des Herrn Prof. Dr. R. KRAEUSEL aus Frankfurt a.M. — Fig. 79, 80. — Fundorte 1 (ZH), 3.

N. lapidosa KRASSKE. — Diese in den unten angeführten Materialen reichlich vorkommende *Navicula* habe ich mit einigem Zweifel als *N. lapidosa* identifiziert, da sie nicht vollkommen mit den Zeichnungen HUSTEDTS (in A. SCHM. Atl. T. 400, Fig. 69—72) übereinstimmt. Bei den gesehenen Exemplaren verläuft die Rhaphe nicht gerade, aber immer leicht bogenförmig gekrümmt (auch bei den kleinsten Individuen, Fig. 71), dementsprechend ist die mässig enge Axialarea auch etwas unsymmetrisch. Ob die Unterschiede in der Streifung nur der Zeichentechnik HUSTEDTS zuzuschreiben ist, konnte ich nicht entscheiden, bei den gesehenen Exemplaren sind die Streifen aus in Phasenkontrast deutlich sichtbaren länglichen, strichförmigen Punkten aufgebaut, von denen die letzten an der Axialarea gröber und deutlicher sind, wodurch die Axialarea einen Saum erhält. Die Variation, Schalengrösse, Streifenzahl und Streifengang entsprechen den zitierten Abbildungen besser, obzwar in diesen reichen Materialen neben den normalen auch sehr kleine und sehr grosse Individuen zu finden waren. Die Länge der Schalen in 10. — Fig. 69—71. — Fundorte 11 (NS), 15 (NS).

N. seminuloides HUST. (1937—39). — Die hier gesehenen, etwas lanzettlichen Formen halte ich dem Typus identisch, besonders nachdem HUSTEDT (1953) ähnliche Formen aus der Oase Gafsa ebenfalls zu dem Typus eingereiht hatte. Die Art scheint in diesem Gebiete (in den Bergen um der südrhodesischen Grenze) in entsprechenden Standorten ziemlich allgemein verbreitet zu sein (vgl. CHOLNOKY 1952, 1954 A). — Fig. 81. — Fundorte 10, 11, 12.

N. Thienemannii HUST. var. ***africana*** n. var. — Die hier gesehenen Exemplare weichen so weitgehend von dem HUSTEDTschen Typus ab, dass ich sie als eine selbständige Varietät auffassen muss. Eine wirklich korrekte Beurteilung der Lage ist dadurch erschwert, dass die Zeichnungen HUSTEDTS in A. SCHM. Atl. T. 402, Fig. 53—56 und in 1937—39, Bd. XV: T. XVII, Fig. 16, 17 untereinander auch verschieden sind. Diese Varietät unterscheidet sich von dem Typus durch die mehr lanzettliche Form der Schalen, die an den Enden breit kopfig sind. Die polaren Enden sind nicht breit und gleichmässig, sondern immer ± deutlich keilförmig abgerundet. Die gesehenen Exemplare waren 12—15 μ lang und 4—5 μ breit (also auch beträchtlich kürzer, als der Typus) mit etwa 25 Transapikalstreifen in der Mitte in 10 μ, von welchen einzelne bei manchen Exemplaren unregelmässig weiter gestellt sein konnten (Fig. 82). Die Streifen in der Schalenmitte sind immer unregelmässig verkürzt. Die lanzettliche Axialarea kann manchmal ziemlich breit sein. Die Schattenlinien in der Nähe der Polen (Septen?), sowie die Punktierung der Streifen entspricht den HUSTEDTschen Zeichnungen in A. SCHM. Atl. l.c. und sind besonders im Phasenkontrast deutlich sichtbar. — Fig. 82, 83. — Fundort 1.

N. tridentula KRASSKE (vgl. HUSTEDT in A. SCHM. Atl. T. 400, Fig. 85—87). — Die Art scheint in den tropischen Gebirgen um der südrhodesischen Grenze unter azidophilen-azidobiontischen Voraussetzungen häufiger vorzukommen (vgl. CHOLNOKY 1954 A). Ich bemerke noch, dass die Struktur bei den hier gesehenen Exemplaren bei weitem nicht so deutlich, wie bei denen aus dem Vumba-Gebirge war, indem ich hier die Streifung nur in der Nähe des Mittelknotens deutlicher sehen konnte. Die Streifenzahl ergab sich auch bei diesen Exemplaren auf 40—42 in 10 μ. Unter den normalen habe ich auch etwas breitere (Breite bis 4,5 μ) Individuen gesehen. — Fig. 84, 85. — Fundort 7.

Nitzschia parvuloides CHOLNOKY (1953 B). — Diese in saueren Gewässern Transvaals entdeckte Art scheint in entsprechenden Standorten des Gebiets eine ziemlich allgemeine Verbreitung zu haben (CHOLNOKY 1954 A, 1954 C). — Fundorte 3, 4, 5, 9, 10, 13, 15 (NS).

N. parvuloides f. *curta* CHOLNOKY (1954 A) — kommt zwischen den typischen Formen meistens vereinzelt, manchmal aber auch »isoliert» vor. In dem unten angeführten Materiale habe ich auch sehr kurze, nur 17—18 μ lange, Exemplare beobachtet. — Fundort 8.

Pinnularia borealis E. var. *rhodesia* CHOLNOKY (1954 A). — Diese in den Vumba-Bergen entdeckte und an *P. lata* (BRÉB.) W. SM. f. *thuringiaca* (RABH.) A. MAYER erinnernde Varietät scheint in diesen saueren, O_2-reichen, tropischen Gewässern in der Nähe der Grenze von Nord-

Transvaal (vielleicht auch in anderen ähnlichen Lokalitäten des südlichen Afrika) häufiger vorzukommen. — Fig. 86. — Fundort 15.

P. brasiliensis HUST. var. **debegenica** n. var. — Die typische Form HUSTEDTS (A. SCHM. Atl. T. 389, Fig. 10) habe ich in den Vumba-Gebirgen Südrhodesiens aufgefunden, von der die hier gesehenen Exemplare einige Abweichungen gezeigt haben, die mir eine Absonderung dieser Formen nötig erscheinen liessen. Die Form der Schalen, deren Länge 65—70 μ beträgt, ist nicht linear sondern linear-elliptisch mit schwach und breit vorgezogenen Enden. Sie sind auch breiter als der Typus, da sie meistens eine Breite von 10 μ erreichen. Die Rhaphe zeigt deutlich einen komplexen Bau, so dass die Art sicher in der Gruppe »*Complexae*» einzureihen wäre. Die Form der Areas, Anzahl und Verlauf der Streifen entspricht dem Typus. — Fig. 87. — Fundort 1.

P. caloneiformis HUST. (1937—39, Bd. XV: 397, T. XXIII, Fig. 6 und A. SCHM. Atl. T. 385, Fig. 8). — Obwohl die gesehenen Exemplare nur 35—45 μ lang und 6 μ breit, mit 11—12 Transapikalstreifen in 10 μ, waren, erscheint es mir zweifellos auch durch die sehr charakteristische Struktur der gesehenen Schalen, dass sie mit der HUSTEDTschen Art identisch sind, desto mehr, da HUSTEDT nur wenige Exemplare gesehen hatte, die kaum die volle Variation der Art erfassen konnten. Die Art ist wahrscheinlich mehr azidophil und ist im Fischteich am Puntjakpass in Westjava sicher nicht autochton. — Fig. 88. — Fundort 9.

P. debegenica n.sp. — Eine kleine Art aus der Verwandtschaft der *P. acoricola* HUST. und *P. obscura* KRASSKE, mit denen sie aber nicht zu verbinden ist. Die Schalen sind linear oder linear-lanzettlich, schlank, an den Enden lang und breit schwach kopfig vorgezogen. Länge: 18—23 μ, Breite: etwa 4 μ. Die Rhapheäste sind etwas verbogen mit einem nicht langen Polspalten, die nach derselben Seite konvex in welcher die einander nicht besonders weit entfernten Zentralporen abgebogen sind. Die Axialarea ist eng und nach der Mitte zu asymmetrisch lanzettlich verbreitet. Die Zentralarea ist eine meistens asymmetrische, bei allen gesehenen Exemplaren stark entwickelte Querbinde, die auf der Seite, nach welcher die Zentralporen abgebogen sind, schmäler ist. Die Transapikalstreifen sind voneinander mässig weit gestellt, in der Mitte radial, an den Enden konvergent. Die feine Struktur, etwa 20 Streifen in 10 μ, und geringe Abmessungen schliessen eine Verwechslung mit anderen ähnlichen Arten aus. — Fig. 89. — Fundort 3.

P. Kraeuselii n.sp. — Steht vielleicht der *P. graciloides* HUST. (A. SCHM. Atl. T. 392, Fig. 2, 3; 1937—39, Bd. 15: 293) am nähesten, mit der sie aber nicht zu verbinden ist. Die Schalen sind linear-elliptisch, an den Enden breit und gleichmässig abgerundet mit nicht gewellten Seitenlinien. Da ihre Länge 120—130 μ und ihre Breite etwa 18 μ beträgt, ist die Schalenform plumper, als bei *P. graciloides.* Die Rhaphespalten verlaufen leicht wellig, die Zentralporen sind einander mässig genähert, die Endspalten lang und gross, ebenso, wie bei *P. graciloides,* stark entwickelt. Die Axialarea ist linear-lanzettlich, mässig breit, etwa 1/4 der Schalenbreite einnehmend, in der Mitte undeutlich, meistens nur einseitig erweitert, wodurch eine wenig entwickelte Mittelarea entsteht, die niemals als eine Querbinde entwickelt ist. Die Transapikalstreifen stehen mässig weit voneinander entfernt, verlaufen bei den meisten Exemplaren etwas unregelmässig, in der Mitte wenig radial, an den Enden mässig konvergent, vor den mittelsten habe ich niemals den für *P. graciloides* charakteristischen, schattenartigen Kranz schwach lichtbrechender Punkte oder Flecke gesehen, 8—9 in 10, die von einem, durch die Kammeröffnungen gebildeten, schmalen, dem Schalenrande genäherten Längsband gekreuzt sind. Abgesehen von dem Bau der Rhaphe wäre eine Verbindung mit Arten aus der Gruppe »*Maiores*» [wie z.B. *P. Debesii* HUST., *P. macilenta* (E.) CL.] auch durch die bei diesen sowohl in der Mitte als auch an den Enden parallelen Streifung unmöglich. — Die Art widme ich dem Herrn Prof. Dr. R. KRAEUSEL aus Frankfurt a.M. — Fig. 90. — Fundort 15.

P. nodosa E. var. **debegenica** n. var. — Die gesehenen Exemplare waren grösser und robuster, als der Typus, da sie eine Länge von 100—110 μ und eine Breite von 13—15 μ aufwiesen. Ausserdem sind die Transapikalstreifen verhältnismässig kürzer, wie bei dem Typus, wodurch eine sehr breite Axialarea entsteht, die den welligen Konturen der Schale folgend wellig begrenzt breit lanzettlich ist. Der wichtigste Unterschied ist, dass die Transapikalstreifen auch polwärts kurz bleiben, im Gegenteil zu dem Typus noch weiterhin verkürzen und nur in einem kurzen Abschnitt der Schalen schwach konvergent sind. Der Rhaphespalt steht sehr deutlich schief. — Fig. 91. — Fundort 5.

P. Schweickerdtii n.sp. — Diese neue Art gehört in der Verwandtschaft der *P. polyonca* (BRÉB.) O. M., mit der sie aber in keiner weiteren Beziehung zu bringen ist. Die Schalen sind linear-lanzettlich mit verbreiteten, grossen, breit-kopfigen Enden, 55—65 μ lang, etwa 8 μ breit. Die Ränder der Schalen sind niemals dreiwellig. Die Rhaphe ist fadenförmig, die Zentralporen stark einseitig abgebogen, einander mässig genähert. Nach derselben Seite zeigt die konvexe Seite des langen, etwas bajonettförmigen Polspaltens. Die Axialarea ist lanzettlich, etwas unregelmässig, deutlich unsymmetrisch, die Zentralarea ist eine ± breite Querbinde, die durch den stets ungleich starken, mässig radialen Verlauf der mittleren Transapikalstreifen ebenfalls asymmetrisch ist, die noch durch den auf der einen Seite mehr allmählichen Anschluss der Axialarea erhöht wird. Transapikalstreifen 11—12 in 10 μ, in der Mitte (beiderseits der Rhaphe asymmetrisch) schwach radial oder beinahe parallel, an den Enden konvergent, die Konvergenz ist aber niemals so stark, wie bei *P. polyonca.* — Die Art benenne ich zu Ehren des Sammlers dieser Materialen, des Herrn Prof. Dr. H. G. SCHWEICKERDT aus Pretoria. — Fig. 92. — Fundort 15.

Stauroneis pygmaea KRIEGER var. ***africana*** n. var. — Die typische Form dieser in Europa nicht besonders oft gesehenen Art habe ich in den angrenzenden südrhodesischen Gebieten (vgl. CHOLNOKY 1954 A, 1954 C) und auch in diesen Proben (Material 4) wiederholt beobachtet, in den unten angeführten Materialen, meistens von dem Typus isoliert, tritt eine andere Form auf, die wohl die gleichen Struktureigenschaften besitzt, aber in ihrer Grösse den Typus weit übertrifft. Ich habe wohl einige Übergangsformen (z.B. im Material 5) gesehen, meine aber, dass die hier zusammengefassten Individuen einem anderen Variationsbereich angehören, so dass ihre Benennung berechtigt zu sein scheint. Die Länge der Schalen der Varietät kann 28—29 μ, ihre Breite 5—6 μ, meistens 6 μ erreichen, in ihrer Form stimmt sie mit der des Typus überein. Die Breite des Stauros variiert ziemlich stark, die Form der Axialarea ist ebensowenig konstant, da sie manchmal deutlich lanzettlich ausgebildet ist (Fig. 94). Transapikalstreifen 30 in 10 μ. — Fig. 93, 94. — Fundorte, 1, 3, 5, 7, 10, 15.

Surirella Schweickerdtii n. sp. — gehört in der Verwandtschaft der *S. gracilis* (W. SM.) GRUN. und *S. delicatissima* LEWIS, von der letzteren ist sie aber so tiefgreifend durch ihre Abmessungen, Struktur und Verkieselung verschieden, dass eine Vergleichung kaum möglich ist. Die Schalen der Art sind vollkommen isopol, aber nicht linear und an ihren Enden keilförmig gerundet, sondern linear-lanzettlich, nach den Polen zu sehr allmählich, gleichmässig verschmälert und hier breit und ebenfalls gleichmässig abgerundet. Die Länge der Schalen ist 85—110 μ, ihre Breite etwa 7 μ, so dass sie verhältnismässig viel länger und schlan-

---

Fig. 90—106. — 90 *Pinnularia Kraeuselii* n.sp. — 91 *P. nodosa* E. var. *debegenica* n. var. — 92 *P. Schweickerdtii* n.sp. — 93, 94 *Stauroneis pygmaea* KRIEGER var. *africana* n. var. — 95, 96 *Surirella Schweickerdtii* n.sp. — 97—100 *Chroococcus debegenicus* n.sp. — 101—103 *Microchaete transvaalensis* n.sp. — 104 *Characium transvaalense* n.sp. — 105, 106 *Closterium Venus* KG. var. *debegenica* n. var. — Vergr. bei den Fig. 90—96 1330/1, bei den Fig. 97—106. 580/1.

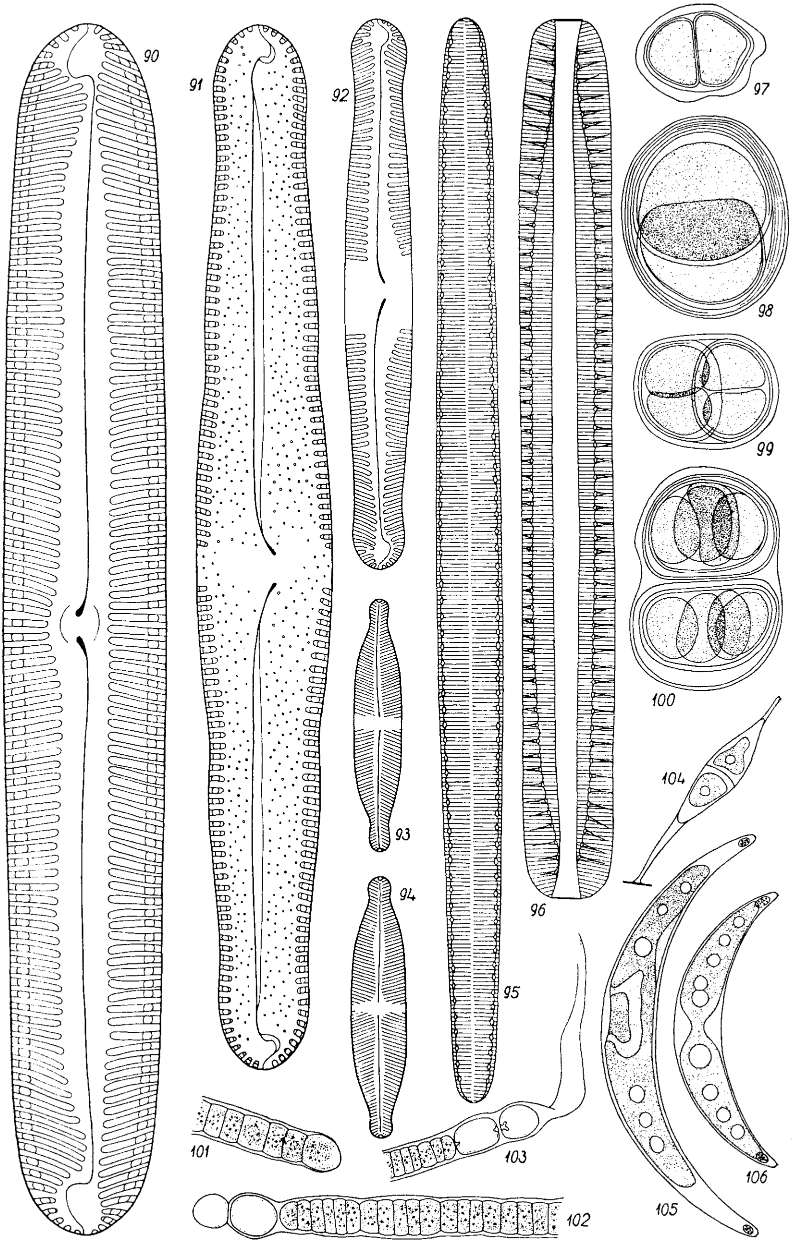


Fig. 90—106.

ker wie *S. gracilis* ist. Die Rippen sind breit, Flügelkanäle etwa 60 in 100 μ. Schalenfläche deutlich gestreift, 22—24 Transapikalstreifen in 10 μ, die in der Mittellinie eine mässig enge Pseudorhaphe frei lassen. Gürtelband linear, an den Enden etwas verschmälert, ebenfalls völlig isopol. — Die Art widme ich dem Herrn Prof. Dr. H. G. SCHWEICKERDT aus Pretoria, der diese Materialen gesammelt hatte. — Fig. 95, 96. — Fundort 4.

Bei der Untersuchung sind mir ausser den Diatomeen auch einige andere Algen aufgefallen, die sicherlich als neue Arten gelten müssen. Diese sind:

Chroococcus debegenicus n.sp. — Die Art kommt in dem unten angeführten Materiale in einer enormen Menge vor, wodurch das ganze in eine schleimige, bräunliche Gallertmasse verwandelt wird. Sie gehört in der Verwandtschaft des *C. Westii* (W. WEST) BOYE P., da die Coenobien, die Struktur der Gallerte und die Form und Position der Zellen in den Coenobien am meisten mit dieser Art übereinstimmen. Ich habe aber viele Coenobien mit acht Zellen gesehen (obzwar diese schon im Zerfallen in Vierergruppen begriffen waren) und besonders die Abmessungen der Einzelzellen — 11—18 μ — bleiben weit unter den Massen des *C. Westii*. Die Ökologie der beiden Arten scheint übereinstimmend zu sein. Einige Stadia der Entwicklung der Coenobien, deren Beobachtung durch das reichhaltige Material ermöglicht wurde, stellen die Fig. 97—100 dar. — Fundort 1.

Microchaete transvaalensis n. sp. — gehört zu den Verwandten der *M. catenata* LEMM. Die Gallertscheide ist auch hier hyalin, nicht geschichtet, farblos und mit dieser sind die Fäden 12—13 μ breit, an den Querwänden leicht eingeschnürt, die Einschnürung ist bei den älteren Querwänden tiefer. Die Länge der Zellen variiert nicht nach der Position in dem Trichom sondern augenscheinlich nach dem Teilungsrhythmus, 2,5—7 μ. Am unteren Ende der Fäden kommt entweder nur eine Heterozyste oder eine Dauerzelle und darunter eine Heterozyste vor. Die Dauerzellen werden meistens mit einem Abstand von 1—1,5 μ von den vegetativen Zellen des Trichoms getrennt, so eine Trennung kommt aber in der Jugend und bei den Heterozysten überhaupt nicht vor. Die Dauerzellen sind ellipsoidisch, ihre Längsachse fällt in der Längsachse des Trichoms, 10×12—13 μ, die Heterozysten sind kugelrund mit einem Durchmesser von etwa 9 μ. Sowohl an den Enden der Dauerzellen als auch an den Polen der Heterozysten kommen besonders im Alter zapfenförmige Wandverdickungen vor. — Fig. 101—103. — Fundort 3.

Characium **transvaalense** n.sp. — Die Art steht dem *C. ornithocephalum* A. BRAUN am nähesten, von dem sie aber schon in ihrer minder asymmetrisch-halbmondförmigen Form abweicht, da die Individuen nur asymmetrisch-lanzettlich sind. Ihre Abmessungen weichen ebenfalls stark ab, da die gesehenen Exemplare etwa 60 lang waren, wovon die Zelle (ohne Stiel und Dorn) 36—37 μ ist. Die Breite ist nur 8—9 μ. — Ein zweizelliger Zustand: Fig. 104. — Fundort 3.

Closterium Venus KG. var. **debegenica** n. var. — Die in den unten angeführten Materialen gesehenen Exemplare waren ohne Ausnahme kurzer und besonders auffallend breiter als der Typus, mit dem sie sonst übereinstimmen. Länge 70—110 μ, Breite 12,5—15 μ. Sonst wie die Art — Fig. 105—106. — Fundorte 1, 4.

Ausser den schon aufgezählten selteneren und neuen, konnte ich in den vorliegenden Proben das Vorhandensein folgender, mehr allgemein verbreiteter Diatomeen feststellen:

Achnanthes affinis GRUN.: 9 (SH), 10 (ZH), 11 (H), 12, 15 (NS). — *A. exigua* GRUN.: 4. — *A. inflata* KG.: 1 (H), 3 (H), 4, 5 (SH), 6 (SH), 7, 9, 10 (ZH), 11, 13 (NS), 15 (H). — *A. lanceolata* (BRÉB.) GRUN. var. *rostrata* HUST.: 4, 5 (NS), 7, 9, 15. — *A. linearis* W. SM.: 2, 3, 4 (NS), 5, 7. — *A. linearis* var. *pusilla* GRUN.: 10, 15. — *A. microcephala* KG.: 4, 10. — *A. minutissima* KG.: 1, 2 (SH), 3 (H), 4 (SH), 5 (H), 6, 7 (SH), 8 (NS), 9, 10 (SH), 11 (H), 12, 13, 14, 15 (SH). — *A. minutissima* f. *cryptocephala* (GRUN.) HUST.: 7 (SH), 8, 15 (H).

Anomoeoneis brachysira (BRÉB.) CL.: 9.

Caloneis silicula (E.) CL. var. *truncatula* GRUN.: 4.

Cocconeis placentula E. var. *euglypta* (E.) CL.: 15.

Cymbella microcephala GRUN.: 1 (H). — *C. naviculiformis* AUERSW.: 11. — *C. turgida* (GREG.) CL.: 3, 5, 10, 15 (NS). — *C. ventricosa* KG.: 3, 4.

Diploneis subovalis CL.: 1 (ZH), 4, 7, 10, 15.

Eunotia arcus E.: 15. — *E. exigua* (BRÉB.) GRUN.: 15 (NS). — *E. praerupta* E.: 1. — *E. praerupta* var. *bidens* GRUN.: 1. — *E. tenella* (GRUN.) HUST.: 5, 9, 11, 15 (NS). — *E. trinacria* KRASSKE var. *undulata* HUST.: 6.

Fragilaria pinnata E.: 2.

Frustulia rhomboides (E.) DE TONI: 4 (ZH). — *F. rhomboides* var. *rhodesica* CHOLNOKY: 4. — *F. rhomboides* var. *saxonica* (RABH.) DE TONI: 4 (H), 5 (NS), 10, 11, 15. — *F. vulgaris* (THW.) DE TONI var. *angusta* CHOLNOKY: 9.

Gomphonema augur E. var. *Gautieri* VAN HEURCK: 4, 7. — *G. gracile* E.: 1, 2, 3, 4, 6, 7, 10, 15 (ZH). — *G. longiceps* E. var. *montanum* (SCHUM.) CL.: 3 (H), 4, 5 (NS), 7, 9, 10 (NS), 11, 12, 14, 15 (ZH). — *G. longiceps* var. *subclavatum* GRUN.: 2 (NS), 3 (NS). — *G. parvulum* (KG.) GRUN.: 2 (ZH), 3 (NS), 4 (H), 5 (H), 6, 7 (H), 9 (NS), 10 (H), 12, 15 (H). — *G. parvulum* var. *lage-*

nulum (GRUN.) HUST.: 2, 3, 4 (H), 5 (H), 6, 7, 8 (NS), 9 (NS), 10 (NS), 12, 15 (H). — *G. parvulum* var. *micropus* (KG.) CL.: 10. — *G. parvulum* var. *subellipticum* CL.: 3, 11, 15.

Hantzschia amphioxys (E.) GRUN.: 14. — *H. amphioxys* f. *capitata* O. M.: 9. — *H. amphioxys* var. *africana* HUST.: 12. — *H. amphioxys* var. *africana* f. *minuta* CHOLNOKY: 3, 5, 8, 9, 10, 11, 12, 16 (NS).

Melosira Dickiei (THW.) KG.: 1 (NS), 10 (ZH), 13, 15. — *M. Roeseana* RABH.: 8 (NS), 15. — *M. Roeseana* var. *epidendron* GRUN.: 1 (SH), 2, 3, 5, 6 (NS), 7, 9 (NS), 12, 13, 14, 15, 15 (SH), 17 (H).

Navicula bryophila PETERSEN: 2, 3 (ZH), 5, 7, 10 (NS), 15 (NS). — *N. cari* E. var. *angusta* GRUN.: 2, 4, 5, 15. — *N. contenta* GRUN.: 3, 8, 13, 15. — *N. contenta* f. *biceps* ARNOTT: 3, 4 (H), 6, 8 (H), 11, 13 (ZH), 14, 15, 16. — *N. contenta* f. *parallela* PETERSEN: 1 (H), 5, 8 (SH), 9 (NS), 11, 12, 13, 14. — *N. contenta* f. *undulata* CHOLNOKY: 1. — *N. cryptocephala* KG.: 2, 4, 9. — *N. hungarica* GRUN. var. *capitata* (E.) CL.: 4, 10. — *N. Krasskei* HUST.: 1 (H), 2 (NS), 5, 8, 9, 10, 12, 14, 15. — *N. Lagerheimii* CL.: 3, 4, 5, 6, 8 (H), 9, 10, 11 (NS), 12, 13 (H), 15 (NS). — *N. Lagerheimii* var. *intermedia* HUST.: 8 (H), 10 (NS), 12, 15. — *N. minima* GRUN. var. *atomoides* (GRUN.) CL.: 10. — *N. mutica* KG.: 3, 9, 16 (H), 17. — *N. mutica* f. *Cohnii* (HILSE) HUST.: 4, 6, 8, 16. — *N. mutica* var. *nivalis* (E.) HUST.: 16. — *N. pupula* KG.: 5. — *N. radiosa* KG.: 2, 4, 5, 9, 15. — *N. radiosa* var. *tenella* (BRÉB.) GRUN.: 4.

Nitzschia denticula GRUN.: 4. — *N. dissipata* (KG.) GRUN.: 4. — *N. frustulum* (KG.) GRUN. var. *perpusilla* GRUN.: 2, 4, 11. — *N. linearis* (AG.) W. SM.: 1, 2, 3, 4, 15. — *N. palea* (KG.) W. SM.: 4.

Pinnularia borealis E.: 1, 13 (NS). — *P. borealis* var. *rectangulata* HUST.: 1, 4, 5, 8 (NS), 9, 10, 12, 13 (H), 17. — *P. borealis* var. *rectangulata* f. *conica* CHOLNOKY: 3, 6. — *P. gibba* E.: 5, 15. — *P. gibba* var. *parva* (E.) GRUN.: 14, 15. — *P. leptosoma* GRUN.: 1, 3. — *P. mesolepta* (E.) W. SM. f. *angusta* CL.: 4. — *P. microstauron* (E.) CL.: 4. — *P. obscura* KRASSKE: 4, 10, 15. — *P. subcapitata* GREG. var. *Hilseana* (JANISCH) O. M.: 4, 10.

Stauroneis anceps E.: 4. — *S. pygmaea* KRIEGER: 4.

Surirella delicatissima LEWIS: 4. — *S. linearis* W. SM.: 4. — *S. linearis* var. *helvetica* (BRUN) MEISTER: 4, 5. — *S. tenera* GREG.: 4.

Synedra minuscula GRUN.: 4. — *S. rumpens* KG.: 13. — *S. rumpens* var. *Meneghiniana* GRUN.: 4. — *S. rumpens* var. *scotica* GRUN.: 2 (H), 4 (ZH), 5, 7 (H), 9, 10, 15 (ZH). — *S. ulna* (NITZSCH) E.: 1, 2 (H), 3 (SH), 4, 5, 7 (ZH), 9, 10 (NS), 12, 14, 15 (NS). — *S. ulna* var. *aequalis* (KG.) HUST.: 10. — *S. ulna* var. *amphirrhynchus* (E.) GRUN.: 7. — *S. vaucheriae* KG. var. *capitellata* GRUN.: 12.

In den teilweise getrockneten, teilweise mit Formazetalkohol fixierten Materialen konnte ich ausser den schon aufgezählten neuen Formen und den unbestimmbaren vegetativen *Conjugatae* und *Oedogonia* auch einige Vertreter anderer Algengruppen beobachten, deren Aufzählung mir durch die vollkommene Unbekanntheit des Gebietes doch erwünscht erscheint. Diese sind:

Cyanophyta:

Aphanocapsa rivularis (CARM.) RABH.: 1; — *Gloeocapsa caldariorum* RABH.: 1; — *G. conglomerata* KG.: 1; — *Lyngbya Martensiana* MENEGH.: 6; — *Microcystis pulverea* (WOOD) MIGULA: 1; — *Nostoc sphaericum* VAUCH.: 1; — *Oscillatoria tenuis* AG.: 6.

Chlorococcale:

Tetraedron longispinum (PERTY) HANSG.: 3, 4.

Zitierte Literatur:

CHOLNOKY, B. J., 1952. Beiträge zur Kenntnis der Algenflora von Portugiesisch Ost-Afrika (Moçambique). I. — Boletim da Sociedade Portuguesa de Ciencias Naturais. Vol. IV. 2a Série (Vol. XIX): 89.

— 1953 A. Diatomeen-Assoziationen aus dem Hennops-Rivier bei Pretoria. — Verh. d. Zool.-Bot. Ver. in Wien, Bd 9: 134.

— 1953 B. Hydrobiologische Untersuchungen in Transvaal I. Vergleichung der herbstlichen Algengemeinschaften in Rayton-Vlei und Leeufontein. — Hydrobiologia. Im Druck.

— 1954 A. Diatomeen aus Süd-Rhodesien. — Portugaliae Acta Biologica. Im Druck.

— 1954 B. Ein Beitrag zur Kenntnis der Algenflora des Mogol-Flusses in Nordost-Transvaal. — Österr. Bot. Zeitschr. Bd. 101: 118.

— 1954 C. Neue und seltene Diatomeen aus Afrika. — Österr. Bot. Zeitschr. Im Druck.

ERLANDSSON, S., 1928. Diatomeen aus Afrika. — Svensk Botanisk Tidskr., Bd. 22: 448.

FRITSCH, F. E. and F. RICH, 1924. Contributions to our knowledge of the freshwater Algae of Africa. 4. Freshwater and subaërial Algae from Natal. — Transactions of the Royal Society of South Africa, Vol. XI: 297.

GEITLER, L., 1932. Der Formwechsel der pennaten Diatomeen. — Archiv f. Protistenkunde, Bd. 78.

HUSTEDT, F., 1937—39. Systematische und ökologische Untersuchungen über die Diatomeen-Flora von Java, Bali und Sumatra. — Archiv f. Hydrob., Suppl. Bd. XV und XVI.

— 1950. Die Diatomeenflora norddeutscher Seen mit besonderer Berücksichtigung des holsteinischen Seengebiets. V.—VII. Seen in Mecklenburg, Lauenburg und Nordostdeutschland. — Archiv f. Hydrob., Bd. XLIII: 329.

— 1952. Neue und wenig bekannte Diatomeen. III. Phylogenetische Variationen bei den rhaphidioiden Diatomeen. — Ber. d. Deutsch. Bot. Ges., Bd. LXV: 133.

— 1953. Diatomeen aus der Oase Gafsa in Südtunesien. Ein Beitrag zur Kenntnis der Vegetation afrikanischer Oasen. — Archiv f. Hydrob., Bd. 48: 145.

MEISTER, F., 1932. Kieselalgen aus Asien. — Gebr. Borntraeger, Berlin.

MESSIKOMMER, E., 1942. Beitrag zur Kenntnis der Algenflora und Algenvegetation des Hochgebirges um Davos. — Beiträge zur geobotanischen Landesaufnahme der Schweiz. Heft 24. Bern.

MÜLLER, O., 1905. Bacillariaceen aus dem Nyassalande und einigen benachbarten Gebieten. Dritte Folge. — ENGLERS Bot. Jahrbücher, Bd. 36: 137.

PATRICK, R., 1940. Some new Diatoms from Brazil. — Notulae Naturae, Nr. 59.

PETERSEN, J. B., 1928. The Aerial Algae of Iceland. — Botany of Iceland, Vol. 2.

RICH, F., 1937. Contributions to our knowledge of the freshwater Algae of Africa. 12. Some Diatoms from the Victoria Falls. — Transactions of the Royal Society of South Africa, Vol. XXIV: 207.

SCHMIDT, A., 1872—1944. Atlas der Diatomaceen-Kunde. — Aschersleben-Leipzig.

BOTANISKA NOTISER 1954, HÄFTE 3. LUND

A new Variety of Euphrasia lapponica.

By OLOF RUNE and OLAF I. RØNNING.
University of Uppsala. Tromsö Museum.

During an excursion to Finnmark in 1953, the present authors visited, among other places, Mount Duken on the Isle of Mageröy which is situated relatively close to the North Cape. This mountain is botanically famed for, inter alia, such remarkable species as *Arenaria humifusa* and *Braya purpurascens,* the latter having there its one and only Scandinavian locality. NORDHAGEN, in 1935, gave an account of the phytogeographic significance of the Mt Duken flora.

In contrast to most earlier visitors, we reached Mt Duken from the south by using the North Cape road which is under construction. In this way, we obtained a chance to study the flora of the narrow limestone belts that radiate southwards for about 10 km from the mountain.

In the limestone area approximately 3 km south of Mt Duken, a rich occurrence of a particular, albinic type of *Euphrasia lapponica* was noticed. Though very small, 1—2 cm, this plant is easily perceived by its pale-green colour, dense appearance and comparatively big, quite white flowers. It was later found in abundance in several places south of Mt Duken, its most northern locality being on the SW slope of the mountain. The North Cape road runs so close to several rich occurrences that botanists travelling along this road in the future can hardly fail to notice this peculiar plant.

As a matter of fact, this type of *Euphrasia* has been collected before in that area, viz, by NORDHAGEN in 1934 and by GJAEREVOLL in 1952. Their collections in the Museum of the University of Bergen and in the Trondheim Museum, respectively, are the only ones traced by us in the official herbaria of Scandinavia.[1]

Earlier botanists, who generally approached Mt Duken from the north evidently failed to detect the most abundant occurrences of this

---

[1] Norwegian material checked by RØNNING, Swedish material by RUNE.

plant to the south of the mountain. In his Flora of Finnmark (1934), OVE DAHL recorded only *Euphrasia frigida* from Mt Duken. NORDHAGEN, in 1934, discovered also *E. lapponica* there (NORDHAGEN 1952). However, his find refers to the type race of the species which occurs sparsely on the dry limestone of the northern side of the mountain. It seems restricted to that part of the area, being, as far as we could see, non-existent in the southern part.

Thus, two different types of *Euphrasia lapponica,* with different areas of distribution, are to be found on Mageröy: (1) the type race occurring sparsely on the dry limestone-scree of the northern and central parts of Mt Duken, and (2) the albinic race appearing in abundance on the southern side of the mountain in stations less dry than those of the former.

The occurrence of *Euphrasia lapponica* on Mageröy constitutes the northernmost outpost of this Scandinavian endemic. The outpost has also a rather isolated position, the nearest finds being in the dolomitic areas round the inner parts of Porsangerfjord and on the Isle of Söröy (see map 1576 in HULTÉN 1950, NORDHAGEN 1952). The albinic forms of *Euphrasia lapponica* are so far heard of only in this isolated part of the distribution area of the species.

The albinic type of *Euphrasia lapponica,* dominant on Mageröy, is very uniform and differs in several respects from the type race of the species. In our opinion, there is justification for classifying it as a variety, var. *pallida* n. var.

Euphrasia lapponica TH. FR. j:r var. *pallida* n. var.

Planta condensata, 1—2.5 cm alta, tota pallide viridis. Corolla pure alba. Folia duplo-triplo longiora quam latiora, utroque margine plerumque bidentata, dentibus laminae aequilatis vel brevioribus. Semina c. 1.5 (1.2—1.8) mm longa. Floret medio Augusti. Ceterum ut forma typica.

Habitat in Mageröy, prov. Finnmarchiae Norvegiae, in solo mineralico calcario sat humido, c. 100 m s.m.

Coll. orig.: Norvegia, Finnmark, par. Nordkapp: prope Sätertind, occidentem versus, ad viam. 29/7 1953 O. RUNE et O. RØNNING. Typus in Mus. Bot. Tromsoeensi.

Var. *pallida* differs morphologically from other types of *E. lapponica* by its pale-green colour, white flowers, invariably smaller size, smaller seeds, and comparatively broader leaves which are so crowded as to give the plant a dense appearance (see Fig. 1).

In general, *Euphrasia lapponica* has the purplish-brown colour typical of the *E. salisburgensis* group. Specimens of a particularly

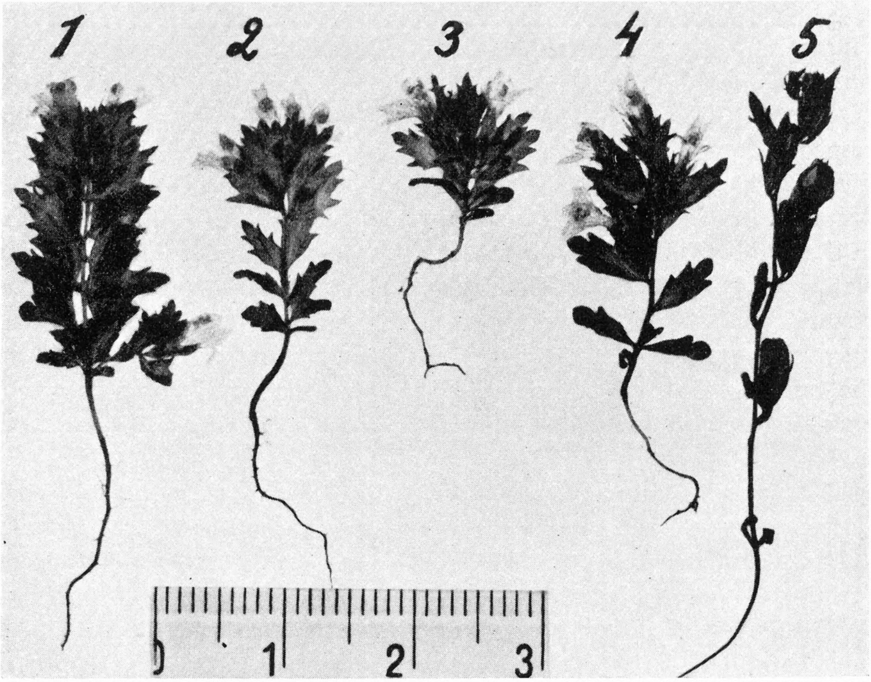


Fig. 1. — 1—4: *Euphrasia lapponica* var. *pallida*. — Different types of specimen from the population of the W side of Mt Sätertind, south of Mt Duken, collected 29/7 1953.

1. Pale-green specimen of about maximum size (rare), 2. D:o, normal size (frequent), 3. D:o, about minimum size (rather frequent), 4. Slightly purple-coloured specimen (rare).

5: *E. lapponica* s. str., typical dwarf specimen from the dolomite at Börselv, Porsanger, collected 14/8 1953.

Note the dense appearance of 1—3 as compared with 5, and also the less dense of the purplish specimen (4) as compared with the pale-green ones 1—3. Unit of the scale 1 cm. — Photo: S. Eriksson.

large growth may sometimes turn more or less dark grey-green. In var. *pallida* the stem, leaves, bracts, and sepals lack all trace of a purplish colour. The corollas are generally pure white, with the yellow spot of the lower lip but slightly perceptible. In some cases, more or less vague, purple lines are to be seen in the white corolla. These lines appear more distinctly on dry material. However, the more or less whitish flowers are not restricted to var. *pallida* but are sometimes manifested also in the type race of *E. lapponica,* whose flowers are normally pale-blue. Recently, a special race with purplish-blue flowers, found in South Norway was described by NORDHAGEN (1952) as var. *purpureocoerulea.*

Apparently, var. *pallida* is an albinic type, differing also in other respects from the type race of the species.

Euphrasia lapponica varies considerably in size. Big and highly branched specimens, 10—15 cm, may be found, e.g., in the scree areas of the Junkerdalen valley in Salten, Norway. On the other hand, exposed stations in the alpine region usually harbour small unbranched specimens, about 5 cm high. In such populations the smallest individuals may even attain a size typical of var. *pallida.* In the latter, however, the *entire population* consists of individuals either falling below or equalling the minimum size of *E. lapponica* s. str., being only 1—2.5 cm high.

The dwarf specimens of *E. lapponica* s. str. generally have few flowers and leaves and the inflorescence is rather open (see Fig. 1).

In spite of the small size, var. *pallida* is rich in leaves and flowers, forming a dense inflorescence (see Fig. 1).

The leaves of *E. lapponica* s. str. have a length 3—4 times their breadth and have 3—4 pairs of acute teeth, exceeding the breadth of the leaf. In var. *pallida,* the leaves are constantly broader or 2—3 times as long as they are broad; their teeth are less acute and comparatively shorter and broader, their length being less than the breadth of the leaf. A similar difference appears in the teeth of the bracts and the sepals.

One of the essential differences between *E. lapponica* and *E. salisburgensis,* as pointed out by TH. FRIES (1921), is the bigger seeds of the former. The length of the seeds of *E. lapponica* (measured by the present authors) is approx. 2 mm (1.8—2.3) while in *E. salisburgensis* approx. 1.5 mm.

However, in var. *pallida* the seeds are clearly smaller than in *E. lapponica* s. str., or equal approximately 1.5 mm (1.2—1.8). This would imply that the variety has seeds similar in size to those of *E. salisburgensis.*

In other respects var. *pallida* differs but slightly from the type race of *E. lapponica.* Thus, the leaves, the bracts and the capsules of var. *pallida* are completely glabrous, while the stem carries a few short and depressed hairs. Except in colour, the flowers of var. *pallida* do not differ from those of the type race of *E. lapponica.* In spite of the small size of the variety, the flowers do not differ in size from those of the species (approx. 7 mm). Accordingly, var. *pallida* is rather largeflowered. Nor do the capsules of the variety differ in shape or size from those of the species.

By the shape of the leaves and the dense appearance of the plant, var. *pallida* is partly reminiscent of *Euphrasia frigida* or, rather, the so-called hybrid between *E. frigida* and *E. lapponica*. However, the complete lack of hairs on the capsules of var. *pallida* closely relates it to *E. lapponica*.

In the population of var. *pallida,* a few specimens (totalling approx. 1—2 %) exist which are more or less purplish-brown in colour, some of them having the normal colour of the species. These specimens approach the type race of *E. lapponica* also in other respects, having narrower leaves and more open inflorescence (see Fig. 1). They cannot be regarded as mere hybrids between var. *pallida* and the type race of *E. lapponica,* the latter being totally lacking in these localities. In addition, they are quite fertile and may be conceived as an aberrant type of the variety.

At our visit to Mageröy on July 29—30, var. *pallida* had just begun to flower. The comprehensive herbarium material collected by the present authors at the time includes but a very few specimens with the capsules and ripe seeds developed. As the Spring of 1953 was unusually warm in N Scandinavia, the vegetation was much ahead of schedule. In more normal summers, the flowering of var. *pallida* is sure to take place in August. Thus, the specimens collected by GJAEREVOLL on August 18, 1952, are in full flower. All the specimens of the type race of *E. lapponica* observed by the present authors on Mt Duken and at Porsanger at the beginning of August had ceased flowering much earlier. However, the stations in question are extremely dry and warm, being situated on dry dolomite gravel. As pointed out by NORDHAGEN (1952), *E. lapponica* is a clearly xerophilous plant, whose early flowering here may partly be due to its occurrence in dry, warm, well-drained, and early snow-free stations. It generally starts to flower a little later than, e.g., *Dryas octopetala,* one of its most constant followers.

The present variety has been found in more moist and less well-drained stations than is typical of the type race of *E. lapponica*. It usually grows in the patches of bare soil of a silty composition formed in *Dryas*-heaths by frost action or wind erosion. Among the species characteristic of this vegetation the following may be mentioned: *Dryas octopetala, Carex glacialis, Thalictrum alpinum, Saxifraga aizoides, Festuca ovina, Euphrasia frigida,* and in some places, *Braya purpuras-*

cens. However, the ground is actually more moist than this list would indicate.

The fact that the flowering of *Dryas octopetala* and most of the other species mentioned above was passed when var. *pallida* had just begun suggests a later flowering of var. *pallida,* as compared with the type race of the species.

Thus, a characterization of var. *pallida* should be supplemented with the following ecologic peculiarities: (1) var. *pallida* flowers later than the type race of the species, and (2) it seems less xerophytic than the latter.

Euphrasia lapponica, usually highly purple-coloured with pale-blue flowers, has two aberrant races, distinguished as varieties: (1) var. *purpureocoerulea* NORDHAGEN with purplish-blue flowers, and (2) var. *pallida* RUNE & RØNNING which is, inter alia, albinic.

A similar variation is seen in another *Euphrasia* species in Scandinavia, i.e. *E. micrantha* RCHB. (*E. gracilis* FR.). This is represented by two races in Scandinavia: (1) *E. micrantha* s. str. with bluish-white flowers and (2) *E. micrantha* var. *primaria* (FR.) HYL. (see HYLANDER 1945) with dark purple flowers. The former occurs in the whole distribution area of the species in Dano-Fennoscandia. The latter is restricted to the western parts of Norway, Sweden, and Denmark. In some districts it is possibly the only representative of the species, while in others both races are present. In the eastern part of Sweden and in Finland var. *primaria* is non-existent.

In addition, an albinic form is also recorded in this species, i.e. f. *pallida* (HÜLPHERS) HYL., characterized by a pale-green colour and white flowers. In this case the loss of colour is not followed by morphological changes. This form is found only in one locality in the province of Halland (Halmstad, in heather growth on sand at the sea shore, leg. A. HÜLPHERS 28/8 1920).

Several other species of *Rhinanthoideae,* with normally more or less coloured leaves or bracts, present albinic forms in Fennoscandia. These are generally characterized by a loss of colour without any morphological changes. Such forms are, e.g., *Melampyrum nemorosum* f. *albidum* SVANL., *M. cristatum* f. *pallens* HARTM., *M. arvense* f. *pallens* STERN., *Odontites litoralis* f. *pallida* BLOM, *Bartsia alpina* f. *ochroleuca* BLYTT, *Pedicularis palustris* ssp. *borealis* f. *ochroleuca* (LÆST.) HYL. These albinic forms of *Rhinanthoideae* usually constitute a limited part of a local population and have consequently been given the lowest taxonomic rank, i.e. forma.

As regards *Euphrasia lapponica* var. *pallida* a higher taxonomic rank than forma is justifiable, the albinism being combined with other characteristics, for instance, the late flowering. Although a seasonal dimorphism cannot be said to occur neither in *Euphrasia lapponica* nor in any other plant of the Arctic with its short vegetational period, var. *pallida* seems to show characters very typical of the intraspecific variation in *Rhinanthoideae,* viz. albinism and different flowering-time.

The authors are much indepted to Dr NILS HYLANDER of Uppsala, for his valuable assistance in the course of these investigations.

Uppsala and Tromsö, May 1954.

References.

DAHL, O., 1934. Floraen i Finnmark Fylke. — Nyt Mag. f. Naturv. 69.

FRIES, TH. C. E., 1921. Die skandinavischen Formen der Euphrasia salisburgensis. — Arkiv f. Bot. 17: 6.

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

HYLANDER, N., 1945. Nomenklatorische und Systematische Studien über Nordische Gefässpflanzen. — Upps. Univ. Årsskr. 1945: 7.

NORDHAGEN, R., 1935. Om Arenaria humifusa og dens betydning for utforskningen av Skandinavias eldste floraelement. — Bergens Mus. Årb. 1935, Naturv. rekke 1.

— 1952. Bidrag till Norges flora. II. Om nyere funn av Euphrasia lapponica Th. Fr. fil. i Norge. — Blyttia 10: 2.

BOTANISKA NOTISER 1954, HÄFTE 3. LUND

Saussurea alpina på Falbygden.

AV LENNART FRIDÉN.

I början av detta sekel konstaterades för första gången på Falbygden förekomsten av fjällskära, *Saussurea alpina* (L.) DC. Fyndet av denna för Sydsverige intressanta relikt gjordes i Dimbo socken öster om Gerumsberget. Det redovisas i litteraturen första gången av WESTFELDT (1927) och omnämnes av ALBERTSON (1946 s. 429). Av samtal med prof. ELIAS MELIN hösten 1953 framgick, att han som skolyngling tillsammans med K. A. STALIN i sin hemsocken, Dimbo, stötte på en liten förekomst av *Saussurea*. Det var vid tidpunkten för eller kort efter utgivandet av RUDBERGS (1902) Västgötaflora, i vilken det inte uppges någon lokal för *Saussurea alpina* i Skaraborgs län. Med ledning av prof. MELINS beskrivning av lokalens läge V om kyrkbyn »vid en liten väg, som leder uppåt berget» (Gerumsberget) företog jag i december 1953 en rekognoscering. Det enda som där påminde om kärr eller fuktig äng var en sänka i en kulturbetesmark med ett *Veronica beccabunga* — *Glyceria fluitans*-källdrag. Av samtalet tycktes vidare framgå, att det av ALBERTSON (1941) omnämnda »Lambevadskärret», som ligger S om kyrkbyn, icke skulle ha varit den åsyftade växtplatsen för fjällskäran (jmfr ALBERTSON 1946 s. 429). På båda här nämnda platser, liksom i trakten i övrigt, har växten förgäves eftersökts under ett flertal exkursioner. *Saussurea*-förekomsten i Dimbo s:n, kanske numera spolierad, har, såvitt författaren kunnat finna, icke angivits på någon utbredningskarta.

Nära femtio år ha gått utan någon ny rapport om *Saussurea* från Falbygden. Det fanns anledning befara, att denna trakt förlorat ett intressant element i sin flora. Glädjande nog är så ej fallet. Till min överraskning har jag de senare åren funnit inalles tre förut okända *Saussurea*-lokaler, samtliga belägna i den sydöstra delen av Falbygden.

Min första upptäckt av *Saussurea* skedde i juli 1951 i Sjöängen i Slöta s:n. Det är ett botaniskt märkligt område med kalkfuktängar och gungflyartade rikkärr, vilka senare uppvisa en rik anhopning av nordöstliga myrväxter. Bland fältskiktets arter må särskilt framhållas den 1946 återupptäckta *Saxifraga hirculus* (ALBERTSON 1946; FRIDÉN 1951 s. 385) och den sedan funna *Stellaria crassifolia* var. *paludosa* (ALBERTSON 1949 s. 178). *Saussurea* växte i en liten björkdunge i fuktängsområdets utkant. Trots omsorgsfullt sökande stod fjällskäran ej att finna på mer än en enda tuva, och denna gjorde märkligt nog intryck av att vara en edafiskt ogynnsam ståndort för växten, med inslag av sådana arter som lingon och *Carex pilulifera*.

Min andra upptäckt av fjällskäran skedde på våren 1952. I en liten betesmark i västra delen av Skörstorps s:n fångades min uppmärksamhet av några tuvor, tämligen rikt beväxta med *Saussurea*-liknande blad. Mina misstankar besannades vid nästa besök den 23 juli. Tuvorna lyste blå av vaniljdoftande fjällskära. Upptäckten stimulerade till förnyade undersökningar i trakten, särskilt på Gerumsbergets nedre sluttningar, där det förekommer åtskilliga kalkkärr och kalkfuktängar med lämpliga ståndorter för fjällskära.

Mitt tredje fynd av *Saussurea* gjordes den 30 augusti 1953 i sydöstra delen av Skörstorps s:n. Där uppträdde fjällskäran i en *Schoenus*-myr, som jag besökt redan 1948 men då blott ägnat en flyktig undersökning vid ett resultatlöst försök att verifiera RUDBERGS (1902) uppgift om *Pedicularis sceptrum-carolinum* i socknen. De båda lokalerna för *Saussurea alpina* i Skörstorps s:n äro belägna ungefär 3 km från varandra och bilda ett litet centrum för denna art på Sydöstfalbygden, till vilket de förut mera isolerade förekomsterna i Dimbo och Slöta socknar ansluta sig.

Den sydsvenska utbredningen av *Saussurea alpina*, dess allmänna orientering och dess isolerade läge i förhållande till artens nordliga areal i vårt land framgår av kartorna hos ERLANDSSON (1940) och HULTÉN (1950). Av de berörda landskapen, Småland och Västergötland, uppvisar det förra blott en enda lokal. Den är belägen vid Nobyån SV om Tranås och upptäcktes av A. G. HANNERZ 1915. De västgötska lokalerna återfinnas i trakten av Ulricehamn, huvudsakligen i anslutning till övre Ätradalen. Båda områdena, ungefär mitt emot varandra på ömse sidor om Vättern, ligga något nedom 58:e breddgraden. Härtill kommer nu det något nordligare belägna förekomstområdet på Sydöstfalbygden. Avståndet från Sjöängen, Falbygdens sydligaste *Saussurea*-lokal, till de närmaste lokalerna i Älvsborgs län i Dalum och Möne socknar är i det närmaste tre mil.

För Ulricehamnstraktens *Saussurea*-lokaler har WESTFELDT (1927) lämnat en utförlig redogörelse, grundad såväl på mångåriga fältstudier som litteratur- och herbarieuppgifter. Enligt nyligen meddelade uppgifter (WESTFELDT 1952) anges över fyrtio lokaler för fjällskäran, fördelade på åtta eller, enligt senare muntligt meddelande, nio fyndsocknar. Det framgår av WESTFELDTS artiklar, att fjällskäran förekommer på »sidlänta, mer eller mindre översilade starrkärrängar med en förhållandevis hög kalkhalt hos den underliggande moränen» (WESTFELDT 1952 s. 74) och är »å samtliga sina förekomster funnen tillsamman med en del avgjort kalkgynnade arter» (WESTFELDT 1927). Förteckningen över sådana arter upptar bl.a. *Cirsium oleraceum, Polygala amarella, Epipactis palustris, Primula farinosa, Lathyrus palustris, Carex lepidocarpa, Schoenus ferrugineus* och *Orchis Traunsteineri.* Av dessa saknas endast *Cirsium oleraceum* på Falbygdens *Saussurea*-lokaler, om nämligen *Orchis cruenta* antages vikariera för *O. Traunsteineri.*

Saussurea-lokalen vid Tranås är beskriven av ERLANDSSON (1940). Fjällskäran växer här inom ett *Filipendula ulmaria*-dominerat, tuvigt område och alltid på något högre liggande tuvor. I en tabell redovisar han för växtsammansättningen på fyra *Saussurea*-förande tuvor. Därjämte lämnas en växtlista för lokalen i dess helhet.

Vad beträffar *Saussurea*-förekomsterna på Falbygden har författaren ägnat särskild uppmärksamhet åt de båda lokalerna i Skörstorp. Ehuru mina undersökningar icke avsett ett ingående sociologiskt studium, torde de framlagda resultaten bidra till att kasta ljus över fjällskärans miljö, dels mera allmänt i de ifrågavarande kalkkärren, dels mera lokalt på *Saussurea*-förande tuvor. För att underlätta en jämförelse med den av ERLANDSSON (1940) gjorde undersökningen har jag liksom han uppgjort en allmän artförteckning för en av lokalerna. För vegetationen på *Saussurea*-förande tuvor redovisas i tabellform, ehuru det ej är fråga om detaljanalys. Täckningsgrad och konstans ha därvid ej angivits. Dessa frågor skall dock beröras i det följande.

I. **Ängen vid Quinnevad.** Så kallar jag den västra Skörstorp-lokalen, belägen på Gerumsbergets ortocerkalklager, en avsats ungefär 220 m ö.h. *Saussurea alpina* förekommer där i en till formen rektangulär betesmark med sidorna respektive 125 och 150 m. Området, som i SV begränsas av en NV-rinnande bäck, sluttar obetydligt mot V. Ungefär halva arealen upptages av kärr och fuktäng, som i riktningen N—Ö bågformigt inramas av björklöväng. Denna, som fläckvis domineras av *Filipendula ulmaria,* hyser riklig *Trollius* och rätt ymnig *Hierochloë odorata.* I kärrvegetationen dominerar *Molinia* och *Carex*-arter, särskilt

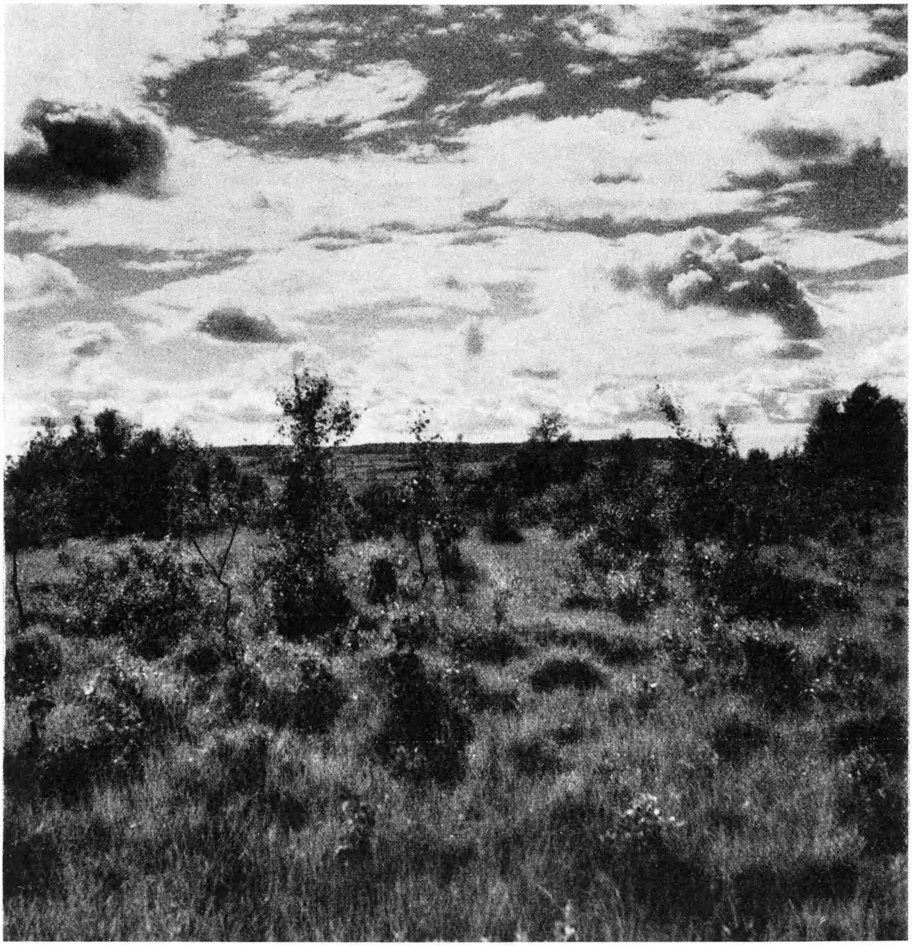


Fig. 1. Ängen vid Quinnevad, sydvästra delen, med utsikt mot Ålleberg i väster. Skörstorps s:n, Falbygden. — Foto: FRIDÉN 23.7.1952.

C. hostiana och *C. panicea*. Växtsamhällena uppvisa därjämte ett rikt inslag av *C. lepidocarpa*. Bottenskiktsdominanter äro *Drepanocladus intermedius* och *Campylium stellatum*. *Eriophorum latifolium,* tämligen rikligt förekommande, framträder i sommaraspekten som tongivande element. Ett färgrikt inslag bildar då *Orchis cruenta,* som uppträder rikligt i täta grupper inom ett begränsat område. I övergångszonen mellan kärr och björklöväng spelar *Molinia*-samhällen, ofta med riklig *Briza media,* en viktig roll. Det är i denna *Molinia* — *Briza media*-

äng som vi främst finner *Saussurea*. Fjällskäran undviker alltför hydrofila växtsamhällen och utväljer som ståndort så gott som undantagslöst de tuvor, vars vegetation illustreras av analystabellen. Det *Saussurea*-förande området mäter i riktningen NV—SÖ 50 m i längd, bredden växlar mellan 15 och 25 m. Fjällskäran träffas dessutom i en del av kärret på gruppvis förekommande ängstuvor samt sparsamt i björklövängen.

I ängen vid Quinnevad blommar fjällskäran rikt med 40—50(—70) cm höga stjälkar men uppträder dessutom som sterila bladrosetter. Den 23 juli 1952 var växten i full blom. Att denna »fortgår till in på hösten» (STERNER i LAGERBERG 1949 s. 1673) stämmer tydligen inte med sydsvenska förhållanden, ty en månad senare, den 24 augusti, var dess blomning vid Quinnevad helt avslutad och alla stjälkar buro fruktsamling. Frukterna voro dock ännu ej mogna, ty trots stark blåst rycktes ej de penselförsedda frukterna loss. Då det visade sig svårt att uppskatta fjällskärans individfrekvens, räknade jag endast de blommande stjälkarna. Deras antal uppgick året 1952 till 160, året därpå till omkring 400.

II. **Schoenus-myren vid Sörgården.** Den andra Skörstorplokalen för *Saussurea alpina* återfinnes S om kyrkan i socknens sydöstra del och ligger på Gissebergets SV-sluttning på ortocerkalk c:a 225 m ö.h. Betesmarken, i vilken fjällskäran förekommer, är betydligt större än föregående och omfattar marker av skilda slag. *Schoenus*-kärren, med tämligen grund torv på kalkmorän, begränsas i V av låga åsar av kalkrikt isälvsgrus samt vidare åt V av djup, numera dränerad torvjord.

Myrområdet omfattar två till typen skilda *Schoenus*-kärr. Det norra kärret, här betecknat som område II a, är störst, sluttar sakta åt V och präglas av en öppen *Schoenus*-dominerad yta, omgiven av björkskog. Denna är stundom, såsom i norra delen, ridåartad men bildar i S en större björkdunge, delvis lövängsartad. S om dungen finna vi det mindre *Schoenus*-kärret, här betecknat som område II b, med litet brantare sluttningar och små källrännilar.

Område II a. Den öppna myren i områdets centrum, med sparsamt förekommande videbuskar och enstaka, förkrympta björkar jämte någon tall, domineras i fältskiktet av *Schoenus ferrugineus* och *Carex hostiana*. *C. lepidocarpa* och *C. panicea* förekomma rikligt. *C. flacca* och *C. capillaris* åter mera sparsamt. Den i *Schoenus*-myren rikligt uppträdande *Molinia coerulea* blir ofta dominant i myrens kantzoner, där björk och vide på något torrare mark tilltaga i frekvens. Bland videarterna märkas särskilt *Salix aurita, S. hastata, S. nigricans* och

Fig. 2. Fjällskäran, *Saussurea alpina,* i *Briza media*-rik *Molinia*-äng med ingående *Potentilla erecta* och *Menyanthes trifoliata*; som inslag märkes *Geum rivale* (t.v.) och *Vicia cracca* (t.h.). — Ängen vid Quinnevad. — Foto: FRIDÉN 23.7.1952.

S. pentandra. Vidare har från området antecknats *Orchis cruenta* och *O. incarnata. Epipactis palustris,* som saknas i område I (Quinnevad), förekommer här i rika bestånd. Dessutom uppträda *Parnassia palustris* och *Primula farinosa* rikligt. På fuktängstuvor nära fastmark mot Ö växer *Gentianella uliginosa* tillsammans med *G. amarella* och *Euphrasia*-arter.

Norra *Schoenus*-myren (II a) är svagt sluttande och översilad, ehuru källmyrkaraktären ej är utpräglad. *Philonotis calcarea* och *Cratoneurum falcatum* ha iakttagits blott som sparsamt inslag i vegetationen. *Drepanocladus intermedius* och *Campylium stellatum* uppträda som bottenskiktsdominanter. Särskilt anmärkningsvärd är rikedomen på levermossor. Förutom *Preissia, Pellia Fabbroniana* och *Riccardia pinguis* ha sådana intressanta arter som *Moerchia hibernica* och *Scapania Degenii* här insamlats.

Förekomsten av *Saussurea alpina* inom området är karakteristiskt nog bunden till övergångszonen mellan den öppna myren i centrum och den omgivande *Betula*-kantskogen. Rikligast företrädd är fjällskäran i det *Molinia*-dominerade ängsbältet i S inemot den förut nämnda större björkdungen. Arten växer här, liksom vid Quinnevad, främst på tuvor.

Område II b. I det mindre, mera sluttande *Schoenus*-kärret är karaktären av kalkkällmyr starkt framträdande med den kalktuffbildande *Cratoneurum commutatum* som bottenskiktsdominant. Även andra element är här rikt kalkinkrusterade, bl.a. *Dreponcladus*-arter och *Philonotis calcarea.* Källmyren uppvisar dessutom vackert utbredda, av betesdjur ej söndertrampade *Ctenidium molluscum*-mattor med rikt inslag av *Preissia quadrata.* Förutom de från II a nämnda arterna av *Moerchia* och *Pellia* har *P. Neesiana* här insamlats. En *Sphagnum*-art har iakttagits, nämligen *S. Warnstorfianum.*

Bland kärlväxterna har från område II b antecknats ymnig *Molinia,* riklig *Eriophorum latifolium* samt *Salix hastata, S. Starkeana *livida* och *Orchis incarnata.* Av förut ej antecknade arter må bl.a. nämnas *Drosera anglica* i *Sphagnum*-samhället, *Peucedanum palustre* i ett *Carex rostrata*-källdrag samt *Inula salicina* i björklöväng. *Saussurea alpina* förekommer flerstädes på tuvor i myren och i närheten av björkuppslag. Detta tätnar ovanför myren mot Ö till en liten skuggrik björkdunge, omkring 40 år gammal. Torvjorden täckes av en rik förna av löv och kvistar. Vegetationen behärskas av *Filipendula ulmaria, Tussilago farfara* och fläckvis av *Rubus idaeus.* Förekomsten av fjällskära i denna björkdunge, här betecknad som område II c, får sannolikt betraktas som en kvarleva från en tid, då marken hölls mera öppen.

Förteckning över växterna på *Saussurea*-lokalen vid Quinnevad i Skörstorps s:n.

Med (+) utmärkas de arter, som ingå i kärlväxtlista och tuv-tabell hos ERLANDSSON (1940).

Betula alba (coll.) (+)

Juniperus communis
Salix hastata
— *nigricans*
— *pentandra* (+)
Salix repens
— *Starkeana *livida*

Anemone nemorosa (+)
Caltha palustris (+)
Campanula rotundifolia

Centaurea jacea	
Cerastium holosteoides	
Cirsium acaule	
— *palustre*	(+)
Crepis praemorsa	
Equisetum arvense	
— *palustre*	(+)
Filipendula ulmaria	(+)
Galium boreale	(+)
— *palustre*	(+)
— *uliginosum*	
Gentianella amarella	
— *uliginosa*	
Geum rivale	(+)
Linum catharticum	
Maianthemum bifolium	
Menyanthes trifoliata	(+)
Myosotis palustris	
Orchis incarnata	
— *cruenta*	
Parnassia palustris	(+)
Pedicularis palustris	(+)
Pinguicula vulgaris	(+)
Polygala amarella	
Polygonum viviparum	
Potentilla erecta	(+)
— *palustris*	(+)
Primula farinosa	
Pyrola rotundifolia	(+)
Ranunculus repens	(+)
Saussurea alpina	(+)
Succisa pratensis	
Taraxacum praestans	
— *cordatum*	
— *Ekmanii*	
— *tenebricans*	
Triglochin palustre	
Trollius europaeus	
Tussilago farfara	
Vaccinium oxycoccos	
— *uliginosum*	(+)
— *vitis-idaea*	
Vicia cracca	(+)
Viola epipsila	

Agrostis gigantea	
Agrostis stolonifera	
Briza media	(+)
Carex caespitosa	
— *capillaris*	
— *dioeca*	(+)
— *flacca*	
— *fusca*	(+)
— *hostiana*	
— *lepidocarpa*	
— *montana*	
— *oederi*	
— *panicea*	(+)
— *rostrata*	
Eriophorum angustifolium	
— *latifolium*	
Festuca ovina	
— *rubra*	(+)
*Juncus alpinus *arthrophyllus*	
— *articulatus*	
Hierochloë odorata	
Luzula multiflora	(+)
Molinia coerulea	

Aulacomnium palustre	(+)
Bryum pseudotriquetrum	
Calliergon giganteum	
Calliergonella cuspidata	(+)
Campylium elodes	
— *stellatum*	
— — **protensum*	(+)
Climacium dendroides	(+)
Cratoneurum filicinum	
Ctenidium molluscum	
Drepanocladus intermedius	
Fissidens adianthoides	
Hylocomium splendens	(+)
Mnium Seligeri	
Philonotis calcarea	
Rhytiadelphus triquetrus	(+)
Thuidium Philiberti	
Tomenthypnum nitens	(+)

Moerchia hibernica	
Plagiochila asplenoides	
Preissia quadrata	
Riccardia pinguis	

Enär *Saussurea* förekommer på tuvor i skilda vegetationstyper, har förteckningen över växterna i fjällskärans miljö blivit tämligen omfattande. En del arter ha dock uteslutits, särskilt från en sumpskogsartad del av björklövängen. *Orchis incarnata* uppträder vid Quinnevad i två skilda typer, den ena rel. storvuxen med röda blommor, den andra liten och spenslig med blommor i ljus rosa. *O. cruenta* avser en lågvuxen typ med purpurfärgade blommor och på båda sidor tätt svartfläckiga blad.

Tab. 1. Analys av vegetationen på *Saussurea*-förande tuvor vid Quinnevad och Sörgården i Skörstorps s:n.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Betula alba (coll.)	—	+	+	—	—	—	+	—	+	—	—	+	—	—	+
Pinus silvestris	—	—	—	—	—	—	—	—	+	—	—	—	—	—	—
Juniperus communis	+	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Salix hastata	—	—	—	—	+	—	—	—	—	—	—	+	—	—	—
— *nigricans*	—	—	+	—	—	—	—	—	—	—	—	—	—	—	—
— *repens*	+	—	—	—	—	—	—	—	+	—	—	—	—	—	—
— sp.	—	+	+	—	—	—	—	—	—	—	—	—	—	—	—
Campanula rotundifolia	—	+	—	—	—	—	—	—	—	—	—	—	—	—	—
Cardamine sp. (ster.)	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—
Cirsium palustre	—	+	—	—	—	—	—	—	—	+	—	+	—	+	—
Crepis paludosa	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+
Empetrum nigrum	—	—	—	—	—	—	—	—	+	—	—	—	—	—	—
Epipactis palustris	—	—	—	—	—	—	—	—	—	+	—	+	—	—	—
Equisetum palustre	—	—	—	—	—	+	—	—	—	—	—	—	—	+	+
Filipendula ulmaria	+	+	—	—	—	+	—	—	—	—	—	—	—	—	—
Galium boreale	+	—	—	—	—	—	—	—	+	—	—	—	—	—	+
— *palustre*	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—
— *uliginosum*	—	+	+	—	+	+	—	+	—	+	—	—	+	—	+
Geum rivale	+	—	+	—	—	+	—	—	—	—	—	+	—	—	+
Linum catharticum	—	—	+	+	—	—	—	—	—	—	—	—	—	—	—
Menyanthes trifoliata	+	—	+	—	+	—	—	—	+	+	—	—	—	+	—
Parnassia palustris	+	+	+	—	+	—	—	+	—	—	—	—	—	—	—
Polygonum viviparum	—	+	+	+	+	—	+	—	—	—	—	—	—	—	—
Potentilla erecta	+	+	+	+	+	+	+	+	+	+	—	+	—	+	+
Rubus idaeus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+
— *saxatilis*	—	—	—	—	—	+	—	—	—	—	—	—	—	—	—
Saussurea alpina	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Succisa pratensis	—	+	—	—	—	—	—	—	—	—	—	+	—	—	—
Tussilago farfara	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+
Vaccinium oxycoccos	—	—	—	—	—	—	—	—	+	—	—	—	—	—	—
— *uliginosum*	—	+	—	—	—	—	—	—	+	—	—	+	—	—	—
— *vitis-idaea*	—	+	—	—	—	—	—	—	+	—	—	—	—	—	—
Veronica chamaedrys	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+
Vicia cracca	+	+	+	—	+	—	—	—	—	—	—	—	—	—	—
Viola epipsila	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+
Briza media	+	—	—	—	+	—	—	—	—	—	—	+	—	—	—
Carex capillaris	—	—	+	—	—	—	—	—	—	—	—	+	—	—	—
— *fusca*	—	+	—	—	—	—	—	—	+	—	—	—	—	—	—
— *hostiana*	—	—	—	+	—	—	—	+	—	+	—	—	—	—	—
— *lepidocarpa*	+	—	—	—	+	—	—	—	—	+	—	+	—	—	—
— *panicea*	+	+	—	+	+	—	—	—	—	—	—	+	—	—	+
— *rostrata*	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—
Deschampsia caespitosa	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Festuca rubra	—	—	—	—	+	—	—	—	—	+	—	—	—	—	—
— *ovina*	—	+	+	—	—	—	—	—	—	—	—	—	—	—	—
*Juncus alpinus *arthrophyllus*	—	—	—	+	—	—	—	—	—	—	—	—	—	—	—
— *articulatus*	—	—	—	—	—	—	+	—	—	—	—	—	—	+	—
Luzula multiflora	—	+	—	—	—	—	—	—	—	—	—	—	—	—	—
Molinia coerulea	+	+	—	—	—	—	—	+	+	+	—	—	—	+	—
Aulacomnium palustre	—	—	—	—	+	—	—	—	—	—	—	—	+	—	—
Brachythecium rivulare	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+
Bryum pseudotriquetrum	—	—	—	+	+	—	+	—	—	—	+	—	—	—	+
Calliergonella cuspidata	—	—	—	+	+	—	—	—	—	—	—	—	—	—	+
Campylium elodes	—	—	—	+	+	—	—	+	—	+	+	—	+	—	—
— *stellatum*	—	+	+	+	+	—	+	+	—	+	+	—	—	+	+
— — **protensum*	—	+	—	+	—	—	+	—	—	+	+	—	—	+	+
Climacium dendroides	—	+	+	—	+	—	—	—	—	—	—	—	—	—	—
Cratoneurum falcatum	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—
Ctenidium molluscum	—	—	—	+	—	—	—	—	—	—	+	—	—	+	—
Dicranum Bonjeani	—	—	—	—	—	—	—	—	+	—	—	—	—	—	+
Drepanocladus intermedius	—	—	—	—	—	—	+	+	—	+	—	—	—	—	—
Fissidens adianthoides	—	—	+	+	—	—	+	+	—	—	+	—	+	+	+
Hylocomium splendens	—	+	+	—	+	+	—	—	+	—	—	—	+	+	+
Mnium undulatum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+
— *Seligeri*	—	—	—	+	+	—	+	+	—	+	—	—	+	+	+
Rhytiadelphus triquetrus	—	+	+	—	—	—	+	—	—	—	—	—	—	—	—
Polytrichum juniperinum	—	—	—	—	—	—	—	—	+	—	—	—	—	—	—
— *strictum*	—	—	—	—	—	—	—	—	+	—	—	—	—	—	—
Sphagnum nemoreum	—	—	—	—	—	—	—	—	+	—	—	—	—	—	—
Thuidium Philiberti	—	—	+	—	+	—	+	—	—	—	—	—	—	—	—
Tomenthypnum nitens	—	—	+	—	+	—	—	—	—	—	—	—	—	—	—
Calypogeia Neesiana	—	—	—	—	—	—	—	—	—	—	—	—	+	—	—
Cephalozia bicuspidata	—	—	—	—	—	—	—	—	—	—	—	—	+	—	—
— *Loitlesbergeri*	—	—	—	—	—	—	—	—	—	—	—	—	+	—	—
Moerchia hibernica	—	—	—	+	—	—	—	+	—	—	—	—	—	+	—
Pellia Fabbroniana	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—
Plagiochila asplenoides	—	—	+	+	+	—	+	+	—	—	+	—	—	—	+
Preissia quadrata	—	—	—	+	—	—	—	—	—	—	—	—	—	—	—
Scapania Degenii	—	—	—	—	—	—	—	—	—	—	+	—	—	—	—

Analyserna nr 1—5 avse område I (Quinnevad), nr 6—13 område II a (norra *Schoenus*-myren), nr 14 område II b (södra *Schoenus*-myren) och nr 15 område II c (liten björkdunge). Provytorna äro i regel mindre än 1 m². Som exempel på tuvornas storlek med resp. längd, bredd och höjd angiven i cm kan anföras till nr 2: 60×55×30, nr 4: 50×50×25, nr 5: 40×30×15, nr 9: 120×95×50, nr 14: 50×50×15 och nr 15: 100×100×20. Nr 8 avser endast en liten tuvslänt. Tidpunkt för analyserna: nr 1: 23.7.1952, nr 2—3: 23.7.1953, nr 4—5: 18.8.1953, nr 6—12: 15.9.1953, nr 13: 2.12.1953 och nr 14—15: 23.6.1954.

I tabellen ingår ej någon analys från Sjöängen. Den *Saussurea*-förande tuvan, närmast ett *Molinia*-ängsfragment nära intill björkträdrötter uppvisar en heterogen artsammansättning av kärr-relikter jämte xerofila och acidifila element. Den 23.6.1954 antecknades följ. arter på en 60×60 cm stor yta: *Rhamnus frangula, Equisetum fluviatile, E. palustre, Filipendula ulmaria, Potentilla erecta, Rubus saxatilis, Saussurea, Tussilago, Vaccinium vitis-idaea, Carex fusca, C. pilulifera, Festuca ovina, Molinia, Aulacomnium palustre, Cli-*

macium dendroides, Dicranum scoparium, Hylocomium splendens, Pleurozium schreberi och *Rhytiadelphus triquetrus.*

Den 22.7.1954 gavs mig tillfälle till ett kort besök i den av WESTFELDT (1939) beskrivna *Saussurea*-lokalen vid Önnarp i Hössna s:n. På en 50×50 cm stor yta, en föga markerad tuva, antecknades följ. arter: *Angelica silvestris, Betula* (ungpl.), *Equisetum palustre, Filipendula ulmaria, Galium uliginosum, Geum rivale, Juncus filiformis, Menyanthes, Polygonum viviparum, Potentilla erecta, Saussurea, Scirpus silvaticus, Carex fusca, Aulacomnium palustre, Climacium dendroides, Hylocomium splendens, Rhytiadelphus triquetrus, Tomenthypnum nitens* och *Thuidium Philiberti.* I närheten *Cirsium oleraceum.* Blad av steril *Saussurea* förekom här i *Tomenthypnum nitens — Sphagnum Warnstorfianum*-samhällen.

Levermossan *Moerchia hibernica* publicerades som ny för Västergötland av ALBERTSON (1942), som anser arten vara »starkt förbisedd i våra kalktrakter» (jmfr ALBERTSON 1949 s. 187). På Falbygden ha sedan flera fynd gjorts. Ö om Falbygden har arten av mig insamlats i Velinge s:n vid Hökensås.

Fyndet av den som sällsynt betraktade levermossan *Scapania Degenii* synes bekräfta ALBERTSONS (1946 s. 426) påstående, att arten ej är så sällsynt på Falbygden. Beträffande artens utbredning i stort kan hänvisas till ALBERTSON (1942) och av honom anförd litteratur. Härtill bör läggas ARNELL (1950), som påvisat arten i material från Nordamerika.

De av mig i tabellen redovisade analyserna ha, som förut antytts, icke avsett fullständig »rutanalys». Några kompletterande anmärkningar må här tillfogas. *Saussurea* (fertil utom i analys nr 15) ingår i samtliga analyser. *Potentilla erecta* uppnår därnäst den högsta konstansen. *Molinia, Briza* och *Vicia cracca* äro underrepresenterade i de analyser, som medtagits. Vad bottenskiktet beträffar nå *Campylium*-arterna hög konstansprocent och *Hylocomium splendens* är vanlig på de högre tuvorna. Som jämförelse meddelas här de arter, som ERLANDSON (1940) konstaterat på samtliga av honom analyserade tuvor (4 st.): *Filipendula ulmaria, Galium palustre, Potentilla erecta, Vaccinium uliginosum* och *Vicia cracca* samt *Climacium dendroides* och *Hylocomium splendens.* Den förstnämnda, älgörten, som vid Nobyån uppträder starkt dominerande, intar lyckligtvis en tämligen blygsam plats i de *Saussurea*-förande ängarna på Falbygden och är ofta steril på fjällskäretuvorna. Dessa lämnas orörda av betesdjuren, något som jag särskilt iakttagit vid Quinnevad.

Ett par odlingshistoriska detaljer må här anföras. Ängen vid Quinnevad, tillhörande ett f.d. soldattorp, har hävdats som slåtteräng till omkring 1910, före vilken tidpunkt den ej var särskilt hägnad gentemot torpets eller granngårdarnas åker. Betningen efter 1910 av den dittills kala ängen har varit mild och området har i sällsynt hög grad förskonats från kulturradikala åtgärder. Namnet Quinnevad betecknar en plats vid sockengränsen mellan Skörstorp och Slöta. Det anger, att en gammal trafikled här nått den från Gerumsberget kommande, tidvis översvämmande bäcken. *Saussurea*-ängen torde ha berörts av dessa översvämningar i sin sydvästra del, där fjällskäran saknas. Bäckfåran har på senare tid avsevärt fördjupats. Område II vid Sörgården ingick före laga skiftet (jmfr karta hos LINDGREN 1939 s. 126) i en vidsträckt, särskilt hägnad äng.

Som väntat uppträder *Saussurea* på Falbygden i näringsrik, kalkbetonad miljö. Sådana kalkindikatorer i fältskiktet som *Schoenus ferrugineus, Carex capillaris* och *C. lepidocarpa* vittna om växtsamhällenas karaktär av vad Du Rietz (1949 s. 292 ff.) kallar extremrikkärr. Ytterligare belägg härför ge sådana bottenskiktselement som *Cratoneurum commutatum, Philonotis calcarea* och *Moerchia hibernica.* Detta motsäges ej av de på åtskilliga tuvor förekommande inslagen av acidifila element, t.ex. *Polytrichum* och *Vaccinium vitis-idaea.* Företeelsen är icke så alldeles ovanlig på tuvor, som växa i höjden i skyddat läge och röna påverkan av björklövsförna. Fjällskäran torde med sina rötter nå ned till kalkrikare jordlager eller träffas av kapillärt uppstigande, kalkhaltigt vatten. I ett fall, då tuv-analysen antagit alltför heterogen karaktär, har jag gjort en uppdelning. Det gäller den höga *Sphagnum nemoreum*-tuvan i II a. De båda analyserna redovisas i tabellen, den från tuvans övre delar som nr 9, den från ett lägre parti som nr 10.

Att *Saussurea alpina* uppträder på Falbygden är ej alldeles överraskande med tanke på att traktens kalkflora har ett rikt inslag av mer eller mindre nordliga (och nordöstliga) arter. Som exempel må särskilt nämnas *Selaginella selaginoides, Poa alpina, Saxifraga hirculus* och *Stellaria crassifolia* v. *paludosa.* Frågan huruvida *Saussurea* tidigare haft större utbredning på Falbygden är svår att besvara. Den inskränkta arealen kan vara spridningshistoriskt betingad. Lokalerna ligga, liksom Ätradalens, ovan den högsta marina gränsen. Förf. frågar sig. varför Östfalbygden har så få *Saussurea*-förekomster, medan Ätradalens äro så talrika. Om fjällskäran tidigare haft högre frekvens på Sydöstfalbygden, vad är då orsaken till att den minskats? Det är ej blott på Falbygden sådana frågor anmäla sig. Kotilainen (1951 s. 144 ff.; karta s. 162), som ingående diskuterar *Saussurea*-problemen i Nordfinland, framhåller, att artens förekomst även där ställer problem och att den håller sig till de kvartärgeologiskt äldsta områdena. Vi får också veta, att fjällskäran är »anspråkslös» längst i N men utpräglat eutrof redan S om den stora vattendelaren.

Att *Saussurea alpina* ej tidigare anträffats i Skörstorp beror väl främst på en bristfällig undersökning av socknen. Som fjällskäran på de båda lokalerna uppträder i hög frekvens, har en inblick i artens livsvillkor och miljö möjliggjorts. Om hemortsrätt för *Saussurea* på Falbygden kan man nu draga säkrare slutsatser än vad de sparsamma och sporadiska förekomsterna i Dimbo och Slöta socknar tillåtit. Ur såväl vetenskaplig som naturskyddande synpunkt är det angeläget, att fjällskärans existens på de skildrade lokalerna ej äventyras. Den nuvarande hävden gynnar uppslag av träd och buskar i starrkärren och deras närmaste omgivning, platser som betesdjuren undvika. Den pågående igenväxningen, påskyndad av dikning (hitintills i mindre omfattning), ger dock ännu rum åt ett rikt blomsterflor på fria kärrytor och ängar med spridda lövträd och buskar. Vi bevittna en tilltalande fas i den utveckling mot slutenhet, som försiggår. Att i tid förhindra fullständig igenväxning och framför allt att avvärja kulturbeteshot på de platser, där fjällskäran ännu dröjer kvar, blir en uppgift för naturskyddet.

Nomenklaturen i denna uppsats följer för kärlväxterna HYLANDER 1941 (und.: *Juncus alpinus *arthrophyllus* sens. HYL. 1953), för bladmossorna JENSEN 1939 och för levermossorna WEIMARCK 1937.

Uppsatsen har möjliggjorts tack vare god hjälp från flera håll. För de forskningstillfällen, som beretts mig på Växtbiologiska Institutionen i Uppsala, tackar jag hjärtligt prof. G. E. DU RIETZ. Dessutom ber jag få framföra ett varmt tack till prof. E. MELIN för värdefulla upplysningar om det första fyndet av *Saussurea* på Falbygden och till docent N. ALBERTSON, överläkare S. ARNELL, fil. drr. C. BLOM och G. HAGLUND samt docent H. SJÖRS för värdefull hjälp med bestämningar.

Litteratur.

ALBERTSON, N. 1941: Bidrag till Falbygdens moss- och lavflora. — Sv. Bot. Tidskr. 35. Uppsala.

— 1942: Selaginella selaginoides (L.) Link. i södra och mellersta Sverige. — Sv. Bot. Tidskr. 36. Uppsala.

— 1946: Saxifraga Hirculus L. vid Lövberga på Falbygden. — Bot. Notiser. Lund.

— 1949: Calliergon sarmentosum och Meesia triquetra i södra Sverige. Några ord om Mellomsjömyren i Dala. — Sv. Bot. Tidskr. 43. Uppsala.

ARNELL, S. 1950: Scapania Degenii and S. Simmonsii found on the North American Continent. — The Bryologist 53.

DU RIETZ, G. E. 1949: Huvudenheter och huvudgränser i svensk myrvegetation. — Sv. Bot. Tidskr., 43. Uppsala.

ERLANDSSON, S. 1940: Saussurea alpina (L.) DC. funnen i Småland. — Bot. Notiser. Lund.

FRIDÉN, L. 1951: Falbygden och dess platåberg — botaniska strövtåg i hembygden. — Swanberg, P. O. och Curry-Lindahl, K., Natur i Västergötland. Göteborg.

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

HYLANDER, N. 1941: Kärlväxter. — Förteckning över Skandinaviens växter I utgiven av Lunds Botaniska Förening, uppl. 3. Lund.

— 1953: Nordisk kärlväxtflora I. — Stockholm.

JENSEN, C. 1939: Skandinaviens bladmossflora. — København.

KOTILAINEN, M. J. 1951: Über die Verbreitung der meso-eutrophen Moorpflanzen in Nordfinnland. — Ann. Acad. Scient. Fenn., A IV: 17. Helsinki.

LINDGREN, G. 1939: Falbygden och dess närmaste omgivning vid 1600-talets mitt. — Geographica nr 6. Uppsala.

RUDBERG, A. 1902: Förteckning öfver Västergötlands fanerogamer och kärlkryptogamer. — Mariestad.

STERNER, R. 1947: Compositae. — LAGERBERG, T., Vilda växter i Norden. Stockholm.

WEIMARCK, H. 1937: Mossor. — Förteckning över Skandinaviens växter, utgiven av Lunds Botaniska Förening. Lund.

WESTFELDT, G. A. 1927: Saussurea alpina (L.) DC. i Västergötland. — Sv. Bot. Tidskr., 21. Uppsala.

— 1939: Cirsium oleraceum (L) Scop. i södra Västergötland. — Acta Hort. Bot. Gothenburgensis. Vol. XIII. Göteborg.

— 1952: Glaciala relikter i Sjuhäradsbygden. — Ur »Från Borås och de sju häraderna». Borås.

Summary.

The species population of *Saussurea alpina* in southern Sweden (HULTÉN 1950) — probably of a relict nature and an immigrant from the south — occurs in Småland (in only one locality; ERLANDSSON 1940) and Västergötland, where the species has many localities in Ätradalen near Ulricehamn (WESTFELDT 1927). It is noteworthy that its distribution is mainly outside Falbygden, the calcareous Cambro-Silurian region in central Västergötland, where the flora includes several so-called northern species, e.g., *Poa alpina, Saxifraga hirculus, Selaginella, Stellaria crassifolia* v. *paludosa.* Only in recent years has the author succeeded in finding *Saussurea alpina* in south-eastern Falbygden, where the species was noted once before, 50 years ago, by Prof. ELIAS MELIN but since then it has not been observed (ALBERTSON 1946, p. 429).

The first of the three finds accounted for here was made in Slöta parish close to »Sjöängen», the fen with a rich growth of *Saxifraga hirculus* described by ALBERTSON (1946). The two localities in Skörstorp parish have been studied in greater detail by the author. As is seen from the list of species (p. 310) the locality at Quinnevad is composed of calcareous fens and moist meadows, where *Saussurea* occurs in *Molinia — Briza media* meadow in the transitional zone between fen and surrounding birch wood. The habitats consist as a rule of ± large hummocks, whose composition of the vegetation is illustrated by the table (p. 312). *Saussurea* is present in all the analyses. If these latter are supplemented with general observations it is clearly evident that *Potentilla erecta, Briza media, Molinia coerulea, Vicia cracca, Campylium* species and, on a certain type of hummocks, *Hylocomium splendens* (cf. ERLANDSSON 1940) attain a high constancy.

The find of the rare liverwort *Scapania Degenii* lends support to the assumption that the species has a centre in Falbygden (ALBERTSON 1942; ARNELL 1950, p. 299).

BOTANISKA NOTISER 1954, HÄFTE 3. LUND

A Physiological Classification of »Shoot Auxins» and »Root Auxins» II.

By BERIT A. M. HANSEN.

Botanical Laboratory, Lund.

(Received July 21, 1954.)

Introduction.

In order to make the set of growth-active compounds in the first paper of this series (9) more complete the following compounds have been investigated:

1-naphthaleneacetic acid = 15
2-naphthaleneacetic acid = 40
1-naphthoxyacetic acid = 41
4-chloro-1-naphthoxyacetic acid = 43
2,4-dichloro-1-naphthoxyacetic acid = 44
2-naphthoxyacetic acid = 42
α-1-naphthoxypropionic acid = 45
α-(2,4-dichloro-1-naphthoxy)propionic acid = 46
α-2-naphthoxypropionic acid = 47
α-1-naphthoxyisobutyric acid = 48
α-2-naphthoxyisobutyric acid = 49

The numbers after the compounds refer to the curves of activity in figures 1—4.

Table 1 shows a survey of the structure of these compounds and is a complement to table 2 in the first paper. Plant materials and methods have been exactly the same as those reported there.

Results.

Even the naphthalene compounds affect the growth of wheat roots in four different ways. They influence cell elongation, geotropism, cell

Table 1. ***Structure of the compounds used.*** **Compounds marked with * have also been used with chlorinated rings. The asymmetric compounds are racemic.**

Acid chains	Ring systems ± oxygen bridge			
	1-naphthalene	2-naphthalene	1-naphthoxy	2-naphthoxy
acetic acid	+	+	+*	+
α-propionic acid			+*	+
α-isobutyric acid			+	+

multiplication and are toxic in high concentrations. The controls behave in all details as has been described in part I of this series. Therefore the morphological chapter of the results in part I will not be repeated.

Cell Elongation.

A survey of the elongation activity of the compounds is given in table 2. Only the literature which has been available to the author is reported. As is seen, the naphthalene compounds which act as auxins in this investigation, i.e., they inhibit cell elongation of roots, are with two exceptions (1, 30) regarded as auxins in the literature. They can be divided here into two groups (Fig. 1). To the first group belongs 1-naphthaleneacetic acid and the data for this compound are taken from part I. The second group consists of three acids, 2-naphthaleneacetic acid, 2-naphthoxyacetic acid, and α-2-naphthoxypropionic acid, which all have the same inhibiting effect on epidermal cell elongation of wheat roots. A $3 \cdot 10^{-8}$ M solution of 1-naphthaleneacetic acid inhibits cell elongation about 50 per cent, whereas a 10^{-5} M solution of one of the other three acids is required to cause the same inhibition.

The references in the literature to the antiauxins (root auxins) are very divergent. The only conclusion which can be drawn is that in most cases the isobutyric acids are inactive in shoots (8, 16, 19, 26). Two exceptions have been found (8, 36). In roots α-1-naphthoxyisobutyric acid is reported as an antiauxin while α-2-naphthoxyisobutyric acid is classified as an auxin and an antiauxin at the same time (35, 36). The 1-naphthoxyacetic and α-1-naphthoxypropionic acids are reported as auxins (8, 16, 24, 26), as antiauxins (34, 35, 36), and as inactive compounds (8, 14, 23). There are no references in the literature to 4-chloro-1-naphthoxyacetic acid and α-(2,4-dichloro-1-naphthoxy)propionic acid, while 2,4-dichloro-1-naphthoxyacetic acid has been mentioned once (20), exhibiting very weak auxin activity. In the present study all these seven acids act as antiauxins (root auxins) (Figs. 1, 2). The

Table 2. ***Survey of the elongation activity of the compounds, found in the literature and in the present study.*** **The references have been classified according to the different tests. Tests which do not directly include cell elongation are collected in the last column. Auxins (shoot auxins) have been marked off in italic type (*00*), antiauxins (root auxins) in bold-faced type (00), and inactive compounds in common type (00). Symbol: * = very weak activity.**

Compounds	Types of tests						
	Avena curvature	Avena cylinder	Pea curvature	Root growth	Root cell elongation		Other growth tests
15. 1-naphthaleneacetic acid	*1, 2, 21, 29*	*21, 22, 28, 29, 36*	*11?, 17, 21, 22, 24, 25, 28, 29*	*4, 14, 33, 34, 35*	*5, 6, 7, 9, 26*	fig. *1*	*10, 12, 13, 24, 30, 31, 32*
40. 2-naphthaleneacetic acid		*36*	*11?*			*1*	*10, 13*, 30, *32*
41. 1-naphthoxyacetic acid	*16, 26,*	8, *16, 26,* **36**	8, *16, 24**	14, 23, **35**		**2**	*8, 10, 15, 16, 24, 26, 30**
43. 4-chloro-1-naphthoxyacetic acid						**2**	
44. 2,4-dichloro-1-naphthoxyacetic acid			*20**			**2**	
42. 2-naphthoxyacetic acid	1, *8, 16, 19, 26*	*8, 16, 19, 26, 36*	*8, 16, 17, 24*	*14, 23, 35*		*1*	*3, 8, 10, 13, 15, 16, 19, 24, 26, 27, 30*
45. α-1-naphthoxypropionic acid	8, *16, 26*	8, *16, 26*	*8, 16, 24**	**34, 35**		**2**	*8, 15, 16, 24, 26*
46. α-(2,4-dichloro-1-naphthoxy)propionic acid						**2**	
47. α-2-naphthoxypropionic acid	*8, 16, 19, 26*	*8, 16, 18, 19, 26*	*8, 16, 18, 19*	*34. 35*		*1*	*8, 15, 16, 19, 27, 30*
48. α-1-naphthoxyisobutyric acid	8, 16, 26	8, 16, 26	*8*, 16	**35**		**1**	8, 15, 16, 26
49. α-2-naphthoxyisobutyric acid	8, 16, 19, 26	8, 16, 19, 26, **36**	*8*, 16	*35, 36*		**1**	8, 15, 16, 19, 26, 27

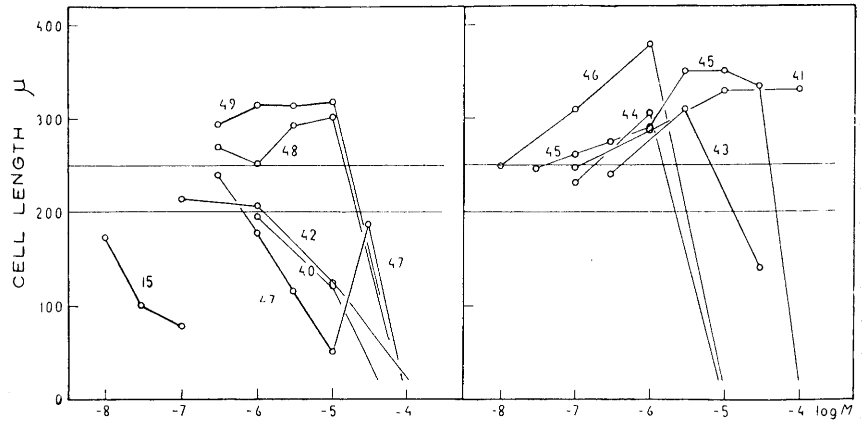


Fig. 1. Fig. 2.

Figs. 1—2. *Root cell elongation activity* in μ. Cell elongation of control roots varies between 194 μ and 251 μ and is marked with horizontal lines. Compounds which inhibit normal elongation have been defined as auxins (shoot auxins), and those which increase cell elongation to more than 251 μ are antiauxins (root auxins). The values for 1-naphthaleneacetic acid have been taken from part I of this publication series.

Fig. 1. 15. 1-naphthaleneacetic acid
40. 2-naphthaleneacetic acid
42. 2-naphthoxyacetic acid
47. α-2-naphthoxypropionic acid
48. α-1-naphthoxyisobutyric acid
49. α-2-naphthoxyisobutyric acid

Fig. 2. 41. 1-naphthoxyacetic acid
43. 4-chloro-1-naphthoxyacetic acid
44. 2,4-dichloro-1-naphthoxyacetic acid
45. α-1-naphthoxypropionic acid
46. α-(2,4-dichloro-1-naphthoxy)propionic acid

maximal values for the different compounds are 302 μ to 379 μ, i.e., 132—163 per cent (control = 100 per cent). The 2,4-dichlorinated naphthoxypropionic acid is the most active one and has about the same activity as α-3-indoleisobutyric acid (Part I, Fig. 9).

The above results show the same gradation of activity as has been reported by VELDSTRA (24): 1-naphtaleneacetic acid is more active than 2-naphthaleneacetic acid; 1-naphthoxyacetic acid is less active than 2-naphthoxyacetic acid. Active means active as an auxin. In the present study 1-naphthoxyacetic acid has no auxin activity at all, i.e., it acts as an antiauxin.

ÅBERG (36) has given an interesting survey of the effects of naphthalene compounds in shoots and roots. The results of the present study agree with his except in one case. He reports α-2-naphthoxyisobutyric acid as having both auxin and antiauxin qualities, as it represses total growth of both roots and shoots of flax. In the present investigation this acid clearly stimulates the growth of wheat roots and is thus only an antiauxin and not an auxin as in ÅBERG's root tests. When cell elongation (Fig. 1) and cell multiplication (Fig. 3), which together constitute total root growth, are studied the acid stimulates both these processes. The acid will be further discussed later.

Geotropism.

In regard to geotropism increases in positive geotropic response of the roots have been caused by some compounds, whereas »ageotropism» has not been observed. Increased positive geotropism is described and discussed in the first part of this study and has been obtained here in treatments with α-1- and α-2-naphthoxyisobutyric acid. *Thus all isobutyric acids employed in part I or II stimulate cell elongation and positive geotropic response of roots* in non-toxic concentrations. The same phenomenon has also been observed in roots treated with α-1-naphthoxypropionic acid and α-(2,4-dichloro-1-naphthoxy)propionic acid, whereas treatments with the acetic acids have not resulted in any alterations of the geotropism.

Cell Multiplication.

Compounds which inhibit cell elongation also inhibit cell multiplication (Fig. 3). Thus the two (shoot) auxin groups are cell-multiplication inhibitors in roots. The antiauxins (root auxins) do not change the normal cell multiplication or they increase it (Figs. 3, 4). This is the same as has been observed in part I and supports the conclusions made there.

Toxicity.

In high concentrations all the compounds disturb the normal morphology of the plants and, furthermore, they inhibit the rate of cell multiplication (Figs. 3, 4). The astonishing shape of the curve showing cell length of plants, grown in α-2-naphthoxypropionic acid (Fig. 1, Curve 47) is correlated with toxicity. When morphological signs of toxicity occur the cell length increases again. Single roots can attain the same cell length as the control roots, but the meristematic

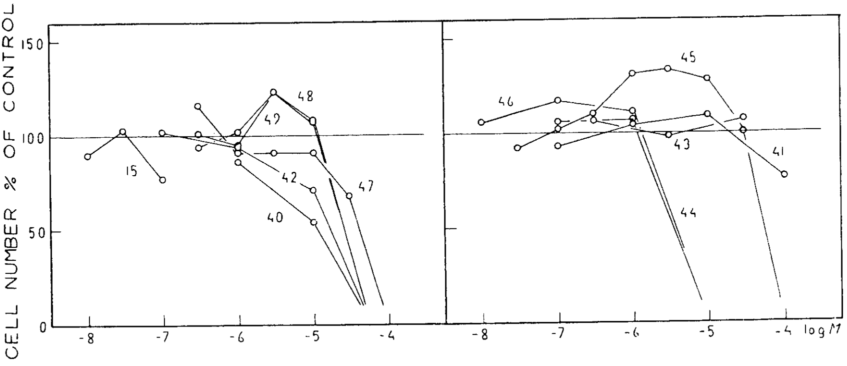


Fig. 3. Fig. 4.

Figs. 3—4. *Root cell multiplication activity,* in per cent of the controls (control= 100 per cent). The auxins (shoot auxins) decrease cell multiplication of roots, while the antiauxins (root auxins) do not decrease but even can increase cell multiplication in non-toxic concentrations.

Fig. 3. The same acids as in fig. 1.

Fig. 4. The same acids as in fig. 2.

processes are deranged. The cells are brown coloured and slender and very easy to distinguish from the control cells. The cell multiplication is inhibited (Fig. 3, Curve 47). ÅBERG (36) has reported a similar phenomenon when using high concentrations of 1-naphthoxyacetic acid and α-2-naphthoxyisobutyric acid in the Avena cylinder test. Both of them inhibit shoot growth in low concentrations and are therefore called antiauxins by him (this is quite in agreement with the present study). In 10^{-4} *M* and 10^{-3} *M* solutions this inhibition is followed by another kind of activity of the same compounds so that total shoot growth increases again. He explains this restoring effect as »residual auxin activity» of the compounds. In the present results this disappearing inhibition of cell length cannot be a growth effect which appears only in absence of toxicity, as it is observed together with morphological signs of toxicity. Further studies of the effects of these acids upon the different processes of flax growth are desirable.

Discussion.

Exceptions to the growth theories, discussed in part I, exist in the foregoing results, even if these theories are restricted to auxin activity in shoots.

According to the two-point attachment theory the 2,4-dichlorinated naphthoxyacetic and propionic acids can be substances which sterically block auxins, but the theory does not explain the ability of the unsubstituted 1-naphthoxyacetic and propionic acid to stimulate cell elongation of roots. Following the theory, they should be inhibitors as both their attachment points are free.

For the same reasons these three acids are exceptions to the three-point attachment theory, as they all have a hydrogen atom attached to the α-carbon of the acid chain.

Neither does any of the other growth theories satisfactorily explain the activity of all compounds employed here. No further theory can be proposed at this stage.

Nevertheless the results obtained with the naphthoxy compounds agree well with those in part I and support the conclusions made there. Applying the same terminology to morphologically similar processes we will have two types of auxins: (i) *shoot auxins, stimulating elongation and multiplication of shoot cells, according to the literature, and, as in this and other investigations, inhibiting the same processes in root cells,* (ii) *root auxins, stimulating elongation and multiplication of root cells.* The reports in the literature of the effects of root auxins among the naphthalene compounds on shoots are not in agreement with each other. *The root auxins, except the 1-naphthoxyacetic acids employed, are furthermore able to increase the positive geotropism of roots.*

Summary.

This paper is a complement to »A Physiological Classification of »Shoot Auxins» and »Root Auxins» I». The effects of 10 additional naphthalene compounds have been investigated and described. They are of the same kind as in part I and can be referred to the same growth processes. The compounds are classified according to these effects as shoot and root auxins.

References.

1. Avery, G. S., Berger, J., Shalucha, B. — Bot. Gaz. 104,281. 1942.
2. — Burkholder, P. R., Creighton, H. B. — Amer. Jour. Bot. 24,226. 1937.
3. Bausor, S. C. — Amer. Jour. Bot. 26,415. 1939.
4. Bonner, J., Koepfli, J. B. — Amer. Jour. Bot. 26,557. 1939.
5. Bosemark, N. O. — Physiol. Plant. 7,497. 1954.
6. Burström, H. — Physiol. Plant. 4,641. 1951.
7. — — Physiol. Plant. 5,391. 1952.
8. Fawcett, C. H., Osborne D. J., Wain, R. L., Walker, R. D. — Ann. Appl. Biol. 40,232. 1953.

9. HANSEN, B. A. M. — Bot. Not. 1954, 230.
10. HITCHCOCK, A. E., ZIMMERMANN, P. W. — Contrib. Boyce Thompson Inst. 17,35. 1952.
11. KOEPFLI, J. B., THIMANN, K. V., WENT, F. W. — Jour. Biol. Chem. 122,763. 1938.
12. LINSER, H. — Pflanzenschutz-Ber. 1949, 131.
13. NORMAN, A. G., WEINTRAUB, R. L. — Nat. Research Council Nat. Acad. Sci. (U.S.) Chem. Biol. Coordination Center, Pub. I Sympos. 46. 1951.
14. NUTMAN, P. S., THORNTON H. G., QUASTEL, J. H. — Nature 155,498. 1945.
15. OSBORNE, D. J., WAIN, R. L. — Proc. IInd Int. Congr. Crop Protection. London 333,1949.
16. — — — Science 114,92. 1951.
17. VAN OVERBEEK, J., BLONDEAU, R., HORNE, V. — Plant Physiol. 26,687. 1951.
18. SMITH, M. S., WAIN, R. L., WIGHTMAN, F. — Ann. Appl. Biol. 39,295. 1952.
19. — — — Proc. Roy. Soc. London B. 139,118. 1951—1952.
20. THIMANN, K. V. — Plant Physiol. 27,392. 1952.
21. — BONNER, J. — Physiol. Rev. 18,524. 1938.
22. — SCHNEIDER, C. L. — Amer. Jour. Bot. 26,328. 1938.
23. THOMPSON, H. E., SWANSON, C. P., NORMAN, A. G. — Bot. Gaz. 107,476. 1946.
24. VELDSTRA, H. — Enzymologia 11,97 and 137. 1944.
25. — — Biochim. et Biophys. Acta 3,278. 1949.
26. WAIN, R. L. — Jour. Sci. Food Agric. 2,101. 1951.
27. — — Lectures, Monographs and Reports No. 2. 1953.
28. WENT, F. W. — Proc. Kon. Ned. Akad. Wetensch. Amsterdam 42, 581. 1939.
29. — — Proc. Kon. Ned. Akad. Wetensch. Amsterdam 42,731. 1939.
30. ZIMMERMANN, P. W. — Torreya 43,98. 1943.
31. — HITCHCOCK, A. E. — Contrib. Boyce Thompson Inst. 8,337. 1937.
32. — WILCOXON, F. — Contrib. Boyce Thompson Inst. 7,209. 1935.
33. ÅBERG, B. — Physiol. Plant. 3,447. 1950.
34. — — Arkiv Kemi 3,549. 1951.
35. — — Ann. Agr. Coll. Sweden 20,241. 1954.
36. — KHALIL, A. — Ann. Agr. Coll. Sweden 20,81. 1954.

BOTANISKA NOTISER 1954, HÄFTE 3. LUND

Endosperm Formation in Salix.

By ARTUR HÅKANSSON.

Institute of Genetics, Lund.

The mature seeds of *Salix* and of *Populus* do not contain any endosperm, the interior of the seed is filled of the embryo. As in most cases of »endosperm-less seeds», some endosperm is formed though it is later absorbed by the embryo; only in *Orchidaceae* and *Podostemonaceae* the division of the primary endosperm nucleus fails. Statements on endosperm development have been made by CHAMBERLAIN (1897) who investigated some *Salix* species from US. He found that the initial endosperm development precedes embryo development, a four-celled embryo being accompanied of eight or ten endosperm nuclei, soon, however, the embryo cells outnumber the endosperm nuclei. The few endosperm nuclei formed are never separated through cell walls. NAGARAJ (1952) has recently investigated two *Populus* species, *P. deltoides* and *P. tremuloides*. Endosperm development always precedes embryo development, the large vacuole here becomes filled of endosperm and walls are formed between the nuclei. Later this endosperm is consumed by the embryo. NAGARAJ corrects the statements of GRAF (1921) of bisporic embryosac and aporogamy in *Populus*: the embryosac develops after the Normal type and the pollen tube uses the micropyle. Also the early description of the embryology of *Salix* contained obscure points. It has later been shown that the embryosac develops after the Normal type (HÅKANSSON 1929, MAHESHWARI and ROY 1951).

Investigation of certain *Salix* hybrids indicated a stronger development of the *Salix* endosperm than previously had been described. I have now studied endosperm formation in *S. caprea* (diploid) and *S. cinerea* (tetraploid), using capsules from isolated and artificially pollinated catkins. The investigation also includes *S. neocinerea* (tetraploid) produced by Prof. NILSSON through crossing *S. caprea* and *S. viminalis*, and a shrub with the number 4805, which was a highly complex hybrid, the result of crossing twelve different species and subspecies. The investigation material of *neocinerea* and the 12-hybrid was from open-pollinated catkins.

This new investigation confirms that in *Salix* endosperm development immediately after fertilization somewhat precedes embryo growth though soon cell divisions in the embryo occur more frequently, while endosperm development slows down. It does not stop, however, though the central vacuole never is filled. Cell formation occurs in a certain degree, but only in the micropylar and chalazal directed parts of the endosperm. Thus the endosperm is more developed than the description of CHAMBERLAIN indicated, though it is no doubt more weak than in *Populus*. Seed development is rather rapid in *Salix*. During the first week after pollination it is comparatively slow but during the second week the considerable embryo growth sets in, which becomes still more rapid in the third week. The rapid growth of the embryo during the second week is connected with the expanding of the leaves, which must by and by result in an increasing nutrient supply to the young capsules.

12-hybrid. — The species and subspecies used by NILSSON in producing this hybrid are *S. viminalis, caprea, nigricans, phylicifolia, purpurea, daphnoides, repens, aurita, aegyptiaca, silesiaca, grandifolia, gracistylis.* The investigated shrub had a very vigorous seed development.

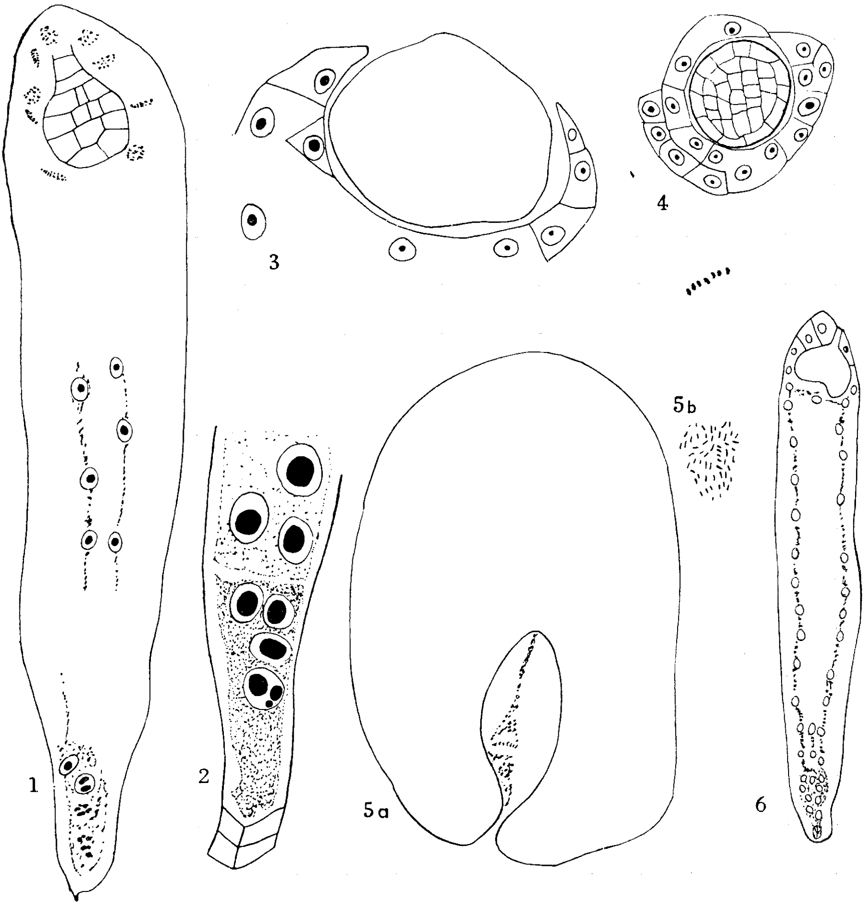
Stages showing the earliest endosperm development were here abundant. A certain differentiation of the young endosperm begins early. When the endosperm contains four nuclei one of them has moved into the narrow pocket of the embryosac which has contact with chalaza cells; this nucleus divides two times (Fig. 2). Perhaps here is the gate through which nutrients stream to the embryosac during the early part of seed development. The cytoplasm is more dense here. The endosperm at the embryo end of the embryosac may take a course of its own, showing independent development. This is clear from Fig. 1. Here all nuclei in this part are dividing while the nuclei in other parts of the endosperm are at rest. A loose tissue of vacuolate endosperm cells is always formed here surrounding the embryo (Fig. 3 and 4). In ovules where the eggcell had broken through the epidermis the embryo was outside the endosperm (compare p. 330). The nuclei from the middle part of the endosperm multiply more or less; their number remains, however, modest in the 12-hybrid. Cells are never formed here.

There is no sharp limits between the three parts of the endosperm as is the case in many *ab initio* cellular endosperms. Nuclei from the middle part contribute to the chalazal as well as to the micropylar endosperm. In older seed with embryo occupying $^2/_3$ of the interior endosperm may still be seen in the two ends of the seed, later it has disappeared.

S. caprea. — During the first week weather conditions had been very bad, open-pollinated capsules showed rather few fertilized ovules, the most advanced had 8 endosperm nuclei, while its embryo consisted of 8 cells. In artificially pollinated catkins most ovules, however, had endosperm and embryo. Common numbers of endosperm nuclei were 16 and 32. In embryosacs with 16 dividing nuclei the most advanced mitotic stages were in the chalaza directed end, the wave of mitosis apparently begins here and proceeds towards the micropylar end of the embryosac. The size of the embryo was rather variable, 9—42 cells, usually 25—39 cells. Sometimes one finds ovules with embryo but lacking endosperm; the undivided central nucleus was close to the embryo. Such ovules were also seen in other investigated *Salix* forms. While ovules with endosperm nuclei rapidly increase in size, remain ovules lacking endosperm unchanged with no mitosis in nucellus or integument. Unfortunately the chromosome number of the embryo in such ovules could not be determined, presumably the embryos are diploid.

After two weeks most embryos had cotyledones. Some very advanced embryos filled half the seed. The endosperm was still developing. In many seeds simultaneous endosperm divisions occurred; in one case their number was about 250, showing the formation of about 500 endosperm nuclei. A rather high percentage seeds with endosperm divisions indicates perhaps a »*seconda primavera*» of the endosperm. As in other *Salix*-forms the endosperm part surrounding the embryo often becomes cellular. It is very poor of cytoplasm. This part of the endosperm had been absorbed in the seeds with the largest embryos. At the chalazal directed part of the seed the cytoplasm of the endosperm is rather dense, containing a somewhat variable number of closely packed nuclei. Also here cellformation may be observed. The lateral parts of the seed has one layer of free endosperm nuclei, they may, however, lie rather close. There is also endosperm between the cotyledones of the embryo: endosperm formed below the embryo has been invaginated by the two cotyledones. One may find endosperm mitosis here (Fig. 5). Mitosis is simultaneous in the whole part of the endosperm having free nuclei.

A number of ovules had only a few endosperm nuclei. Such ovules



Figs. 1—6. Endosperm in *Salix*. — 1—4: 12-hybrid. — 1: Young embryo and endosperm, mitosis in the micropylar directed part of the latter. ×150. — 2: chalazal part of the endosperm shortly after fertilization. ×700. — 3, 4: tissue formation in the micropylar part of the endosperm. ×700. — 5: *S. caprea*, two weeks after pollination, endosperm divisions between the cotyledones of the embryo. ×150. — 5 b: the same more enlarged. × 1000. — 6: *S. cinerea*, two weeks after fertilization, embryo and endosperm. × 50.

show very reduced size; the embryo is small having only 50—100 cells. Also ovules with a central nucleus are still observed. The absence or weakness of endosperm is no doubt detrimental to the development of ovule and embryo. Small, undifferentiated embryos in seeds with little endosperm had often an abnormal position at the lower end of the micropylar canal. It has been observed that old embryosacs in ovules with delayed fertilization have destroyed the nucellar epidermis. The abnormal position of the resulting embryo leads to abortion, probably owing to defective contact between endosperm and embryo.

After three weeks the embryo of *S. caprea* filled the seed. A small rest of the endosperm may be at the chalazal end of the seed, but there is no endosperm between the main part of the embryo and the testa, as erroneously stated in NETOLITZKY.

S. cinerea. — Ovule and embryosac were larger in this tetraploid species. A somewhat slower seed development than in *caprea* is probable. A fixation made 6 days after pollination showed often 16 endosperm nuclei while the highest number of embryo cells observed was 30. However, the development had partly been under better weather conditions than in *S. caprea* during the first week. In a second *cinerea* fixation one week after pollination showing development under still better weather conditions most ovules had 32 endosperm nuclei; the embryo had here in larger ovules 56—70 cells. Later embryo development becomes more rapid, in ovules fixed 11 days after fertilization one may find embryos with small cotyledones. The endosperm seems, judging from the latter fixation and one made after 14 days to have a smaller number of nuclei than the endosperm of *S. caprea*. Cellformation is perhaps more frequent at least in the chalazal part, but the main part of the *cinerea* endosperm is less developed, the free nuclei lying less closely than in *caprea*.

After three weeks the embryo does not fill the seed though it may occupy $^3/_4$ of the interior. Some endosperm may still be seen below the embryo also in large seeds. Curious are occasional endosperm formations showing a superficial resemblance to young embryos. They are spherical but there are no cell walls between the nuclei. The capsules of *S. cinerea* contain two and three weeks after pollination many bad ovules, that is ovules with a small embryo having only about 50 though more often 100—150 cells. Endosperm was lacking or very weak. Such ovules have reduced size and clearly are aborting though one may long observe occasional mitosis in the embryo. The percentage aborting seeds was much higher than in *S. caprea*.

S. neocinerea. — The seeds had probably in most cases been formed after fertilization with pollen from *S. cinerea,* a shrub of the latter species growing quite close. The young seeds show a certain development of a micropylar and a chalazal endosperm part but on the whole the endosperm seems very meagre. Embryo development seemed more slow than in *cinerea*. However, the seeds of bursting capsules are completely filled of a fully differentiated embryo; they showed no trace of endosperm.

Conclusions. — The endosperm of *Salix* has no storage function being of ephemeral nature. During the earlier half of seed development it is, however, rather conspicuous and may long show mitotic activity. No doubt the endosperm has certain physiological functions during this period. The formation of growth substances inciting the growth of the fertilized ovules is such a function. When no endosperm is formed ovules remain small. The occurrence of auxins in endosperms has been established in several cases, for instance in rye. A second function of the *Salix* endosperm is probably a certain influence on the development of the embryo. Early some endosperm nuclei are in contact with the embryo and the young embryo is surrounded of endosperm. Young embryos outside the endosperm do not seem to attain the stage of cotyledone formation. A function in supplying the embryosac with nutrients has perhaps the chalazal endosperm assemblage.

No doubt the endosperm of *Salix* is reduced. In the ancesters of the genus must have been forms with endosperms of the more usual angiospermous type. The occurrence of cells in small parts of endosperm indicate reduction from a stage of cell formation in the whole endosperm. Judging from the investigation of NAGARAJ the *Populus* endosperm is less reduced, filling the central vacuole, though it later disappears also here. This is in agreement with the fact pointed out of several authors that the embryology of *Populus* seems more primitive. Among primitive *Populus*-characters enumerated by NAGARAJ may be mentioned two integuments in certain species, a larger parietal tissue and more archesporial cells in the nucellus. Embryologists have therefore concluded that *Populus* is the more primitive, *Salix* the more derived genus. This is also the most common opinion of morphologists. HJELMQUIST (1948) while acknowledging that »in the embryology of *Populus* there are some features that appear more primitive than in *Salix*» considers, however, the latter genus as the older. The reason of this divergent opinion is among other things the more variable and original floral organization of *Salix*. The higher number of stamens, carpels and ovules in *Populus* is secondary (l.c. p. 163).

The family *Salicaceae* has an isolated position in the system. It forms an order *Salicales* whose relations to other angiosperms is unclear. The flower is very simple and ENGLER ranges the order as number 2 in his system. In view of the reductional traits of the seeds this position seems too low. HJELMQUIST has rather recently discussed its phylogeny. He includes *Salicales* in the order group *Amentiferae* stressing similarities to the order *Juglandales* with the families *Myricaceae* and *Juglandaceae, Amentiferae* he considers to be a primitive group related to the most primitive dicotyle, *Casuarina*. On the other side we have the views of many modern authors that the simplicity of the flower is secondary (BESSEY, HALLIER, HUTCHINSON, GUNDERSEN, LAWRENCE). NAGARAJ who investigated the embryology of *Populus* is convinced of this more high position.

Clearly the embryology of *Salicales* shows certain reductional traits in ovule and endosperm. This reduction seems, however, partly an adaption to the dispersal of the seeds with the wind. The capsule fruit with the often rather numerous small seeds with hairs is an important character of *Salicales*.

In *Betulales, Fagales* and *Juglandales* the fruit has only one large seed lacking endosperm, however. The difference in the fruit has not precluded the common view that *Salicales* is related to *Amentiferae*. Under such circumstances the embryological differences do not seem to prevent the assumption of affinity. The ovule of the family *Fagaceae* has two integuments but the nucellus has already a moderate size, showing a certain reduction. The reduction in *Salicales* is more pronounced.

Literature.

CHAMBERLAIN, J. C. 1897. Contribution to the life history of *Salix*. — Bot. Gaz. 23.

GRAF, J. 1921. Beiträge zur Kenntnis der Gattung *Populus*. — Beih. bot. Centralbl., 38.

HAGERUP, O. 1938. The gynaeceum of *Salix cinerea*. — K. Dansk. Vid. Selsk. Biol. Meddelelser 14.

HÅKANSSON, A. 1929. Die Chromosomen in der Kreuzung *Salix viminalis* × *caprea* von HERIBERT NILSSON. — Hereditas 13.

MAKESHWARI, P. and ROY, S. K. 1951. The embryosac of *Salix*. — Phytomorphology 1.

NAGARAJ, M. 1952. Floral morphology of *Populus deltoides* and *P. tremuloides*. — Bot. Gaz. 114.

NETOLITZSKY, F. 1926. Anatomie der Angiospermen-Samen. — LINSBAUER Handb. d. Pflanzenanatomie X, Berlin.

Litteratur.

BURGEFF, H.: Samenkeimung und Kultur europäischer Erdorchideen, nebst Versuchen zu ihrer Verbreitung. — G. Fischer Verlag, Stuttgart. 1954. 48 sid. Pris 4 DM.

Denna lilla bok ger en intressant exposé över en undersökning, som igångsattes för att lösa ett praktiskt problem, och skildrar det arbete, som nedlagts av några tyska forskare på odling av europeiska jordorkideer. Undersökningen kom till stånd på amerikanskt initiativ och planlades redan 1934. U.S.A. hade då ett stort behov av salepsrot, ty salepsdekokt utgjorde det dåvarande viktigaste läkemedlet mot Cholera Infantum. Då de naturliga förekomsterna av orkideer naturligtvis ej kunde räcka till, gällde det att försöka med odling i stor skala. I boken behandlas undersökningar från 1935 och fram till 1953, således under en lång följd av år. Krigsåren störde arbetet avsevärt, bl.a. genom byte av forskare och vidare förstördes en stor del av observationsresultaten vid ett bombanfall mot Botaniska institutionen i Würzburg. Liksom annorstädes hade man i Tyskland lagt märke till att orkideerna i naturen snabbt minskade i antal och att det fungerande naturskyddet var fullständigt ineffektivt i detta hänsende. Ett av undersökningsproblemen var därför att söka ta reda på om det fanns möjlighet att genom odling öka bestånden i naturen. Boken omfattar i stort två avsnitt, varav det första behandlar laboratorieförsök och den andra delen fältförsök. Den första delen, som gjordes i slutet på 30- och början på 40-talet, är naturligtvis delvis redan föråldrad, och författaren har ej berört de resultat man erhållit i U.S.A. vid laboratorieodling av orkideer. Men den ger en ingående beskrivning av metodik och ger en tydlig bild av de stora svårigheter, som äro förbundna med odling av denna typ av orkideer. Försöken gåvo emellertid vid handen, att det fanns stora möjligheter att med gott resultat dra upp jordorkideer ur frön och sedan odla dem i växthus. Det var emellertid stora risker för felslag och odlingsproblemet hade sålunda ej lösts till grunden. Särskilt stor omsorg fordrar arbetet med symbiossvampen. Den andra delen av boken visar hur svårt det är att tillfredsställande utföra fältförsök i större skala, så att signifikanta resultat kunna erhållas. Ofta kan ett år med olämpliga klimatiska förhållanden medföra att plantorna dö ut. Fältförsöken utfördes i olika typer av vegetation och ge vid handen, att det är mycket svårt att få de utplanterade orkideerna att trivas. I allmänhet hade samtliga exemplar dött ut vid försökstidens slut, d.v.s. efter något mer än 10 år. Orsakerna härtill hade ej utretts tillfredsställande. Överhuvud har författaren tagit mycket lätt på den fysiologiska sidan av problemet, och han kommer ofta med rena antaganden angående orsaken till orkideernas försvinnande. Författaren lyckas ej lösa problemet att odla orkideer i stor skala för framställning av salepsdrog. Till de i mångt och mycket negativa resultaten bidrager säkerligen förhållandet, att undersökningen verkställdes under delvis mycket besvärliga omständigheter.

ARTUR ALMESTRAND.

OTTO PESTA: Berggewässer. Naturkundliche Wanderungen zur Untersuchung ostalpiner Tümpel und Seen im Hochgebirge. Wissenschaftliche Alpenvereinshefte. Heft 14. Universitätsverlag Wagner. Innsbruck. 1953. 46 sid.

Bokens syfte är att stimulera alpvandrarna till undersökningar av de vackra små alpsjöar de träffa på. I slutet uppräknas ett antal apparater och insamlingsutensilier, som äro nödvändiga redskap för kemisk-fysikaliska och biologiska studier. En beskrivning ges av olika miljöfaktorer, som förläna sjöarna här en annan typ än låglandssjöarna, t.ex. de extrema temperaturförhållandena, vilka endast tillåta en månadslång sommartid. Förf. skiljer noga mellan sjöar och »Tümpeln», de senare i allmänhet mindre och grundare. Karakteristiska växt- och djurarter omnämnas, varvid huvudvikten till synes lagts på de senare, som illustreras med ett antal figurer. Förf. konstaterar, att de flesta organismerna äro ubikvister utan specifika miljökrav. Han pekar även på ett område, som hittills icke varit föremål för studier, nämligen bakterielivet, vilket väl för övrigt i lika hög grad gäller alla andra sjöar.

Förf. skriver lättfattligt och utan tyngande termer och kan säkerligen vänta sig en stor läsekrets bland alpbitna amatörer.

ASTA ALMESTRAND.

WALTER BAUMEISTER: Mineralstoffe und Pflanzenwachstum. — Fischer, Stuttgart 1954. 176 sid. Pris 18: 90 kr.

Förlaget har i år utgett en ny upplaga av BAUMEISTER's lilla men starkt koncentrerade och innehållsrika arbete om växtens mineralnäringsämnen. Det behandlar ämnenas förekomst i marken, upptagning samt biokemiska och praktiska betydelse. För vart ämne ges en kort litteraturöversikt och i sin helhet är boken mycket väl planerad och klart och redigt skriven. Uppdelningen av mineralämnena i »element med ionverkningen», »spårelement» och »element med okänd verkan» är naturligtvis som alla sådana klassificeringar artificiell och dömd att misslyckas. Denna anmärkning väger dock lätt. Det märkliga är att boken tryckts om oförändrad, så att den står kvar på 1951 års ståndpunkt. Framstegen sedan dess äro dock så markanta, t.ex. beträffande betydelsen av Mo och Co, att en bearbetning hade varit påkallad. Boken fyller otvivelaktigt ett behov som bekväm uppslagsbok, särskilt för den som icke är fackman, och vore fullt användbar även som lärobok på högre stadium. Man får därför hoppas att förlaget låter nybearbeta nästa upplaga; något större hänsyn bör då också tagas till den engelskspråkiga litteraturen.

HANS BURSTRÖM.

MAX KOERNICKE: (E. STRASBURGER), Das kleine botanische Praktikum für Anfänger. — 14:e upplagan. Fischer, Stuttgart 1954. 248 sid. Pris 14 DM.

De identiska 13:e och 14:e upplagorna av detta klassiska verk ha följt tätt på varandra, ett tydligt bevis på att detta fortfarande är den nära nog enda praktiska handledning som finns i växtanatomi. Förändringarna mot föregående upplagor äro obetydliga. — Innehållet i boken kan delas upp i två från varandra skilda och egentligen oberoende moment. Det ena är de praktiska anvisningarna för framställning och undersökning av mikroskopiska växtpreparat av alla slag. I fråga om detaljrikedom och erfarenhet bakom uppgifterna är denna del oöverträffad. Detta är väl också bokens huvudtema. — Det andra är det anatomiska kunskapsstoff som är inflätat i de tekniska skildringarna; då det gäller kormofyter står det tyvärr inte på samma nivå utan är egentligen en upprepning av adertonhundratalets synpunkter på växtanatomin. Detta visar sig både i terminologi, begreppsbildning och val av material. Det är skada att bearbetaren icke moderniserar boken i detta avseende. Det kan inte hjälpas, att det trots det stora tekniska värdet av boken gör ett förlegat intryck att se xylem på en och samma rad kallat ved, xylem, kärldel, vasaldel och hadrom utan hänsyn till innebörden av begreppen, finna silceller sammanblandade med silrör, samt *Aristolochia* anförd som typ för en dikotyledonstam. En påtaglig brist är fortfarande att en skildring av typmaterial med sekundär rottillväxt saknas.

Denna kritik riktar sig naturligtvis ej mot de kapitel som behandla tallofyter, och som teknisk vägledning bibehåller boken sitt värde.

HANS BURSTRÖM.

B. S. MEYER och D. B. ANDERSON: Plant Physiology, 2:a uppl. van Nostrand, New York 1954. 784 sid. Pris 47: 60 kr.

Första upplagan av denna lärobok utkom 1939 och är därför sedan länge föråldrad. Man hälsar därför med verklig tillfredsställelse icke bara att en ny upplaga utgivits utan också att förff. inte skytt någon möda att revidera och modernisera boken. Förändringarna mot förra upplagan är avsevärda. Kapitlen om vattenbalans, vilket är förff:s eget forskningsområde, har skurits ner starkt, och är nu bättre balanserade mot de övriga avsnitten, de inledande kolloidkemiska kapitlen ha också begränsats eller uteslutits. I stället har ett nytt kapitel »Enzymes» införts och hela ämnesomsättningsfysiologin omredigerats. Särskilt kapitlet om fotosyntes har utökats. Detsamma gäller avsnitten om tillväxt, som vidgats från c:a 130 till 200 sidor. Avvägningen mellan de olika delarna av fysiologin är mycket bättre än i första upplagan, och förff. är värda en eloge för det resoluta sätt på vilket de redigerat om sitt verk. Två allmänna anmärkningar kan man dock rikta mot denna bok, liksom mot alla amerikanska läroböcker: retningsfysiologin är behandlad styvmoderligt och endast som ett bihang till auxinläran, och den europeiska litteraturen borde ha beaktats bättre. I båda avseendena är dock denna bok vida bättre än andra amerikanska och är utan tvivel en av de bästa allmänna läroböcker i växtfysiologi som finns för närvarande.

HANS BURSTRÖM.

Growth and differentiation in plants. Red. av WALTER E. LOOMIS. — The Iowa State College Press, Ames, Iowa 1953. — X+458 sid. Pris 7: 50 doll.

Tillväxtfenomenen — uppbyggandet av nytt organiskt material inordnat i en levande struktur — intar en central ställning inom biologin. De utgör inte bara en angelägenhet för fysiologerna utan berör även morfologi, anatomi, embryologi, genetik m.fl. vetenskapsgrenar, för att inte tala om den betydelse de har ur agrikulturell synpunkt. Det är alltså ett vidsträckt ämne av stort allmänt intresse, som föreliggande bok behandlar. Den ingår i den serie monografier över växtfysiologiska ämnen, som utgives av »American Society of Physiologists».

Innehållet utgöres av aderton uppsatser, de flesta författade av amerikanska forskare. Vid urvalet av bidragen har begreppet tillväxt getts en rätt vid tolkning. Sålunda förekommer en utförlig framställning av hela problemkomplexet heterosis, vilken huvudsakligen håller sig på det genetiska planet, vidare uppsatser om fotoperiodiska reaktioner och vernalisering. En lång uppsats om elektriska potentialer hos växter förefaller att ha rätt lös anknytning till det i bokens titel angivna ämnet. I ett inledningskapitel ger redaktören en översikt över det komplicerade område boken behandlar och på samma gång en sammanfattning av innehållet i de följande uppsatserna. Detta är ett lyckat grepp: det hjälper läsaren att hitta den röda tråden i verket, och det ger red. en väl utnyttjad möjlighet att komplettera och sammanfoga det tämligen heterogena materialet i de övriga uppsatserna. Ett par av kapitlen utgöras av primärmaterial från undersökningar över tillväxten hos majsrötter resp. sträckningstillväxten hos bomullsfibrer. Det hade varit lyckligare, om de ersatts med en mera allmän diskussion av de fysiologiska aspekterna av meristematisk tillväxt och sträckningstillväxt, ett aktuellt område där en mera allsidig belysning saknas i boken.

Även i övrigt är boken tämligen ojämn, t.ex. beträffande de olika författarnas sätt att lägga upp sitt ämne och förmåga att göra en både inträngande och intressant analys av problemen. Somliga nöjer sig med att utan djupare eget engagemang behandla litteraturen på området, medan andra visar prov på en mera självständig behandling av själva ämnet. Det senare sättet är avgjort det mest givande och passar bäst i en bok av denna typ, vars syfte är att ge en mera allmän belysning av problemen. En uppsats, som behandlar vad som väl måste anses vara det centrala i diskussionen om tillväxt och differentiering, nämligen den levande protoplasman, kan anföras som exempel på den förra typen. »Structure and Synthesis of Protoplasm» är titeln och författare är H. S. MCKEE, Sydney. Uppsatsen är späckad med fakta, och på 30 sidor hinner förf. med att ge över 300 litteraturhänvisningar. Den har naturligtvis åtskilligt att ge i fråga om forskningsresultaten på området, men man saknar onekligen en mera resonerande framställning om protoplasmans funktion, när det gäller cellens tillväxt och utformning. En kort översikt av morfogenetiska fenomen och faktorer av E. SINNOTT representerar i viss mån den motsatta ytterligheten — inte en enda litteraturhänvisning. Men den ger ett klart intryck av hur utomordentligt sammansatta de företeelser är, som ligger bakom organismens utveckling av en bestämd form eller struktur. Redaktören själv har skrivit en intressant redogörelse för »Growth Correlation». En annan uppsats, som bör nämnas för sitt intresseväckande framställningssätt, är en, som handlar om »Dormancy» — viloperioder — av N. C. THORNTON. En uppsats mot slutet av boken om patologisk tillväxt av A. J. RIKER och A. C. HILDEBRANDT utmärker sig också genom en personlig stil. Den är mycket innehållsrik och mängder av forskningsresultat refereras, men författarnas förmåga att plocka in sina egna synpunkter på problemen gör det hela levande. De kan lätta upp framställningen med en sådan passus som: At least once a year a colleague appears with a new issue of a learned journal and says, »Well, I see the crown gall problem has been solved!» We reply, »What, again?» — Detta ger ett karakteristiskt drag, som gäller inte bara gallforskning utan många andra grenar av biologisk forskning. Forskaren frestas att ur sitt ofta mycket speciella material dra långtgående slutsatser, vilka lätt ger intrycket, att problemet nu är löst.

Växternas tillväxtfysiologi har under de senaste decennierna i allt högre grad blivit liktydigt med hormonfysiologi, och diskussioner av auxinet och dess inverkan på snart sagt alla fenomen, som står i samband med tillväxten, kommer igen i de flesta kapitlen. En uppsats författad av S. GORDON är ägnad åt en mera direkt översikt av hormonfysiologin. I denna behandlas teorierna om tillväxthormonernas natur, bildningssätt och verkningsmekanism. Den slutsats författaren komer till är, att den biokemiska mekanism, varigenom auxinet ingriper i cellförloppen, fortfarande är höljd i dunkel trots allt det arbete, som lagts ned på att klara upp problemet.

En uppsats om »Cellular Differentiation» av B. COMMONER och M. ZUCKER innehåller en strikt analys av hithörande biologiska problem och en grundlig genomgång av de möjligheter, som erbjuder sig att experimentellt studera differentieringsförloppen på det cellulära planet. Tyvärr skrevs uppsatsen redan 1950, varför den senare delen hunnit förlora mycket av sin aktualitet till följd av den snabba utvecklingen på det cytokemiska området. KATHERINE ESAU, ledande amerikansk växtanatom, ger en koncis och överskådlig framställning av den moderna uppfattningen om hur vävnaderna hos stam och rot differentieras ur de apikala meristemen. I övrigt förekommer uppsatser om den matematiska behandlingen av olika typer av tillväxt och om heterotrof tillväxt hos växter.

Som en sammanfattning kan sägas, att boken innehåller mycket vetande och ger många intressanta synpunkter på centrala biologiska problem. Den ger en god bild av den botaniska tillväxtforskningens nuvarande läge och utgör en värdefull tillgång för forskare inom de områden den har anknytning till och bör även kunna tillfredsställa andra, som har ett mera allmänt intresse för botanisk forskning.

LENNART ELIASSON.

WALTER W. KREUGER: Principles of Microbiology. W. B. Saunders Company, Philadelphia & London. 1953. — XXIII+648 sid., 143 ill. — Pris 5: 50 doll.

Det föreliggande arbetet är ämnat att vara grund för en nybörjarkurs i mikrobiologi för »college students» och som sådan spänna över hela det område, där mikroorganismer utöva sin verksamhet, utan att dock lägga särskild vikt vid någon speciell gren av ämnet. Av bokens c:a 650 sidor ägnas ungefär hälften fundamentella frågor, nödvändiga för den, som vill få en inblick i mikrobiologi, medan andra hälften utgöres av den praktiska tillämpningen — en beskrivning av alla de processer i det praktiska livet, där mikroorganismer på ett eller annat sätt gripa in. Överhuvud lägger man märke till författarens strävan att visa den nära kontakten mellan den mikrobiologiska vetenskapen och det praktiska livet. Detta gör, att boken utomordentligt väl lämpar sig för den, som vill få en allmän inblick i mikroorganismernas värld, medan en mera vetenskapligt inriktad läsare måhända skulle önskat sig litet större utrymme för såväl den teori, som ligger bakom dessa tillämpningar, som den teknik, som är oumbärlig för den, som vill arbeta på området.

Arbetet inledes dels med en historisk översikt av mikrobiologien från Leeuwenhoek's till våra dagar, dels med en genomgång av protoplasmans uppbyggnad och betydelse hos mikroorganismerna, enligt författarens förord avsedd för den, som ej tidigare sysslat med biologi överhuvud. — Härefter följer en genomgång av de grupper av organismer, som konstituerar »the microscopic world»: bakterier, svampar, protozoer, rickettsior och virus. Bakterierna uppta här givetvis största utrymmet. Bakteriecellens byggnad ägnas stort intresse, och bl.a. frågan om bakteriernas kärna diskuteras med moderna rön som bakgrund. Framställningen beledsagas av en mängd fotografiska upptagningar, som äro mycket upplysande. Bakteriernas systematiska ställning diskuteras, och ett större antal teoretiskt eller praktiskt viktiga bakterier, inordnade i släkten och familjer, namnges och beskrives. — Den följande genomgången av mikroskopiska svampar är mindre uttömmande, och bildmaterialet är betydligt magrare, vilket också gäller för protozoerna. Rickettsior och virus ha fått sin berättigade plats, storleksordningen belyses genom jämförelse med övriga mikroorganismer och ett flertal elektronmikroskopiska bilder fullständigar framställningen.

Efter denna systematiska genomgång av mikroorganismerna övergår förf. till mikroorganismernas fysiologi. Att på 50 sidor belysa rollen av enzymer, näring och metabolism, yttre faktorers inverkan samt ärftlighets- och variationsförhållanden torde inte vara en lätt uppgift, i synnerhet som framställningen samtidigt skall göras elementär. Här har också populariseringen stundom resulterat i oklarhet. Detta gäller ett flertal kemiska grundläggande begrepp. Sålunda är pH-frågan dunkelt behandlad, med påföljd att även t.ex. begreppet buffert blir oklart. — För en mera praktiskt inriktad läsare ges här emellertid ideligen exempel på tillämpningen av teorien. Vid behandlingen av temperaturförhållandena hos mikroorganismer t.ex. överföres uppmärksamheten till verkan av pastörisering av mjölk, konservering av födoämnen och frystorkning av bakterier, medan i osmoskapitlet intresset överföres till konservering medelst höga koncentrationer av socker och salt.

Mikrobiologisk teknik behandlas i ett av arbetets större delar. Man finner här en genomgång av vanliga medier för odling och differentiering av mikroorganismer, spridningsmetoder, en mycket utförlig beskrivning av mikroskop och deras fysikaliska bakgrund, inklusive faskontrast- och elektronmikroskopen, ävensom olika färgningsförfaranden. Olika steriliseringsmetoder, fysikaliska och kemiska, ägnas ett kapitel och antibiotika ett. — Möjligen skulle den praktiskt arbetande nybörjarmikrobiologen önska sig en något utförligare beskrivning av exempelvis metoder för ympning och mätning av tillväxt.

Ett kapitel om mikroorganismer i jord och deras verksamhet bildar övergången till bokens mera praktiska del. Kolets, kvävets och svavlets kretslopp i naturen belyses bl.a. schematiskt, vilket kan vara till stor hjälp för läsaren, men riktigheten av den del av kvävecykeln, som vill åskådliggöra denitrifikationen, är i den föreliggande formen tvivelaktig (s. 320). Likaså är det förlopp, som försiggår vid svavelbakteriers oxidation av svavelväte, ytterst förbryllande beskrivet (s. 321—322).

Man får sedan följa författarens beskrivning av det industriella utnyttjandet av mikroorganismer vid framställningen av alkoholika, jäst, org. syror, aceton och andra produkter. Födoämnen av olika slag, från ost till sauerkraut, analyseras ingående. Knappast någon produkt torde här vara överhoppad. — En analys av avloppsvatten och behandling av sådant samt mikrofloran hos vatten i övrigt och dettas rening ägnas var sitt kapitel. — Efter en skildring av mikroorganismer i mjölk och analysmetoder för mjölk avslutas denna del av boken med ett kapitel om matförgiftning.

Den allmänt intresserade läsaren finner i arbetets två sista delar svar på många frågor av vital betydelse i praktiska livet. Det torde inte finnas många infektionssjukdomar, som här ej omnämnes och vilkas upphovsorganism ej nämnes och beskrives, de må utgöras av bakterier, svampar, protozoer, rickettsior eller virus. Av särskilt stort värde för förståelsen av profylax och terapi vid dessa infektioner är härvidlag kapitlet om immunitet och immunisering.

Ett i förhållande till bokens övriga omfång mycket kortfattat kapitel om växtsjukdomar orsakade av mikroorganismer avslutar arbetet.

Till varje kapitel har förf. fogat ett antal frågor på innehållet i kapitlet, avsedda som hjälp vid kurshandledning. Likaledes åtföljes varje kapitel av en lista med handböcker, tyvärr enbart engelskspråkiga, för fördjupade studier i ämnet.

Tryckfel (?) av det mera allvarliga slaget föreligga på sid. 107 (avsnittet Nitrobacteriaceae) och sid. 187 (näst sista stycket, fjärde raden), där nitrat i båda fallen rimligtvis bör ersättas med nitrit.

Genom sin breda uppläggning och genom den utförlighet, varmed i synnerhet alldagliga företeelser beskrives, är KREUGERS bok mycket lättläst och lämplig för den, som vill skaffa sig en allmän översikt över ämnet. Författarens avsikt att för läsaren betona den roll mikroorganismerna spela i naturen och i vårt dagliga liv, praktiskt och ekonomiskt, har förvisso lyckats.

BIRGIT NORDBRING-HERTZ.

Die Evolution der Organismen herausgegeben von G. HEBERER. 2. erweiterte Auflage. Lief. I. Grundlagen und Methoden. S. 1—172. Subskriptionspris DM 12:10. — Lief. II. Die Geschichte der Organismen. S. 173—422. Subskr.pris DM 17: 70. — Gustaf Fischer Verlag, Stuttgart.

Högproduktionen av större arbeten i evolutionslära har fortsatt. I Förenta Staterna har G. G. SIMPSON publicerat »The major features of evolution» i vilken material från hans tidigare viktiga bok »Tempo and mode in evolution» ingår. I Storbritannien har utkommit två samlingsverk. Det ena »Evolution» innehåller ett 30-tal föredrag hållna vid ett symposium i Cambridge anordnat av »The society of experimental biology». En trevlig resumé av J. B. S. HALDANE inleder boken. En utmärkt recension av den finner man i ett av de sista häftena av tidskriften Evolution. Under titeln »Evolution as a process» har ett 20-tal kända zoologer med JULIAN HUXLEY i spetsen publicerat uppsatser med ofta mycket trevligt innehåll. CARTER's »Animal evolution» ligger en smula längre tillbaka i tiden (1951). I Sverige har utkommit det till sidantalet största verket, HERIBERT NILSSON's »Synthetische Artbildung». Detta har dock en alltigenom anti-evolutionär karaktär. I Tyskland har utkommit bl.a. REMANE's »Die Grundlagen des natürlichen Systems, der vergleichende Anatomie und der Phylogenetik», en ny upplaga av RENSCH »Neuere Probleme der Abstammungslehre», ZIMMERMANN's »Evolution» samt det här recenserade arbetet.

Första upplagan kom ut 1943, alltså mitt under kriget, vilket troligen är orsaken till att det värdefulla verket utanför Tyskland förefaller vara relativt okänt, i varje fall ser man det sällan citerat i anglosachsisk litteratur. Det består av ett 20-tal självständiga uppsatser, var och en åtföljd av en litteraturförteckning. Författarna äro alla framstående, ofta intressanta forskare. Olika aspekter av evolutionen belysas, så att verket mer eller mindre framstår som en handbok i evolutionslära. Den nya upplagan är tryckt på utmärkt papper och har goda illustrationer. Med hänsyn till utstyrseln och det stora formatet (stor oktav), är priset moderat.

Lieferung I inledes av »Die philosophische Begründung der Deszensenztheorie» av professor DINGLER, troligen en kär läsning för tyskar. Det största avsnittet är WALTER ZIMMERMANN's »Die Methoden der Phylogenetik». Här finnes mycket av intresse och många värdefulla synpunkter, men framställningen är kanske något svårläst, bl.a. beroende på en formlig hierarki av rubriker och underrubriker. En resumé av evolutionsmetodernas historia som utförligt behandlats i ett större nyutkommet arbete finnes här. Ett intressant zoologiskt problem behandlar RENSCH i »Die phylogenetische Abwandlung der Ontogenese». Här diskuteras bl.a. fylogenetisk neotäni, d.v.s. att djur med helt ny organisation kan uppkomma genom att den ontogenetiska utvecklingen avstannar på larvstadiet då könsmognad inträder (av förf. ej använt exempel, lansettfisk ur tunikat-larv). Det sista avsnittet »Psychologie und Stammesgeschichte» är skrivet av den nu världskände KONRAD LORENZ. Han har gjort banbrytande undersökningar över fiskars och fåglars etologi men ger sig här även i kast med svårare problem i kapitlet »Von den Voraussetzungen der Menschwerdung» med sina tre underrubriker »Die zentrale Repräsentanz des Raumes und die Greifhand», »Die Spezialisation auf Nicht-Spezialisiert-Sein und die Neugier» och »Die Domestikation und die Weltoffenheit». Parentetiskt må anmärkas, att i »Evolution as a process» ett mera begränsat hithörande problem behandlas av TINBERGEN under rubriken »The origin and evolution of courtship and threat display».

Lieferung II som behandlar organismernas historia inledes av en uppsats över den absoluta kronologin av LUDWIG RÜGER, varpå följer ett större paleontologiskt bidrag av WEIGELT »Die Paläontologie als stammesgeschichtliche Urkundenforschung». Det är rent zoologiskt men förhållandevis utförligt och även för en botanist erbjuder det en intressant och trevlig lektyr. Ett nytt avsnitt är FRIEDRICH-FREDGAS »Die stammesgeschichtliche Stellung der Virus-

Arten und das Problem der Urzeugung». Av en framstående fackman får vi här en utmärkt framställning av virusforskningens resultat. Förf. har ej kunnat citera från volymen om virus i Cold Spring Harbor »Symposia on quantitative biology», tydligen kom den ut alltför sent, men många andra skrifter från 1953 äro med, så refereras WATSON och CRICK's uppfattning av molekylstrukturen hos DNA (desoxiribosnukleinsyra). Nyare teorier över livets uppkomst refereras. De två sista avsnitten över växternas och djurens historia äro mycket koncentrerade vilket ju är oundvikligt om förf. skall behandla alla viktigare grupper. Om växterna skriver KARL MÄGDEFRAU. Han blev ju mycket känd genom sin utmärkta »Paläobiologie der Pflanzen» men framställningen här är ej lika bra. Den är mycket lättläst, har väl valda figurer men gör intryck av att vara en aning för ytlig. M. menar att angiospermerna icke är en enhetlig grupp. Som bekant har många forskare ansett *Polycarpicae* vara de äldsta angiospermerna medan andra betonat monochlamydéernas primitivitet. Men fråga är om denna stridsfråga löses genom att ge båda parterna rätt. M. förfäktar att en del av angiospermerna härstamma från koniferema via *Casuarina,* en annan del från Cycadofyter ev. genom *Caytoniales.* I det avbildade stamträdet komma de båda angiospermgrupperna synnerligen långt från varandra; de avsluta två olika huvudgrenar som skiljas åt redan nära tidig devon. Det verkar egendomligt. Det kan tydligen ej ofta nog betonas, att förekomsten av åttakärnig embryosäck av karakteristiskt utseende och av dubbelbefruktning inom alla större angiospermgrupper talar starkt emot en polyfyletisk härstamning. Djurens historia har A. REMANE skildrat. Det väldiga materialet synes han ha behandlat mycket skickligt, och han har givit en även för en icke-fackman läsbar framställning.

Den nya upplagan är ännu icke färdig, ytterligare två eller tre Lieferungen bebådas. Bl.a. skall genetik och evolutionsforskning hos växter och djur, kulturväxternas uppkomst, domestikation och hominidernas fylogeni behandlas. Det är fråga om ett mycket värdefullt arbete, som i den nya upplagan bringats fullt up-to-date och kan rekommenderas åt alla biologer.

ARTUR HÅKANSSON.

Botaniska Notiser 1954, Häfte 3. Lund

Notiser.

Doktorsdisputation. Agron. lic. Carl Gustaf von Hofsten försvarade tisdagen den 25 maj 1954 i Ultuna en gradualavhandling med titeln: »Studier över släktet *Taraxacum* Wigg. med särskild hänvisning till gruppen *Vulgaria* Dt i Skandinavien».

Lunds Botaniska Förenings stipendier. Lunds Botaniska Förening har ur Svante Murbecks fond utdelat ett stipendium å 180 kr. till fil. kand. Kerstin Lexander för inköp av enzympreparat för undersökning av rotpigment hos vete och ur Jubileumsfonden ett stipendium å 150 kr. till fil. stud. Karin Holmquist som bidrag till växtgeografiska fältarbeten inom Ravlundaområdet.

Forskningsanslag. Statens naturvetenskapliga forskningsråd har utdelat bl.a. följande anslag: till fil. lic. K. Aschan 3.300 kr. för genetiska och fysiologiska studier av hattsvampen *Collybia velutipes,* till prof. H. Burström 12.000 kr. för arbeten över tillväxtens mekanism, till prof. G. E. Du Rietz 2.500 kr. för botanisk fältforskning i Frankrike och England rörande artdifferentieringen inom *Euphrasia,* havsstrandklippornas lav- och algbälten samt myrarnas ekologi, till prof. F. Fagerlind 12.000 kr. för undersökning över kärlväxternas fundamentala byggnad, kompatibilitetsundersökningar med ympat och sugkraftsmodifierat material samt morfologiska och embryologiska studier inom vissa tropiska växtgrupper, till prof. R. Florin och docent C. Harling 9.152 kr. för forskning vid Bergianska institutionen, till agr. dr. L. Fredriksson 8.900 kr. för inköp av apparatur för automatisk mätning och registrering av några olika växters fosfatupptagande, till docent T. Hemberg 6.150 kr. för undersökningar av balansen mellan fritt och bundet auxin och andra auxinförstadier hos groende frön och rotande sticklingar samt av de enzymer som reglerar denna balans, till fil. lic. H. Horn af Rantzien 6.000 kr. för undersökningar över fossila charofyter, till institutionen för systematisk botanik, Lund, 7.200 kr. för embryologiska, cytologiska och morfologiska arbeten, till kommittéen för palynologi, Bromma, 38.000 kr. för palynologisk forskning, till docent B. Lindberg 6.600 kr. för undersökning av kolhydrater i lavar och alger, till fil. lic. B. Lövkvist 9.600 kr. för morfologiskt-taxonomisk undersökning över *Cardamine pratensis*-komplexet baserad på erhållna cytogenetiska och biosystematiska resultat, till prof. E. Melin och docent N. Fries 7.000 kr. för undersökning över tillväxt och metabolism hos svampar i kontinuerlig vätskekultur, till laborator T. Nilsson 3.600 kr. för pollenanalytisk bearbetning av provserier från Ageröds mosse, till docent B. Norkrans 3.300 kr. för studier över frågor förbundna med cellulosans och licheninets enzymatiska nedbrytning, till laborator A. Nygren 7.200 kr. för undersökningar inom släktena *Calamagrostis* och *Poa,* till fru E. Nyholm 10.656 kr. för arbete med »Illustrated Moss Flora Fennoscandinavia», del II, till fil. lic. H. Runemark 9.000 kr. för undersökningar av cellulosabildningen hos vissa slemsvampar, till prof. M. G. Stålfelt 7.200 kr. för undersökning av ljusets inverkan på protoplasmans viskositet hos landväxterna, till växtbiologiska laboratoriet, Lund, 9.850 kr. för studier över den naturliga vegetationens beroende av sitt substrat.

BOTANISKA NOTISER 1954, HÄFTE 4. LUND

Studies in the Floral Morphology of Opuntia Dillenii Haworth.

1. Development of the Ovule and Gametophytes.

By Y. D. TIAGI.
Department of Botany, Agra College, Agra, India.

Introduction.

There has been a considerable divergence of opinion as to the systematic position of the family *Cactaceae*. It has been assigned different places by different authors (WETTSTEIN 1944, ENGLER and DIELS 1936, WARMING 1904, HUTCHINSON 1926, LAWRENCE 1951, GUNDERSON 1950). A historic résumé of the various positions assigned to *Cactaceae* in the natural systems of classifications from the time of JUSSIEU to ENGLER has been given by HUBER (1929). In 1950 Prof. MAHESHWARI (Delhi) suggested to Prof. B. TIAGI (Ajmer) that he work out the embryology of *Opuntia Dillenii*. Since the latter was preoccupied with his studies on *Cuscutaceae* and *Orobanchaceae* in the summer of 1952, Prof. MAHESHWARI asked me to undertake this work with a view of further elucidating the morphology, affinities and systematic position of *Cactaceae*. This family is, moreover, characterized by an inferior ovary. As is well known, the nature of the inferior ovary has been one of the most bitterly debated topics of floral morphology. In view of this Prof. V. PURI (Meerut) also approved of my working out the vascular anatomy of the flower of *Cactaceae* along with other aspects of floral morphology so that our knowledge regarding the nature of the inferior ovary, especially in this family, might be increased. The present work which is the first of its series was started at Delhi and continued at Agra.

Material and Methods.

Opuntia Dillenii is naturalized in several parts of Northern India. At one time it was a very serious and troublesome pest but has recently been brought under control by the cochineal insect. At Ajmer it is very commonly used as an effective hedge plant, flowering twice a year, in the months of March—April and September—October. In the beginning several hundred slides, already prepared by Prof. TIAGI were passed on to me. Subsequently, more material was collected. The outer tissues of the ovarian wall were trimmed off and the material fixed on the spot. in F.A.A. In the case of some older buds and flowers the ovules were removed.

Previous Work.

Literature on the embryology of *Cactaceae,* especially the gametophytes prior to 1931 has been carefully summarized by SCHNARF (1931). The following is a brief summary of the work done on the embryology of this family after 1931.

MAURITZON (1934) studied the development of the embryo sac in three species of *Rhipsalis.* The second meiotic division in the micropylar dyad cell is said to be never completed, so that the tetrad consists of an upper dyad cell with a resting or dividing nucleus and two lower megaspores. The mature embryo sac conforms to the '*Polygonum*' type of development (MAHESHWARI 1950). A few stages in the development of the embryo are also figured from which the type of embryonomy cannot be definitely made out. On the basis of his embryological studies the author strongly supports the inclusion of the *Cactaceae* in the order *Centrospermales* (WETTSTEIN 1944).

The following year NEUMANN (1935) studied the development of pollen, ovule and embryo sac of *Pereskia amapola* var. *argentina.* The mature pollen grain is trinucleate. The embryo sac conforms to the '*Polygonum*' type of development. On the basis of remarkable similarities in the development of *Pereskia* with other *Centrospermalean* families she decidedly favours the position taken by WETTSTEIN (1944) regarding the systematic position of the family.

It may be mentioned here that none of these authors studied the morphology of *Passifloraceae. Cactaceae* also shows significant features of resemblance with *Passifloraceae* and may possibly be also related to *Passiflorales.* Work in this direction is in progress in this laboratory.

ARCHIBALD (1939) investigated the development of the ovule and seed of *Opuntia aurantiaca.* Her account of the development of the ovule is praiseworthy since it has removed all previous anomalies regarding its designation. The mature ovule is rightly termed 'Circinotropous' and the third 'integument' has been shown to be formed by the funicle. Development of the embryo sac is described as conforming to the '*Allium*' type (MAHESHWARI 1950). She reports frequent undevelopment and disorganization of the embryo sac and the production of adventive embryos from the nucellar cells resulting in polyembryony. The endosperm is reported to be absent and consequently the adventive embryos develop without it — an observation recorded for the first time, constituting a new and third type of adventive embryony.

Recently TIAGI (1954) has reported the salient features of the life history of *Opuntia Dillenii.* Since then MAHESHWARI and CHOPRA (1954) have reported polyembryony due to the presence of adventive embryos of nucellar origin in *Opuntia Dillenii.* This was abundantly present in my material.

Microsporogenesis.

The young anther consists of a homogeneous mass of parenchymatous cells and it is nearly ellipsoidal in cross section but soon becomes fourlobed. The single archesporial cell is hypodermal and not very conspicuous in early stages (Fig. 1). As seen in longitudinal sections, the number of archesporial cells varies from six to ten. The archesporial cell divides periclinally to form a small outer parietal cell and a large inner sporogenous cell with denser cytoplasm, conspicuous nucleus and nucleolus. The primary parietal cell by periclinal and anticlinal divisions forms a wall of three layers surrounding the single primary sporogenous cell (Fig. 2). The tapetum is 'glandular' in nature. Its cells become enlarged with denser cytoplasm and more prominent nuclei. The tapetal cells remain in situ till they are completely absorbed. The nuclei of the tapetal cells divide just before the initiation of the reduction division in the microspore mother cells. The divisions are typically mitotic (Figs. 6—11) but cytokinesis does not take place with the result that most of the tapetal cells become binucleate (Fig. 12). In the majority of cases the tapetal cells remain binucleate throughout; sometimes the divisions may proceed further resulting in the formation of a tri- to polynucleate cell. In such cases the nuclei may show fusions (Fig. 12). The cells of the single middle layer become flattened and crushed at maturity. At the shedding stage of the pollen the endothecial cells become enlarged and develop fibrous thickenings (Fig. 19), while the anther epidermis becomes flattened and slightly lignified; some of its cells grow as papillae as the anther approaches maturity (Fig. 19).

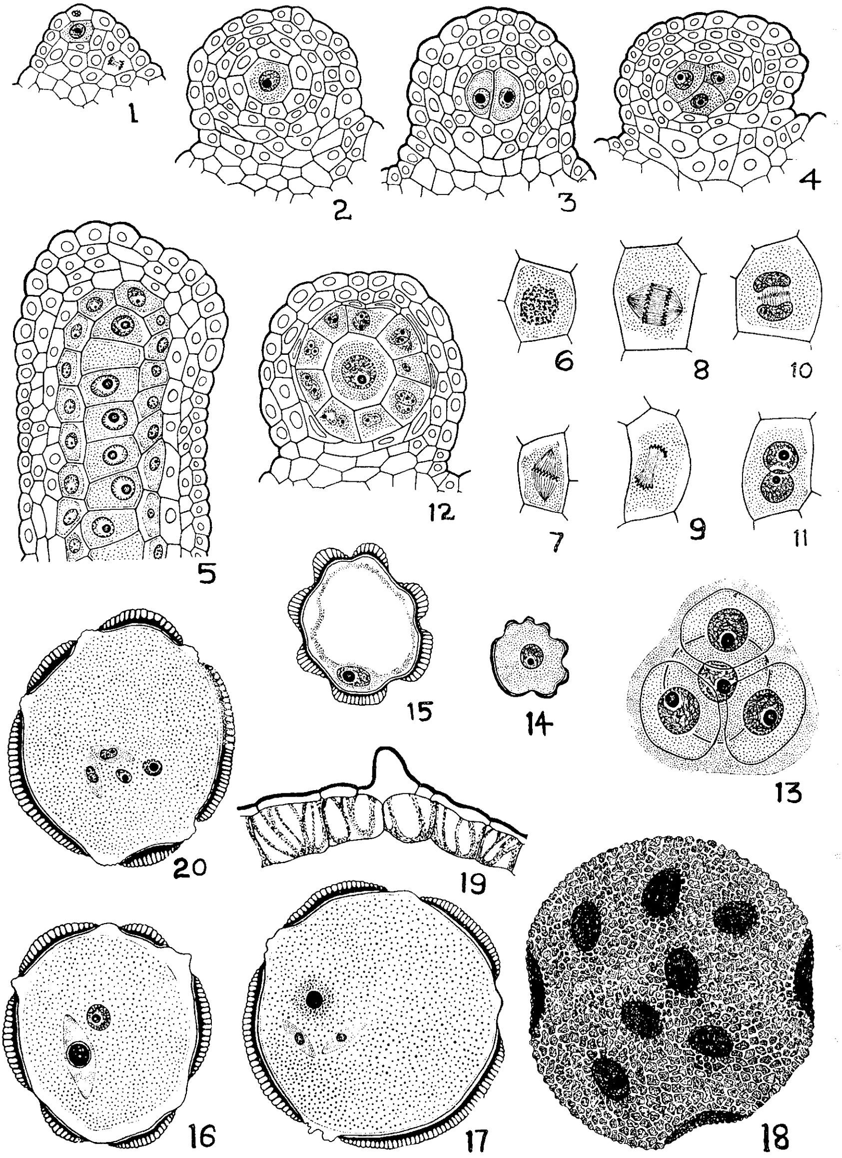
In most cases the primary sporogenous cells divide transversely so that there is a single row of microspore mother cells as seen in a longitudinal section of the anther (Fig. 5). However sometimes one or two vertical divisions may also occur resulting in the formation of two or more microspore mother cells, seen in a cross section of the anther (Figs. 3, 4). The stages of reduction division were not present in my material. Cytokinesis seems to occur by furrowing; the resulting microspores are arranged in a tetrahedral manner (Fig. 13). In addition to the original wall of the microspore mother cell, a mucilaginous wall is secreted by the protoplast which surrounds the young tetrad. Microspores are liberated in the loculus by the dissolution of this mucilaginous envelope, the original wall disappearing somewhat later with the tapetal cells.

Male Gametophyte.

The young microspore (Fig. 14) enters upon a growth period during which its cytoplasm first becomes uniformly vacuolate; later the vacuoles unite to form a single large central vacuole. Consequently the nucleus becomes displaced towards the periphery in the thin peripheral layer of cytoplasm (Fig. 15). At maturity the cytoplasm increases and the vacuole disappears. The next stage observed is the binucleate condition in which the pollen grain contains the spindle-shaped generative cell lying free in the cytoplasm of the larger tube cell (Fig. 16). The generative cell divides to form two spindle-shaped male gametes which

---

Figs. 1—20. Microsporogenesis and the male gametophyte. — 1: c.s. anther showing the single hypodermal archesporial cell. — 2: same, showing the microspore mother cell surrounded by three wall layers. — 3, 4: same, but with two and three microspore mother cells respectively. — 5: l.s. of a portion of anther showing the single row of microspore mother cells. — 6—11: Various stages in the mitotic divisions of the nuclei of tapetal cells. — 12: c.s. anther showing binucleate tapetal cells, crushed middle layer; one tapetal cell shows four nuclei in the process of fusion. — 13: A tetrad of microspores enveloped in mucilage. — 14: A young microspore. — 15: A uni-nucleate vacuolate pollen grain. — 16: A two-celled pollen grain, the generative cell is spindle-shaped. — 17: A mature pollen grain showing the spindle-shaped male gametes, tube nucleus degenerating. — 18: Surface view of a mature pollen grain showing the ornamentation and the germ pores. — 19: Fibrous thickenings in the endothecium; note a papillate epidermal cell. — 20: A double pollen grain showing two tube nuclei and two generative cells, each binucleate. — c.s.=cross section; l.s.=longitudinal section.



Figs. 1—20.

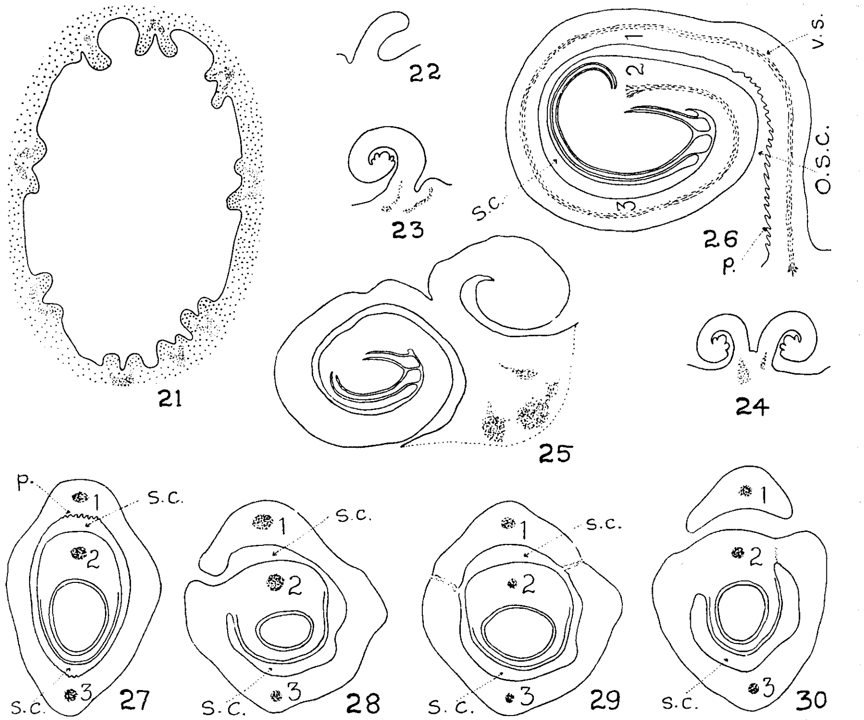
are definite cells, the cytoplasmic sheaths around the nuclei being very conspicuous (Fig. 17). In the mature pollen grain the tube nucleus shows signs of degeneration and is reduced to a lump of chromatin (Fig. 17). The pollen grain at the shedding stage is trinucleate; the intine is thin and smooth, the exine is coarsely reticulate and shows about twelve germ pores (Fig. 18).

An interesting case of a double pollen grain containing two tube nuclei and two generative cells each having two nuclei of the male gametes, there being no cytokinesis, was also observed (Fig. 20).

Ovule.

The development of the ovule (Figs. 21—26) largely follows the same course, as outlined by ARCHIBALD (1939) for *Opuntia aurantiaca*. The ovule arises as a small protuberance on the placenta, which elongates and forms the funicle. The tip of the funicle then bends on account of vigorous growth on the outer side, the two rows of the ovules on a placenta bending in opposite directions. By the time the rudiments of the inner integument followed by those of the outer appear on it, the ovule becomes erect again (Figs. 23, 24). The curvature of the funicle does not stop here; by the time the embryo sac is fully mature the ovule lies once more in an anatropous position (Fig. 26). The term 'Circinotropous' was coined by ARCHIBALD (1939) for this type of ovule. Both the integuments are two-layered (Fig. 41) though the inner integument becomes multilayered at the apex and alone forms the micropyle by its protruding, swollen apex. At maturity there is a conspicuous air space between the two integuments in the chalazal region (Figs. 40, 46). ARCHIBALD (1939) has also reported a similar space in her material of *Opuntia*. NEUMANN (1935) also records the presence of a similar air space in *Pereskia* and regards it as an important point of resemblance with *Centrospermales* where it is a frequent occurrence.

Transverse sections of the ovule (Figs. 27—30) at different levels show the way in which the margins of the funicle grow out, ultimately fusing with the part of the funicle on the opposite side and encasing the ovule in a third 'integument'. In early stages the line of fusion is distinct but at maturity all traces of fusion disappear. In longitudinal section of the ovule the spiral canal leading to the micropyle is distinctly seen on the inner surface of the funicle, lined by glanular papillae (Fig. 26). GUIGNARD (1886) thinks that the papillae help the



Figs. 21—30. Development of the Ovule. — 21: c.s. of young ovary showing ovular primordia, outer tissues trimmed. — 22: An ovular primordium. — 23—26: l.s. ovule showing origin of integuments and curvature of funicle. — 25: Two ovules borne on a single funicle. — 27—30: c.s. of ovule at various levels showing the funicular integument. — o.s.c. = opening of the spiral canal; p. = glandular papillae; s.c. = spiral canal; v.s. = vascular strand.

pollen tube in their journey to the micropyle. The opening of the spiral canal is a small pore just near the base of the funicle (Fig. 26, o.s.c.).

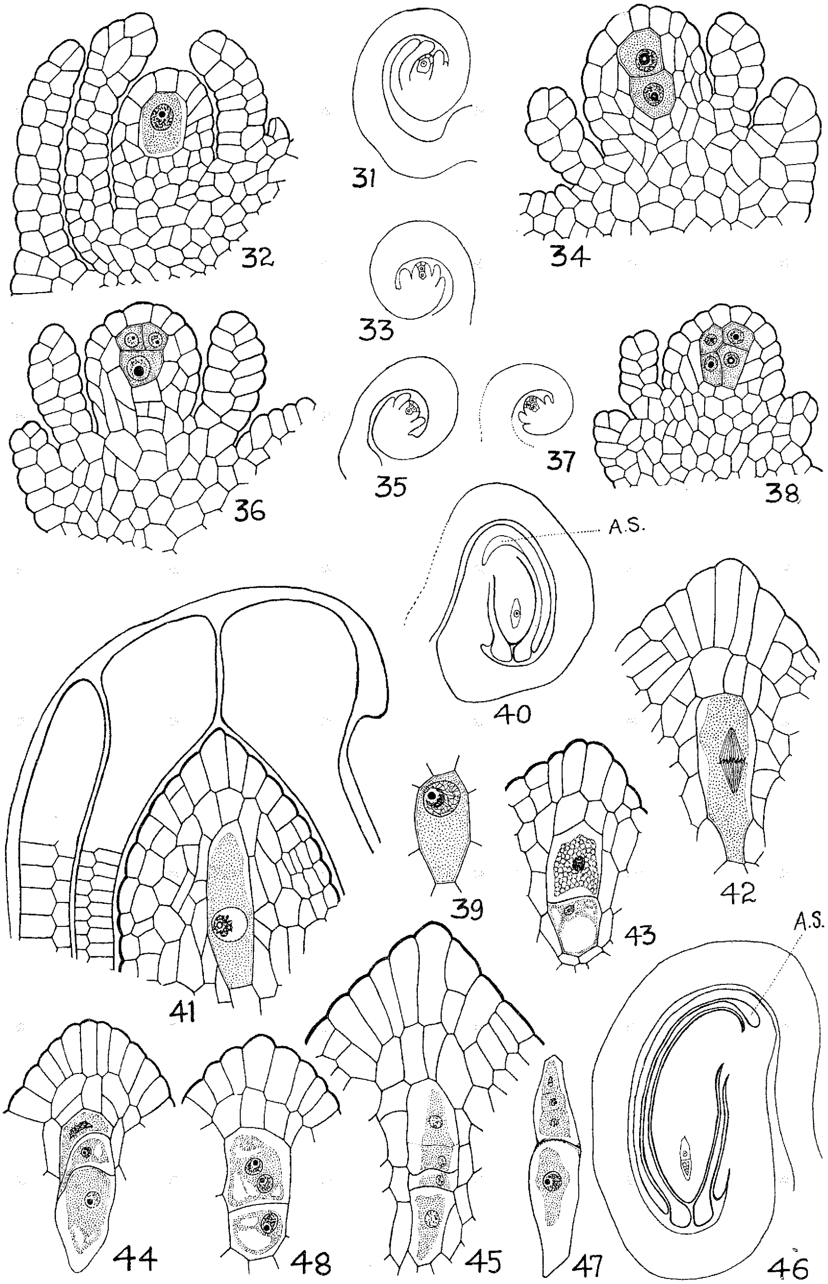
Sometimes two ovule initials arise side by side and their funicles begin to grow all together (Figs. 24, 25) giving the impression that the two ovules arise by branching of a single funicle. This condition is similar to that of *Cereus tortuosus* where GUIGNARD (1886) reports that the main trunk of the funicle gives rise to about thirty branches or 'secondary funicles' each tipped by an ovule. A single vascular strand enters the funicle from the placental bundle and travels up to the chalazal region (Fig. 26, v.s.).

The cells of the nucellar epidermis in the apical region become highly elongated radially and sometimes may even simulate pollen tubes. The nucellus increases rapidly on account of anticlines and periclines in the parietal cell and later in the nucellar epidermis, ultimately resulting in the formation of a characteristic beaked nucellar cap. NEUMANN (1935) thinks that the nucellar cap facilitates the passage of the pollen tubes to the embryo sac; this she regards as another important point of resemblance with the *Centrospermales* where a nucellar cap occurs frequently.

Megasporogenesis.

Usually there is a single large hypodermal archesporial cell (Figs. 31, 32); sometimes there are two, both hypodermal or one hypodermal and the other beneath it (Figs. 33, 34). The archesporial cell or cells by periclinal division form a small outer primary parietal cell and a large inner megaspore mother cell which becomes deep-seated on account of divisions in the parietal cell and the nucellar epidermis (Figs. 35—38). The megaspore mother cell elongates and its nucleus moves to a central position (Figs. 39—41). The bivalent chromosomes then arrange themselves on the equator (Fig. 42) and a wall is formed at the conclusion of the first meiotic division, resulting in the formation of two dyad cells (Fig. 43). At the conclusion of the second meiotic division a linear tetrad of four megaspores is produced (Figs. 45—47). In many cases the upper dyad cell fails to divide and a row of three cells is produced (Fig. 44). The walls separating the two lower from the two upper megaspores or the undivided micropylar dyad cell is markedly oblique (Figs. 44, 49) in most cases. In *Rhipsalis* (MAURITZON 1934) the second meiotic division in the micropylar dyad cell was never completed. Usually the chalazal megaspore functions (Fig. 49), but occasionally the micropylar megaspore may also enlarge simultaneously with the chalazal one (Fig. 45).

Figs. 31—48. Megasporogenesis. — 31, 32: Single hypodermal archesporial cell. — 33, 34: two archesporial cells. — 35, 36: Megaspore mother cell associated with two parietal cells. — 37, 38: Two megaspore mother cells, each with a parietal cell. — 39—41: Megaspore mother cells. — 42: Megaspore mother cell showing the first reduction division. — 43: Two dyad cells, upper one degenerating. — 44: A row of three cells, the uppermost is a dyad cell the two lower megaspores; note the oblique transverse walls. — Fig. 45: A linear tetrad of four megaspores, the micropylar and chalazal have enlarged. — 46, 47: A completely mature ovule showing a linear tetrad of megaspores. — 48: Two dyad cells, upper probably converted into a bisporic binucleate embryo sac.



Figs. 31—48.

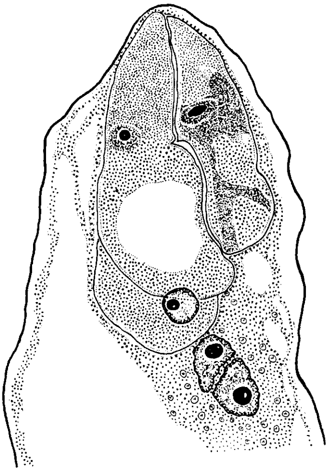
Embryo Sac.

The bi-, tetra- and octonucleate stages (Figs. 50—52) are rapidly passed. Mature embryo sac conforms to the '*Polygonum*' type of development. The prominently hooked synergids (cf. DAHLGREN 1938) are pyriform in shape and show a large prominent basal vacuole (Figs. 54, 55). The two prominent polar nuclei seem to fuse sufficiently late in the development of the embryo sac. As in other plants of the family (DAHLGREN 1939) they are surrounded by starch grains (Fig. 56) which may increase in amount. The antipodal cells are generally ephemeral and vary in shape and arrangement (Figs. 55—57). In one case the antipodal cells were prominent and two of them became binucleate (Fig. 55). Perfectly healthy embryo sacs contain little starch but embryo sacs showing signs of degeneration accumulate an abundance of starch grains, obscuring its structure.

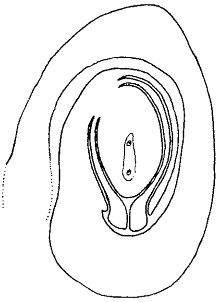
In one case indications of bisporic development were also seen. Here after the conclusion of the first meiotic division, the nucleus of the micropylar dyad cell had divided giving rise to a prominent bisporic E.S. while the lower dyad cell was still undivided (Fig. 48). ARCHIBALD (1939) reported a bisporic embryo sac of the *Allium* type for *Opuntia aurantiaca*. Strong doubts regarding ARCHIBALD's work were expressed by MAHESHWARI (1950): "Her figures are not convincing and it seems probable that the development is really of the *Polygonum* type as in the other Cactaceae". MAHESHWARI (1941) had also questioned the reported occurrence of a bisporic embryo sac of the *Allium* type in *Cuscuta reflexa* (JOHRI and NAND 1934) simply because development of the embryo sac in other species of *Cuscuta* conforms to the monosporic '*Polygonum*' type. In a reinvestigation of this species (JOHRI and TIAGI 1952), TIAGI prepared and examined several thousand slides at Ajmer and it was shown conclusively, to the entire satisfaction of Prof. MAHESHWARI, that the development of the embryo sac follows the '*Allium*' type as was reported earlier. In the Angiosperms there is an evident tendency for megasporogenesis and megegametogenesis to overlap. It is in this way that the various types of bisporic and tetrasporic

---

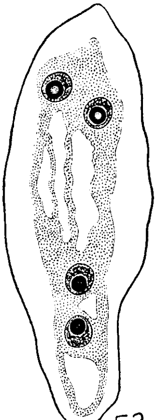
Figs. 49—57. Embryo sac. — 49: Embryo sac mother cell, capped by three degenerating megaspores. — 50, 51: Binucleate embryo sac. — 52: Tetranucleate embryo sac. — 53, 54: Mature embryo sac, without antipodals which have degenerated; the vacuolate synergid has overgrown the other synergid. — 55: Mature embryo sac, antipodal cells conspicuous, two of them binucleate. — 56: Mature embryo sac, synergids degenerated. — 57: Octonucleate embryo sac, the egg apparatus and the antipodals degenerating.



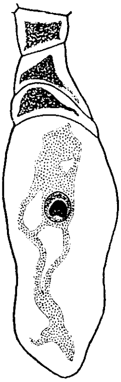
54



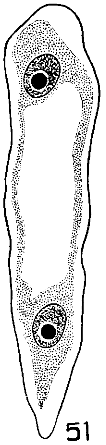
50



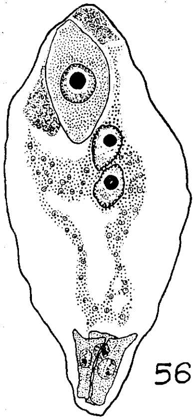
52



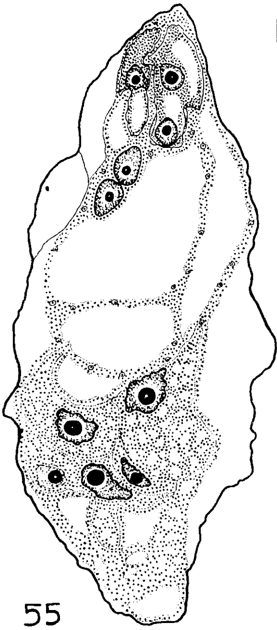
49



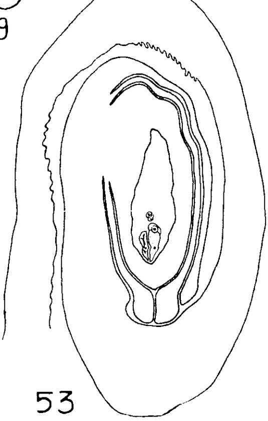
51



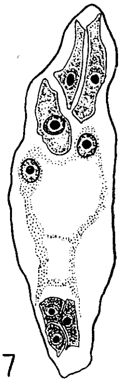
56



55



53



57

Figs. 49—57.

embryo sacs are presumed to have evolved from the monosporic type (SCHNARF 1936). A few more cases may be cited from the literature where development of the embryo sac follows different types in the same genus, sometimes even in the same species. *Scilla indica* and *S. hyacinthina* are monosporic (GOVINDAPPA and SHERIFF 1951, SULBHA 1954) while all other species investigated so far (HOARE 1934) conform to the '*Allium*' type. *Zizyphus jujuba* is monosporic (SRINIVASACHAR 1940) and is also reported to be bisporic (KAJALE 1944); *Zizyphus oenoplia* is monosporic (SRINIVASACHAR 1940); *Zizyphus rotundifolia* is bisporic (ARORA 1953). Many more instances of a similar nature may be added to this list.

Frequently the embryo sac disorganizes (Fig. 57), the general sequence although not always constant being, egg, antipodals, synergids and lastly the secondary nucleus. The lacuna thus formed in the nucellus usually enlarges. In most of these cases the integuments and perisperm develop normally resulting ordinarily in non-embryonate seeds. Due to adventive embryony from nucellar cells some embryonate seeds are also formed. This behaviour is more usual for the *Opuntia* specimens under cultivation. It is suspected that in the case of *Opuntia Dillenii,* plants raised from seeds develop embryonate seeds while plants propagated by vegetative means may ultimately lose the capacity of producing embryonate seeds. Occasionally the embryo sac fails to develop; this occurs after the formation of the megaspore mother cell. Completely mature ovules in which the development of the embryo sac had been arrested at the tetrad stage were present in my material (Figs. 46, 47).

The embryogeny and endosperm of *Opuntia Dillenii* will be dealt with separately.

Summary.

1. There is a single row of microspore mother cells in each of the four loculi of the anther. Divisions of the tapetal nuclei are typically mitotic.
2. The mature pollen grain is three-celled. A double pollen grain is reported. The exine is coarsely reticulate, shows about a dozen germ pores.
3. The mature ovule is of the "Circinotropous" type, crassinucellate, with a beaked nucellar cap, bitegmic, micropyle formed by the inner integument. The third "integument" is formed by the funicle.
4. The single, sometimes two hypodermal archesporial cells cut off primary parietal cells which by their divisions along with divisions in the nucellar epidermis form a nucellar cap and add to the nucellus.
5. The four megaspores show a linear arrangement; sometimes there are three, the uppermost being an undivided dyad cell.
6. The mature embryo sac has the usual eight-nucleate appearance.

Acknowledgments.

The author wishes to express his deep apprecition to all those who have assisted him in making this study. He is especially grateful to the following persons:

Prof. B. TIAGI and Prof. V. PURI for their guidance and inspiration.

Prof. S. SINHA and Principal V. V. JOHN for their facilities and encouragement.

Prof. K. V. O. DAHLGREN for his assistance in preparing the manuscript for publication.

The Director of the Institute of Systematic Botany, Uppsala, for the loan of some literature.

Prof. P. MAHESHWARI for the translation of some of the German literature and his encouragement when the author was in Delhi.

Literature Cited.

ARCHIBALD, E. E. A., 1939: The development of the ovule and seed of jointed cactus (Opuntia aurantiaca LINDLEY). — South African Jour. Sci. 36: 195—211.

ARORA, NIRMAL., 1953: The embryology of Zizyphus rotundifolia LAMK. — Phytomorphology, 3: 88—98.

DAHLGREN, K. V. O., 1938: Hakenbildungen bei Synergiden. Zweite Mitteilung. — Svensk Bot. Tidskr., 32: 221—237.

— 1939: Sur la présence d'amidon dans le sac embryonnaire chez les angiospermes. Deuxième communication. — Bot. Notiser 1939: 221—231.

ENGLER, A., and DIELS, L., 1936: 'Syllabus der Pflanzenfamilien' 11th ed. — Berlin.

*GUIGNARD, L., 1886: Observations sur les ovules et la fécondation des Cactées. — Bull. soc. bot. France, 33: 276—280.

*— 1886: Quelques observations sur les ovules et la fécondation des Cactées. — Bull. soc. Bot. Lyon, 2. ser., 4: 18—22.

GUNDERSON, A., 1950: 'Families of Dicotyledons'. — Waltham Mass.

GOVINDAPPA, D. A. and SHERIFF, A., 1951: Contribution to the life history of Scilla indica BAKER. — J. Mys. Univ., 12: 15—21.

*HOARE, G., 1934: Gametogenesis and fertilization in Scilla nonscripta. — La Cellule, 42: 269—292.

HUBER, J. A., 1929: Blüten und Samenentwicklung der Kakteen und ihre Bedeutung für deren systematische Stellung. — Monatsschrift Deutschen Kakteen, Ges. 1 (9): 175—190.

HUTCHINSON, J., 1926: 'The Families of Flowering Plants'. I. Dicotyledons. — London.

JOHRI, B. M. and NAND, S., 1934: The development of male and female gametophytes in Cuscuta reflexa ROXB. — Proc. Indian Acad. Sci. B. 1: 283—289.

JOHRI, B. M. and TIAGI, B., 1952: Floral morphology and seed formation in Cuscuta reflexa ROXB. — Phytomorphology, 2: 162—180.

KAJALE, L. B., 1944: A contribution to the life history of Zizyphus jujuba LAMK. — Proc. Nat. Inst. Sci. India 10: 387—391.

LAWRENCE, G. H. M., 1951: 'Taxonomy of Vascular Plants'. — New York.

---

* Not seen in original.

MAHESHWARI, P., 1950: 'An Introduction to the Embryology of Angiosperms'. — New York.

MAHESHWARI, P. and CHOPRA, R. N., 1954: Polyembryony in Opuntia Dillenii. — Current Science (India), 23(4): 130—131.

MAURITZON, J., 1934: Ein Beitrag zur Embryologie der Phytolaccaceen und Cactaceen. — Bot. Notiser: 111—135.

NEUMANN, M., 1935: Die Entwicklung des Pollens, der Samenanlage und des Embryosackes von Pereskia amapola var. argentina. — Österr. bot. Zeitschr. 84: 1—30.

SCHNARF, K., 1931: 'Vergleichende Embryologie der Angiospermen'. — Berlin.

— 1936: Contemporary understanding of embryo sac development among Angiosperms. — Bot. Rev. 2: 565—585.

SRINIVASACHAR, D., 1940: Embryological studies of some members of Rhamnaceae. — Proc. Indian Acad. Sci. B. 11: 107—115.

SULBHA, 1954: Embryo sac of Scilla. — Current Science, 23: 98—99.

TIAGI, Y., 1954: Morphology of the Ovule and fruit of Opuntia Dillenii L. — Proc. Indian Sci. Congress. 41: p. 143.

WARMING, E., 1904: 'A Handbook of Systematic Botany' (Eng. Transl.) — London.

WETTSTEIN, R. and F., 1944: 'Tratado de Botanica sistematica'. — Barcelona.

BOTANISKA NOTISER 1954, HÄFTE 4. LUND

True or Apparent Sub-chromatid Breakage and the Induction of Labile States in Cytological Chromosome Loci.

By GUNNAR ÖSTERGREN and THERESIA WAKONIG.

Institute of Genetics, University of Lund, Lund, Sweden.

Many of the phenomena of chromosome breakage that result from treatments of the most various kinds occur in essentially the same manner irrespective of what special kind of treatment that was used. A thorough knowledge of the characteristic ways of reaction of the chromosomes will consequently be a necessary basis for a detailed analysis of the action of any individual chromosome-breaking agency.

One type of effect which has been produced by many different kinds of treatment is the so-called "sub-chromatid" breakage. It was reported from treatments with ultra-violet light and with x-rays by SWANSON (1947) working on pollen-tube mitosis of *Tradescantia*. Recent studies using x-rays are those of LA COUR and RUTISHAUSER (1953) on endosperm of *Scilla sibirica,* and CROUSE (1954) on meiosis in *Lilium*. The effect, which these authors interpret as the consequence of half-chromatid or sub-chromatid interchanges, has also been reported by various investigators using treatments with chromosome breaking chemicals (DARLINGTON and KOLLER 1947, LEVAN and TJIO 1948, ÖSTERGREN 1948, D'AMATO 1950 a and b, 1952 a and b, AVANZI 1950, KIHLMAN 1952 a). It is not necessary to review here all the various interpretations presented in connection with these observations.

These possible sub-chromatid interchange figures were called "pseudochiasmata" by LEVAN and TJIO (1948), a term which unfortunately had earlier been used by various authors for another effect, *viz.* for chromatid interchanges of the ordinary type. In the absence of a better term we are still going to use it here (in the sense of LEVAN and TJIO).

Two different phenomena are characteristic of this effect which, at least superficially, looks like sub-chromatid breakage:

(A) The occurrence of *constrictions* in the chromatids, induced by the treatment. These are the so-called "erosions" of LEVAN and TJIO. We suggest that they may be called *break-constrictions*. The region distal to such a constriction is an *"attached fragment"*. These constrictions have been interpreted as sub-chromatid or half-chromatid breaks by various authors (SWANSON 1947, D'AMATO 1952 b, MARQUARDT 1950), *i.e.* due to a breakage of some but not all the strands of a chromonema which is conceived as a multi-strand or, at least, as a double-strand structure.

(B) The second effect consists in the phenomenon that the anaphase chromosomes remain attached to one another in strictly localized points; thus a phenomenon quite distinct from a general stickiness of the whole chromosome body. These points of attachment are the pseudochiasmata of LEVAN and TJIO (1948). The effect looks very much like what would be expected in the case of a sub-chromatid (or half-chromatid) interchange and it has sometimes been interpreted so, as already mentioned above. In favourable cases this effect may be recognized also in metaphase-type chromosomes.

It is a characteristic feature of these two effects that they are produced by x-ray treatment of prophase (and perhaps also metaphase) chromosomes (SWANSON 1947, LA COUR and RUTISHAUSER 1953, CROUSE 1954). Thus it would appear that these effects result from breakage of the chromosomes when they are in the contracted and spiralized state. The effect is different from that obtained in the resting nucleus, where "full breaks" of the ordinary type are obtained. Thus, if the effects were due to sub-chromatid breakage, then it appears to be an important feature of the chromosomes to respond towards x-ray treatment in this way only during a special period of the cell cycle.

Another interpretation of these effects was suggested by the present writers at the Genetics Congress, 1953, in Bellagio. This interpretation will be described and discussed a little more in detail in the present paper. According to our theory these effects are due to the induction of ordinary "full" breaks in chromosomes that are spiralized and covered with matrix. The matrix prevents the pieces resulting from the breakage to separate from one another. If the breaks induced in a chromonema under these circumstances are able to rejoin in new combinations, the expected result will be in complete agreement with the observed so-called "sub-chromatid interchanges" or pseudochiasmata.

In these interchange figures four chromatid segments will be united. They are connected in the directions of the old combinations by that part of the matrix which had been formed before the chromosomes were broken, and they are connected in the directions of the new combinations by the rejoined chromonemata which are covered by that part of the matrix which was formed after the reunion had taken place.

The induced constrictions are supposed by us to be due to simple breaks (of ordinary "full" type) where the pieces remain connected by the matrix. It is supposed that the continued development of the matrix is inhibited at the break, with the consequence that there results a constriction. In accordance with this idea one will expect that the break-constrictions will have a different appearance at metaphase depending upon what stage has been treated. The earlier that the break occurs during prophase, the higher will be the degree of constriction at metaphase and a treatment of the very earliest stages of matrix formation will give rise to various transition stages between attached and free fragments. These expectations are in good agreement with what we have found in x-ray experiments with root tip mitoses of *Allium Cepa,* a result which strongly supports our theory.

An advantage of our theory is that it easily explains *why* breakage during the division stages gives another result than breakage during the resting stage. The reason is simply the presence of the matrix which keeps the fragments together. If we assume sub-chromatid breakage we have to face the difficulty of explaining why x-rays produce this type of change only during the division stages and not in the resting nuclei. On the basis of our interpretation, on the other hand, it is possible to assume that the chromonemata react in principle in the same way, by "full breaks", during all stages of the nuclear cycle, which appears to be a simple and natural assumption.

Our interpretation is also in good agreement with the observations of SPARROW (1944, 1948, 1951), SPARROW and MALDAWER (1950), SPARROW, MOSES and STEELE (1952), and HAQUE (1953), who found that the spiralized stages of the chromosome cycle are much more sensitive to x-ray treatment than the resting nucleus; the induced breaks, however, are not to be seen in the treated mitoses, only in the next division are the results of the fragmentation directly visible as full breaks. This is easy to understand if the fragments remain connected by the matrix when induced during mitosis, as suggested here. DARLINGTON and LA COUR (1953) have also realized that it might be the matrix (or "nucleic acid charge") which holds the parts together at meta- and anaphase (*l.c.*, p. 54). With regard to the type of breakage found at the next division in such cases, see further below.

The envelope or "matrix" of the mitotic chromosomes may consist of layers of rather different constitution. Thus, there is probably often a rather fluid surface layer. Changes in this layer may be the cause of such an effect as chromosome stickiness. Obviously, however, this material cannot be responsible for the effects considered here. The appearance of the chromosomes when subjected to mechanical deformation by the mitotic forces (bivalents of first metaphase; dicentric bridges) suggests, however, that the main carrier of the mechanical properties of the meta- and anaphase chromosomes is not something like a spiral spring (chromonema) but rather like a continuous body having properties more or less intermediate between India rubber and chewing gum. This material would be a kind of "matrix" of another nature than the rather fluid surface layer. It is this very tough material which we assume to be responsible for the present effects.

Experimental work bearing on the present question has been carried out by us with coumarin.[1] When onion root tips are treated with coumarin practically no breakage of the chromosomes occurs in the resting nuclei. The treatment has, however, a very effective chromosome-breaking action during mitosis (ÖSTERGREN and WAKONIG, Proceed. 9th Internat. Congress of Genetics, in the press). The result of this breakage becomes fully visible only in the next mitosis (in a similar way as in SPARROW's work on x-irradiation of metaphase chromosomes). The treatment used by us was 1 mM per litre for 12 hrs at 13° C or, in some cases, at room temperature. Some experiments were made with coumarin alone and some with colchicine applied simultaneously with and after the coumarin. By the use of colchicine it is possible to distinguish the cells which divide during the coumarin treatment from those that remain in the resting condition; the former become tetraploid while the latter remain diploid.

In the mitoses passing under direct influence of the coumarin treatment (the X_1 mitoses) the effect consists practically only of pseudochiasmata and induced constrictions (attached fragments). "Full" chromatid breaks occur only rarely. These X_1 mitoses are found during the period of treatment and shortly afterwards (*e.g.* 12 hrs. after treatment at 13° C in combined experiments with colchicine). These facts

---

[1] The chromosome breaking activity of coumarin was discovered by ÖSTERGREN (1948).

suggest that the treatment breaks the chromosomes during a period of the mitotic cycle when the chromosomes have a matrix. Possibly the sensitive period begins just before the start of the matrix formation, an idea which might explain the few "full" breaks occurring besides the many changes of "partial" type. Now, *if* these changes had been real half-chromatid or sub-chromatid ones, *then* they would have appeared at the next (tetraploid) mitosis as chromatid (or sometimes even sub-chromatid) changes. The tetraploid mitoses (the X_2 mitoses) show, however, a high frequency of chromosome-type changes (*i.e.* changes affecting both chromatids), a fact supporting the idea that the changes in the previous division were of chromatid type, as assumed in our interpretation of the nature of these pseudochiasmata and induced constrictions.

The influenced tetraploid cells show an average of something like 40 breaks per cell. (Many of the fragments are of the "minute" type. As these probably are interstitial deletions they were counted as two breaks.) In a sample of 37 cells containing more than a hundred recognizable chromosome-type interchanges (dicentrics and polycentrics) there was found a single quadriradial (possible chromatid interchange) and 4 triradials. An important feature of the quadriradial and at least three of the triradials was the occurrence of constrictions in some of the chromatids at the loci of breakage and reunion or their sister loci. This suggests that these figures might derive from delayed breakage (in the X_2 prophase) of labile loci induced at the treatment (*cf.* below).

The quadriradial and the 4 triradials were found in 5 different cells, one of these changes in each cell. Besides these changes the cells in question also contained numerous other changes which all were of chromosome type. The quadriradial might possibly be derived from a pseudochiasma of the previous division, if the half-chromatid interchange idea were valid, but the triradials are not easily explained on such an interpretation. We cannot expect a half-chromatid-interchange pseudochiasma of the X_1 cell to appear as a triradial in the X_2 division. In order to explain our triradials we have to assume that some other mechanism has been working and under these circumstances, this other mechanism is very likely to produce quadriradials also. Consequently the occurrence of the triradials may give more evidence against than in favour of the half-chromatid-interchange interpretation of the pseudochiasmata. (An explanation of the origin of the quadri- and triradials is given below.)

Thus, the quadriradials expected from the pseudochiasmata of the previous division on the basis of the sub-chromatid interchange idea were on the whole absent; the single observed case has a dubious character because of the constrictions present in it. Unfortunately the evidence may not be considered as quite conclusive, however, as it may be suggested that the strongly influenced cells showing pseudochiasmata in the X_1 mitoses did not survive to give a tetraploid X_2 division. The X_2 mitoses studied may derive from X_1 cells showing no or only very few pseudochiasmata and the changes of chromosome type seen in the tetraploid cells might derive from fragmentation at a stage other than that first supposed (*e.g.* at telophase of the X_1 mitoses). On the other hand, it seems very probable, however, that the strongly fragmented X_2 cells derive directly from the strongly influenced X_1 cells, and that we are studying the same fragmentation effect at two different developmental stages.

An interesting feature of the formation of the pseudochiasmata in the X_1 cells is that, in some types of treatment at least, they are more often formed between non-sister chromatids than between sister chromatids. This fact gives strong evidence against the idea that the pseudochiasmata might be simply a consequence of some kind of stickiness.[1] The result is in agreement with the idea that they result from breakage, however, in so far as breaks distributed at random should only rarely occur in about the same position in both the two sister chromatids. In the X_1 mitoses it is also found that the induced constrictions usually occur in one only of the two sister chromatids at each influenced locus. It is difficult to judge if pairs of constrictions occur more often than expected from randomness, if so, this effect might suggest a non-random distribution of breaks, some loci being especially sensitive. Pairs of constrictions might theoretically be due also to negative heteropycnosis of heterochromatic regions. Negative heteropycnosis can, in any case, not be a general explanation of the constrictions, as most of them occur in one chromatid only.

In the tetraploid X_2 cells many induced constrictions are found to occur besides the ordinary breaks. In these cells, however, the constrictions usually occur in pairs, *i.e.* simultaneously in both the two sister loci of each influenced chromosome. A similar picture is repeated in

---

[1] Naturally, this does not exclude the possibility that there could *also* exist some pseudochiasma-like figures resulting from simple stickiness in this as well as in other experiments. It is quite possible that the pseudochiasmata may have a heterogenous origin, and that stickiness may be the cause of some cases.

the octoploid (X_3) cells, although here the constrictions may not so often occur in pairs (a possible difference between tetraploid and octoploid cells in this respect should be subjected to further study in order to ascertain it). Negative heteropycnosis or "nucleic acid starvation" is not likely to be the complete explanation of these paired constrictions, because in an octoploid cell studied we found only 2 out of 8 homologous satellite chromosomes showing paired constrictions of this induced kind. All the 8 homologous heterochromatic regions should have been starved, as they were under the same physiological conditions (in the same cell). If the plant were heterozygous with respect to this hypothetical heterochromatin, there should in any case be 4 satellite chromosomes showing the same effect.[1] Furthermore, there are all intermediates between paired attached fragments and paired free fragments, a fact suggesting that these paired constrictions are a fragmentation effect.

Now, we have seen in the x-ray experiments that the constrictions originate from irradiation of late stages of the nuclear cycle, *i.e.* stages which soon pass into metaphase (presumably these stages belong to the prophase). Then it seems reasonable to suppose that the paired constrictions found in the X_2 cells of the coumarin experiment might also represent cases in which the chromosome breakage has occurred during the prophase of the studied mitosis. Our interpretation is as follows: During the treatment some loci in the treated X_1 cells may change or "mutate" to a labile state. In the following resting stage each of these may reproduce to give two labile sister loci, one in each chromatid. These may remain relatively stable during the resting stage, but the prophase (and probably the other mitotic stages) represents a critical period during which breaks easily arise in these labile loci. When breakage occurs during the X_2 prophase in such a pair of labile loci the result will be a pair of induced constrictions in the following metaphase. The critical period of the division cycle in the X_2 cells may correspond to the coumarin-sensitive period in the X_1 cells. It may begin just before the onset of the matrix formation and thus also explain the occurrence of a few "full" breaks of ordinary kind. A delayed breakage of this kind may explain the origin of the single quadriradial and the four triradials found. The constrictions observed at the interchange points in these are presumed to be due to prophase

---

[1] It would be valuable to collect more evidence of this kind, but it is not so easy to get it, as the chromosome complement of the onion contains one chromosome pair only, which is easy to recognize: the main satellite chromosome pair.

breakage of a sister locus to the locus that a little earlier went through "ordinary" chromatid breakage.

Pairs of constrictions occurring at X_2 might, however, also be suggested to be due to another mechanism, *viz.* a more or less identical reproduction of a chromosome showing a sub-chromatid break. In this way we would get two chromatids each showing a partial break of the same kind as the mother chromosome. This interpretation was suggested by D'AMATO in the discussion at the Eighth International Congress of Botany, Paris 1954. We have no definite evidence bearing on this question but we have, for the time being, adopted the labile-locus idea as our working hypothesis feeling that it may be more probable. In any case we are still considering the other idea as an alternative possibility. It is naturally even possible that both these effects may occur in the same material.

It should be mentioned that the tetraploid cells also contain many cases where the induced constriction is found in one only of the two sister chromatids. The majority of these constrictions occur in a paired condition, however. On the basis of the labile-locus idea the single constrictions would represent cases where only one of the two sister loci has broken. The unbroken one may survive for some time and break at a later mitosis. Perhaps some "healing" or back-mutation to stability might also occur and perhaps be involved in some of these cases. The induced constrictions seen in the octoploid mitoses might be due to labile loci that have been able to survive the tetraploid division.

A changed chromatid in an X_1 cell will naturally appear as a changed chromosome (two changed sister chromatids) in the tetraploid X_2 cell generation. In the next mitosis (the octoploid X_3 generation) the same change will be represented by a pair of sister chromosomes of identical appearance. This is also the rule in the X_3 cells. These octoploid cells are very difficult to analyze, but still our observations are sufficient to demonstrate that besides these changed chromosomes occurring in pairs there are also many changed chromosomes that are represented by a single specimen only in each cell. The shape of these exceptional chromosomes suggests an origin from sister reunion in the tetraploid cells. Perhaps they may, some of them at least, originate from the paired constrictions of the tetraploid cells, these being breaks which become more reactive for reunion in the X_2 telophase, when the matrix has disappeared. In the tetraploid cells there are, however, also some cases of sister reunion of ordinary type. These may result from reunion following pre-prophase breakage of labile sister loci, that is a kind of "iso-chromatid" breakage, or they may possibly be due to a delayed reunion of chromosome-type breaks (reproduction followed by reunion).

Besides numerous normal diploid cells a very low number of diploid cells showing changes was observed in the recovery phase of these experiments. The frequency of changes in these cells deviated strongly from randomness (Poisson series), each influenced cell usually showing many changes. For this reason it is supposed that these cells had been in a sensitive period when treated. Our interpretation is that they were in prophase when treated, but instead of completing their division, they reverted to resting nuclei, a phenomenon not very unusual at various toxic treatments of mitosis (*e.g.* D'AMATO 1950 c). We suppose that during the recovery phase of the experiment they may start mitosis again, still remaining diploid cells. As expected from this idea all these cells showed changes of chromatid type. Besides chromatid-type changes they also showed induced constrictions, usually only in one of the sister loci. These constrictions may represent delayed breaks corresponding to the paired constrictions in the tetraploid cells. Then, these cells would be a kind of "demasked" X_1 cells, the matrix has been broken down and later been formed anew. It is interesting to notice the presence of "full" chromatid interchanges in these cells, as expected from our interpretation of the nature of the pseudochiasmata. Our idea was that the pseudochiasmata were full chromatid interchanges that were masked by the presence of matrix.

Inspired by KIHLMAN's results (1951, 1952 a and b) we also made a similar experiment with caffein. In our study we used 10 mM per litre for 12 hrs. Colchicine was applied two hours before the caffein in order to start the c-mitosis, during the caffein treatment, and afterwards. The experiment was performed at 13° C. The result was fairly similar to that of the coumarin experiments. In this case, however, the frequency of changed diploid cells found during the recovery phase was much higher. In this case, too, the relatively few changed diploid cells showed many changes each. They presumably represent reverted prophases that have entered mitosis again (demasked X_1 cells). The tetraploid cells resemble those of the coumarin experiments. They show besides ordinary chromosome changes very many attached fragments present in a paired condition. Chromatid interchanges were more common in these tetraploid cells than in the tetraploid coumarin cells. Perhaps they are due to delayed breakage as suggested above.

Our observations are in agreement with KIHLMAN's conclusion that caffein breaks the chromosomes only during mitosis. The occurrence of diploid cells with changes (presumably reverted prophases) demonstrates, however, that caffein is capable of penetrating into the nucleus even though the nuclear membrane is present. It is quite possible that the limitation of the caffein action to the mitotic stages may be a matter of differences in sensitivity of different stages, rather than a matter of penetration power as suggested by KIHLMAN. His interpretation was that the purine derivatives which were found to induce chromosome breakage in the resting nuclei could do so because they were able to penetrate into the resting nuclei through a lipoid layer surrounding these, while the other purine derivatives which induced fragmentation only during mitosis were unable to penetrate through this lipoid layer. These ideas are supported by his observations on the solubility properties of the purines in question; the partition coefficient lipoid/water being much higher for the substances inducing breakage in the resting nucleus. It is, however, a characteristic feature of his data that the substances which combine the two properties: (1) ability to cause breakage in the resting nucleus, and (2) high relative lipoid solubility, also have a third property in common, *viz.* a special chemical structure (they are, all of them, alkyl ethers or thioethers at carbon atom nr. 8). It is quite possible that the two mentioned properties may both be conditioned by this characteristic structure, instead of the one being caused by the other. It is interesting to notice that coumarin which has a much higher solubility in solvents of lipoid type than in water[1] still acts according to the same scheme as the TMU-type of KIHLMAN, thus in disagreement with his interpretations. KIHLMAN could observe the presence of lipoids around the nuclei by means of staining with Sudan black. But, of course, there could be an accumulation of lipoids

---

[1] A rough test that we have made demonstrated that the solubility of coumarin in ethyl ether is somewhat more than ten per cent; its solubility in water, on the other hand, is, according to HODGMAN's Handbook of Chemistry and Physics, 0.01 per cent. Our personal impression is that the water solubility of coumarin is somewhat higher than that, but in any case the partition coefficient ether/water will have a value of several hundred. — Another substance of interest in the present connection is maleic hydrazide. According to McLEISH, this substance influences the chromosomes in the resting nuclei (1953, p. 143). We have not seen much about its solubility properties, but the statement in the Merck Index (6th ed.) that it is slightly soluble in hot alcohol and more soluble in hot water does raise the suspicion that its partition between lipoid and water will be largely in the direction of the water phase. It is quite possible that here we may have an exception to KIHLMAN's rule of the opposite kind, *viz.* a substance of low relative lipoid solubility causing breakage inside the resting nucleus.

there even without their influencing the permeability; they might form a porous envelope.

The critical remarks presented here naturally do not disprove KIHLMAN'S permeability theory. This interpretation might still be valid, if we make the assumptions that: (1) caffein penetrates into the prophase nuclei because the lipoid envelope may be dissolved at an earlier stage than the ordinary nuclear membrane, and (2) it is possible that coumarin itself may not be acting directly on the chromosomes, but in the cytoplasm it is transformed into or induces the formation of another substance of chromosome-breaking activity, which is unable to penetrate through the lipoid envelope of the nucleus. Assumptions of this kind are certainly not improbable at all, but it must remain for further work to test if they also apply to the actual situation.

The fact that in certain treatments the effect is restricted to the division stages was given an alternative interpretation here, *viz.* that the different stages vary very strongly in their sensitivity to the treatments. Such a variation in sensitivity is known from x-ray experiments (*e.g.* SPARROW 1944, 1948, 1951, HAQUE 1953). These experiments demonstrate that the division stages are much more sensitive to x-rays than the resting stage. If effects of this kind shall be able to explain the differences between different substances it will naturally be necessary to assume that the different substances do not act in the same way on the various mitotic stages; the increase in sensitivity of the mitotic stages relative to the resting stage is much higher in some substances than in others. This is not an improbable assumption; we know already that there are differences in the mode of action between different substances and other treatments, thus KÖLMARK (1953) reports that different gene loci respond rather differently towards different mutagenic treatments, one locus may give more mutations with one treatment and another locus more mutations with another treatment. It is also known that different chemicals differ from one another with respect to their chromosome breaking action on specific chromosome regions, some substances give more breaks in one region and others give more in other regions. (LEVAN 1952, MCLEISH 1953).

The nature of the changes in the chromosomes which make them much more sensitive towards x-rays during the mitotic stages are unknown. It seems a reasonable working hypothesis, however, to assume that these same chromosome physiological changes also cause the difference in response of the chromosomes towards coumarin treatment which is found between resting nuclei and mitotic chromosomes, although in this case the effect of the changes is much bigger. Furthermore, our observations of the X_2 cells suggest that there occurs in them a breakage in the prophase of loci that have turned labile during the treatment. We have assumed that these labile loci remain relatively stable during the resting stage but that they break during a sensitive period in the prophase. It seems very probable that this sensitive period is identical with the period of increased x-ray sensitivity and with the period of coumarin sensitivity of the chromosomes. It is probable that this period may extend all through the contraction stages of the chromosome cycle (from prophase until telophase). A breakage of labile loci occurring in fully contracted chromosomes would, however, not be recognizable in the same mitotic cycle; only by indirect evidence from the next mitosis might it be possible to test its existence and even then only with great difficulty. (We have at present but little hope that it will ever be possible to test this special question.)

The interpretation presented here involving the idea of a delayed breakage of labile loci induced during the treatment is in good agreement with the observations by AUERBACH (1951, 1952) and AUERBACH and MOSER (1953) that chemical treatments (nitrogen mustard, formaldehyde) often cause a mutation of genes to a labile state. Such labile genes often mutate at later stages to give rise to various stable mutation-types. Our observations may well concern the cytological aspect of the same effect; chromosome breakage and gene mutations being closely related phenomena.

Some of the effects suggested in our interpretations of the coumarin experiments may also occur in the experiments by REVELL (1953) on chromosome breakage in *Vicia Faba* by means of di-(2:3-epoxypropyl) ether. He reports that the cell is sensitive to this substance during early resting stage, but that the real breaks originate only at a later period. He has found a constant ratio of chromatid to chromosome type of breaks, with variable dosages and intensities of treatment. Furthermore, some of his structural changes are of the "partial" type, such as is characteristic of chromosome breakage during the mitotic stages. These observations suggest to us that his treatment may induce a labile state in some chromosome loci during the sensitive period in early resting stage. After that, these labile loci reproduce, each of them giving two daughter loci, when the chromosome is passing over into the post-split condition. Later on follows a critical period in the chromosome cycle, when a great number of these labile loci break. Sometimes both the two sister loci break, simulating a break of chromosome type, and sometimes only one of them breaks to give a chromatid break. The proportion of these two events will, of course, be constant irrespective of the dosage and intensity of the previous treatment. This critical period of breakage probably starts somewhat before the formation of the matrix and continues into the matrix period, a fact which would explain the occurrence of both full and partial breaks. The observations by McLEISH (1953) on the effect of maleic hydrazide on *Vicia* suggest similar phenomena. He thinks that in this case, too, there may be a sensitive period in early resting stage (*l.c.*, p. 139). He also gets many attached fragments and partial changes in his experiments, a fact suggesting to us that the real breakage often takes place when the matrix formation has already started. An interesting observation made by him is that the "quadriradials and triradials often show a constriction at the same locus of breakage but in the undamaged chromatid" (*l.c.*, p. 142). This is a result in good agreement with our observations and interpretations concerning the triradials and the single quadriradial found by us in the tetraploid X_2 cells of the coumarin experiment.

Chromosome breakage at meiosis should be able to give important evidence concerning the nature of the apparent sub-chromatid interchanges (or pseudochiasmata). Irradiation of first prophase and metaphase should give changes of this kind. When these occur between sister chromatids and are located between the first and the second chiasma (or between the third and the fourth *etc.*) they should be visible as bridges of the characteristic "pseudochiasma" type at first anaphase. When such sister-chromatid effects are located proximally of the first chiasma or between the second and the third (or the fourth and the fifth), then they will connect chromosome regions that are due to separate only at the second division. If they were true half-chromatid interchanges, then we should find them again as "pseudochiasmata" in the second anaphase. If a half-chromatid interchange occurred between non-homologous chromatids that both became included in the same tetrad nucleus (an event that sometimes should take place), then we should find it again in the first pollen mitosis as a chromatid interchange. But if the pseudochiasmata were due to full-chromatid interchanges that are masked by the presence of the matrix, as assumed in our working hypothesis, then they should be found as full-chromatid changes in the second division and as chromosome-type changes in the first pollen mitosis.

Now, CROUSE (1954) is of the opinion that she has found "half-chromatid" interchanges at the second anaphase in *Lilium* after x-irradiation of first metaphase. Her fixation was made 8 hrs after irradiation. We believe it possible that her timing of the stages was faulty and that, in reality, she may have irradiated second prophase. According to CROUSE, cells irradiated at first metaphase may be found in first anaphase two hours later. If we subtract these 2 hrs from her 8 hrs, there will be 6 hrs left for T_I, interkinesis, P_{II}, M_{II} and part of A_{II}, which seems too short a time, as telophases and especially prophases are usually much slower than meta- and anaphases, judging from their relative frequency in root tips. The synchronization of stages between different anthers is often somewhat incomplete, and the timing of stages in such an experiment as the present one by means of this phenomenon is rather difficult. It is of interest to notice that REES (1953) found pseudochiasmata in root tip anaphases of *Scilla campanulata* in the period from 2 to 8 hrs after the irradiation. Obviously the cells have, in this case, been in a stage 8 hrs before fixation which responds with pseudochiasmata and which belongs to the same mitotic cycle as the observed anaphases. It seems reasonable to assume that these cells were irradiated in the prophase of the same mitosis as was later fixed in anaphase.

HAQUE (1953), on the other hand, carried out an experiment on *Tradescantia* in which he x-irradiated diakinesis and studied second anaphase. He got a great deal of chromatid-type changes and "a number of cells" (no indication of the frequency is given) showing pseudochiasmata; some attached fragments were also seen. The fixation was made 24—30 hours after irradiation, so the cells are not likely to have been in second prophase. More information concerning various details of the results would be needed in order to judge if these second division changes of "partial" type might be due to a real survival of half-chromatid changes from the first division or if they might result from a delayed breakage of loci that had turned labile as a consequence of the treatment.

Also, the possibility is not excluded that some pseudochiasma-like figures might arise from stickiness in cells physiologically disturbed by the genotypical changes caused by the radiation. (Physiological changes resulting directly from the irradiation may also be considered, but seem less likely, as the x-ray dosage used was very low, 18 r, and a relatively long time had passed before the fixation.)

Furthermore, HAQUE studied the first pollen mitosis after x-irradiation of various earlier stages. He found that irradiations given at about the time of the meiotic divisions produced a great quantity of breaks of chromosome type; no breaks of chromatid type are reported. Some control of the interpretation that the cells irradiated were in the meiotic division stages is given by the fact that they show a strongly increased sensitivity towards the treatment. SPARROW has demonstrated that such an increased sensitivity towards breakage is characteristic of the chromosomes, when they are in the division stages.

As the general conclusion of our own observations, as well as of the other results discussed here, we think it may be stated that there is some evidence supporting the view that some effects appearing like sub-chromatid breakage may instead be due to ordinary chromatid breakage which is masked by the presence of a matrix. Such chromosome changes may either originate *directly,* when the chromosome-breaking treatment is applied to a stage when the chromosomes have a matrix, or *indirectly* if the treatment is capable of changing certain loci in the chromosomes to a labile state, which makes them liable to become broken, later on, at a stage when the chromosomes have a matrix.

We do not consider the evidence on this question to be conclusive, as yet. Sub-chromatid breakage can also, with a higher or lower probability, be suggested to account for such observations as those discussed here. Naturally, many of the various interpretations suggested here do not mutually exclude one another. Thus, the "pseudo-chiasmata" might, as far as we know, be due both to masked full-chromatid interchanges and to sub-chromatid interchanges, which might even occur in the same cell.

The fact that we are favouring an interpretation which does not assume half-chromatid structural changes does not mean that we are doubting the existence of a subdivision of the chromatids in half chromatids. Such a subdivision has been reported by many authors and we feel that it is very probable. Our interpretation simply means that we are assuming that the two halves of a chromatid or of an early resting-stage chromosome actually form a functional unit with respect to chromosome breakage and reunion. This would explain why x-radiation of early resting stage usually gives the chromosome type of change. We suppose that there may be a biological adaptation for this kind of chromosome to function as a single unit of breakage. There is one stage in the life cycle when breakage is a normal event, *i.e.* at the crossing-over in the meiotic prophase. When the chromatids break and rejoin in the crossing-over process, each chromatid acts as a single unit; it may be adapted to do so because sub-chromatid crossing-over would prevent the first meiotic anaphase disjunction of the paired chromosomes. It is quite possible that the same biological adaptation may be involved, when the two half-chromatids or the two halves of an early resting stage chromosome are functioning as unit of breakage together.

Breakage may be considered as a normal way of reaction of the chromosomes, a type of behaviour which they are adapted to show as a normal phenomenon during the meiotic prophase. You have just to pull the right "switch" in order to make them do so at other stages of the life cycle, too. When the appropriate kind of "stimulus" is applied to a chromosome region, it responds by putting the meiotic breakage mechanism into work, and this mechanism gives as the result a breakage all across the chromatid: all its sub-units are broken. During the meiotic prophase this mechanism extends its action even beyond an individual chromatid: another chromatid intimately paired with the first one is also broken all across its width at the same locus where the first chromatid was broken. This isolocus breakage of two paired chromatids makes it possible for the crossing-over to take place.

This interpretation involves the idea that the breakage follows upon the transmission of a kind of impulse across the chromatid and that this breakage impulse may even be transmitted over to another chromatid intimately paired with the first one. The production of isochromatid breaks by x-radiation of mitotic chromosomes is usually considered to be due to the fact that the ionization track (of the electron liberated at the absorption of the x-ray quantum) is so broad that it is sometimes capable of hitting the two chromatids of a single chromosome. We do not intend to criticize or to shed doubt on this interpretation, but only to suggest that conceivably an alternative mechanism might work in some cases, *viz.* that a breakage impulse might be transferred from one chromatid to another one in contact with it.

Ideas of this kind would be able to explain how a chemical change due to a chromosome breaking substance may be able to break a chromatid all through. The chemical change at the point of attack may have been very small, perhaps only a bimolecular reaction between a molecular group in the chromatid and a single molecule of the attacking substance. The chromatid is very likely to consist of numerous parallel strands. The primary change in one of them may act as a "stimulus" which starts a mechanism resulting in breakage of all of these parallel sub-units.

Naturally, the meiotic crossing-over process is different in very important respects from the events of induced chromosome breakage. Thus: (1) the meiotic breaks always rejoin in new combinations (or maybe restitute into the old combinations), they never *remain open* as induced breaks sometimes do; and (2) the exchanges at meiosis always give two monocentric chromatids, never a dicentric and an acentric one (except of course in cases of abnormal gene seriation as in inversions). This difference may be due to subsidiary factors present in the meiotic prophase, especially the very close and intimate pairing between homologous regions, factors absent in other cells. Thus, this difference need not be an argument against the idea presented here of a close relationship between crossing-over and induced breakage.

The idea of a close relationship between the induced breakage and the natural breakage of the crossing-over process is not a new one. Such a relationship was earlier suggested by MARQUARDT (1950) and REVELL (1953). Their ideas are, however, in many respects different from the hypotheses presented above.

Acknowledgement. Economic support for the present investigation has been received from the Swedish Natural Science Research Council, a fact which is gratefully acknowledged.

Summary.

In the present paper the nature of what has been considered as sub-chromatid breakage is discussed. The effect consists of two different phenomena: (1) the occurrence of induced constrictions, separating "attached fragments" from the main part of the chromosome, and (2) the occurrence of what looks like sub-chromatid interchanges between two chromatids.

The interpretation is presented that these two effects are in reality due to a full-chromatid breakage which has taken place in a chromatid that is spiralized and covered by matrix. The matrix maintains in continued connection the pieces that were associated before the breakage and the result looks like part-chromatid changes.

The material used in our investigation was *Allium Cepa*. X-ray experiments show that changes of this "sub-chromatid" type are found in cells fixed a short time after the treatment, *i.e.* presumably treated in prophase. Chromosome breakage experiments by means of coumarin support our interpretation. In order to make it more easy to recognize the different cell generations colchicine was also applied in some of the coumarin experiments. Coumarin breaks the chromosomes practically only during mitosis, the resting stage being insensitive to the treatment. In the X_1 cells which are under direct influence of the coumarin a very large majority of the changes are of the "sub-chromatid" type. In the next cell generation (X_2) there are, however, nearly exclusively changes of chromosome type (*i.e.* affecting both the two chromatids). This suggests that the changes in the previous mitosis were in reality of chromatid type, although they were masked by the presence of a matrix.

The occurrence of induced constrictions in pairs in the X_2 cells (*i.e.* affecting both chromatids at the same locus) suggests that the treatment has caused a change to a labile state in some loci during the treated X_1 mitosis. These labile loci have reproduced during the resting stage to give two labile sister loci and these have, both of them, broken during a critical period in the X_2 prophase.

Our evidence is not considered, at present, to prove our interpretations conclusively. It is still possible to suggest the alternative interpretation, from many of our observations, that the effects are due to a real sub-chromatid breakage.

Other results on chromosome breakage are discussed in connection with our ideas and some suggestions are made to explain why the chromatids, although multiple in their composition, may still behave as units in breakage and reunion. These suggestions imply the idea of a close relationship between the induced breakage and the natural process of crossing-over.

References.

1. AUERBACH, C. 1951. Some recent results with chemical mutagens. — Hereditas XXXVII: 1—16.
2. — 1952. Problems in chemical mutagenesis. — Cold Spring Harbor Sympos. on Quant. Biol. XVI: 199—213.
3. AUERBACH, C. and MOSER, H. 1953. Analysis of the mutagenic action of formaldehyde food. II. The mutagenic potentialities of the treatment. — Zeitschr. für Indukt. Abstamm. und Vererb.-lehre 85: 547—563.
4. AVANZI, M. G. 1950. Frequenza e tipi di aberrazioni cromosomiche indotte da alcuni derivati dell'α-naftalene. — Caryologia III: 165—180.
5. CROUSE, H. V. 1954. X-ray breakage of lily chromosomes at first meiotic metaphase. — Science 119: 485—487.
6. D'AMATO, F. 1950 a. The chromosome breaking activity of chemicals as studied by the *Allium Cepa* test. — Pubbl. Staz. Zool., Napoli 22, Suppl.: 158—170.
7. — 1950 b. Studio statistico dell'attività mutagena dell' acridina e derivati. — Caryologia II: 229—297.
8. — 1950 c. The quantitative study of mitotic poisons by the *Allium Cepa* test: Data and problems. — Protoplasma 39: 423—433.
9. — 1952 a: Further investigations on the mutagenic activity of acridines (XXXIII—LI). — Caryologia IV: 388—413.
10. — 1952 b. The cytological study of chemical mutagens. — Genetica Iberica IV: 3—20.
11. DARLINGTON, C. D. and KOLLER, P. C. 1947. The chemical breakage of chromosomes. — Heredity 1: 187—221.
12. DARLINGTON, C. D. and LACOUR, L. F. 1953. The classification of radiation effects at meiosis. — Heredity, Suppl. to Vol. 6: 41—55.
13. HAQUE, A. 1953. The irradiation of meiosis in *Tradescantia*. — Heredity, Suppl. to Vol. 6: 57—75.
14. KIHLMAN, B. 1951. The permeability of the nuclear envelope and the mode of action of purine derivatives on chromosomes. — Symbol. Botan. Upsalienses XI (2): 1—40.

15. — 1952 a. Induction of chromosome changes with purine derivatives. — Symbol. Botan. Upsalienses XI (4): 1—96.

16. — 1952 b. A study of purine derivatives as inducers of chromosome changes. — Hereditas XXXVIII: 115—127.

17. KÖLMARK, G. 1953. Differential response to mutagens as studied by the *Neurospora* reverse mutation test. — Hereditas XXXIX: 270—276.

18. LACOUR, L. F. and RUTISHAUSER, A. 1953. Chromosome breakage experiments with endosperm: sub-chromatid breakage. — Nature 172: 501—502.

19. LEVAN, A. 1952. Chemically induced chromosome reactions in *Allium Cepa* and *Vicia Faba*. — Cold Spring Harbor Sympos. on Quant. Biol. XVI: 233—243.

20. LEVAN, A. and TJIO, J. H. 1948. Induction of chromosome fragmentation by phenols. — Hereditas XXXIV: 453—484.

21. MCLEISH, J. 1953. The action of maleic hydrazide in *Vicia*. — Heredity, Suppl. to Vol. 6: 125—147.

22. MARQUARDT, H. 1950. Neuere Auffassungen aus der Pathologie der Kernteilung. — Naturwiss. 37: 416—424 and 433—438.

23. ÖSTERGREN, G. 1948. Chromosome bridges and breaks by coumarin. — Botaniska Notiser 1948: 376—380.

24. ÖSTERGREN, G. and WAKONIG, T. (in the press). A sensitive period at the chromosome breaking activity of coumarin. — Proceed. IX Internat. Congr. of Genet. (Bellagio, 1953).

25. REES, H. 1953. Centromere control of chromosome splitting and breakage. — Heredity, Suppl. to Vol. 6: 235—245.

26. REVELL, S. H. 1953. Chromosome breakage by x-rays and radiomimetic substances in *Vicia*. — Heredity, Suppl. to Vol. 6: 107—124.

27. SPARROW, A. H. 1944. X-ray sensitivity changes in meiotic chromosomes and the nucleic acid cycle. — Proceed. Nat. Acad. Scienc. 30: 147—155.

28. — 1948. Relative x-ray sensitivity of metaphase and interphase chromosomes. — Nature 162: 651.

29. — 1951. Radiation sensitivity of cells during mitotic and meiotic cycles. — Ann. N.Y. Acad. Sci. 51: 1508—1540.

30. SPARROW, A. H. and MALDAWER, M. 1950. Differential rejoining as a factor in apparent sensitivity of chromosomes to x-ray breakage. — Proceed. Nat. Acad. Sci. 36: 636—643.

31. SPARROW, A. H., MOSES, M. J., and STEELE, R. 1952. A cytological and cytochemical approach to an understanding of radiation damage in living cells. — Brit. Journ. of Radiol. 25: 182—189.

32. SWANSON, C. P. 1947. X-ray and ultraviolet studies on pollen tube chromosomes. II. The quadripartite structure of the prophase chromosomes of *Tradescantia*. — Proceed. Nat. Acad. Sci. 33: 229—232.

BOTANISKA NOTISER 1954, HÄFTE 4. LUND

Actinotaenium
genus Desmidiacearum resuscitatum.

By EINAR TEILING.

Limnological Institution of the University of Lund.

Already the earlier desmidiologists have paid particular attention to the elongate, baculiform desmids: *Closterium* NITZSCH 1817, *Cylindrocystis* MENEGHINI 1838, *Penium, Docidium* and *Spirotaenia* BRÉBISSON 1844, *Tetmemorus* RALFS 1844, *Mesotaenium, Pleurotaenium* and *Netrium* NÄGELI 1849 and *Triploceras* BAILEY 1851. Later discoveries are *Roya* WEST 1896, *Ichtyocercus* WEST 1897 and *Triplastrum* IYENGAR et RAMANATHAN 1942. In the past century a large number of baculiform species have been distinguished which because of the straight cells and lack of sculpture have generally been assigned to *Penium* and also *Cylindrocystis.*

LÜTKEMÜLLER's epoch-making research (1902) on the structure of the desmid cell wall opened up a new and safe ground for the taxonomy of the baculiform desmids. As to their biosystematy, LÜTKEMÜLLER (1905) made a revision of the species assigned to *Penium.* He approved only twelve species as true *Penia,* the remaining were transferred to *Cylindrocystis, Netrium, Closterium,* and no fewer than fourteen species to *Dysphinctium,* a genus that he earlier (1902) had included in *Cosmarium.* Later on (1910, p. 479) he rejected *Dysphinctium* and used the name *Cosmarium* for these species. His revision of *Cylindrocystis* (1913) comprised seven true species, and seven doubtful whereas five were excluded and assigned to *Cosmarium.* This system of classifying has, to a certain degree, been continued by KRIEGER (1937).

Most of the species, excluded from *Penium* and *Cylindrocystis* and included in *Cosmarium,* possess a fusiform shape with rounded apex, a shallow isthmus furrow, no wall sculpture, and a stelloid chloroplast.

Their placoderm nature is evident by the dense pores over all the wall except the isthmus zone.

The present author (1952, p. 292) has united this group under the interimistic name of the *Clevei*-section and emphasized that this group represents a taxonomic unity that must be kept quite separate from the collective name *Cosmarium* as well as from any real diagnosed desmid genus. In the following the author, on the basis of the principles submitted in his papers 1950 and 1952, intends to rise this section to the rank of a new genus: *Actinotaenium*.

Cosmarium and Dysphinctium.

In order to elucidate the taxonomical position of *Actinotaenium* it is necessary to disentangle the concepts *Cosmarium* and *Dysphinctium*.

Cosmarium appears at the first time as a generic name invented by CORDA (1835) and used on some species, later assigned to *Cosmarium, Micrasterias,* and *Euastrum*. Out of this diffuse concept it has developed into a generic name reserved for biradiate desmids without spines, insertions and processes. The biradiate character "inflato-compressed segments" (RALFS 1848, p. 92) is emphasized also by MENEGHINI and EHRENBERG, while RALFS admits that "some species with globular or cylindrical segments can by no means be separated from the compressed ones". When comparing these species with *Penium,* he says: "In *Cosmarium* the fronds are never elongated, are always constricted in the middle, and the starch vesicles are scattered". RALFS' list of species contains 33 species. The WESTS, in Monograph II, p. 126, says: "One of the distinguishing features of a *Cosmarium* is the entire outline of the cells, which are likewise destitute of spines." At present negative characters exceed in the definition of *Cosmarium*.

During the century that has elapsed since RALFS' declaration, *Cosmarium* has been used as a storage-box for species which have not conveniently been placed in more definite genera. By this, the concept of *Cosmarium* has got a very promiscuous content and, actually, to an extent which itself proves the character of a provisory, PRINTZ (1929) rates the number of species at 809! In spite of this hodgepodge, obvious to every desmidiologist, *Cosmarium* seems to be comprehended as a genus *sensu stricto* and the desmidiologists have eagerly been at work in enlarging it with new species instead of finding out new points of view in order to discern the genetic, or at least, the typological lines into which *Cosmarium* must be disintegrated.

Dysphinctium was instituted by NÄGELI in 1849 as a genus with the following subgenera and species:

Actinotaenium: *Dys. Regelianum* (=*curtum*), fusiform, omni-radiate cell and stelloid chloroplast.

Calocylindrus: *Dys. annulatum,* cylindrical with series of small nodules, chloroplast with 1—2 pyrenoids. *Dys. cylindrus* (=*Penium*).

Dysphinctium: *Dys. Meneghinianum* (=*connatum*), pseudo-omniradiate, chloroplast furcoid, dicentric. *Dys. striolatum* (=*tesselatum*), pseudo-omniradiate, chloroplast furcoid, limbo-parietal.

NÄGELI [1] gives (p. 109) the following diagnosis: "Zellen einzeln oder getrennt, an den Polen abgerundet, in der mitte einer leichten ringförmigen Furche, Querprofil kreisförmig oder oval, in jeder Hälfte ein centrales oder zwei neben dem Mittelpunkt liegenden Chlorophyllbläschen". And he comments: "Diese Gattung ist eine künstliche, sie vereinigt mehrere Typen, welche aus Mangel an vollständigen Untersuchungen noch nicht als selbständige Gattungen aufgestellt werden können, und hier als Untergattungen folgen".

In spite of this obvious and critical declaration, NÄGELI's genus was taken up by several taxonomists, probably in order to have a genus for the increasing number of species that otherwise could not be placed anywhere but under the diffuse name of *Cosmarium.* This trend has especially been forwarded by DE BARY (1858), REINSCH (1867), DELPONTE (1873), KIRCHNER (1876), HANSGIRG (1888), DE TONI (1889), and TURNER (1896). DE BARY incorporated *Dysphinctium* in *Cosmarium.* Of his four subgenera *Dysphinctium* contains the globoid species, e.g. *moniliforme* and *connatum,* and *Calocylindrus* (including *Actinotaenium*!) embraced baculiform species, e.g. *Cucurbita, Palangula,* and *curtum.* REINSCH enlarged *Dysphinctium* with *Tetmemorus* as a subgenus. KIRCHNER raised *Calocylindrus* to a separate genus containing ten species and placed it between *Closterium* and *Docidium* but rejected the rest of *Dysphinctium.* HANSGIRG maintained *Dysphinctium* with the subgenera *Actinotaenium* and *Calocylindrus,* and added a new one: *Tetmemoridium.* This basis of division was accepted by DE TONI who gave *Actinotaenium* 24, *Calocylindrus* 12, and *Tetmemoridium* 3 species. By this the artificial composition of *Dysphinctium* was accentuated in absurdum. TURNER divided *Dysphinctium* into *Cylindrosphinctium* and *Sphaerosphinctium* the character of which is indicated by the names. No further efforts of consolidating the genus were made and in this

---

[1] It seems very unlikely that NÄGELI was aware of RALFS' book, at least, RALFS' name is not mentioned in NÄGELI's treatment of these desmids.

century it has been quite omitted, its species bear the name of *Cosmarium*. Rabenhorst (1865) abandoned it and at recent time also the Wests who justify their rejection by finding it "based upon indefinite characters and the limitation of which could not be clearly defined" (Monograph II, p. 127). Actually, the latter failing is valid also for a good deal of the desmid genera, especially in regard to *Cosmarium,* and is impossible to avoid: there are only few limits in Nature, limits are made by Man, artificial and conventional.

The taxonomic problem of the former *Dysphinctium* species has not been solved by placing them in *Cosmarium,* it has been put in an out-of-the-way corner. Nevertheless, Nägeli's idea was a good one, it was wrecked by the contemporaneous lack of taxonomic principles except the one of similar shape in quite general terms. At present, it is possible to distinguish between primary and secondary cylindrical shape of the cell and we know different kinds and degrees of the evolution of the chloroplast. Several characters of potential taxonomic value are not clear, for instance the structure of the zygospore and of the surface of the cell wall. There is, at least at present, not found any genetic connection between a smooth and a granulated or verrucate surface. In my opinion, the desmids with these two kinds of surface must be kept separate as regards their taxonomic position. On the contrary, we know that the baculiform shape is attained by desmids of quite different origin and that the convergency phenomenon is rather common.

Certain features of this historical genus *Dysphinctium* are incompatible with the general concept of *Cosmarium*. This implies that they represent diverse lines of evolution, for instance the *Actinotaenium* type, the *connatum* type, the *tesselatum* type, the *Debaryi* type etc. In order to show the generic position of *Actinotaenium* I shall develop my comprehension of the taxonomic differences between it and the other placoderm desmids. According to Camp (1951) the term *taxonomy* is used in the sense of distinguishing genera and higher taxa, the *biosystematy* dealing with species and lower taxa. Hitherto but little used terms are defined in Teiling 1950 and 1952.

Taxonomic discussion.

The starting point is LÜTKEMÜLLER's epoch-making research on the structure of the cell wall on the basis of which he could assign the desmids into the main groups *Saccoderms* and *Placoderms,* the latter divided into three tribus: *Penieae, Closterieae* and *Cosmarieae* according to the manner of cell division and growth which depends on the structure of the cell wall.

As mentioned above, LÜTKEMÜLLER, by the aid of this new taxonomic principles, was able to revise and emend some desmid genera. Especially in *Penium* and *Cylindrocystis* he found a lot of species which, owing to their cell wall pores and the manner of division and formation of the zygospore were separated from these genera and placed in *Cosmarium.*

Other principles are founded on the vertical symmetry of the semicell, the so called desmid radiation and, in intimate connection with this feature, the morphology of the chloroplast. In his paper 1952 the present author has drawn up the probable evolution of the desmid chloroplast on the basis of its comparative morphology and increasing efficiency from lower to higher forms. In this way it has been possible to derive the diverse types of parietal chloroplasts from primitive axile ones.

The general trend to a better light ecology that favours the mutations resulting in a more effective photosynthesis, has gone along the path of increasing the surface of the chloroplast and consequently the surface of the cell. The most primitive type of desmids now existing may be represented by a desmid in structure and dimensions something like *Cylindrocystis,* having a short cylindrical cell with an unsegmented cell-wall without pores, a central nucleus and a stelloid chloroplast. The cell division is of normal vegetative type. In the saccoderm desmids the enlargement of the cell and chloroplast occurs in apical direction, a faint lateral enlargement is known but in a few cases (*Netrium*). In the lower placoderms (*Penieae* and *Closterieae*) evolution has gone the same paths, viz. apical extension, in *Closterium* also combined with a lateral inflation. By this, *Penium* possesses a typical baculiform shape. Its generic characters, compared with other similar genera, are the lack of pores and isthmus furrow, the peculiar manner of division and, combined with this, the intercalary growth. Thus, the porous cell wall of *Penium*-like desmids at once (often after staining) decides their taxonomic position. Most of the species of *Actinotaenium* have been separated from *Penium*, some of them also from *Cylindrocystis*, by the aid of this character. The chloroplast of *Penium* and the small *Closterium* species is typical stelloid.

All higher placoderm desmids, i.e. LÜTKEMÜLLER's tribus *Cosmarieae*, possess a compound porous cell wall with a constant oblique fissure lying in a plan that exactly divides the cell in two symmetrical semicells. This group consists of two quite different parts: *Actinotaenieae* and *Anguloradiateae*, demonstrated on p. 385. For the actual problem of *Actinotaenium* it is convenient to summarize the occurrence of the types of the chloroplast in those genera from which most of the species have been distinguished:

Penium: typical stelloid with entire lamellae.

Cylindrocystis: lobo-stelloid, i.e. a central core with one pyrenoid and radiating laciniate or dissected lamellae, the lobes of which often being thickened in their parietal ends.

The main part of the placoderm desmids, i.e. all of them except the *Actinotaenieae*, show an angulo-radiate structure. The lamellae of the starlike chloroplast are grown out radially and the cell wall is grown out in corresponding bulges, the *radii*, that gives the semicell, when seen in end-view, a regular poly-bigonal shape. The primitive bulges are short angles but they are mostly developed into an immense richness of forms, especially in *Staurastrum*. It must be emphasized that the fundamental structure of a desmid is either omniradiate or anguloradiate.

The radial extension of the semicell has not affected the isthmus zone, except in a small number of cases. In this way, these desmids have got their characteristic shape: a cell, by a false "constriction" in the middle, forming two symmetrical semi-cells ("segments" according to RALFS and earlier desmidiologists).

The lateral expansion of the lamellae in the bulges itself implies an increase in photosynthesis. This is made even more effective by the longitudinal division of the edges of the lamellae, a feature characteristic of the tribus *Anguloradiateae mihi*, see p. 385. In primitive desmids of this tribus e.g. *Desmidium* and *Staurastrum*, this *furcoid* chloroplast is very evident when seen in end view. The furcoid chloroplast is capable of a most elaborate metamorphosis in a great number of forms according to the size and shape of the semicell. The furcoid nature of the most evolved derivations are discernible only by means of the transitions analyzed by comparative morphology.

The present author has (1950) emphasized that the primitive angular desmids were multiradiate and that their evolution to the present state has proceeded by means of successive reduction of the number of the radii; i.e. from perhaps 10-radiate through decreasing number to the at present common quadri-, and triradiate stages up to the biradiate end stage. This process is clearly visible in the variability of certain species, that exhibit 6-, 5-, 4-, and 3-radiate facies, e.g. *Staurastrum zonatum*. The *Janus*-forms consisting of semi-cells of different radiation, e.g. 5+3, 4+3, 4+2, 3+2 are demonstrative transitions. The selecting factor of the reduction is *light*; the chloroplasts of the "compressed biradiate desmid exhibit a greater surface in relation to the volume than pluriradiate desmids and, actually, the biradiate show a richness in forms, superior to the pluriradiate ones. The vast majority of the *Anguloradiatae* are biradiate, especially considering the genera. This evolution is quite analogous to the flattened shape of all green organs: leaves, cladophylls, phyllodia, flat thalli and similar forms occurring in the whole vegetable kingdom.

The biradiate desmids are the most advanced and their evolution has proceeded in several diverse paths. Some of these are morphologically very distinct, e.g. *Micrasterias* and the long *Euastra,* some other are conventionally assorted in small genera by the aid of morphological peculiarities, e.g. *Oocardium, Cosmocladium, Onychonema,* and the vast majority are brought together under the name of *Cosmarium*. In *Cosmarium,* however, a number of desmids circular in end view, have been inmixed and their position has been codified, mainly by the authority of RALFS. *Staurastrum* is the name of a collection of several other evolutionary branches, still on their way to the end stage and, consequently, showing diverse stages of radiation. *Staurodesmus* is one of these lines recently distinguished, its biradiate stage has since long been known under the name of *Arthrodesmus*. Several of the normally biradiate great genera, *Cosmarium, Micrasterias, Euastrum,* and *Xanthidium,* contain species that sometimes occur as tri-, and even quadriradiate specimens. They must be interpreted as examples of occasional reversion back to stages that have been passed during the phylogenetic evolution of the actual species.

Dysphinctium in the light of modern taxonomic principles.

Dysphinctium was erected in order to unite the rounded desmids, uncombinable with the omniradiate genera then known, e.g. *Cylindro-*

cystis and *Penium*. As this concept was formed out, it was quite as artificial as *Cosmarium*, it contained two morphological groups: baculiform and globular desmids, the latter comprising bi-globular and monoglobular forms. Disregarding the omni-radiate species, belonging to *Actinotaenium*, the other types will be dealt with from evolutionary points of view.

Especially in biradiate desmids evolution has proceeded in regressive direction, forming desmids more or less rounded in cross-section in which the biradiate character in some cases is difficult to discern. As a rule, this inflation has affected but the semicells, not the isthmus, significant examples are shown by the bigloboid *Cosmaria*, e.g. *moniliforme, praegrande,* and the *excavatum*-group. *Cosmarium Welwitschi* is interesting since its ornamentation has conserved the biradiate pattern. An inflation of the isthmus zone is very rare, in *Cosmarium* it is found e.g. in *connatum* and *pseudoconnatum, australe,* and *alpestre*. In other anguloradiate desmids an extreme degree of isthmal enlargement is found in *Hyalotheca, Desmidium* spp., and *Bambusina,* in the latter the isthmus is even wider than the semicells. Two or three small granules, regularly dispersed on the surface of the semicells of *Hyalotheca* and *Bambusina* must be interpreted as rudiments of the earlier angles (TEILING 1950, p. 306). This secondary circular structure is termed *pseudo-omniradiate*. Some genera have conserved their angulo-radiate origin more evidently in their apices, viz. *Tetmemorus, Ichtyocercus* and *Triploceras*. Their baculiform structure is a matter of convergency towards the primitive baculiform structure in *Actinotaenieae, Closterium, Penium,* and certain saccoderm genera.

The baculiform species of *Dysphinctium,* except the species here assigned to *Actinotaenium,* are such secondarily rounded and elongate desmids although their baculiform character is less pronounced compared with *Tetmemorus* etc. They are characterized by the *deep sinus* and the *transverse section* of the semicells that generally is not quite circular but broad-oval, conveniently termed *quasi-omniradiate,* showing the origin from biradiate desmids of *Cosmarium*-type. At any rate, the narrow sinus and the broad-oval cross-section (very seldom circular in certain specimens) are features that at once distinguish these desmids from the *Actinotaenieae.*

In many cases the biradiate origin of the pseudo-omniradiate and quasi-omniradiate desmids of the former *Dysphinctium* with smooth cell wall is visible in their chloroplasts. *Cosmarium connatum, Printzii,* and *Thwaitesii* possess a dicentric and *pseudoconnatum* a tetracentric chloroplast; both types are normal derivations in large cells of a biradiate furcoid chloroplast. *Cosmarium pseudarctoum* occurs also in a triradiate facies (BORGE 1923), thus proving that the circular shape is a secondary one. Intricate cases are found in some rounded desmids in which the inflation of the semicell has given rise to frontal secondary ridges of the chloroplast, thus forming a pseudo-stelloid chloroplast very similar to the primitive stelloid one where all radiate ribbons are primitive lamellae (see TEILING 1952, p. 282). Unmistakable examples are e.g. *Tetmemorus* and *Triploceras.*

A little revision of Lütkemüller's desmid system.

The principles of desmid taxonomy that have appeared from my studies of the desmid radiation and the comparative morphology of the desmid chloroplast have necessitated a revision of LÜTKEMÜLLER's system (1902, p. 408). The change affects only the highest placoderms, the tribus *Cosmarieae.* This tribus is characterized by a three layered cell wall with pore-apparatus and a constant fissure joining the semicells where the division takes place.

It consists of two quite different parts. The first, *Actaeniotaenieae,* embrasing four genera, is characterized by a) the primitive omniradiate baculiform shape with the apical growth common to the lower placoderms (i.e. *Penieae* and *Closterieae*) and b) the primitive stelloid chloroplast that in *Actinotaenium* and *Docidium* is typical in the smaller species and in the larger species is transformed, more or less, into the taenio-parietal type; in *Pleurotaenium* it is mainly taenio-parietal and in *Groenbladia* is reduced to the laminate type. The second part, *Anguloradiateae,* embrasing the main part of LÜTKEMÜLLER's *Cosmarieae,* is characterized by a) the angulo-radiate shape and b) the *furcoid* chloroplast which has developed into the very many kinds of forms, neglected or unexplained by the desmidiologists. The ability of angular expansion and lateral enlargement of the cell wall in connection with the exceptional ability of the furcoid chloroplast in developing new and effective forms of parietal chloroplasts has given rise to an immense evolution of desmid species and also genera, a circumstance that necessitates a taxonomic expansion of LÜTKEMÜLLER's tribus.

A survey of the present system of the placoderm desmids according to the author's results is presented in the next page.

A. Non-constant fissure of division. Omniradiate cells.

  3. Tribus ***Penieae.*** Cell wall without pore-apparatus, chloroplast stelloid.
  4. Tribus ***Closterieae.*** Cell wall with pore-apparatus, chloroplast stelloid → holo-parietal.

B. Constant fissure of division. Cell wall with pore-apparatus. Cells always composed of two quite symmetrical semicells.

  5. Tribus ***Actinotaenieae.*** Omniradiate cells. Chloroplast stelloid or developed into taenio-parietal or laminate ones.

Genera:

Cell wall without sculpture:

Actinotaenium. Chloroplast stelloid or developed into a taenio-parietal one.

Groenbladia. Chloroplast laminate.

Cell wall with sculpture:

Docidium. Chloroplast stelloid → taenio-parietal.

Pleurotaenium. Chloroplast stelloid, or mostly, taenio-parietal.

  6. *Tribus* ***Anguloradiateae.*** Cells angulo-radiate or developed into pseudo-omniradiate. Chloroplast furcoid, often developed into pseudo-stelloid, limbo-parietal, sector-parietal, and discoid.

Genera:

pluri — — — — — — — — — biradiate:

Staurastrum	*Euastridium*	*Cosmarium* *Xanthidium*	*Oocardium*
Staurodesmus		*Euastrum* *Micrasterias*	*Cosmocladium*
filiform:			
Phymatodocis *Desmidium*	*Streptonema*	*Spondylosium* *Sphaerozosma* *Hyalotheca* *Bambusina*	*Onychonema*
baculiform:			
	Triploceras *Triplastrum*		*Tetmemorus* *Ichtyocercus*

Actinotaenium (NÄGELI) TEIL. — genus novum, olim subgenus *Dysphinctii*.

Cellulae singulae, omniradiatae, a fronte visae, fusiformes, crassiores aut magis tenues, vel etiam cylindricae sulco isthmiali inconspicuo praeditae, extremitatibus cellularum rotundatis aut obtuso-planatis. Membrana levis, in speciebus nonullis infra apicem incrassata; poris praedita nisi in sulco isthmiali; pori, precipue regionis apicalis, in quibusdam speciebus satis magni; in his poris interdum organa pororum, velut granula membranae olim interpretata. Massa chlorophyllacea stelloidea vel lobo-stelloidea, vel etiam in speciebus quibusdam majoribus taenio-parietalis.

Omniradiate cells, in front view thicker or slender, fusiform or cylindrical; with a faint isthmus furrow; the ends of the cells rounded or obtuse-planned. Cell-wall smooth, in some species thickened on the inside of the apex; with pores except the isthmus furrow, in certain species also fairly great pores, especially in the apical part; in these pores there are often pore-organels that have been interpreted as granules of the wall. Chloroplast stelloid or lobo-stelloid, in larger species even taenio-parietal.

It seems as if the desmidiologists have been too bound by tradition to react against the unnatural mixture of omniradiate and biradiate species in *Cosmarium*. Thus, it is of great interest that SCHELLENBERG (1897), in an account of a lecture delivered in the Botanical Society of Zürich, proposed *Actinotaenium* as a separate genus, though vaguely and on unsufficient premises. He had examined a subaerial desmid that he considered belonging to *Actinotaenium* and had also in NÄGELI's literary remains found five anonymous species evidently belonging to *Actinotaenium*. He considered this little group as intermediate between *Cosmarium* and *Penium*. If *Actinotaenium* could not be approved as a separate genus, it would, as a section, be alotted quite as well to *Cosmarium* as to *Penium*. A foreshadowed later description of these species has not appeared.

Morphological survey.

The cell-wall is smooth. The granules mentioned in the diagnoses of several species, are the protruding pore-organels (=Porenorgane *sensu* LÜTKEMÜLLER) of the great apical pores, e.g. in *A. trachypolum, rufescens, Clevei,* and *Taylori*. On the contrary, a zone of greater pores are situated on the basal part of the semi-cell of *A. sydneyense*. Scattered great pores among the small ones are recorded in several species, a feature that probably has been overlooked in many cases. All species have dense pores arranged irregularly or in oblique-crossing rows. *A. subpalangula* shows transverse rows of greater pores visible by the prominent pore-organels, its forma *depauperatum* is created on the basis of specimens from which the protruding parts are lost, because of the action of chemical factors, stated by KLEBS.

An apical interior thickening of the cell-wall is stated in several species. This is a rather common feature in desmids with rounded ends.

The cell is always omni-radiate, the form a fronte is fusiform — cylindrical — guitar-shaped with a faint isthmus-furrow. The apex is rounded or obtuse, never tapering to a point. In a few species of the *curtum* group a faint constriction of the apical part is noted. Slightly inflated semi-cells are also noted.

The chloroplast is stelloid, lobo-stelloid, or taenio-parietal. In the vast majority of the species, having less than about 50 μ diameter, the chloroplast is regular with entire or parietally thickened edges of the lamellae and one pyrenoid. In elongate species, *A. angulatum, elongatum, diadematum* and *Clevei* two or three pyrenoids are stated. In *subpalangula, subtile, perminutum, pyramidatum, viride,* and *diplosporum* the chloroplast with one pyrenoid is lobo-stelloid. In the fairly large *Taylori* 45—50 μ thick, the edges of the lamellae are intensively plicate and the chloroplast has a corresponding augmented number of dispersed pyrenoids.

The large species *A. turgidum, capax,* and probably *grande* with a diameter of 60 μ and more have taenio-parietal chloroplasts with many pyrenoids. *Cosm. hibernicum,* possibly a large form of *diplosporum,* is recorded having parietal band-like chloroplast with several pyrenoids. It seems very unlikely that a taenio-parietal chloroplast *sensu stricto* has been formed in a desmid only 45 μ in diameter. Probably a misinterpretation of badly conserved material.

The formation of spores is known in a few species. The spores recorded show a puzzling diversity. Azygospores are found in *diplosporum* by SKUJA (1949, Tab. 27: 11) as well as true zygospores (Fig. 12). In this species several scientists have found double spores interpreted as zygospores, viz. LUNDELL, EICHLER, DUCELLIER, HOMFELD, and ALLORGE. These are meant to be formed in that manner that the protoplasts of the two cells divide, thus forming four gametes, a process reconstructed by OLTMANNS (1922, p. 122, Fig. 88: 1) in regard to *Closterium lineatum*. However, to judge from HOMFELD's picture of the initial stage of the sporeformation (1929, Tab. 5: 58), it is not unlikely that these spores are azygospores when considering the limits of the protoplasts. In pictures of corresponding cases in *Closterium* the position of the double spores of *Cl. lineatum* and *lunula* gives the impression that they are real zygospores, whereas the double spores of *rostratum* seem to be azygo-spores according to LAGERHEIMS picture (1886, p. 48, Fig. 3).

LÜTKEMÜLLER has, in letters to NORDSTEDT (1911) an to G. S. WEST (1912) sent drawings of double-zygospores of *cucurbitinum* at the formation of which four cells are participants (eight semicells!), Fig. nostr. 78. Consequently they must be regarded as true zygospores. From an initial sphaerial form they become more square-shaped as the definite shape. LÜTKEMÜLLER, in his letter to NORDSTEDT, brings up the question, if not NORDSTEDT's find of a spore of *cucurbitinum* var. *polymorphum* (1888, p. 71, Tab. 7: 20 c) may be an isolated half of a mature double zygospore.

Angular mono-zygots are known in *A. minutissimum, crassiusculum, pseudocucurbita,* and *Mooreanum,* the latter with one papilla in each of the four corners. *A. pyramidatum* has oval somewhat angular zygospores. Globular, smooth zygospores are found in *A. sydneyense* and *truncatum* and sphaerial zygospores with conical papillae are recorded in *cucurbita* and *subglobosum.* A similar spore is assigned to *Clevei* by CUSHMAN (1905, Tab. 7: 8) but the determination seems questionable.

Remarks of methodics.

The generic difference between *Penium* and *Actinotaenium* contains several elements.

Penium: cell wall without pores, ornamented with punctuations, granulations, or striations, the fissure of division is variable, a circumstance sometimes marked by intercalary segments.

Actinotaenium: cell wall always with small pores, in certain species also great pores (scrobiculations) with protruding pore organels, the fissure of division is constant, situated in a faint isthmus furrow.

The consequences of these distinguishing characters, (valid also if the name *Actinotaenium* is substituted by the name *Cosmarium*) developed by LÜTKEMÜLLER, have not been exploited and in many cases quite neglected. Thus, there are still some desmids of uncertain position, for instance *Penium rufescens, gelidum.* In measure, this depends on doubts about the absence of pores in the membrane of *Penium.* In *Penium polymorphum,* LÜTKEMÜLLER was unable to find any pores (1902, p. 382, Tab. 18: 44, 45) while KRIEGER (1935, p. 225) emphasized that apical pores have been stated by him. Both may be right; the possibility exists that the specimens examined by KRIEGER may belong to a form of *Actinotaenium,* in shape and dimensions agreeing to *Penium polymorphum.* On the other side, pores probably may occur in *Penium* quite as well as in the near related *Closterium.* That is why the wall ornamentation and the manner of division signify the deciding characters.

By a compilation like this it is not expedient and even not possible to try to make a revision of certain polymorphic species, e.g. *A. curtum, rufescens, cucurbitinum, cucurbita, inconspicuum.* The short forms of *Pleurotaenium minutum,* a very heterogeneous species, may quite as well be alotted to *Actinotaenium* as to the more specialized genus *Pleurotaenium.* The changes of the nomenclature undertaken by the author, are based on the extensive survey obtained from studies during several years, but they are, as all biosystematic work, a matter of taste and, consequently, very easy to be critisized by every desmidiologist.

By the formation of *Actinotaenium* the nomenclature makes justice to the original names given by the authors. When a lot of *Penia* and *Cylindrocystides* were transferred to *Cosmarium,* several of their names were already attached to species of the latter genus. Thus, several of these names must be rejected and new ones were created, especially by LÜTKEMÜLLER. These new names must now, in their turn, be rejected and the old names are restored. To each species there is added a list of literary references containing directions to pictures and nomenclature of the actual species, varieties and formae.

The selection of the species is made on the basis of the descriptions and pictures from the literature available to me. Of course, the incompleteness of the sources, often met with, has not permitted a definite decision in several cases, especially the chloroplast is very often quite neglected. Some species have been revised as to their biosystematy and nomenclature. No diagnoses are communicated but in many cases comments of similiarities and differences are given. The chorological distribution is not considered. These limitations depend on my opinion that it seems reasonable not to anticipate the thorough revision of the part of *Cosmarium,* corresponding to *Actinotaenium,* probably undertaken by KRIEGER for the new edition of RABENHORST's Kryptogamenflora before his sudden and regrettable death.

Abbreviations. As a rule, no abbreviations beyond the traditional ones are used, only *Actinotaenium* and *Cosmarium* are abbreviated in combination with species names. The often used double name W. and G. S. WEST ist written WEST. Dim: (followed by figures) means dimensions, the figures before the cross indicate the length and those after the cross indicate the breadth of the cell in microns. The thickness of the isthmus is insignificant and omitted.

The species now assigned to *Actinotaenium*, are dealt with in the order of the following list, in which they are arranged typologically according to the chloroplast and the shape.

A. Species with stelloid chloroplast.

The *curtum* group:

1. *curtum*,
2. *lagenarioides*,
3. *elongatum*,
4. *Clevei*,
5. *rufescens*,
6. *turgidum*,
7. *grande*,
8. *capax*.

The *cucurbitinum* group:

9. *cruciferum*,
10. *subglobosum*,
11. *Wollei*,
12. *trachypolum*,
13. *cucurbitinum*.

The *adelochondrum* group:

14. *adelochondrum*,
15. *obcuneatum*,
16. *tumidum*,
17. *sydneyense*.

The *cucurbita* group:

18. *palangula*,
19. *inconspicuum*,
20. *truncatum*,
21. *crassiusculum*,
22. *Taylori*,
23. *cucurbita*,
24. *pseudocucurbita*.

The *Mooreanum* group:

25. *minutissimum*,
26. *Mooreanum*.

B. Species with lobo-stelloid chloroplast.

The *pyramidatum* group:

27. *pyramidatum*.

The *subpalangula* group:

28. *subpalangula*,
29. *subtile*,
30. *perminutum*.

The *viride* group:

31. *viride*,
32. *diplosporum*.

1. ***Actinotaenium curtum*** (Bréb.) comb. nov. Dim: 22—60×10—32. Fig. 1.

Cosm. curtum: Ralfs 1848, p. 109, Tab. 32: 9. N. Carter 1920, p. 271, Fig. 1 A, B. West and Carter 1923, p. 267. Insam und Krieger 1936, p. 99, Tab. 1: 25, 26. — *Penium curtum*: Kützing 1849, p. 167. Wille 1885, p. 87, Tab. 13: 3. Turner 1886, Tab. 1: 3. West 1904, p. 97, Tab. 10: 21, 22. Borge 1911, p. 8, Fig. 1, 2. Sampaio 1944, Tab. 2: 29—31. — *Dysphinctium Regelianum*: Nägeli 1849, p. 110, Tab. 6: E. — *Penium Regelianum*: Wille 1879, p. 55, Tab. 13: 7. — *Dysphinctium curtum*: De Toni 1889, p. 877. — *Calocylindrus curtus*: Kirchner 1878, p. 143. Cooke 1886, p. 126, Tab. 43: 11. Wolle 1887, p. 54, Tab. 12: 15, 16. — *Cosm. Thwaitesii* var. *curtum*: Klebs 1879, p. 27. — *Penium phymatosporum*: Wille 1885, p. 87, Tab. 13: 4.

f. *majus*. Dim: 41—48×21—25. Wille 1879, p. 56, Tab. 14: 73. West 1904, p. 98, Tab. 10: 24, 25. Borge 1899 a, p. 762, Fig. 5. Insam und Krieger 1936, p. 99, Tab. 1: 28. Messikommer 1942, p. 142, Tab. 4: 7, and 1945, Tab. 2: 39.

f. *minus*. Dim: 30—32×15—16. Wille 1879, p. 56, Tab. 13: 75. West 1904, p. 142, Tab. 10: 23. Messikommer 1942, p. 142, Tab. 4: 8.

f. *intermedium*. Dim: 36—38×15—17. Wille 1879, p. 56, Tab. 13: 74.

var. *obtusum*. Dim: 41—45×20—23. Fig. 9. WEST 1900, p. 289. Tab. 412: 1, 2. WEST 1904, p. 99, Tab. 10: 26.

var. *globosum*. Dim: 31—38×24—28. WILLE 1879, p. 56, Tab. 13: 72.

A. curtum, under the name of *Regelianum,* is thê type specimen of *Actinotaenium* being the species for which NÄGELI created the subgenus *Actinotaenium* of the collective genus *Dysphinctium* in 1849. NÄGELI's picture of *Regelianum* is clear and also complete, (even division stage) showing the fusiform shape with apical internal papilla and the stelloid chloroplast with six lamellae. This form has been refound and depicted by several authors, often without the apical papilla, but the name *curtum* has also been applied to desmids of varying forms of which especially the rounded ones seem to be foreign to the type, e.g. by N. CARTER, WOLLE, COMÈRE and MESSIKOMMER. WILLE (1879) however, found several forms, viz. *majus,* and *medium* which, in his opinion, form a continuous series between f. *typicum* and his var. *globosum.*

PEVALEK (1924, p. 62, Fig. 6) has described a var. *velebitinum,* the semicells of which have inflated bases and slightly excavated apices. It makes the impression neither belonging to *curtum* nor to *Actinotaenium.*

var. *attenuatum* (INSAM et KRIEGER) comb. nov. Dim: 62—87×20—30. Fig. 2. — *Cosm. attenuatum*: RALFS 1848, p. 110, Tab. 17: 9. WEST 1908, p. 118, Tab. 74: 24, 25. — *Cosm. curtum* var. *majus*: RABENHORST 1868, p. 177. — *Calocylindrus attenuatus*: COOKE 1886, p. 127, Tab. 43: 1, 2. — *Dysphinctium attenuatum*: TURNER 1892, p. 44. — *Cosm. Thwaitesii*: KLEBS 1879, p. 27. — *Calocylindrus Thwaitesii*: WOLLE 1884, p. 56, Tab. 12: 19. — *Cosm. curtum* var. *attenuatum*: INSAM und KRIEGER 1936, p. 99, Tab. 1: 27. — Not MASKELL 1888, p. 15, Tab. 2: 16!

Already RALFS (p. 110) confessed that he in certain cases had been doubtful about specific difference between *A. curtum* and *attenuatum.* MASKELL (1888) used the name *Cosm. curtum* var. *attenuatum* for a desmid of exactly the same front view as *attenuatum.* This name must be rejected because of the clearly biradiate structur in apical view.

var. *Bourrellyi* nom. nov. Dim: 34×17. Fig. 3. — *Cosm. conicum*: BOURRELLY 1949, p. 186, Tab. 4: 50.

BOURRELLY's desmid differs so much from the WEST's insufficiently known *Cosm. conicum* that it is here proposed as a scrobiculate variety of *curtum.*

It is impossible to maintain a specific difference between *A. lagenarioides, pseudotinecense, elongatum,* and *lanceolatum*; the differences being vague concerning only proportions and dimensions. Probably earlier desmidiologists have been standing in awe of the generic names, for instance on the one side *Penium lanceolatum* and on the other side *Cosmarium elongatum.* The present author has compromised by joining the broader *lagenarioides—pseudotinecense* and the more slender *elongatum—lanceolatum.*

The typical *Clevei* falls, in my opinion, somewhat outside this group and is in itself rather differentiated in direction to a more cylindrical shape, such as *rufescens.* As mentioned earlier the scrobiculations of the vertex, when observed, possess not deciding but only secondary rank as a specific character.

2. *Actinotaenium lagenarioides* (ROY) comb. nov. Dim: 92—95×45. Fig. 4.

Penium lagenarioides: BISSET 1884, p. 197, Tab. 5: 6. WEST 1904, p. 93, Tab. 9: 12. — *Dysphinctium lagenarioides*: LÜTKEMÜLLER 1905, p. 337. — *Cosm. lagenarioides*: LÜTKEMÜLLER 1910, p. 479.

BISSET's picture seems to be unique, WEST's is a copy of it. In a written comment BISSET has corrected the arrangement of the pores: they should be scattered, not in rows.

var. *pseudotinecense* (GRÖNBL.) comb. nov. Dim: 122—157×45—57. Fig. 5. — *Cosm. pseudotinecense*: GRÖNBLAD 1921, p. 42, Tab. 7: 61. — *Cosm. lagenarioides*: GRÖNBLAD 1920, p. 43, Tab. 5: 24. — *Cosm. elongatum:* IRÉNÉE-MARIE 1952, p. 112, Tab. 11: 1. — *Cosm. Faakense*: BECK-MANNAGETTA 1929, p. 3, Fig. 2.

GRÖNBLAD's distinguishing of his species depended on the stelloid chloroplast in contrast to the very similar *Cosm. turgidum* var. *tinecense* RACIB. This author had not mentioned anything about the chloroplast but *turgidum* has a taenio-parietal one. Like *tinecense* also *pseudotinecense* has a constricted vertex but GRÖNBLAD has sent me a picture of *pseudotinecense* without this constriction and he is inclined to consider *lagenarioides* as belonging to the normal, unconstricted *pseudotinecense.*

3. *Actinotaenium elongatum* (RACIB.) comb. nov. Dim: 128—186×34—59. Fig. 6.

Cosm. elongatum: RACIBORSKI 1885, p. 68, Tab. 11: 1. BORGE 1923, p. 8, Tab. 1: 3. SKUJA 1928, p. 156, Tab. 4: 1. GRÖNBLAD 1936, p. 2, Tab. 1: 4. — *Calocylindrus elongatus*: RACIBORSKI 1884, p. 9.

f. *brevius.* Dim: 106×36. BORGE 1923, p. 8, Tab. 1: 4. — *Cosm. elongatum*: CEDERGREN 1932, p. 45, Fig. 14.

The typical form of this species quite agrees with *A. curtum* var. *attenuatum* and could be regarded as a f. *maximum* of it.

var. *lanceolatum* (Turn.) comb. nov. Dim: 81—98×26—36. Fig. 8.

Penium lanceolatum: Turner 1892, p. 17, Tab. 1: 7. Borge 1903, p. 74, Tab. 1: 3. — *Dysphinctium lanceolatum*: Lütkemüller 1905, p. 337. — *Cosm. lanceolatum*: Lütkemüller 1910, p. 479.

f. *subcylindricum* (W. et G. S. West) comb. nov. Dim: 134×35. — *Penium lanceolatum* var. *subcylindricum* West 1902, p. 134, Tab. 18: 5.

var. *africanum* (Schmidle) comb. nov. Dim: 96—128×27—35. Fig. 7. — *Penium Clevei* var. *africanum*: Schmidle 1898, p. 20, Tab. 1: 12. — *Penium Clevei* f. *elongatum*: West 1907, p. 140, Tab. 13: 2.

4. *Actinotaenium Clevei* (Lund.) comb. nov. Dim: 85—116×35—42. Fig. 10, 13.

Penium Clevei: Lundell 1871, p. 86, Tab. 5: 11. West 1904, p. 87, Tab. 8: 36, 37. — *Penium Thwaitesii*: Cleve 1864, p. 492. — *Calocylindrus Clevei*: Wolle 1884, p. 56, Tab. 50: 27. — *Calocylindrus Thwaitesii*: Wolle 1884, p. 56, Tab. 50: 28. — *Dysphinctium Clevei*: De Toni 1889, p. 893. — *Cosm. Clevei*: Lütkemüller 1910, p. 479. West and Carter 1923, p. 267. Grönblad 1920, p. 40, Tab. 5: 23. Taft 1937, Tab. 2: 37. Irénée-Marie 1949, p. 253, Tab. 1: 5. — *Penium breve* var. *arcticum*: Wille 1879, p. 57, Tab. 14: 76. — *Penium diadematum*: Gutwinski 1902, p. 585, Tab. 37: 20 (Fig. nostr. 13).

var. *delicatulum* (Josh.) comb. nov. Dim: 63×26. Fig. 80 (in Fig. 23!). — *Penium delicatulum* Joshua 1885, p. 653, Tab. 25: 9.

f. *minus*. Dim: 37×15. — *Penium delicatulum* var. *minus* West 1895, p. 47, Tab. 5: 36.

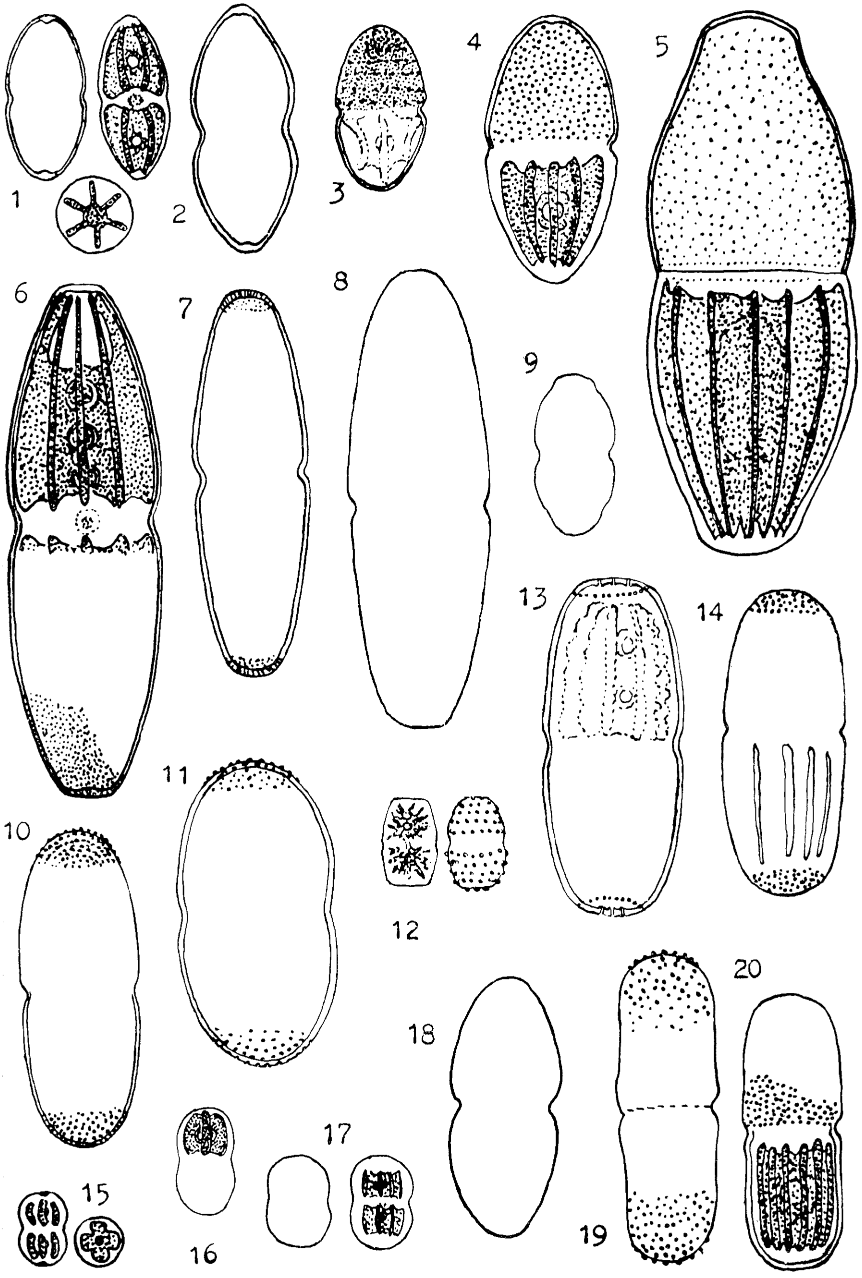
var. *crassum* (W. et G. S. West) comb. nov. Dim: 80—98×42—45. Fig. 11. — *Penium Clevei* var. *crassum*: West 1894, p. 4, Tab. 1: 5. West 1904, p. 88, Tab. 8: 38. Cushman 1905, p. 225, Tab. 7: 8 (zygospore).

var. *gelidum* (Wittr.) comb. nov. Dim: 36—62×14—49. Fig. 14. — *Penium gelidum*: Wittrock 1883, p. 122, Tab. 3: 24. Cedergren 1932, p. 25, Tab. 1: 3. — *Penium rufescens*: Gutwinski 1909, p. 445, Tab. 7: 8. ?Messikommer 1942, p. 136, Tab. 2: 5. — ?*Peniella sudetica*: Beck-Mannagetta 1926, p. 6, Fig. 9—12.

Krieger (1935, p. 240) united *gelidum* with his *Penium rufescens* in spite of the apical scrobiculations. The same objection must be raised to his placing of *Peniella sudetica* in *Penium polymorphum* (p. 229); Beck-Mannagetta emphasizes the porous cell wall. On the other side, the absence of an isthmus furrow speaks against its position in *Actinotaenium*.

5. *Actinotaenium rufescens* (Cleve) comb. nov. Dim: 50—94×20—32. Fig. 19, 20.

Penium rufescens: Cleve 1864, p. 493, Tab. 4: 5. Borge 1903, p. 75, Tab. 1: 6. West 1904, p. 99, Tab. 6: 12, 13. Messikommer 1943, Tab. 6: 3. Irénée-Marie 1939, p. 88, Tab. 9: 13. Krieger 1935, p. 240, Tab. 10: 13, 14. Taft 1937, Tab. 2: 36. Lhotsky 1949, p. 4, Tab. 1: 8. Messikommer 1927, p. 95, Tab. 2: 7, and 1935, p. 39,



Figs. 1—20. — 1: *curtum* — 2: var. *attenuatum* — 3: var. *Bourrellyi* — 4: *lagenarioides* — 5: var. *pseudotinecense* — 6: *elongatum* — 7: var. *africanum* — 8: var. *lanceolatum* — 9: *curtum* var. *obtusum* — 10: *Clevei* — 11: var. *crassum* — 12: *subpalangula* — 13: *Clevei* — 14: var. *gelidum* — 16: *cruciferum* — 15: f. *minus* — 17: var. *pluriradiatum* — 18: *turgidum* var. *ovatum* — 19—20: *rufescens*.

Tab. 1: 7 (f. *achroa*). — *Penium chrysoderma*: BORGE 1906, p. 15, Tab. 1: 7. DUCELLIER 1916, p. 54, Fig. 30, 31. DICK 1923, p. 215, Tab. 4: 12 (Fig. nostr. 19). — *Docidium breve* var. *arcticum*: GUTWINSKI 1896, Tab. 6: 24. — *Penium didymocarpum* var. *alpinum*: SCHMIDLE 1895, p. 346, Tab. 14: 17.

This species is by KRIEGER (1932, p. 240) placed in *Penium* in spite of the great apical scrobiculations of *chrysoderma* which, in KRIEGER's (and HOMFELD's 1929, p. 15) opinion belongs to *rufescens*. LÜTKEMÜLLER has (in litt. 12/II 1912) communicated to G. S. WEST, that he had studied a rich material of *rufescens* and discerned a dense pore-apparatus. As distinguished from the rest of the *curtum* group, this desmid is almost cylindrical with rounded ends, transitional forms occur in *Clevei*. *A. rufescens* also shows an apparent similiarity to *cucurbitinum* and certain pictures assigned to this species could quite as well be called *rufescens*.

6. ***Actinotaenium turgidum*** (BRÉB.) comb. nov. Dim: 138—207 × 73—100. Fig. 21.

Cosm. turgidum: RALFS 1848, p. 110, Tab. 32: 8. PETKOFF 1900, p. 10, Tab. 1: 4. BORGE 1901, p. 23, Tab. 2: 12. WEST 1908, p. 115, Tab. 75: 1—3. MESSIKOMMER 1943, Tab. 10: 4 (Fig. sinistr.). KRIEGER 1932, Tab. 8: 10. — *Pleurotaenium turgidum*: DE BARY 1858, p. 75, Tab. 5: 31. — *Pleurotaeniopsis turgida*: LUNDELL 1871, p. 51. LÜTKEMÜLLER 1893, p. 43, Tab. 3: 26. *Calocylindrus turgidus*: KIRCHNER 1878, p. 142. COOKE 1886, p. 127, Tab. 44: 1. — *Disphinctium turgidum*: DELPONTE 1877, p. 133, Tab. 21: 1—6. — *Cosmaridium turgidum*: HANSGIRG 1888, p. 145. — *Cosm. DeBaryi* var. *turgidum*: KLEBS 1879, p. 28.

var. *subrotundatum*. Dim: 140 × 77. Fig. 28. WEST 1908, p. 116, Tab. 75: 4.

var. *ligatum*. Dim: 116—153 × 50—68. Fig. 24. WEST 1907, p. 204, Tab. 13: 7. BORGE 1918, p. 32, Tab. 2: 27, 28. MESSIKOMMER 1943, Tab. 10: 4 (Fig. dextr.).

var. *ornatum*. Dim: 200 × 84. SCHMIDLE 1895 a, p. 72, Tab. 1: 16.

var. *ovatum*. Dim: 164—240 × 83—97. Fig. 18. NORDSTEDT 1888, p. 63, Tab. 7: 30. INSAM und KRIEGER 1936, p. 110, Tab. 2: 6.

var. *tinecense*. Dim: 160—167 × 69. RACIBORSKI 1885, p. 69, Tab. 10: 2.

This large species of obtuse *curtum* type differs from the proceeding species of this group by its taenio-parietal chloroplasts, carefully studied by LÜTKEMÜLLER (1893). To it some interesting varieties have been assigned, viz. *ligatum* with an isthmal constriction, extremely scarse in *Actinotaenium*, further *subrotundatum* with almost globular semicells, and *tinecense* with a slightly constricted apical part.

7. ***Actinotaenium grande*** (DELP.) comb. nov. Dim: 216 × 100. Fig. 26.

Disphyntium (!) *grande*: DELPONTE 1877, p. 231, Tab. 21: 9.

This desmid differs from *A. turgidum* by its larger size and cylindrical shape. DELPONTE has not seen the chloroplast but according to the size there is no doubt that it has taenio-parietal chloroplasts.

var. *cuneatum* (W. B. TURNER) comb. nov. Dim: 195—220×95—100. Fig. 23. — *Dysphinctium grande* var. *cuneatum*. TURNER 1892, p. 40, Tab. 7: 5.

This desmid agrees with *grande* in the size, the small constriction of the apical part also occurs in *turgidum* var. *tinecense, lagenarioides* var. *pseudotinecense,* and *curtum* var. *obtusum*.

8. ***Actinotaenium capax*** (JOSHUA) comb. nov. Dim: 140—165× 66—90. Fig. 29.

Cosm. capax: JOSHUA 1885, p. 645, Tab. 8: 25. — *Dysphinctium subturgidum*: TURNER 1892, p. 80, Tab. 7: 4. — *Cosm. subturgidum* (TURN.) SCHMIDLE in WEST 1908, p. 116, Tab. 75: 5.

There is no difference in shape nor dimensions between *capax* and *subturgidum*: they are identical and the name *capax* possesses the priority. The chloroplast is taenio-parietal.

The forma *minus* must more correctly be considered a variety:

var. *minus* (SCHMIDLE) comb. nov. Dim: 60—120×37—64. Fig. 25. — SCHMIDLE 1895 b, p. 300, Tab. 4: 2. WEST 1908, p. 116, Tab. 116: 22, 23. KRIEGER 1932, p. 188, Tab. 8: 7. CEDERGREN 1932, p. 45, Fig. 15. SKUJA 1949, p. 143, Tab. 26: 8, 9. VAN OYE 1953, p. 284, Fig. 74. — *Pleurotaeniopsis subturgida* var. *minor*: SCHMIDLE 1896, p. 305.

9. ***Actinotaenium cruciferum*** (DE BARY) comb. nov. Dim: 15—30×10—15. Fig. 16, 17.

Cosm. cruciferum: DE BARY 1858, p. 72, Tab. 7: 3—6. VAN OYE 1953, p. 281, Fig. 64. SAMPAIO 1944, Tab. 2: 16, 17. — *Dysphinctium cruciferum*: HANSGIRG 1888, p. 185 and 243. GUTWINSKI 1896, p. 43, Tab. 6: 25. — *Penium cruciferum*: NORDSTEDT 1888, p. 71, Tab. 7: 19. WEST 1904, p. 100, Tab. 10: 18—20. var. *pluriradians*: WITTROCK 1889, p. 48. WOLLE 1887, Tab. 61: 9—11. TAYLOR 1834, p. 242, Tab. 45: 16. TAFT 1837, p. 398, Tab. 2: 35. ?SCHMIDLE 1898 a, p. 17, Tab. 1: 12, 13. LOWE 1923, Tab. 3: 7. — *Cosm. subarctoum*: MANGUIN 1936, p. 8, Tab. 1: 12, and 1940, Tab. 1: 12. — *Cosm. globosum* f. *minus*: BOURRELLY 1952, p. 495, Tab. 8: 75. WEST 1909, Tab. 68: 5.

f. *latius*. Dim: 21—24×16—19. MESSIKOMMER 1942, p. 143, Tab. 4: 12, 13. GRÖNBLAD 1935, p. 4, Fig. 15, 16. TAFT 1937, p. 198, Tab. 2: 10.

f. *minus*, f. nov. Dim: 12×7—8. Fig. 15. — *Cosm. pseudarctoum* var. *perminutum*: MANGUIN 1937, Tab. 2. BOURRELLY 1952, p. 222, Tab. 28: 513, 514.

A. cruciferum has a stelloid chloroplast while the similar species *perminutum* and *subtile* have lobo-stelloid chloroplast. The cell in front view is guitar-shaped. Several circular forms of *Cosm. pseudarctoum* and *Cosm. globosum* of a similar frontal shape are noted and also carefully depicted. It seems correct to assign some of these to *cruciferum.* In the part containing probable and doubtful species the separation of circular forms, previously assigned to biradiate *Cosmaria* is discussed.

DE BARY founded his species on a fairly slender form with a chloroplast having four lamellae (observe the name), larger forms have five or more lamellae which has given rise to the superfluous name *pluriradiatum,* Fig. 17.

The statements given by BORGE and SKUJA of *cruciferum*, cannot, on the basis of the structure of the chloroplast, be referred to *cruciferum.* A further discussion is given in connection to *subtile.*

10. ***Actinotaenium subglobosum*** (NORDST.) comb. nov. Dim: 32—48×15—30. Fig. 33.

Cosm. subglobosum: NORDSTEDT 1878, p. 14, Tab. 1: 13. JOHNSON 1894, p. 287, Tab. 1: 13. The following pictures, only outline drawings in front view, may possibly belong to this species: KRIEGER 1932, p. 187, Tab. 8: 12, INSAM und KRIEGER 1936, p. 109, Tab. 1: 8, BOURRELLY 1952, p. 224, Tab. 29: 531, SCHMIDLE 1895 b, p. 300, Tab. 4: 3, and *Cosm. curtum* f. MESSIKOMMER 1942, p. 142, Tab. 4: 9, 10.

This desmid has a ratio of length : breath of only 1.5, semi-globular ends and a faint constriction at the isthmus. The chloroplast is stelloid with 6—10 lamellae, the edges of which are slightly laciniate.

The zygospore is globular with mamillate verrucae.

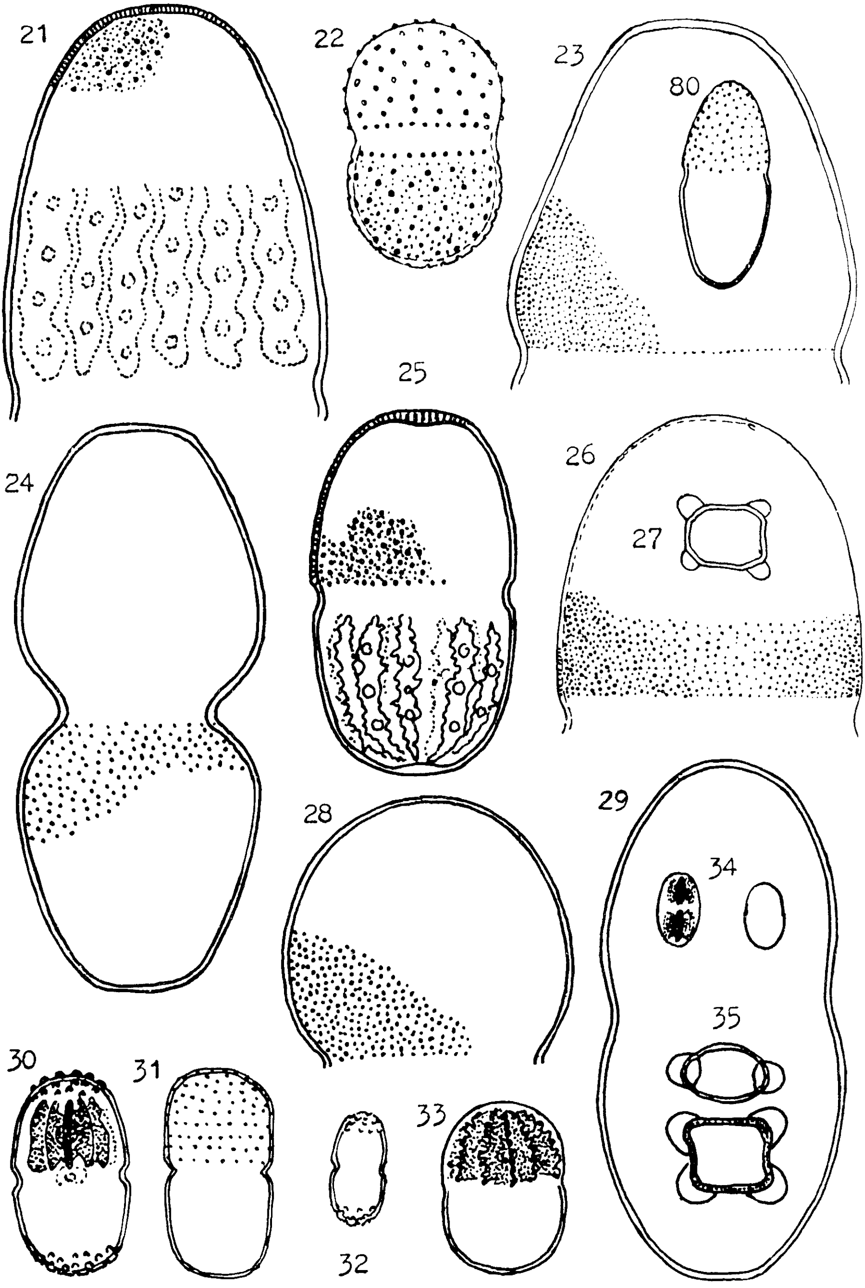
11. ***Actinotaenium Wollei*** (GRÖNBL.) comb. nov. Dim: 35—51×28—35. Fig. 40.

Cosm. Wollei: GRÖNBLAD 1924, p. 14, Tab. 2: 66, 67. IRÉNÉE-MARIE 1952, p. 138, Tab. 12: 10. — *Cosm. globosum*: WOLLE 1884, p. 60, Tab. 49: 14—17. IYENGAR 1951, Fig. 3: D. — *Cosm. globosum* var. *Wollei*: WEST 1906, p. 151, Tab. 15: 17. KRIEGER 1932, p. 177, Tab. 7: 8, 9. G. S. WEST 1907, p. 118, Tab. 7: 10. WEST 1902, Tab. 20: 42. — *Dysphinctium subellipticum*: SCHMIDLE 1898 a, p. 21, Tab. 1: 15.

The shape is in most cases almost globoid with a faint isthmus-furrow. The stelloid chloroplast has 6—9 lamellae.

The zygospore is smooth and globoid (WEST 1896).

PLAYFAIR's *Cosm. globosum* var. *Wollei* (1914, Tab. 3: 3) can not belong to this species because of its dicentric chloroplast; it is pseudo-omniradiate from a biradiate origin.



Figs. 21—35, 80. — 21: *turgidum* — 22: *trachypolum* var. *Messikommeri* — 23: *grande* var. *cuneatum* — 24: *turgidum* var. *ligatum* — 25: *capax* var. *minus* — 26: *grande* — 27: *minutissimum* var. *octangulare* — 28: *turgidum* var. *rotundatum* — 29: *capax* — 30: *trachypolum* — 31: *pseudocucurbita* — 32: *trachypolum* var. *elongatum* — 33: *subglobosum* — 34—35: *minutissimum* — 80: *Clevei* var. *delicatulum*.

12. *Actinotaenium trachypolum* (W. et G. S. WEST) comb. nov. Dim: 22—30×11—17. Fig. 30.

Cosm. trachypolum WEST 1897 c, p. 166, Tab. 8: 14, 15. SKUJA 1949, p. 144, Tab. 26: 4. — *Penium cuticulare*: COSANDEY 1934, p. 44, Tab. 2: 15, 16.

var. *elongatum*. Dim: 32—44×16—18. Fig. 32. WEST 1902, p. 168. Tab. 20: 39, 40. KRIEGER 1932, p. 189, Tab. 9: 11.

var. *Messikommeri* nom. nov. Dim: 33×20—22. Fig. 22. LÜTKEMÜLLER 1900, p. 12, Tab. 1: 31, 32. MESSIKOMMER 1935, p. 50, Tab. 4: 36.

The type form has apical great pores and the protruding parts of their pore-organels have been taken for granula; the form described by MESSIKOMMER shows a homogeneous pore-apparatus of mixed small and great pores.

13. *Actinotaenium cucurbitinum* (BISS.) comb. nov. Dim: 51—90×23—35. Fig. 36.

Penium cucurbitinum: BISSET 1884, p. 197, Tab. 5: 7. STRØM 1919, p. 21, Tab. 4: 4. WEST 1904, p. 94, Tab. 9: 13, 14. G. S. WEST 1904, p. 139, Fig. 51 D. GISTL 1914, p. 15, Tab. 1: 8. — *Dysphinctium cucurbitinum*: LÜTKEMÜLLER 1905, p. 337. — *Cosm. cucurbitinum*: LÜTKEMÜLLER 1910, p. 479. TAYLOR 1934, p. 252, Tab. 45: 15. MANGUIN 1937, Tab. 2: 29 (Fig. dextr.). PRESCOTT and SCOTT 1952, p. 8, Tab. 4: 11. INSAM und KRIEGER 1936, p. 99, Tab. 1: 3. — *Calocylindrus cucurbitinus*: KIRCHNER 1878, p. 143. — *Cosm. palangula*: VAN OYE 1953, p. 178, Fig. 35. — *Penium delicatulum* var. *perforatum*: GUTWINSKI 1902, p. 584, Tab. 37: 19.

f. *minus*. Dim: 43—58×17—24. WEST 1904, p. 95, Tab. 9: 16. GRÖNBLAD 1934, p. 267, Tab. 4: 4, 5. PRESCOTT 1936, Tab. 16: 8. BOURRELLY 1948, p. 494, Tab. 8: 70, and 1952, p. 219, Tab. 19: 535. MANGUIN 1937, Tab. 2: 30. ROSA 1951, p. 215, Tab. 12: 14.

f. *majus*. Dim: 97—100×35—43. WEST 1904, p. 95, Tab. 9: 17.

f. *minutissimum*. MANGUIN 1937, Tab. 2: 31.

var. *angustum*. Dim: 74×19. Fig. 37. GRÖNBLAD 1945, p. 17, Tab. 5: 97.

var. *grande*. Dim: 89—118×36—48. GRÖNBLAD 1921, p. 43, Tab. 7: 62. BORGE 1930, p. 33, Tab. 2: 25, and 1936, p. 32, Tab. 1: 20. INSAM und KRIEGER 1936, p. 99, Tab. 1: 1, 2. HIRN 1903, p. 17, Tab. 2: 27.

var. *magellanicum* (BORGE) comb. nov. Dim: 47—57×19—20. Fig. 42. — *Penium magellanicum*: BORGE 1906, p. 29, Tab. 2: 7. Compare *A. palangula* var. *Wollei*!

var. *Manguini* var. nov. Dim: 57—58×24. Fig. 44. — *Cosm. cucurbitinum* forma. MANGUIN 1937, p. 24, Tab. 2: 29 (Fig. sinistr.).

This variety is characterized by the quite cylindrical shape with semi-globoid ends. It had an internal apical papilla, only found in one other picture of *cucurbitinum*, viz. PRESCOTT and SCOTT 1952. Probably not belonging to *cucurbitinum*.

var. *minutum* PRESCOTT. Fig. 39. MESSIKOMMER 1945, Tab. 2: 38.

var. *subpolymorphum*. Dim: 71—86×29—38. Fig. 41. NORDSTEDT 1888, p. 71, Tab. 7: 20. WEST 1904, p. 95, Tab. 9: 19, 20, and 1907, p. 189, Tab. 13: 14. MASKELL 1889, p. 27, Tab. 5: 50. KRIEGER 1932, p. 174, Tab. 9: 14.

var. *subretusum*. Dim: 47×30. Fig. 38. MESSIKOMMER 1954, p. 33, Tab. 1: 5. ?BORGE 1894, p. 22, Tab. 2: 17.

var. *truncatum*. Dim: 53: 70×15—29. Fig. 43. KRIEGER 1932, p. 174, Tab. 9: 15. — *Cosm. cucurbitinum*: IRÉNÉE-MARIE 1939, p. 182, Tab. 26: 12. — ?*Penium lagenarioides* var. *intermedium*: GUTWINSKI 1902, p. 584, Tab. 37: 18. — *Cosm. cucurbitinum* f. *minus*: BOURRELLY 1946, p. 93, Tab. 4: 49.

var. *scoticum*. Dim: 95—97×42—44. WEST 1904, p. 96, Tab. 9: 18. — *Cosm. Thwaitesii* var. *scoticum*: WEST 1894, p. 8, Tab. 1: 15.

As seen from the list above this desmid has been depicted by many desmidiologists who have found it very rich in forms. That all of these belong to the real *A. cucurbitinum* is dubious, the author has only brought most of the literary finds together and also added some desmids published under other names.

The name hints a similiarity to *cucurbita*. The reason why BISSET assigned his desmid to *Penium* instead of *Cosmarium* is unknown; his diagnosis is very laconic: "Frond shaped as figured. Endochrome in fillets, three of which are usually seen in frontview. Membrane sparsely punctate. Length 85—90 μ breath 32—35 μ." I have examined a slide with BISSET's own type specimen in NORDSTEDT's collection and can confirm BISSET's picture, except the distribution of the pores: they are scattered, not in rows, a lithographer's error that BISSET has noted in the reprints.

Most of the desmids cited above, show a narrow oval—slightly fusiform shape with rounded ends, but also forms with retuse ends WEST 1904, Tab. 9: 13, 17, STRÖM 1919, Tab. 4: 4, and IRÉNÉE-MARIE 1939 p. 182, Tab. 26: 12 are assigned to this species. The latter are to be compared with the retuse forms of *A. cucurbita* and would probably more correctly be assigned to this species; agreement in shape is more important than difference in size, at least on the present stage of our knowledge.

An almost square zygospore (of var. *subpolymorphum*) was firstly described by NORDSTEDT. Later, LÜTKEMÜLLER found double zygospores. His pictures are not published but he sent drawings to NORDSTEDT and G. S. WEST. His spores (Fig. 78) are immature, globoid with a beginning square-form, LÜTKEMÜLLER thought that NORDSTEDT's find was one isolated part of the mature double-spores.

14. ***Actinotaenium adelochondrum*** (ELFV.) comb. nov. Dim: 32—52×15—20. Fig. 45.

Penium adelochondrum: ELFVING 1881, p. 17, Tab. 1: 13. WEST 1892, p. 128, Tab. 19: 19, 1904, p. 93, Tab. 8: 30, 31, and 1907, p. 190, Tab. 13: 15. SCHMIDLE 1893 a, p. 547, Tab. 28: 2. — *Dysphinctium Palangula*: HEIMERL 1891, p. 594, Tab. 5: 7. — *Dysphinctium adelochondrum*: LÜTKEMÜLLER 1905, p. 337. — *Cosm. adelochondrum:* LÜTKEMÜLLER 1910, p. 479. BORGE 1936, p. 30, Tab. 1: 19. — *Penium cylindrus* var. *attenuatum*. RACIBORSKI 1890, p. 74, Tab. 7: 21. — *Penium minutum* var. *crassum*: BORGE 1903, p. 75, Tab. 1: 4. — *Penium fusiforme*: GAY 1884, p. 69, Tab. 2: 11.

var. *Kriegeri*. Dim: 26—36×12—13. Fig. 46. MESSIKOMMER 1942, p. 143, Tab. 4: 20. KRIEGER 1938, p. 60, Tab. 1: 29.

This desmid, fusiform with retuse (or rounded) ends, has great pores the pore-organels of which ELFVING interpreted as granula, corrected by BORGE (1936, p. 30). Probably it is these "granula" that RACIBORSKI has depicted on his *Penium cylindrus* var. *attenuatum*, both the constricted cell and the size agree with *adelochondrum*. KRIEGER (1932, p. 241) has considered *Penium fusiforme* GAY as a synonym of *Closterium navicula*. It may, however, more correctly be assigned to *adelochondrum*; shape and size agree and GAY did not find any vacuoles or crystals. Possibly other finds of *Closterium* or *Penium navicula* will be assigned to *Actinotaenium*, in specimens without end-vacuole, the structure of the isthmus or the division-stages are decisive.

A spiny and globoid zygospore, found by W. WEST (1892, Tab. 21: 18) and at first assigned to *obcuneatum*, is suspected to belong to *adelochondrum* (WEST 1908, p. 111).

15. ***Actinotaenium obcuneatum*** (W. WEST) comb. nov. Dim: 28—42×15—18. Fig. 59.

Cosm. obcuneatum: W. WEST 1892, p. 162, Tab. 21: 18. — *Cosm. parvulum*: WEST 1908, p. 110. KRIEGER 1933, Fig. 9: J, K. BOURRELLY 1946 a, p. 495, Tab. 7: 69 "parfaitement circulaire". ALLORGE 1931, p. 358, Tab. 8: 6. SAMPAIO 1944, Tab. 13: 42—44.

Cosm. parvulum is a dimorphous species. BRÉBISSON's diagnose contains no statement as to the cross-section but of the pictures of later authors some show an ovale, others a circular cross-section, sometimes confirmed in the description. Even if quasi-omniradiate forms of *parvulum* theoretically may develop circular specimens, it is probable that the forms depicted by KRIEGER, ALLORGE, and BOURRELLY represent a separate species. This is one of the cases in which, because of the simplicity of the form, a convergency of omniradiate and biradiate desmids may occur. WHELDEN (1947, p. 84, Tab. 5: 1) and MESSIKOMMER (1945, p. 101, Tab. 2: 45) have given pictures of the biradiate *parvulum* and also have shown that a small apical excavation occurs on biradiate specimens. This excavation, previously observed by BORGE (1911, p. 13, Fig. 8) and HANSGIRG (1888, p. 187, Fig. 109, under the name of *Dysphinctium pusillum*, incorrect end-view!) may be a character of the biradiate *parvulum* in contrast to *obcuneatum*.

16. ***Actinotaenium tumidum*** (WOLLE) comb. nov. Dim: 65—70× 28—31. Fig. 51.

Cylindrocystis tumida: WOLLE 1887, p. 23, Tab. 56: 7, 8. — *Cylindrocystis angulata*: WEST 1896, p. 237, Tab. 13: 25, 26. — *Cosm. floridanum*: LÜTKEMÜLLER 1913, p. 228.

var. *brasiliense* (GRÖNBLAD). Dim: 65—84×21—27. Fig. 52. — *Cosm. floridanum* var. *brasiliense*: GRÖNBLAD 1945, p. 135, Tab. 6: 108. KRIEGER 1950, p. 40, Fig. 34.

This species was depicted by WOLLE under the name of *Cylindrocystis tumida* GAY. WOLLE's picture has a distinct isthmus-furrow, while GAY's picture is devoid of it and shows a lobo-stelloid chloroplast, that is why WOLLE must be regarded as the author. The WESTS described it as *Cyl. angulata* and LÜTKEMÜLLER changed the name to *floridanum* since the names *angulatum* and *tumidum* already were occupied in *Cosmarium*.

17. ***Actinotaenium sydneyense*** (RACIB.) comb. nov. Dim: 69—73× 25—29. Fig. 50.

Penium lagenarioides var. *sydneyense*: RACIBORSKI 1892, p. 368, Tab. 6: 3. — *Penium heterotaphridium*: WEST 1902, p. 135, Tab. 18: 3, 4. — *Dysphinctium heterotaphridium*: LÜTKEMÜLLER 1905, p. 357. — *Cosm. heterotaphridium*: LÜTKEMÜLLER 1910, p. 479.

RACIBORSKI's desmid was overlooked when the WESTS named their desmid. The two desmids agree exactly in form, dimensions, and the arrangement of pores and scrobiculations. RACIBORSKI described a stelloid chloroplast with eight lamellae and one pyrenoid. The WESTS found a smooth (immature?) globoid zygospore.

18. ***Actinotaenium palangula*** (BRÉB.) comb. nov. Dim: 32—48× 14—17. Fig. 49.

Cosm. Palangula: RALFS 1848, p. 212. BRÉBISSON 1856, p. 132, Tab. 1: 21. NOTARIS 1867, Tab. 3: 24. WEST 1908, p. 108, Tab. 74: 4—6. GRÖNBLAD 1947, p. 25, Fig. 17. — *Calocylindrus Palangula*: KIRCHNER 1878, p. 143. — *Dysphinctium Palangula*: HANS-

GIRG 1888, p. 184. — *Cosm. Cordanum* f. *minus*: MASKELL 1888, p. 16, Tab. 2: 20 (Fig. dextr.). — *Cosm. Cucurbita* var. *Palangula*: KLEBS 1879, p. 28, Tab. 3: 8 b—d.

var. *Wollei*. Dim: 51—75×21—25. Fig. 47. — *Calocylindrus Cucurbita:* WOLLE 1884, p. 64, Tab. 12: 14. — idem f. *Wollei*: EICHLER 1894, p. 126, Tab. 2: 14. — *Penium Cucurbitinum*: GISTL 1914, p. 15, Tab. 1: 8. — *Cosm. cucurbitinum*: TAYLOR 1933, p. 252, Tab. 45: 14.

var. *silesiacum* (KIRCHNER) comb. nov. Dim: 42—51×12—14. Fig. 48. — *Calocylindrus Cylindrus* var. *silesiacus*: KIRCHNER 1878, p. 143. — *Penium cylindrus* var. *silesiacum*: SCHMIDLE 1893, p. 20, Tab. 3: 6. JOHNSON 1895, p. 291, Tab. 239: 2.

BRÉBISSON's picture (lithographed by himself) shows a baculiform cylindrical cell with obtuse or slightly rounded ends. In the short diagnosis he emphasized that the pores are arranged in transverse rows and persisted in it against RALFS' critique (1848, p. 212). RALFS and also DE NOTARIS have found the pores arranged as a system of two oblique-crossing series of pores, a pattern that implies the vertical rows. Except for the pore arrangement *palangula* differs from *cucurbita* only by a greater ratio of length : breadth, thus, it could be regarded as a long variety of *cucurbita,* as KLEBS hos proposed.

KIRCHNER (1878) created var. *silesiacus* of *Calocylindrus* (*Penium*) *Cylindrus* and characterized it by its dense and irregular punctae, i.e. granules. SCHMIDLE (1893) and JOHNSON (1895) have used this name for a desmid with an evident isthmus-furrow. JOHNSON has depicted the pores and SCHMIDLE the granules, i.e. in this case the protruding pore-organels. Though KRIEGER has taken up these two pictures as belonging to *Penium cylindrus*, it seems inevitable to reject them as *Penium* and assign them to *Actinotaenium,* most probably to *A. palangula.*

19. ***Actinotaenium inconspicuum*** (W. WEST) comb. nov. Dim: 13—19(—30)×5—8. Fig. 57, 58.

Penium inconspicuum: W. WEST 1894, p. 4, Tab. 1: 6, 7. WEST 1896, p. 237, Tab. 12: 34, and 1904, p. 101, Tab. 10: 15—17. — *Dysphinctium inconspicuum:* LÜTKEMÜLLER 1905, p. 337. — *Cosm. bacillare*: LÜTKEMÜLLER 1910, p. 484. ALLORGE et MANGUIN 1941, p. 166, Fig. 17.

A. inconspicuum f. *bacillare* (ad interim): GRÖNBLAD 1921, p. 37, Tab. 1: 38. ALLORGE 1931, p. 353, Tab. 10: 19, 20. MESSIKOMMER 1928, p. 206, Tab. 8: 4, and 1943, Tab. 9: 18. KRIEGER 1932, p. 170, Tab. 9: 12. HUZEL 1936, p. 76, Tab. 9: 12. BOURRELLY 1952, p. 219, Tab. 28: 507 (f. *majus*).

W. WEST's species has a double-ovale shape but an other somewhat deviating form with the same dimensions has been published by several authors. This desmid has straight-sided, slightly conical semicells and, in certain cases, an internal apical papilla. It is recorded from different parts of the world and is uniform also in the dimensions. It makes the impression of a small form of *Pleurotaenium minutum* and may conveniently be called f. *bacillare* until its relations are quite known. It agrees with IRÉNÉE-MARIE's picture (1952, Tab. 2: 11, 12), labelled as *Penium crassum* var. *inflatum* but this author has in a letter told me that it should correctly be called *Pleurotaenium minutum* var. *crassum*.

LÜTKEMÜLLER (1910, p. 484) recorded a dwarf form of only 7 × 4.5 μ.

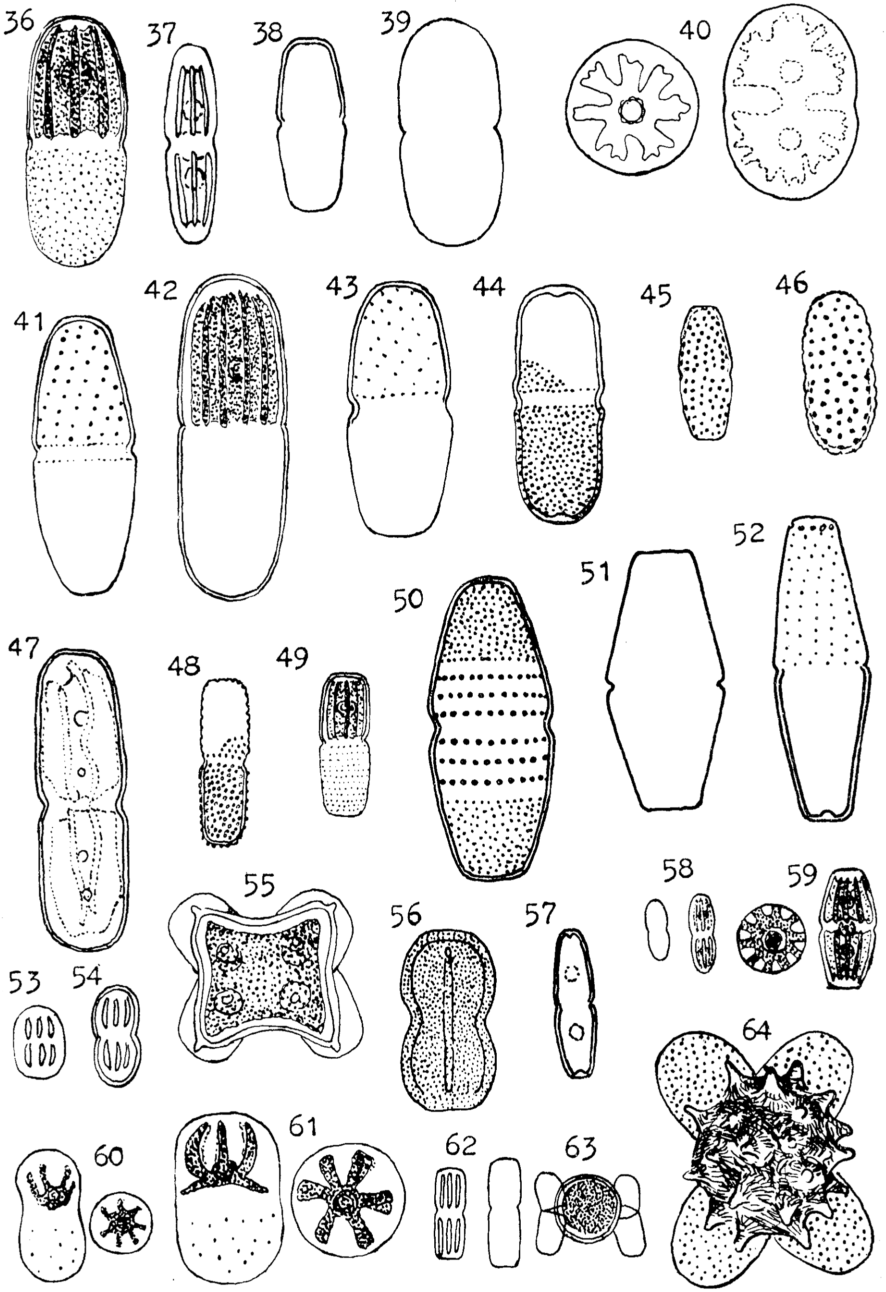
20. ***Actinotaenium truncatum*** (BRÉB.) comb. nov. Dim: 22—47 × 10—14. Fig. 62, 63.

Penium truncatum: RALFS 1848, p. 152, Tab. 25: 5 (c. zyg.). DELPONTE 1877, p. 181, Tab. 15: 37—39. NOTARIS 1867, p. 69, Tab. 8: 78. WOLLE 1884, p. 35, Tab. 5: 9, 10, and Tab. 5: 21, 22 (variety). COOKE 1886, p. 14, Tab. 17: 4. WEST 1904, p. 82, Tab. 8: 24—26. — *Pleurotaenium truncatum*: CLEVE 1863, p. 494. — *Cosm. abscissum* LÜTKEMÜLLER in manuscr.: KRIEGER 1935, p. 342.

Already RALFS described *Penium truncatum* to be "minutely dotted" and LÜTKEMÜLLER reported to G. S. WEST (in litt. 1911) that he had examined this desmid and had found its membrane to be porous, consequently belonging to *Cosmarium*. In KRIEGER (1935, p. 242) *Cosm. truncatum* is taken up as a synonym to *Cosmarium abscissum* LÜTK. LÜTKEMÜLLER had invented this name for *Penium truncatum* and in his manuscript he gives the diagnose: "Chloroplast axil mit 6 ganzrandigen Längsleisten. Von *Cosmarium Palangula* durch die parallelen nach oben nicht convergierenden Seiten, den abgestutzten Scheitel, durch die dünnere Zellhaut und die abweichende Verteilung der Poren unterschieden", (communicated by Dr. GRÖNBLAD). GRÖNBLAD has (1921, p. 29) described a *Cosm. abscissum*. As *Cosm. abscissum* LÜTK. is a *nomen nudum*, there may not be any confusion.

The zygospore is smooth and sphaerial (RALFS, WOLLE).

Figs. 36—64. — 36: *cucurbitinum* — 37: var. *angustatum* — 38: var. *subretusum* — 39: var. *minutum* — 40: *Wollei* — 41: *cucurbitinum* var. *subpolymorphum* — 42: var. *magellanicum* — 43: var. *truncatum* — 44: var. *Manguini* — 45: *adelochondrum* — 46: var. *Kriegeri* — 49: *palangula* — 47: var. *Wollei* — 48: var. *silesiacum* — 50: *sydneyense* — 51: *tumidum* — 52: var. *brasiliense* — 53: *Mooreanum* — 54: f. *constrictum* — 55: zygospore — 56: *viride* — 58: *inconspicuum* — 57: f. *bacillare* — 59: *obcuneatum* — 60: *perminutum* — 61: *subtile* — 62—63: *truncatum* — 64: *cucurbita*, zygospore.


36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64

Figs. 36—64.

21. ***Actinotaenium crassiusculum*** (DE BARY) comb. nov. Dim: 56—70×11—23. Fig. 77.

Penium crassiusculum: DE BARY 1858, p. 73, Tab. 5: 5—7. BÖRGESEN 1890, p. 931, Tab. 2: 1. LÜTKEMÜLLER 1900, p. 116, Tab. 6:2. BORGE 1906, p. 15, Tab. 1: 6. WEST 1904, p. 96, Tab. 8: 4, 5. DUCELLIER 1916, p. 56, Fig. 33—35. IRÉNÉE-MARIE 1952, p. 30, Tab. 4: 1. COOKE 1886, p. 44, Tab. 17: 17. — *Penium Brebissonii* var. *crassiusculum*: KLEBS 1879, p. 23, Tab. 3: 1. — *Cosm. crassiusculum*: INSAM und KRIEGER 1936, p. 98, Tab. 1: 5. ALLORGE et MANGUIN 1941, p. 168, Fig. 22.

This desmid was not transferred from *Penium* by LÜTKEMÜLLER in his revision of 1905, but he has later (in a letter to G. S. WEST) stated it a *Cosmarium* (the pores have been noted already by BÖRGESEN). Evidently the pores are more difficult to discern than on *palangula* and this circumstance may have caused these two so similar species to be assigned to different genera. The difference seems to lie mainly in the size; *crassiusculum* is, as a rule, longer, more than 50 μ compared with *palangula* that scarsely exceeds 50 μ.

DE BARY depicted a lateral nucleus, (repeated in WESTS' Monograph), a position that has not been verified by DUCELLIER. The chloroplast has 6—7 lamellae. ROY and BISSET (1894) have found the zygospore "similiar to that of phymatosporum but with angles less prominent and more round".

22. ***Actinotaenium Taylori*** (N. CARTER) comb. nov. Dim: 160—230×45—50. Fig. 65.

Cosm. Taylori: N. CARTER 1935, p. 169, Figs. 27, 28.

This interesting species has a scrobiculate cell wall, the upper third of the semicell bears pores in transversal and longitudinal rows with protruding pore-organels. In connection with the largeness of the cell the chloroplast has developed in a parietal direction; the edges of the lamellae are curled and laciniate. It contains several axile pyrenoids.

23. ***Actinotaenium cucurbita*** (BRÉB.) comb. nov. Dim: 29—51×15—24. Fig. 66.

Cosm. cucurbita: RALFS 1844, p. 395, Tab. 11: 10, and 1848, p. 108, Tab. 17: 7. KLEBS 1879, p. 28, Tab. 3: 8 b, c, g. SCHMIDLE 1894, p. 89, Tab. 6: 3. WEST 1908, p. 106, Tab. 73: 31—33. KRIEGER 1932, p. 174, Tab. 9: 16. TAYLOR 1934, p. 252, Tab. 51: 6. IRÉNÉE-MARIE 1939, p. 181, Tab. 22: 11. INSAM und KRIEGER 1936, p. 99, Tab. 1: 14. LHOTSKY 1948, p. 3, Tab. 2: 46. HUZEL 1936, p. 91, Tab. 11: 2, 3. BOURRELLY 1952, p. 219, Tab. 29: 532 (forma). SAMPAIO 1944, p. 350, Tab. 13: 37—39. — *Cosm. Palangula*: DE BARY 1858, p. 72, Tab. 6: 51. — *Dysphinctium Cucurbita*:

Grunow 1858, p. 500. Gutwinski 1909, p. 448, Tab. 7: 11 a (var. *inflatum*). — *Calocylindrus Cucurbita*: Kirchner 1878, p. 143. Cooke 1886, p. 125, Tab. 44: 7. W. West 1889, p. 18, Tab. 3: 15. — *Penium adelochondrum*: Kufferath 1914, p. 297, Fig. 8 (var. *punctatum*), and p. 298, Fig. 9 (var. *constrictum*).

f. *majus*. Dim: 60×30. W. West 1892, p. 162, Tab. 24: 25. West 1908, p. 107, Tab. 74: 2.

f. *minus*. Dim: 24×12. Bourrelly 1946, p. 93, Tab. 4: 52.

f. *minimum*. West 1895, p. 176.

f. *rotundatum*. Dim: 28×16. Krieger 1932, p. 174, Tab. 8: 13. van Oye 1953, p. 281, Fig. 65, and 1949, p. 295, Fig. 21. N. Carter 1920 a, p. 217, Tab. 10: 14, 15.

f. *latius*. Dim: 37—40×23—27. West 1908, p. 108, Tab. 74: 1. Insam und Krieger 1936, p. 99, Tab. 1: 6. Ducellier 1918, p. 123, Fig. 106. — *Calocylindrus Palangula* var. *rotundatus*: Istvanffi 1888, p. 288, Tab. 1: 21, 22. — *Cosm. Palangula*: Klebs 1886, p. 357, Tab. 2: 15. — *Cosm. conicum*: Gutwinski 1909, p. 492, Tab. 7: 16.

var. *attenuatum*. Dim: 24—46×15—23. Fig. 67—69. G. S. West 1904 b, p. 286, Tab. 464: 18. West 1908, p. 108, Tab. 73: 34—36. Lowe 1923, Tab. 3: 8. Allorge et Manguin 1941, p. 168, Tab. 26: 1—3. Grönblad 1938, p. 3, Fig. 8. Krieger 1944, p. 269, Fig. 45. Skuja 1949, p. 120, Tab. 26: 1, 2. Irénée-Marie 1952, p. 109, Tab. 10: 17. Sampaio 1944, p. 351, Tab. 13: 40, 41. — *Cosm. curtum*: Borge 1894, p. 22, Tab. 2: 17. — *Dysphinctium cucurbita* f.: Schmidle 1895, p. 347, Tab. 14: 16. Gutwinski 1909, p. 448, Tab. 7: 11 (var. *inflatum*). — *Cosm. Cucurbita*: Klebs 1879, p. 28, Tab. 3: 8 d. Manguin 1937, Tab. 2: 28. Messikommer 1943, Tab. 10: 5. Kossinskaja 1938, Tab. 2: 11. — *Cosm. Palangula*: van Oye 1952, p. 178, Fig. 35. — *Cosm. conicum*: West 1895, p. 71, Tab. 8: 12. Roubal 1947, p. 50, Tab. 5: 10 (var. *brevius*).

var. *robustum*. Dim: 63—65×30—33. Fig. 70. Krieger 1950, p. 40, Fig. 8.

Zygospores: West 1908, p. 166, Tab. 74: 3. Homfeld 1929, p. 41, Tab. 5: 54. Grönblad 1921, p. 53, Tab. 7: 63. Fritsch and Rich 1937, p. 184, Fig. 13: 1, Fig. nostr. 64. Skuja 1949, p. 120, Tab. 26: 3.

Judging from the many varieties and forms this species is very variable; next to *A. cucurbitinum* the most depicted species of *Actinotaenium*. Brébisson's main type is cylindrical with abruptly retuse ends but the attenuate type with more conical semi-cells and slightly rounded ends may be quite as prominent. Within these two types there is a great variation in the proportions and the size.

The Wests (1908, Tab. 73: 32) have depicted the chloroplast, showing lappets of the lamellae radiating from the pyrenoid. Already De Bary (1858, Tab. 6: 51), however, has depicted a typical stelloid chloroplast, a structure confirmed by N. Carter, Bourrelly, Klebs, and Huzel, the latter has described a parietal extension of the edges.

Mature zygospore have a globoid shape with conical verrucae, Fig. 64.

It is of interest that Krieger (1944) and Bourrelly (1952) have seen an internal apical papilla.

Cosm. conicum West seems to fall into one of the many forms of *cucurbita.* There is another desmid, *Dysphinctium conicum* TURNER, that may be assigned to *Actinotaenium,* see species inquirendae, p. 415.

24. ***Actinotaenium pseudocucurbita*** (BOURR.) comb. nov. Dim: 24×16. Fig. 31.

Cosm. pseudocucurbita BOURRELLY 1946, p. 96, Tab. 4: 50, 51.

It differs from *cucurbita* in the rectangular zygospore. The cells show a striking similiarity to *Calocylindrus Palangula* var. *rotundatus* ISTWANFFY (1888, Fig. 21) but this one is twice the size of *pseudocucurbita.*

25. ***Actinotaenium minutissimum*** (NORDST.) comb. nov. Dim: 12—19×9—11. Fig. 34, 35.

Penium minutissimum: NORDSTEDT 1873, p. 46, Tab. 1: 21. COOKE 1886, p. 95, Tab. 17: 10. WEST 1904, p. 81, Tab. 8: 20—23. N. CARTER 1922, p. 63, Tab. 4: 15. KRIEGER 1932, Tab. 7: 9. — *Cosm. nanum* LÜTKEMÜLLER (*in manuscr.*) GRÖNBLAD 1934, p. 269, Fig. 5: C. TAFT 1937, p. 402, Tab. 2: 15. — *Cosm. Luetkemuelleri*: GRÖNBLAD 1935, p. 4.

f. *majus.* Dim: 13—27×10—18. WILLE 1884, p. 48, Tab. 3: 9. BORGE 1903, p. 94, Tab. 1: 2.

Cell broad-ovale, without isthmal constriction, chloroplast with four lamellae (GRÖNBLAD, TAFT). BORGE has found a questionable forma *major* with a faint isthmus-furrow; it may be a small form of *A. cucurbitinum.*

The zygospore is lens-shaped with four rounded angles (NORDSTEDT, WILLE, KRIEGER, N. CARTER).

Var. *suboctangulare* (W. WEST) comb. nov. Dim: 14—16×10. Fig. 27.

Penium suboctangulare: W. WEST 1892, p. 128, Tab. 224: 20. WEST 1904, p. 81, Tab. 8: 14—19.

KRIEGER (1932, p. 242) has proposed that this desmid be assigned to *Mooreanum,* the latter, however, has the angles of the zygospore ending in a distinct papilla while the zygospore of *suboctangulare* has the angles cut off, giving it the shape of an octagon.

26. ***Actinotaenium Mooreanum*** (ARCH.) comb. nov. Dim: 17—26×11—15. Fig. 53, 55.

Penium Mooreanum: ARCHER 1864, p. 50, Tab. 1: 34—44. COOKE 1886, p. 44, Tab. 17: 5. SCHMIDLE 1893, p. 21, Tab. 3: 8, 9. WEST 1904, p. 80, Tab. 8: 8—10. GUTWINSKI 1907, p. 444, Tab. 7: 9 (zygospore). STRÖM 1923, p. 464, Tab. 12: 6. — *Penium pusillum*: DELPONTE 1877, p. 185, Tab. 15: 34—36. — *Dysphinctium cruciferum* var. *tatri-*

cum: GUTWINSKI 1909, p. 447, Tab. 7: 10. — *Dysphinctium Mooreanum*: LÜTKEMÜLLER 1905, p. 337. — *Cosm. Mooreanum*: LÜTKEMÜLLER 1910, p. 479. BORGE 1936, p. 35, Tab. 1: 21.

f. *constrictum*. Fig. 54. SCHMIDLE 1893, p. 21, Tab. 3: 10, 11, and 1897, p. 22, Fig. 3 (zygosp.). — *Penium sp.* BORGE 1930, p. 26, Tab. 1: 12, 13.

Penium sp. BORGE agrees well in the shape with slightly constricted shape, the size and the chloroplast.

Cell broad-oval or cylindrical with rounded ends. Chloroplast stelloid with six lamellae. Zygospore quadrangular with slightly constricted sides and one papilla on each angle.

27. ***Actinotaenium pyramidatum*** (W. et G. S. WEST) comb. nov. Dim: 34—49×22—26. Fig. 71, 72.

Cylindrocystis pyramidata: WEST 1902, p. 134, Tab. 18: 1, 2. WEST 1907, Tab. 13: 4, 5. — *Cosmarium cylindrocystiforme*: G. S. WEST 1912, p. 85. BOURRELLY 1952, p. 219, Tab. 29: 536. — *Penium pyramidatum* KRIEGER 1932, Tab. 7: 13.

This desmid is similar to a broad *curtum* but has a lobo-stelloid chloroplast. The zygospore is ellipsoidal and smooth.

Cosm. subpyramidatum (WEST) LÜTK. (WEST 1901, p. 78, Tab. 2: 8—11 and LÜTKEMÜLLER 1913, p. 228, Tab. 2: 28) is no doubt an *Actinotaenium* but as yet insufficiently known. The shape is of *curtum* type and very similar to that of *pyramidatum*. However, the diagnose does not mention anything about the chloroplast and WESTS' picture gives no information of it but a great pyrenoid. LÜTKEMÜLLER has examined WESTS' material and has stated the porous cell wall and the oval zygospore. In a picture, sent to G. S. WEST in 1912, he has depicted the contracted chloroplasts and they agree more with a lobo-stelloid chloroplast than with a stelloid one.

In spite of the somewhat smaller size and the still obscure chloroplast but according to the similiarity in shape and the identity of the zygospore, this desmid is likely to be united with *pyramidatum*. In this case the name *subpyramidatum* possesses priority.

28. ***Actinotaenium subpalangula*** (ELFV.) comb. nov. Dim: 25—34× 20—25. Fig. 12.

Cosm. subpalangula: ELFVING 1881, p. 14, Tab. 1: 11. BORGE 1906, p. 29, Tab. 2: 20. BORGE 1936, p. 37, Tab. 1: 18. WEST 1908, p. 109, Tab. 74: 7. — *Dysphinctium subpalangula*: DE TONI 1889, p. 882.

f. *depauperatum*: LAGERHEIM 1886, p. 47.

The barrel-shaped cell is very characteristic, compare *A. cucurbita* f. *latius*. The large pores are arranged in transverse rows, bearing protruding pore-organels. These may be lacking or overlooked; f. *depauperatum*. The chloroplast is lobo-stelloid.

DICK's *subpalangula* (1930, p. 41, Tab. 7: 12) differs in shape so much that BORGE (1936, p. 37) found it dubious. Probably these granules are true ones and not pore-organels. The circular form in end-view caused DICK to deny a connection with *Cosm. amoenum,* perhaps it may be a small form of *Cosm. elegantissimum* var. *simplicius,* compare IRÉNÉE-MARIE 1939, Tab. 30: 12.

29. ***Actinotaenium subtile*** (W. et G. S. WEST) comb. nov. Dim: 14—18×10—12. Fig. 61.

Penium subtile: WEST 1897 a, p. 479, Tab. 6: 8, 9. WEST 1904, p. 92, Tab. 8: 27—29. — *Dysphinctium subtile*: LÜTKEMÜLLER 1905, p. 336. — *Cosm. subtile*: LÜTKEMÜLLER 1910, p. 494. BEYERINCK 1926, p. 50, Tab. 8: 165. BORGE 1936, p. 38, Tab. 1: 26. ALLORGE 1931, p. 361, Tab. 10: 27, 28. *Cosm. cruciferum*: BORGE 1930, p. 32, Tab. 1: 21—23. BORGE 1936, p. 32, Tab. 1: 22. SKUJA 1934, p. 69, Fig. 97.

var. *subsparsepunctatum*: GRÖNBLAD 1921, p. 38, Tab. 7: 34—37.

This desmid has a very simple shape, broad-oval with obtuse ends and a faint isthmus-furrow. It is distinguished from similar desmids by the lobo-stelloid chloroplast with 5—7 lobes, carefully depicted by GRÖNBLAD. On stained specimens BORGE has observed the pore-organels.

Desmids published as *Cosm. cruciferum* by SKUJA and BORGE are probably to be assigned to *subtile* because of the lobo-stelloid chloroplast. SKUJA, however, has (p. 69) mentioned that the cell-division is performed in the simple manner, characteristic of the saccoderms, *Penium* and *Closterium*. If this observation is confirmed, his desmid must be placed with the saccoderms, nearest to *Cylindrocystis*.

30. ***Actinotaenium perminutum*** (TURNER, G. S. WEST) comb. nov. Dim: 10—14×5—8. Fig. 60.

Cylindrocystis minutissima: TURNER 1892, p. 16, Tab. 1: 24. WEST 1904, p. 62, Tab. 5: 9. HUZEL 1936, p. 75, Tab. 19: 18. TAFT 1937, p. 402, Tab. 2: 24. — *Cosm. perminutum*: G. S. WEST 1914, p. 1041. GRÖNBLAD 1921, p. 37, Tab. 7: 39—41. — *Cosm. pseudarctoides*: STRÖM 1920, p. 31, Tab. 3: 7, 8. — *Cosm. pseudarctoum* var. *perminutum*: BOURRELLY 1946, p. 496, Tab. 8: 71.

Cell guitar-shaped in front view, chloroplast lobo-stelloid with 4—7 lobes.

31. *Actinotaenium viride* (CORDA) comb. nov. Dim: 40—65×20—36. Fig. 56, 73.

Colpopelta viridis: CORDA 1835, p. 206, Tab. 2: 28. — *Cosm. Colpopelta*: BRÉBISSON 1861, p. 734. — *Cosm. Cordanum*: RABENHORST 1858, p. 177. TURNER 1885, p. 954, Tab. 4: 15. BORGE 1906, p. 36, Tab. 2: 21. WOLLE 1887, Tab. 40: 28. — *Cosm. viride*: JOSHUA 1885, p. 34, Tab. 254: 3. WEST 1895, p. 71, Tab. 9: 27, and 1908, p. 113, Tab. 74: 16—18. BORGE 1928, p. 101, Tab. 1: 15. KRIEGER 1932, p. 190, Tab. 8: 11. TAYLOR 1934, p. 272, Tab. 50: 14, and Tab. 55: 8. INSAM und KRIEGER 1936, p. 111, Tab. 1: 9. SAMPAIO 1944, Tab. 13: 45—48. — *Dysphinctium Cordanum*: HANSGIRG 1888, p. 186. — *Dysphinctium viride*: DE TONI 1884, p. 885. — *Cylindrocystis* (?) *depressa*: TURNER 1892, p. 16, Tab. 7: 11. — *Calocylindrus diplosporus*: WILLE 1884, p. 56, Tab. 12: 8. — *Dysphinctium globosum* var. *subviride*: SCHMIDLE 1893, p. 24, Tab. 6: 13, and 1894, p. 51, Tab. 7: 7 (*Cosm. moniliforme* f. *subviride*).

f. *minus*. Dim: 31—33×18—19. W. WEST 1892, p. 161. MASKELL 1888, p. 15, Tab. 2: 20 (Fig. sinistr.). WEST 1907, p. 205, Tab. 13: 12 (var. *truncatum*), and 1908, p. 113, Tab. 74: 19.

This desmid is one of the first distinguished as a picture (Fig. 56) given by CORDA (1835, p. 206, Tab. 2: 25) with explanation, under the name of *Colpopelta viridis*. There may be little doubt that CORDA's "animalcule" is a desmid, though he has seen both "bouche" and "tube alimentaire". He mentioned the content as green and the skin as rough. Since then it has been found and depicted by several botanists, all of them showing the guitar-shape with rounded or retuse ends in front view and (sometimes) also the circular end view. As regards the chloroplast nothing was mentioned, but SKUJA (1934, p. 76) has given a description: a central core with a large pyrenoid and numerous radiating lappets with somewhat thickened ends, i.e. a lobo-stelloid chloroplast.

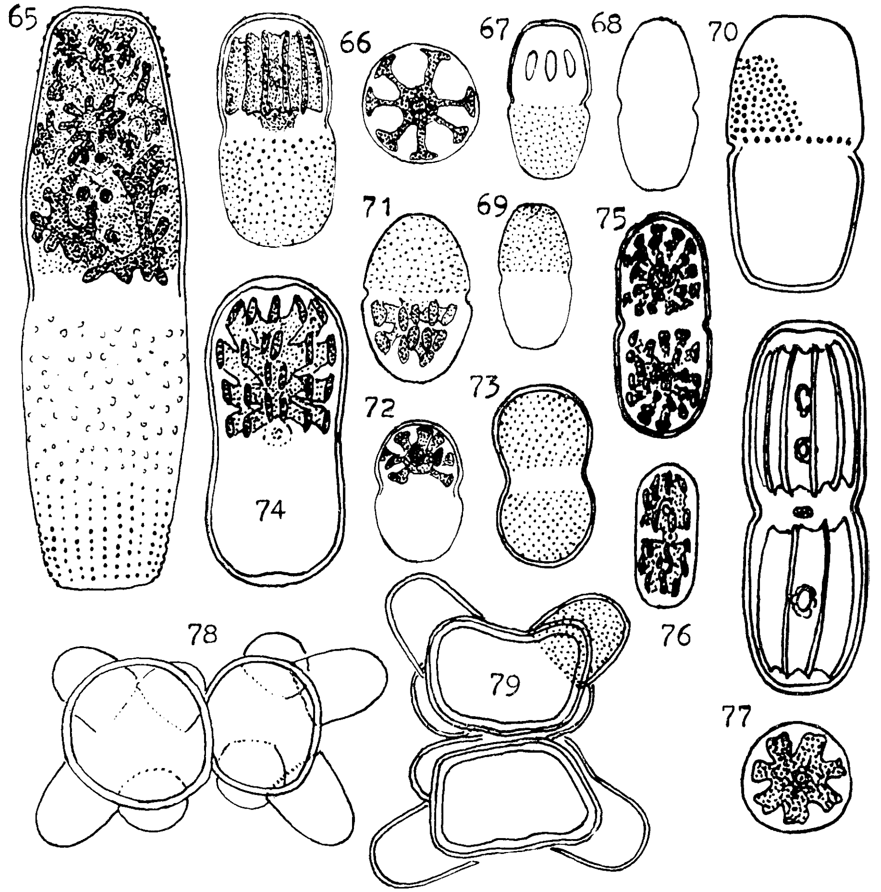
The var. *truncatum* and f. *glabrum* WEST are omitted; the separating characters are of no biosystematical interest. Perhaps *Dysphinctium inferum* TURNER (1892, p. 40, Tab. 1: 21) and *Penium* sp. FRITSCH (1912, p. 20, Tab. 3: 45, 46) belong to f. *minus*.

It is impossible to distinguish outline pictures of *viride* from certain desmids described as *Cosm. moniliferum* var. *panduriforme* and *Cosm. globosum*, which, however, have a furcoid chloroplast, the lamellae having entire edges.

Cosm. viride var. *compressum* TAFT (1945, p. 200, Tab. 3: 37, 38) is not *viride* because of the biradiate shape and the granulate cell wall.

32. *Actinotaenium diplosporum* (LUND.) comb. nov. Dim: 60—72×28—29. Fig. 74.

Cylindrocystis diplospora: LUNDELL 1871, p. 83, Tab. 5: 7 (c. zyg.). NORDSTEDT 1888, p. 72, Tab. 7: 25. BORGE 1891, p. 13, Fig. 11. TURNER 1892, p. 16. Tab. 7: 8.



Figs. 65—79. — 65: *Taylori* — 66: *cucurbita* — 67—69: var. *attenuatum* — 70: var. *robustum* — 71—72: *pyramidatum* — 73: *viride* — 74: *diplosporum* — 75: var. *americanum* — 76: f. *minus* — 77: *crassiusculum* — 78: *cucurbitinum*, zygospore — 79: *diplosporum* var. *americanum* f. *minus*, zygospores.

West 1904, p. 61, Tab. 4: 40, 41 (c. zyg.). G. S. West 1916, p. 306, Fig. 230 I. Ducellier 1916, p. 50, Fig. 27 (zyg.). Taylor 1934, p. 240, Tab. 45: 8. — *Penium diplosporum*: Jacobsen 1874, p. 161. — *Cosm. cordanum*: W. West 1889, p. 18, Tab. 3: 23. — *Cosm. diplosporum*: Lütkemüller 1913, p. 227, Tab. 2: 27. N. Carter 1920, p. 271, Tab. 10: 21. Allorge 1841, p. 355, Tab. 8: 9 (c. zyg.). — *Cosm. pseudohibernicum*: Lütkemüller 1910, p. 492, Tab. 2: 27. — *Cosm. hibernicum:* Grönblad 1920, p. 42, Tab. 5: 21, 22. — *Cosm. viride*: Irénée-Marie 1939, p. 182, Tab. 21: 16, and Tab. 24: 14, and 1948, p. 173, Tab. 3: 7. — ?*Schizospora pachyderma*: Reinsch 1875, p. 87, Tab. 17: 1.

f. *minus*. Dim: 31—43×15—17. — *Cylindrocystis americana* var. *minor*: Irénée-Marie 1839, p. 377, Tab. 66: 1, 2. *Cosm. quadratum* f. *cylindricum*: Eichler 1894, p. 126, Tab. 2: 15.

f. *majus*. Dim: 102—150×47—55. — *Cylindrocystis diplospora* ssp. *major* f. *constricta*: WEST 1894, p. 4, Tab. 1: 9 a. *Cylindrocystis diplospora* var. *major*: WEST 1904, p. 61, Tab. 4: 43. — *Cosm. diplosporum* var. *majus*: ALLORGE 1931, p. 355, Tab. 8: 10 (c. zyg.). IRÉNÉE-MARIE 1949, p. 255, Tab. 1: 7. SKUJA 1949, p. 122, Tab. 26: 11 (var. *majus*!).

The pictures of this desmid show in front view 2 types: one is slightly guitar-shaped and the other almost cylindrical. The former is LUNDELL'S type form. It somewhat resembles *A. viride* but has a broader isthmal part, more obtuse ends and, in most pictures, the internal apical papilla. I have used this papilla as a distinguishing character against *viride* and also against var. *americanum*. In the list above only IRÉNÉE-MARIE'S picture in 1939, Tab. 21: 16 has the shape and size of *viride,* while his f. *typicum* is typical *diplosporum*.

A. diplosporum has, as *viride,* a lobo-stelloid chloroplast, described by LÜTKEMÜLLER and N. CARTER and unmistakeably depicted already by LUNDELL.

The double zygospore, depicted by several authors, consists of two squares with rounded, somewhat bulged angles. SKUJA (1949) found azygospores and zygospores of normal type, both formed by the cylindrical type without apical papilla. The cylindrical type agrees very well with:

var. *americanum* (W. et G. S. WEST) comb. nov. Dim: 52—64×22—26. Fig. 75. — *Cylindrocystis americana*: WEST 1898, p. 281, Tab. 18: 5, 6. CUSHMAN 1904, p. 161, Tab. 7: 3. TAYLOR 1934, p. 239, Tab. 45: 9. IRÉNÉE-MARIE 1948, p. 47, Tab. 2: 17. — *Cylindrocystis diplospora*: EICHLER 1893, p. 163, Tab. 10: 32. SKUJA 1949, p. 122, Tab. 25: 10, and Tab. 27: 11, 12 (spor.). HOMFELD 1927, p. 43, Tab. 6: 57 (spor.). KRIEGER 1933, p. 70, Fig. 25 F.

f. *minus* nob. Dim: 31—40×14—18. Fig. 76. — *Cylindrocystis americana* var. *minor*: CUSHMAN 1905, p. 582, Tab. 26: 1. IRÉNÉE-MARIE 1939, p. 37, Tab. 9: 6, 7. *Cylindrocystis diplospora* f. *intermedia*: SCHMIDLE 1894, p. 50, Tab. 7: 9. *Cosm. illudens* LÜTKEMÜLLER mscr.

f. *majus*. Dim: 88—103×43—48. — *Cylindrocystis diplospora* var. *major*: W. WEST 1892, p. 131, Tab. 20: 5. WEST 1904, p. 61, Tab. 4: 42, and 1907, p. 190, Tab. 13: 1. — *Cosm. diplosporum* var. *majus*: HOMFELD 1927, p. 43, Tab. 6: 58, 59.

The structure of the cell wall is not known well enough to establish the placoderm character, but points of agreement with other desmids transferred from *Cylindrocystis* to the *Placodermae* are enough to assign it to *Actinotaenium*. Several scientists have depicted the porous cell wall, e.g. WEST 1907, ALLORGE, SKUJA.

According to WEST, this variety is cylindrical with rounded ends and has no apical papilla. The few statements of the dimensions hint a size somewhat smaller than *A. diplosporum.* The chloroplast is lobostelloid.

Lütkemüller has (according to letters to Nordstedt in 1911 and to G. S. West in 1912) studied a desmid of somewhat smaller size and the same shape, although without isthmus-furrow, and laciniate stelloid chloroplast, which he considered a new species: *Cosm. illudens* Fig. 79. It forms double zygospores of exactly the same type as *diplosporum* formed by four mother-cells. In his picture the apical papilla is lacking. This desmid is here ranged in var. *americanum* f. *minus.*

Of the pictures of *A. diplosporum* var. *majus* and f. *intermedium,* some show the apical papilla, others do not. According to the proposed division of this species they are assigned to *diplosporum* and var. *americanum.*

Note about Penium didymocarpum Lund.

Krieger has (1934, p. 241) recommanded *Penium didymocarpum* to be a synonym of *Cosm. diplosporum. Didymocarpum,* however, is a true *Penium* according to Lütkemüller (1905, p. 337). After extended studies on this genus, L. communicated (in a letter to G. S. West in 1911), that the cell wall of *Penium didymocarpum* has no pores but longitudinal rows of small granula, visible after staining, quite as other *Penia.* He also sent a picture of the microstructure of *Penium polymorphum, didymocarpum, phymatosporum* and his *incurvum* n.sp. mscr. Thus, the uniting of *didymocarpum* with *diplosporum* must be considered incorrect.

Unsufficiently known desmids probably belonging to Actinotaenium.

Penium australe Raciborski (1892, p. 7, Tab. 6: 11). The porous cell wall, depicted by Raciborski, G. S. West (1907, p. 108, Tab. 6: 3, 4), West (1897 c, Tab. 8: 6) confirms the placoderm character. No information of the chloroplast is given, but Playfair (1907, p. 168, Tab. 2: 5) recorded, under this name, a similar with slightly attenuate semicells that has 6—8 lamellae and one great pyrenoid. On the other side, Playfair (1914, p. 98, Tab. 3: 2) found a dicentric f. *crassius.*

Penium bisporum Turner (1892, p. 17, Tab. 1: 10). This is only a peculiar double spore with four adhering semicells and belongs to *Cosmarium* according to Krieger (1933, p. 24).

Dysphinctium conicum Turner (1892, p. 43, Tab. 1: 26) not identical with *Cosm. conicum* West, here assigned to *cucurbita* var. *attenuatum*.

Dysphinctium dubium Turner (1892, p. 40, Tab. 1: 2). The diagnose is incomplete, nothing about the end-view or the chloroplast. Skuja (1949, p. 122, Tab. 26: 15) has depicted it with a lobo-stelloid chloroplast. Bernard (1908, p. 91, Tab. 6: 121) has, with a ?, submitted a *Cosm. dubium* n.sp. of a quite different kind. Diagnosis unsufficient.

Dysphinctium exile Turner (1892, p. 40, Tab. 1: 21*). The shape suggests a small *curtum*.

Penium granulatum (Bennett) West (1904, p. 87, Tab. 8: 39) reminiscent in shape and size of Schmidle's *Penium cylindrus* var. *silesiacum*, here labelled as *palangula* var. *silesiacum*.

Dysphinctium inferum Turner (1892, p. 40, Tab. 1: 21) reminiscent in shape of *cruciferum*, nothing about the chloroplast.

Cosmarium globosum Buln. p.p. This desmid was originally described as biradiate and even triradiate (Wille 1879, Tab. 13: 41), but there are also desmids of the shape of *globosum* in front-view, that modern desmidiologists have described as quite circular in end-view. In the cases where the chloroplast is described as stelloid or lobo-stelloid, these desmids must be taken into consideration as belonging to *Actinotaenium*. The desmids described by West (1909, p. 29, Tab. 68: 1, 2), Irénée-Marie (1939, p. 174, Tab. 21: 14), Bourrelly (1952, p. 220, Tab. 29: 533, 534), Borge (1894, p. 23, Tab. 12: 20), Insam und Krieger (1936, p. 100, Tab. 5: 10), Schmidle (1893, p. 24, Tab. 6: 13) are examples of this category. This point of view is also applicable to *Cosm. subarctoum*, from which some forms have been transferred to *cruciferum*.

Cosm. hibernicum W. West (1892, p. 163, Tab. 21: 19). This desmid is similar to *viride* in the shape but is twice the size. Most striking are the irregularly disposed taenio-parietal chloroplasts. In West 1909, Tab. 74: 21, W. West's picture is retoushed with regularly disposed chloroplasts. Probably the chloroplast is stelloid and erroneously interpreted. The desmid is found only in one locality. Grönblad's supposed *hibernicum* (1920, p. 42, Tab. 5: 21, 22) is in shape and dimensions *diplosporum*.

Pleurotaenium minutum var. *crassum* W. West may contain transitional forms to *Actinotaenium*, e.g. Irénée-Marie (1952 a, p. 21, Tab. 1: 2) and (1952, Tab. 2: 11, 12) under the name of *Penium crassum*.

Cylindrocystis roseola Turner (1893, p. 436, Fig. 18).

Penium pachydermum Playfair (1907, p. 166, Tab. 2: 6), *Dysphinctium Thwaitesii* var. *incrassatum* f. *tatricum* Gutwinski (1909, p. 444,

Tab. 7: 12), *Cylindrocystis diplospora* (?) CEDERGREN (1932, p. 224, Tab. 1: 1). — The two latter are very similar in shape with their thick walls (teratological?), they are reminiscent of *cucurbita*.

Cosm. Schomburgkii BORGE (1800, p. 21, Tab. 1: 24) is a large desmid with semicells circular in front-view as in end-view and open acute sinus. Nothing about the chloroplast. It seems to agree well with *turgidum* var. *subrotundatum*.

Penium (?) *sibiricum* BOLDT (1885, p. 120, Tab. 6: 43). Only the tetraedrical zygospore with each angle ending in a short spine and adherent semicells of the mother cells are found. It is very similar to the zygospore and also to the semicells of *Closterium navicula*, compare FRITSCH and RICH (1937, p. 165, Fig. 3 A). These authors state that many of the specimens had broader and more truncate ends than usual, a circumstance agreeing with BOLDT's picture. KRIEGER (1933, p. 242) declared it to be a *Cosmarium*.

Cylindrocystis diplospora var. *stenocarpa* SCHMIDLE (1898 a, p. 16, Tab. 1: 10). LÜTKEMÜLLER (1913, p. 228) considered it a separate species.

Penium subrufescens BORGE (1918, p. 13, Tab. 1: 6).

Cosm. subpyramidatum (WEST) LÜTK., see p. 409.

Cosm. subtilissimum G. S. WEST (1914, p. 1041, Tab. 22: 45) is an *Actinotaenium* of *cucurbita*-type but only 15 μ long. The chloroplast is single with an isthmal pyrenoid. Such a reduction occurs in small desmids, e.g. *subtile*.

Cosm. Thwaitesii (BORGE 1899 a, p. 762, Fig. 6) is a double-oval desmid, circular in end-view, by BORGE compared with *cucurbitinum* var. *scoticum* W. WEST.

Rejected species.

There are also many species of the *Dysphinctium*-type that are similar to certain species of *Actinotaenium*. They can be ranged in three groups:

A. Those that have a deep or narrow sinus. They are dealt with in the introduction.

B. Desmids of globoid shape and a faint, open sinus. In this group there are several desmids with circular cross-section. Their pseudo-omniradiate nature is reveiled by the chloroplast, dealt with in the introduction and TEILING 1952.

Dicentric chloroplast occur for instance in *Cosm. Rehmanii* GUTWINSKI (1909, p. 449, Tab. 7: 13), *Cosm. Westii* BERNARD (1908, p. 91,

Tab. 6: 120) and Skuja (1949, p. 145, Tab. 26: 6, 7), *Cosm. connatum* Bréb. (in most figures broad ovale), *Cosm. Printzii* Borge (1921, p. 16, Tab. 1: 7).

Tetracentric: *Cosm. pseudoconnatum* Nordst., *Cosm. alpestre* Roy et Biss. according to Cosandey (1934, p. 453), *Cosm. zonarium* West, if Bernard's var. *latius* (1909, p. 40, Tab. 3: 56) belongs to *zonarium*.

C. Desmids of baculiform shape.

Cosm. Thwaitesii Ralfs has been the incorrect name of several desmids, now in *Actinotaenium*. It has a broadly oval end-view and is dicentric (Klebs 1879, Tab. 3, 5). *Cosm. Debaryi* Arch. contains some quasi-omniradiate forms with a small, open sinus. *Cosm. gonioides* West is sometimes depicted as almost circular in end-view. *Cosm. anceps* Lund. has a front-view, almost exactly like *Act. obcuneatum*, it has, however, a very characteristic biradiate end-view. *Cosm. variabile* Maskell (1888, Tab. 2: 15) is clearly biradiate.

D. *Dysphinctium sparsepunctatum* Schmidle (1895, p. 348, Tab. 15: 1—6) is very similar to *subtile* but is according to the diagnosis elliptical in end-view.

The figures are drawn after pictures from papers of the following authors:

Bisset: 4, 36.
Borge: 8, 42.
Bourrelly: 3, 15, 31, 57, 71.
Carter: 65.
Cedergren: 14.
Corda: 56.
Delponte: 26.
Dick: 19.
Elfving: 12, 45.
Fritsch and Rich: 64.
Grönblad: 5, 17, 37, 40, 60, 61, 77 (orig.).
Gutwinski: 13, 55.
Huzel: 66.
Johnson: 33.
Joshua: 29, 80.
Krieger: 2, 20, 21, 32, 41, 43, 52, 59, 70.
Lundell: 10.
Lütkemüller: 74, 76 (orig.), 78, 79.
Manguin: 44.
Messikommer: 22, 38, 39, 46.
Nordstedt: 18, 35.
Nägeli: 1.
Raciborski: 50.
Schmidle: 7, 48, 53, 54, 67.
Skuja: 6, 25, 36.
Taylor: 16, 34, 47.
Turner: 23, 73.
West: 9, 11, 24, 27, 28, 49, 58, 62, 63, 68, 69, 72, 75.
Wolle: 51.

I owe Miss Hannah Croasdale and Dr. Rolf Grönblad my sincere thanks, the former for the Latin diagnose and correcting the manuscript, the latter for valuable informations.

Literature cited.

ALLORGE, V. et P. 1931: Hétérocontes, Euchlorophycées et Conjugées de Galicie. — Revue Algologique 5.

ALLORGE, P. et MANGUIN, E. 1941: Algues d'eau douce des Pyrénées basques. — Bull. Soc. bot. France 88.

ARCHER, W. 1864: Descriptions of a new species of *Cosmarium* (CORDA) and of *Penium* (BRÉB.). — Quat. Journ. micr. Soc. 4.

DE BARY, A. 1858: Untersuchungen über die Familie der Conjugaten. — Leipzig.

BECK-MANNAGETTA, G. 1929: Neue Grün- und Blaualgen aus Kärnten und den Sudeten. — Arch. Protistenkunde 66.

BEIJERINCK, W. 1926: Over Verspreiding en Periodicitet van de Zoetwaterwieren. — Verh. K. Akad. Wet. Amsterdam 25: 2.

BENNETT, A. W. 1887: Fresh-water Algae of North Cornwall. — Journ. Roy. Micr. Soc. 1887.

BERNARD, CH. 1909: Algues unicellulaires d'eau douce récoltées dans le domaine malais. — Dept. agricult. Indes Néerlandaises.

BISSET, J. R. 1884: List of Desmidieae, found in gatherings made in the neighbourhood of Lake Windermere. — Journ. Roy. Micr. Soc. 4.

BOLDT, R. 1885: Bidrag till kännedomen om Sibiriens Chlorophyllophycéer. — Öfvers. K. Vet. Ak. förhandl.

BORGE, O. 1891: Ett litet bidrag till Sibiriens Chlorophyllophycéenflora. — Bih. K. Vet. Akad. handl. 17: III: 2.

— 1894: Süsswasser-Chlorophyceen, gesammelt von Dr. A. Osw. Kihlman in nördlichsten Russland, Gouvernement Archangel. — Ibid. 19: III: 5.

— 1899: Ueber tropische und subtropische Süsswasser-Chlorophyceen. — Ibid. 24: III: 12.

— 1899 a: Süsswasseralgen von Franz Josephs Land, gesammelt von der Jackson-Harmworth'schen Expedition. — Öfvers. K. Vet. Akad. Förhandl. 1899 nr 7.

— 1901: Süsswasseralgen aus Süd-Patagonien. — Bih. K. Vet. Akad. Handl. 27: 10.

— 1903: Die Algen der ersten Regnellschen Expedition, II, Desmidiaceen. — Arkiv f. Bot. 1. Stockholm.

— 1906: Beiträge zur Algenflora von Schweden. — Ibid. 6.

— 1911: Die Süsswasseralgenflora Spitzbergens. — Widenskabs-selsk. skrifter. I: 11. Kristiania.

— 1918: Die von Dr. A. Löfgren in Sao Paolo gesammelten Süsswasseralgen. — Ark. f. Bot. 15: 3.

— 1921: Die Algenflora des Tåkernsees. — Sjön Tåkerns fauna och flora n:o 4.

— 1923: Beiträge zur Algenflora von Schweden 3. — Ark. f. Bot. 18: 10.

— 1928: Süsswasseralgen (in Zellpflanzen Ostafrikas). — Hedwigia 68.

— 1930: Beiträge zur Algenflora von Schweden 4. — Ark. f. Bot. 23: 12.

— 1936: Beiträge zur Algenflora von Schweden 5. — Ibid. 28: 6.

BOURRELLY, P. (et R. LEBOIME), 1946: Notes sur quelques Algues d'eau douce de Madagascar. — Biol. Jaarboek, Dodonaea, 13.

— (et E. MANGUIN), 1946 a: Contribution à la Flore algale d'eau douce des Azores. — Mem. Soc. de Biogeographie 8.

— — 1949: Contribution à l'étude de la flore algale d'eau douce de Madagascar. — Mem. Inst. Sci. Madagascar, ser. B, II: 2.

— — 1952: Algues d'eau douce de la Guadeloupe. — Paris.

BRÉBISSON, A. 1856: Liste des Desmidiées observées en Basse-Normandie. — Paris.

— 1861: in Pritchard's History of the Infusoria, ed. 4. — London.

BÖRGESEN, F. 1890: Desmidieae (in Symb. flor Brasiliae centr. cognosc). — Videnskapl. Meddel. fra naturh. Forening. Köbenhavn.

CAMP, W. H. 1951: Biosystematy. — Brittonia 7: 3.

CARLSSON, G. W. 1913: Süsswasseralgen aus der Antarctis, Südgeorgien und den Falklandinseln. — Wiss. Erg. schwed. Südpolarexp. 1901—03. 34.

CARTER, NELLIE 1920: Studies on the Chloroplast of Desmids III. — Ann. of Bot.

— 1922: Freshwater Algae from New Caledonia and the Isle of Pines. — Linn. Soc. Journal 46. London.

— 1935: Alpine desmid flora of British Columbia. — Ibid. 50.

CEDERGREN, G. 1932: Die Algenflora der Provinz Härjedalen. — Ark. f. Bot. 25 A: 4.

CLEVE, P. T. 1864: Bidrag till kännedomen om Sveriges sötvattensalger af familjen Desmidieae. — Öfvers. K. Vet. Ak. Förh. 20.

COMÈRE, J. 1899: Conjugées des environs de Toulouse. — Bull. Soc. bot. France 46.

CORDA, A. J. 1835: Observations sur les animalcules microscopiques. — Almanach de Carlsbad.

COSANDEY, F. 1934: Contributions à la connaissance des Desmidiacées des environs de Sainte-Croix. — Mem. Soc. Vaudoise Sci. Nat. 31.

CUSHMAN, J. A. 1904: Desmids from South Western Colorado. — Bull. Torrey bot. Club 31.

— 1904 a: Desmids from New Foundland. — Ibid. 32.

— 1905: A contribution to the Desmid flora of New Hampshire. — Rhodora 7.

— 1905 a: Notes on the zygospores of certain New England desmids. — Bull. Torrey bot. Club 32.

— 1906: New England desmids of the subfamily Saccodermeae. — Ibid. 33.

DELPONTE, J. B. 1877: Specimen Desmidiacearum subalpinarum II. — Turin.

DICK, J. 1923: Beiträge zur Kenntnis der Desmidiaceenflora von Süd-Bayern II. — Botan. Archiv III.

DUCELLIER, F. 1916: Contribution à l'étude de la flore desmidiologique de la Suisse I. — Bull. Soc. bot. Genève. 7.

— 1918: Contributions etc. II. — Ibid. 10.

EICHLER, B. 1894: Materialy do Flory wodorostow okolic Miedzyrzecza. — Pamietnik Fizyjo-graficzny 12.

— 1894: Materialy do Flory etc. — Ibid. 13.

ELFVING, F. 1881: Anteckningar om finska desmidiéer. — Acta Soc. fauna flora Fennica II: 2.

ESPENSCHIED, E. 1903: Die Desmidiaceen des bergischen Landes. — Jahresber. naturf. Ver. Elberfeld.

FRITSCH, F. E. 1912: Freshwater Algae. — National Antarctic Expedition 4.

— and RICH, F. 1937: Algae from the Belfast Pan, Transvaal. — Trans. Roy. Soc. South Africa 25: 2.

GAY, F. 1884: Essai d'une Monographie locale des Conjugées. — Montpellier.

GISTL, R. 1914: Beiträge zur Kenntnis der Desmidiaceenflora der Bayrischen Hochmoore. — Diss. München.

— 1927: Beobachtungen über die Desmidiaceenflora der Moore um Kirchsee. — Kryptog. Forsch. Bayer. bot. Ges. München 7.

GRUNOW, A. 1858: Die Desmidiaceen und Pediastreen einiger österreichischen Moore. — Verh. zool. bot. Ges. Wien.

GRÖNBLAD, R. 1920: Finnländische Desmidiaceen aus Keuru. — Acte Soc. Fauna. Flora Fennica 47.

— 1921: New Desmids from Finland and Northern Russia. — Ibid. 49.

— 1924: Observations on some Desmids. — Ibid. 55.

— 1934: A short report of the Freshwater Algae recorded from the neighbourhood of the zoological Station at Tvärminne. — Mem. Soc. Faun. Flor. Fennica 10.

— 1935: Subaerial Desmids II. — Soc. Sci. Fenn. Comm. biol. 5: 4.

— 1939: Algologische Notizen III. Desmidiaceen aus Lunz, Niederösterreich. — Ibid. 7.

— 1945: De algis Brasiliensibus, praesipue Desmidiaceis. — Acta Soc. Sci. Fenn. Nov. ser. B, II: 6.

— 1947: Desmidiaceen aus Salmi. — Ibid. 66: 1.

GUTWINSKI, R. 1896: De nonnullis algis novis. — Acta Acad. Krakow 33.

— 1902: De Algis a Dr:e M. RACIBORSKI anno 1899 in insula Java collectis. — Bull. Acad. sci. Cracoviae.

— 1909: Flora Algarum montium Tatrensium. — Bull. Acad. Sci. Cracovie.

HANSGIRG, A. 1888: Prodromus der Algenflora von Böhmen II. — Prag.

HEIMERL, A. 1891: Desmidiaceae alpinae. — Verh. zool.-bot. Ges. 41.

HIRN, K. E. 1903: Zur Kenntnis der Desmidiaceen Finnlands. — Acta Soc. fauna flora Fennica 25: 3.

HOMFELD, H. 1929: Beitrag zur Kenntnis der Desmidiaceen Nordwestdeutschlands. — Pflanzenforschung 12.

HUZEL, C. 1936: Beitrag zur Kenntnis der microskopischen Pflanzenwelt der Rauhen Wiese. — Veröff. Württ. Landesstelle f. Naturschutz 13.

INSAM, I. und KRIEGER, W. 1936: Zur Verbreitung der Gattung Cosmarium in Südtirol. — Hedwigia 76.

IRÉNÉE-MARIE 1939: Flore desmidiale de la région de Montreal. — Laprairie.

— 1948: Contributions à la connaissance des Desmidiées de la région des Trois-Rivières III. — Le Naturalist Canadian 75.

— 1949 a: Contribution etc. V. — Ibid. 76.

— 1949: Quelques Desmidiées du Lac Mistassini. — Ibid. 76.

— 1952: Contribution à la connaissance des Desmidiées de la région du Lac-St. Jean. — Hydrobiologica 1952.

— 1952 a: Desmidiées de la Region de Quebec IV. — Le Naturalist Canadien 79.

ISTVANFFI, G. 1888: Algologische Untersuchungen der Torfbildungen in Ober-Ungarn (in Hungarian language). — Budapest.

JACOBSEN, J. P. 1874: Apercu systematique et critique sue les Desmidiacées du Danemark. — Botanisk Tidskrift, Köbenhavn.

JOHNSON, L. N. 1894: Some new and rare Desmids of the United States I. — Bull Torr. bot. Club 21.

— 1895: Some new etc. II. — Ibid. 22.

JOSHUA, W. 1885: Burmese Desmidieae. — Journ. Linn. Soc.-Bot. 21.

KIRCHNER, O. 1878: Kryptogamen-Flora von Schlesien II: 1. — Breslau.

KLEBS, G. 1879: Ueber die Formen einiger Gattungen der Desmidien Ostpreussens. — Schriften Physikal.-ökonom. Ges. Königsberg 20.

— 1886: Ueber die Organisation der Gallerte bei einigen Algen und Flagellaten. — Unters. bot. Instit. Tübingen 2.

KOSSINSKAJA, C. 1938: Algae from the environments of Jukki (in Russian language). — Acta Inst. bot. Acad. sci. Sovjet. ser. II.

KRIEGER, W. 1932: Die Desmidiaceen der Deutschen limnologischen Sundaexpedition. — Arch. Hydrobiol. Supplementband 11.

— 1935: Die Desmidiaceen (in Rabenhorsts Kryptogamen-Flora 13: I: 1.

— 1938: Süsswasseralgen aus Spitzbergen. — Ber. deutsch. bot. Ges. 56.

— 1944: Süsswasseralgen aus Griechenland. — Ibid. 61.

— 1950: Desmidiaceen aus der montanen Region Südost-Brasiliens. — Ibid. 63.

KUFFERATH, H. 1914: Notes sur la Flore algologique du Luxembourg septentrional. — Annal. Biol. lacustr. 7.

KÜTZING, F. T.: Species Algarum. — Lipsiae.

LAGERHEIM, G. 1886: Algologiska bidrag I. — Bot. Notiser. Lund.

LHOTSKY, O. 1948: Klic k urceni ceskych ras spaejivych. — "Vesmir".

— 1949: Poznamka k flore Desmidiacei Hrubeho Jeseniku. — Cas. Vlast. Spotku musejniko v Olomuci 58.

LOWE, CH. 1923: Freshwater Algae and Diatoms. — Canadian Arctic Exp. 1913, 18. Vol. 4.

LUNDELL, P. M. 1871: De Desmidiaceis quae in Suecia inventae sunt. — Acta Reg. Soc. Sci. Upsal.

LÜTKEMÜLLER, J. 1893: Beobachtungen über die Chlorophyllkörper einiger Desmidiaceen. — Österr. bot. Zeitschr.

— 1900: Desmidiaceen aus der Umgebung des Millstättersees in Kärnten. — Verh. K. K. zool.-bot. Ges. Wien.

— 1902: Die Zellmembran der Desmidiaceen. — Cohn, Beitr. Biol. d. Pflanzen 8: 3.

— 1905: Zur Kenntnis der Gattung *Penium*. — Verh. zool. bot. Ges. Wien 55.

— 1913: Die Gattung *Cylindrocystis* Menegh. — Ibid. 63.

— 1910: Zur Kenntnis der Desmidiaceen Böhmens. — Ibid. 60.

MANGUIN, E. 1937: Les Algues des Rochers suintants de Saint-Léonard-des-Bois. — Bull. Soc. Agr. Sci. Arts de la Sarthe 56.

MARGALEF, R. 1948: Flora, Fauna y communidades bioticas de las aguas del Pirineo de la Cerdaña. — Monogr. Estacion Estudios Pirenaicos.

MASKELL, W. M. 1888: Further notes on the Desmidieae of New Zealand. — Trans. New Zealand Instit. 21.

MESSIKOMMER, E. 1927: Biologische Studien im Torfmoor von Robenhausen. — Mitt. bot. mus. Univ. Zürich 122.

— 1928: Die Algenvegetation des Hinwiler- und Oberhöflerriedes. — Vierteljahrschr. Naturf. Ges. Zürich 73.

— 1935: Die Algenwelt der inneren Plessur-alpen. — Ibid. 80.

— 1942: Beitrag zur Kenntnis der Algenflora und Algenvegetation des Hochgebirges von Davos. — Beitr. Geobot. Landesaufnahme Schweiz 24.

— 1943: Hydrobiologische Studie an der Moorreservation der Schweizerischen Naturforschenden Gesellschaft in Robenhausen-Wetzikon. — Vierteljahrschr. naturforsch. Ges. Zürich, Beih. 2.

— 1945: Algen aus dem westlichen Berner Oberland. — Mitt. naturf. Ges. Bern. 2.

— 1954: Beitrag zur Kenntnis der Algenflora des Urner Reusstales. — Hydrobiologia 6.

NORDSTEDT, O. 1878: De algis aquae dulcis et de Characeis ex insulis Sandvicensibus a Sv. Berggren 1875 reportatis. — Minnesskr. Fysiograf. Sällsk. Lund.

— 1888: Freshwater Algae, collected by Dr. S. Berggren in New Zealand and Australia. — Sv. Vet. Akad. Handl. 22: 8.

DE NOTARIS, G. 1867: Elementi per lo studio delle Desmidiacee Italiche. — Genova.

OLTMANNS, FR. 1922: Morphologie und Biologie der Algen I. — Jena.

VAN OYE, P. 1949: Nouvelles Données sur les Desmidiacées des Environs de Matadi (Congo belge). — Hydrobiologia 1.

— 1953: Contribution à la connaissance des Desmidiacées du Congo belge. — Ibid. 5.

— 1953 a: Etude sur les desmidiacées du grand-duché de Luxembourg. — Bull. Soc. Roy. bot. Belgique 85.

PETKOFF, ST. 1922: La vegetation des eaux de Vitocha. — Annuaire Univ. Sophia 18.

PEVALEK, I. 1924: Geobotanicka i algoloska istrazwanje cretova u Hrvatskoj i Slovenyi. — "Rad" 230.

PLAYFAIR, G. I. 1907: Some new or less known Desmids found in New South Wales. — Proceed. Linnean Soc. New S. Wales 32.

— 1914: Contribution to a knowledge of the Biology of the Richmond river. — Ibid. 39.

PRESCOTT, G. W. 1936: Notes on alpine and subalpine Desmids from Western United States. — Mich. Acad. Sci. Arts Letters 21.

— and SCOTT, A. M. 1952: Some South Australian Desmids. — Trans. Roy. Soc. South Australia 75.

RABENHORST, L. 1868: Flora Algarum aquae dulcis et submarine III. — Lipsiae.

RACIBORSKI, M. 1884: Desmidyje okoloc Krakowa. — Kom. fizyjogr. Akad. Umiej. Krakowie 19.

— 1885: De nonnullis Desmidiaceis novis vel minus cognitis quae in Polonia inventae sunt. — Pam. Akademii umiejetn. Krakowie 10.

— 1890: Nowe Desmidyje. — Ibid. 17.

— 1892: Desmidyja zebrane przez Dr. E. Ciastonia w podrozy na okolo ziemi. — Ibid. 22.

RALFS, J. 1844: On the British Desmidieae. — Ann. Mag. Nat. Hist. 14.

— 1848: The British Desmidieae. — London.

REINSCH, P. 1875: Contributiones ad Algologiam et Fungologiam 1. — Leipzig.

ROUBAL, L. 1947: The Desmidiaceae of the Pirin Planina. — Sumptibus Soc. bot. Ceckoslovacae 8.

ROY, J. and BISSETT, J. P. 1893/94: On Scottish Desmidieae. — Ann. Scott. Nat. Hist.

SAMPAIO, J. 1944: Desmidias portuguesas. — Boletim da Sociedade Broteriana 18.

SCHELLENBERG, H. C. 1897: Ueber eine neue Desmidiaceengattung. — Ber. Schweiz. bot. Ges. 7.

SCHMIDLE, W. 1893: Beiträge zur Algenflora des Schwarzwaldes und der Rheinebene. — Ber. naturf. Ges. Freiburg 7.

— 1893 a: Algen aus dem Gebiete des Oberrheins. — Ber. Deutsch. bot. Ges. 11.

— 1894: Aus der Chlorophyceen-Flora der Torfstiche zu Virnheim. — Flora 78.

— 1894 a: Einzellige Algen aus den Berner-Alpen. — Hedwigia 33.

— 1895: Beiträge zur alpinen Algenflora. — Österr. bot. Zeitschr.

— 1895 a: Weitere Beiträge zur Algenflora der Rheinebene und des Schwarzwaldes. — Hedwigia 34.

SCHMIDLE, W. 1895 b: Einige Algen aus Sumatra. — Hedwigia 34.

— 1896: Süsswasseralgen aus Australien. — Flora 82.

— 1897: Beiträge zur Algenflora des Schwarzwaldes und des Oberrheins VI. — Hedwigia 36.

— 1897 a: Zur Kritik einiger Suesswasseralgen. — Nuova Notarisia 8.

— 1898: Ueber einige von KNUT BOHLIN in Pite Lappmark und Vesterbotten gesammelte Süsswasseralgen. — Bih. K. Vet. Akad. handl. 24.

— 1898 a: Die von Prof. Dr. VOLKENS und Dr. STUHLMANN in Ostafrika gesammelten Desmidiaceen. — Englers bot. Jahresber. 26.

SKUJA, H. 1928: Vorarbeiten zu einer Algenflora von Lettland IV. — Acta Horti bot. Univ. Latviens. 3.

— 1934: Beitrag zur Algenflora Lettlands I. — Ibid. 7.

— 1949: Zur Süsswasseralgenflora Burmas. — Nova Acta Reg. Soc. sci. Upsal. ser. IV: 14.

STRÖM, K. M. 1919: Freshwater Algae from Tuddal in Telemark. — Nyt Mag. naturvidensk. 57.

— 1923: The Algae Flora of the Sarek Mountains. — Nat. wiss. Unters. Sarekgebirg. 3.

TAFT, CL. 1937: The Desmids of Oklahoma III. — Trans. Amer. micr. Soc. 56.

TAYLOR, R. 1934: The Freshwater Algae of Newfoundland I. — Mich. Acad. Sci. Arts & Lett. 19.

TEILING, E. 1950: Radiation of Desmids. — Bot. Notiser. Lund.

— 1952: Evolutionary studies on the shape of the cell and of the chloroplast in desmids. — Bot. Notiser. Lund.

DE TONI, G. B. 1889: Sylloge Algarum I: 2. — Pavia.

TURNER, W. B. 1885: On some new and rare Desmids. — Journ. Roy. micr. Soc. II: 5.

— 1886: Notes on Freshwater Algae. — The Naturalist.

— 1892: The Fresh-water Algae (principally Desmidieae) of East India. — K. Svensk. Vet. Akad. Handl. 25: 5.

— 1893: Desmidiological Notes. — The Naturalist.

WEST, W. 1889: List of Desmids from Massachusetts, U.S.A. — Journ. Roy. micr. Soc.

— 1892: A Contribution to the Freshwater Algae of West Ireland. — Journ. Linnean Soc. 29.

WEST, G. S. 1904: A Treatise on the British freshwater Algae. — Cambridge biol. series.

— 1904 b: West Indian freshwater Algae. — Journ. of Bot. 42.

— 1907: Report on the Freshwater Algae, including Phytoplankton, of the third Tanganyika Expedition — Journ. Linn. Soc. Bot. 38.

— 1912: Algological Notes VII. Algae from Queensland. — Journ. Botany. 50.

— 1914: A Contribution to our Knowledge of the Freshwater Algae of Columbia. — Mem. Soc. Sci. nat. Neuchatel 5.

— 1916: Algae I. — Cambridge Botanical Handbooks.

WEST, W. and G. S. 1894: New British Freshwater Algae. — Journ. Roy. micr. Soc.

— 1895: A Contribution to our Knowledge of the Freshwater Algae of Madagascar. — Trans. Linn. Soc. 5.

— 1896: On some North American Desmids. — Ibid.

WEST, W. and G. S. 1897 a: A Contribution to the Freshwater Algae of the South of England. — Journ. Roy. micr. Soc.

— 1897 b: Welwitsch's African freshwater Algae. — Journ. Botany.

— 1897 c: Desmids from Singapore. — Journ. Linn. Soc. 33.

— 1898: On some Desmids of the United States. — Ibid.

— 1900: Notes on Freshwater Algae II. — Journ. Botany.

— 1902: A Contribution to the Freshwater Algae of Ceylon. — Trans. Linn. Soc. VI.

— 1904: A Monograph of the British Desmidiaceae I. — London.

— 1908: A Monograph of the British Desmidiaceae III. — London.

— 1907: Freshwater Algae from Burma. — Ann. Roy. bot. Garden Calcutta 6.

WEST and CARTER, NELLIE 1923: A Monograph of the British Desmidiaceae V. — London.

WHELDEN, R. M. 1947: Algae, in Botany of the Canadian Eastern Arctic. — National Museum of Canada Bulletin 97.

WILLE, N. 1879: Ferskvandsalger fra Novaja Semlja. — Öfvers. K. Vet. Akad. förhandl.

— 1884: Bidrag till Sydamerikas algflora I—III. — Bih. K. Sv. Vet. Akad. handl. 8: 18.

— og ROSENVINGE, L. K. 1885: Alger fra Novaja-Zemlja og Karahavet. — Djimpna-Togtets zool.bot. Udbytte.

WITTROCK, V. B. 1883: Om snöns och isens flora. — NORDENSKIÖLD: Studier och forskningar.

— & NORDSTEDT, O. 1889: Algae aquae dulcis exsiccatae. fasc. 21. — Stockholm.

WOLLE, FR. 1883: Freshwater Algae VII. — Bull. Torr. bot. Club 10.

— 1884: Desmids of the United States. — Bethlehem, U.S.A.

— 1887: Freshwater Algae of the United States. — Bethlehem.

WOOD, N. C. 1873: A Contribution to the History of the Freshwater Algae of North America. — Smithson Contrib. Knowledge 19.

Index of taxa in Actinotaenium

(including synonyms of *Calocylindrus, Cosmarium, Cylindrocystis, Dysphinctium, Penium* etc.). Synonyms are printed in *italics*.

BOTANISKA NOTISER 1954, HÄFTE 4. LUND

A new Species of Lepidozia from South Africa.

By SIGFRID ARNELL.

Gävle, Sweden.

Lepidozia spinosa — nov. spec.

S. Africa: Cape Prov.: Table Mountain, Disa Gorge, ARNELL, n. 1078, 1097 etc. — Knysna, Deepwall forest, ARNELL, n. 1515, 1925 etc. Type specimen n. 1515 (Riksmuseum, Stockholm).

Dioica, viridis, in solo humido vel in cortice repens. Caulis usque 25 mm longus, remote pinnatus, pinnis attenuatis. Folia caulina contigua, recte patula, asymmetrica, breviter tri—quadrilobata; lobis triangularibus, basi 3—4 cellulas latis, cellula apicali longa, hyalina, in angulo 90° divergente; disco brevi. Cellulae 10—12(—18) μ, cellulae basales majores. Amphigastria parva, tri—quadrilobata, lobis uniseriatis; cellula apicali longa, hyalina. Perianthia in ramo brevi postico terminali posita, fusiformia, profunde quadrilobata; cellula apicali longa, hyalina. Capsula oblonga. Sporae 10 μ, brunneae, laeves. Elateres bispiri, 5—6×200 μ.

Dioicous, dark—pale green, on wet soil rich in humus or on decaying bark. Stem up to 25 mm long, about 60 μ in diameter, pinnate, branches projecting at 45—90° to the stem, with long leafless or microphyllous stolons. Leaves approximate, somewhat concave, asymmetrical, 5—7 lobed. Ventral (upper) lobes triangular, short, base 3—4 cells wide, dorsal lobes 2—4, 2—3 cells long and one cell wide, all lobes with a long hyaline apical cell, generally at right angles to the axis of the lobe and directed towards the apex of the shoot. Discus broad, at the base of the upper lobe usually an obtuse tooth or shoulder. Insertion transversal in the dorsal portion, in the lateral portion oblique at about 30° to the axis of the stem. The leaf nearest below the exit of the branches smaller and consists usually of the 3—4 short dorsal lobes, occasionally also 4—5 lobed with one or two larger lateral (ventral) lobes. Cells 10—12(—18) μ, basal cells larger. Amphigastria small ± patent, 3—4-

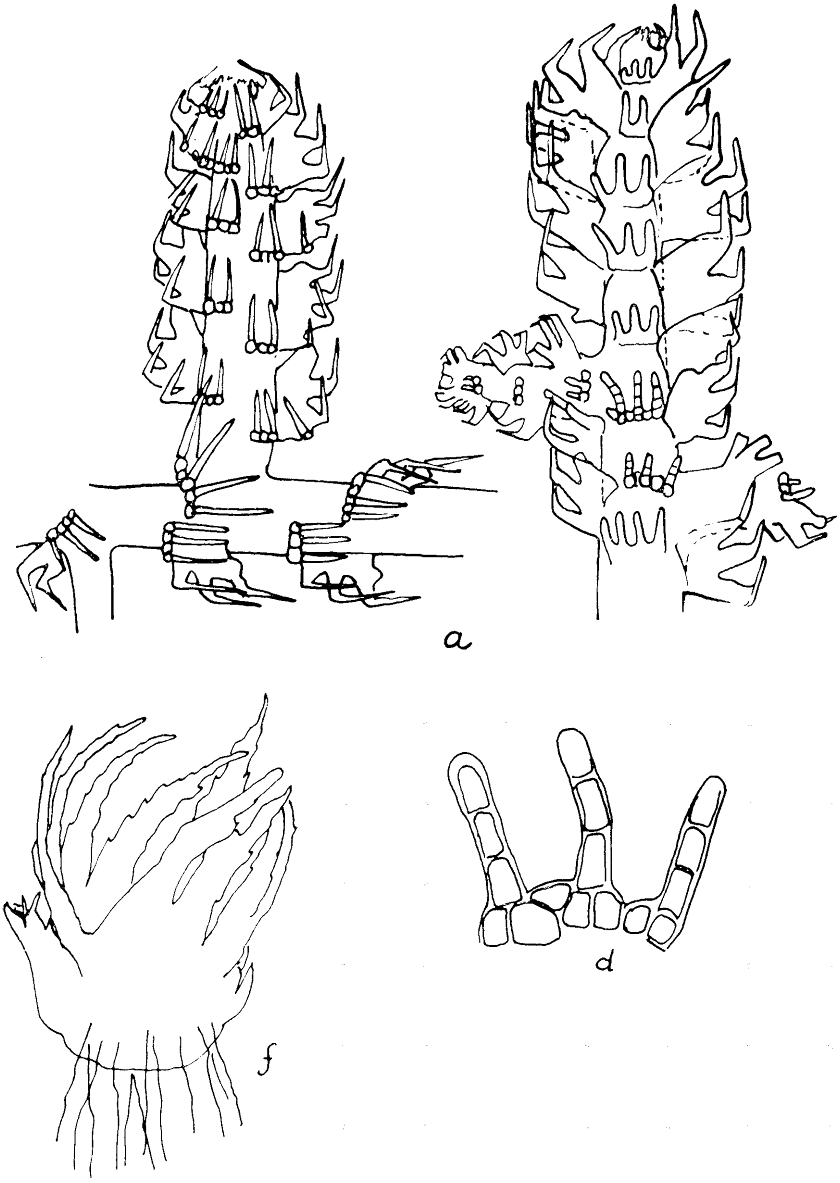


Fig. 1. *Lepidozia spinosa* S. ARN. — *a* Fragments of shoots in dorsal (left) and ventral view (right). — *d* Amphigastria. — *f* Bracts.

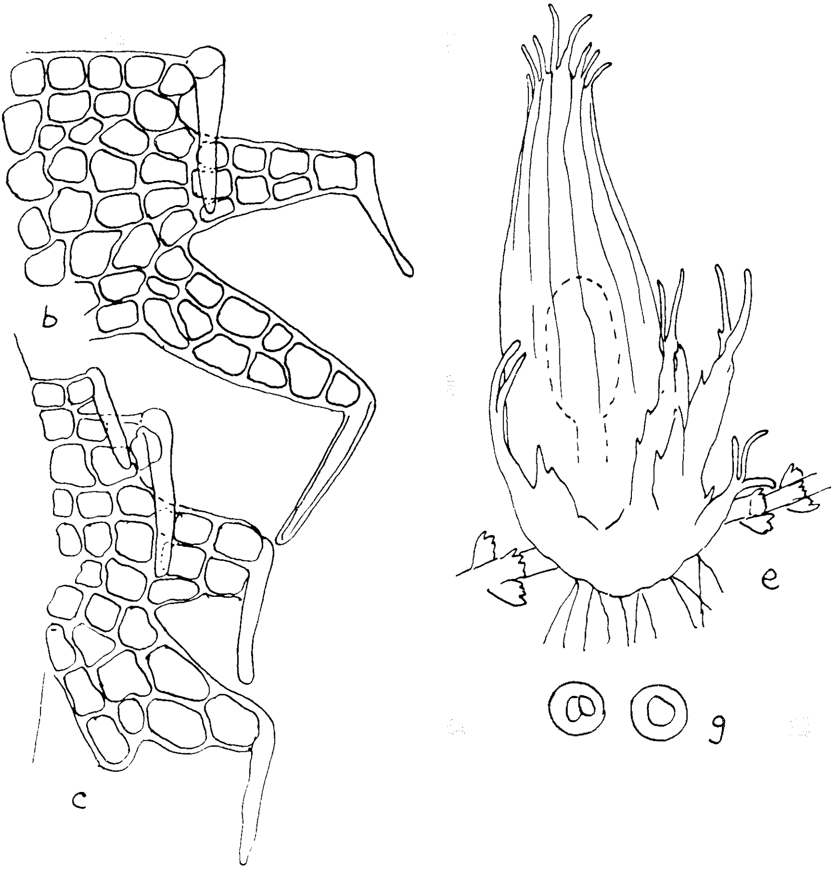


Fig. 2. *Lepidozia spinosa* S. ARN. — *b* Lateral lobes of a leaf from a branch. — *c* Ditto from the stem. — *e* Female organ with perianth. — *g* Spores.

lobed, lobes uniseriate and frequently with a hyaline apical cell. Female organs on short ventral branches. Bracts in 1—2 pairs, inner bracts deeply 4-lobed, lobes dentate, with a long apical cell. Perianth longly ovate, pluriplicate almost to the base, mouth dentate with ciliate teeth. Calyptra thin. Sporogonium ellipsoid. Spores 10 μ, brown, smooth, with 1—2 large chloroplasts. Elaters bispirate, 5—6 μ wide and up to 200 μ long. Male organs not observed.

This species holds an isolated position in the genus and I propose a new subgenus for it, ***Apiculo-Lepidozia***, characterized by long apical cells of the leaves and amphigastria, and by the shape of the insertion line of the leaves as described above.

BOTANISKA NOTISER 1954, HÄFTE 4. LUND

Smärre uppsatser och meddelanden.

Några anmärkningsvärda gräsfynd.

Under en exkursion längs stranden söderut från Timmernabben i Ålems socken av Kalmar län den 3 juli 1954 fann jag i Alsterån *Leersia oryzoides* (L.) Sw. Den växte invid östra stranden nära åmynningen. Någon klar uppfattning av beståndets storlek var svår att få, eftersom endast bladen av de närmast stranden växande exemplaren nådde över vattenytan. Då artens utbredning nyligen varit föremål för utförlig behandling i denna tidskrift (av ASTA LUNDH 1942 och av HELGE RICKMAN 1947) äro kommentarer till fyndet överflödiga.

Ammophila arenaria (L.) LINK påträffades av mig den 2 september 1945 vid Sandviken på Järflotta i Ösmo socken, Södermanland, och den 26 augusti 1951 på Nåtarö i Utö socken, där den växer vid både Stora och Lilla Sand. Fynden äro omnämnda av HYLANDER i Nordisk Kärlväxtflora (Stockholm 1953, s. 311) och av ALMQUIST i Natur i Södermanland (Göteborg 1952, s. 82) och skulle alltså kunna anses tillräckligt offentliggjorda och ej behöva ytterligare omnämnas.

Emellertid äro fyndomständigheterna sådana, att några kommentarer torde vara lämpliga. Arten är sannolikt en nyinvandrare i Stockholmstrakten. Frånsett ett adventivfynd vid Sandhamn omkring 1890 och ett vid Djupe i Bergsjö socken, Hälsingland, var den ej känd från östkusten norr om Blekinge förrän på 1930-talet, då den påträffades på Ålö i Utö socken (Stockholmstraktens Växter, 2. uppl. s. 19), där den växer på stranden av viken på öns sydöstsida. Vikens strand är av utskjutande berguddar uppdelad i flera bågformade sandiga partier. På det yttersta på nordöstra sidan funnos vid mitt första besök den 5 aug. 1934 något 10-tal tuvor av *Ammophila*; för övrigt eftersöktes den förgäves längs stranden. Ett par år senare var situationen oförändrad, men vid ett besök den 26 september 1954 befanns den ha spritt sig högst betydligt och bildade nu ett 150 m långt och 5—10 m brett bestånd längs stranden. *Elymus arenarius* var så gott som fullständigt undanträngd. På de övriga sandiga strandpartierna längs viken funnos enstaka tuvor.

De båda Nåtarö-lokalerna besökte jag 16 aug. 1934 utan att anträffa *Ammophila*. Till mitt förfogande hade jag då, som ofta vid exkursioner i skärgården, endast en knappt utmätt tid mellan landstigning på en brygga och avfärd från en annan, varför den floristiska inventeringen ej kunde bli så grundlig som önskvärt. Emellertid saknas *Ammophila* även i en förteckning på sällsynta växter, som docent STEN SELANDER år 1923 anträffade på Nåtarö. Denna lista

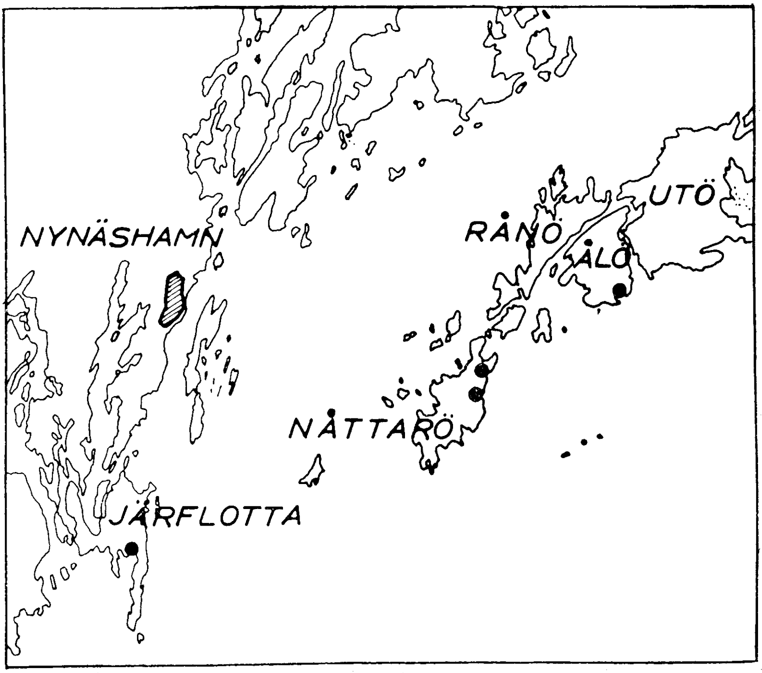


Fig. 1. *Ammophila arenaria* (L.) LINK i Stockholmstrakten.

Utom på de 4 på kartan markerade lokalerna funnen en gång vid Sandhamn, tillfälligt inkommen med barlast omkring 1890. — Kartan fig. 1 godkänd för publicering i rikets allmänna kartverk den 14 december 1954.

ställdes av finnaren godhetsfullt till mitt förfogande, då Stockholmstraktens Växter redigerades. Det är mycket osannolikt, att ingen av oss skulle ha sett *Ammophila,* om den funnits där vid tiden för våra besök, i synnerhet som vi båda funnit den vida mindre iögonenfallande *Elytrigia juncea* vid Stora Sand (säkerligen = SELANDER's Östra Sand enl. ex. i Riksmuseets herbarium). Endast några få men kraftiga *Ammophila*-tuvor sågos 1951 på vardera av de båda Nåtarö-lokalerna.

På Järflotta fann jag 1945 en ej särdeles stor men rikt vippbärande tuva av *Ammophila arenaria.* År 1929 hade jag gjort en mycket ingående inventering av öns flora, framför allt av sandsträndernas, utan att finna arten, varför den här måste ha vandrat in under mellantiden. Vid senare besök har jag återsett den ursprungliga tuvan och dessutom funnit ett par mindre, helt sterila. Vid det senaste (1949) befunno sig alla tuvorna i ett mycket dåligt skick, och det är tvivelaktigt, om de alltjämt finnas kvar.

Av den rika flora, som jag fann 1929 (*Selaginella, Salsola, Cakile, Lathyrus maritimus* etc.) fanns 1949 ej mycket kvar. Alla de 4 nämnda arterna hade försvunnit, och *Carex arenaria* och *Atriplex litoralis* ha helt tagit överhand.

(Den sistnämnda fanns där redan 1929, liksom även på sandstränderna på Torö. Att endast Stockbonäs udde nämnes under Södertörnsområdet i Stockholmstraktens Växter, beror på ett förbiseende.)

Den närmast de nämnda lokalerna belägna plats, där *Ammophila* förekommer, är så vitt känt Gotska Sandön. Det ligger nära till hands att antaga, att den invandrat därifrån. Avståndet dit är 80 km, både Ålö-lokalen och Nåtarölokalerna vetta mot sydöst eller öster och öppna havet, och sydöstliga vindar äro ej sällsynta. Sannolikast är kanske, att rhizombitar drivit över och givit upphov till de första tuvorna. Artens rika förekomst på Gotska Sandön är betingad av inplantering, jfr ARWIDSSON i K.V.A. Avh. i Naturskyddsärenden N:o 1 (1938) s. 36. Någon anledning att antaga, att *Ammophila* skulle vara inplanterad på Ålö och Nåtarö finnes ej. Sandviken på Järflotta ligger mera skyddad för vindar från öppna havet, men är dock öppen mot söder. Naturligtvis kan en rhizombit av en tillfällighet ha drivit dit.

Elytrigia juncea (L.) NEVSKI ssp. *boreoatlantica* (SIM. & GUIN.) HYL. finnes på Ålö invid det stora *Ammophila*-beståndet. Den sågs ej alls 1934 och år 1954 endast i sterila exemplar. Även på Nåtarö och vid Drumbudd på Utö har jag endast sett den steril, SELANDER's ovan nämnda Nåtarö-exemplar ha däremot ax, och vid Sandhamn är den flera gånger sedd axbärande och tycks alltså trivas där. Det förefaller egendomligt, att *Ammophila* ej lyckats sätta sig fast på Sandön.

Vid Stenshuvud (Södra Mellby socken, Skåne) påträffade jag den 7 juli i år ett bestånd av *Hordelymus europaeus* (L.) HARZ i en *Carpinus*-dunge invid den väg, som från den sydöstligaste gården i Svinaberga by leder ned mot sandfältet söder om berget. Ett tjugotal fertila strån funnos på en yta av några kvadratmeter. Lokalen ligger utanför det fridlysta området.

Arten i fråga är i Skåne tidigare känd endast från Röddingedalens nordsida, där den förekommer inom Röddinge och Sövde socknar i bestånd, av vilka åtminstone ett par äro ojämförligt rikare än det vid Stenshuvud. För övrigt är den i Sverige känd från ett litet område på Gotland (se HYLANDER, Nordisk Kärlväxtflora s. 382; 9 lokaler uppges i litteratur och på herbarieetiketter, flera av dem ligga emellertid mycket nära varandra eller äro möjligen delvis identiska), vidare 6 lokaler på Öland (5 på mellersta Öland, därav 2 vid Borgholm mindre än 1 km från varandra, och 1 i Böda nära öns nordspets), 1 i Smålandsdelen av Kalmar län, 2 i Södermanland och ej mindre än 9 i Uppland, därav 5 i Möja inom ett litet område, vilket dock är större än det, som rymmer 5 av de gotländska lokalerna.

Hordelymus har alltså en anmärkningsvärt stor frekvens i den nordligaste delen av sitt utbredningsområde. I Danmark finns den på många lokaler, rikligast på södra delen av Jyllands östkust (se HYLANDER's Flora och HULTÉN's Atlas, karta 274), i Norge och Finland saknas den. Utanför vårt floraområde är den utbredd mot väster till Skottland och Irland, franska Atlant-kusten, Pyrenéerna, mellersta Spanien, åt söder till Algeriet och Mindre Asien och åt öster till Kaspiska Havet och övre Volga. Utbredningen är ojämn och har många luckor.

ERIK ASPLUND.

Potentilla anglica × P. erecta i Västergötland.

Sensommaren 1952 upptäckte undertecknad hybriden mellan *Potentilla anglica* och *P. erecta* på två lokaler i Björketorps socken i sydvästra Västergötland.

På den ena lokalen, som var skuggig och relativt fuktig, växte gles granskog med en undervegetation av bl.a. mossor, *Potentilla erecta* (rikligt), *Melampyrum silvaticum, Goodyera repens* och *Listera cordata* (sparsamt).

Denna hybrid var storvuxen med revor på upp till 8 dm:s längd. Stjälkbladen, av vilka endast ett var 5-fingrat, voro grovt och vasst sågade. Spetstanden på de flesta uddbladen var långt framskjuten, påminnande om stora *P. erecta*-blad. Det 5-fingrade bladets skaft var 2,5 cm, medan de övrigas höll sig mellan 0,5 och 1 cm.

Den andra lokalen, ett par km från föregående, utgjordes av en starkt solexponerad gräskant, belägen mellan en landsväg och en gärdesgård. Förutom hybriden insamlade jag där också *Potentilla anglica,* som förekom i ett flertal individ tillsammans med *P. erecta.*

Hos denna hybrid voro kronorna 5-taliga. För övrigt var växten liten, endast omkring 28 cm hög. Samtliga stjälkblad voro 3-fingrade och överensstämde närmast med blad hos *P. anglica.*

ELOF CARLSSON.

Amscottia Grönbl. — Nom. nov.

A correction to the article "A new Genus and a new Species among the Desmids" by R. GRÖNBLAD and P. KALLIO. — Botaniska Notiser 1954, Häfte 2.

Since it has come to our knowledge that the name "*Scottia*" of a new genus of the *Desmidiaceae,* published by the author, is a homonym, another genus bearing the same name — *Scottia* R. BR. 1812 (*Papilionaceae*) — and having been previously published, the name created by us is not valid and must be rejected. (Internat. Rules of Botan. Nomencl., Art. 60).

Thus the name ***Amscottia*** GRÖNBL., nom. nov. — derived from A. M. SCOTT — has to replace "*Scottia* GRÖNBL. 1954" with the diagnosis unchanged. Accordingly the new species "*Scottia mira* GRÖNBL." is to be called ***Amscottia mira*** GRÖNBL., nov. comb. with the diagnosis unchanged.

ROLF GRÖNBLAD.

BOTANISKA NOTISER 1954, HÄFTE 4. LUND

Svensk Botanisk Litteratur 1953.

(Meddelanden från Lunds Botaniska Museum, Nr 108.)

Förteckningen omfattar skrifter, som helt eller delvis äro av vetenskapligt-botaniskt innehåll och som tryckts i Sverige under 1953, samt vidare skrifter av samma art, publicerade i utlandet detta år av svenska författare. Endast vetenskapliga arbeten i egentlig mening medtagas; populärvetenskapliga skrifter och recensioner ha i allmänhet utelämnats. Från den internationella kongressens i Stockholm förhandlingar medtagas vetenskapliga bidrag och meddelanden, men diskussionsinlägg i anslutning till dessa anföras ej särskilt.

Kompletteringar mottagas tacksamt av utgivaren.

Förkortningar.

ACS: Acta Chemica Scandinavica, Köbenhavn (tr. i Helsinki).
AfB: Arkiv för Botanik, Stockholm.
AfK: Arkiv för Kemi, Stockholm.
AHB: Acta Horti Bergiani, Stockholm.
BN: Botaniska Notiser, Lund.
ECR: Experimental Cell Research, New York (tr. i Uppsala).
GFF: Geologiska Föreningens i Stockholm Förhandlingar.
Her.: Hereditas, Lund.
KLA: K. Lantbrukshögskolans Annaler, Uppsala.
KLT: K. Lantbruksakademiens Tidskrift, Uppsala.
Nat. i Dls.: Natur i Dalsland. Under red. av N.-G. KARVIK och K. CURRY-LINDAHL. Stockholm.
Nat. i Ång.: Natur i Ångermanland och Medelpad. Under red. av O. ELOFSON och K. CURRY-LINDAHL. Stockholm.
NST: Norrlands Skogsvårdsförbunds Tidskrift, Stockholm.
PBC: Proceedings of the Seventh International Botanical Congress Stockholm 1950. Stockholm-Waltham (tr. i Uppsala).
PFÅ: Sveriges Pomologiska Förenings Årsskrift, Stockholm.
PP: Physiologia Plantarum, Köbenhavn (tr. i Lund).
SBT: Svensk Botanisk Tidskrift, Stockholm.
SS: Statens Skogsforskninginstitut, Stockholm.
SST: Svenska Skogsvårdsföreningens Tidskrift, Stockholm.

SUT: Sveriges Utsädesförenings Tidskrift, Stockholm.
SV: Statens Växtskyddsanstalt, Experimentalfältet.
SvN: Sveriges Natur, årsbok och tidskrift, Göteborg.
VT: Våra träd. Red. av T. ARNBORG och I. HUSTICH. Stockholm.

Anatomi. Morfologi. Embryologi.

1. ALLEN, O. N., and ALLEN, E. K., The production of rootlets from nodules of certain woody leguminous plants. PBC, 159—160.
2. ALMEIDA, F. J. DE, Morphological and physiological anomalies in Olea europaea L. PBC, 378.
3. BALL, E., Experimental dividing of a shoot apex. PBC, 371—372.
4. BAUM, HERMINE, Die Bedeutung der postgenitalen Verwachsung für das Verständnis des Baues von Karpell und Gynözeum. PBC, 355—356.
5. BELL, P. R., Stelar structure in the genus Elaphoglossum. PBC, 381.
6. BISSET, K. A., and HALE, C. M. F., Complex cellular structure in bacteria. ECR 5, 449—454.
7. BUCHHOLZ, J. T., Embryology of gymnosperms. PBC, 374—375.
8. — The cones of certain rare conifers of the southern hemisphere. PBC, 581.
9. BUVAT, R. A., Les effets cytologiques de l'eau et le déterminisme de la forme des chondriosomes. PBC, 366—367.
10. CAMICI, LEONTINA, and SERMONTI, G., Morphological observations on the organisation of the mycelium of Penicillium chrysogenum in submerged culture. PBC, 452—453.
11. VAN CAMPO-DUPLAN, MADELEINE, Du terme »sillon» dans la nomenclature palynologique. PBC, 876—877.
12. CAMUS, G. C., Histological differentiation as caused by buds. PBC, 371.
13. CHAMPAGNAT, P., Fixation des préséances sur les rameaux d'un an des végétaux ligneux. PBC, 384—385.
14. CHIARUGI, A., Polyploidy in the female gametophyte of flowering plants. PBC, 375.
15. CHOWDHURY, K. A., and TANDAN, K. N., Meristems and differentiations of plant tissues with special reference to trees. PBC, 358—359.
16. CLOWES, F. A. L., The promeristem of roots. PBC, 357—358.
17. COMBES, R., Le mécanisme d'action du milieu extérieur sur la forme des végétaux. PBC, 246—247.
18. DEBRAUX, G., La feuille isolée en survie. Réactions histologiques et anatomiques. PBC, 379—380.
19. DIXON, H. M., Mitotic hormone. PBC, 783.
20. DREW BAKER, KATHLEEN M., Aspects of the life history of Porphyra umbilicalis (L.) Kütz. PBC, 834—835.
21. EKLUNDH EHRENBERG, CARIN, Studies on elm pollen. BN, 308—316.
22. ERDTMAN, G., On the difference between the pollen grains in Alnus glutinosa and those in Alnus incana. SBT 47, 449—450.
23. — Pollenmorfologien hos de svenska alarterna. GFF 75, 397—398.
24. — Pollen morphology and plant systematics. PBC, 859—860.
25. ERNST-SCHWARZENBACH, M., Development and flower biology of Elodea species and their hybrids. PBC, 377.

26. ESAU, K., Developmental aspects of primary vascularization. PBC, 359.
27. FAGERLIND, F., The phyllotaxy and the fundamental structure of the higher cormophytes. PBC, 387.
28. FELDMANN, J., Les types d'alternance de générations chez les Algues et leurs relations avec la phylogénie et la classification. PBC, 820—821.
29. FINEAU, J. B., SJÖSTRAND, F. S., and STEINMANN, E., Submicroscopic organisation of some layered lipoprotein structures (nerve myelin, retinal rods, and chloroplasts). ECR 5, 557—559.
30. FOSTER, A. S., Venation patterns in the leaves of angiosperms, with special reference to the Quiinaceae. PBC, 380—381.
31. FREY-WYSSLING, A., Electron microscopy of cell walls. PBC, 362—363.
32. FRITSCH, F. E., The heterotrichous state. PBC, 817—820.
33. GILLES, A., Evolution nucléaire chez Neurospora tetrasperma. PBC, 432—433.
34. GRÆBE, J., Fynd av en monstruös Anemone-hybrid. BN, 236—237.
35. GREGUSS, P., Xylotomie der Koniferen. PBC, 383—384.
36. v. GUTTENBERG, H., Die Entwicklungsvorgänge im Vegetationspunkt der Wurzel. PBC, 356—357.
37. HARLING, G., On the embryo sac development in the genus Anthemis. PBC, 377.
38. HERING, E. M., Veränderungen pflanzlicher Gewebe unter dem Einfluss minierender Insektenlarven. PBC, 372—373.
39. HJELMQVIST, H., The embryo sac development of Quercus robur L. Phytomorphology 3, 377—384.
40. HÅKANSSON, A., Die Samenbildung bei Nothoscordum fragrans. BN, 129—139, summary 139.
41. HÖFLER, K., Fluorochrome-staining on vital cells. PBC, 365.
42. IVERSEN, J., Identification of difficult pollen types by means of structural characters. PBC, 873—874.
43. KADRY, A. EL RAHMAN, The development of the female gametophyte in Cistanche tinctoria (Forssk.) G. Beck. SBT 47, 488—508.
44. KNOX, ELIZABETH, Spore morphology in the Lycopodiales and its significance in the study of Paleozoic microfossils. PBC, 887—888.
45. KOLBE, R. W., On the microstructure of diatoms. PBC, 840—841.
46. KÜHNER, R., Quelques caractères microscopiques des mycéliums et des germinations d'Agaricales utilisables en systématique. PBC, 407.
47. LAM, H. J., Stachyospory and phyllospory as factors in the natural system of the Cormophyta. PBC, 860—862.
48. LEVRING, T., Surface layers of unfertilized and fertilized eggs of some fucoids. PBC, 837—838.
49. LEYON, H., The structure of chloroplasts. ECR 4, 371—382.
50. — The structure of chloroplasts. II. The first differentiation of the chloroplast structure in Vallota and Taraxacum studied by means of electron microscopy. ECR 5, 520—529.
51. LILJEFORS, A., Studies on propagation, embryology, and pollination in Sorbus. AHB 16(: 10), 277—329.
52. LUYET, B. J., Evidence and lack of evidence of sexuality in Myxomycetes. PBC, 433—434.
53. MAEKAWA, F., Origin of stipules — a new hypothesis. PBC, 378—379.
54. MAHESHWARI, P., Embryology of angiosperms: its aims and objects. PBC, 376.

55. Markgraf, F., Morphologisch-phylogenetische Studien an Blüten der Rhoeadales. PBC, 857—858.

56. — Morphologisch-phylogenetische Studien an Blüten von Cruciferen und Papaveraceen. PBC, 352—354.

57. Martens, P., Blocage indéfini de la méiose et formation de pseudospores anucléés et aplasmiques chez une Hydroptéridale. PBC, 216.

58. Moewus, Liselotte, Über einige Ursachen der morphologischen Variabilität bei der Gattung Enteromorpha. PBC, 841—842.

59. Monoyer, A., Contribution à l'anatomie vasculaire de Ceratophyllum demersum L. PBC, 381.

60. Moore, Lucy B., Oogamy in Sphacelariales. PBC, 834.

61. Morgan-Jones, J. F., Morpho-cytological studies of the genus Gnomonia. I. Gnomonia intermedia Rehm: its development in pure culture. SBT 47, 284—308, 2 pl.

62. Mudd, S., and Winterscheid, L. C., A note concerning bacterial cell walls, mitochondria and nuclei. ECR 5, 251—254.

63. Plantefol, L., Les méthodes et les résultats de l'étude phyllotaxique. PBC, 385—386.

64. Prat, H., Manifestation de gradients au cours de la différentiation des tissus végétaux. PBC, 382—383.

65. Puri, V., Placentation in angiosperms. PBC, 354—355.

66. Rauh, W., Das primäre Dickenwachstum der Dikotylen. PBC, 359—361.

67. Ribi, E., Electron microscopic investigation of the cell wall organization of wood. ECR 5, 161—172.

68. Richards, F. J., Phyllotaxis patterns in relation to the growth of the apex. PBC, 386—387.

69. Robinow, C. F., and Murray, R. G. E., The differentiation of cell wall, cytoplasmic membrane and cytoplasm of gram positive bacteria by selective staining. ECR 4, 390—407.

70. Rutishauser, A., and Hunziker, H. R., Zur Zytologie des Endosperms. PBC, 377—378.

71. Satina, I., and Blakeslee, A. F., Periclinal chimeras, a tool in determining the contribution of germ layers to floral organs in Datura. PBC, 351—352.

72. Scardovi, V., Some remarks on the life-cycle of Torulopsidoideae. PBC, 398—399.

73. Scott, F. M., Plasmodesmata, nucleodesmata, and plastodesmata, and the suberization of the internal surface of plant tissues. PBC, 364.

74. Smith, G. M., Sexuality, zygote formation, and zygote germination in Chlamydomonas. PBC, 836—837.

75. Stenar, H., The embryo sac type in Smilacina, Polygonatum and Theropogon (Liliaceae). Phytomorphology 3, 326—338.

76. Straka, H., Untersuchungen über Salix-Pollen. PBC, 874—876.

77. Suneson, S., The bispore problem in the Corallinaceae. PBC, 835—836.

78. Svedelius, N., Über die sogenannten lobierten Zellen bei den Galaxauren. Öst. Bot. Zeitschr. 100, 217—225.

79. Söderberg, E., Om partenokoni och dioci hos släktet Pinus. Lustgården 33—34, 66—74.

80. THOMAS, H. H., The telome theory and the new morphology. PBC, 552—553.
81. TJEDER, B., En egendomlig svamp från Falu gruva. Fauna och flora, 254—255.
82. WARDLAW, C. W., Comparative morphogenesis in Pteridophytes and Spermatophytes by experimental methods. PBC, 370—371.
83. VAROSSIEAU, W. W., On the use of the electron microscope in wood anatomy. PBC, 363—364.
84. ZIMMERMANN, W., Cytologische und anatomische Basis der Telomtheorie. PBC, 553—554.
85. — Die radiären Strukturen der Sporangienstände (Sporophylle) in den Blüten. PBC, 578—580.

Se även nr 119, 161, 316, 341, 387, 388, 395, 400, 422, 430, 431, 452, 470, 471a, 483, 512, 517, 523, 526, 531, 532, 536, 555, 570, 575, 579, 580, 789, 790.

Fysiologi. Biokemi.

86. ALGÉUS, S., Nitrogen heterotrophy of a green alga. PBC, 776.
87. ARNON, D. I., Extracellular reactions of chloroplasts. PBC, 749—750.
88. — Inorganic micronutrient requirements of higher plants. PBC, 263—264.
89. ASCHAN, KARIN, and NORKRANS, BIRGITTA, A study in the cellulolytic variation for wildtypes and mutants of Collybia velutipes. I. PP 6, 564—583.
90. ASUNMAA, SAARA, and LANGE, P. W., Esterification of the carbohydrates in the plant cell wall with p-phenylazobenzoyl chloride for microspectrographic investigation. Sv. papperstidn. 56, 85—90. Zusammenf. 85. Sammanfattn. 85.
91. AUDUS, L. J., and THRESH, RUTH, A method of plant growth substance assay for use in paper partition chromatography. PP 6, 451—465.
92. BACH, ERNA, On hydrocyanic acid formation in Pholiota aurea. PBC, 454.
93. BÁNHIDI, Z. G., and ERICSON, L.-E., Bioautographic separation of vitamin B_{12} and various forms of folinic acid occurring in some brown and red seaweeds. ACS 7, 713—720.
94. BÁNHIDI, Z. G., SJÖSTRÖM, A. G. M., GRÖMMER, S., and LUNDIN, H., On the behavior of various Lactobacilli, members of the vitamin B_{12} group and desoxyribosides in the cup plate assay of vitamin B_{12}. AfK 5, 393—412.
95. BARTON, LELA V., Soaking injury to seeds as affected by supply of different gases. PBC, 796—797.
96. BENTLEY, J. A., and HOUSLEY, S., Growth of Avena coleoptile sections in solutions of 3-indolylacetic acid and 3-indolylacetonitrile. PP 6, 480—484.
97. BILLE-HANSEN, E., Fructification of a coprophilous Coprinus on synthetic medium. PP 6, 523—528.
98. BITANCOURT, A. A., and ROSSETTI, VICTORIA, The role of thiamin in the nutrition of Phytophthora spp. PBC, 391—392.
99. BJÖRKMAN, E., A new theory for the formation of ectotrophic mycorrhiza. PBC, 439.
100. BLACKMAN, G. E., The integrated effects of light intensity on net assimilation rate, leaf area and the growth rate of different species. PBC, 227—228.
101. BLINKS, L. R., HAXO, F., and YOCUM, C., Photosynthesis action spectra of marine algae. PBC, 745—746.

102. Bonde, E. K., Growth inhibitors and auxin in leaves of cocklebur. PP 6, 234—239.

103. Bonner, J., Bandurski, R. S., and Millerd, Adele, Linkage of respiration to auxin-induced water uptake. PP 6, 511—522.

104. Bouillenne, R., et Bouillenne-Walrand, Marie, La théorie de la rhizogénèse. PBC, 797—798.

105. Brauner, L., The function of the lamina in the tropisms of the Tropaeolum leaf. PBC, 791—793.

106. Brian, P. W., and Wright, J. M., An antifungal and phytotoxic metabolic product of the plant-pathogenic fungus Alternaria solani. PBC, 447—448.

107. Burström, H., Growth and water absorption of Helianthus tuber tissue. PP 6, 685—691.

108. — Physiology of root growth. Ann. Rev. of Plant Phys. 4, 237—252.

109. — Problems in the assimilation of nitrate. PBC, 773—774.

110. — Studies on growth and metabolism of roots. IX. Cell elongation and water absorption. PP 6, 262—276.

111. Butler, G. W., Ion uptake by young wheat plants. I—III. PP 6, 594—661.

112. — The connexion between respiration and salt accumulation. I. PP 6, 662—671.

113. Bünning, E., Umwelt und pflanzliche Eigenrhythmik. PBC, 247—248.

114. Caballero Lopés, A., Relations entre les substances de croissance et la fertilité des plantes supérieures. PBC, 795—796.

115. Calvin, M., The path of carbon in photosynthesis. PBC, 747—748.

116. Carr, D. J., On the nature of photoperiodic induction. I—II. PP 6, 672—684.

117. Chapman-Andresen, Cicily, Autoradiographs of algae and ciliates exposed to tritiated water. ECR 4, 239—242.

118. Chouard, P., Traitements photopériodiques de longue durée; conclusions à en tirer pour la physiologie et l'écologie. PBC, 248—250.

119. Dangeard, P., Sur la destruction du chondriome par l'acide acétique dilué et sa régénération dans la radicule de Pin maritime. PBC, 365—366.

120. Debraux, G., and Gauvaudan, P., Réactions des pièces florales isolées aseptiquement. PBC, 370.

121. Dianzani, M. U., Modification of some enzymatic characters of a strain of Staphylococcus albus obtained by treatment with desoxyribonucleic acid from other staphylococci. ECR 5, 311—319.

122. Douin, R., Sur le photo-géotropisme des carpophores des Marchantiées. PBC, 798—799.

123. Eckardt, F., Transpiration et photosynthèse chez un xérophyte mésomorphe. PP 6, 253—261. Summary 260.

124. Ehrensvärd, G., and Reio, L., The formation of tyrosine in Escherichia coli and Neurospora crassa, grown on isotope-labelled acetate as the sole source of carbon. AfK 5, 229—234.

125. — — The formation of tyrosine in Rhodospirillum rubrum grown on acetate and carbon dioxide, isotope labelled, under anaerobic condition. AfK 5, 327—332.

126. Ekdahl, I., Studies on the growth and the osmotic conditions of root hairs. Symb. Bot. Upsal. XI: 6. 83 s. 2 pl. (Diss. Uppsala.)

127. Elliott, B. B., and Leopold, A. C., An inhibitor of germination and of amylase activity in oat seeds. PP 6, 65—77.

128. Emerson, R., Experimental investigations of the physiology, cytogenetics, and cytotaxonomy of the Blastocladiales. PBC, 412—413.

129. Erdtman, H., Kemiska bidrag till barrträdens systematik. Stat. Naturv. Forskningsråds årsb. 6, 108—112. Summary 112.

130. Ericson, L.-E., Further studies on growth factors for Streptococcus faecalis and Leuconostoc citrovorum in marine algae. AfK 6, 503—510.

131. — On the vitamin B_{12}-, folic acid-, and folinic acid groups of factors, and on the occurrence of these vitamins and of niacin, pantothenic acid and amino acids in a number of marine algae. Upps. 1953, 79 s. (Diss. Stockh., Tekn. Högsk.) Delv. förut tryckt i Acta Chem. Scand. 1952—53, Chemistry and Industry, 1952.

132. Ericson, L.-E., and Bánhidi, Z. G., Bacterial growth factors related to vitamin B_{12} and folinic acid in some brown and red seaweeds. ACS 7, 167—172.

133. Ericson, L.-E., and Carlson, Blenda, Studies on the occurrence of amino acids, niacin and pantothenic acid in marine algae. AfK 6, 511—522.

134. Ericson, L.-E., and Lewis, L., On the occurrence of vitamin B_{12}-factors in marine algae. AfK 6, 427—442.

135. Ericson, L.-E., and Sjöström, A. G. M., Growth factors for E. coli 113-3, other than the vitamin B_{12}-group or methionine. ACS 7, 704.

136. Ericson, L.-E., Widoff, E., and Bánhidi, Z. G., Studies on growth factors for Streptococcus faecalis occurring in marine algae. ACS 7, 974—979.

137. Fischer, F. G., und Werner, G., Eine Analyse des Chemotropismus bei einigen Saprolegniaceen. PBC, 389—390.

138. Fitting, H., Über die Umkehrung der Polarität bei Laubmoosen. PBC, 791.

139. Forssberg, A., and Nybom, N., Combined effects of cystein and irradiation on growth and cytology of Allium cepa roots. PP 6, 78—95.

140. Fransson, P., Studies on auxin in young stem parts of Pinus silvestris. PP 6, 544—550.

141. Fredga, A., Studies on synthetic plant growth substances. IV. AfK 5, 223—227.

142. Fredrick, J. F., Preliminary studies on the synthesis of polysaccharides in the algae. III—IV. PP 6, 96—105.

143. French, C. S., and Koski, Violet M., The fluorescence spectra and photochemical activity of chloroplast pigments. PBC, 741—742.

144. Fries, Lisbeth, Factors promoting growth of Coprinus fimetarius (L.) under high temperature conditions. PP 6, 551—563.

145. Fries, N., Further studies on mutant strains of Ophiostoma which require guanine. Journ. Biol. Chem. 200, 325—333.

146. — Intermediates in the biosynthesis of purines in fungi. PBC, 392—393.

147. — Limiting factors in the growth of the pea seedling root. PP 6, 292—300.

148. Fåhræus, G., Growth and excretion of phenoloxidase from the mycelium of Polyporus versicolor. PBC, 161.

149. Fåhræus, G., and Lindeberg, G., Influence of tyrosine and some other substances on the laccase formation in Polyporus species, PP 6, 150—158.

150. Gabrielsen, E. K., On the CO_2-threshold in photosynthesis of leaves. PBC, 751—752.

151. Galston, A. W., Riboflavin as a photoreceptor and its relation to the light-growth reactions of plants. PBC, 784—785.
152. Galston, A. W., Baker, Rosamond S., and King, J. W., Benzimidazole and the geometry of cell growth. PP 6, 863—872.
153. Gautheret, R. J., La nutrition des cultures de tissus végétaux. PBC, 787—788.
154. Gavaudan, P., et Brebion, G., L'echelle des inhibitions fonctionelles dans la cellule végétale. PBC, 213—214.
155. Gibbs, R. D., Seasonal changes in water-contents of trees. PBC, 230—231.
156. Girton, R. E., Respiration studies on excised maize roots under aseptic conditions. PBC, 763—764.
157. Goddard, D. R., Terminal oxidases and plant respiration. PBC, 764—765.
158. Goksöyr, J., Boeri, E., and Bonnichsen, R. K., The variation of ADH and catalase activity during the germination of the green pea (Pisum sativum). ACS 7, 657—662.
159. Gottlieb, D., and Siminoff, P., The activity of antibiotics in soil. PBC, 449—450.
160. Granhall, I., Köldhärdighetens växtfysiologiska grundvalar. Nord. Jordbrugsforskn. 35, 36—51.
161. Groves, J. W., Sexuality and heterothallism in the Sclerotiniaceae. PBC, 433.
162. Hartt, Constance E., and Burr, G. O., Photosynthesis by sugar cane fed radioactive carbon dioxide. PBC, 748.
163. — — Translocation by sugar cane fed radioactive carbon dioxide. PBC, 748—749.
164. Hasman, M., Investigations of the water exchange of potato tissue under the effect of 6-aminoundecane and di-n-amyletic acid. PP 6, 187—198.
165. Heath, O. V. S., Control of stomatal movement by carbon dioxide and other factors. PBC, 756—758.
166. Heilbronn, A., Über die ökologische Bedeutung der ätherischen Öle. PBC, 232.
167. Heitz, E., Direct measurement of the grand period of growth of consecutive cells in the root-tip. PBC, 361.
168. Hellström, N., An attempt to explain the interaction of auxin and antiauxin in root growth by an adsorption mechanism. ACS 7, 461—468.
169. Hemberg, T., The effect of vitamin K and vitamin H′ on the root formation in cuttings of Phaseolus vulgaris L. PP 6, 17—20.
170. — The role of growth-inhibiting substances in the potato rest-period. PBC, 786—787.
171. Henckel, P. A., The adaptive significance of dormancy in plants. PBC, 789—790.
172. Hendricks, S. B., Borthwick, H. A., and Parker, M. W., Action spectra and pigment type for photoperiodic control of plants. PBC, 785.
173. v. Hofsten, B., v. Hofsten, Angelica, and Fries, N., Continuous liquid culture of the fungus Ophiostoma multiannulatum. ECR 5, 530—535.
174. — — — The technique of continuous culture as applied to a fungus, Ophiostoma multiannulatum. Proc. Sixth Int. Congr. Microbiol. 1, 406.
175. van den Honert, T. H., Quantitative considerations in stomatal transpiration. PBC, 758—760.
176. Huber, B., Versuche zur Messung des Gaswechsels von Pflanzenbeständen. PBC, 228.

177. Humphries, E. C., The absorption of ions by excised root systems. PBC, 736—737.
178. Hygen, G., Experiments with excised objects in the study of plant transpiration. PBC, 738—739.
179. — Studies in plant transpiration. II. PP 6, 106—133.
180. Hylmö, B., Transpiration and ion absorption. PP 6, 333—405. (Äv. diss. Lund.)
181. Höfler, K., New facts on water permeability. PBC, 737—738.
182. Ingestad, T., Kinetic aspects on the growth-regulating effect of some phenoxy acids. PP 6, 796—803.
183. James, W. O., and James, G. M., The use of solanaceous grafts in the study of alkaloid formation. PBC, 774—775.
184. Jefferys, E. G., Antibiotics in soil ecology. PBC, 448—449.
185. Jensen, H. L., Nitrification of pyruvic acid oxime by heterotrophic bacteria. PBC, 160—161.
186. Jönsson, Å., Synthetic plant hormones. IV. Preparation and physiological activity of some α-phenoxy fatty acids, especially *iso*-butyric acids. ACS 7, 596—602.
187. Jørgensen, E. G., Silicate assimilation by diatoms. PP 6, 301—315.
188. Jørgensen, E., and Vejlby, K., A new polyphenol oxidase test. PP 6, 533—537.
189. Kylin, A., The uptake and metabolism of sulphate by deseeded wheat plants. PP 6, 775—795.
190. Larsen, P., Influence of gravity on rate of elongation and on geotropic and autotropic reactions in roots. PP 6, 735—774.
191. Laties, G. G., An oxidative, cyanide insensitive system in the chloroplasts of a higher plant. PBC, 760—761.
192. — The dual role of adenylate in the mitochondrial oxidations of a higher plant. PP 6, 199—214.
193. — Transphosphorylating systems as a controlling factor in mitochondrial respiration. PP 6, 215—225.
194. Levitt, J., Further remarks on the thermodynamics of active (non-osmotic) water absorption. PP 6, 240—252.
195. — Metal-protein complexes in the potato. PBC, 762—763.
196. Lexander, Kerstin, Growth-regulating substances in roots of wheat. PP 6, 406—411.
197. Lindberg, B., Low-molecular carbohydrates in algae. I—III. ACS 7, 1119—1124, 1218—1219.
198. Lindberg, B., Misiorny, A., and Wachtmeister, C. A., Studies on the chemistry of lichens. IV. ACS 7, 591—595.
199. Lindberg, B., and Wickberg, B., Studies on the chemistry of lichens. III. ACS 7, 140—142.
200. Lindeberg, G., Different types of phenol oxidases in the cultivated mushroom. PBC, 455.
201. Lindegren, C. C., and Haddad, S. A., The control of nuclear and cytoplasmic synthesis by the nucleo-cytoplasmic ratio in Saccharomyces. ECR 5, 549—550.
202. Lona, F., Untersuchungen über Blühbedingungen in Kurztagpflanzen. PBC, 161—162.

203. LOWE, J. S., The enzymic absorption of sugars by excised roots. PBC, 753—754.
204. LUNDBERG, B., Methane fermentation of Penicillium mycelium. AfK 5, 1—9.
205. LUNDEGÅRDH, H., Complex reactions of cytochrome c. Nature 172, 303.
206. — Controlling effect of salts on the activity of the cytochrome oxidase. Nature 171, 477—478.
207. — Properties of the cytochrome system of wheat roots. AfK, 97—146.
208. — Reaction kinetics of the cytochrome system. Nature 171, 521—522.
209. — The anion respiration. PBC, 765—770.
210. LUYET, B. J., Ultra rapid cooling and the preservation of life. PBC, 796.
211. LÖHR, ERIKA, Die Redistribution von Kalium in Getreide. PP 6, 859—862.
212. — Die Zuckerarten im Blutungssaft von Betula und Carpinus. PP 6, 529—532.
213. MAC DOUGAL, D. T., and DUFRENOY, J., Mycorrhizae of excised roots of the Monterey Pine, Pinus radiata. PBC, 438—439.
214. MAGROU, J., MARNEFFE, H., et MARIAT, F., Action morphogène des vitamines sur certains champignons. PBC, 390—391.
215. MANDELS, G. R., Localization of carbohydrases at the surface of fungus spores by acid treatment. ECR 5, 48—55.
216. MATELL, M., α-N-Arylaminocarboxylic acids as plant growth-regulators. ACS 7, 228—229.
217. — Stereochemical studies on plant growth regulators. II—III. AfK 5, 187—192, 341—347.
218. — Stereochemical studies on plant growth regulators. V—VIII. AfK 6, 251—260, 355—360, 365—373, 375—379.
219. — Stereochemical studies on plant growth substances. KLA 20, 205—240. (Även diss. Uppsala.)
220. MATELL, M., and LARSSON, S., Stereochemical studies on plant growth regulators, IV. AfK 5, 379—385.
221. MAYER, A. M., Quantitative aspects of the behaviour of coumarin as a germination inhibitor. PP 6, 413—424.
222. MCRAE, D. H., and BONNER, J., Chemical structure and antiauxin activity. PP 6, 485—510.
223. MELIN, E., Recent studies on the nature of tree mycorrhizae. PBC, 435—436.
224. MELIN, E., and NILSSON, H., Transfer of labelled nitrogen from glutamic acid to pine seedlings through the mycelium of Boletus variegatus (Sw.) Fr. Nature 171, 134.
225. MIKAELSEN, K., and HALVORSEN, H., Experiments on the respiration of X-irradiated barley seeds. PP 6, 873—879.
226. MITCHELL, K. J., Influence of light and temperature on the growth of ryegrass (Lolium spp.). I—II. PP 6, 21—46, 425—443.
227. MIX, A. J., Studies in the genus Taphrina. Behavior of various species as to utilization of nitrogen compounds. PBC, 397—398.
228. MOEWUS, F., Physiologie und Biochemie der Selbststerilität bei Forsythia. PBC, 777.
229. MOREL, G., Recent advances in callus tissue culture. PBC, 788—789.
230. NADEL-SCHIFFMANN, MINA, L'influence de la température et de la pluviosité sur l'apparition des differentes espèces de Phytophthora. PBC, 414—415.

231. Neugnot, D., Deuxième contribution à l'étude cytochimique des cyanophycées. PBC, 367.

232. Nielsen, N., and Nilsson, N. G., Investigations on the phosphorus metabolism in Rhodotorula gracilis. I. ACS 7, 984—986.

233. Nilsson, N. G., and Nielsen, N., Investigations on the phosphorus metabolism in Rhodotorula gracilis. II. ACS 7, 1067—1070.

234. Nishimura, M. S., Wittingham, C. P., and Emerson, R., The quantum requirement of photosynthesis. PBC, 739—741.

235. Nômmik, H., Fluorine in Swedish agricultural products, soil and drinking water. Acta Polytechnica 127, Stockholm, 121 s. (Diss. Uppsala, Lantbrukshögsk.)

236. Nordström, C. G., Isolation of a benzylidenecoumaranone (aurone) from a yellow dahlia. Chem. and Indust. (London), 823. (Tills. m. T. Swain.)

237. — The flavone glycosides of parsley. I. The isolation of 7-(apiosyl-glucosyl)-luteolin. Chem. and Indust. (London), 85. (Tills. m. T. Swain och A. J. Hamblin.)

238. Norén, B., Methods of growth-determination of myxobacteria. PBC, 423.

239. — On the production of antibiotics by myxobacteria. SBT 47, 402—410.

240. — Studies on myxobacteria. II. Bacteriolytic activity. SBT 47, 309—332.

241. Norkrans, Birgitta, On cellulolytic enzymes of different Tricholoma species. PBC, 454—455.

242. — The effect of glutamic acid, aspartic acid, and related compounds on the growth of certain Tricholoma species. PP 6, 584—593.

243. Norkrans, Birgitta, and Aschan, Karin, A study in the cellulolytic variation for wildtypes and mutants of Collybia velutipes. II. Relations to different nutrient media. PP 6, 829—836.

244. Olsen, C., The significance of concentration for the rate of ion absorption by higher plants in water culture. II—IV. PP 6, 837—858.

245. Petersen, E. L., and Naylor, A. W., Some metabolic changes in tobacco stem tips accompanying maleic hydrazide treatment and the appearance of frenching symptoms. PP 6, 816—828.

246. Peyronel, B., L'étude des mycorrhizes par l'observation directe. PBC, 436—438.

247. Pfeiffer, H. H., Fortschritte in der Analyse des »capillary birefringent effect» des Cytoplasmas. PBC, 361—362.

248. Pisek, A., Transpiration und Wasserhaushalt der Fichte bei zunehmender Luft- und Bodentrockenheit. PBC, 229—230.

249. Plantefol, L., et Moyse, A., Les oxydations cellulaires et la respiration. PBC, 761—762.

250. Pohjakallio, O., On the effect of day-length on the yield of potato. PP 6, 140—149.

251. Politis, J., Origine des vacuoles spécialisées. PBC, 368.

252. — Recherches cytologiques sur le mode de formation de l'acide chlorogénique chez les Composées. PBC, 367—368.

253. Pollock, B. M., The respiration of Acer buds in relation to the inception and termination of the winter rest. PP 6, 47—64.

254. Prevot, P., Recherches sur la croissance, la nutrition minérale et le diagnostic foliaire de l'arachide. PBC, 793—795.

255. Reinders-Gouwentak, Cornelia A., and Smeets, L., Substances involved in fruit and flower drop. PBC, 785—786.

256. Rennerfelt, E., Heartwood constituents in some conifers and their fungicidal properties. PBC, 316—317.

257. Rennerfelt, E., and Paris, Sheila K., Some physiological and ecological experiments with Polyporus annosus Fr. Oikos 4(: 1), 58—76.

258. Ritchie, D., and Hazeltine, Patricia, Mitochondria in Allomyces under experimental conditions. ECR 5, 261—274.

259. Roberts, O., Translocation in the fungi. PBC, 453—454.

260. Robertson, R. N., and Wilkins, M. J., The effects of 2,4-dinitrophenol on salt accumulation and respiration. PBC, 771.

261. Ruhland, W., Zur Ultrafiltertheorie der Permeabilität nebst Bemerkungen zur Theorie der Narkose. PBC, 772—773.

262. Said, H., Sucrose inversion and absorption by plant tissues. PBC, 754—755.

263. Schopfer, W. H., Les équilibres vitaminiques chez les microorganismes. PBC, 388—389.

264. Schwartz, W., Sedimentbakteriologie. PBC, 455—456.

265. Scott Russel, R., Studies in the absorption and utilization of phosphorus by tracer methods. PBC, 192—193.

266. Siegel, S. M., On the biosynthesis of lignins. PP 6, 134—139.

267. Šimak, M., and Gustafsson, Å., X-ray photography and sensitivity in forest tree species. Her. 39, 458—468.

268. Sjöström, A. G. M., and Ericson, L.-E., The occurrence in lichens of the folic acid-, folinic acid-, and vitamin B_{12}-group of factors. ACS 7, 870—872.

269. Smith, J. H. C., Chlorophyll formation and its correlation with the development of photosynthetic activity. PBC, 752—753.

270. Snellman, O., and Danielsson, C. E., An experimental study of the biosynthesis of the reserve globulins in pea seeds. ECR 5, 436—442.

271. Sobels, Johanna C., Culture and antibiotic properties of Myxomycetes. PBC, 450—451.

272. Sossountzov, I., Action du glycocolle sur le développement in vitro des colonies prothalliennes de Gymnogramme calomelanos, Filicinée Polypodiacée. I. PP 6, 723—734.

273. Steemann Nielsen, E., Carbon dioxide concentration, respiration during photosynthesis, and maximum quantum yield of photosynthesis. PP 6, 316—332.

274. Stocker, O., Begriff und Wesen der Dürreresistenz. PBC, 232—234.

275. Street, H. E., Factors controlling meristematic activity in excised roots. III. Light as a factor in the »location effect» noted with roots of Lycopersicum esculentum, Mill. PP 6, 466—479.

276. Street, H. E., and McGonagle, Moira P., Factors controlling meristematic activity in excised roots. IV. Habituation of the main axis meristem of excised tomato roots to repeated subculture. PP 6, 707—722.

277. Street, H. E., McGonagle, Moira P., and Roberts, E. H., Factors controlling meristematic activity in excised roots. II. Experiments involving repeated subculture of the main axis meristem of roots of Lycopersicum

esculentum, Mill. and Lycopersicum pimpinellifolium, Dunal. PP 6, 1—16.

278. Sullivan, A. J. Jr., Some aspects of the biochemistry of dormancy in the myxomycete Physarum polycephalum. PP 6, 804—815.

279. Tamiya, H., New observations on photosynthesis in flashing light. PBC, 742—745.

280. — Some new approaches to the problem of mode of action of antibacterial substances. PBC, 447.

281. Thimann, K. V., The biochemistry of growth and inhibition in isolated plant parts. PBC, 777—780.

282. Todd, G. W., Enzyme studies on dormant and active potato tubers. PP 6, 169—186.

283. Tonzig, S., The significance of ascorbic acid in plants. PBC, 755—756.

284. Waksman, S. A., Antibiotics and their significance in the physiology of microorganisms. PBC, 440—447.

285. Walter, H., Der osmotische Wert (die Hydratur) als Indikator der Wasserbilanz von ökologischen Typen in verschiedenen Klimazonen. PBC, 234—235.

286. Wareing, P. F., Growth studies in woody species. V. Photoperiodism in dormant buds of Fagus silvatica L. PP 6, 692—706.

287. Waris, H., The significance for algae of chelating substances in the nutrient solutions. PP 6, 538—543.

288. Wassink, E. C., On phosphate exchanges accompanying photosynthesis. PBC, 746—747.

289. Weibull, C., The free amino groups of the Proteus flagella protein. ACS 7, 335—339.

290. Weintraub, R., Studies on the action of exogenous plant growth-regulators. PBC, 783—784.

291. Veldstra, H., Some chemical aspects of growth substance action. PBC, 780—783.

292. Went, F. W., The effects of climate on plant growth and distribution. PBC, 56—63, 4 pl.

293. Wetmore, R. H., Tissue and organ culture as a tool for studies in development. PBC, 369—370.

294. Wikén, T., Der Einfluss minimaler Mengen Sauerstoff auf die Vergärung der Glukose durch die Kulturweinhefe »Fendant». Experientia 9, 417—419. (Tills. m. O. Richard.)

295. — Untersuchungen über die Physiologie der Weinhefen. IV. Antonie van Leeuwenhoek 19, 279—299, summary 294—298. (Tills. m. O. Richard.)

296. — Über die Verwertung der Propionsäure durch Butylbakterien. Schweiz. Zeitschr. f. allg. Path. u. Bakt. 16, 836—845. (Tills. m. F. Zobrist.)

297. Williams, W. T., and Barrett, F. A., A simple »scoring» method for the estimation of stomatal starch in Pelargonium. PP 6, 226—233.

298. Virgin, H. I., and Ehrenberg, L., Effects of β- and γ-rays on the protoplasmic viscosity of Helodea cells. PP 6, 159—165.

299. Virtanen, A. I., Microbiology and chemistry of symbiotic nitrogen fixation. PBC, 156—159.

300. WITHROW, R. B., and WITHROW, ALICE P., A linear recording AC conductance bridge for measuring salt exchange in plants. PP 6, 444—450.

301. WONG, D. T. O., and AJL, S. J., Replacement of carbon dioxide by factors obtained from Lebedev juice. ECR 4, 42—51.

302. ÅBERG, B., On optically active plant growth regulators. KLA 20, 241—295.

303. — On the effect of different sugars upon the ascorbic acid content of detached leaves. KLA 20, 125—138.

304. — On the interaction of 2,3,5-triiodobenzoic acid and maleic hydrazide with auxins. PP 6, 277—291.

305. ÅBERG, B., and KHALIL, A., Some notes on the effect of auxin antagonists and synergists upon coleoptile growth. KLA 20, 81—103.

Se även nr 1—3, 9, 12, 15, 19, 38, 52, 74, 82, 316, 325, 366, 383, 384, 394, 397, 485, 580, 648, 654, 698, 706, 720, 722, 735, 756, 774, 840, 900, 928, 955, 1006, 1026.

Genetik. Cytologi.

306. BAKER, H. G., The agamic complex in Limonium (sections Densiflorae and Dissitiflorae Boiss.). PBC, 329—330.

307. BAUCH, R., Die Konstanz der experimentell erzeugten Gigas-rassen der Hefe. PBC, 424—427.

308. — Mutationsauslösung durch Trypaflavin. PBC, 224—226.

309. BERNSTRÖM, P., Cytogenetic intraspecific studies in Lamium. II. Her. 39, 381—437.

310. — Increased crossability in Lamium after chromosome doubling. Her. 39, 241—256.

311. — Species relationships in Lamium. PBC, 280.

312. BLAKESLEE, A. F., Demonstrations of a horticultural type developed from a wild weed, Rudbeckia hirta. PBC, 336—337.

313. — New hybrids in Datura from culture of excised embryos. PBC, 324—325.

314. BRIEGER, F. G., Distribution and origin of maize and theory of collective centres of origin. PBC, 174—179.

315. BRITTAN, N. H., Cytotaxonomy of some species of Agrimonia L. PBC, 278.

316. BRODIE, H. J., Sexuality, inheritance studies and nuclear migration in the Nidulariaceae (Gasteromycetes). PBC, 431—432.

317. BÖCHER, T. W., LARSEN, K., and RAHN, K., Experimental and cytological studies on plant species. I. Kohlrauschia prolifera and Plantago Coronopus. Her. 39, 289—304.

318. CAROLI, G., and BLIXT, S., The morphology of the chromosomes of Pisum. Agri Hort. Gen. 11, 133—140. Zusammenfassung 139.

319. CATCHESIDE, D., The nature of gene mutations. PBC, 325—326.

320. CHODAT, F., Gènes de tempérament et développement phasique chez Daucus carota. PBC, 340.

321. CLELAND, R. E., Extra diminutive chromosomes in Oenothera. PBC, 214—215.

322. CROSBY, J. L., The selection of unfavourable genes. PBC, 339—340.

323. DAHLGREN, K. V. O., Die eigenartigen Vererbungsverhältnisse der micrantha-Form von Fragaria vesca. SBT 47, 1—15. Summary 13—14.

324. DARLINGTON, C. D., The study of the cell in the understanding of life. PBC, 88—103.

325. EHRENBERG, L., GUSTAFSSON, Å., LUNDQVIST, UDDA, and NYBOM, N., Irradiation effects, seed soaking and oxygen pressure in barley. Her. 39, 493—504.

326. ERICKSON, R. O., and OGUR, M., Nucleic acids and cell division. PBC, 326.

327. GALÁN, F., Analyse génétique de la monoecie et de la dioecie zygotiques et de leur différence dans Ecballium elaterium. PBC, 340—341.

328. GATES, R. R., The taxonomic units in relation to cyto-genetics and genecology. PBC, 287—288.

329. GELIN, O. E. V., Mitotische Störungsfrequenzen in röntgenbestrahlter Gerste. Agri Hort. Gen. 11, 66—81. Summary 80.

330. GLUSHCHENKO, I. E., Hybridization of plants by means of grafting. PBC, 346—347.

331. GODWARD, MAUD B. E., Cytological criteria in the taxonomy of Spirogyra. PBC, 833—834.

332. GRANHALL, I., X-ray mutations in apples and pears. Her. 39, 149—155.

333. GRANHALL, I., EHRENBERG, L., and BORENIUS, S., Experiments with chronic gamma irradiation on growing plants. BN, 155—162.

334. GUSTAFSSON, Å., The cooperation of genotypes in barley. Her. 39, 1—18.

335. HAGBERG, A., Further studies on and discussion of the heterosis phenomenon. Her. 39, 349—380.

336. — Heterosis in barley. Her. 39, 325—348.

337. — Heterozygosity in erectoides mutations in barley. Her. 39, 161—178.

338. HALLQVIST, C., Change of dominance in different genic environments. Her. 39, 236—240.

339. HARTE, CORNELIA, Die Wirkung von Meterwellen auf Zellkern und Chromosomen. PBC, 209—210.

340. HOWARD, H. W., Induced and natural polyploidy in Nasturtium and Rorippa. PBC, 331—332.

341. HÅKANSSON, A., Endosperm formation after $2x$, $4x$ crosses in certain cereals, especially in Hordeum vulgare. Her. 39, 57—64.

342. — Some chromosome numbers in Umbelliferae. BN, 301—307.

343. KIHLMAN, B., Purine derivatives in the Allium test. PBC, 212—213.

344. KÖLMARK, G., Differential response to mutagens as studied by the Neurospora reverse mutation test. Her. 39, 270—276.

345. KÖLMARK, G., and WESTERGAARD, M., Further studies on chemically induced reversions at the adenine locus of Neurospora. Her. 39, 209—224.

346. LAMM, R., Investigations on some tuber-bearing Solanum hybrids. Her. 39, 97—112.

347. LAMPRECHT, H., Bisher bekannte und neue Gene für die Morphologie der Pisum-Blüte. Agri Hort. Gen. 11, 122—132. Summary 131—132.

348. — Ein Gen für schmale Hülsen bei Pisum und seine Koppelung. Agri Hort. Gen. 11, 15—27. Summary 26.

349. — Ein neuer Fall von multipler Allelie bei Pisum. Agri Hort. Gen. 11, 28—39. Summary 38.

350. — Ein neues Gen Rf und die Genenkarte von Chromosom III von Pisum. Agri Hort. Gen. 11, 55—65. Summary 64.

351. — Further studies of the interchange between the chromosomes III and V of Pisum. Agri Hort. Gen. 11, 141—148. Zusammenfassung 148.

352. LAMPRECHT, H., New and hitherto known polymeric genes of Pisum. Agri Hort. Gen. 11, 40—54. Zusammenfassung 52—53.

353. — Petunia axillaris (Lam.) B. S. P. und ihre Synonyme P. violacea Lindl. und P. inflata R. Fries, mit Betrachtungen zum konventionellen und naturbedingten Artbegriff. Agri Hort. Gen. 11, 83—108. Summary 106—107.

354. — Taxonomy on genic and cytological basis. PBC, 287.

355. — The mathematical and genetical evaluation of segregation ratios. Agri Hort. Gen. 11, 1—14.

356. LESLEY, J. W., and LESLEY, MARGARET M., A cytogenetic study of a pleiotropic mutant of Lycopersicum esculentum. PBC, 221.

357. LEWIN, R. A., Genetics of Chlamydomonas moewusii Gerloff. PBC, 430.

358. LIMA-DE-FARIA, A., The chromosomes of Secale cereale at pachytene. PBC, 217.

359. LINDER, R., L'incompatibilité dans Oenothera missouriensis. PBC, 344.

360. LUNDQVIST, A., Inbreeding in autotetraploid rye. Her. 39, 19—32.

361. LÖVE, Á., Subarctic polyploidy. Her. 39, 113—124.

362. LÖVE, DORIS, Cytotaxonomical remarks on the Gentianaceae. Her. 39, 225—235.

363. LÖVKVIST, B., Polyploidy and differentiation in the Cardamine pratensis complex. PBC, 333—334.

364. MACFARLANE, EILEEN W. E., Cytological conditions in root tip meristem after gross antagonism of phenylmercuric poisoning. ECR 5, 375—385.

365. MANTON, IRENE, Polyploidy and its probable significance in the Pteridophyta. PBC, 332—333.

366. MARKERT, C. L., Lethal and mutagenic effects of ultraviolet radiation on Glomerella conidia. ECR 5, 427—435.

367. MARQUARDT, H., Abbauprodukte körpereigener Stoffe als mutagene Agentien. PBC, 219—220.

368. MATHER, K., The genetical architecture of heterostyly in Primula sinensis. PBC, 338—339.

369. MATHIESON, M. J., and CATCHESIDE, D. G., Mutation in Bombardia lunata and Chromocrea spinulosa. PBC, 427—428.

370. MATSUURA, H., On the structural aberration of chromosomes found in natural populations of Trillium. PBC, 222—223.

371. MEHLQUIST, G. A. L., Inheritance in Delphinium hybrids between D. cardinale Hook. and D. elatum L. PBC, 278—279.

372. — Polyploidy in orchid genera of commercial importance. PBC, 335.

373. MICHAELIS, P., Ergebnisse der Plasmavererbung und ihre Bedeutung für das Artbildungsproblem. PBC, 341—343.

374. DE MOL VAN OUD LOOSDRECHT, W. E., Somatic mutation in tulips by treatment with neutrons. PBC, 221—222.

375. MÜNTZING, A., Några aktuella problem inom genetiken. Stat. Naturv. Forskningsråds årsb. 6, 9—40.

376. — Polyploidernas ekologi. KLT 92, 119—130. Summary 129.

377. — Ärftlighetsforskning. En översikt av metoder och huvudresultat. Stockholm. 278 s.

378. Nilsson, H., Synthetische Artbildung. Grundlinien einer exakten Biologie. I—II. Lund. 1303 s. Summary 1139—1246.

379. — Über die Entstehung der Selbstfertilität beim Roggen. Her. 39, 65—74.

380. Nordenskiöld, Hedda, A genetical study in the mode of segregation in hexaploid Phleum pratense. Her. 39, 469—488.

381. — An investigation into two tetraploid strains of vetches (Vicia sativa) and their hybrid products. KLA 19, 209—225.

382. — Cyto-taxonomic studies in the genus Luzula. PBC, 282—283.

383. Nybom, N., Some experiences from mutation experiments in Chlamydomonas. Her. 39, 317—324.

384. Nybom, N., Lundqvist, Udda, Gustafsson, Å., and Ehrenberg, L., Biological effects of X-irradiation at low temperatures. Her. 39, 445—457.

385. Nygren, A., Biotype and species formation in some grass genera. PBC, 281.

386. — How to breed Kentucky bluegrass, Poa pratensis L. Her. 39, 51—56.

387. Oldén, E. J., Sexual and apomictic seed formation in Malus Sieboldii Rehd. BN, 105—128.

388. Olsson, G., Undersökning av självfertiliteten hos artificiell raps. KLT 92, 394—402. Summary 401—402.

389. Perje, Ann-Margaret, The variation within and between clones in Ranunculus ficaria L. PBC, 271—272.

390. Plaut, W. S., DNA synthesis in the microsporocytes of Lilium Henryi. Her. 39, 438—444.

391. Politis, J., Sur des gènes produisant de l'anthocyane chez quelques Convolvulées. PBC, 344—345.

392. Randolph, L. F., Crossability of maize and Tripsacum in relation to theories of the origin of maize. PBC, 179—180.

393. Rasmusson, J., Autotetraploid sugar beets. Vitality changes in subsequent generations. Her. 39, 257—269.

394. Raut, Caroline, A cytochrome deficient mutant of Saccharomyces cerevisiae. ECR 4, 295—305.

395. Rollins, R. C., The nature and occurrence of apomixis in Parthenium (Compositae). PBC, 326—327.

396. v. Rosen, G., Radiomimetic activity and the periodical system of the elements. BN, 140—142.

397. Ross, H., Physiologie der Reziprokenunterschiede bei einigen Epilobium-Bastarden. PBC, 343—344.

398. Rothmaler, W., Die »Gen»-Zentren der Kulturpflanzen. PBC, 181—182.

399. Rudorf, W., Inbreeding and heterosis with Helianthus annuus L. PBC, 198—199.

400. Rutishauser, A., Sexuality and apospory in some pseudogamous plants. PBC, 328—329.

401. Sakisaka, M., Critical considerations of chromosome numbers in relation to plant habit (life forms). PBC, 286—287.

402. Satina, Sophia, and Blakeslee, A. F., Chromosomal end arrangements due to segmental interchange in ten species of Datura. PBC, 223—224.

403. Schiemann, Elisabeth, Artbildung in der Gattung Fragaria. PBC, 180—181.

404. — Ursprung und Entwicklung von Weizen und Gerste. PBC, 273—275.

405. Sears, E. R., The origin and evolution of the wheats. PBC, 273.

406. SIMMONDS, N. W., Polyploidy in bananas. PBC, 335—336.

407. SKOVSTED, A., Some colchicine experiments with hops (Humulus). Her. 39, 156—160.

408. STAKMAN, E. C., Mutation and hybridization in the smut fungi. PBC, 428—429.

409. STOLETOV, V. N., Nature of the hybrid plants. PBC, 348—349.

410. SUCHOW, K. S., Directed changeability of phytopathogenic viruses. PBC, 347.

411. TAYLOR, J. H., Autoradiographic detection of incorporation of P^{32} into chromosomes during meiosis and mitosis. ECR 4, 164—173.

412. THERMAN, EEVA, Chromosomal evolution in the genus Polygonatum. Her. 39, 277—288.

413. TISCHLER, G., Die Basiszahlen der Chromosomen innerhalb der natürlichen Ordnungen und Familien bei den Angiospermen. PBC, 337.

414. — Über die Unterschiede der inducierten und natürlichen Polyploiden und ihre Auswirkung auf pflanzengeographische Probleme. PBC, 330—331.

415. TJIO, JOE HIN, Chromosome fragmentation by pyrogallol in Vicia faba. PBC, 210—211.

416. TIMONEN, S., The sensitivity of the cell to X-rays. ECR 4, 142—150.

417. TURBIN, N. V., New experimental data on the nature of fertilization in plants. PBC, 347—348.

418. VAARAMA, A., Chromosome fragmentation and accessory chromosomes in Orthotrichum tenellum. Her. 39, 305—316.

419. VALENTINE, D. H., Interspecific compatibility and hybrid fertility as taxonomic criteria. PBC, 285—286.

420. WINGE, Ö., The polymeric genes for maltose fermentation in yeasts, and their mutability. PBC, 424.

421. ÅBERG, E., Studies on the origin and classification of barleys and their significance for the principles in classification of selfpollinated cultivated plants. PBC, 275—276.

422. ÅKERBERG, E., The progeny of artificial hybrids between Poa pratensis L. (coll.) and Poa alpina L. PBC, 327—328.

423. ÅKERBERG, E., and BINGEFORS, SIGRID, Progeny studies in the hybrid Poa pratensis × Poa alpina. Her. 39, 125—136.

424. ÖSTERGREN, G., Behaviour of chromosomes on the spindle. PBC, 215—216.

425. — Cytological standards for the quantitative estimation of spindle disturbances. PBC, 211—212.

426. ÖSTERGREN, G., KOOPMANS, A., and REITALU, J., The occurrence of the amphiastral type of mitosis in higher plants and the influence of aminopyrin on mitosis. BN, 417—419.

427. ÖSTERGREN, G., and VIGFÚSSON, E., On position correlations of univalents and quasi-bivalents formed by sticky univalents. Her. 39, 33—50.

Se även nr 19, 21, 25, 51, 57, 70, 89, 128, 139, 145, 243, 429, 432, 444, 446, 449, 456, 458, 662, 685—87, 693, 757, 772, 821, 830, 1061.

Nomenklatur. Systematik.

1. Fanerogamer.

428. Boivin, B., Le groupe du Stellaria longifolia Muhlenberg (Caryophyllaceae). SBT 47, 43—46.
429. Böcher, T. W., Cultivation experiments with Geranium Robertianum, Veronica officinalis, and Prunella vulgaris. PBC, 268—269.
430. van Campo-Duplan, Madeleine, Pollens et phylogénie chez les Conifères. PBC, 877—880.
431. Eames, A. J., Are the Ephedrales derivatives of Cordaite stock? PBC, 382.
432. Earnshaw, F., The nature of ecotypes. PBC, 269—270.
433. Garay, L. A., Orchidaceae austro-americanae. I. SBT 47, 190—234, 4 pl.
434. Gjærevoll, O., Jørgensen, R., Fjällfjora. Med färgteckningar av Dagny Tande Lid. Sv. bearb. av S. Selander. Stockholm. 160 s.
435. Hering, E. M., Die Oligophagie phytophager Insekten als Hinweis auf Pflanzenverwandtschaften. PBC, 871—872.
436. Hochreutiner, B. P. G., Réflexions sur la taxonomie des Malvacées. PBC, 862.
437. Hylander, N., Hosta. En översikt över de svenska trädgårdarnas funkior eller blåliljor. Lustgården 33—34, 5—52.
438. — Nordisk kärlväxtflora omfattande Sveriges, Norges, Danmarks, Östfennoskandias, Islands och Färöarnas kärlkryptogamer och fanerogamer. I. Stockholm. XV+392 s., 1 kartbil.
439. — Some ideas regarding the systematics of Scandinavian grasses. PBC, 854—855.
440. — Svenska träd- och busknamn. Ett supplement. Lustgården 33—34, 61—65.
441. — Taxa et nomina nova in opere meo: Nordisk kärlväxtflora I (1953) inclusa. BN, 352—359.
442. Hässler, A., The group Cheloneae of the genus Euphorbia. PBC, 868.
443. Kanér, R., Om tolkningen av Rubus pruinosus Arrh. BN, 233—235. Summary 234—235.
444. Keck, D. D., Examples of the applications of experimental methods to taxonomy. PBC, 277—278.
445. Lourteig, A., Ranunculaceae of temperate South America. PBC, 863—864.
446. Löve, Á., The taxonomical evaluation of types with different chromosome numbers. PBC, 283—284.
447. Löve, Doris, Cirsium Flodmani (Rydb.) Arth., f. albiflorum, forma nova. Rhodora 55, 362—363.
448. Melderis, A., Generic problems within the tribe Hordeeae. PBC, 853—854.
449. Muller, C. H., Ecological control of hybridization in Quercus; a factor in the mechanism of evolution. PBC, 284—285.
450. Nomenclature. Report (by J. Lanjouw). Discussions. Supplements I—IV. PBC, 457—550.
451. Óskarsson, I., A new Alchemilla species of the eu-vulgares group found in Iceland. SBT 47, 30—33.

452. PILGER, R., Bemerkungen zum System der Gramineae. PBC, 852—853.

453. PONCE DE LÉON Y AYMÉ, A., Contribution to the phylogenetic arrangement of the Dicotyledones. PBC, 870.

454. ROTHMALER, W., Die Taxonomie der Kulturpflanzen. PBC, 180.

455. RYBERG, M., Corydalis solida (L.) Sw. subsp. laxa Fr., and Corydalis pumila (Host) Rchb. Supplementary notes. AHB 16(: 7), 233—240.

456. VAARAMA, A., Cytotaxonomic studies on northern Tripleurospermum forms. PBC, 279—280.

457. WEIMARCK, H., Two new Cliffortia species from the Cape Province. BN, 78—80.

458. VICKERY, R. K. JR., An experimental study of the races of the Mimulus guttatus complex. PBC, 272.

459. YOUNG, D. P., Autogamous Epipactis in Scandinavia. BN, 253—270.

Se även nr 24, 39, 47, 55, 56, 311, 315, 317, 328, 353, 354, 378, 385, 419, 421, 522, 531, 577, 750, 853, 915, 945.

2. Kryptogamer.

460. DES ABBAYES, H., Les Cladonia du sous-genre Cladina: essai de classification naturelle. PBC, 813—814.

461. AHLNER, S., Some aspects of nomenclature and taxonomy of lichens. PBC, 809.

462. ARNELL, S., A new South African species of Exormotheca. Trans. of the Brit. Bryol. Soc. 2, 283—284.

463. — Hepaticae collected in South Africa 1951. SBT 47, 107—118.

464. — Hepaticae collected in South Africa 1951. New and little known species. II—III. BN, 163—186, 271—289.

465. — List of Hepaticae collected in Marion Island by Mr. R. W. Rand Dec. 1951—April 1952. SBT 47, 411—425.

466. BARTRAM, E. B., Additional mosses from Northeast New Guinea. SBT 47, 397—401.

467. BERG, Å., Diatoms from the Upper Finke River, Central Australia, collected by Dr. O. H. Selling. BN, 65—72.

468. BUCH, H., Experimentelle Methoden in der Lebermoossystematik. PBC, 806—808.

469. CEJP, K., Proposals for characterizing the taxonomic units of Fungi imperfecti. PBC, 395—396.

470. CHADEFAUD, M., Les cellules flagellées des Algues et leur importance systématique. PBC, 821—822.

471. CLEVE-EULER, ASTRID, Die Diatomeen von Schweden und Finnland. II—III. K. Sv. Vet.-ak. Handl., ser. 4, 4: 1 o. 5. 158 s., 35 pl. o. 255 s., 41 pl.

471a. COPELAND, E. B., and GIAUQUE, F. A., Life history of ferns. PBC, 848—849.

472. DAHL, E., On the use of lichen chemistry in lichen systematics. PBC, 810—811.

473. DEGELIUS, G., The experimental method in lichen taxonomy. PBC, 804—805.

474. DROUET, F., and DAILY, A., Revision of coccoid Myxophyceae. PBC, 838—839.

475. DU RIETZ, G. E., Nomenclature of Laminaria digitata (Huds.) Lamour. and Laminaria hyperborea (Gunn.) Foslie. SBT 47, 16—23.

476. FALCK, R., Die Degobasidie und die Degobasidiales. PBC, 402—407.

477. FRANCKE-GROSMANN, HELENE, Zur Ökologie und Taxonomie eines mit Borkenkäfern vergesellschafteten Bläuepilzes, Ophiostoma ips (Rumb.) Nannf. PBC, 317—318.

478. HAWKER, LILIAN E., Some British hypogaeous Basidiomycetes. PBC, 411—412.

479. HEIM, R., Esquisse sur la phylogénie des Basidiomycètes. PBC, 400.

480. HERZOG, T., Eine neue Lebermoosgattung, Pseudomarsupidium Herz. n. gen. aus Westpatagonien. SBT 47, 34—42.

481. HOLM, L., Taxonomical notes on Ascomycetes. III. The herbicolous Swedish species of the genus Didymella Sacc. SBT 47, 520—525.

482. HUSTEDT, F., Die Systematik der Diatomeen in ihren Beziehungen zur Geologie und Ökologie nebst einer Revision des Halobien-Systems. SBT 47, 509—519.

483. — Parallelismus in der Strukturentwicklung verwandter Diatomeengattungen und seine Bedeutung für die Systematik. PBC, 839.

484. HYLANDER, N., JØRSTAD, I., NANNFELDT, J. A., Enumeratio Uredinearum Scandinavicarum. Opera Botanica 1: 1, 102 s.

485. JAAG, O., Über die Variabilität einiger Cyanophyceen unter dem Einfluss der Umweltbedingungen. PBC, 825—826.

486. LANGE, M., The concept of species in the genus Coprinus. PBC, 410—411.

487. LE GAL, M., Revision de la position taxonomique du genre Trichophaea Boudier et ses conséquences du point de vue phylogénetique. PBC, 394—395.

488. LEVRING, T., The marine Algae of Australia. I. Rhodophyta: Goniotrichales, Bangiales and Nemalionales. AfB, ser. 2, 2(: 6), 457—530.

489. LINDAHL, P.-O., The taxonomy and ecology of some Peltigera species, P. canina (L.) Willd., P. rufescens (Weis) Humb., P. praetextata (Flk.) Vain. SBT 47, 94—106, 2 pl.

490. LOHAMMAR, G., Limnomyces neglectus n. gen. et n. sp., a parasite of Elatine triandra. SBT 47, 526—529, 2 pl.

491. MAGNUSSON, A. H., New lichens mainly Rinodina species from U.S.A. BN, 187—196.

492. MANTON, IRENE, Experimental methods available for the taxonomy of the Pteridophyta. PBC, 808.

493. MOEWUS, LISELOTTE, About the occurrence of fresh-water algae in the semi desert round Broken Hill (New South Wales, Australia). BN, 399—416. Zusammenfassung 415.

494. MUNK, A., Some remarks on relations between stromatic and non-stromatic Pyrenomycetes. PBC, 396—397.

495. MÜLLER, K., Neue, für die Lebermoossystematik wichtige Merkmale. PBC, 844—845.

496. NANNFELDT, J. A., and ERIKSSON, J., On the hymenomycetous genus Jaapia Bres. and its taxonomical position. SBT 47, 177—189.

497. NYHOLM, ELSA, Bryologiska notiser. I—II. BN, 290—300. Summary 299—300.

498. PAPENFUSS, G. F., Problems in the classification of the marine algae. PBC, 822—823.

499. PATRICK, RUTH, Some new methods for dealing with variation in diatoms. PBC, 841.

500. PICHI-SERMOLLI, R. E. G., On the nomenclature of some genera of ferns. PBC, 849—850.

501. POCOCK, MARY A., Cell division in the Volvocales and its taxonomic significance. PBC, 832—833.

502. Poelt, J., Zur Kenntnis der gracile-Formen der Sammelart Schistidium apocarpum (L.) Bryol. eur. SBT 47, 248—262.

503. Pringsheim, E. G., The use of culture in algal toxonomy. PBC, 800—803.

504. Richards, P. W., Taxonomy of Musci with special reference to experimental methods. PBC, 805—806.

505. Romagnesi, H., Sur les rapports des Cyphellinées avec certains groupes d'Agaricales. PBC, 407—410.

506. Runemark, H., Taxonomy and distribution of the yellow species of Rhizocarpon in Europe. PBC, 814—815.

507. Santesson, R., The new systematics of lichenized fungi. PBC, 809—810.

508. Silva, P. C., and Starr, R. C., Difficulties in applying the international Code of botanical nomenclature to certain unicellular algae, with special reference to Chlorococcum. SBT 47, 235—247.

509. Singer, R., Antibiotic activity and formation of ectotrophic mycorrhiza in relation to natural affinity in the classification of the Basidiomycetes. PBC, 401—402.

510. Skottsberg, C., On two collections of Antarctic marine Algae. AfB, ser. 2, 2(: 7), 531—566, 1 pl.

511. Skuja, H., Phylogenetische Stellung der Glaucophyceen. PBC, 823—825.

512. Svedelius, N., Critical studies on some species of Galaxaura from Hawaii. Nova acta reg. soc. sci. ups. Ser. IV, 15: 9, 92 s.

513. Vanden Berghen, C., Quelques Hépatiques récoltées par O. Hedberg sur les montagnes de l'Afrique orientale. SBT 47, 263—283.

514. Waterhouse, Grace M., Identification of Phytophthora species by means of oospores produced in dual cultures. PBC, 413—414.

515. Wehmeyer, L. E., Considerations of some methods of approach to the taxonomic study of the fungi. PBC, 393—394.

516. Vischer, W., On the importance of pure culture for the lower algae. PBC, 803—804.

Se även nr 28, 32, 46, 72, 128, 331, 438, 638, 852, 903, 913, 929, 950, 962.

Paleobotanik, pollenanalys, arkeologisk botanik.

517. Andrews, H. N., The telome theory with reference to the early ferns and pteridosperms. PBC, 554—555.

518. Arnold, C. A., Silicified mesozoic and tertiary plants of western North America. PBC, 566.

519. — The spores of Archaeopteris, with remarks on the affinities of the genus. PBC, 559—561.

520. Barghoorn, E. S., Changes in the generic composition of Tertiary floras of North America and their relation to the determination of age. PBC, 574—575.

521. Berger, W., Eine neue Carpinus-Art aus dem Oberoligozän des Rheinlandes. BN, 341—344.

522. — Studien zur Systematik und Geschichte der Gattung Carpinus. BN, 1—47.

523. Chowdhury, K. A., Structure of cell wall in ancient and fossil woods. PBC, 566—567.

524. Chowdhury, K. A., Tertiary floras and problems of regional phytogeography in eastern India. PBC, 575.

525. Corsin, P., La répartition stratigraphique des Pécoptéridées dans les bassins houillers français. PBC, 561—563.

526. — Morphologie des Fougères et des Pteridospermées houillères. PBC, 555—556.

527. Couper, R. A., Harris, W. F., Cookson, Isabel C., and Duigan, Suzanne L., Terminology and nomenclature for fossil pollens and spores. PBC, 890—891.

528. Emberger, L., Les préphanérogames. PBC, 563—564.

529. Fægri, K., On the presentation of pollen-analytical data. PBC, 883.

530. Firbas, F., Die quartäre Vegetationsentwicklung zwischen den Alpen und der Nord- und Ostsee. PBC, 630—631.

531. Florin, R., On the morphology and taxonomic position of the genus Cycadocarpidium Nathorst (Coniferae). AHB 16(: 9), 257—275.

532. — The female reproductive organs of the stachyosperms. PBC, 576—578.

533. Florschütz, F., On the palynological boundary Pliocene-Pleistocene in Europe. PBC, 883—884.

534. — On the vegetation in the Netherlands during the last glaciation. PBC, 631.

535. Fries, M., A pre-Quaternary pollen found in post-glacial clay mud at Varnhem in Västergötland, Sweden. GFF 75, 106—108.

536. Gaussen, H., L'évolution du cône chez les Conifères. PBC, 580—581.

537. Godwin, H., The late-glacial vegetation of Great Britain. PBC, 633—634.

538. Gothan, W., Allgemeine Verbreitung der paläozoischen Floren mit Ausblicken auf die mesozoischen. PBC, 588—591.

539. Guthörl, P., Corynepteriden und ähnliche Gewächse aus dem Saar-Karbon. PBC, 596—597.

540. — Neue Pflanzen-Funde aus dem Karbon und Perm des Saar-Nahe-Gebiets. PBC, 597—599.

541. Halle, T. G., The Carboniferous flora of East Greenland. PBC, 594—595.

542. van der Hammen, T., Die spätglaziale Vegetationsentwicklung in den Niederlanden. PBC, 631—633.

543. Harris, T. M., Nilssonia and its reproductive organs. PBC, 581—582.

544. Hessland, I., Note on Balanus hammeri (Ascanius) as hydrological indicator. With a diatom analysis by Astrid Cleve-Euler. Bull. Geol. Inst. Univ. Ups. 34, 1—24, 1 pl.

545. Hjelmqvist, H., Ett bidrag till kulturväxternas äldsta historia i Sydsverige. BN, 420—430. Summary 429.

546. Hofmann, Elise, Phosphatisierte Hölzer aus Prambachkirchen in Oberösterreich. PBC, 571—572.

547. — Pollenkörner im Oberkreideflysch von Muntigl bei Salzburg. PBC, 886—887.

548. Horn af Rantzien, H., Charophyta from the Middle Trias of the boring Höllviken II. Sv. Geol. Unders. Årsb. 47 (Ser. C: 533), 1—16, 1 pl.

549. — Staining and plastic embedding of small mineralized plant fossils. Nature 171, 516—517.

550. Hsü, J., Devonian spores from Yunnan, China. PBC, 888.

551. — New information on Homoxylon rajmahalense Sahni. PBC, 583—584.

552. Hyde, H., Atmospheric pollen studies in Great Britain in their relation to the pollen analysis of post-glacial deposits. PBC, 882—883.

553. Iversen, J., Origin and postglacial development of the flora of West Greenland in the light of pollen analysis. PBC, 634—636.

554. Jacob, Chinna, and Jacob, K., Cuticles from the Tertiary lignite of Cuddalore, S. Arcot, India. PBC, 572—573.

555. Jacob, K., The stele in Tinpaharia, a new genus of petrified mesozoic ferns from the Rajmahal Hills, Bihar, India. PBC, 564—566.

556. Jongmans, W. J., Carboniferous floras round the paleozoic Mediterranean. PBC, 591—594.

557. Kobayashi, T., The transformation of the Permo-Triassic flora in East Asia elucidated by the climatic change caused by the Akiyoshi crustal deformation. PBC, 599—600.

558. Kräusel, R., Pflanzenwanderungen im Tertiär. PBC, 574.

559. Larsson, B., Diatomésuccessionen i Näsnaren. SBT 47, 426—438, 3 diagram utom texten.

560. Leclerq, Suzanne, A zygopterid from Upper Devonian rocks. PBC, 559.

561. Lona, F., Pollenanalytische Untersuchungen in der Po-Ebene. PBC, 888.

562. Lundblad, Britta, Heterosporous Lycopodiinae in Mesozoic floras. PBC, 595—596.

563. Lüdi, W., Interglacial woods of the Swiss plateau. PBC, 629—630.

564. Marcelle, H., Callixylon Velinense nov. sp., un bois à structure conservée du Devonien de la Belgique. PBC, 600—601.

565. Mitchell, G. F., Naias flexilis (recent and fossil) and Naias marina (fossil) in Ireland. PBC, 636—637.

566. Müller-Stoll, W., Die Diagnostik fossiler Dicotylenhölzer in ihrem Verhältnis zur rezenten Holzanatomie. PBC, 569—571.

567. Nilsson, T., Fossilens vittnesbörd om vegetation och djurliv i nordvästra Skåne under stenkolens bildningstid. »Stenkol och lera» utg. av Höganäs-Billesholms Aktiebolag, 1, 121—173.

568. — Pollenanalys av svämtorv från Vollmon, Jämtland. GFF 75, 507—508.

569. — The pollen-analytical dating. I: Stjernquist, Berta, Nilsson, T., and Nybelin, O., Some Stone Age fishing tackle from Scania. K. Hum. Vet.-samf. i Lund årsber. 1952—1953, 139—146, 1 pl.

570. Ogura, Y., A new pteridosperm and the morphology of the female cone of gymnosperms. PBC, 558.

571. Olausson, E., En submorän torvbildning i Skåne. GFF 75, 513—514.

572. Potonié, R., Über die Nomenklatur der tertiären und älteren Pollenkörner und Sporen. PBC, 889—890.

573. Ross, N.-E., Investigations of the Senonian of the Kristianstad district, S. Sweden. I. On a Cretaceous pollen and spore bearing clay deposit of Scania. Bull. Geol. Inst. Univ. Ups. 34, 25—43, 3 pl.

574. Sandegren, R., Interglacialfynd i Ångermanland och Medelpad. Nat. i Ång., 32—41.

575. Schopf, J. M., Male fructifications of some paleozoic pteridosperms. PBC, 556—557.

576. Selling, O. H., Late Quaternary history of the Hawaiian Islands. (Abstract.). Proc. Seventh Pac. Sci. Congr. Auckland and Christchurch, N. Z. 1949: 5, 99.

577. Thomas, H. H., The relationships between the Bennettitales and Cycadales. PBC, 582—583.

578. Thomson, P. W., Die Sukzession der Moortypen und Pflanzenvereine im Hauptflöz der rheinischen Braunkohle. PBC, 575—576.

579. Walton, J., Pteridosperm fructifications. PBC, 557—558.

580. Varossieau, W. W., Ancient buried and decayed wood, from a biological, chemical and physico-mechanical point of view. PBC, 567—569.

581. Waterbolk, H. T., Palynological investigation of burial mounds. PBC, 884—885.

582. Wenner, C. G., Investigation into the possibilities of distinguishing the pollen of the various species of Betula in fossil material. GFF 75, 367—380.

Se även nr 22, 42, 44, 80, 84, 85, 378, 1040, 1042, 1052, 1066a, 1080.

Patologi.

583. Andersson, H., Kvarstående effekt av hormonderivat på träd och buskar. SV Växtskyddsnot., 59—64.

584. Andrén, F., Orienterande betningsförsök mot penselmögel på utsäde. SV Växtskyddsnot., 38—39.

585. Anerud, K., Växtsjukdomar och skadedjur. Stockholm. 144 s.

586. Armstrong, G. M., and Armstrong, L. K., A comparison of the host relationships of the American, Indian, and Egyptian cotton-wilt Fusaria. PBC, 697—698.

587. Bald, J. G., Development of plant viruses in host cells. PBC, 720.

588. Bauer, R., Immunität und Resistenz gegenüber Sphaerotheca mors uvae (Schw.) Berk. bei Ribes. PBC, 701.

589. Bawden, F. C., Some properties of the tobacco necrosis viruses. PBC, 705—706.

590. Baxter, D. V., Relation of cultural practices to disease in American forest plantation. PBC, 319—321.

591. Beale, Helen P., and Beale, J. H., A virus disease of Syringa vulgaris L. PBC, 721.

592. Björkman, E., Om »granens gulspetssjuka» i plantskolor. SST 51, 211—229. Summary 227.

593. — The occurrence and significance of storage decay in birch and aspen wood with special reference to experimental preventive measures. Skogshögskolan 125 år. K. Skogshögsk. Skrifter 12—19, 53—90. Sammanfattning 88—89.

594. — Virkesskador och virkesvård. Forskning och teknik 3, 1—21.

595. Björling, K., Växtföljden och växtsjukdomarna. Sv. Sockerfabriksaktiebol. Odlaremeddelande nr 23, 5—10.

596. Björling, K., och Ossiannilsson, F., Sjukdomar och skadedjur på sockerbetan. För Sverige bearb. uppl. av E. Gram & P. Bovien, Rodfrugternes Sygdomme og Skadedyr. Arlöv. 59 s., 18 pl.

597. Black, L. M., Multiplication of clover club-leaf virus in its insect vector. PBC, 707—708.
598. Borg, Å., Vitaxighet på råg 1952. SV Växtskyddsnot., 14—15.
599. Boyce, J. S., Development of tree diseases in the United States. PBC, 321—322.
600. Brown, J. G., Antibiotics in relation to some bacterial diseases of plants. PBC, 449.
601. de Bruyn, Helena, Adaptation of Phytophthora infestans to various potato hybrids. PBC, 695—697.
602. Buchwald, N. F., Pseudotsuga and Phaeocryptopus Gäumanni in Denmark. PBC, 296—297.
603. Burkholder, W. H., Certain bacteria that cause rots in tubers and bulbs. PBC, 723—724.
604. Cadman, C. H., and Harris, R. V., Recent advances in research on raspberry virus diseases. PBC, 706—707.
605. Caldwell, J., Some aspects of seed transmission of virus. PBC, 721.
606. Debraux, Germaine, Chimiothérapie du mildiou de la vigne par les composés organiques. PBC, 725—726.
607. Ekstrand, H., Markvegetationens övervintringsproblem. Nord. Jordbrugsforskn. 35, 51—64.
608. Emilsson, B., The relation between content of chlorogenic acid and scab resistance in potato varieties. Acta Agricult. Scand. 3, 328—333.
609. Emilsson, B., and Gustafsson, N., Scab resistance in potato varieties. Acta Agricult. Scand. 3, 33—52.
610. Esbo, H., och Kolk, H., Svartrostens (Puccinia graminis tritici, Eriks. & Henn.) inverkan på veteskördens kvalitet och dess värde som utsäde. Medd. fr. Stat. Centr. Frökontrollanst. 28, 29—43. Summary 42—43.
611. Findlay, W. P. K., and Savory, J. G., Breakdown of timber in water cooling towers. PBC, 315—316.
612. Flentje, N. T., Specialization and variation in Rhizoctonia solani Kühn. PBC, 698.
613. Gassner, G., Neuere Untersuchungen über die Flugbrandbekämpfung bei Weizen und Gerste. PBC, 721—723.
614. Glynne, Mary D., Factors affecting the incidence of eyespot Cercosporella herpotrichoides Fron., on cereals. PBC, 728—729.
615. Goodey, T., Oats and varietal susceptibility to stem eelworm infestation. PBC, 203—204.
616. Gravatt, G. F., The problem of world-wide spread of forest diseases. PBC, 294—295.
617. Gregory, P. H., Factors controlling plant disease gradients. PBC, 728.
618. Hagborg, W. A. F., Adaptation of Xanthomonas translucens to different host plants. PBC, 697.
619. Hellmers, E., and Dowson, W. J., Further investigations of potato black leg. Acta Agricult. Scand. 3, 103—112.
620. Hellqvist, H., Besprutningstekniska försök mot potatisbladmögel [Phytophthora infestans (Mont.) De By]. I. KLT 92, 194—212. Summary 212.
621. Howard, F. L., and Horsfall, J. G., Concepts and progress in plant chemotherapy. PBC, 299—300.

622. Hull, R., Some factors affecting the incidence of Yellows virus in sugar beet in Great Britain. PBC, 729—730.

623. Hutchins, L., On virus diseases of forest trees. PBC, 295—296.

624. Hyde, M. B., The occurrence and significance of sub-epidermal fungi in cereal grains. PBC, 206—208.

625. Johansson, N.-O., Potatisbladmöglet kommer till Chile. SV Växtskyddsnot., 12—13.

626. — Sotsvamp på majs. SV Växtskyddsnot., 57—58.

627. Keitt, G. W., Inheritance of pathogenicity in Venturia inaequalis. PBC, 704.

628. Klingström, A., Granrostens härjningar i Norrbottens län. Fältbiologen 6, 54—55.

629. af Klinteberg, H. B., Rotbrand som följd av näringsbrist. Växtnäringsnytt 9: 2, 12—15.

630. Klotz, L. J., Virus diseases of Citrus. PBC, 712—715.

631. Kolk, H., Aktuella svampsjukdomar hos utsädet. Sv. Jordbruksforskn., 104—113.

632. Köhler, E., Beitrag zum Prämunitätsproblem; Studien am Tabakmosaik. PBC, 708—709.

633. Leyon, H., Virus formation in chloroplasts. ECR 4, 362—370.

634. Lihnell, D., Virussjukdomar hos hallon. Sv. Jordbruksforskn., 114—121.

635. Manigault, P., Réactions histochimiques de Pelargonium zonale au cours du développement de tumeurs expérimentales. PBC, 716.

636. Mathiesen, Aino, Die Insektenbläuen in Schweden. PBC, 318—319.

637. Mathiesen-Käärik, Aino, Almsjukans utbredning i Sverige under åren 1950—1952. Skogen 40, 2*—3*, 11*.

638. — Eine Übersicht über die gewöhnlichsten mit Borkenkäfern assoziierten Bläuepilze in Schweden und einige für Schweden neue Bläuepilze. SS Medd. 43: 4, 1—74. Sammanfattning 69—72.

639. Middleton, J. T., Peronosporaceae of the Colorado desert of California, U.S.A. PBC, 415—416.

640. — Pythium root rot of Leguminosae. PBC, 724—725.

641. Montagne, J. T. W., Soil fumigation for the control of plant diseases and conditions affecting the results. PBC, 204—205.

642. Moore, Bertha, and Tveit, M., Antibiotic action of Chaetomium sp. on organisms causing root-rot of oats. PBC, 208.

643. Müller, K. O., The hypersensitivity reaction of the potato to Phytophthora infestans from a genetical and phytopathological point of view. PBC, 699—700.

644. Nadel-Schiffman, Mina, Une contribution à la pathogenicité du Penicillium digitatum et Penicillium italicum sur les fruits des Agrumes. PBC, 726.

645. Nobecourt, P., Cultures de tissus et phytopathologie. PBC, 715.

646. Nobles, Mildred K., Cultural identification of fungi causing decay in coniferous trees of British Columbia. PBC, 297—298.

647. Oort, A. J., Hypersensitivity of wheat to Loose Smut. PBC, 700—701.

648. Pohjakallio, O., Salonen, A., and Relander, Eeva, Investigations into the micro-organisms limiting damage by the clover rot fungus. Acta Agricult. Scand. 3, 53—60.

649. Reichert, I., A biogeographical approach to phytopathology. PBC, 730—731.

650. Riker, A. J., and Hildebrandt, A. C., Stimulation or inhibition by basic nutrients of diseased plant tissue growth clarified by studies in vitro. PBC, 715—716.

651. Riker, A. J., Kouba, T. F., Brener, W. H., and Patton, R. F., White-pine trees selected for resistance to white-pine blister rust. PBC, 322—323.

652. Rozendaal, A., Thung, T. H., and van der Want, J. P. H., Curing virus diseases by heat. PBC, 710—712.

653. — — — Soil-borne virus diseases. PBC, 709—710.

654. Sadasivan, T. S., The role of trace elements in control of root-infecting fungi. PBC, 195—196.

655. Silberschmidt, K., Experimental and spontaneous transmission of »Infectious Chlorosis» of Malvaceae. PBC, 718—719.

656. van Slogteren, E., Coming and going of plant diseases. PBC, 727—728.

657. Stakman, E. C., Variation in plant pathogenic fungi and its practical importance. PBC, 702—704.

658. Stapp, K., Über Stand und Bedeutung des serologischen Virusnachweises von Kartoffelviren in Deutschland. PBC, 719—720.

659. Statens Växtskyddsanstalt, Potatiskräftan i Sverige. SV Flygbl. 100, 8 s.

660. — Vitaxighet hos havre. SV Flygbl. 101, 7 s.

661. Stevens, N. E. (†), and Ellis, H. R., Wasting and recovery of Zostera marina on the atlantic coast of the United States of America. PBC, 732—733.

662. Syrach Larsen, C., Studies of diseases in clones of forest trees. Her. 39, 179—192.

663. Tamm, C. O., Mera om granens gulspetssjuka. SST 51, 390—396. Summary 395.

664. Traaen, A. E., Injury to Norway spruce caused by calcium chloride used against dust on roads. PBC, 185—186.

665. Tunblad, B., Något om frostskador på bladverk och kart hos frukttrad. SV Växtskyddsnot., 17—21.

666. — Om »knöliga päron». SV Växtskyddsnot., 85—90.

667. Tutin, T. G., Some general aspects of the Zostera problem. PBC, 733—735.

668. Wahlin, B., Några viktiga sjukdomar och skadedjur på oljeväxterna i Östergötland år 1953. SV Växtskyddsnot., 44—47.

669. — Vetet och stråbassjukdomarna. SV Växtskyddsnot., 53—57.

670. Watson, D. J., Effects of infection with beet yellows virus on growth and carbohydrate metabolism of sugar beet. PBC, 704—705.

671. Watson, Marion A., The behaviour of persistent and non-persistent aphid-transmitted viruses. PBC, 717—718.

672. Viennot-Bourgin, G., Étude morphologique de quelques lésions charbonneuses des végétaux. PBC, 701—702.

673. van Vloten, H., Tree diseases in relation to provenance. PBC, 304—305.

674. Zycha, H., Die Rindenfäule der Buche (Fagus silvatica). PBC, 298—299.

Se även nr 230, 256, 709, 808, 809, 817, 821, 826, 828, 869, 903.

Tillämpad botanik.

1. Jordbruksvetenskap.

675. Andersen, S., Using hormone derivatives at different stages of development of the cereals. PBC, 184—185.

676. ANDERSSON, G., Odlingsmaterialet av oljeväxter genom åren. Skånes oljeväxtodlareförening 1943—1953, Kristianstad, 35—43.

677. ANDERSSON, G., och OLSSON, G., Försök med sareptasenap och svartsenap som oljeväxter. SUT 63, 397—415. Summary 412—413.

678. ANDERSSON, G., och TEDIN, O., Oljeväxtodlingen 1947—1948. SUT 63, 210—289. Summary 286—289.

679. BARANOV, P. A., Cultivated plants in extreme conditions in the Pamirs. PBC, 245—246.

680. DAUBENMIRE, R. F., Contrasted effects of different types of animals and seasons of grazing on the botanical composition of virgin grassland. PBC, 171.

681. DAYTON, W. A., Range management research of the U.S. Forest Service. PBC, 244—245.

682. FOSS, H., Nattefrost og frostvern. Nord. Jordbrugsforskn. 35, 29—36.

683. FRANCK, O., Gödslingseffekten på hormonbehandlad jord. Stat. Jordbruksförs. Medd. nr 44, 16 s., summary 15—16.

684. GRAHN, B., En försöksmässig orientering om bor. Växtnäringsnytt 9: 4, 20—22.

685. GUSTAFSSON, Å., Nya vägar inom växtförädlingen. Sv. Jordbruksforskn., 39—44.

686. HAGBERG, A., Frekvensen av plantor med avvikande kromosomtal i marknadspartier av tetraploid råg (Dubbelstålråg). KLT 92, 417—427. Summary 426.

687. — Kärnansatsen hos Dubbelstålråg vid odling i grannskap av diploid råg. SUT 63, 63—69. Summary 69.

688. HAGSAND, E., Den kemiska ogräsbekämpningen i spånadslin. Lin. Dansk-svensk Hørtidsskrift 7, 17—24. Summary 23—24.

689. HEDIN, L., Recherches sur l'écologie des prairies françaises: Un essai de classification. PBC, 165—167.

690. VON HOFSTEN, C. G., Ogräsbekämpning. Utgiven av LTK och Radiotjänst. Kristianstad. 122 s.

691. JACOBSON, G., Bekämpning av ogräs, buskvegetation och bärris med hänsyn till risken för skada på bin och humlor. SV Växtskyddsnot., 28—30.

692. — Ogräsbekämpning i oljelin. Skånes oljeväxtodlareförening 1943—1953, Kristianstad, 64—97.

693. JOSEFSSON, A., Förädlingsarbeten med gummimaskros. SUT 63, 293—385. English summary 380—384.

694. — Tetraploida rovor, förädling och försök vid Sveriges Utsädesförening. SUT 63, 165—180. Summary 179—180.

695. JULÉN, G., Försök rörande spridningstidens inverkan på kvävegödslingens effekt på avkastning och råproteinhalt hos timotej. SUT 63, 440—468. Summary 466—467.

696. KILLIAN, C., Nouvelles observations sur les conditions édaphiques et les réactions des plantes indicatrices dans les reserves de pâturages de la région alfatière algérienne. PBC, 172.

697. LARSON, C., Kvävegödslingsförsök i sockerbetor. Stat. Jordbruksförs. Medd. nr 45, 43 s., summary 40—43.

698. NICHOLAS, D. J. D., The use of Aspergillus niger (Mulder's M strain) for the determination of mineral nutrients in soils and plants. PBC, 196—198.

699. NILSSON, R., EMILSSON, B., och LILLIEROTH, C. G., Behandling av matpotatis

med groningshämmande medel. Nya försök 1952—1953. Försök och forskning 10, 77—79.

700. NILSSON-LEISSNER, G., Baljväxternas betydelse för markens bördighet. Grundförbättring 6, 177—188.

701. — Introduktion av växtmaterial från främmande länder. Frågan belyst med baljväxtarterna som exempel. KLT 92, 379—393. Summary 393.

702. NYGREN, A., Nya vägar i gröeförädlingen. Sv. Jordbruksforskn., 50—56.

703. OPPENHEIMER, H. R., Plant reactions as indicators of irrigation requirement. PBC, 172—173.

704. OSVALD, H., On antagonism between plants. PBC, 167—171.

705. PAATELA, J., Inventering av finska slåttervallar. Nord. Jordbrugsforskn. 35, 100—107.

706. PHILIPSON, T., Boron in plant and soil, with special regard to Swedish agriculture. Acta Agricult. Scand. 3, 121—242. (Även diss. Uppsala, Lantbrukshögsk.)

707. PLAUT, M., Die Anwendung von Aethylendibromid als Schutzmittel für die Aufbewahrung von Saat und Getreide. PCB, 205—206.

708. — Die Einführung von Sommerroggen als landwirtschaftliche Kultur in Israel. PBC, 154—155.

709. POEHLMAN, J. M., Breeding winter barleys for hardiness and disease resistance. PBC, 202—203.

710. RAPPE, G., Nitrification in eight farm soils. Oikos 4(: 1), 28—43.

711. — Seasonal variations in some properties of arable soil. I. Variations in oat plant-producing capacity. Plant and Soil 4, 197—222.

712. REGEL, C., Pflanzenrohstoffe als botanisches und landwirtschaftliches Problem. PBC, 151—152.

713. SELERUD, Å., Vårfrostens skadegörelse på höstoljeväxterna. Sv. Frötidn. 22, 33—37.

714. ST. JOHN, H., Origin of the sustenance plants of the Polynesians. PBC, 152—154.

715. SVANBERG, O., Minor elements in pastures and their relation to animal nutrition in Sweden. PBC, 196.

716. TORSSELL, B., Några studier över genotypisk och fenotypisk variation hos åkerbruksväxterna och dess betydelse för odlingsvärdet. SUT 63, 416—439. English summary 438—439.

717. TORSSELL, R., ÅKERBERG, E., och TORSSELL, B., Några resultat från förädlingen av lusern vid Sveriges Utsädesförenings Ultunafilial. KLT 92, 164—184. Summary 182—183.

718. WAHLEN, F. T., Plant sciences and world husbandry. PBC, 34—42.

719. WEXELSEN, H., och JULÉN, G., Nyare erfarenheter om polyploida klöverstammar. Nord. Jordbrugsforskn. 35, 95—97.

720. WHYTE, R. O., The physiological nature of a herbage plant. PBC, 162—165.

721. WIKLANDER, L., Kalkproblemet — Några tillrättalägganden. Grundförbättring, 235—246.

722. WOODFORD, E. K., The assessment of relative toxicity and the evaluation of selective herbicides. PBC, 186—190.

723. ÅBERG, E., Biology of weeds and hormone weed killers. PBC, 182—184.

724. — Ogräskampen inom jordbruket. Sv. Jordbruksforskn., 57—65.

725. Åkerberg, E., Såtidsförsök med höstoljeväxter. Sv. Jordbruksforskn., 66—74.
726. Åslander, A., Lime and agricultural plants. A discussion of the problem in its bearing on plant ecology. PBC, 264—265.

Se även nr 160, 170, 250, 254, 265, 299, 314, 334, 381, 386, 392, 393, 398, 404, 405, 421, 545, 595, 596, 607, 608, 610, 613, 619, 631, 641, 648, 840, 874, 974.

2. Skogsbotanik.

727. Aichinger, E., Vegetationsentwicklungstypen als Grundlage unserer land- und forstwirtschaftlichen Arbeit. PBC, 312—313.
728. Aminoff, F., Naturvård i statens skogar i Skåne. Skånes Natur 40, 119—156.
729. Andersson, S.-O., Om tidpunkten för den årliga diametertillväxtens avslutande hos tall och gran. SS Medd. 43: 5, 1—27. Summary 26.
730. Arnborg, T., Det nordsvenska skogstypsschemat. 3:e omarb. uppl. Stockholm, 20 s., 4 pl.
731. — Tallen. VT, 40—73.
732. Björkman, E., Om orsakerna till granens tillväxtsvårigheter efter plantering i nordsvensk skogsmark. NST, 285—316. Summary 313—315.
733. Bornebusch, C. H. (†), Boken. VT, 145—162.
734. Burger, H., Der Einfluss teilweiser Entnadelung auf den Zuwachs von jungen Schwarzföhren und Fichten. PBC, 311—312.
735. Bäckström, H., och Welander, E., En undersökning av remissionsförmågan hos blad och barr av olika trädslag. NST, 141—169. Summary 166—168.
736. Carbonnier, C., Kontinentgranen. Diskussionsinlägg. SST 51, 148—150.
737. Chapman, V. J., and Mirams, R. V., Natural regeneration in the Kauri. PBC, 309.
738. Dahlbeck, N., Almarna. VT, 206—217.
739. David, R., L'utilisation des »Hormones de Synthèse» pour la protection de la forêt landaise contre l'incendie. PBC, 310—311.
740. Enecrantz, G., Skogsträden kring Kalmar. Det grönskande Kalmar, 137—151.
741. Erlandson, U., Bidrag till kännedom om heddegenerationen i övre Dalarnas tallskogar. SST 51, 275—295.
742. Fall, E., Skogsträdens fruktsättning år 1953. SS Flygbl. 68, 12 s.
743. Gaussen, H., Les forêts des Pyrénées françaises. PBC, 290.
744. Hagberg, E., Malmöhus läns skogar enligt de båda riksskogstaxeringarna. Medd. fr. Malmöhus läns skogs- o. betesvårdsför. 2, 7—13.
745. Heiberg, S. O., and White, D. P., Potassium deficiency of reforested pine and spruce stands in northern New York. PBC, 250—251.
746. Heimburger, C., The breeding of white pine (Pinus Strobus L.) in Canada. PBC, 307.
747. Huss, E., Om behandling av barrträdens kott och frö. SST 51, 230—241.
748. — Tall- och granfröets grobarhet 1952. Skogen 40, 9*—10*.
749. Hustich, I., Hur många trädarter finns det i Norden? VT, 244—248.
750. Hylander, N., Tårgranar. Några ord till en bild. Lustgården 33—34, 119—122.
751. Jacobson, G., Buskbekämpning med kemiska medel. NST, 191—241. Summary 228—231.
752. Johnsson, H., Development of triploid and diploid Populus tremula during the juvenile period. Zeitschr. f. Forstgen. u. Forstpflanzenzücht. 2, 73—77.

753. Johnsson, H., Hybridaspens ungdomsutveckling och ett försök till framtidsprognos. SST 51, 73—96.

754. — Species hybrids in forest tree breeding. PBC, 302—303.

755. Johnsson, H., Kiellander, C. L., och Stefansson, E., Kottutveckling och fröbeskaffenhet hos ympträd av tall. SST 51, 358—389.

756. Karlberg, S., Om behandling av tall- och granfrö i groningsstimulerande syfte. K. Skogshögsk. Skrifter 11, 42 s. Summary 39.

757. Kiellander, C. L., Induced and natural polyploidy in Picea Abies (L.) Karst. PBC, 303—304.

758. — Kontinentgran. Skogen 40, 46*—48*.

759. — Kontinentgranen. SST 51, 130—147.

760. — Om kontinentgranen. Härdighet, rasförädling och fröförsörjning. Sv. papperstidn. 56, 900—919, 941—954. Zusammenfass. 950—953.

761. Kujala, V., On the geographical distribution of forest types. PBC, 292—293.

762. Lagerberg, T., Alarna. VT, 135—144.

763. — En och idgran. VT, 218—225.

764. Langlet, O., Die praktische Verwertung der Provenienzversuche in Schweden. PBC, 305—306.

765. — Några data från det internationella granproveniensförsöket av 1938 i Sverige. Skogen 40, 238—239, 244—245.

766. Leyton, L., The growth and mineral nutrient relationships of trees growing on Calluna dominated sites. PBC, 251—252.

767. Lindquist, B., Björkarna. VT, 108—125.

768. — Lönn och lind. VT, 196—205.

769. Lindroth, S., Tallens fröproduktion i Norrbotten. SST 51, 29*—42*. (Från skogsvårdsstyrelsernas arbetsfält 1953: 3.)

770. Mathiesen, A., Some observations on the defoliation of trees. AHB 16(: 8), 241—255.

771. Möller, C. Mar., Tyndingens indflydelse på massetilvæksten. II. SST 51, 1—14.

772. Nielsen, P. C., Experiments with controlled pollinations within the genus Fagus. PBC, 301—302.

773. Norborg, F. v., Skogarna på Dal. Nat. i Dls., 80—90.

774. Nordström, L., A method of stimulating the germination of pine seed (Pinus silvestris). Skogshögskolan 125 år. K. Skogshögsk. Skrifter 12—19, 91—108. Sammanfattn. 107.

775. — Klängning av svårklängd tallkott. NST, 1—19.

776. — Vår försörjning med tallfrö med särskild hänsyn tagen till Norrlands höjdlägen. NST, 20—84.

777. Nylinder, P., Volymviktsvariationer hos planterad gran. SS Medd. 43: 3, 1—44. Summary 40—42.

778. Olofson, Å., Om de svenska björkarternas morfologiska variation och skogliga värde. Del 1. Sv. papperstidn. 56, 785—798, 818—839. Summary 837—839.

779. Paterson, S. S., Irans skogstillgångar. SST 51, 405—413. Summary 413.

780. Pauley, S. S., Work of the Cabot Foundation. PBC, 304.

781. Petrini, S., Intérêt simple ou intérêts composés dans le calcul de la croissance. Skogshögskolan 125 år. K. Skogshögsk. Skrifter 12—19, 35—42. Sammanfattn. 42.

782. Plym Forshell, Christina, Kottens och fröets utbildning efter själv- och korsbefruktning hos tall (Pinus silvestris L.). SS Medd. 43: 10, 1—42. Summary 24—27.

783. Rancken, T., Asken. VT, 179—195.

784. Regel, C., Ist der Wald eine Landschaft oder ein Pflanzenverein? PBC, 293—294.

785. Robak, H., Growth check in young spruce on heath in western Norway. PBC, 252—253.

786. von der Schulenburg, A. F., Islands skogliga problem. SST 51, 296—301.

787. — Provenienzfragen bei Zellstoffhölzern. PBC, 306—307.

788. Šimák, M., Beziehungen zwischen Samengrösse und Samenanzahl in verschieden grossen Zapfen eines Baumes (Pinus silvestris L.). SS Medd. 43: 8, 1—15. Summary 15. Sammanfattning 15.

789. — Über die Samenmorphologie der gemeinen Kiefer (Pinus silvestris L.). SS Medd. 43: 2, 1—32. Summary 29. Sammanfattning 29—30.

790. Šimák, M., och Gustafsson, Å., Röntgenfotografering av skogsträdsfrö. Skogen 40, 58*—61*.

791. Sirén, G., Granen. VT, 74—107.

792. Sjöström, H., Hamra revir och kronopark. NST, 595—613.

793. Stefansson, E., Något om problem vid insamling och klängning av tallkott. I—II. Skogen 40, 12—15, 6*—8*.

794. — Preliminära resultat av proveniensförsök med gran utlagda av Kramfors AB. NST, 335—366.

795. — Skogarna i Ångermanland och Medelpad. Nat. i Ång., 102—115.

796. Stridsberg, E., Sammansatt ränta vid tillväxtprocentberäkning i fleråriga perioder. Skogshögskolan 125 år. K. Skogshögsk. Skrifter 12—19, 43—52. Zusammenfassung 50—52.

797. Stååł, E., Några synpunkter på ekens utvecklingsmöjligheter i blandbestånd. SST 51, 1*—6*. (Från skogsvårdsstyrelsernas arbetsfält 1953: 1.)

798. Sylvén, N., Aspen. VT, 126—134.

799. — Våra småträd. VT, 226—243.

800. Syrach-Larsen, C., Tree displays. PBC, 300—301.

801. Tamm, O., Hamra revir. Naturbeskrivning. Skogstyper. NST, 579—593.

802. Tirén, L., Jämförelser mellan olika såddmetoder. SS Medd. 43: 9, 1—83. Summary 73—83.

803. Tüxen, R., Über den Stand der forstlich-soziologischen Kartierung in Deutschland. PBC, 291—292.

804. Weimarck, H., Ekarna. VT, 163—178.

805. v. Wettstein, W., Über die Blütenbiologie unserer Waldbäume. PBC, 309—310.

806. Vogel, K., Försök att upprätta en skogsodlingsfacit för norra Sverige. NST, 411—425.

807. Åkebrand, V., Redogörelse för 1952 års frötäktsinventering m.m. inom delar av Gävleborgs län, Kopparbergs län och Jämtlands län. Medd. nr 58 till Sällsk. f. prakt. skogsförädl. ledam. Stenc. Uppsala.

Se även nr 99, 155, 248, 267, 583, 592—94, 638, 661, 663, 664, 832, 834, 871, 1019, 1029, 1030, 1054, 1064, 1065.

3. Hortikulturell botanik.

808. ANJOU, K., Vinterskador på äpple- och päronträd vid Balsgård 1953. PFÅ 54, 139—147. Summary 146—147.
809. — Vårfrostskador hos äpple och päron vid Balsgård 1953. PFÅ 54, 66—78. Summary 77—78.
810. BAVENDAMM, W., Über die Möglichkeiten einer künstlichen Zucht von holz- und humusbewohnenden Speisepilzen zur Gewinnung von Eiweiss und Heilmitteln. PBC, 314—315.
811. BERGGREN, SONJA, Flickskolans trädgård. Det grönskande Kalmar, utg. av Kalmar naturvet. sällsk., 61—68.
812. BERGSTEN, K., Naturaliserade växter i Stadsparkens växthus. Det grönskande Kalmar, 36—45.
813. BOUILLENNE, R., La sexualisation du Fraisier des quatre saisons à fruits rouges. PBC, 200—201.
814. ENGSTEDT, G., Pomologiska strövtåg i Kalmarbygder. Det grönskande Kalmar, 46—55.
815. ERLANDSON, M., Stadsparken — en botanisk främlingslegion. Det grönskande Kalmar, 13—35, 1 karta.
816. ERLANDSSON, N., Vinodling på friland. Det grönskande Kalmar, 88—96.
817. FERNQVIST, I., Frostskador på fruktträd i övre Norrland. PFÅ 54, 153—157.
818. FOGELQVIST, N., Liljor i gamla Kalmar-trädgårdar. Det grönskande Kalmar, 79—87.
819. GELIN, O., och MATTSSON, H., Fortsatta försök med belysning. Weibulls Allehanda 1953: 1, 4—5.
820. GRANHALL, I., Frost resistance problems in fruit tree breeding. PBC, 201—202.
821. — Kan äppelskorven bemästras genom växtförädling? PFÅ 54, 17—28. Summary 27.
822. HENRIKSSON, L. E., och SVENSSON, E., En Laelio-Cattleya uppdragen ur frö i Uppsala. SBT 47, 119—122.
823. JOHANSSON, E., Kaligödslingsförsök med äppleträd vid Alnarp 1937—52. Medd. fr. Stat. Trädg.-förs. 82, 11 s., summary 10, resumo 11.
824. JOHANSSON, E., LUNDSTEDT, H., och BERGELIN, E., Gödslingsförsök med äpple vid Ekerum och Ugerup 1941—1951. Medd. fr. Stat. Trädg.-förs. 78, 20 s., summary 18—20, resumo 20.
825. MEURMAN, O., Trials with »Spindelbusch» apple trees in Finland. Acta Agricult. Scand. 3, 292—306.
826. MULDER, D., The distribution and causes of nutritional diseases of fruit trees in the Netherlands. PBC, 193—194.
827. NILSSON, R., Gaslagringsförsök med äpplen och päron. Fruktodlaren, 159—160.
828. OLDÉN, E. J., Frostskador hos körsbärsträdens blommor. Fruktodlaren, 108—110.
829. — Frysningsförsök med äpplegrundstammar. PFÅ 54, 122—131. Summary 130—131.
830. — Hur ärver Amaryllis? Trädgårdstidningen 1953: 11, 14—15 o. 24.
831. — Växtförädlingsarbeten med äpplegrundstammar. PFÅ 54, 40—57. Summary 55—56.
831a. REUTERSWÄRD, G., Vildflor och trädgårdsblommor. Stockholm. 230 s.
832. SYLVÉN, N., Arboretum Ekebyhof. Lustgården 33—34, 53—60.

833. Sylvén, N., Några dendrologiska anteckningar från Hollandsresan 1951. Lustgården 33—34, 101—118.
834. Vidvei, E., Virkningen av 2,4 D og 2 M—4 K på 25 lignoseslag. Nord. Jordbrugsforskn. 35, 3—17. Summary 16.
835. Wikesjö, K., Mullbär, fikon och ruiner. PFÅ 54, 58—65.
836. Östlind, N., Kemisk kartgallring. PFÅ 54, 110—121.

Se även nr 160, 255, 312, 332, 403, 437, 634, 666, 770, 1051, 1038, 1043.

4. Medicinsk och farmaceutisk botanik.

837. Danielson, U., Medicinalväxter i våra trakter. Det grönskande Kalmar, 152—158.
838. Emmons, C. W., The natural occurrence in animals and soil of fungi which cause disease in man. PBC, 416—421.
839. Frisk, A., and Hedenius, P., The histoplasmin test as a diagnostic aid in obscure pulmonary affections. PBC, 421—422.
840. Maurizio, Anna, Bienenvergiftungen mit pflanzlichen Wirkstoffen. PBC, 190—192.

Se även nr 284.

Växtgeografi (med floristik), ekologi.

841. Accorsi, W. R., Biology and ecology of the Podostemonaceae of the Piracicaba Fall. PBC, 681—682.
842. Ahlner, S., Om Ångermanlands lavflora. Nat. i Ång., 191—196.
843. Aleem, A. A., Ecology of marine littoral diatoms. PBC, 831.
844. Allan, H. H., Classifying vegetation for the geographer. PBC, 653.
845. Allegård, T., Glimtar från Haverö. Nat. i Ång., 378—390.
846. Almborn, O., Some aspects of the sociology of epiphytic lichen communities. PBC, 815—816.
847. Almquist, E., och Hamrin, A., Gagea spathacea i Västmanland. SBT 47, 388—389.
848. Andersson, L., och Sjögren, J., Hästefjorden, ett sjösänkningsföretag. Nat. i Dls., 277—285.
849. Atkins, W. R. C., Chemical evidence on the abundance and botanical composition of the marine phytoplankton. PBC, 262—263.
850. Barkman, J. J., Some proposals for a phytosociological nomenclature. PBC, 662—666.
851. Bartler, E., Ulvöarna och Gnäggen. Nat. i Ång., 263—271.
852. Bartram, E. B., New Caledonian mosses collected by Dr. O. H. Selling. BN, 197—203.
853. Benson, L., Relationships of the Ranunculi of the Continental Divide and of the Pacific and Eastern Forests of North America. PBC, 862—863.
854. Berggren, Sonja, Mitt bästa svampställe. Det grönskande Kalmar, 132—136.
855. Bergvall, F., Orkidéängarna i Gideåberg. Nat. i Ång., 209—215.
856. Bharucha, F. R., and Dubash, P. J., The problem of nitrophily. PBC, 681.
857. Boyko, H., Regeneration problems of the vegetation in arid zones. PBC, 678.
858. Braun-Blanquet, J., Le classement des unités végétables. PBC, 651—653.
859. Brian, P. W., Curtis, P. J., and Jefferys, E. G., Antibiotics produced by fungi isolated from acid heath soils. PBC, 254—255.

860. Brindeland, A., Strövtåg i Åmålstrakten. Nat. i Dls. 206—215.
861. Brown, C. A., Studies on the isolated prairies of Louisiana. PBC, 682—683.
862. Brunel, J., Étude historique et phytogéographique de la phycologie canadienne. PBC, 842—843.
863. Böcher, T. W., The steppe vegetation in continental West Greenland. PBC, 612—613.
864. Cantor-Lund, Hilda M., Planctonic Phycomycetes. PBC, 413.
865. Cedercreutz, C., Felsenalgen in Fennoskandien. PBC, 830—831.
866. Cedergren, G. R., Vegetation, flora och fauna. Skellefte sockens historia I: 1, 136—185, 3 pl.
867. Chapman, V. J., and Ronaldson, J. W., Mangrove soils in New Zealand. PBC, 260.
868. Conway, Elsie, Studies in the spread of bracken. PBC, 238—239.
869. Cook, M. T., The distribution of species of the genus Synchytrium in North America. PBC, 415.
870. Dahlgren, L., Nya lokaler för Nitella Nordstedtiana och Equisetum variegatum i Södermanland. BN, 142—143.
871. Daubenmire, R., A classification of forest associations in the northern Rocky Mountains. PBC, 618—619.
872. Dawson, E. Y., On the correlation of marine vegetation with upwelling along the Pacific Coast of Baja California, Mexico. PBC, 827.
873. Deloffre, G., L'inondation à l'eau de mer de la région de Dunkerque en 1944—1945, ses conséquences sur les sols et sur le développement de la végétation. PBC, 261.
874. Drar, M., The problem of the Sudd in relation to stabilizing and smothering plants. PBC, 668—670.
875. Durango, S., Besök på Fårö. Stockholm, 94 s.
876. Egler, F. E., A commentary on American plant ecology, based on the textbooks of 1947—1949. PBC, 620—621.
877. Elofson, O., Medelpads kustland. Nat. i Ång., 321—343.
878. Emberger, L., Nécessité d'une entente internationale pour la classification des climats en biogéographie. PBC, 644—646.
879. Enbågen, O., Kring Laxsjön. Nat. i Dls., 196—205.
880. Ericson, J., Bidrag till Skånes Flora. 46. Floran i Tjörnarps socken. BN, 81—96.
881. Erlandson, M., Laboratorieholmen — en grönskande idyll. Det grönskande Kalmar, 97—101.
882. Evers, E., Norafjärden och dess flora. Nat. i Ång., 281—287.
883. Fægri, K., On long-distance pollen transport. PBC, 238.
884. Flinck, K. E., Hybriden Erigeron acre × canadense, funnen i Skåne. BN, 144.
885. Forsman, B., Strändernas och fjärdarnas vegetation. Det grönskande Kalmar, 115—122.
886. Fosberg, F. R., The American element in the Hawaiian flora. PBC, 866—867.
887. Foury, A., Contribution à l'étude de la flore des Hauts-Plateaux du Maroc Oriental. PBC, 683—685.
888. Fridén, A., Lathyrus heterophyllus i Tåsjö. SBT 47, 450—451.
889. — Ny lokal för Sarothamnus scoparius i Västergötland. SBT 47, 388.

890. Fridén, L., Orobanche reticulata Wallr. på Ålleberg. BN, 345—351. Summary 350.

891. Fries, M., Fjällelement och andra västliga inslag i Ångermanlands och Medelpads flora. Nat. i Ång., 91—101.

892. Fröman, I., Lilla Karlsös växtvärld — några framträdande drag. SvN, tidskr. 44, 161—164.

893. Fulford, Margaret, Some distribution patterns of South American leafy Hepaticae. PBC, 845—846.

894. Gams, H., Neue Vegetationskarten aus den Ostalpen. PBC, 625—626.

895. — The importance of growth forms for taxonomical and ecological systematics. PBC, 654—655.

896. Gilliland, H. B., The experimental investigation of grass communities on the Witwatersrand university's field research station Frankenwald at Johannesburg, South Africa. PBC, 241—243.

897. Goodspead, T. H., Illustrations of the vegetation of portions of western South America. PBC, 78—82.

898. Gorham, E., Soil status and nutrient uptake by natural vegetation. PBC, 261—262.

899. Grapengiesser, S., Översikt av den högre floran i Medelpad och Ångermanland. Nat. i Ång., 72—90.

900. Grossbard, Erna, The production of antibiotic substances in the soil. PBC, 255—256.

901. Guinochet, M., Intérêt des notions d'association végétale, alliance et ordre pour la découverte et la définition des races écologiques. PBC, 685.

902. Gustafsson, A., och Karvik, N.-G., Väster om Stora Le. Nat. i Dls., 153—163.

903. Gustavsson, A., Some species of the genera Peronospora and Pseudoperonospora new to Sweden. BN, 48—64.

904. Hall, A., Vårtecken i Osbytrakten. Natur i Göinge, 22—26.

905. Hanson, S., Floran vid Kalmarsunds strand. Det grönskande Kalmar, 107—114.

906. — Skälby damm. Det grönskande Kalmar, 123—127.

907. Hanson, T., Dalsländska vänerstränder. Nat. i Dls., 223—234.

908. Harroy, J.-P., La nouvelle signification de la protection de la nature. PBC, 685—691.

909. Hasselberg, G. B. E., Växter vid havsstranden i norra Ångermanland. Nat. i Ång., 227—235.

910. Hasselrot, K. och T. E., Några anmärkningsvärda växtfynd i Västergötland. SBT 47, 538—539.

911. Hasselrot, T. E., Ett litet bidrag till Ålands lavflora. SBT 47, 531—538.

912. — Kompletterande floristiska anteckningar från Anten-Mjörn-området i västra Västergötland. SBT 47, 465—487.

913. — Nordliga lavar i Syd- och Mellansverige. Acta Phytogeogr. Suec. 33, VIII+200 s., 27 kartor.

914. Hedberg, O., Vegetation belts of the East African mountains. PBC, 608—610.

915. Hjelmqvist, H., Cuscuta australis R. Br. i Sverige. BN, 97—104. Summary 103—104.

916. Holm, K., Natur vid Indalsälven. Nat. i Ång., 352—367.

917. Holmdahl, S., Några anteckningar om floran i speciellt norra Halland. Hallands Natur, 9—22.
918. Hosokawa, T., On the nomenclature of aerosynusiae. PBC, 691—694.
919. Hueck, K., Der jetzige Stand der Vegetationskartierung in Argentinien. PBC, 626—627.
920. Hultén, E., Areal (Cartographical material for the history of flora and vegetation). SBT 47, 547—551.
921. Humbert, H., Une merveille de la nature à Madagascar. PBC, 627—629.
922. Hård av Segerstad, F., Några synpunkter på växters invandring och spridning. SBT 47, 333—339. Zusammenfassung 337—338.
923. Höfler, K., Durch plasmatische Trockengrenzen bedingte Lebermoosvereine. PBC, 621—623.
924. Ingmar, T., »Floran» — den uppländska vildmarksmyren. SvN, tidskr. 44, 182—189.
925. Johansson, U., Ett botaniskt paradis i Tärnafjällen. Västerbotten. Västerbottens läns hembygdsför:s årsb. 34, 129—142.
926. Junell, S., Das Phytoplankton des Sees Hjälmaren. SBT 47, 47—93.
927. Kaaret, P., Wasservegetation der Seen Orlången und Trehörningen. Med bil. av K. Thomasson, R. W. Kolbe och A. Silfversparre. Acta Phytogeogr. Suec. 32, 64 s., 16 pl.
928. Killian, C., Le bilan hydrique et l'échauffement de végétaux types du Fouta Djallon (Guinée) en saison sèche. PBC, 231—232.
929. Kucyniak, J., The occurrence of Grimmia teretinervis Limpr. in North America with notes on its distribution. PBC, 847—848.
930. Kullenberg, B., Några iakttagelser över insektbesöken på blomman av Parnassia palustris L. SBT 47, 439—448. Summary 448.
931. — Observationer över Arum-pollinerare i Libanons kustområde. SBT 47, 24—29. Summary 28—29.
932. Levyns, M., The phytogeography of Polygalaceae in South Africa. PBC, 867—868.
933. Lidfelt, Astrid, Växtgeografiska undersökningar av några kalkområden i Nederkalix skärgård sommaren 1952. Norrbottens Natur, 23—27.
934. Lindahl, P.-O., Några märkligare lavfynd i västra Norge (Lecanora demissa, Parmeliella atlantica). SBT 47, 530—531.
935. Lohammar, G., Berglöken, Dalslands märkligaste växt. Nat. i Dls., 74—79.
936. — Dalslands växtvärld. Nat. i Dls., 48—73.
937. Lund, J. W. G., Chemical and habitat factors in relation to freshwater phytoplankton. PBC, 263.
938. Lundberg, F., En Polypodium vulgare-form återfunnen efter 40 år. BN, 432—433.
939. — Typha latifolia i Västerdalarna. BN, 434—435.
940. Lundqvist, G., Långspridning av svampsporer. GFF 75, 39—42. Abstract 39.
941. Luther, H., Höhere Wasservegetation und Standortsfaktoren in der Ostsee. PBC, 679—680.
942. — Über die nordische Verbreitung von Chaetophora incrassata (Huds.) Hazen. BN, 317—340.
943. Lüdi, W., Experimental investigations into the sub-alpine Nardetum. PBC, 240.

944. Löve, Doris, Studies on Bryoxiphium. The Bryologist 56, 73—94, 183—203. (Tills. m. Á. Löve.)

945. Meusel, H., Die Bedeutung der Wuchsformen für die Entwicklung des natürlichen Systems der Pflanzen und für das Verständnis der Pflanzengesellschaften. PBC, 655—659.

946. Modin, E., Nipsippan (Anemone patens). Nat. i Ång., 205—208.

947. Moore, Lucy B., Mat plants of the genus Raoulia as weeds in pastoral land. PBC, 677—678.

948. Mossberg, C., Botaniska strövtåg mellan Vänern och Ärven. Nat. i Dls., 183—195.

949. Müntzing, A., Samolus Valerandi L. på Kullen. BN, 431—432.

950. Mårtensson, O., Ett bidrag till kännedomen om mossfloran i svenska Neadalen med omnejd. K. Sv. Vetenskapsakad:s Skrifter i naturskyddsär. 48, 96 s., summary 94—95.

951. Nordin, I., Krusnate i Västmanland. Fältbiologen 6, 64.

952. — Sommarobservationer i Västmanland. Fältbiologen 6, 64.

953. Nordström, A., Skuleberget. Nat. i Ång., 272—280.

954. Norlindh, T., Bidrag till Skånes Flora. 47—48. Flora och vegetation i Glimåkra socken I—II. BN, 204—232, 369—398.

955. Oppenheimer, H. R., Summer drought and water balance in the Near East. PBC, 235—236.

956. Oredsson, A., Nya förekomster av sällsynta arter av johannesört-släktet. Natur i Göinge, 31.

957. — Växtlokaler huvudsakligen från Stoby socken. Natur i Göinge, 15—16.

958. Pearsall, W. H., Ecology of wet soils in Britain. PBC, 259—260.

959. Pekkari, S., Fynd av Chara Braunii vid Haparanda. BN, 73—77.

960. Persson, Brita, Observationer rörande blommornas biologi hos raps (Brassica Napus L.) med hänsyn till faran för bidöd vid behandling av rapsfält med insekticider. SV Medd. 66, 67 s. Summary 61—66.

961. Persson, C., Sörlin, A., Besök i Jämtlandsfjällen. Stockholm. 123 s.

962. Persson, H., Some problems concerning the bryophyte flora of Alaska. PBC, 846—847.

963. Pettersson, B., An experimental investigation of the dispersal of mainly anemochorous nordic phanerogams. PBC, 236—237.

964. Polunin, N., The real Arctic. PBC, 611—612.

965. Porsild, A. E., The vascular flora of the North American Arctic. PBC, 613—614.

966. Quennerstedt, N., On the diatoms of Swedish mountain lakes. PBC, 831—832.

967. Ramaut, J. L., Recherche sur le rôle de Sphagnum recurvum dans l'acidité des tourbières de la Baraque Michel. PBC, 257—258.

968. Rawitscher, F., Climax and pseudoclimax vegetation in the Tropics (South America). PBC, 616—618.

969. Raymond, M., On the presence of Eriophorum angustifolium Honck. in the Southern Hemisphere. SBT 47, 122—123.

970. — Quelques limites naturelles de la flore du Québec, telles qu'indiquées par la distribution de quelques espèces du genre Carex. PBC, 619—620.

971. Rechinger, K. H., Flora and vegetation of Iran. PBC, 864—866.

972. Regel, C., La limite entre l'Europe Centrale et la région de la Méditerranée. PBC, 667—668.
973. Reichert, I., Steppes and deserts in the eastern Holarctis in relation to lichens. PBC, 676—677.
974. Renner, F. G., Experimental studies on natural grazing lands of the U.S. PBC, 243—244.
975. Richards, P. W., The structure of tropical evergreen forest in America, Asia and Africa. PBC, 606.
976. Rivas Goday, S., Essai sur les climax dans la Péninsule Ibérique. PBC, 648—650.
977. Robyns, W., On the phytogeographic elements in the Congo flora. PBC, 607.
978. Round, F. E., The ecology of the algae of some littoral sediments of some English lakes. PBC, 829—830.
979. Rousseau, J., La zone hémiarctique dans le Québec. PBC, 615.
980. — Les plantes indicatrices des nunataks dans le Québec. PBC, 614—615.
981. Rune, O., Plant life on serpentines and related rocks in the north of Sweden. Acta Phytogeogr. Suec. 31, 139 s., 8 pl.
982. Rydorff, B.-Å., Fältvädd i Hässleholm. Natur i Göinge, 31—32.
983. Sauvage, C., Les reliques de la flore tropicale au Maroc. PBC, 650—651.
984. Schmid, E., Demonstration von Vegetationskarten kleinen Masstabes. PBC, 624—625.
985. — Propositions for the analyses of vegetation. PBC, 654.
986. Scholander, C., En vacker lunddäld i Halmstadtrakten. Hallands Natur, 23—26.
987. Schwickerath, M., Das Ganzheitsprinzip in seiner Bedeutung für die Formung des Assoziationsprinzips. PBC, 661—662.
988. Schön, E., Brännön. Nat. i Ång., 348—351.
989. Segelberg, I., Violer i Sundsvallstrakten. Nat. i Ång., 344—347.
990. Sjöbeck, M., Nordvästra Skånes naturbetingelser och kultursamband. »Stenkol och lera», utg. av Höganäs-Billesholms Aktiebolag, 1, 174—216.
991. Sjögren, J., En tillfällig Chenopodiacévegetation. BN, 235—236.
992. Sj-n [Sjögren], W., En utböling i Hallandsfloran. Hallands Natur, 42—43.
993. — Ett par märkliga gräsfynd i Halmstadtrakten. Hallands Natur, 43—44.
994. Sjörs, H., Kroppefjäll. Nat. i Dls., 246—262.
995. — Myrar på Dal. Nat. i Dls., 91—97.
996. Smith, A. C., The vegetation and flora of Fiji. PBC, 866.
997. Snell, A. J., Särlingar i Kalmarfloran. Det grönskande Kalmar, 102—106.
998. van Steenis, C. G. G. J., On the hierarchy of environmental factors in plant ecology. PBC, 637—644.
999. Sterner, R., Kinnekulle — botanisternas vallfartsort. Kinnekulle. Skrifter utg. av Biologilär:s för. 1, 22—42, 2 pl.
1000. Stjerna-Pooth, Ingeborg, Die Kieselalgenvegetation in zwei azidotrophen Seen des Küstengebietes von Nordschweden. Ann. Rep. Inst. Freshwater Res. Drottningholm 34, 122—140.
1001. Sucatjev, V. N., On the exploration of the vegetation of the Soviet Union. PBC, 659—660.
1002. Sylvén, N., Enligt naturskyddslagen i Skåne fridlysta enskilda växtarter. Skånes Natur 40, 75—102.

1003. Säfverstam, Z., Ytterligare en lokal för Sarothamnus scoparius i Västergötland. SBT 47, 531.

1004. Söderström, O., Om Härnösandstraktens flora. Nat. i Ång., 297—306.

1005. Tamm, C.-O., Growth and nutrient consumption in a moss community. PBC, 253.

1006. — Growth, yield and nutrition in carpets of a forest moss (Hylocomium splendens). SS Medd. 43: 1, 1—140. Sammanfattn. 124—132. (Äv. diss. Stockholm.)

1007. Taylor, A. R. A., Observations on the distribution, growth and ecology of Zostera marina L. in eastern Canadian waters. PBC, 733.

1008. Taylor, W. R., Marine algal vegetation of the Marshall Islands in comparison with other tropical areas. PBC, 826—827.

1009. Teiling, E., Phytoplanctic associations of Swedish lakes. PBC, 828—829.

1010. Trochain, J., Les types de végétation en Afrique Noire Française. PBC, 680—681.

1011. Troll, C., Der Vergleich der Tropenvegetation der Alten und Neuen Welt. PBC, 602—606.

1012. — Die thermischen Klimatypen und das Vegetationsprofil der Erde, PBC, 646—648.

1013. — Savannentypen und das Problem der Primärsavannen. PBC, 670—675.

1014. Uggla, A. och W., Bidrag till Stockholmstraktens mossor. SBT 47, 378—386.

1015. Wærn, M., Pictures of brackish algal vegetation of the Baltic. PBC, 828.

1016. Walker, F. T., Some factors from the sublittoral seaweed survey of Scotland. PBC, 843—844.

1017. Vallin, S., Zwei azidotrophe Seen im Küstengebiet von Nordschweden. Ann. Rep. Inst. Freshwater Res. Drottningholm 34, 167—189.

1018. Weimarck, Gunhild, Studier över landskapets förändring inom Lönsboda, Örkeneds socken, nordöstra Skåne. Lunds univ. årsskr. N.F., Avd. 2, 48: 10. 140 s., 24 pl. Diss. Lund.

1019. Weimarck, H., De enligt naturskyddslagen skyddade botaniska objekten i Skåne. Skånes Natur 40, 17—74.

1020. Westfeldt, G. A., Safsan (Osmunda regalis) i södra Västergötland. SvN, årsb., 88—92.

1021. Westman, G., Tåsjö och Tåsjöberget. Nat. i Ång., 197—204.

1022. Vide, Lilleba, Runmarö. Fältbiologen 6, 25—26, 31.

1023. Wiger, J., Om Lactuca tatarica (L.) C. A. Meyer i Halland. SBT 47, 386—387.

1024. Willén, T., Najas marina och Chara tomentosa från sötvatten i Uppland. SBT 47, 123—125.

1025. Woldmar, S., Floristiska anteckningar från Sarven, en Cladiumsjö i Bohuslän. SBT 47, 125—130.

1026. Vouk, V., Die Probleme der Biologie der Thermen im Lichte der neuesten Forschungen. PBC, 103—113.

1027. Zohary, M., Phytogeographical problems of the Near-East countries. PBC, 675—676.

1028. Öhlin, Kjerstin, Resultatet av 1952 års fenologi. Fältbiologen 6, 5—6.

Se även nr 34, 81, 118, 166, 176, 264, 274, 285, 292, 361, 376, 414, 428, 438, 447, 455, 467, 477, 482, 489, 493, 502, 506, 510, 513, 522, 524, 552, 565, 649, 679, 689, 696, 700, 705, 726—28, 737, 761, 784, 795, 1066, 1070.

Årsberättelser, historia, personalia.

1029. ARNBORG, T., and HADDERS, G., The society for practical forest improvement. SST 51, 172—182.

1030. Berättelse över verksamheten vid Statens Skogsforskningsinstitut under perioden 1946—1952 jämte förslag till arbetsprogram för den kommande femårsperioden. SS Medd. 43: 6, 1—79.

1031. VAN BEVERWIJK, AGATHE L., and WESTERDIJK, JOHANNA, A survey of the development and the desires of the collection of the Centraalbureau voor Schimmelcultures. PBC, 451—452.

1032. BODENHEIMER, F. S., and UGGLA, A. H., The »album itineris» of Frederic Hasselquist. Sv. Linné-sällsk. årsskr. 35, 18—30.

1033. Botaniska Föreningen i Göteborg. [Sammankomster år 1952.] SBT 47, 152—153.

1034. Botaniska Sektionen av Naturvetenskapliga Studentsällskapet i Uppsala. [Sammankomster år 1952.] SBT 47, 154—155.

1035. Botaniska Sällskapet i Stockholm. [Sammankomster år 1952.] SBT, 47, 155.

1036. Botanistklubben vid Stockholms Högskola. [Sammankomster år 1952.] SBT 47, 156.

1037. BRYK, F., Linné und die Species Plantarum. Taxon 2, 63—84. 2 pl.

1038. COWAN, J. M., The Royal Botanic Garden, Edinburgh. PBC, 870—871.

1039. CUFODONTIS, G., Wilhelm Schimper, a pioneer of Ethiopian botany. PBC, 869—870.

1040. ERDTMAN, G., Literature on palynology. XVI. GFF 75, 17—38.

1041. Excursions. PBC, 116—140.

1042. FÆGRI, K., The pollen-analytic laboratory of the University botanical museum in Bergen. GFF 75, 108—112.

1043. FLORIN, R., Le jardin botanique de Bergius à Stockholm et autres jardins botaniques suédois. L'anné biol. 57, sér. 3, 29: 7—10, 263—265.

1044. FOSBERG, R., Functions of the modern herbarium. PBC, 869.

1045. FREDBÄRJ, T., Ett 1700-talsherbarium. Sv. Linnésällsk. årsskr. 35, 107—109.

1046. FRIES, C., I Linnés smålandsbygd. Småland. Under red. av H. SCHILLER. Stockholm, 155—161, 4 pl.

1047. Från Lunds Botaniska Förenings förhandlingar 1952. BN, 145—148.

1048. Förteckning över nordisk jordbrukslitteratur 1949—1951, 1952. Nord. Jordbrugsforskn. 34, 157—297, 35, 179—253.

1049. HJELMQVIST, H., Svensk Botanisk Litteratur 1952. BN, 441—461.

1050. HOLMBERG, A., P. J. Bergius' anteckningar från en resa till Dalarna år 1751. Sv. Linné-sällsk. årsskr. 35, 71—85.

1051. HYLANDER, N., Östgötsk herrgårdstur. Några glimtar från föreningens [för dendrologi och parkvård] sommarexkursion 16—18 juni 1950. Lustgården 33—34, 75—90.

1052. JIMBÔ, T., Palynology in Japan. GFF 75, 400—402.

1053. JOHANSSON, N., In Memoriam. Olof J. Hasslow. BN, 436—440.

1054. KIELLANDER, C. L., och STEFANSSON, E., Resa till Norge och Finland för studium av främmande barrträd. NST, 85—129.

1055. LINNAEUS, C., Linnés Dalaresa jämte Utlandsresan och Bergslagsresan. Med utförlig kommentar. Under red. av A. H. UGGLA. Stockholm. XVI+432 s., 16 pl., 2 bil.

1056. Linnaeus, C., Till den gunstige läsaren. [Företal till Species Plantarum 1753.] Sv. Linné-sällsk. årsskr. 35, 1—4. (Översättn.)

1057. Linnell, T., Några ord om Linnés Peloria och dess locus classicus. Sv. Linné-sällsk. årsskr. 35, 62—70. Summary 114—115.

1058. L. [Linnell], T., Vad man kan finna i ett elevherbarium. Ett apropos till 200-årsminnet av Systema Naturae 1753. Medl.-bl. f. biol.-lär:s för. 19, 95—97, 99.

1059. Malmström, C., Botaniska Sällskapet i Stockholm 70 år. SBT 47, 340—377.

1060. Mattick, F., Die Lichenologie in Deutschland seit 1870 und ihre Zukunftsaufgaben. PBC, 816—817.

1061. Müntzing, A., Några synpunkter på svensk ärftlighetsforskning. Stat. Naturv. Forskningsråds årsb. 6, 168—172.

1062. Nannfeldt, J. A., Linnés »Species Plantarum», ett 200-årsminne. Naturh. Tid. 17, 23—25.

1062a. — Species Plantarum 1753—1 May—1953. Taxon 2, 37—38.

1063. Nordwall, J. F., J. A. O. Skårman. 12/12 1862—19/8 1950. SBT 47, 140—151.

1064. Näslund, M., Die Forstliche Forschungsanstalt Schwedens, Arbeitsaufgaben und Organisation. SS Medd. 42: 3 C, 24 s.

1065. — The Forest Research Institute of Sweden, its work and organization. SS Medd. 42: 3 B, 20 s.

1066. Peters, B., Västra kretsens [av biol.-lär:s för.] vårexkursion. Medl.-bl. f. biol.-lär:s för. 19, 77, 79.

1066a. Radforth, N. W., Palaeoecological research in northern Canada. PBC, 573.

1067. Rydén, S., José Celestino Mutio och hans förbindelser med Linné och hans krets. Sv. Linné-sällsk. årsskr. 35, 31—38. Summary 114.

1068. Societas pro Fauna et Flora Fennica. [Sammankomster år 1952.] SBT 47, 156—159.

1069. Suneson, S., Algforskningen på Kristineberg. K. Sv. Vetenskapsak:s årsb. för år 1953, 461—478.

1070. Svenska Botaniska Föreningen. Föreningens vårutflykt till Torö 1952 (av I. Fröman). Föreningens exkursion vid Västkusten den 20—22 juni 1952 (av V. Gillner). Föreningens höstexkursion till Länna och Frötuna den 28 sept. 1952 (av E. Almquist och G. E. Haglund). Årsmötet 1952. SBT 47, 160—175.

1071. Svenska Växtgeografiska Sällskapet. [Sammankomster år 1952.] SBT 47, 159.

1072. Thomasson, K., In Memoriam. Teodor Lippmaa. BN, 238—243. Résumé 240—241.

1072a. [Thunberg, C. P.,] Forskningsmaterial rörande C. P. Thunberg. (Äv. japansk titel.) Utdrag av C. P. Thunbergs skrifter samt bidrag av K. G. Lagerfelt, B. Lindquist o. japanska författare. Tokyo. VIII+155 s., 1 karta, 2 pl.

1073. Turrill, W. B., Curtis's Botanical Magazine. PBC, 83—87.

1074. Uggla, A. H., Fredric Hasselquist. Ett tvåhundraårsminne. Sv. Linné-sällsk. årsskr. 35, 5—17. Summary 114.

1075. — Försvunna Linné-handskrifter. Sv. Linné-sällsk. årsskr. 35, 89—91.

1076. — Linné som smålänning. Småland. Under red. av H. Schiller. Stockholm. 296—302, 5 pl.

1077. UGGLA, A. H., The preparation of the Species Plantarum. Taxon 2, 60—62.
1078. VERDOORN, F., The international plant science congresses, their history and aims. PBC, 42—56, 4 pl.
1079. VOUK, V., Die Botanik im Systeme der biologischen Wissenschaften. PBC, 855—857.
1080. VAN ZINDEREN BAKKER, E. M., Palynology in South Africa. GFF 75, 398—400.

Se även nr 780, 833, 862.

Tillägg till Svensk Botanisk Litteratur 1952.

463. EHRENBERG, L., and GRANHALL, I., Effects of *beta*-radiating isotopes in fruit trees. Her. 38, 385—419.
464. EHRENBERG, L., and NYBOM, N., Chemical and biological effects of neutrons and X-rays. Her. 38, 481—501.
465. ERDTMAN, G., On pollen and spore terminology. The Palaeobotanist (Lucknow) 1, 169—176.
466. ERICSON, L.-E., Uptake of radioactive cobalt and vitamin B_{12} by some marine algae. Chemistry and Industry, 829—830.
467. FLORIN, R., On two sonifers from the Jurassic of south-eastern Australia. The Palaeobotanist 1, 177—182, 2 pl.
468. FRIES, R. E., Annonaceae. Contr. to the flora of trop. America LIV, Kew Bull., 255—256.
469. — Annonaceae. Plant exploration of G. Wilson-Browne, S. J., in British Guiana I, Kanuku Mountains, Brittonia 7, 395.
470. HAGBERG, A., Heterosis in some crosses between populations of rye and red clover. Her. 38, 506—510.
471. HAGBERG, A., NYBOM, N., and GUSTAFSSON, Å., Allelism of erectoides mutations in barley. Her. 38, 510—512.
472. HALLE, T. G., Professor Sahni's palaeobotanical work. The Palaeobotanist 1, 22—41.
473. HÅKANSSON, A., Seed development after $2x$, $4x$ crosses in Galeopsis pubescens. Her. 38, 425—448.
474. NÄSLUND, M., Statens Skogsforskningsinstitut, dess arbetsuppgifter och organisation. SS Medd. 42: 3 A, 23 s.
475. PALMCRANTZ, P. J., Über die Züchtung von Elodea densa. Beitr. z. Biol. d. Pflanzen 29, 220—231.
476. WESTFELDT, G. A., Glaciala relikter i sjuhäradsbygden. Från Borås och de sju häraderna, 71—86.
477. WIKÉN, T., Untersuchungen über die Physiologie der Weinhefen. II—III. Antonie van Leeuwenhoek 18, 31—44, 293—315. Summary 42—43, 311—315. (Tills. m. O. RICHARD.)
478. WIKLANDER, L., On the release of plant nutrients. Trans. Intern. Soc. Soil Science (Dublin) 1, 189—194.

H. HJELMQVIST.

Litteratur.

JOHN RAMSBOTTOM: Mushrooms and Toadstools. — Collins. London. 1953. Pris 30 s.

I den engelska serien The New Naturalist har utkommit många böcker, som är utmärkta till sitt pris. Frågan är emellertid om inte toppunkten nås av RAMSBOTTOMS svampbok. Den bygger på traditioner från ISAAC WALTONS dagar och är en riktig bibel för svampälskaren. Bokens säregna karaktär kommer tydligast till uttryck i kapitlen om ätliga och giftiga svampar, svampodling, älvringar, tryffeljakt, röta och mykologiens historia. Här är fakta och fabler sammanflätade till fantasieggande och tjusande mönster på ett helt enkelt mästerligt sätt.

Materialet är icke systematiskt behandlat, ehuru särskilda kapitel finnas om röksvampar, jordstjärnor, stinksvampar, brödkorgssvampar och tryfflar. Fängslande som en äventyrsroman är kapitlen om sporkaraktärer, självlysande svampar, mykorrhiza och penicillin. Därjämte finnas flera tyvärr alltför korta kapitel om ekologien i olika växtsamhällen.

De strålande bilderna i färg och svart-vitt bidraga förtjänstfullt till att ge boken en kvalitet, som man inte är bortskämd med.

BENGT ÅKESSON.

Notiser.

Göteborgs botaniska trädgård. Till intendent vid Göteborgs botaniska trädgård har utnämnts docent GUNNAR DEGELIUS.

Tryckningsbidrag till Botaniska Notiser och Opera Botanica. Av Statens naturvetenskapliga forskningsråd har Lunds Botaniska förening erhållit ett anslag å 12.000 kr. för utgivande av Botaniska Notiser under 1955 och 6.000 kr. för utgivande under 1955 av Opera Botanica.

Rättelse: häfte 3, p. 342. fil. lic. H. RUNEMARK 9.000 kr. för undersökningar av cellulosabildningen hos vissa slemsvampar (enl. tidningsuppgift) — läs: för undersökningar inom lavsläktet *Rhizocarpon*.

Lunds Botaniska Förening 1954.

Beskyddare.

H. M:T KONUNGEN.

Hedersledamöter.

Överste GEORG BJÖRNSTRÖM, Grönegatan 24, Lund.
F.d. Telegrafkommissarie THORVALD LANGE, Olympiavägen 13, Hälsingborg.
Professor em. HERIBERT NILSSON, Magnus Stenbocksgatan 1, Lund.
Professor NILS SYLVÉN, Vegagatan 16, Lund.
Professor GÖTE TURESSON, Västra Ågatan 22, Uppsala.

Styrelse.

Fil. dr ASTA ALMESTRAND, ordförande; Docent HEMMING VIRGIN, vice ordförande; Docent HUGO SJÖRS, adjungerad vice ordförande; Amanuens LENNART ELIASSON, sekreterare; Amanuens ROLF DAHLGREN, vice sekreterare; Professor HANS BURSTRÖM, Professor HENNING WEIMARCK, Direktör KARL EVERT FLINCK, Docent ROBERT LAMM och Amanuens NILS MALMER.

Funktionärer.

1:e Museiintendent TYCHO NORLINDH, arkivarie och redaktör för Botaniska Notiser; Akademiträdgårdsmästare AXEL TÖRJE, kassör; Assistent K. H. MATTISSON, bytesföreståndare.

Ombud.

I Uppsala: Amanuens PER-OLOF LINDAHL, Institutionen för Systematisk Botanik.
I Stockholm: Fil. lic. MÅNS RYBERG, Institutionen för Morphologisk Botanik, Stockholms Högskola.
I Finland: Docent HANS LUTHER, Snellmansgatan 16 C, Helsingfors.

Sektionen Skånes Flora.

Överstelöjtnant SEVERIN AXELL, ordförande; Överste GEORG BJÖRNSTRÖM, vice ordförande; Professor HENNING WEIMARCK, sekreterare.

Under år 1954 nytillkomna medlemmar.

Abrahamsson, Hans, Fil. stud., Svanegatan 7 a, Lund.
Arnell, Hampus, Fil. stud., Trångsund 2 B, Stockholm.
Bjurulf, S. J., Rektor, Bäckalyckevägen 14, Jönköping.
Bringer, Carl-Göran, Fil. stud., Sturegatan 13, Uppsala.
Danielson, C. E., Docent, AB Findus, Bjuv.
Dybern, Bernt-Ingemar, Fil. stud., Luthagsesplanaden 21 A, Uppsala.
Ehrenberg, Lars, Fil. lic., Inst. för organisk-kemisk forskning, Sandåsgatan 2, Stockholm.
Ellesson, Jan, Fil. stud., Sölvegatan 6, Lund.
Fransson, Sven, Fil. stud., Sturegatan 11 A, Uppsala.
Gawelin, Nils E., Box 3544, Skellefteå 2.
Holmgren, Paul, Fil. mag., Studentstaden 19, Uppsala.
Ingmar, Tord, Fil. mag., Övre Slottsgatan 5 A, Uppsala.
Jacobson, Astrid, Fil. kand., Floragatan 14, Uppsala.
Karlsson, Birgitta, Fil. stud., Sölvegatan 11, Lund.
Kennedy, Elisabet, Fru, Odersberga, Fjälkestad.
Lexander, Kerstin, Fil. kand., Lagerbrings väg 5 A, Lund.
Lindahl, Per-Olof, Amanuens, Inst. för Systematisk Botanik, Uppsala.
Lindskog, Hans, Fil. stud., Östra Fäladsvägen 21, Lund.
Lundberg, Bengt, Stud., Vallhallavägen 7, Karlskrona.
Lööf, Bengt, Fil. stud., Sveriges Utsädesförening, Svalöf.
Markström, Allan, Fil. stud., Pilåkersvägen 28, Malmö.
Meerut College, Department of Botany, Meerut, Indien.
Molander, Leif, Kandidat, Anders Knopes väg 4, Uddevalla.
Nordenstam, Tore, Fil. stud., Skillnadsgatan 49, Göteborg S.
Nordholm, Uno, Apotekare, Apoteket Svanen, Lund.
Norén, Börje, Fil. lic., Tegnérgatan 38 B, Uppsala.
Pärnoja, Evi, Fil. kand., Stora Tvärgatan 12 A, Lund.
Pöder, Valdar, Jägmästare, Järnbrogatan 1 A, Uppsala.
Stadsbiblioteket, Visby.
Steen, Eliel, Överassistent, Luthagsesplanaden 15 A, Uppsala.
Svensson, Sven Börje, Fil. stud., Östra fäladsvägen 21, Lund.
Tullin, Vagn, Civilingenjör, Arlövs Sockerbruk, Arlöv.
Universitetsbiblioteket, Uppsala.
Wendelbo, Per, Dr, Botanisk Museum, Bergen, Norge.
Wittström, Rolf, Stud., Ballingslöv.