

Leaf Anatomy in the Grass Series Phragmitiformes (Harz) Avdulov.

By

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The taxonomy of the Gramineae is by no means straightforward and is complicated by many factors. Due largely to a lack of data there is still no general agreement regarding the subdivision of the family into tribes or even subfamilies. The flowers are not showy, the component parts are often much reduced and the vegetative parts have reached a high degree of specialization. A close examination of the glumes, lemmas, paleae, lodicules, androecium and gynoecium reveals a wide degree of diversity among these organs. It is, therefore, not surprising that most systems of classification are based mainly on spikelet morphology. Recently, however, evidence regarding the relations of the species and genera has become available which differs conspicuously from most older observations. Leaf anatomy (Duval-Jouve, 1875, Pee-Laby, 1898, Grob, 1895-1897 and Prat, 1932, 1936) was proved to be useful in grass taxonomy. Similarly, Avdulov (1931) and Hunter (1934) indicated a close correlation between cytological data and the physiological observations of Trucel (1858) and Harz (1880-1882). More recently, Reeder (1946, 1953) combining with his own observations the data of Burns (1892) and Kennedy (1899) indicated that embryo anatomical observations may be used taxonomically. Reeder and von Maltzhan (1953) also pointed out that different types of root hair development were observed which allow for a subdivision of the Gramineae on the same lines as pointed out by Avdulov (1931) and Prat (1936). It is generally agreed among modern taxonomists that anatomy, cytology, genetics, ecology and physiology provide more reliable clues towards the true relationships in the Gramineae than spikelet morphology alone. Subdivisions based on gross morphology is essential for the easy and rapid identification of individual plants. Such is the recent classification of Pilger (1954). The leaf anatomy of the genera included in his subfamilies Festucoideae Hitchc., Micrairoideae Pilger, Oryzoideae Parodi, Olyroideae Pilger, Bambusoideae Krause and Anomochloideae Pilger will be discussed. An attempt will be made to evaluate the available data and supplement them with some personal observations in determining the phylogenetic position of some genera of controversial affinity.

The terms Panicoid type, Festucoid type, Eragrostoid type and Oryzoid type of internal leaf anatomy and epidermal histology were fully discussed by Prat (1936) and de Wet (1954, 1956a). The reader is referred to the diagrams later in this paper for more details.

MATERIAL AND METHODS: Specimens investigated were obtained from the National Herbarium, Pretoria. Slides were prepared according to the procedure outlined by Prat (1948). Drawings were made with the aid of a Camera Lucida.

Subfamily FESTUCOIDEAE.

1. **Festuceae - Festucinae:** *Lintonia* and *Cynosurus* were found to be Festucoid in all respects. The genera *Urochlaena*, *Lasiochloa* and *Plagiochloa* are characterized by the Festucoid type of internal leaf anatomy and the Panicoid type of epidermis. They are further characterized by truncate lodicules and ciliated ligules.

The genera *Lamarckia*, *Briza*, *Dactylis*, *Poa*, *Nephelochloa*, *Cutandia*, *Scleropoa*, *Vulpia* and *Festuca* are Festucoid in all respects according to Prat (1936). Prat (1936) also indicated a Panicoid type of leaf anatomy for *Uniola* and *Distichlis*, and a Festucoid type of chlorophyll distribution with variable epidermal traits in *Aeluropus* and *Fingerhutia*. Moffet and Hurcombe (1949) demonstrated a Eragrostoid type of leaf anatomy and cytology for *Tetrachne*.

Festuceae – Triodinae: *Plectrachne* and *Notochloa* are unknown cytologically and anatomically. Brown (1950) refers *Astrebta* to the Chlorideae because of its small chromosomes and basic number of $n = 10$. *Triodia* is characterized by $n = 8$ (Brown, 1950) and Burbidge (1946) demonstrated a Festucoid type of leaf anatomy.

Festuceae – Sesleriinae: The leaf anatomy of *Entoplocamia* and *Orcuttia* is of the Eragrostoid type. They are further characterized by ciliated ligules, large embryos and the grains are loosely enclosed by the lemmas and palea. Prat (1936) demonstrates a Festucoid type of epidermis and internal anatomy for the genera *Sesleria* and *Echinaria*. Myers (1947) lists large chromosomes with basic numbers $n = 7$ and $n = 9$ in these genera respectively. No data regarding chromosomes, anatomy and lodicules are available for the remaining genera included in this subtribe.

Festuceae – Beckmanniinae: Includes a single genus *Beckmannia* usually referred to the Chlorideae. Von Tieghem (1897), Avdulov (1931), Prat (1936) and Krishnaswamy (1941) indicated relations with the tribe Agrostae as recognized by Hubbard (1934). Reeder (1953) studied the embryo anatomy and indicates relations with the genera *Alopecurus*, *Phleum* and *Polypogon*.

Festuceae – Melicinae: Only two of the genera included in this subtribe have been studied. Morphologically *Melica* and *Schizachne* differ from the Festuceae in spikelet morphology. Their lodicules are truncate and vasculated, their stigma branches are broad and dichotomous, their caryopsis do not adhere to the palea and their embryos are relatively large. Both genera are characterized by the Panicoid type of histology. In the case of *Melica*, Avdulov (1931) demonstrated large chromosomes in multiples of $n = 9$.

Festuceae – Glyceriinae: *Pleuropogon* and *Glyceria* resemble the Festuceae in superficial characters but do not seem to be related to members of Festuceae. The chromosomes are medium large and Avdulov (1931) demonstrated $n = 9$ in *Glyceria* and $n = 8$ in *Pleuropogon*. Leaf anatomy is of the Festucoid type. *Poaagrostis* has been transferred by de Wet (1956a) to the Danthonieae. The genus *Puccinella* on the other hand is Festucoid in all respects (Prat, 1936). Furthermore, in the latter genus the lodicules have appendages, the embryo is small and the grain is tightly embraced by the hardened lemma and palea.

Festuceae – Psilurinae: The single genus *Psilurus* is characterized by a Festucoid type of leaf anatomy (Prat, 1936) and Avdulov (1931) demonstrated large chromosomes and a basic number of $n = 7$. Hubbard (1934) includes *Psilurus* together with *Pholiurus*, *Lepturus* and *Ischnurus* in the tribe Leptureae. Prat (1936) demonstrated that this tribe as recognized by Hubbard (1934) is completely Festucoid in all respects. Pilger (1954) retains *Pholiurus* in the subfamily Festucoideae tribe Monermeae. *Lepturus* and *Ischnurus*, however, Pilger (1954) refers to the Chlorideae, which evidently is incorrect.

Festuceae – Loliinae: Includes a single genus *Lolium* which is Festucoid in all respects. The cytology was investigated by Faworski (1927) and leaf anatomy by Prat (1936).

Festuceae – Bromineae: A truly Festucoid tribe according to Avdulov (1931), Prat (1936) and Myers (1947).

Festuceae – Streptogyinae: The single genus *Streptogyne* is unknown cytologically and anatomically.

Festuceae – Centothecinae: Both Pilger (1954) and Hubbard (1934) regards the Centothecinae as a subtribe of the Festuceae. It definitely does not belong here. Prat (1936) illustrates an Oryzoid type of leaf epidermis for *Centotheca*, *Lophatherum* and *Zeugites*. On the other hand, *Orthoclada* was found to have the Panicoid type of epidermis. Chlorophyll distribution is of the Festucoid type in all these genera. Avdulov (1931) demonstrated $n = 12$ in *Centotheca*, a cytology quite foreign to the Festuceae. In *Centotheca* the ligule is scarious, a Festucoid type of character, but the two lodicules are cuneate and without appendages which again are Panicoid characteristics.

Festuceae – Pommercullinae: The genus *Pommerculla* has not been studied.

Festuceae – Monanthochloinae: The single genus *Monanthochloe* is characterized by the Festucoid type of leaf anatomy but it differs from the Festuceae in spikelet morphology. The lodicules are truncate and the stigma branches are elongated.

2. **Triticeae – Henrardiinae:** The genus *Henrardia* is unknown cytologically and anatomically.

Triticeae – Eutriticinae: Prat (1936) and Avdulov (1931) indicated that the genera included in this tribe are characterized by all the peculiarities typical of the subfamily Festucoideae.

3. **Monermeae:** Only *Pholiurus* of the genera included in this tribe is known cytologically and anatomically. Prat (1936) indicated that this genus is Festucoid in all respects.

4. **Aveneae – Aveninae:** This subtribe has been fully discussed by de Wet (1954, 1956a). *Schismus*, *Afrachneria* and *Prionanthium* occupy an artificial position in the Aveneae.

Aveneae – Duthiinae: The single genus *Duthiea* has not been studied.

Aveneae – Danthoniinae: This subtribe was discussed by de Wet (1956a). A number of the genera included in this subtribe are still unknown anatomically and cytologically. Their phylogenetic position in the Gramineae is still uncertain.

5. **Arundineae:** A primitive tribe closely allied to the Danthoniinae (de Wet, 1956a). The morphological characters are peculiar and differ from those of typical members belonging to the subfamily Festucoideae. The lemmas are primitively awned from the sinus of the lobes, the ligule is ciliated, lodicules are more or less cuneate and vasculated and the stigma branches tend to be expanded and flattened in most species. Avdulov (1931) indicated a basic chromosome number of $n = 12$. Leaf anatomy, Prat (1936) and de Wet (1954) is of the Panicoid type.

6. **Arundinelleae:** The genera *Arundinella*, *Trichopteryx*, *Loudetia* and *Tristachya* are Panicoid in respect to leaf anatomy and morphology but resemble the Phragmitiformes of Avdulov (1931) in cytology (de Wet, 1954). *Danthoniopsis* on the other hand according to de Wet (1954) is Panicoid in all respects. The genus *Gilgichloa* has not been investigated.

7. **Thysanolaeneae:** The single genus *Thysanolaena* is characterized by the Panicoid type of epidermis and chlorophyll distribution. It is also Panicoid in respect of the grain which is free from the lemma and palea, the large embryo and lodicules which are cuneate. Typical Festucoid characters are the disarticulation of the spikelet above the glumes and the scarious rim which forms the ligule.

8. **Phalarideae:** *Ehrharta* and *Microlaena* are characterized by the Oryzoid type of leaf anatomy (Prat, 1936) and cytology (Avdulov, 1931). The remaining genera, Prat (1936), are typically Festucoid.

9. **Pappophoreae:** In the genera *Schmidtia* and *Enneapogon* the siliceous cells are Panicoid but the bicellular hairs are typically *Eragrostoid*. Prat (1936) recorded an Eragrostoid type of epidermis of *Cottea* and *Pappophorum*. Chlorophyll distribution is of the Festucoid type.

Small chromosomes and a basic number of $n = 10$ were recorded by Covas (1945) in the genera *Cottea* and *Pappophorum*. For the genera *Schmidtia* and *Enneapogon* de Wet (1956b) demonstrated a basic chromosome number of $n = 9$. In the latter two genera the stigma branches are stalked, the lodicules are cuneate and the embryo occupies $\frac{3}{4}$ or more of the length of the grain.

10. **Stipeae:** The chromosomes are mostly small but medium large in *Piptochaetium* and a few species of *Stipa*. The basic chromosome numbers are $n = 11$ in *Piptochaetium* and some species of *Oryzopsis*, while $n = 12$ in some other species of the latter genus (Johnson, 1945). In *Stipa*, Myers (1947), Brown (1949, 1951) and Ono and Tateoka (1953) demonstrate an aneuploid series, perhaps originally derived from $n = 6$ or $n = 5$. Internal leaf anatomy is of the Festucoid type and epidermal traits are variable (Prat, 1936).

11. **Nardeae:** Prat (1936) demonstrated a Festucoid type of chlorophyll distribution and Eragrostoid type of epidermis. Avdulov (1931) observed a basic chromosome number of $n = 13$ in the monotypic genus *Nardus stricta*.

12. **Coleantheae:** The single genus *Coleanthus* is Eragrostoid in respect of leaf anatomy. Lack of material made it impossible to study spikelet morphology.

13. **Lygaeae:** The monotypic genus *Lygaeum sparteum* has $n = 20$ and medium large chromosomes (Myers, 1947). Leaf anatomy is unknown.

14. **Phyllorachieae:** The genera included in this tribe were fully discussed by de Wet (1956b). It was pointed out that this tribe is closely related to the Oryzeae.

15. **Parianeae:** Contains a single tropical New World genus *Pariana* which is unknown anatomically and cytologically.

Subfamily MICRAROIDEAE: Tribe **Micraireae:** Includes a single genus *Micraira* which was not available for study.

Subfamily ORYZOIDEAE: Tribe **Oryzeae:** The genera *Oryza*, *Leersia*, *Potamophila* and *Zizania* are all characterized by the Oryzoid type of epidermis and Festucoid type of chlorophyll distribution. Kuwado (1910) and Ramanujam (1938) demonstrated a basic chromosome number of $n = 12$ in *Oryza*. A similar basic chromosome number and medium large chromosomes are also present in *Leersia* (Ramanujam, 1938). The remaining genera included by Pilger (1954) in this subfamily are unknown anatomically and cytologically.

Subfamily OLYROIDEAE: Tribe **Olyreae:** The genera *Pharus* and *Leptaspis* are characterized by the Panicoid type of epidermis. These genera are included by Hubbard (1934) in the tribe Phareae. Of the other genera belonging to the Olyreae, *Raddia*, *Lithachne* and *Olyra* are characterized by the Oryzoid type of epidermis. Chlorophyll is distributed according to the Festucoid type in all genera investigated.

Subfamily BAMBUSOIDEAE: This subfamily has been fully investigated by Prat (1936) who indicated a very peculiar type of leaf anatomy. Pilger (1954) also includes the tribe Streptochaetae of Hubbard (1934) in this subfamily. The genus *Streptochaeta*, the only member of this tribe, has not been studied anatomically. Stebbins (Unpubl.) reports $n = 11$ chromosomes in one of the two known species of this genus.

Subfamily ANOMOCHLOIDEAE: This includes a single genus, *Anomochloa*. No data regarding cytology, anatomy or detailed spikelet morphology is available.

One tribe of the subfamily Eragrostoideae the Aristideae as recognized by Pilger (1954) also needs to be mentioned. Pilger (1954) includes the genera *Aristida*, *Amphipogon* and *Diplopogon* in this tribe. Only the genus *Aristida* was available for study. The basic chromosome number is $n = 11$ and $n = 12$ in *Aristida* according to de Wet (1954, 1956b). A further indication that this genus does not belong in the Eragrostoideae comes from a study of leaf anatomy. The chlorophyll distribution is of the Panicoid type, but epidermal traits are variable. For instance in *A. ciliata* it is Eragrostoid, in *A. barbicollis*, *A. bipartita* and *A. aequiglumis* the epidermis is of the Panicoid type and in species such as *A. gracilior*, *A. obtusa* and *A. sericans* the epidermis is typically of the Festucoid type.

SUBDIVISION OF THE PHRAGMITIFORMES: The family Gramineae has been subdivided at various times into two or more subfamilies or series. As early as 1810, Brown noted two main groups, the Panicoideae and Pooideae. Pilger (1954) recognizes nine subfamilies. Combining the evidence presented by Harz (1880-1882), Avdulov (1939), Prat (1936) and the data presented by numerous taxonomists on spikelet morphology at least four series become evident. The characteristics of these, the Phragmitiformes, Paniciformes, Eragrostiformes and Festuciformes were discussed by de Wet (1954).

The subfamily Festucoideae as recognized by Pilger (1954) includes a diverse group of species and genera. In the classification of the Gramineae the true Panicoids, true Festucoids and the true Eragrostoid-chloridoids constitute no problem. A number of tribes and genera, however, do not belong to any one of these distinct groups and these are lumped together into a miscellaneous series the Phragmitiformes (Avdulov, 1931). The more outstanding tribes and genera involved are discussed below. Their position in grass phylogeny was pointed out by Stebbins (1956).

1. **Streptochaeteae:** Includes a single tropical genus, *Streptochaeta*. It has 3 lodicules, 6 stamens, 3 stigmas and the palea is split nearly to the base. Bentham (1881) refers this genus to the Paniceae and Hackel (1889) to the Oryzeae. Hubbard (1934) indicates that it is distinct from both these tribes.

2. **Bamuseae:** The genera are distributed throughout the tropics and subtropics. A few genera extend into the temperate regions. As pointed out by Hubbard (1934) it includes genera with the most primitive floral structure, but they are highly specialized vegetatively. Spikelets are all alike, lemmas awnless or rarely awned from the tip, lodicules usually 3, and 3, 6 or more stamens are present. Most of the species studied are high polyploids on the basis of $n = 12$ (Myers, 1947). Hunter (1934) indicates $n = 9$ in a species of *Arundinaria*. Internal leaf anatomy, Prat (1936) is characteristic. Epidermal traits are variable, but more or less of the Panicoid type.

3. **Phareae:** This is a tropical tribe, probably of close common ancestry with the Bamuseae. As is recognized by Hubbard (1934) the genera *Pharus* and *Leptaspis* are included. The spikelets are 1-flowered, awnless and unisexual. The lodicules are mostly 3, stigmas 3 and stamens 6. The chromosomes are small and the basic number is $n = 12$ (Valencia ex Stebbins unpublished). The leaf anatomy is Panicoid.

4. **Olyreae:** This tribe differs from the Phareae in the reduction of the stamens to 3 or 2 and in the Oryzoid type of epidermis. It includes the genera as recognized by Hubbard (1934).

5. **Centothecae:** Anatomical characters are Festucoid in respect to chlorophyll distribution, but the epidermal traits are either Panicoid or Oryzoid. This tribe is recognized to include the genera *Centotheca*, *Lophatherum*, *Zeugites*, *Orthoclada* and *Magastachya*. Both Hubbard (1934) and Pilger (1954) combine these genera as a subtribe of the Festuceae.

6. **Parianeae:** Contains a single New world genus which was not studied. Hubbard (1934) indicates that *Pariana* resembles the *Hordeae* in superficial inflorescence characters. This genus appears to present a highly specialized end line.

7. **Anomochloae:** This tribe is recognized in the sense of Hubbard (1934) to include *Anomochloa merantoidea* of the Brazilian forest. This genus is incompletely known and it shows no close affinity with any other genus.

8. **Phyllorachieae:** Chlorophyll distribution is of the Festucoid type, epidermis of the Oryzoid type and the chromosomes are small in multiples of $n = 12$. As was done by Hubbard (1939) the genera *Phyllorachis* and *Humbertochloa* are included. This tribe resembles the Oryzeae closely not only in anatomy and cytology, but also in spikelet morphology and starch grains. For this reason it would appear as if they developed from a common stock and might well be united.

9. **Oryzeae:** The genera *Ehrharta*, *Microlaena* and *Tetrarrhena* should be added to the tribe as recognized by Hubbard (1934). The starch grains are angular, the chromosomes small and in multiples of 12 and the leaf anatomy is typical. *Ehrharta*, *Microlaena* and *Tetrarrhena* are southern in distribution and represent the most primitive members of the tribe. The tribe as a whole has reached a high degree of specialization in the tropics.

10. **Arundineae:** Is a very large tribe. To the genera included by Pilger (1954), the tribe Danthonieae as recognized by de Wet (1956a) could be added. In other words, as recognized by Pilger (1954) the subtribe *Danthoniinae* of the Aveneae, the genera *Schismus*, *Afrachneria* and *Prionanthium* of the Aveneae subtribe Aveninae and from the Festuceae subtribe Glyceriinae the genus *Poagrostis*. Further also the genera *Arundinella*, *Trichopteryx*, *Loudetia*, and *Tristachya* from Hubbard's (1934) tribe the Arundinelleae. These data were fully discussed by de Wet (1954, 1956a and 1956b). The leaf anatomy may be either Panicoid or Festucoid, the chromosomes are medium large and in multiples of 6 and 7 (Avdulov, 1931, Calder, 1937, Stebbins and Love, 1941 and de Wet, 1954). The genera are mostly temperate in distribution with a few montane species extending to the tropics.

11. **Stipeae:** Is recognized in the sense of Hubbard (1934) to include the genus *Aristida*, except that *Melica* is removed. This tribe may be subdivided into two distinct groups which appear to have developed independantly. The one group includes *Aristida* and the other the remaining genera.

12. **Unioleae:** Pilger (1954) includes *Uniola*, *Distichlis*, *Monanthochloe*, *Vaseyochloa* and *Aeluropus* in various subtribes of the Festuceae. The genus *Jouvea* which also belongs here, Pilger refers to the tribe Jouveneae of the Eragrostoideae. These genera from a natural group in having truncate lemmas with several parallel veins which often end in awns. They differ from members of the Festucoideae in leaf anatomy, cytology and spikelet morphology.

13. **Pappophoreae:** Besides the four genera placed by Hubbard (1934) in this tribe *Orcuttia* and *Neostapfia* are added. The epidermis is more or less Eragrostoid and the chromosomes are small in multiples of $n = 10$.

14, 15 and 16. **Lygeae, Nardeae and Micraireae:** These tribes consist of monotypic genera, all of which need further investigation. With the present evidence available they are difficult to place, but do not seem to be related to each other.

RELIC GENERA: A number of relic genera still remain to be discussed. These are *Schizachne*, *Melica*, *Pleuropogon*, *Glyceria*, *Fingerhutia* and *Coleanthus*. They are temperate in distribution and have vegetative characters resembling the true members of the Festuciformes. In the case of *Melica*, the chromosomes are as large as those of members belonging to the Festuciformes, but the basic chromosome number appears to be $n = 9$ (Avdulov, 1931).

That they do not belong in the Festuciformes is quite evident. Their lodicules are truncate and often vasculated, their stigma branches are broad and dichotomous, their caryopses do not adhere to the palea and the embryo is relatively large. In *Glyceria* and *Pleuropogon* the chromosomes are medium large with basic numbers 9 and 8 respectively (Avdulov, 1931).

The chlorophyll distribution is of the Festucoid type in *Melica* and of the Festucoid type in *Glyceria* and *Pleuropogon*. In *Melica* the epidermis is also of the Panicoid type and of the Festucoid type in the latter two genera. In *Fingerhutia* the epidermis is either of the Festucoid or the Eragrostoid type. In *Coeleanthus* the leaf anatomy is typically Eragrostoid.

Morphological, cytological and anatomical data suggest an affinity with the Pappophoreae. It would appear, however, as if they originated from the primitive Arundineae stock, as did the Pappophoreae. These genera, although showing superficial resemblances to the Festuceae, are not closely related to them.

TABLE 1.—A tentative key to the classification of the Phragmitiformes.*

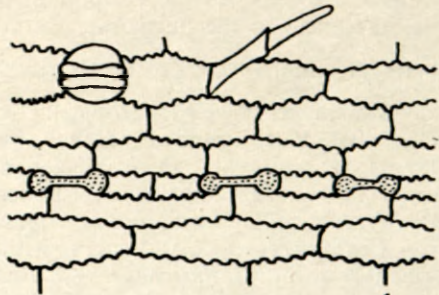
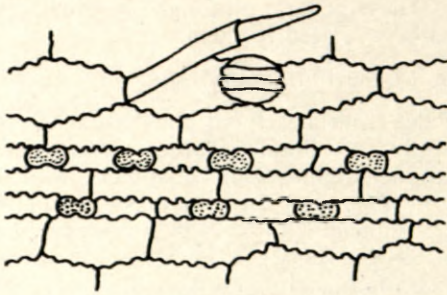
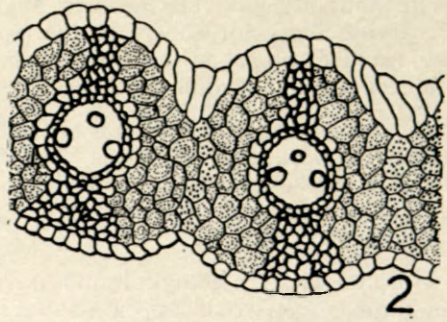
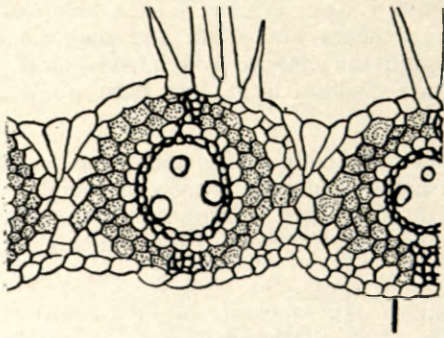
A. Leaves with cross veins; tropical. B. Palea split nearly to the base: Strepto-chaeteae. BB. Palea bilobed at the apex only. C. Plants arboreal: *Bambuseae*. CC. Plants not arboreal. D. Lodicules mostly 3; stigmas 3 or 2; spikelet with one functional flower. E. Stigmas 3; stamens 6: *Phareae*. EE. Stigmas 2; stamens 2 or 3: *Olyreae*. DD. Lodicules 2; stigmas 2; spikelet with more than one functional flower: *Centotheceae*. AA. Leaves without cross veins; tropical or temperate. F. Stamens 6 or more: *Parianeae*. G. Spikelets often enclosed in a sheath-like spathe. H. Stigma 1; stamens 4: *Anomochloaeae*. HH. Stigmas 2; stamens 6–4: *Phyllo-rachieae*, *Oryzeae*. FF. Stamens 3. GG. Spikelets not enclosed by a spathe. I. Stigmas 2. J. Lemmas with a single awn from the sinus between the lobes, awns reduced in some specialized groups. K. Spikelets with several florets: *Arundineae*. KK. Spikelets with a single functional floret; lemma indurated: *Stipeae*. JJ. Lemmas awnless or with several veins excurrent into awns. M. Lemmas awnless, laterally compressed: *Unioleae*. MM. Lemmas with several parallel veins, which usually end in awns; rounded on the back: *Pappophoreae*. II. Stigma 1. N. Spikelet solitary, surrounded by a sheath-like spathe: *Lygeae*. NN. Spikelets in spikes: *Nardeae*.

SUMMARY.

The leaf anatomy was investigated of a number of genera belonging to the series Phragmitiformes (Harz) Avdulov. Anatomical characters are found to be variable. Chlorophyll distribution is of the Panicoid or the Festucoid type. Epidermal traits may be of the Panicoid, Festucoid, Eragrostoid or Oryzoid type. The subfamilies Festucoideae, Oryzoideae, Olyroideae, Bambusoideae, Micraioideae and Anomochloideae as recognized by Pilger (1954) are discussed. A number of genera and even whole tribes included by Pilger (1954) in the subfamily Festucoideae together with the other subfamilies are regarded as belonging to the series Phragmitiformes. Anatomical, cytological and morphological data support such a subdivision. The genera *Jouvea* and *Aristida* in the subfamily Eragrostoideae of Pilger are also transferred to the Phragmitiformes. The Phragmitiformes are classified and the affinities of the tribes pointed out. A key to the identification of these tribes is tentatively proposed.

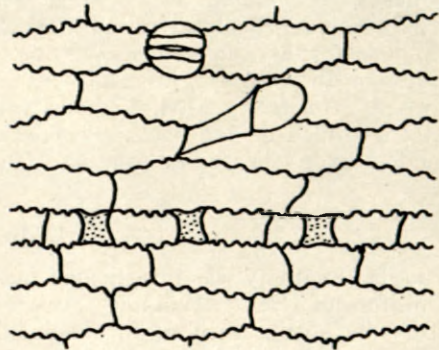
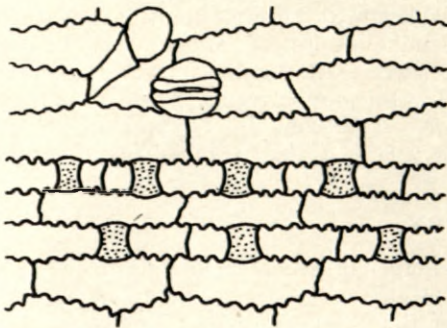
It was pointed out that a miscellaneous group of grasses are lumped together in the Phragmitiformes. Most of these genera are more or less related to the true panicoids, true festucoids or the true eragrostoid-chloridoids. Others appear to be relic genera with no obvious affinities to these distinct groups of grasses.

* A number of relic genera and the tribe Micraireae have been left out of this key.



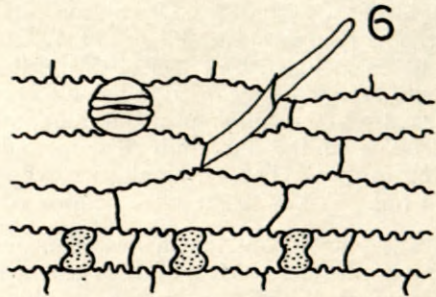
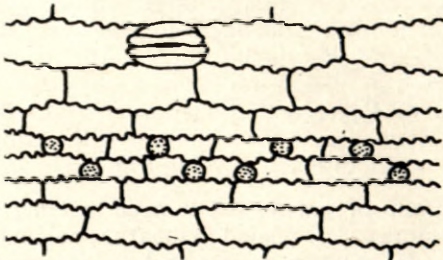
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LEGEND TO FIGURES.

FIGURES 1-2.—Semidiagrammatical drawings of leaf anatomy types, $\times 500$.

FIGURE 1.—Panicoid type.

FIGURE 2.—Festucoid type.

FIGURES 3-8.—Semidiagrammatical drawings of epidermal types, $\times 500$.

FIGURE 3.—Panicoid type; *Aristida barbicollis*.

FIGURE 4.—Panicoid type; *Aristida bipartita*.

FIGURE 5.—Eragrostoid type; *Aristida ciliata*.

FIGURE 6.—Eragrostoid type; *Fingerhutia sesleriaeformis*.

FIGURE 7.—Festucoid type; *Aristida gracilior*.

FIGURE 8.—Oryzoid type; *Olyra latifolia*.

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