Hunt Institute for Botanical Documentation
5th Floor, Hunt Library
Carnegie Mellon University
4909 Frew Street
Pittsburgh, PA 15213-3890
Telephone: 412-268-2434
Email: huntinst@andrew.cmu.edu
Web site: www.huntbotanical.org

The Hunt Institute is committed to making its collections accessible for research. We are pleased to offer this digitized item.

Usage guidelines
We have provided this low-resolution, digitized version for research purposes. To inquire about publishing any images from this item, please contact the Institute.

About the Institute
The Hunt Institute for Botanical Documentation, a research division of Carnegie Mellon University, specializes in the history of botany and all aspects of plant science and serves the international scientific community through research and documentation. To this end, the Institute acquires and maintains authoritative collections of books, plant images, manuscripts, portraits and data files, and provides publications and other modes of information service. The Institute meets the reference needs of botanists, biologists, historians, conservationists, librarians, bibliographers and the public at large, especially those concerned with any aspect of the North American flora.

Hunt Institute was dedicated in 1961 as the Rachel McMasters Miller Hunt Botanical Library, an international center for bibliographical research and service in the interests of botany and horticulture, as well as a center for the study of all aspects of the history of the plant sciences. By 1971 the Library's activities had so diversified that the name was changed to Hunt Institute for Botanical Documentation. Growth in collections and research projects led to the establishment of four programmatic departments: Archives, Art, Bibliography and the Library.

Digitized by Hunt Institute for Botanical Documentation

Papers on the Gramineae (1905–1931)

1. The Anatomy of the Scutellum in Zea Maïs. By Ethel Sargant & Agnes Robertson. Ann. Bot. XIX, 1905, pp 115–123, 1 plate.

2. The Comparative Morphology of the Embryo & Seedling in the Gramineae. By Ethel Sargant & Agnes Arber. Ann. Bot. XXIX, 1915, pp 161–222, 2 plates, 35 text-figures

3. Leaves of the Gramineae. Bot. Gaz. LXXVI, pp 374–398, 3 plates, 1923

4. Studies in the Gramineae. I The Flowers of certain Bambuseae. Ann. Bot. XL, pp 447–469, 1926

5. Studies in the Gramineae. II. Abnormalities in Cephalostachyum bigeatum, Kurz, & their Bearing on the Interpretation of the Bamboo Flower. Ann. Bot. XLI, pp 47–74, 9 text figures, 1927

6. Studies in the Gramineae. III. Outgrowths of the Reproductive Shoot, & their Bearing on the Significance of Lodicule & Epiblast. Ann. Bot. XLI, pp 473–488, 1927.

7. Studies in the Gramineae. IV. I. The Sterile Spikelets of Cynosurus

Digitized by Hunt Institute for Botanical Documentation

and Lamarkia. 2. Stamen-bodies in Schizostachyum.
3. The Terminal Leaf of Gymnocladus. Ann. Bot. XLII, pp
173-187, 1928

Digitized by Hunt Institute for Botanical Documentation

The Anatomy of the Scutellum in Zea Maïs.

BY

ETHEL SARGANT AND AGNES ROBERTSON, B.Sc.

With Plate V.

BOTANISTS have long been familiar with the external structure of the Grass-embryo, which is sufficiently different from that of the embryo in other Monocotyledons to leave some doubt as to the homology of their parts. We began the examination of several Grass seedlings in the autumn of 1902, hoping that their anatomy at a period soon after germination might throw light on this vexed question. We did not propose to monograph the family from this point of view, but, having chosen a few genera from very different parts of it, to compare their seedlings anatomically with each other, and with those of the Monocotyledons already worked out by one of us.

Digitized by Hunt Institute for Botanical Documentation

Even this skeleton scheme has not yet been completed, for we have not succeeded in getting all the material desirable. Side issues of some importance have been raised, however, and in particular the anatomical structure of the Maize scutellum offers some features of interest which we believe to be still undescribed[1]. They are clearly bound up with its function as a sucking organ, and the subject is thus a digression from the main morphological line of research, and is more conveniently treated in a separate form.

External Morphology of Embryo.

Within the ripe fruit the main axis of the embryo is triply protected. Embryo and endosperm alike are enclosed in the dry covering of the grain. When a part of this is removed, the whole embryo is seen lying against one face of the endosperm (Fig. 3, Pl. V, cf. also Figs. 1 and 6). The second covering is formed of the scutellum (*sc.* in Figs. 1, 5, 7), a cushion-like structure which is wrapped round the embryonic axis and still conceals the greater part of it in the first days of germination (Fig. 3).

[1] Ethel Sargant and Agnes Robertson, 'On some Anatomical Features of the Scutellum in Zea Maïs.' Report Brit. Assn., Southport, 1903, p. 860.

SARGANT, ETHEL, AND ARBER, AGNES

THE COMPARATIVE MORPHOLOGY OF THE EMBRYO AND SEEDLING IN THE GRAMINEAE

[Annals of Botany, Vol. XXIX, No. CXIV, April, 1915.]

Digitized by Hunt Institute for Botanical Documentation

LEAVES OF THE GRAMINEAE

(WITH PLATES XXVIII-XXX)

AGNES ARBER

Digitized by Hunt Institute for Botanical Documentation

Reprinted for private circulation from
THE BOTANICAL GAZETTE, Vol. LXXVI, No. 4, December 1923

1926 4

ARBER, AGNES.

STUDIES IN THE GRAMINEAE.
I. THE FLOWERS OF CERTAIN BAMBUSEAE.

Digitized by Hunt Institute for Botanical Documentation

[Annals of Botany, Vol. XL. No. CLVIII. April, 1926.] Printed in England.

1927 5

ARBER, AGNES.

STUDIES IN THE GRAMINEAE.

II. ABNORMALITIES IN CEPHALOSTACHYUM VIRGATUM, KURZ, AND THEIR BEARING ON THE INTERPRETATION OF THE BAMBOO FLOWER.

Digitized by Hunt Institute for Botanical Documentation

[Annals of Botany, Vol. XLI. No. CLXI. January, 1927.] Printed in Great Britain.

1927 2 6

ARBER, AGNES.

STUDIES IN THE GRAMINEAE.

III. OUTGROWTHS OF THE REPRODUCTIVE SHOOT, AND THEIR BEARING ON THE SIGNIFICANCE OF LODICULE AND EPIBLAST.

Digitized by Hunt Institute for Botanical Documentation

[Annals of Botany, Vol. XLI. No. CLXIII. July, 1927.] Printed in Great Britain.

1928! 7

ARBER, AGNES.

STUDIES IN THE GRAMINEAE.

IV. 1. THE STERILE SPIKELETS OF CYNOSURUS AND LAMARKIA. 2. STAMEN-LODICULES IN SCHIZOSTACHYUM. 3. THE TERMINAL LEAF OF GIGANTOCHLOA.

Digitized by Hunt Institute for Botanical Documentation

[Annals of Botany, Vol. XLII. No. CLXV. January, 1928.] Printed in Great Britain.

1928 2 8

ARBER, AGNES.

STUDIES IN THE GRAMINEAE. V.

1. ON LUZIOLA AND DACTYLIS.
2. ON LYGEUM AND NARDUS.

Digitized by Hunt Institute for Botanical Documentation

[Annals of Botany, Vol. XLII. No. CLXVI April, 1928.] Printed in Great Britain.

1929 9

ARBER, A.

STUDIES IN THE GRAMINEAE.

VI. 1. STREPTOCHAETA. 2. ANOMOCHLOA. 3. ICHNANTHUS.

Digitized by Hunt Institute for Botanical Documentation

[Annals of Botany, Vol. XLIII. No. CLXIX. January, 1929.] Printed in Great Britain.

1929 10

ARBER, AGNES.

STUDIES IN THE GRAMINEAE.

VII. ON HORDEUM AND PARIANA, WITH NOTES ON 'NEPAUL BARLEY'.

Digitized by Hunt Institute for Botanical Documentation

[Annals of Botany, Vol. XLIII. No. CLXXI. July, 1929.] Printed in Great Britain.

the three male spikelets on the opposite side of the axis representing the other triad. This view appears to me well founded, and in Fig. 8, A_6, p. 529,

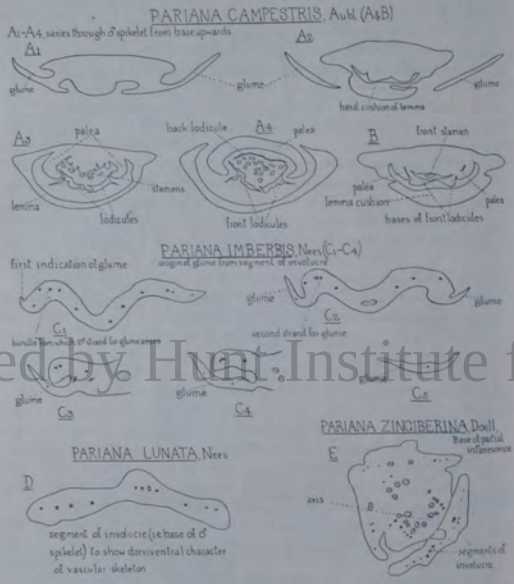

FIG. 9. A and B, *Pariana campestris*, Aubl., Surinam, 1841, Hostmann, 20. A_3–A_6, series of transverse sections between Fig. 8, A_3 and A_6, p. 529, showing structure of *male spikelet* 1 in greater detail (× 24). B, *male spikelet* 2 at level between A_3 and A_4 (× 24). C_1–C_5, *Pariana imberbis*, Nees, prope Barra, Prov. Rio Negro, R. Spruce, 1855; series of transverse sections from below upwards (× 24) to show origin of glume from involucral segment. Bundles difficult to follow and may not be represented exactly. Before the origin of the second glume bundle it appears that the bundle from which it is derived fuses with the adjacent lateral. D, *Pariana lunata*, Nees, French Guiana. transverse section of an involucral segment (× 24). E, *Pariana zingiberina*, Doell, Altson, British Guiana, No. 314, transverse section of base of a partial inflorescence (× 14).

I have indicated the boundary between the presumed triads by means of a broken line. This diagram should be compared with the section of

I have checked this magn.: & find it is correct. The fls may be 1·5 mm wide (my magn. 24, & it may be 1·75 mm wide) (Fig A4 opposite) A. A.

THE LABORATORY,
CITADEL HILL,
PLYMOUTH.
Jan 18th 1935.

Dear Mrs. Arber,

I am sorry I have been so long in thanking you for the drawing, but I was working at Kew and having a very busy time. I am rather worried about the magnification which you put as ×24 on the Hostmann sheet but which seems to me from my measurements of the Hostmann specimen and other specimens too, as though it ought to be ×12.

I will do my best to get the flowers you want though I know of no locality for Philodice or Tonina. One of the Forest Officers will probably get Mayaca & Xyris as he lives within a few yards of them. There are at least six species of Xyris in Guiana, and two of Abolboda.

Digitized by Hunt Institute for Botanical Documentation

I will write to him about them, but it will take at least two months before they can arrive.

I'm just recovering from a prolonged struggle with Begonias. They are dreadful things.

Yours sincerely

Digitized by Hunt Institute for Botanical Documentation

H. vulgare (Fig. 1, D, p. 508) in which I have also inserted a broken line in the corresponding plane.

7. Summary.

The points in the morphology of *Hordeum* and *Pariana* dealt with in the present paper may be summarized as follows:

1. The ear of cultivated Barley (*H. vulgare*, L.) is shown to bear at its base a reduced foliar member which may be called the collar leaf. The collar leaf bears a shoot in its axil—a spikelet triad—and this shoot may produce a prophyll, an organ which I have not found elsewhere in the inflorescences of *Hordeum*. The collar leaf is peculiar in being entirely non-vascular, though it is relatively massive. It is the most highly developed example of a non-vascular leaf which I have met with among the flowering plants (pp. 509–511 and Fig. 1, A, B, C, p. 508).

2. From a comparative study of the partial inflorescences of *Hordeum* and *Pariana*, it is concluded that the lateral 'glumes' are neither sterile spikelets nor halves of the first outer glume, but are true glumes, corresponding to the first and second outer empty glumes of other Grasses. It is claimed that their peculiar lateral position is brought about by the excessively dorsiventral character of the axis or its branches, which results in the vascular supply of the triad of *Hordeum* and of the male spikelet of *Pariana* diverging from radial symmetry, and forming an arc or band. The first organs to be developed from the spikelet base arise from it at the level where it is still thoroughly dorsiventral and their vascular system is naturally derived from the margins of the arc. Their unusual right-and-left position is thus mechanically inevitable (pp. 511–519, Figs. 2, A and B_1, p. 510, and Figs. 9, C_1–C_4, p. 530).

3. The anatomical examination of *Hordeum* spikelets has incidentally brought to light some evidence for the view that an unlignified bundle may be an efficient conducting channel (p. 513).

4. In *H. trifurcatum*, Jacq., the only species in which the history of the vascular supply for the lodicules has been followed, it has been found that each of these organs receives a single vascular strand. Before the lodicule becomes free, this strand gives rise by repeated branching to a number of small, delicate, scattered bundles (pp. 521 and Figs. 4, C and D, p. 517).

5. Doell's view (9), according to which the partial inflorescence of *Pariana* is comparable with two triads of *Hordeum*, is confirmed; the relation of the two can be understood by the comparison of Fig. 1, D, p. 508, and Fig. 8, A_6, p. 529.

6. It is shown that in the abortive lateral spikelets of *H. distichum*, L., var. *nigrum*, the relation of leaves and axis does not accommodate itself

1929] 11

ARBER, AGNES.

STUDIES IN THE GRAMINEAE.
VIII. ON THE ORGANIZATION OF THE FLOWER IN THE BAMBOO.

Digitized by Hunt Institute for Botanical Documentation

[Annals of Botany, Vol. XLIII. No. CLXXII. October, 1929.] Printed in Great Britain.

1930 / 12

ARBER, AGNES.

STUDIES IN THE GRAMINEAE.

IX. 1. THE NODAL PLEXUS. 2. AMPHIVASAL BUNDLES.

Digitized by Hunt Institute for Botanical Documentation

[Annals of Botany, Vol. XLIV No. CLXXV, July, 1930.] Printed in Great Britain.

is liable to give an impression of greater regularity than really exists. The lettering I have used is arbitrary, and attempts no significance. The bundle A will be the median bundle in the next leaf, and O, in the next leaf but one. These two bundles are shaded, to give fixed points for the eye in following the diagrams. In Fig. 4, *2*, the group of bundles in the neighbourhood of A is seen at a higher level, and on a larger scale, than in Fig. 4, *1*. A number of the bundles have divided; F and E have given off branches, vertical like themselves, and B has divided into two. We see here the first indication of the nodal plexus—the appearance of two horizontal branches, b_1 and b'_1, associated with A. The exact mode of connexion between these bundles is shown in fuller detail in Fig. 5, *1* A and B, p. 601, which are below Fig. 4, *2*; Fig. 5, *2*, shows the mode of origin of two vertical branches from F. In both cases the connexion is established through the intrafascicular cambium of the vertical bundles; Fig. 5, *1* A, is cut at the level of origin of b'_1, but b_1 arose at a slightly lower level. (In these descriptions I shall for convenience speak of the horizontal bundles as *arising by branching* of the vertical ones, without prejudice to the question of whether these connexions are original or merely secondary.) From their point of origin from A, b_1 and b'_1 each develop in two directions. Each passes upwards and outwards for a short distance; they then curve towards one another and become attached on either side of the non-lignified bundle external to A, labelled B (Fig. 5, *1* B). But their main development is slightly upwards in the opposite direction, advancing towards the centre of the stem. In the course of their differentiation in this sense they form very slight attachments to the faces of C and C′, which lie towards A. It would better represent the connexions of these bundles if b_1 were called $(A_1+B_1+C_1)$ and b'_1, $(A'_1+B'_1+C'_1)$. But the subsequent history of b_1 and b'_1 is too complex for such labelling in the diagrams. A small vertical bundle, b_2, arises from b_1 at the level of its junction with B, and a corresponding bundle, b'_2, is developed from b'_1. A branch, b_3, is given off from b_2, and b'_3 from b'_2. If the branch b_1 is followed, it is found that after running horizontally inwards, as described, it turns vertically upwards near the centre of the axis. It then again becomes horizontal and moves outwards, passing close between C′ and b'_2 (Fig. 4, *5*), and then turns upwards vertically to form one of the bundles of the next internode, b_{1B}, giving off also a branch, b_{1a}, which enters the axillary bud. In this statement I have disregarded the anastomoses which b_1 forms with other horizontal bundles; in Fig. 4, *4*, it is seen in its inward passage, united with other strands. The bundle b'_1 follows a similar course. It first passes horizontally inwards, then runs vertically, and then turns outwards. Its connexion with other bundles of the horizontal plexus during its inward journey is shown in Fig. 4, *4*, and during its later outward passages in Fig. 6, *5*, p. 603. These two figures give some idea of the general construction of the nodal plexus. It is seen in

Fig. 6, *5*, that a connexion can be traced between b'_1 and bundles as remote as L, P, Q, and T. In Figs. 4, *2*, *3*, and *5*, certain changes in the minor bundles can be followed. In Fig. 4, *3*, D is seen to have divided into three bundles, D_1, D_2, and D_3; and D_2 has again split into D'_2 and D''_2. In

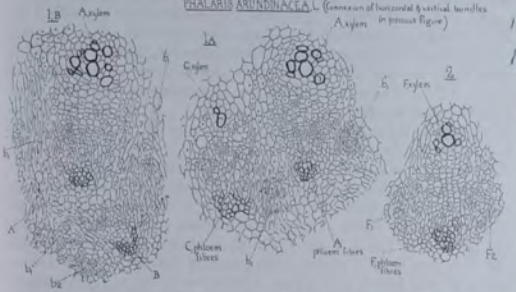

Fig. 5. *Phalaris arundinacea*, L., *picta*, L. Transverse sections (× 163) from the same node as Fig. 4, p. 599, and Fig. 6, p. 603, to illustrate the origin of horizontal branch bundles in greater detail than in Fig. 4, p. 599. *1*, A (between Figs. 4, *1* and 4, *2*) attachment of b'_1 to bundle A seen to the right; b_1 was attached to the cambium of A to the left, but at a lower level. *2*, B, a slightly higher stage in which b_1 and b'_1 have produced outwardly directed branches fusing with B. *3* (a little below Fig. 4, *2*), shows bundle F giving off strands F_1 and F_2 on either side from the cambial region.

Fig. 4, *4*, fusion has taken place between D_1 and b_3 and between D_2 and B. It will be noticed in Fig. 4, *4*, that the main bundles have elongated in section, and that the vertical and horizontal branching which we have described has increased the number of minor bundles, especially to the south in the neighbourhood of the midrib of the next leaf which will be axillant to a bud. In Fig. 4, *5*, the minor bundles are seen arranging themselves in preparation for this bud. At the same time there has been a redistribution of the major bundles, so that A, and the other strands for the next leaf, are now nearer to the margin, while those which are related to younger leaves are further in. The row of small bundles, including E'_2, E''_2, E_1, (D_1+b_3), x, (D_2+B), b'_3, G_2, F'_1, and F_1, will all enter the bud.

On comparing Fig. 4, *1*, and Fig. 4, *6*, we realize the fate of the group of lettered bundles to the south. A enters the next leaf as its median strand, F as one of its main laterals, G as one of the minor laterals, and two branches of D as minor peripheral bundles. C and C′ pass up into the next internode in addition to b'_2, b_2, b_{1B} and b'_{1B}, which are branch strands with which A, B, C, and C′ were originally involved, but which became associated with other strands in the horizontal plexus. C′ enters

Digitized by the Internet Archive for Preservation

each marked T_1, and one of them passes inwards at a higher level. Fig. 6, *5*, which is just above Fig. 4, *5*, shows the whole section on a smaller scale, and gives a general view of the plexus of horizontal bundles. That marked W

FIG. 7. *Avena barbata*, Brot. Transverse sections from a series through a young node (× 23). The median bundle, A, of the leaf exserted at the node is shaded. For explanation see text, pp. 605, 606. *1*, internode below node studied. *2*, appearance of horizontal branches from the ring of bundles. For mode of attachment of vertical and horizontal branches see Fig. 8, p. 605, in which the history of bundle E is followed. *3*, slightly higher than *2*, to show horizontal plexus; the branches not visible exactly at this level are dotted. *4*, further history above the plexus. *5*, just below detachment of leaf; the inner bundles form a ring for the next internode.

is derived from K and L. The dotted lines show connexions which do not occur exactly at this level.

The further distribution of the northerly group of bundles can be followed in Fig. 6, *6–8*. In Fig. 6, *7* (which is just below Fig. 4, *6*) the leaf whose median bundle is A is beginning to detach itself from the axis. At the base it forms a closed sheath, but in Fig. 6, *8*, the sheath has opened on the side remote from A, and we see that the bundle K enters the inner margin, while N, Q, and T enter the overlapping margin. The strands O, J, and S form major bundles for the next internode; one of the minor bundles of the same ring (that to the left of O, the median bundle) is formed by a branch of N, while that between it and J consists of branches K and L (Fig. 6, *7*); branches from K and L also take part in the formation of the ring of very small strands placed closer to the periphery. In Fig. 6, *8*, the formation of horizontal strands in connexion with the next node has already begun.

(c) *Avena barbata*, Brot.

In *A. barbata* I have studied a single node from a mature plant. I have not got the shoot apex in my series, but I believe, from internal evidence, that the shoot was a young inflorescence axis; the leaf borne at

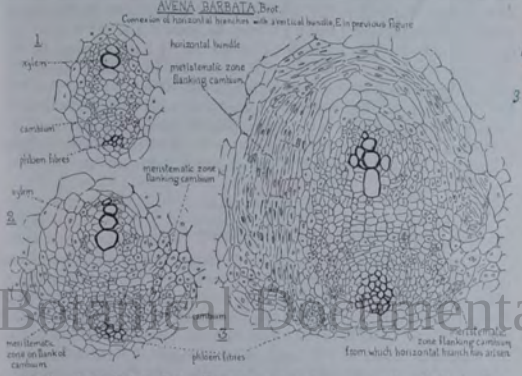

FIG. 8. *Avena barbata*, Brot. Transverse sections from a series through the bundle E in Fig. 7, p. 604, to show the connexion of the horizontal branches with the meristem flanking the cambium (× 163). (Orientation not uniform with Fig. 7.) *1*, bundle E in Fig. 7, *1*; *2*, bundle E between Fig. 7, *1* and *2*; *3*, bundle E in Fig. 7, *2*.

the node in question had no axillary bud, so this node has the advantage of enabling one to examine a plexus of horizontal bundles which has no connexion with any bud (or root). Fig. 7, *1*, p. 604, shows the internode below this node. For the sake of having a fixed point to follow in the diagrams, the median bundle for the next leaf exserted is shaded; the lettering is arbitrary. In Fig. 7, *2*, horizontal branches are appearing between the bundles, and forming arcs around their inner apices. It is difficult to give an exact idea of the relations of these branches in a diagrammatic sketch, so, in Fig. 8, above, I have drawn the bundle E at three successive levels on a larger scale. Fig. 8, *1*, shows the bundle at the level of Fig. 7, *1*; it has a small but clearly distinguishable cambium. In Fig. 8, *2*, which is a little higher, meristematic activity has invaded the parenchyma on either side of the cambium. Fig. 8, *3*, which is from the same section as Fig. 7, *2*, shows a further stage, in which this meristematic activity has resulted in the formation of a horizontal arc of procambium,

Digitized by Hunt Institute for Botanical Documentation

Debasement of herbal illustrations due to copying, 55, 186, 188, 197–199

derived from branches of the median bundle of the axillant leaf, which for part of their course ran horizontally in the plexus, and became linked up even with strands belonging to the other side of the internode. The relatively median position of these two branches, when they return towards the shoot surface, makes it natural that they should supply this particular leaf, which is in the heart of the bud.

The asymmetry of the two leaves succeeding the prophyll is of interest because it seems natural to suppose that it may be a parallel phenomenon to the lack of symmetry about the midrib which characterizes Monocotyledonous prophylls. When a lateral bud has grown out into a branch, its apex is supplied by its own shoot bundles, which develop without constraint, and can arrange themselves symmetrically, and hence can supply a symmetrical skeleton for the leaves. But in the young bud of *Phalaris* described, the bundles for the first three leaves are all directly traceable to the parent axis; the lateral branch-axis can scarcely be said to exist at this early stage. The bud is thus receiving its vascular system direct from a dorsiventral source—an irregular row of bundles in the parent axis on its flank (Fig. 4, *5*, p. 599). It is not surprising that this should result in irregularity in the vascular supply of the bud.

The relation of the bud bundles to the nodal plexus will be considered in (d), p. 609.

(c) *Discontinuity within the Leaf- and Bud-traces.*

A question of some theoretical importance, which arises out of the study of my sections, relates to the continuity or discontinuity of the leaf- and bud-traces in their early stages. It is commonly said that the traces

of leaves and of buds make their appearance first in the base of the lateral member, and that there is then a downward differentiation linking up the vascular skeleton of the lateral appendage with that of the parent shoot. One would like to know whether this can be depended upon as a general statement, and especially whether it is applicable to all Grasses. Something of the kind is undoubtedly true of some traces. For example, the median strand of leaf 4 in *Avena sativa*, L. (Fig. 3, *4*, p. 598), has at this stage no attachment to any lower trace, and no longer exists at the lower level of Fig. 3, *3*. And in *Coix lacryma-Jobi*, L., two of the bud-strands (b_3 and b_5 in Fig. 1, C, p. 595) die out at the base of the bud when traced downwards. But in other traces which I have followed it is difficult to imagine that discontinuity of this type has ever occurred. In the node of *Phalaris arundinacea* described, seven of the smaller strands seen in Fig. 4, *5*, p. 599, can be traced continuously up to the base of the bud and yet they are too embryonic to be followed to their destinations in the leaves of the bud (p. 602); it seems as though differentiation here were proceeding entirely upwards from below. And, returning to our seedling of *C. lacryma-Jobi*, not only the median strands of the first, second, and third plumular leaves, but even certain laterals of leaves 3 and 4, can be followed up as individuals from the level of exsertion of the coleoptile strands (Fig. 1, A, p. 595) into their respective leaves. In such examples it seems improbable that each of these traces ever existed in the form of two segments, and that the gaps between these segments were then each neatly bridged. But further comparative evidence is needed before this question, which has been a subject of discussion from the days of von Mohl (18), can be treated as settled.

(d) *The Origin and History of the Nodal Plexus.*

Four divergent views have been held by botanists who have discussed the origin of the nodal plexus in Grasses. De Bary (11) and van Tieghem (22) attributed its whole organization to the bundles of the axillary bud, with which Strasburger (21) would also associate those of the adventitious roots; Guillaud (17) considered that it was entirely cauline, and bore no relation to the leaves; Chrysler (15) speaks of it as resulting from the anastomosis of the leaf-traces; and in more recent times Bugnon (12 and 14), after reviewing earlier work, has suggested that it arises by change of direction of leaf-traces which can find no room to pursue a vertical course when they enter the node from the leaf. The subject is, indeed, one of difficulty, which is mirrored in this divergence of opinion. I do not think that it is possible to come to any final solution of the problems of nodal anatomy without the use of serial sections, and it is thus not worth while to discuss the earlier work in detail; reference may be made to von Mohl (18) and the literature which he cites. The only research on the subject based on paraffin sections is that of Bugnon, who, in a seedling of *Oryza sativa*, L.,

Digitized by Smithsonian Institute for Botanical Documentation

1931 13

ARBER, AGNES.

STUDIES IN THE GRAMINEAE. X. 1. PENNISETUM, SETARIA, AND CENCHRUS. 2. ALOPECURUS. 3. LEPTURUS.

Digitized by Hunt Institute for Botanical Documentation

[Annals of Botany, Vol. XLV, No. CLXXIX, July, 1931. Printed in Great Britain.

1928 3 14

THE TREE HABIT IN ANGIOSPERMS: ITS ORIGIN AND MEANING

BY

AGNES ARBER

FROM THE NEW PHYTOLOGIST, VOL. XXVII, NO. 2, 30 MAY, 1928.

Digitized by Hunt Institute for Botanical Documentation

WHELDON AND WESLEY, LTD.
2, 3 AND 4, ARTHUR STREET, NEW OXFORD STREET
LONDON, W.C. 2

PRINTED IN GREAT BRITAIN

PRINTED IN GREAT BRITAIN AT THE UNIVERSITY PRESS, OXFORD
BY JOHN JOHNSON, PRINTER TO THE UNIVERSITY

[From THE NEW PHYTOLOGIST, Vol. XXIX, No. 5,
8 December, 1930]

ROOT AND SHOOT IN THE ANGIOSPERMS: A STUDY OF MORPHOLOGICAL CATEGORIES[1]

By AGNES ARBER

(With 2 figures in the text)

CONTENTS

I. History of the categories of formal morphology

The impulse to analyse the plant into component members seems, in the first instance, to have arisen out of the desire to establish a comparison between construction in the animal and vegetable body; for the existence of a close analogy between the two was a fundamental postulate with the biologists of ancient Greece. The first extant attempt at such a morphological analysis is, in some respects, strikingly alien to modern botanical thought. It is that of Theophrastus (42), who, in the fourth century B.C., stated that "the primary and most important parts...are these—root, stem, branch, twig; these are the parts into which we might divide the plant, regarding them as members, corresponding to the members of animals: for each of these is distinct in character from the rest, and together they make up the whole." Theophrastus then proceeds to distinguish as subsidiary parts the leaf, flower, fruit, etc. He was influenced in this discrimination by the fact that in the tree, which he regards as the standard of plant life, the trunk and its branches persist permanently, whereas the leaf, flower and fruit are ephemeral. The importance of the leaf was destined to remain for long unrecognised, and it was not

[1] This paper forms part of the work carried out with the aid of a grant from the Dixon Fund of the University of London. An abstract of it was read at the International Botanical Congress, Cambridge, August 1930.

Digitized by Hunt Institute for Botanical Documentation

Digitized by Hunt Institute for Botanical Documentation