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SCYPHOSTEGIA BORNEENSIS STAPF

Anatomy of Stem and Leaf in Relation to its Taxonomic Position

C. R. METCALFE *

SUMMARY

From an examination of anatomical characters it appears that the genus *Scyp'hostegia* is not related to Monimiaceae and Moraceae but represents a separate family related to Flacourtiaceae.

INTRODUCTION

As the taxonomic position of *Scyphostegia* has been disputed, an anatomical examination of the stem and leaf was undertaken at the suggestion of Dr Van Steenis in the hope that the microscopical structure of these organs would afford evidence concerning the affinities of the genus. As was only to be expected with a, genus that exhibits so many characters in the morphology of the inflorescence and flower that are both distinctive in themselves and which cannot readily be matched, in any of the well established families of Dicotyledons, anatomical evidence likewise points to the somewhat isolated position of the genus. It is thus reasonable to follow Hutchinson (2) in recognising that the genus merits the status of a distinct family. As is shown below,' however, there is little anatomical evidence to suggest that *Scyphostegia* is related either to the Monimiaceae or Moraceae. The facts indicate rather that its nearest existing relations are to be found amongst the Flacourtiaceae, although there is no particular genus in this family, amongst those of which the anatomy has been investigated, that appears to have a specially close relationship. The possibility of a taxonomic relationship of *Scyphostegia* to the Flacourtiaceae rests rather on the fact that *Scyphostegia exhibits* a combination of characters that are also to be found in a number of genera and species that are well established as members of the Flacourtiaceae. In this article the anatomy of the leaf and stem of *Scyphostegia* is described, and the evidence that suggests that the genus has affinities with the Flacourtiaceae, rather than with the Monimiaceae or Moraceae,. is discussed.

LEAF. Hairs; none seen. Adaxial epidermis, in surface view, consisting of variously shaped cells with thin, curved/but not sinuous walls.

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Abaxial surface also composed of variously shaped cells, with thin walls but these are slightly sinuous. Stomata confined to the abaxial surface; abundant; paracytic (rubiaceous), each stoma accompanied on either side by a subsidiary cell parallel to the pore. Mesophyll dorsiventral, with 2—3 rows of short to tall palisade cells, and a broader zone of slightly spongy parenchyma. In some leaves, e.g. in a leaf from the specimen collected by J. and M. S. Clemens 26062, the layer of cells immediately below the adaxial epidermis is differentiated as a distinct hypodermis, but this hypodermal layer was less clearly apparent in material from the Penang Botanic Garden. The height of the palisade cells also varies in different leaves. Some of the mesophyll cells, especially those towards the adaxial surface, are filled with amorphous, probably tanniniferous, contents that stain readily with haematoxylin. Structure of the large lateral veins obscure in transverse sections of the leaf because of their oblique course in relation to the long axis of the leaf, but each vascular stand is encircled by a fibrous sheath. Smallest vascular bundles deeply embedded in the mesophyll, and often accompanied by only a few fibres, mostly on the abaxial side, each small bundle being surrounded by a rather irregular sheath of thin-walled cells. Large, solitary, clustered crystals occur sporadically throughout the mesophyll tissue.

Midrib with a longitudinal ridge that projects prominently from the abaxial, and another that projects slightly from the adaxial surface, the ridges consisting mostly of slightly collenchymatous tissue. Vascular system of the midrib surrounded by a narrow, circular, but abaxially flattened cylinder of fibrous cells with wide lumina, and only moderately thickened walls. Vascular tissue consisting essentially of adaxial and abaxial parts. The abaxial part appears either as a cylinder of xylem that is somewhat concave on its adaxial side, or as an arc that is not quite closed adaxially. The cylinder or arc of xylem surrounds a central, pith-like tissue, and is itself surrounded externally by thin-walled phloem. The adaxial part of the vascular tissue consists of a collateral strand of xylem and phloem that lies on the adaxial side of the cylinder or arc that has just been described, the phloem of the collateral strand being almost continuous with the phloem on the adaxial side of the abaxial cylinder. The xylem of the adaxial strand abuts directly, or almost directly, on to the fibrous cylinder by which the whole vascular system is surrounded. Branches from the adaxial strand pass out into the mesophyll at intervals. The vessels, wherever they occur in the xylem, are mostly in radial multiples.

PETIOLE, in transverse sections immediately at the base of the lamina, exhibiting a vascular structure not unlike that of the midrib, but there is no fibrous cylinder surrounding the vascular system. The abaxial vascular cylinder, or almost completely closed arc, that occurs in the midrib, has the form of a deeply U-shaped strand in the distal part of the petiole. Situated between the arms of the U there is an adaxially flattened cylinder of xylem and phloem, formed by the amalgamation of the adaxial vascular arc of the midrib with the adaxial part of the abaxial cylinder.

The vascular cylinder between the arms of the U consists externally of xylem that surrounds the phloem which has the form of a number of closely placed strands, the somewhat triangular ground tissue surrounded by the phloem consisting of parenchyma. At a lower level in the petiole, the vascular system has the form of an abaxial cylinder of xylem and phloem, accompanied adaxially by an irregularly shaped and complex mass of xylem and phloem. Towards the base of the petiole the adaxial mass of xylem and phloem has the form of a rather irregular arc which is, at this level, continuous with the main abaxial vascular strand, so that the whole vascular system appears in transverse section as a somewhat uneven cylinder. Towards the base of the petiole the whole vascular system is surrounded by a narrow cylinder of fibrous cells with fairly thick walls and wide lumina, the fibrous ring being similar to that which surrounds the vascular system in the midrib. Cluster crystals are abundant in the ground tissue, especially at the centre of the petiole, and smaller, but similar crystals in the phloem. The exact appearance of the vascular system in the petiole, and to some extent in the midrib, varies from section to section, and there also appear to be minor variations from leaf to leaf.

STEM, (a) Stem 2 mm in diameter.

Stem more or less rectangular in transverse section. Hairs; none seen. Phloem and xylem in the form of cylinders of about equal width. Large cluster crystals occur in the cortex and near the phloem fibres, and smaller but similar cluster crystals in the phloem. Other particulars as in (b) below.

(b) Stem 3 mm in diameter.

Cork originating in the epidermis; consisting of thin-walled markedly rectangular cells. Amorphous, (tanniniferous?) deposits present in some of the cork cells. Primary cortex about 7 cells wide, consisting mostly of thin-walled parenehymatous cells, but outer cells locally smaller than those elsewhere, and somewhat collenchymatous. Outer boundary of the phloem marked by a continuous sclerenchymatous ring, consisting of thick-walled fibres with narrow lumina and irregularly shaped sclereids with wider lumina. Phloem and xylem in the form of closed cylinders traversed by narrow rays. Phloem devoid of sclerenchyma apart from the ring at the outer periphery. Vessels solitary and in short radial multiples of 2—4 or occasionally more; even those vessels that are solitary are located on definite radii from the stem centre. Individual vessels 31—58μ. in internal radial diameter. Inner part of the primary xylem consisting of specially small elements that are stained more readily by haematoxylin than by safranin, and are therefore apparently less lignified than those of the rest of the xylem. The occurrence of these unlignified portions of xylem abutting on the pith suggests that there is considerable centrifugal development of xylem before the primary xylem is wholly lignified, and there may be some centripetal lignification of the xylem. Pith somewhat stellate in outline, with 4 arms; parenehymatous; thick-walled and lignified at the periphery, and thin-walled and less lignified at the centre. The

thickening and lignification of the cells continue centripetally as the stem grows older, and the pith ultimately becomes homogeneous in appearance. Crystals similar to those described under (a) above, but less numerous.

(c) Secondary xylem, 1 cm in diameter.

Vessels sometimes solitary, but mostly in radial multiples of 2—4, or occasionally more; a few irregular multiples also present. Individual vessels in each multiple flattened where in contact with one another; those not pressing against one another are circular or oval in outline. Vessels 40—100 JA in internal radial diameter. Vessel members with simple, but very oblique, perforations; lateral pitting alternate, pits crowded to rather sparse, mostly rounded in outline and with circular to horizontally oval apertures. Fibres constituting practically the whole of the ground tissue of the wood; with fairly thick walls and oval to circular lumina; with numerous, fine, transverse septa, and rather large bordered pits with slit- shaped apertures in the radial, but not in the tangential walls. Parenchyma absent, apart from occasional paratracheal cells. Rays very densely crowded, not conspicuous in transverse sections; mostly uniseriate, but a few partly bi- or triseriate; uniseriate rays composed mostly of tall, narrow cells, but some rays, especially those that are more than uniseriate, are markedly heterogeneous; at least 9—28 cells high, and sometimes appearing higher owing to fusions between rays.

TAXONOMIC AFFINITIES

It seems, from the anatomical evidence, that *Scyphostegia* has no very close affinities with well established families. This is also emphasized by the distinstive morphology of the inflorescence and flower. Hitherto the most commonly expressed opinion has been that the genus has affinities with the Monimiaceae, although it has always been felt that the affinities cannot be very close. Hutchinson (2), on the other hand, has taken the view that the genus should be in a distinct family related to the Moraceae. This discrepancy of view largely depends on varying interpretations of the morphology of the flowers and inflorescence, which, in turn have been partly due to lack of adequate material. Hutchinson, now that more material has been at his disposal, has changed his views about the relationship of *Scyphostegia* to the Moraceae. The varying interpretations of the morphology of the flower and inflorescence have been summarized by Swamy (6), who, however, does not make any constructive suggestions concerning the affinities of the genus. A study of the anatomy of the stem and leaf fails to provide any convincing evidence that the genus has any close affinities with either the Moraceae or Monimiaceaee. On the contrary the anatomical evidence suggests rather remote affinities with the Flacourtiaceae or with the Euphorbiaceae. The suggestion of a relationship with the Euphorbiaceae is, however, of doubtful significance, as the Euphorbiaceae themselves constitute a large heterogeneous group, in which the range of anatomical structure is correspondingly great. Furthermore some genera of Euphorbiaceae are themselves not unlike some of the Flacourtiaceae, at least so far as their wood structure is concerned.

It must be emphasized that there is no particular genus in the Flacourtiaceae to which *Scyphostegia* is especially similar. The point is rather that *Scyphostegia* exhibits a number of characters that occur in certain genera of Flacourtiaceae, and this combination of characters suggests that *Scyphostegia* may have affinities, although these may be somewhat remote, with the Flacourtiaceae. The characters that suggest this relationship include the following: — In the leaf, the paracytic (rubiaceous) stomata and the occurrence of adaxial hypoderm. The midrib structure of *Scyphostegia.* is not unlike that of certain Flacourtiaceae such as *Dipentodon.* On the other hand, petiolar vascular structure of the type that occurs in *Scyphostegia,* has not yet been recorded in the Flacourtiaceae. The superficial origin of the cork in the stem of *Scyphostegia,* and the thin-walled cells of which it is composed, have their counterparts in the Flacourtiaceae. This applies also to the radial multiples of small vessels in the wood; the sparse wood parenchyma; the uniseriate rays composed of hign, upright cells; the ociurrence of vestically fused rays the septate wood are common to both *Scyphostegia* and the Flacourtiaceae.
fibses, with pits limited to the radial walls. Specially large cluster crystals

The first anatomical objection to the inclusion of *Scyphostegia* in the Monimiaceae came from Perkins and Gilg (5) who pointed out that the leaves of *Scyphostegia,* unlike those of the Monimiaceae, do not contain secretory cells. Baehni (1), and, more recently, Money, Bailey and Swamy (4) and Swamy (6) have reminded us of this fact. In addition, the last 3 authors have pointed out that *Scyphostegia* differs from the Monimiaceae in having trilacunar nodes, and tricolpate pollen grains. A perusal of Metcalfe and Chalk's "Anatomy of the Dicotyledons" (3) reveals further anatomical reasons for believing that there are no close affinities between *Scyphostegia* and the Monimiaceae. For example the stomata in Monimiaceae are usually anomocytic (ranunculaceous) in contradistinction to the paracytic rubiaceous) stomata of *Scyphostegia.* The Monimiaceae also differ from *Scyphostegia* in having crystals that are usually needle-shaped; vessels that are seldom in radial multiples; a less complex vascular structure in the petiole. The rays in the wood of the Monimiaceae are variable in form, but uniseriates of the type that occur in *Scyphostegia* are unknown.

Turning now to the Moraceae it may be noted that the family as a whole generally differs from *Scyphostegia* in not usually having paracytic (rubiaceous) stomata, whilst laticiferous canals, unknown in *Scyphostegia,* are characteristic of many members of the Moraceae. The wood of the Moraceae differs from that of *Scyphostegia* in having vessels that are mostly solitary; parenchyma that is typically paratracheal, and usually aliform or confluent. Uniseriate rays are uncommon in the family, and, where they do occur, they are not of the same type as those in *Scyphostegia.* On the other hand the wood of *Scyphostegia* resembles that of both the Moraceae and Monimiaceae in having septate fibres, but this character, although of diagnostic value because of its restricted occurrence, is to be found sporadically throughout the Dicotyledons, and it occurs in families between which there are no close affinities.

Taking all of these facts into consideration, the anatomical evidence seems to suggest that *Scyphostegia* can best be treated as a distinct family the Scyphostagiaceae, having some taxonomic affinities with the Flacourtiaceae.

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MATERIAL EXAMINED

Sample 927 from the Botanic Gardens, Penang.

Herbarium specimens collected by J. and M. S. Clemens, reference no. 26062.

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NOTES ON INDONESIAN FRESHWATER ALGAE II.

Ichthyodontum, a new desmid genus from Sumatra.

ARTHUR M. SCOTT * and GERALD W. PRESCOTT **

SUMMARY

Described and figured are *Ichthyodontum,* a new genus belonging to the desmidiaceous algae, with /. *sachlanii,* a new species with its new variety *parorthium,* showing a peculiar bipolarity. From southern Sumatra.

Ichthyodontum Scott & Prescott, *gen. nov.*

Cells elongate-cylindric and rectangular in front view, the poles truncate and bearing at each angle a blunt spine or tooth which may be either vertically or laterally directed, the apical margin with a shallow median notch or depression; semicells slightly swollen at the base, with **a** circumferential supraisthmian row of blunt teeth, the two series of teeth intermeshing and completely enclosing the shallow median incision; side view of cell elongate subfusiform; basal view broadly elliptic.

Cellulae a fronte visae elongato-cylindricae reetangularesque, polis truncatis et in utroque angulo spinam obtusam vel dentem verticaliter lateraliterve directum ferentibus, margine apicali incisuram mediam non profundam vel depressionem praebente; semicellulae ad basim subinflatae dentibus obtusis in ordine circumferentiali supraisthmiali praeditae, dentibus amborum ordinum implexis et incisionem median non profundam omnino includentibus; cellula a latere visa elongato-subfusiformis; a basi visa late elliptica.

Ichthyodontum sachlanii Scott & Prescott, *spec. nov.*—Fig. 1

Cells of medium size, length 6 to 7 times the width, in front view elongate-cylindric and decidedly curved, apices truncate with a shallow median subcircular notch with a prominent tubercle at each side on the margin, each apical angle bearing a stout upwardly directed tooth that is prolonged into a sharp fine spine; semicells slightly swollen at the base with one lateral margin more inflated than the other, and bearing **a** supraisthmian row of 10 longitudinal folds (5 showing) which bear each a prominent basally directed tooth, the teeth of one semicell intermeshing (not interlocking) with those of the other, thus completely enclosing the shallow median incision of the cell; cell wall sparsely punctate and having

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