FOLIAR ANATOMY AND THE DELIMITATION OF THE GENUS TRIODIA R. BR.

by

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(with 3 plates)

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Triodia as originally described by Robert Brown (4) included six Australian species but later authorities (1) (9) adopted a wider concept of the genus and included a number of American species and the European *Sieglingia decumbens* Bernh.. According to Hubbard (12) a return to the former condition was made during rearrangement of the material in the Kew Herbarium by Stapf.

Recent work on Australian material is completely in accordance with Stapf's view and when the anatomy of certain species was being described (6) (7) it occurred to the writer that difference in leaf formation would probably give further support. This paper is a result and it will be shown that the leaf anatomy in Australian species of *Triodia* is markedly different from that in species from other parts of the world. On the other hand resemblances between the leaves of *Triodia* and *Plectrachne* Henr. are remarkable. In the field plants of these genera have very similar habits and without inflorescences it is often difficult to distinguish between them. Some grasses now included under *Plectrachne* were formerly placed with *Triraphis* which, in Australia, is represented by Robert Brown's type species *T. mollis*, a soft annual grass whose leaf anatomy is more closely comparable with that of the American *Tridens* spp. than with that of any species of *Plectrachne* yet studied.

TAXONOMY AND NOMENCLATURE.

In the Genera Plantarum, Bentham and Hooker divided the genus into three sections: (I) *Isotria* which included the Australian species having deeply lobed lemmas, (II) *Uralepis* with the short-lobed Australian material, a number of American species and *Sieglingia* and (III) *Tricuspis* with several American species. These sections were modified by Hackel (9) who retained *Isotria*, placed *Sieglingia decumbens* and *Triodia irritans* in a separate group under section *Sieglingia* and divided the American species between *Rhombolytrum* and *Tricuspis*. *Triplasis* Beauv. is included as a final section. Bews (3) followed Hackel's arrangement except that *Triplasis* was given generic rank.

Of the six species originally described under *Triodia* by Robert Brown *T. pungens, T. procera, T. microstachya,* and *T. irritans* are still retained. *T. parviflora* was transferred to *Diplachne* by Bentham (2) and on the preceding page of the same work *T. ambigua* is given as a synonym of *Diplachne fusca.* The removal of these two leaves a sharply defined group into which the more recently described species, with the possible exception of *T. intermedia* Cheel, fit quite satisfactorily. They all show a marked similarity of habit and the tridentate lemmas have three groups of nerves or, if the groups are reduced to one nerve each, there are usually vestiges of others (5). By this character of the lemma the species can be distinguished from *Sieglingia* with five or more nerves but a three-lobed lemma and *Tridens* where there are three nerves but the apex is more or less two-lobed with an excurrent nerve between.

The illegitimacy of the name *Tricuspis* Beauv. has been dealt with by Hitchcock (11) and the species placed under it by earlier authorities are now grouped under *Tridens* Roem. and Schult. of which *T. flavus* is the type species.

Plectrachne Henr. (10) was based on *P. Schinzii* but now includes a number of species some of which were formerly placed under *Triraphis* R. Br. (2). Henrard's recognition of the former as a distinct genus has been justified by subsequent work.

MATERIAL.

The slides and diagrams prepared during a previous study were available and formed the basis for the remarks on *Triodia.* A number of herbarium specimens, received as exchanges through the courtesy of Mrs Agnes Chase of the United States National Herbarium, provided leaves of the following species of *Tridens*: *T. pulchellus* Hitchcock, *T. pilosus* Hitchcock, *T. flavus* Hitchcock, *T. texana* Nash, *T. albescens* (Vasey) N. T. Burbidge *nov. comb., T. muticus* Nash and also of *Triplasis purpurea* (Walt.) Chapm.. Leaves of several species of *Plectrachne* (*P. Schinzii* Henr., *P. Dielsii* C. E. Hubbard, *P. danthonioides* [F. Muell.] C. E. Hubbard, *P. pungens* [R. Br.] C. E. Hubbard) were obtained from Mr C. A. Gardner, Government Botanist in Western Australia. Material of *Triraphis mollis* and *Sieglingia decumbens* was available from the herbarium of the University of Adelaide.

In all cases leaves from vegetative shoots were used. They were either boiled or revived by McLean's method (14). Sections were cut freehand from the lower third of the lamina.

LEAF ANATOMY.

In *Triodia* the lamina shows considerable specialisation and in herbarium material it appears terete due to the folding together of the halves on either side of the midrib. Internally the construction may be either of two types. The first includes the type species *T. pungens* (*Pl. I, fig. 1*) and several eastern Australian species whose anatomy has not yet been fully studied. In these the midrib is flanked by two small nerves on either

side and the five are separated from one another by bands of motor tissue which extend across the full width of the lamina in transverse section. The remaining lateral portions are broad and grooved only on the inner i. e., the upper surface. In the second type the bands of motor tissue are not developed, though small bulliform cells are present in the inner grooves adjacent to the midrib and the small nerves, of which there may be one or two pairs. The lamina is deeply grooved on both surfaces (*Pl. I, figs. 3* and *5*). The two leaf forms share the following characters: (i) division of the phloem into two or sometimes three groups by the intrusion of small fibres, (ii) the presence of thin-walled chlorenchymatous cells adjacent to the grooves only, though plastids occur in the sheaths around the vascular bundles. The full details of the construction of these leaves has been given elsewhere (7).

The same types of lamina occur in *Plectrachne* and these are illustrated diagrammatically in *Pl. I, figs. 2, 4* and *6*. The detail to be observed in the two forms is shown in *Pl. III, figs. 1* and *2*.

In the American *Tridens* material the leaf blades were rolled, involute or conduplicate due to the presence of large bulliform cells in groups between each nerve and its neighbours. The vascular bundles were conspicuous due to the large cells of the parenchyma sheath. The nerves were divisible into primary ones such as the midrib and the main laterals and the secondaries between them. In each case the number of secondaries varied with the species and with the distance from the midrib (*Pl. II, figs. 2* and *3*). When the motor tissue is turgid the surface is barely grooved though a midrib is discernible.

In *Triplasis purpurea* the structure is very similar to that in *Tridens* but the leaf surface is more definitely grooved on both faces and there is no midrib though there is a central primary nerve (*Pl. II, fig. 4; Pl. III, fig. 4*).

In *Sieglingia decumbens* the vascular bundles are much smaller both actually and in relation to the volume of the leaf. There is also a larger amount of general body tissue which may break down between the nerves (*Pl. III, fig. 6*). There is a well-defined midrib with large motor cells in the grooves on either side. Smaller groups of motor cells occur between the lateral nerves but they decrease in size and disappear towards the margins of the blade (*Pl. II, fig. 1*).

A figure for *Triraphis mollis* is given (*Pl. II, fig. 5; Pl. III, fig. 5*) for comparison with *Plectrachne* and also with *Tridens* and *Triplasis*.

It will be seen that all these genera illustrate the bundle characters of the subfamily *Pooidae* in that both parenchyma and mestome sheaths are present. *Sieglingia decumbens* was the only species in which the cells of the mestome sheath had the walls of the inner face more thickened than those of the outer.

DISCUSSION.

In view of the great diversity in leaf anatomy among grasses contrasts are almost certain to be present in any selected group of material. Allowance must also be made for variations in structure of leaves from

different parts of the same plant. Apart from this latter difficulty differences in leaf anatomy have been found to be of diagnostic value e.g., Burr and Turner's work on pastures species (8).

The differences between the Australian *Triodia* material and the non-Australian would in this case seem to be too great to be explained merely as the result of geographical isolation or an arid habitat. Also, whatever the reason, the differences remain as facts which can be used taxonomically to distinguish between the groups of species, and the contrasts substantiate Stapf's views concerning *Triodia* and *Tridens*. The generic status of *Triplasis* is quite satisfactory on the basis of the lemma characters. It was included here partly as a matter of interest, though it was unfortunate that material of the type species *T. americana* was not available. *Sieglingia* also stands apart with its five-nerved lemma and different leaf anatomy.

The resemblances between *Tridens* and *Triplasis* form an interesting parallel to those between *Triodia* and *Plectrachne*. The affinity between the latter two has received little comment. The two genera are separated by the relative length of the lobes of the lemma. These are long and awnlike in *Plectrachne* which also has a callus at the base of the lemma. The fact that the lobes in *Triodia* vary from almost nothing in *T. irritans* to appendages two or three times as long as the base in *T. lanigera* Domin reduces the value of the first character.

SUMMARY.

Peculiarities in leaf anatomy support the opinion that the name *Triodia* R. Br. should be confined to the Australian species.

The leaves of species of *Plectrachne* Henr. are quite different from those of *Triraphis mollis*, though formerly included in this genus, but are remarkably similar to those of *Triodia*.

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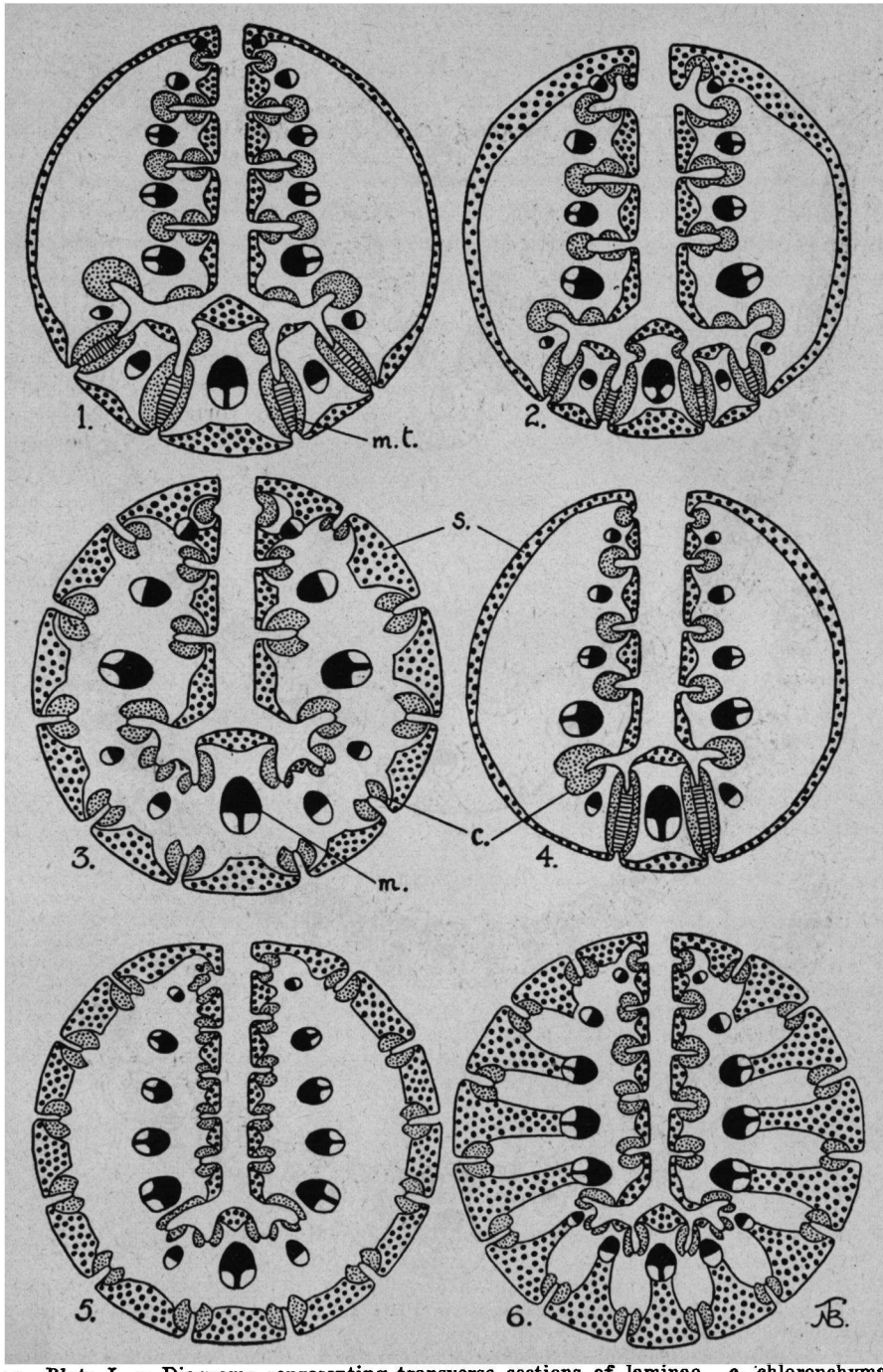

Plate I — Diagrams representing transverse sections of laminae. c. chlorenchyma, m. midrib, motor tissue, s. sclerenchyma. Phloem left white. × 60.

1. *Triodia pungens.* 2. *Plectrachne Schinzii.* 3. *T. lanigera.* 4. *P. pungens.* 5. *T. longiceps.* 6. *P. Dielsii.*

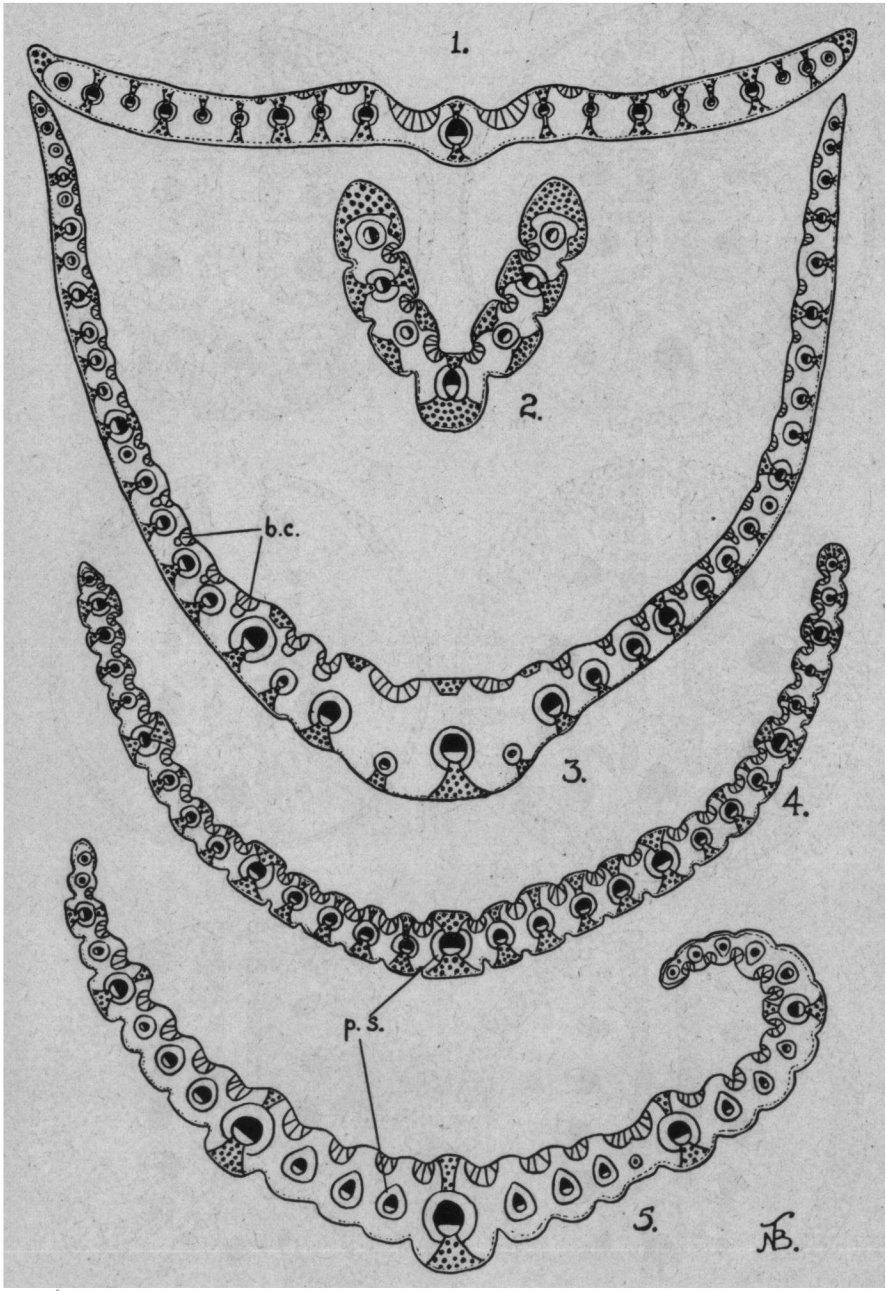

Plate II — Diagrammatic sections as in Plate I. b.c. bulliform cells. p.s. paren chyma sheath. × 50.

1. *Sieglingia decumbens*. 2. *Tridens pulchellus*. 3. *T. flavus*. 4. *Triplasis purpurea*. 5. *Triraphis mollis*.

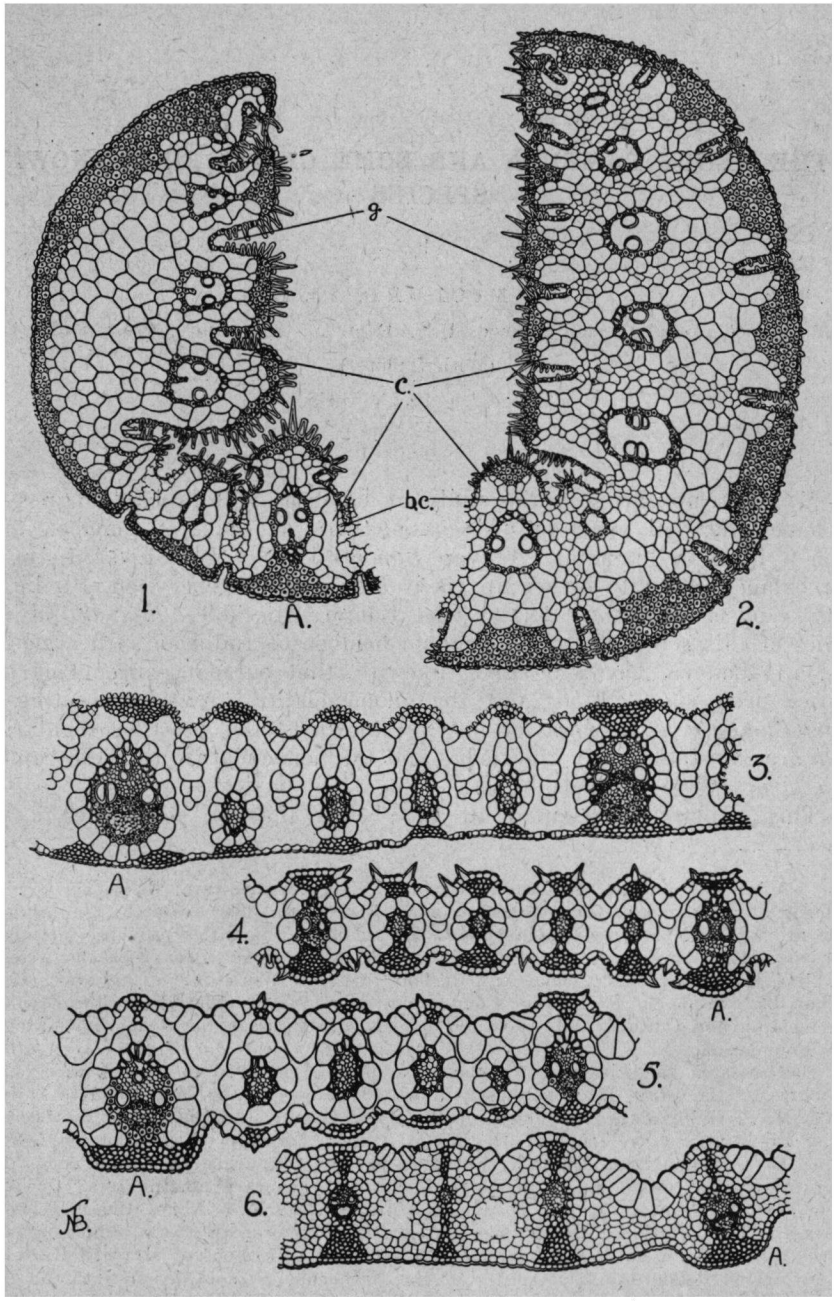

Plate III — 1. *Plectrachne Schinzii.* 2. *Triodia longiceps.* 3. *Tridens albescens.* 4. *Triplasis purpurea.* 5. *Triraphis mollis.* 6. *Sieglingia decumbens.*
A. midrib, g. groove with stomata, c. chlorenchyma, b. c. bulliform cells.
Detail of vascular bundles omitted in 1. and 2. and of chlorenchyma in all figures. × 90.