STUDIES IN THE GLOSSOPTERIS FLORA OF INDIA--31. SOME REMARKS ON THE GENUS *GLOSSOPTERIS* STERNB.

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ABSTRACT

The genus *Glossopteris* so abundant in the southern Palaeozoic flora has neither been properly circumscribed nor correctly delimited into species so far. The reason for this is a complete lack of accepted criteria on which to base these delimitations. In the present paper, the views expressed and the work done so far on this problem have been summarized. On the basis of the study of several hundred specimens from the Barakar and Raniganj stages as well as a survey of published literature some suggestions have been put forth for bringing harmony in the specific circumscription within this genus.

INTRODUCTION

THOUGH the Glossopteridales are the most abundant of all plants in the Permian flora of the Southern Hemisphere, they have been neither properly classified into different genera nor circumscribed in definite species within a genus. The main reason for this was a complete lack of accepted criteria on which to base such classifications. The first attempt in this direction was made by Arber (1905a) whose system of generic separation and specific circumscription has been widely followed. In view of the recent researches on the morphography (the term 'morphography' is used in this paper to mean the external characters) and the cuticular structure of the leaves and on the nature of fructifications borne by these leaves, his system, however, has now become obsolete.

The first recent attempt to classify these allied leaves was made by Srivastava (1957) who studied the cuticular structure of 16 species of *Glossopteris*, 6 species of *Gangamopteris* and one species of *Palaeovittaria* to find out if the cuticular evidence can provide a clue towards a better classification. On the basis of this study Surange & Srivastava (1957) found that these species fall under 6 different groups, each group probably representing a taxon of generic rank. The other notable attempt in this direction was made by Plumstead (1958a) who on the basis of evidences obtained from the attached fructifications tried to place various species of the Glossopteridales in different groups which she thought were taxa of generic rank.

One of the more obvious questions which the above schemes have posed is that the genera *Glossopteris*, *Gangamopteris* and *Palaeovittaria*, which are morphographically distinct, tend to fall under one or more 'cuticular' or 'fructification' groups, and there is an apparent lack of agreement between the two systems of classification. Here it may not be out of place to mention that the main reason why these two systems of classification do not agree seems to be the unsatisfactory identifications of many leaves morphographically, both by Srivastava and by Plumstead. Hence, there is a greater need for further work in this direction and the evidences thus obtained have to be correlated with those obtained by more critical studies on the fructifications and the cuticular structure. In words of Plumstead (1958a, p. 73) "The author believes, that when these differences are sorted out, the discrepancy between the two results will be far smaller than it appears to be at present, particularly as regards parallel horizons."

Though the evidences provided by the cuticles and the fructifications are very important, their application is admittedly limited as most of the Lower Gondwana fossils occur more frequently as impressions. Hence, the natural thing is to devise a classification based on the morphographic characters. On the basis of morphography the retention of the taxonomic status of the present genera seems to be most advisable and advantageous, in spite of the obvious difficulties sometimes encountered in determination of transitional forms. It is hoped that if due care is taken in identifying the specimens, most of them will fit in present taxa and only in a few cases the necessity may arise of creating new taxa.

THE GLOSSOPTERIDALES

At present five leaf genera, viz. *Glossopteris, Gangamopteris, Palaeovittaria, Rhabdotaenia* and *Rubidgea* can be tentatively assigned to the Glossopteridales. Of these *Gangamopteris* and *Rubidgea* differ from the others in the absence of a midrib. Feistmantel (1890, p. 130) called *Gangamopteris* as a *Glossopteris* without a midrib. Similarly *Palaeovittaria* is almost a *Glossopteris* without the anastomosing of the secondary veins. Three genera, viz. *Rhabdotaenia, Glossopteris* and *Palaeovittaria* possess a midrib. *Rhabdotaenia* and *Palaeovittaria* differ from *Glossopteris* in the absence of anastomosing of the secondary veins. *Rhabdotaenia* differs from *Palaeovittaria* in usually having a persistent midrib. Further in the former the secondary veins are almost at right angles to the midrib unlike the latter where the veins are oblique. *Gangamopteris* is distinguishable from *Rubidgea* by the presence of meshes. Though in typical forms these genera can be easily distinguished on the basis of above characters yet in some intermediate forms or in specimens not too well preserved some difficulty is encountered in assigning them to different genera. However, in the transitional forms the difficulty can be surmounted to some extent by detailed and careful analysis. On the whole the generic separation based on morphographic studies is quite satisfactory and easily accomplished than that based on the characters of the cuticle or the fructifications, which are rarely found.

THE GENUS *GLOSSOPTERIS*

The name *Glossopteris* was proposed by Brongniart (1822) as a section of *Filicites* for certain tongue-shaped leaves from the Palaeozoic of India and Australia. This name was later raised to generic status by Sternberg (1825). This genus is extremely abundant in Permian strata throughout Gondwanaland countries, viz. India, South Africa, Australia, South America and Antarctica and is of great stratigraphical significance. Unfortunately, however, little is known about the nature and habit of the plants which bore these leaves. Recently much evidence has been put forth to show that the axis genus *Vertebraria* is one of the stems which bore such leaves (Dolianiti, 1954; Surange & Maheshwari, 1962; Pant, 1962). The probability of other stems bearing these leaves can not be ruled out; infact it is a possibility. These leaves were borne on stems either in whorls (Surange & Maheshwari, *l.c.*, Fig. 8) or in pairs (Dolianiti, *l.c.*, Fig. 1). Seward (1931, p. 247) believed that both *Gangamopteris* and *Glossopteris* were shrubs of similar habit. Teichert (1942, p. 325), however, believed that *Gangamopteris* had a different habit and was high and narrow. The habit of growth of Glossopteridae as a group has been dealt in detail by Plumstead (1958b, p. 92) who drew the conclusion that " It is probable that they were deciduous, woody plants, with an arborescent habit, and that the leaves, flowers and fruits were borne on short shoots, a few of which developed into long shoots to form branches ".

From time to time various and diversified structures have been described as fructifications of *Glossopteris* (Arber, 1905b; Walkom, 1928b; du Toit, 1927a; Sen, 1954, 1955a, 1955b, 1956; White, 1962). The first attached fructification was figured by Zeiller (1902, Pl. 4, Fig. 9) under the name *Ottokaria bengalensis* which is attached to a *G. indica* type of leaf. In recent years a large number of attached fructifications of *Glossopteris* have been described (Plumstead, 1952, 1956, 1958a; Sen, 1955c; Rigby, 1962; Maheshwari, 1965b). Plumstead has variously regarded these fructifications as being bisexual or unisexual. In fact on the basis of her belief that the fructification of *G. longicaulis* was unisexual she (1962, p. 548) remarked that the leaves of *Glossopteris* type may have been common also to groups other than the Glossopterideae. But as has been pointed out by Pant (1962) and many others there is as yet no definite evidence to prove that these fructifications were bisexual or unisexual or even what was their actual nature. Pant (*l.c.*, p. 312) has very rightly remarked that " The interpretation of the two counterparts of her supposed bisexual fructifications as the male and female halves of bivalved structures is doubtful, for if so there should at least be a thin layer of matrix between the two counterparts. " It may be pointed out that such hasty conclusions may result in further complications as is the case with the Gonophyll theory of Melville (1960) who believing that the glossopterid fructifications were enclosed structures suggested in his theory of Angiosperm flower that

Glossopteris must have been very close to proangiosperm stock at that level of evolution. The view that the angiosperms could have had ancestors in the Glossopterideae was perceived by Plumstead as early as 1958 when she remarked (1958a, p. 92) " Do the dwarf shoots and peculiar secondary wood of *Vertebraria* suggest a gymnospermous affinity or do the enclosed fructifications and branching deciduous trees anticipate the Angiosperms ? " She has further elaborated on this subject in a later paper (1962a, p. 123). It may, however, be pointed out that one of the fructifications, viz. *Vannus gondwanensis* attached to *Gangamopteris clarkei* (PLUMSTEAD, 1963) is quite different and does not fit in the Gonophyll theory. Until, enclosed nature of glossopterid fructifications is definitely proved any suggestion of a relationship between *Glossopteris* and the angiosperms will be highly conjectural. Infact most of the evidence available till now seems to favour a true gymnospermous affinity of this genus.

SPECIATION IN *GLOSSOPTERIS*

Though much work is being done about the nature, habit and fructifications of *Glossopteris*, not much has been done about its proper circumscription into species. Before the application of cuticular techniques the specific delimitation within this genus was based on the morphographic characters alone. However, so far, there has been no agreement about the distinctive characters of the various species and instances are not rare in literature when similar leaves have been given different specific epithets, e.g. separation of *G. fuchsii* (PLUMSTEAD, 1962a, PL. 12, FIGS. 1 & 2) from *G. indica* (PLUMSTEAD, *l.c.*, PL. 4, FIGS. 1 & 2), or different leaves included in the same species, e.g. inclusion of some forms resembling *G. decipiens* in *G. damudica* by Seward & Walton (1923). There has been considerable disagreement about the characters on which specific circumscriptions may be based. Certain workers preferred to separate forms into different species whenever there was a difference while others were rather conservative and believed in broad-based species. These two categories have been termed as " splitters " and " lumpers " respectively (PLUMSTEAD, 1962a). The confusion in specific delimitation of this genus has been so great that Plumstead (*l.c.*, p. 37) has remarked " Possibly it has suffered more than any other common plant fossil in classification. " Seward (1904) found it practically impossible to give specific diagnoses which may seem as indices of well-defined differences and urged that a dominant form should be selected round which may be grouped such leaves as exhibit a more or less well-marked departure from the central type. He (1910, p. 507) says " The arbitrary separation of sterile leaves, which differ by small degrees from one another in form and details of venation, by the application of specific names is a thankless task necessitated by custom and convenience; it is, however, idle to ignore the artificial basis of such separation. " Walkom (1922) also thought that the species should be broad-based. He says (*l.c.*, p. 11) " The adoption of the alternative (of distinguishing in detail) must lead to a multiplication of specific names, and with this increase there is the added disadvantage that it becomes increasingly difficult to diagnose the species (so-called) concisely and accurately ".

The most ardent advocate of the broad-based species, however, was Arber and he (1905a) listed the various reasons as to why the species should be broad-based. Refering to *Glossopteris* he said (*l.c.*, p. 45) " . . . there existed a considerable variation in the form and shape of the leaf of *Glossopteris*, and in details of nervation, even in fronds which there is reason to believe belonged to the same plant. " Here the question arises that without knowing the complete plant how do we know that there was such a variation in the same species. Arber believed that size and shape of the leaves were dangerous guides in specific delimitation. Seward (1897, p. 317) had also said something similar — " The test of size is always dangerous, and can not be as a rule regarded as a taxonomic character of much value ". On the basis of the study of leaves supposed to be bearing fructifications belonging to the same type Plumstead (1958a, p. 73) concluded that the shape and size of the leaves are not useful as criteria for purposes of classification. Arber also did not agree that the characters of the midrib, nature of the apices or the angle of divergence of the secondary veins from the midrib are trustworthy characters for specific delimitation. The

only character which he recognized as of importance in circumscription of the species was the size and shape of the meshes. He said (*l.c.*, p. 46) " The one character which does appear to be fairly constant, though it is by no means without a certain amount of variation, is the average openness or closeness of the secondary nerves, and consequently the shape of the meshes ". The problem arises that when a variation is presumed in a character, how are we to know its range ? It will necessarily be an arbitrary one.

Arber suggested that as the classification of *Glossopteris* is an artificial one it would be better to maintain comparatively few species by grouping together those species which differ in one or two characters but are not sufficiently dissimilar in the aggregate of their characters. He also doubted the usefulness of creating varieties or subspecies and in this connection he is amply supported by Edwards (1928, p. 325) who says " . . . . I think that the custom of applying varietal names to isolated fossil leaf impressions is to be deprecated . . . The use of trinomial nomenclature does not appear to add to the convenience of this artificial classification. " While the tendency to create varieties or sub-species is to be deprecated it is equally true that a genus, howsoever artificial has to be critically resolved into various specific components, whatever their number. Seward (1897) has very rightly observed that " while endeavouring to avoid dangerous and unscientific practice of needlessly multiplying specific names, we must be careful to bear in mind the possibility of carrying too far the system of linking together distinct types by a long series of intermediate forms. " Arber was infact more interested in reducing the number of species by linking together, which resulted in a conglomeration of many distinct types under fewer names which sometimes became so unwieldly as to be of no stratigraphical value. His *Glossopteris browniana* may particularly be cited as an example where different and distinct forms were huddled together, e.g. *G. parallela, G. linearis, G. taeniopteroides*, etc.

Recent researches have, however, shown the unsatisfactory nature of Arber's broad-based specific circumscriptions. They go a long way in supporting Feistmantel's "liberal" circumscription of the species. It is interesting to note that so far almost none of the species delimited by Feistmantel have been contradicted by cuticular studies or on fructification evidence. In fact some of Feistmantel's species need even further delimitation as is evident from the works of Srivastava (1956), Pant (1958) and Hϕeg & Bose (1960) on the epidermal structures and of Plumstead (1956) on the fructifications. As an example may be cited the *G. indica* type of leaf which has been found to possess many different types of epidermal structures, e.g. *G. indica, G. communis, G. jamottei, G. arberi, G. hispida* and *G. fibrosa*. Here it is not meant to say that the above species are morphographically indistinguishable from the typical *G. indica* leaf. However, this distinction between these species can only be accomplished when we leave aside Arber's " broad-based " system and take into account all the important morphographical characters whether gross or minute. As shown in an earlier paper (MAHESHWARI, 1965a) *G. brownii* also seems to be a complex species as is evident from the different types of fructifications borne by such leaves.

It seems that these leaves had a generalized pattern. Hence it is important that a morphographical approach must now take into account all recognizable characters — whether gross or minute — and they should be critically analysed in various ways in order to find a more reasonable and precise basis for specific delimitations. Morphographic circumscriptions can be further verified by other evidences such as cuticular, if and when they are available. An example is the case of *G. fibrosa* Pant. Ordinarily this leaf would have been placed in *G. indica* but by detailed observations the interstitial veins were discovered which lead to the creation of this species. This specific circumscription was supported by characters of the epidermis.

On the basis of the study of several hundred specimens from the Barakar and Raniganj stages of the Damuda series and a survey of the published literature it has been found that in specific circumscriptions aggregate of characters should be taken into account and attempt must always be made to verify difference in one character by other characters too. In some exceptional cases, however, species may have to be established on the basis of one character

alone. Morphographic characters which seem to be of interest from the point of view of specific circumscription are: shape, margin, apex and base of the leaf, and nature of the midrib, course of the secondary veins and the shape and size of the meshes. *Size* does not generally seem to be a character worthy of special consideration. If material is available, it is suggested that, statistical methods should be tried.

The leaves vary in *shape*, e.g. linear (*G. formosa*), linear-lanceolate (*G. angustifolia*), lanceolate (*G. indica*), lanceolate-spathulate (*G. indica*), spathulate (*G. brownii*), oblong (*G. emarginata*), obovate (*G. retusa*), cordate (*G. cordata*), obcordate (*G. spathulato-cordata*) etc. A species can not be delimited on the basis of this character alone but combined with one or more characters it can form a base for specific separation.

The *apex* seems to be an important character only when wide differences are present, e.g. between obtuse (*G. brownii*) and emarginate (*G. emarginata*) or acute (*G. communis*) and retuse (*G. retusa*) otherwise this character is of little significance.

The *base* of the leaf may be auriculate (*G. decipiens*) contracted (*G. brownii*) or petiolate (*G. longicaulis*) and this character is quite important from the point of view of specific delimitation. It is suggested, however, that as far as possible this character be used in combination with other characters.

Margin may be entire (*G. communis*) or notched (*G. retusa*) and if the latter feature is not because of preservation the difference between the two is important enough.

The *midrib* may be persistent or evanescent. This character sometimes leads to confusion but in well-defined forms, e.g. *Glossopteris decipiens* it can be used safely. The midrib may further be thick and well-marked or flat and indistinct. This character seems to be a constant one. On the midrib sometimes vertically running striations are found but these never anastomose and in this sense are different from the median veins of the genus *Gangamopteris* which though sometimes simulate a midrib, show definite anastomoses.

The most important character in specific delimitation as already emphasized by Arber (1905a) is the *nature of the secondary veins and the meshes* formed by them. The first thing to be noticed is the obliquity of the veins which may be almost perpendicular to the midrib (*G. taeniopteroides, G. euryneura*) or may form acute angles with it (most of the species). In the latter case the veins may be almost straight (*G. intermittens, G. jonesii, G. mitchelii*), arched (*G. indica, G. communis, G. brownii* etc.) or sinuous (*G. verticillata*) etc. The per centimeter concentration of the veins should also be given enough importance, e.g. in both *G. taeniopteroides* and *G. euryneura* the secondary veins are almost perpendicular to the midrib but in the latter case the number of veins per centimeter is much less as compared to the former. This difference is verified by the flexuous nature of the secondary veins in the latter, unlike the former where the veins follow an almost straight course. In some species the veins anastomose only rarely, e.g. *G. taeniopteroides* and *G. intermittens* while in others the anastomoses are frequent, e.g. *G. brownii, G. formosa, G. retifera* etc. In certain species the secondary veins do not show much branching and thus follow almost parallel course, e.g. *G. parallela* while In others the secondary veins branch profusey and the concentration of the veins at the margins is much higher than near the midrib, e.g. *G. brownii*. The shape of the meshes formed by the secondary veins depends considerably on the concentration of the veins as well as number of anastomoses. The meshes may be broad and open (*G. conspicua*), narrow-elongate (*G. communis*), elongate-polygonal (*G. brownii*), polygonal (*G. retifera*), trapezoid (*G. tortuosa*) etc.

Thus a clever approach to the various morphographical characters in all their details, is likely to yield better clues as to which character or characters should be specially stressed in the circumscription of a species.

SOME IMPORTANT RECORDS OF *GLOSSOPTERIS*

* Identification doubtful
\+ with fructification
c cuticular structure known
f first description

AFRICA

G. angustifolia	Zeiller 1896, Seward 1903, Seward & Leslie 1908, Walton 1929 cf.

G. communis	Etheridge 1901
G. fibrosa	Pant 1958 [f,c]
G. brownii	Zeiller 1896, Seward 1903, Seward & Leslie 1908, du Toit 1927c, Walton 1929, Plumstead 1956[+], Hϕeg & Bose 1960
G. brownii var. *vaalense*	Plumstead 1958a[+,f]
G. ampla	Seward 1903, Arber 1905a, du Toit 1927c, Teixera & Goncalves 1959
G. conspicua	*Plumstead 1956
G. damudica	Feistmantel 1889, Plumstead 1958a[+]
G. decipiens	Plumstead 1958a[+]
G. feistmantelii	Rigby 1964 (du Toit 1927a *G. cordata*)
G. hispida	Pant 1958[f,c]
G. indica	*Zeiller 1896, Seward 1903, Seward & Leslie 1908, du Toit 1927b-c, Walton 1929, Plumstead 1952[+], Pant 1958, Hϕeg & Bose 1960.
G. jamottei	Hϕeg & Bose 1960[+,c]
G. longicaulis	Plumstead 1958a[+]
G. nephroedicus	*du Toit 1929
G. angustifolia var. *taeniopteroides*	Seward & Leslie 1908 (*G. sewardii*, Plumstead 1962a)
G. retifera	Seward & Leslie 1908cf., du Toit 1927c, *Walton 1929, *Plumstead 1956[+]
G. stricta	Seward 1903, Leslie 1921, Plumstead 1958a[+]
G. tortuosa	Walton 1929
G. tortuosa var. *vaalense*	*Plumstead 1962a[f,+]
G. verticillata	Thomas 1958[f] (1952 as *G. longicaulis*)

ANTARCTICA

G. ampla	Plumstead 1962a, Cridland 1963
G. angustifolia	Plumstead 1962a, Cridland 1963
G. brownii	Plumstead 1962a, Cridland 1963
G. communis	Plumstead 1962a
G. cf. *cordata*	Plumstead 1962a
G. cf. *conspicua*	*Plumstead 1962a
G. antarctica	Plumstead 1962a[f]
G. fuchsii	*Plumstead 1962a[f]
G. damudica	Plumstead 1962a, Cridland 1963
G. formosa	Plumstead 1962a
G. indica	*Seward 1914, *Edwards 1928, Schopf 1962, Plumstead 1962a, Cridland 1963
G. indica var. *wilsoni*	*Seward 1914
G. longicaulis	Plumstead 1962a
G. orbicularis	Plumstead 1962a
G. parallela	Plumstead 1962a
G. spathulato-cordata	Plumstead 1962a
G. stricta	Plumstead 1962a

ARGENTINA

G. ampla	Archangelsky, 1957, Archangelsky 1958
G. argentina	Archangelsky 1957[f]
G. brownii	Archangelsky 1957, Archangelsky 1958
G. conspicua var. *patagonica*	*Archangelsky 1957, *Archangelsky 1958[f]
G. damudica	Archangelsky 1957, Archangelsky 1958
G. indica	Archangelsky 1957, *Archangelsky 1958
G. retifera	Archangelsky 1957, *Archangelsky 1958
G. stricta	Archangelsky 1957, Archangelsky 1958
G. stipanicicii	Archangelsky 1957, Archangelsky 1958[f]

AUSTRALIA

G. ampla	Dana 1849[f], Feistmantel 1890, Arber 1902, Walkom 1922
G. angustifolia	Walkom 1928a, White 1962[+]
G. brownii	Brongniart 1828[f] (as *G. browniana* var. *australisica*), Dana 1849, Feistmantel 1890, Arber 1902, Walkom 1922
G. clarkei	Feistmantel 1890[f]
G. communis	Feistmantel 1890, Walkom 1922
G. cordata	Dana 1849[f], Feistmantel 1890, Rigby 1964
G. elegans	Feistmantel 1890[f]
G. elongata	Dana 1849[f], Feistmantel 1890
G. gangamopteroides	*Feistmantel 1890[f]
G. linearis	McCoy 1847[f], Dana 1849, Feistmantel 1890
G. indica	*Walkom 1922
G. jonesii	Walkom 1922[f]

G. mitchelli	Walkom 1928b[f]
G. nephroedicus	Etheridge 1904 (? *G. cordata*)
G. parallela	Feistmantel 1890[f]
G. primaeva	*Feistmantel 1890[f]
G. reticulum	*Dana 1849[f]
G. spathulatocordata	Feistmantel 1890[f]
G. taeniopteroides	Feistmantel 1890[f]
G. wilkinsoni	Feistmantel 1890[f]
G. tortuosa	Walkom 1922

BRAZIL

G. ampla	White 1908, Read 1941
G. angustifolia	Dolianiti 1953
G. angustifolia var. *taeniopteroides*	Dolianiti 1953
G. brownii	White 1908, Lundqvist 1919?, Read 1941
G. formosa	Dolianiti 1953
G. indica	Dolianiti 1948, Read 1941, Lundqvist 1919
G. occidentalis	*White 1908, *Dolianiti 1948
G. spatulocordata	Dolianiti 1953
G. stricta	*Dolianiti 1953 (? *G. taeniopteroides*)

FALKLAND ISLANDS

G. angustifolia	Halle 1912
G. angustifolia var. *taeniopteroides*	Seward & Walton 1923
G. brownii	Halle 1912
G. communis	Halle 1912
G. damudica	Halle 1912
G. indica	Halle 1912, Seward & Walton 1912
G. indica cf. *G. decipiens*	*Seward & Walton 1923

INDIA

G. angustifolia	Brongniart 1828[f], Feistmantel 1881, 1886, Zeiller 1902, Sahni 1923[c], Saksena 1961, Maheshwari & Prakash 1965.
G. arberi	Srivastava 1956[f,c]
G. brownii	Bunbury 1861, Feistmantel, 1881, 1882, 1886, *Srivastava 1956[c], Saksena 1961, Maheshwari & Prakash 1965
G. communis	Feistmantel 1879[f], 1881, 1882, 1886, Srivastava 1956[c], Maheshwari & Prakash 1965
G. conspicua	Feistmantel 1880[f], Srivastava 1956[c]
G. damudica	Feistmantel 1881[f], 1886, Zeiller 1902, Srivastava 1956[c], Maheshwari & Prakash 1965.
G. decipiens	Feistmantel 1879[f], 1881, 1886, Maheshwari 1965a
G. divergens	Feistmantel 1881 , *Srivastava 1956[c]
.G emarginata	Maheshwari & Prakash 1965[f], Maheshwari 1965a
G. euryneura	Maheshwari 1965a[f]
G. feistmantelii	Rigby 1964[f] (Feistmantel 1882 as *G. cordata*)
G. cf. *fibrosa*	Maheshwari 1965a
G. formosa	Feistmantel 1881[f], 1882, 1886, Srivastava 1956[c], Maheshwari & Prakash 1965
G. indica	Brongniart 1828[f] (as *G. browniana* var. *indica*), Feistmantel 1881, 1886, *Zeiller 1902, *Saksena 1961, Maheshwari & Prakash 1965
G. intermedia	Feistmantel 1880[f], Maheshwari 1965a
G. intermittens	Feistmantel 1881[f], Srivastava 1956[c]
G. leptoneura	Bunbury 1861[f]
G. linearis	Maheshwari 1965a
G. longicaulis	Feistmantel 1879[f], Maheshwari 1965a, *Maithy 1965, *Srivastava 1956[c]
G. musaefolia	Bunbury 1861[f]
G. orbicularis	Feistmantel 1881[f]
G. parallela	Maheshwari & Prakash 1965
G. retifera	Feistmantel 1881[f], 1886, Srivastava 1956[c], Maheshwari & Prakash 1965
G. retusa	Maheshwari 1965a[f]
G. sahnii	Srivastava 1965[f,c]
G. spathulatocardata	Maithy 1965
G. srivastavae	Surange & Maheshwari 1962[f,c]
G. stricta	Bunbury 1861[f], Feistmantel 1881, 1882
G. taenioides	Feistmantel 1882[f],

	*Srivastava 1956[c]	MADAGASCAR	
G. taeniopteroides	*Srivastava 1956[c], Maheshwari 1965a	*G. indica*	Carpentier 1935
G. tortuosa	Zeiller 1902[f], Maheshwari 1965a	TURKEY	
G. verticillata	Maheshwari 1965a	*G.* cf. *stricta*	Wagner 1962

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