CUTICULAR STRUCTURE AND AFFINITIES OF CHEIROPHYLLUM LACERATA (FEISTMANTEL) N. COMB.

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ABSTRACT

A new genus Cheirophyllum is made for some lobed leaves which were described earlier by Feistmantel (1886) under the name Noeggerathiopsis lacerata, and by Maithy (1965) as Palmatophyllites lacerata (Feistmantel) comb. nov. as well as some newly collected identical duplicates from the Karharbari Stage of the Giridih Coalfield. The cuticles of C. lacerata (Feistmantel) comb. nov. are also described. It is pointed out that the name Palmatophyllites lacerata is illegitimate.

INTRODUCTION

UNDER the name Noeggerathiopsis lacerata Feistmantel (1886) and others described some scale-like deeply lobed leaves from Karharbari Stage of the Lower Gondwanas of India. The lobed character of the leaves clearly distinguishes them from leaves of Noeggerathiopsis and also from scales attributed to it and to other genera. Doubts about their inclusion in Noeggerathiopsis were expressed by Zeiller (1902), Arber (1905) and Pant and Verma (1964). Subsequently, Maithy (1965) included them under a new name Palmatophyllites lacerata (Feistmantel) Maithy, and suggested that they are of the nature of megasporophylls. Since, even the drawings and photographs of Maithy’s seed-bearing specimens looked rather different from the typical fossils of this species and also because the structural details of Noeggerathiopsis lacerata were unknown, we collected some compressed duplicates and studied their cuticular structure. We have also re-examined Feistmantel’s type collection in the G.S.I. Museum and the specimens which were attributed to the species by Maithy. The results of our study are embodied in the present paper.

MATERIAL AND METHODS

The compressions of deeply lobed small leaves were collected from the Karharbari Stage of the Giridih Coalfield. External features were studied and photographed under incident light and oil. Cuticles were prepared by maceration of the leaf sub-

stance by the usual Schulze’s method and mounted in safranin glycerine jelly. All the slides and specimens figured in this paper are kept in D.D. Pant collection at present located in the Botany Department, Allahabad University.

OBSERVATIONS

Genus — Cheirophyllum nov.

Diagnosis — Detached simple leaves, lamina contracted towards base and showing a number of deeply divided narrow lobes on distal side. Veins parallel, non-anastomosing, lobes multiveined. Midrib absent but one to three median longitudinal ridges or furrows often present in basal part. Leaf base truncated.

Leaf amphistomatic, stomata on one surface far more numerous than on other face. Stomata haplocheilic. Guard cells sunken.

Type Species — Cheirophyllum lacerata (Feistmantel) n. comb.

Cheirophyllum lacerata (Feistmantel) n. comb.

Pls. 1, 2; Text-figs. 1, 2

1886 Noeggerathiopsis lacerata Feistmantel, pl. 15, figs. 1-3, 4a; pl. 17, figs. 2, 3.
1902 Noeggerathiopsis (?) lacerata Zeiller, pl. 7, figs. 2, 3.
1905 (Noeggerathiopsis — ?) lacerata Arber, fig. 39.
1920 Squama forma lacerata Seward & Sahni, pl. 2, fig. 16.
Diagnosis — Leaf small about 3 to 7 cm long, 1·5 to 3 cm wide in widest part, lamina tapering towards base, basal part 0·6 cm to 1 cm wide, middle portion of lamina showing one or a few ridges or grooves, apex of lamina showing 12 to 16 deeply cut lobes, lobes 1-2 cm long and 0·2-0·3 cm wide, sides parallel but pointed near distal end towards bluntly pointed apex, lobes showing 2-3 parallel veins. Leaf amphistomatic but one surface paucistomatic and other multistomatic. Both cuticles thick, cuticle of paucistomatic surface thicker about 4 \( \mu \text{m} \) thick, cuticle of multistomatic surface about 3 \( \mu \text{m} \) thick.

Cells of paucistomatic surface not differentiated into vein and mesh areas, cells rectangular, longitudinally elongated, averaging at 78 \( \mu \text{m} \times 31 \mu \text{m} \) (68-93 \( \mu \text{m} \) long \( \times 22-33 \mu \text{m} \) wide), anticlinal walls of cells straight, 3 \( \mu \text{m} \) thick, surface of cells usually showing a single thickened papilla 12 \( \mu \text{m} \) wide.

Multistomatic surface showing differentiation of vein and mesh areas, surface papillae over cells sometimes obscure or absent, non-stomatiferous vein areas 4-8 cell wide, cells averaging 89 \( \times 26 \mu \text{m} \) (74 -112 \( \mu \text{m} \) long \( \times 22-31 \mu \text{m} \) wide), rectanguloid, longitudinally elongated, anticliral walls straight, 3 \( \mu \text{m} \) thick. Cells of stomatiferous areas tending to be isodiametric, about 40 \( \mu \text{m} \) wide or long (31 -46 \( \mu \text{m} \) long \( \times 34 -46 \mu \text{m} \) wide). Anticlinal walls straight or arched about 3 \( \mu \text{m} \) thick, cells along margins narrow and elongated.

Stomatiferous areas showing one to four ill-defined longitudinal rows of stomata, stomata of adjacent rows generally alternating with each other, stomata as a rule longitudinally orientated, haplocheilic, monocyclic or incompletely amphicyclic, subsidiary cells 4 to 8, forming a regular or irregular ring of short or elongated ordinary epidermal cells, inner (poral walls) of subsidiary cells thickened, sometimes obscurely papillate overarching guard cells, polars not different from laterals, size of subsidiary cells averaging about 40\( \times 33 \mu \text{m} \), stomatal pit measuring 43 \( \mu \text{m} \) long \( \times 16 \mu \text{m} \) wide (37-46 \( \mu \text{m} \) long \( \times 15-19 \mu \text{m} \) wide). Surface of guard cells hyaline.

Lectotype — No. 5455; Museum, Geological Survey of India, Calcutta.

Locality — Dhamni, ca 2 miles south of Khaira, South Rewa Gondwana Basin.

Horizon — Karharbari Stage, Lower Gondwana.

Nomenclature — Under the name Noeggerathiopsis lacerata Feistmantel (1886) described clearly lobed detached leaves but their assignment to Noeggerathiopsis, which is a genus of unlobed spatulate leaves, is obviously improper. Zeiller (1902) suggested that leaves of this kind were similar to those of Ginkgoales but he even thought that they could be compared with Whittleseya, Cycadospadix and megasporophylls of Cycas. A comparison of \( N. \) lacerata with Whittleseya is untenable as it has been proved to be a microsporangiate organ of the pteridosperms (see Halle, 1929). The presumed similarity of \( N. \) lacerata with Cycadospadix or megasporophylls of Cycas is equally far-fetched since the leaves of \( N. \) lacerata are sterile. Another suggestion about the nature of the leaves of \( N. \) lacerata was made by Seward and Sahni (1920), who thought that they could be protective bracts of some cordaitean reproductive shoots and accordingly they named them Squama forma lacerata. The name Squama is, however, applied to imperfectly preserved scales of diverse form and affinities. Some of them have been assigned to Glossopteris (Walton, 1929) on account of their showing similar anastomosing veins while other unlobed scales have been thought to belong to Noeggerathiopsis (Seward & Sahni, 1920). We are, therefore, inclined to think that the present structurally preserved, clearly lobed leaves need to be assigned to a new genus even though, Maithy (1965) has
already included all previously described leaves of *Noeggerathiopsis lacerata* Feistmantel and also some of his own freshly found duplicate specimens to *Palmatophyllites lacerata* (Feistmantel) Maithy.

While Maithy retained Feistmantel’s specific epithet “lacerata” in his new combination, contrary to rules he selected one of his own duplicate specimens as the holotype, and another as isotype, of the new combination. His generic diagnosis too, is defective since he wrongly described that the lobes were univeined and also mixed up therein the characters of a seed (Maithy, 1965, specimen no. 31395/425 or 31393/425) and found that their lobes are multiveined. Further, it is now clear that his isotype, specimen no. 32805/499, is a cupulate seed which is quite different from his other specimens belonging to *N. lacerata*. Maithy has in fact made self contradictory statements when he calls specimen no. 31395/425 as holotype in the text and specimen no. 31393/425 as the holotype in the explanation of pl. 2, fig. 16. Moreover, the genus *Palmatophyllites* is invalid under Articles 7 and 63 of the "International Code of Botanical Nomenclature" which lays down that a new combination must be 'typified by the type of the basionym' (Article 7) and that "a name is illegitimate and is to be rejected if it was nomenclaturally superfluous when published, i.e. if the taxon to which it was applied as circumscribed by its author, included the type of a name or epithet which ought to have been adopted under the rules." (Article 63). Accordingly, the leaves of this form are here included under a new name, *Cheirophyllum* gen. nov.

**Description, Comparison & Discussion** — In spite of the fact that the lectotype and other specimens of *Noeggerathiopsis lacerata* in Feistmantel’s type collection, kept in the G.S.I. Museum, do not show any well-preserved carbon, the newly found structurally preserved duplicates described in this paper are referred to the same species since their size and external form are identical to those of the type material.

The diagnosis is based on a first hand study of Feistmantel’s type material from South Rewah Gondwana basin (kept in the Museum of the Geological Survey of India, Calcutta), as well as Maithy’s duplicate material from Srirampur Colliery, Giridih Coalfield (kept in Birbal Sahni Institute of Palaeobotany, Lucknow) and our own duplicates from Passerabhia in the same coalfield (kept in the Botany Department, Allahabad University). The diagnosis also takes into account the description and figures given by Feistmantel (1886) and Maithy (1965).

The external features of the numerous specimens described from different localities, all of Karharbari Stage, are identical. Indeed, fossil leaves of this kind are so far not reported from any other stage of Gondwanas. Accordingly, *Cheirophyllum* could be regarded as a reliable index fossil out of the numerous other fossils which are found in beds of this age, e.g. *Noeggerathiopsis*, *Ganagamopteris*, *Glossopteris*, *Botrychiptosis*, *Phyllotheca*, *Buradia*, *Ottokaria*, *Cardiarcus*, *Samaropsis*, *Rubidgea*, *Sphenopteris*, *Schizoneura*, *Arberia*, *Vertebraria* and *Euryphyllum*.

Out of sixteen leaves in our collection only nine are nearly complete and the
counterpart of one of these complete specimens is also available. Wherever the leaf base is complete it is transversely truncated and seems to have been cut off by the formation of a clean abscission layer (Text-fig. 1 D, E; Pl. 1, fig. 5). In the remaining specimens the basal part is more or less broken. Seven specimens show clearly marked median ridges and another six show well-marked median grooves. This feature could, therefore, be due to one side of the leaf being grooved.

One of the two cuticles in the leaves (Pl. 2, fig. 12) is slightly thicker (4 \( \mu \)m) and paucistomatic (Text-fig. 2 A, C-H; Pl. 2, figs. 10, 11, 13) while the other is thinner (about 3 \( \mu \)m) and multistomatic (Text-fig. 2 B, I-K; Pl. 2, figs. 14-16). We, therefore, presume that the paucistomatic surface of the leaves was held upwards or kept more exposed by the plants.

The cuticles show clearly marked cell outlines. The anticlinal walls appear minutely dentate (Text-fig. 2 I-K) due to presence of pits and the surface of the cuticle shows a fine mottling caused by impressions of light coloured oval pits (Text-fig. 2E). Stomatal pores are clear but vague indications of the outlines of guard cells were also seen in some stomata. Otherwise the stomata show only the hyaline stomatal pit bounded by subsidiary cell walls. The irregular arrangement of subsidiary cells in some stomata and the occurrence of thinner partition walls in some stomatal subsidiaries may suggest that the cells which surrounded the guard cell mother cells were perigene and the regular rings of subsidiaries were perhaps formed by subsequent divisions in the perigene cells (Text-fig. 2 C, D; Pl. 2, fig. 11).

Between the ordinary epidermal cells on the paucistomatic surface are scattered a few dark or ordinary short cells, each of which is surrounded by a ring of cells which resembles the subsidiaries around a stoma (Text-fig. 2F, G; Pl. 2, fig. 10). The darker patches or short cells could, therefore, represent abortive or arrested stomata (see Pant, 1965), or hair bases although we could not find any hair over the leaves or the adjacent rock matrix.

A few disaccate Sritiatites type of pollen grains were found sticking to the paucistomatic cuticle of the leaves.

A comparison of Cheirophyllum with leaves of Noeggerathiopsis (to which they were previously assigned) and Cordaites shows that even though these leaves are clearly different from Cheirophyllum in being entire, their epidermal cells are arranged in similar stomatiforous and non-stomatiforous areas. All the same, the stomata in the leaves of Noeggerathiopsis and Cordaites have well-differentiated polar and lateral subsidiaries but in the stomata of Cheirophyllum the polars are not distinct from the laterals. A distinction of lesser importance pertains to the cells of the upper cuticle of Noeggerathiopsis and Cordaites being as a rule non-papillate whereas those of Cheirophyllum are typically papillate.

The multilobed character of Cheirophyllum leaves may be compared with that of some fossil Ginkgoales like Sphenobateria (Harris & Millington, 1974), Baiera (Harris & Millington, 1974); and Ginkgoites (Seward, 1919). multifid leaves of a presumed conifer, Buriadia (Seward & Sahni, 1920; Pant & Nautiyal, 1967) and such unassigned genera of presumed coniferophytes like Dicho­phyllum (Elias, 1936; Andrews, 1941) Dicranophyllum (Grand Eury, 1877) and Triehopitys (Saporta, 1875). However, the details of Cheirophyllum differ from those of all these leaves. Wherever known their epidermal structure too is different. The flattened leaf of Cheirophyllum has a clearly abscissed undissected base which is almost as long as the apical lobed part. The leaf shows a dorsal and a ventral cuticle right up to the tips of the lobes. The lobes are multiveined, rather regular and almost equally incised and their tapering apices are bluntly pointed. In contrast, lobed leaves of Ginkgo and Ginkgoites differ from those of Cheirophyllum in having a distinct petiole and a wedge-shaped lamina which may show deeply incised flat blunt lobes. Sphenobateria and Baiera too differ from Cheirophyllum in having irregularly dichotomised lamina often with unequal lobes. The flattened multifid leaves of Buriadia are narrower, cuneate and their univeined short segments may be equally or unequally incised. Attached leaves of Dicho­phyllum appear to arise from "axes" which could even be lower portions of much divided fronds which show more or less equal dichotomies ending in slender deeply cut
linear segments. The bases of the much narrower leaves of Dicranophyllum are decurrent and their apices show deeply divided lobes. The leaves of Trichopitys are described as being terete and as a rule they dichotomise repeatedly.

Cheirophyllum would thus appear to be an isolated kinless relic having no recognisable allies and since the other parts of the plant which bore these leaves are so far unknown, we are presently unable to determine even the broad group to which it belongs.

**SUMMARY**

Leaves described earlier as Noeggerathiopsis lacerata (Feistmantel, 1886) and some specimens called Palmatophyllites (Maithy, 1965) and a number of identical newly collected duplicates from the Lower Gondwana beds of Karharbari Stage in the Giridih Coalfield are referred to *Cheirophyllum lacerata* (Feistmantel) n. comb. It is pointed out that the lobed leaves of this kind cannot be referred to a genus of undivided spatulate leaves Noeggerathiopsis and that the name Palmatophyllites lacerata is illegitimate. The resistant cuticle of the newly collected duplicates is described and it suggests that these leaves may belong to the gymnosperms. However, a comparison of Cheirophyllum with other forms with similar looking leaves, e.g. Sphenobotara, Batera, Ginkgoites, Buriadia, Dicaphyllum, Dicranophyllum and Trichopitys suggests that the genus is clearly different and at present unclassifiable.

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**REFERENCES**


PLATE 1

*Cheirophyllum lacerata*

1-6. Wide and narrow leaves. The apical part of leaf in fig. 5 is complete and its base with a single median groove is truncated. Figs. 1 and 6 have two or more median grooves while figs. 2, 3, and 4 show median ridges. Figs. 1 to 6, respectively, specimen nos. 8007. × 2; 8001. × 2; 8003. × 2; 8005. × 1.5; 8008. × 1.5; 5535. × 1.5.

7. A few lobes of leaf in fig. 6 enlarged to show venation. × 12.

PLATE 2

*Cheirophyllum lacerata*

8. Incident light photograph of a leaf. Specimen no. 8000. × 2.

9. Same in oil. × 2.

10. An abortive or arrested stoma from paucistomatic surface. Slide no. 5527a. × 310.

11. An ordinary stoma from paucistomatic surface. Slide no. 5527a. × 325.

12. Both cuticles from lobe apex. Slide no. 5527a. × 34.


14. Cuticle from multistomatic surface showing stomatiferous and non-stomatiferous bands. Slide no. 5527a. × 130.

15. 16. Stomata from multistomatic surface showing number and arrangement of subsidiary cells. Slide no. 5527 a. × 375.
PLATE 1