SOME SPECIES OF THE GENUS *GLOTTOLEPIS* BOSE & SRIVASTAVA; FROM THE TRIASSIC OF NIDPUR, INDIA

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ABSTRACT

Certain observations on *Glottolepis rugosa* Bose & Srivastava, regarding the morphography of veins and the distributional pattern of stomata, have been made. Four new species of the genus *Glottolepis* have been instituted on the basis of their external and epidermal features. Amongst the new species, in the texture, *G. glabrosa* is smooth and *G. tuberculata* has prominent tubercles but *G. sidhiensis* and *G. ovata* are uneven. Further, in broadly ovate form and shape, *G. ovata* is quite different from others. In their epidermal characters, *G. glabrosa* is having usually smooth periclinal walls, whereas *G. tuberculata* possesses diffused papillae on both the surfaces but in *G. sidhiensis papillae* are confined only to anticlinal walls while in *G. ovata* almost the entire cell surface bears fine striations inclusive of subsidiary cells.

INTRODUCTION

NEXT to *Dicroidium*, the scale-leaf genus *Glottolepis* appears to be quite frequent in the Triassic Shale of Nidpur. Mostly these are seen in detached form but sometimes forming spirally arranged groups attached to a thick axis. After studying more than two dozen specimens from the fresh collections, most of them have been found belonging to the type species *Glottolepis rugosa* (Bose & Srivastava, 1970). A few specimens of *G. rugosa* have also revealed distinct venation consisting of irregular meshes of varying size and shape. Furthermore, a few specimens which look like scale-leaf, have shown salient features of the genus *Glottolepis* but these are quite distinct from the type species *G. rugosa*. Henceforth, these specimens have been ascribed to four new species: *G. glabrosa*, *G. tuberculata*, *G. sidhiensis* and *G. ovata*. All of them have been differentiated from one another, chiefly in their texture and epidermal characters.

DESCRIPTION

Genus — *Glottolepis* Bose & Srivastava, 1970

Glottolepis rugosa Bose & Srivastava

Pl. 1, fig. 1; Text-figs. 1 A-B, E-H

On the upper surface thick veins are anastomosing variously and forming irregular meshes of varying size and shape all over the surface. In the basal part meshes are long and broad at the emergence but gradually becoming shorter towards the margin. In median region lamina consists of unusually thickened veins, and short and broader meshes. Sometimes meshes are squarish or rectangular. In apical region, veins are arising slightly at an angle, forming short some-what oblique polygonal meshes, thereafter arching and frequently dichotomizing to form elongated polygonal meshes up to the margin.

Usually longitudinally orientated stomata are distributed all over the lower surface more often in interveinal region but mostly concentrated at base and apex. In median region, generally stomata are distantly distributed. Stomata are rare along the margin.

Remarks — From new collection three specimens belonging to *G. rugosa* type have revealed distinct anastomosing veins. Out of these the two specimens, although imperfect, have shown clear anastomosing in their basal and apical regions. In this way, venation pattern on the entire surface of the scale-leaf could be assessed. In some specimens where upper and lower surface are well preserved, distinct meshes have even been observed after maceration.

For determining the definite distribution of stomata, whole mount preparations were made. In these preparations both the surfaces were found well preserved, and thus stomata could easily be marked in various parts. In one of the whole mount preparations, a few stomata could also be located at the extreme of apex on the upper surface.

Comparison — In general appearance, the venation of *G. rugosa* seems to be of glossopteroid type but it is distinct from other scale-leaves known from Lower Gondwana in having irregular meshes. In Palaeozoic forms the veins forming meshes are usually arising from basal part and afterwards dichotomizing and diverging up to

TEXT-FIG. 1 — A, *Glottolepis rugosa*, upper part of scale-leaf enlarged to show venation; No. 35196 × 6. B, *G. rugosa*, showing mesh forms in apical region; No. 35201 × 8. C, *G. glabrosa* sp. nov., showing anastomosing veins on the entire surface; No. 35198 × 2. D, *G. tuberculata* sp. nov., showing tubercles on the entire surface from base to apex; Holotype no. 35197 × 2. E, *G. rugosa*, macerated specimens, showing dichotomising veins forming irregular meshes on both upper and lower surfaces respectively; Slide nos. 35202-1 & 2 (E-F) × 2; 35203-1 & 2(G-H) × 2.

apex. (Seward & Sahni, 1930; Walkom, 1922).

Glottolepis glabrosa sp. nov.

Pl. 1, figs 3-5, 8; Pl. 2, figs. 13, 15
Text-figs. 1C, 2B, 3E-F

Diagnosis — Detached scale-leaf measuring 3·2 × 2·5 cm in size, ovoid-shaped, margin entire, apex more or less emarginate, surface glabrous; venation consisting of short polygonal meshes at base, running at right angle up to the margin, slightly longer and broader along the margin, irregular anastomosing frequent in median part, forming narrow and rectangular meshes, at apex meshes generally polygonal.

Scale-leaf hypostomatic, upper surface 2·5 μ thick, non-stomatiferous, cells rectangular or polygonal, longer than broad, serially arranged, anticlinal walls straight, periclinal wall smooth; lower side slightly thinner, about 1 μ in thickness, cells short, rectangular or polygonal, anticlinal walls straight, periclinal wall smooth or thickened usually bearing narrow thin strips running in longitudinal, transverse or in irregular direction; on the entire surface distinct, rounded or thinly cutinized polygonal area present intermingled with sparsely distributed stomata having irregular orientation; subsidiary cells 5 or 6 rarely 7 in number, radially divided, dicyclic, specialized, surface-wall occasionally striped or thickened; guard cells thinly cutinized, stomatal pit rounded or oval.

Holotype — No. 35198 of the B. S. I. P., Lucknow.

Locality — Nidpur, Sidhi District, M. P., India.

Age — ?Lower-Middle Triassic.

Remarks — Out of many *Glottolepis*-type of scale-leaves only one specimen of *G. glabrosa* could be recovered. Its cuticle is quite brittle because of which preparations from basal, median and apical regions were made separately and thus the distribution of stomata could be ascertained as a whole.

Comparison — Externally, *G. glabrosa* contrasts from *G. rugosa* in its shape and smooth texture of lamina because the later species is tongue-shaped and has rough surface. In venation both the species anastomose frequently but in the former species shape of the meshes are defined whereas in the later, veins are thick and meshes are variable in size and shape looking irregular in appearance.

In their cuticle, *G. glabrosa* is thinner than *G. rugosa*. In the striped and thickened cell surface wall, both resemble each other but the presence of strips is frequent in the former species whereas in the later, occasional presence of strips has been marked. Also in both the species cutinized oval or rounded area is present except that in *G. rugosa*, these are concentrated at base and apex whereas in *G. glabrosa* occurrence of this feature is uniform on the entire surface. In their subsidiary cells, *G. glabrosa* differs from *G. rugosa* in having lesser number while in the later, number is much higher. In the former one, subsidiary cells are radially divided and smooth except for the occasional presence of strips, whereas in the later subsidiary cells are papillate or having less developed papillae projecting towards stomatal pit.

Glottolepis tuberculata sp. nov.

Pl. 1, figs. 2, 7, 9; Text-figs. 1D, 2A

Diagnosis — Scale-leaf tongue-shaped, 3·5 × 1·9 cm in size, base truncate, both ends notched, apex obtuse or somewhat rounded, tubercles present on the surface, margin entire or slightly wavy; cuticle 2·5 μ; hypostomatic, upper surface 1 μ thick, cells rectangular or squarish usually polygonal more or less serially arranged, anticlinal walls straight, periclinal wall uneven, irregular cutinized thickening leading towards the formation of varied-shaped papillae, papillae diffused, hollow or solid rarely smooth; lower surface 2 μ thick, stomatiferous, cells elongated rectangular or polygonal, longer than broad, anticlinal walls straight, periclinal wall papillate, usually papillae diffused sometimes papillae solid or mottled rarely smooth, at times finely striated or associated with a longitudinal strip; more often thinly cutinized area or holes present at apex; longitudinally orientated stomata distantly distributed from base to apex, stomatal apparatus distinguishable from the ordinary cells, subsidiary cells 5-7, rarely 4 forming usually a ring, sometimes outline irregular, surface-wall thickly mottled or with a definite solid,

papillae; guard cells moderately cutinized, sunken, encircling cells commonly present and specialized, mostly with smooth or thickened surface.

Holotype — No. 35197 of B. S. I. P., Lucknow.

Locality — Nidpur, Sidhi District, M. P., India.

Age — ?Lower-Middle Triassic.

Remarks — Out of nearly 50 specimens of the genus *Glottolepis*, only two, could be found quite distinct from others externally as well as on its epidermal characters. *G. tuberculata* shows the successive stages of the development of papillae on both the surfaces. In early stages, it seems after examining the slides that the papillae were quite minute in appearance, looking somewhat like a single dot or knob-like in appearance. These may be seen in the corner near the margin or the median region of the periclinal walls. These minute papillae when diffused, look like crescent-shaped or beaded in structure, sometimes may be hollow or solid. Upper surface is thickly covered with these developing papillae, hardly a few cells could be devoid of it. A few stomata are also met with on the upper side but are restricted at the apex and are similar like those on the lower surface. Longitudinal irregular folds are common on lower surface and the cells bear variously-shaped papillae but smooth or mottled cells have also been observed.

Like other species of *Glottolepis*, *G. tuberculata* does not show the presence of oval or circular cutinized area on the lower surface. But holes of varying size have been marked all over the cell surface.

Comparison — In external morphology, *G. tuberculata* differs from all the species of *Glottolepis* in having tuberculate surface and notched basal ends. Since the venation is obscure, *G. tuberculata* can not be compared with *G. rugosa* and *G. glabrosa*. In epidermal structure *G. tuberculata* bearing papillate upper surface differs from *G. rugosa* and *G. glabrosa*. In all these species of *Glottolepis*, upper surface reveals usually smooth surface of the epidermal cells and as regards the lower surface, *G. tuberculata* resembles *G. rugosa* in orientation of stomata, occasional presence of strips on the cell surface, papillate or thickly mottled subsidiary cells and in nature of guard cells, but the former is readily distinguishable because of its characteristic papillae on the surface wall similar to the upper surface. At base and apex, *G. tuberculata* rarely shows the occurrence of oval or circular cutinized area, which has been a common feature in the other species of *Glottolepis*. As far the distribution of stomata is concerned stomatiferous zones are not distinct in the former species as has been reported in *G. rugosa*. *G. glabrosa* sharply contrasts from *G. tuberculata* in having both the surfaces smooth but all are similar in bearing usually 5 subsidiary cells.

Glottolepis sidhiensis sp. nov.

Pl. 2, figs. 12, 14; Text-figs. 2C, 3C, 3G

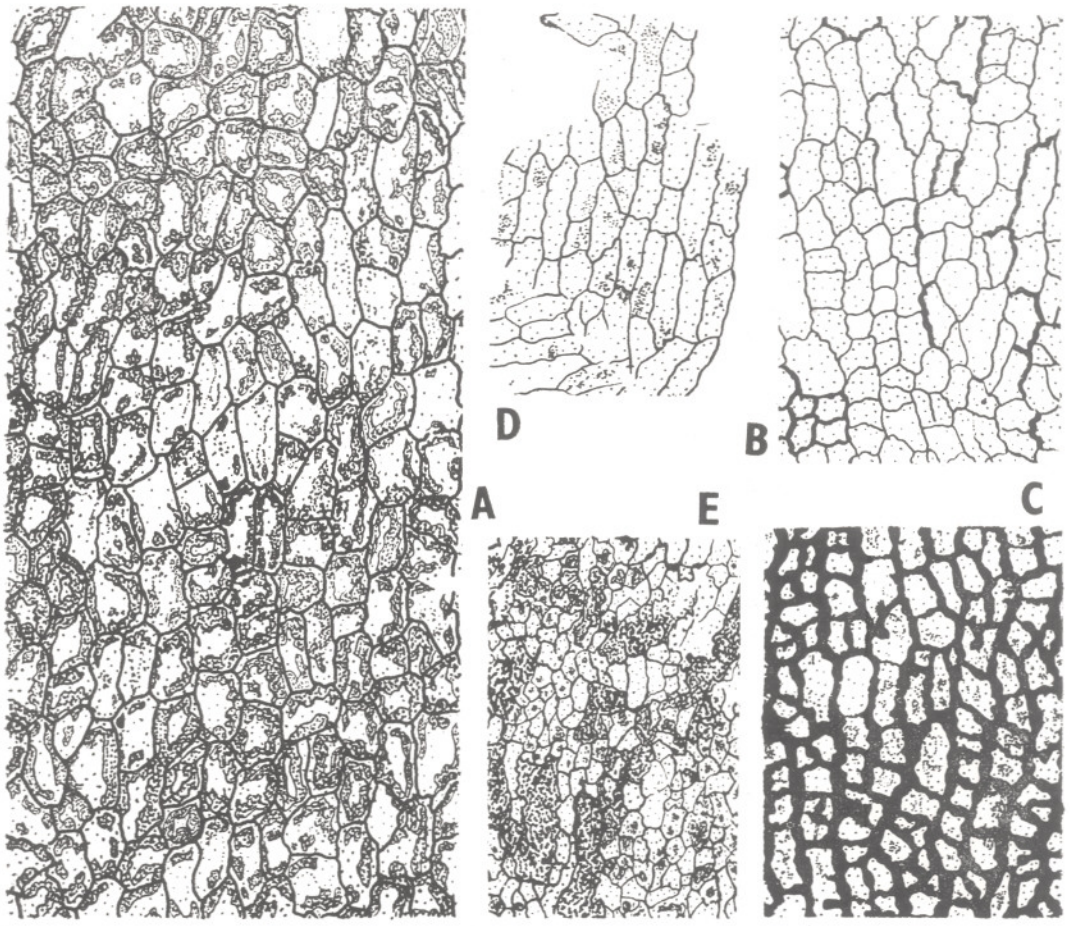
Diagnosis — Scale-leaf tongue-shaped, about 2 cm long and 1·7 cm broad, broken at base, apex obtuse, margin entire, surface uneven; cuticle 3·5 μ thick, upper surface 2·5 μ, cells rectangular, squarish or polygonal, anticlinal walls generally straight at places undulated, periclinal wall smooth; lower surface 2·5 μ, stomatiferous zones distinct, stomata longitudinally orientated, epidermal cells along the stomatiferous zones slightly thickened comparable to the cells over the non-stomatiferous zones, anticlinal walls papillate mostly papillae solid at times papillae, emerging like a protuberance from lateral and end-walls expanding up to surface-walls, anticlinal walls over the non-stomatiferous zone usually papillate, sometimes devoid of papillae, periclinal wall commonly smooth; subsidiary cells 5 or 6 mostly smooth, anticlinal-walls papillate, scantily papillae present on inner wall of subsidiary cells, encircling cells commonly present, stomatal apparatus rounded in outline, guard cells cutinized, rectangular in shape, sometimes not preserved.

Holotype — No. 35200 of B. S. I. P., Lucknow.

Locality — Nidpur, Sidhi District, M. P., India.

Age — ?Lower-Middle Triassic.

Remarks — *G. sidhiensis* sp. nov., although represented by one imperfect specimen, yet has been assigned to a new species because of its characteristic features. Both the surfaces are well preserved and the



TEXT-FIG. 2 — A, *Glottolepis tuberculata* sp. nov., showing diffused and variously-shaped papillae on the upper surface. Slide no. 35197-1 × 100. B, *G. glabrosa* sp. nov.; upper epidermal cells. Slide no. 35198-2 × 100. C, *G. sidhiensis* sp. nov., cells from upper side showing undulated or hemispherical anticlinal walls. Slide no. 35200-1 × 100. D, *G. ovata* sp. nov., epidermal cells from upper side. Slide no. 35199-1 × 100. E, *G. ovata*, lower surface cells at base, showing longitudinal irregular folds associated with slightly mottled cells. Slide no. 35199-2 × 60.

scale-leaf is of hypostomatic nature, but a single stomata on upper surface has been marked towards the apex where subsidiary cells are partially concealed with elongated and diffused papillae, present on its anticlinal walls projecting towards the pit. Frequent occurrence of cutinized oval or other cells on lower side have been seen. They are not easily distinguishable from other epidermal cells. At places only a part of surface wall has been found cutinized and some times such cutinized areas have got a definite shape with elliptical holes, which can not be differentiated from other cells. Papillae on the anticlinal walls look very closely placed in the marginal region and at places projecting out across the margin.

Comparison — Glottolepis sidhiensis sp. nov. strikingly differs from all the species of *Glottolepis* in bearing papillae on its anticlinal walls. In its smooth surface wall of subsidiary cells, *G. sidhiensis* is distinct from *G. rugosa* and *G. tuberculata*. *G. sidhiensis* can be differentiated from *G. glabrosa* in presence of papillae.

Glottolepis ovata sp. nov.

Pl. 1, fig. 6; Pl. 2, figs. 10, 11; Text-figs. 2D-E; 3A-B, D

Diagnosis — Scale-leaf broadly ovate in shape, measures about 5·5×3·2 cm in size, terminal part rounded, margin entire, surface rough bearing minute longitudinal wrinklings arising from basal portion, running irregularly in upward direction; slightly less broader at base than apex; cuticle hypostomatic, upper surface 2·5 μ, brittle, cells rectangular or polygonal, longer than broad, anticlinal walls straight, occasionally end-walls oblique, surface wall smooth; lower surface 3·5 μ thick, cells rectangular or elongated polygonal, anticlinal walls usually beaded or knotted generally from median region up to apex, sometimes more or less straight, anticlinal walls at their corner of end-walls having varied-shaped irregular cutinized thickening, at places such cutinized structure extending up to lateral walls, sometimes end walls showing hemispherical thickening, periclinal walls usually thickened or mottled at base more or less pitted, pits of irregular size present, periclinal wall striated, striations minute, running in transverse or longitudinal direction sometimes irregularly placed; cells along the non-stomatiferous zones rectangular somewhat narrower, polygonal or rounded and slightly shorter in size, periclinal walls commonly striated, at places thickened; stomata distantly distributed, more concentrated in upper half region, afterwards gradually reducing, and at base scarcely visible or even absent, stomata usually longitudinally orientated, sometimes in transverse or oblique direction; stomatal apparatus elongated oval in shape, consisting of 5-8 subsidiary cells, commonly 6 rarely 5 or 8 often radially divided, surface wall transversely or longitudinally striated, sometimes strong cutinized thickening almost concealing subsidiary cells and stomatal pit, stomatal pit dumble-shaped or rhomboidal, guard-cells strongly cutinized, aperture thin elliptical or slit-like, encircling cells commonly present, asymmetrically striated.

Holotype — No. 35199 of B. S. I. P., Lucknow.

Locality — Nidpur, Sidhi District, M. P., India.

Age — ?Lower-Middle Triassic.

Remarks — Among the scale-leaves, one specimen has shown characteristic features externally as well as on cuticular grounds. Presence of longitudinal irregular wrinklings on the surface of scale-leaf is represented in the form of folds on cuticle. Sometimes these folds are quite thickened and are traversing in haphazard manner. At places, where such folds are prominent, cells along the non-stomatiferous zone are indistinct. Generally non-stomatiferous zones are quite distinct in upper half part of scale-leaf where stomata are commonly met with. As regards the unusual cutinized thickening of anticlinal walls, that too is less common at base but are observed more frequently in terminal half part of lamina. These cutinized structures are looking more or less star-shaped, angular or some what elongated having irregular outline and gradually increases in number towards the apical region and are mostly seen associated with the cells of stomatiferous zone. They have also been observed at places covering the entire periclinal wall. However, it is very interesting to note that such cutinized structures are always situated at the junction of a few cells, and only because of its occurrence the end-walls look at their corners unusually thickened with a greater cutinization. In some places such thickenings are extending along the lateral-walls.

Towards the apical region, particularly, variations have been noticed regarding the orientation of stomata, number of subsidiary

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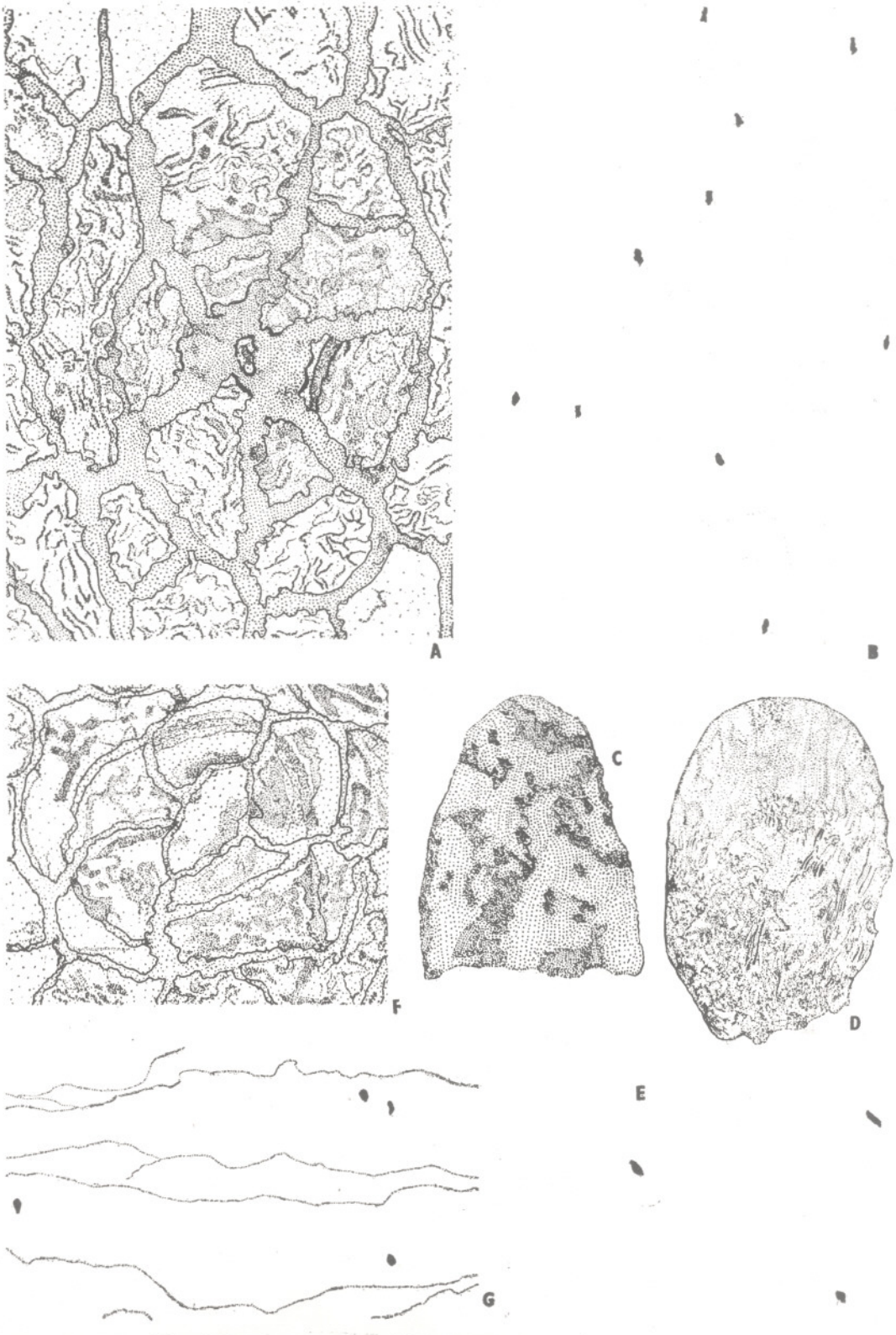
TEXT-FIG. 3 — A, *Glottolepis ovata* sp. nov., an elongated oval stomatal apparatus from lower side, showing irregularly striated subsidiary cells and encircling cells. Slide no. 35199-4 × 500. B, *G. ovata*, lower surface showing stomatal distribution in longitudinal direction. Slide no. 35199-3 × 50. C, *G. sidhiensis* sp. nov.; Holotype no. 35200 × 2. D, *G. ovata*; Holotype no. 35199 × 1. E, *G. glabrosa* sp. nov., lower side showing obliquely orientated stomata. Slide no. 35198-1 × 50. F, *G. glabrosa*, a single obliquely placed stomata with fine irregular striations on subsidiary cells. Slide no. 35198-1 × 500. G, *G. sidhiensis*, showing well marked stomatiferous and non-stomatiferous zones. Slide no. 35200-1 × 30.



TEXT-FIG. 3

cells and the presence of striations on periclinal wall.

Comparison — In its broadly-ovate shape, *G. ovata* differs from all the tongue-shaped forms, viz., *G. rugosa*, *G. tuberculata* and *G. sidhiensis*. From *G. glabrosa*, *G. ovata* resembles up to certain extent in its general shape but the later, in its quite larger size and uneven surface distinguishes itself from the former species. *G. glabrosa* as compared to *G. ovata*, is much smaller in size and bears smooth surface with distinct anastomosing veins. Apart from its larger size, also *G. ovata* contrasts from *G. rugosa*, *G. sidhiensis* and *G. tuberculata* in absence of transverse wrinklings and tubercles on the surface.

In upper surface *G. ovata* is similar to *G. rugosa*, *G. glabrosa* and *G. sidhiensis* in having smooth surface wall of the epidermal cells but, the former species is quite distinct like other species from *G. tuberculata* in the absence of papillae on the upper surface. *G. ovata* shows distinction from other species like *G. rugosa*, *G. tuberculata* and *G. sidhiensis* in presence of striations almost all over the surface except for a few cells at base where the striations are uncommon. In this respect, *G. rugosa* comes closer to *G. ovata* but in the former striations are not a common feature while in the later species, entire surface bears mostly striations including subsidiary cells. *G. tuberculata* may be differentiated in its lower side from *G. ovata* in revealing distinct papillae on periclinal walls. In *G. rugosa* and *G. sidhiensis* stomata are confined to stomatiferous zones whereas in case of *G. ovata*, although stomata are met within the stomatiferous zones yet the zones are not distinct as has been marked in the former two species. In orientation of stomata *G. ovata* shows similarity with other species of *Glottolepis* but in this feature, the former reveals little variations in having at places transversely or obliquely orientated stomata. In *G. ovata* subsidiary cells are always transversely striated and associated with strong cutinization at stomatal pit, but in this character *G. ovata* is distinguishable from *G. rugosa* and *G. tuberculata* in absence of papillae or mottled nature of surface-wall of subsidiary cells. From *G. sidhiensis*, *G. ovata* differs in absence of papillae on anticlinal walls of the cells, whereas *G. glabrosa* contrasts from the later in its smooth surface wall of the cells.

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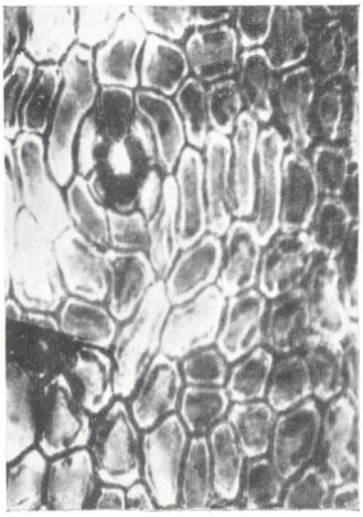
EXPLANATION OF PLATES

Plate 1

1. *Glottolepis rugosa* Bose & Srivastava, specimen enlarged to show venation; No. 35196 × 3.
2. *Glottolepis tuberculata* sp. nov.; Holotype no. 35197 × 1.
3. *Glottolepis glabrosa* sp. nov.; Holotype no. 35198 × 1.
4, 5. Specimen figured in 3, showing venation on entire surface and a part enlarged to show the distinct meshes. No. 35198 × 2, 4 respectively.
6. *Glottolepis ovata* sp. nov.; Holotype no. 35199 × 1.
7. *G. tuberculata*, upper surface showing variously shaped papillae. Slide no. 35197-1 × 150.
8. *G. glabrosa*, lower surface showing two distantly placed stomata intermingled with cutinized oval-circular structure. Slide no. 35198-1 × 150.
9. *G. tuberculata*, lower surface showing a stomata and variously-shaped papillae similar to upper surface. Slide no. 35197-1 × 150.

Plate 2

10. *Glottolepis ovata* sp. nov., lower surface, showing a few stomata and unusual thickening along the anticlinal walls. Slide no. 35199-3 × 150.
11. *G. ovata*, a complete stomatal apparatus bearing striations on the surface wall of subsidiary cells and encircling cells. Slide no. 35199-3 × 500.
12. *Glottolepis sidhiensis* sp. nov., two closely placed stomata on the lower surface. Slide no. 35200-1 × 150.
13. *Glottolepis glabrosa* sp. nov., a single stomata on lower side. Slide no. 35198-1 × 500.
14. *G. sidhiensis*, epidermal cells along the veins and interveinal region showing papillate anticlinal-walls. Slide no. 35200-1 × 100.
15. *G. glabrosa*, epidermal cells from upper surface showing slightly thickened cells in interveinal region. Slide no. 35198-2 × 100.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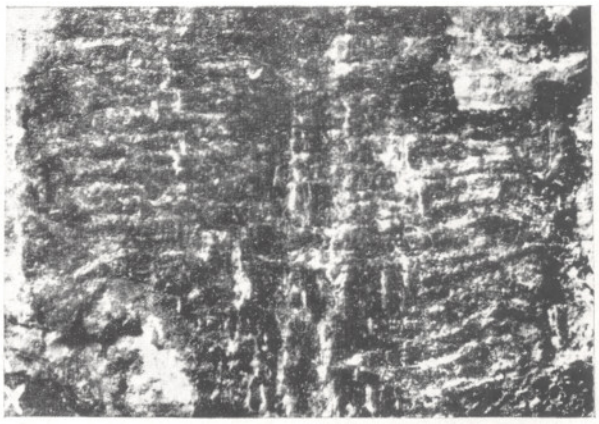
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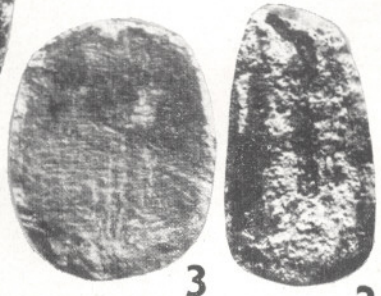
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