

# WALKOMIELLA INDICA, A NEW CONIFER FROM THE LOWER GONDWANAS OF INDIA

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## INTRODUCTION

IN his two memoirs of 1928 and 1931, the late Prof. Sahni revised all the known fossil conifers from India. As regards the conifers in the Lower Gondwana formations he wrote, "The Lower Gondwana records are very few and uncertain. The uncertainty as regards affinities makes it unsafe to assert (at least on present evidence) that any conifers existed in India during this period" (1931, p. 108). Sahni (1928) described three forms, *Moranocladus*, *Buriadia* and *Voltzia*—the coniferous nature of which was uncertain—from the Permian and Upper Carboniferous formations. As regards the first the horizon was not certain, and *Voltzia* was too unsatisfactorily preserved to permit a more precise determination. Except for *Buriadia heterophylla* (Sahni, 1928, p. 6; Florin, 1940) Florin doubts whether the two other forms, namely, *Moranocladus* and *Voltzia*, are at all related to coniferales. The form described in this paper is now the second definite conifer from the Lower Gondwanas of India.

*Walkomiella* (1940) is a genus of conifers instituted by Florin from the Australian *Brachyphyllum ? australe* O. Feistmantel, which was found to possess a structure of its own and represented a type of a new genus. He described only one species *Walkomiella australis* (O. Feistmantel) Florin from the Upper Permian of Australia and according to him, *W. australis* is the only conifer hitherto known from that country. The Indian form is the second species of the genus and is confined to the Lower Permian.

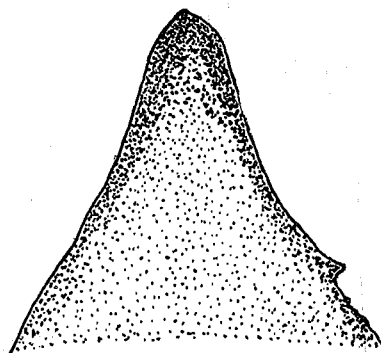
## DESCRIPTION

*Walkomiella indica* sp. nov.

The leaves were isolated from the maceration of coal in bulk from Pindra Seam, located in the West Bokaro Coal fields of Bihar. The coal seam belongs to the Barakar stage of the Lower Gondwanas which is regarded as Lower Permian in age.

Big pieces of coal were treated with concentrated nitric acid and after washing with alkali and water, leaves of *Walkomiella* and some seeds were recovered.

The leaves (Pl. XI, Fig. 1) were brittle and broke easily in handling. They are very tiny, about 4 mm. in length and 2 mm. in breadth, somewhat triangular in face view but the shape could not be ascertained with certainty, bifacial, leathery and squamiform with almost acuminate tip (Text-Fig. 1). The margins have long and upwardly curved



TEXT-FIG. 1. Apex of the leaf showing somewhat acuminate tip.  $\times 140$ .

hairlike toothlets which extend up to just below the acuminate tip. As regards venation we agree with Dr. Florin that the leaves may have been either uni-nerved or three-nerved. Our material does not permit precise statement.

#### EPIDERMAL STRUCTURE

Stomata are confined to only one surface of the leaf which is probably epistomatic. The stomata are arranged in two bands, broader at the lower end and narrowing towards the apex (Pl. XI, Fig. 2). The stomata are irregularly crowded and orientated longitudinally, obliquely and at right angles to the longitudinal direction of the leaf. Marginal hairs are unicellular and upwardly curved.

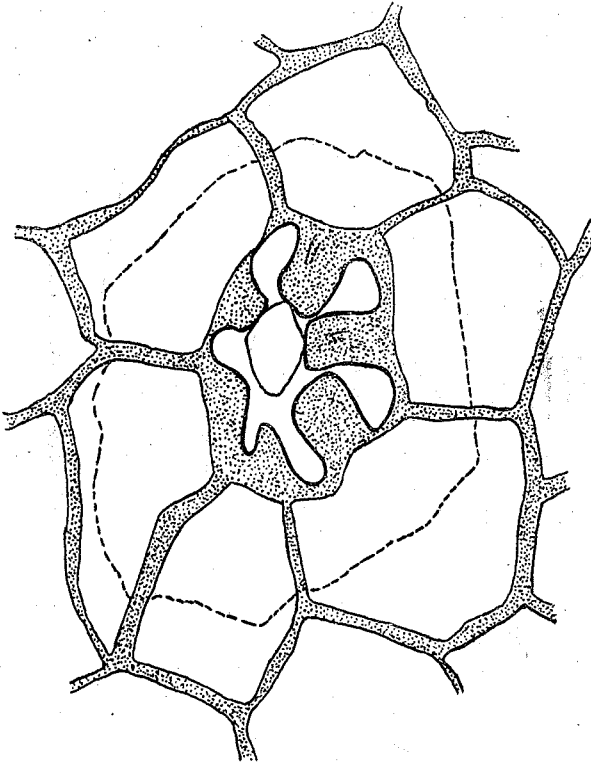
Flanking the two stomatal bands are the non-stomatiferous regions of the upper surface of the leaf. The epidermal cells in this region are thickened, sinuous and longer than broad, but not so much as those of the lower surface (Pl. XI, Figs. 2, 3 and 5). Some of the cells near the stomatiferous bands have cuticular papillæ. So far as can be ascertained no hairs are present.

The epidermal cells in the stomatiferous bands are smaller in size, smooth and angular (Pl. XI, Figs. 4 and 6; Text-Fig. 2). Mostly each cell carries a cuticular papilla.

The non-stomatiferous surface (probably lower) of the leaf is thickly cutinised. The cells are sinuous, much longer than broad and toothed (zig-zag thickenings) (Pl. XI, Fig. 3). They show no hairs or papillæ.

The Stomata (Pl. XI, Fig. 6; Text-Fig. 2) are of the haplocheilic type, monocyclic or incompletely amphicyclic. The number of subsidiary cells varies from 5 to 7. Two subsidiary cells are polar and

the rest lateral. Subsidiary cells have papillæ which project over the stomatal opening. In some smaller stomata they entirely close the



TEXT-FIG. 2. A stoma with six subsidiary cells and papillæ hanging over the stomatal opening.  $\times 1,190$ .

stomatal openings. We have not been able to observe any common subsidiary cells between the two neighbouring stomatal apparatuses.

*Diagnosis.*—Leaves tiny, bifacial, firm, leathery somewhat acuminate at the tip and with unicellular toothlike hairs at the margins; stomata present only on one surface of the leaf and in two papillate bands with irregularly arranged stomatal apparatus oriented longitudinally, obliquely and at right angles to the longitudinal direction of the leaf; subsidiary cells 5-7, each cell having cuticular papilla projecting over the stomatal opening; cuticular papillæ also spread over the straight-walled epidermal cells of the stomatal bands and a few sinuous cells lying outside the bands; cells of the non-stomatiferous surface of the leaf are sinuous, toothed and without hairs or cuticular papillæ.

## DISCUSSION

Since Florin (1940) regarded the systematic position of *Voltzia* as quite uncertain, *Buriadia heterophylla* remained the only plant related to the conifers from the Lower Gondwanas of India. *Walkomiella indica* is now added as a new conifer from these strata.

Florin (1940, pp. 14-15) has already compared *Walkomiella* with *Buriadia* and *Voltzia* and stated that no conifer resembling *Walkomiella australis* has been found in the flora of the Lower Gondwanas of India.

*Walkomiella indica* resembles *Walkomiella australis* in being probably epistomatic, with densely and irregularly orientated stomata in two definite bands; straight and smooth-walled epidermal cells in the stomatal bands, but sinuous and toothed in non-stomatiferous areas on the upper as well as the lower surface of the leaf. In both species the leaves are bifacial, squamiform and leathery.

*Walkomiella indica*, however differs from the Australian species in more than one respect, *Walkomiella australis* is confined to the Upper Permian, while *W. indica* is found in the Barakars of the Lower Gondwanas which are regarded as Lower Permian in age. The number of subsidiary cells in *W. australis* is 5-9, whereas in *W. indica* it is 5-7. In the latter cuticular papillæ are absent on the non-stomatiferous surface of the leaf but are confined only to the two stomatal bands and occasionally to two or three layers of cells outside the stomatal bands, whereas in *W. australis* cuticular papillæ are spread over the whole upper surface and also scattered over the lower surface of the leaf. So far as can be ascertained, in *W. indica* no common subsidiary cells are found and no hairs are present on any surface of the leaf, except at the margins, where they are unicellular. In *W. australis* common subsidiary cells are found occasionally and hairs are 1-3-celled and are present on the basal parts of the upper surface and the margins of the leaf. These differences in our opinion are of specific value and therefore we have assigned the Indian form to a new species.

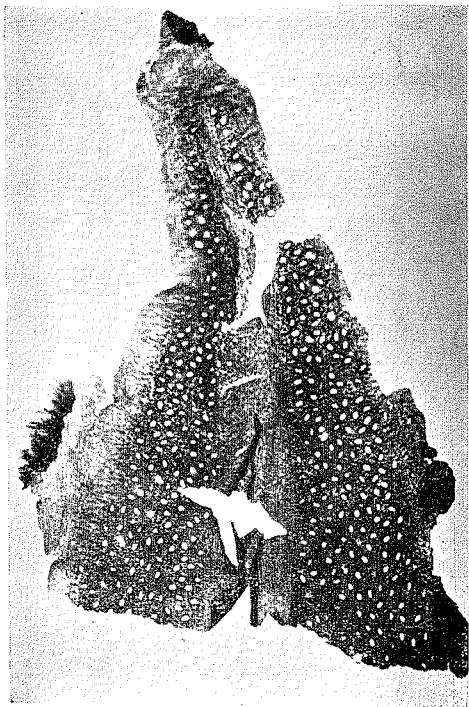
Of the two South American genera *Buriadia* and *Paranocladus*, the latter is confined to the Lower Permian but differs from *Walkomiella australis* in several respects as has been shown by Florin (1940, p. 16). These differences, except for a few mentioned below, hold good for *W. indica* as well. The resemblances between *W. indica* and *Paranocladus Dusenii* are in the absence of hairs from both the surfaces and the absence of cuticular papillæ from the lower surface. In addition both forms are confined to the Lower Permian.

As regards the fossil conifers from the Northern Hemisphere *Walkomiella indica* does not resemble with any of them. Florin has already compared *W. australis* with the conifers of the Northern Hemisphere. The same comparison holds good for the Indian species.

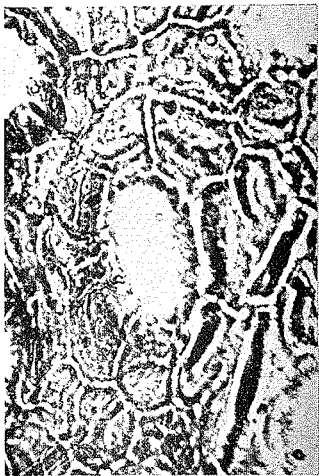
The conclusion, therefore, is that the conifer described here can only be identified with the genus *Walkomiella* instituted by Florin. As it differs in several characters, which we think are of specific value, from the only other known species of the genus, *Walkomiella australis*, we have assigned our form to a new species.



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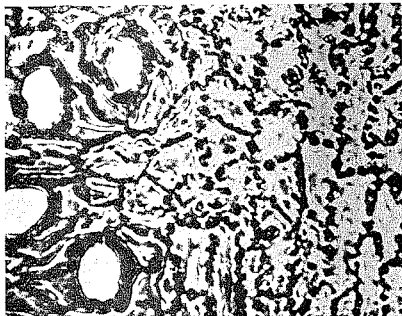
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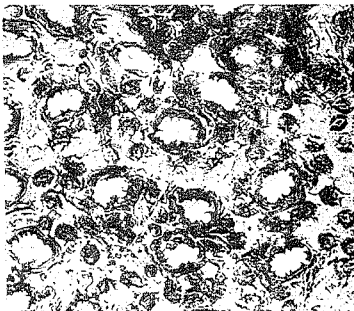
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We wish to express our thanks to Dr. Florin, Stockholm, for confirming our identification of the conifer described here with the genus *Walkomiella*.

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#### EXPLANATION OF PLATE

- FIG. 1. A leaf of *Walkomiella indica* as recovered from maceration of coal. Hairs are present on the margins.  $\times 17\frac{1}{2}$ .
- FIG. 2. Stomatiferous surface of the leaf showing stomata arranged in two bands.  $\times 25\frac{1}{2}$ .
- FIG. 3. Unicelled marginal hairs and epidermal cells of the non-stomatiferous surface of the leaf showing zigzag thickenings.  $\times 230$ .
- FIG. 4. Overmacerated portion of the stomatal band showing stomata and cuticular papillæ in the epidermal cells of the stomatal band.  $\times 160$ .
- FIG. 5. Shows the straight walled cells in the stomatal band and sinuous cells outside the band.  $\times 230$ .
- FIG. 6. A stoma magnified to show the subsidiary cells. The papillæ have disappeared in overmaceration.  $\times 550$ .