THE FEMALE DWARF SHOOT OF *WALKOMIELLA INDICA* — A CONIFER FROM THE LOWER GONDWANAS OF INDIA

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INTRODUCTION

IN our previous paper (SURANGE & PREM SINGH, 1951) we described foliage leaves of a new species of *Walkomiella* under the name *W. indica* from the Lower Gondwanas of India. In 1940 Florin had established the genus from Australian material and described its vegetative shoots under the name *Walkomiella australis* (O. Feistm.) Florin (SELLING, 1948). No reproduction parts of this conifer were known and its systematic position, therefore, could not be determined.

When we were macerating in bulk the coal from the Pindra seam, from which foliage leaves of *Walkomiella indica* were obtained, we recovered a number of detached seeds, a few seeds still attached to small shoots and some shoots without seeds. On close examination the seed-bearing shoots were found to possess similar characters as those of *Walkomiella indica*. These were the dwarf shoots or the female flowers of this plant (SURANGE & PREM SINGH, 1952).

We still do not know anything about the cones of *W. indica*. We have obtained our fertile material from maceration of coal and, therefore, it is unavoidable that it is fragmentary and incomplete. Even then it does throw some light on the morphology of the female reproductive organs and the systematic position of *Walkomiella*. We have, therefore, thought it better to describe these female flowers, pending the discovery of better material.

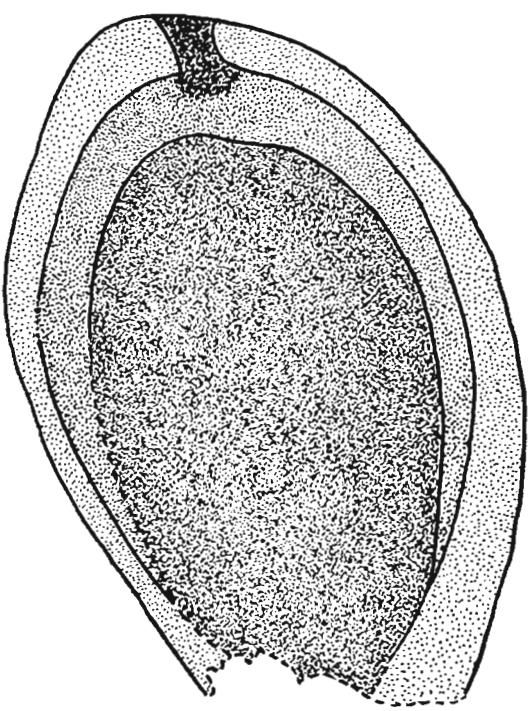
DESCRIPTION

FERTILE DWARF SHOOT

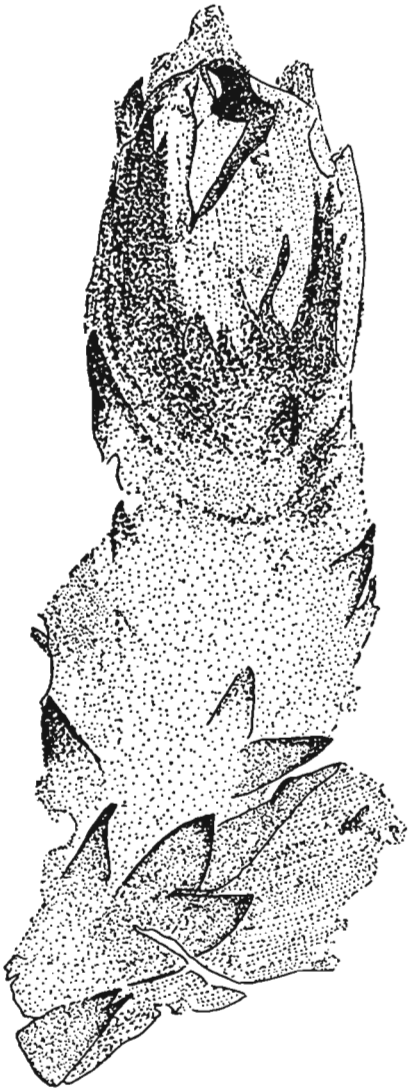
Text-fig. 2

Pl. 1, Fig. 1, shows a radially symmetrical fertile dwarf shoot or a female " flower " of *Walkomiella indica*, carrying several sterile scale and a single erect ovule. The shoot measures about 6·5 mm. in length. All the fertile dwarf shoots we have obtained are pressed flat, brittle and, therefore, could not be dissected out for detailed observations.

The axis of the shoot bears a number of sterile scale leaves arranged in simple spiral. In some shoots the scale leaves on the axis reach a little higher up than the micropyle of the seed and the seed itself does not seem to occupy exactly the centre of the shoot. Perhaps the seed and the scale leaves are inserted along a simple spiral on the axis. The bract in the axil of which the dwarf shoot or the " flower " must have been situated is lost, because perhaps being decurrent on the axis it was more firmly attached to it than the axis of the " flower ".



TEXT-FIG. 1 — An ovule showing the integument, nucellus with micropyle and the megaspore. ×42½.



TEXT-FIG. 2 — A female " flower ". × 22½.

The scale leaves have sheathing bases and in some shoots have covered the ovule completely.

The scale leaves are either slender and much longer than broad or they are somewhat broadly triangular (PL. 1, FIG. 2). Their cuticular structure is less well preserved than that of the foliage leaves. Also it was not possible to make the scale leaves entirely free from each other to show more clearly the structure of the upper and under side. Nevertheless, it is possible to state that the cuticle of the scale leaves closely corresponds in general characters to that of the foliage leaves.

The scale leaves do not have much long hairs at the margins as the foliage leaves, but they are furnished with short hair-like epidermal outgrowths (PL. 1, FIG. 2). The scale leaves are epistomatic, but whether the stomata are arranged in two bands, as is the case in foliage leaves, could not be determined with certainty. The cells in the stomatal region are smaller in size, quadrangular and with straight walls. Each cell carries a cuticular papilla (PL. 1, FIG. 4). The cells of the non-stomatal region are non-papillate, much longer than broad and their anti-clinal walls often show traces of being slightly sinuous and toothed.

In some dissected shoots stomata are closely visible. Each stoma carries seven papillate subsidiary cells. Probably owing to the state of preservation the pipillae do not stand out as clearly as in the foliage leaves. Guard cells could not be observed, perhaps because they are more sunk.

The epidermal characters mentioned above are those of *Walkomiella indica* (cf. SURANGE & PREM SINGH, 1951). Coupled with this is the fact that the same coal which yielded foliage leaves of *W. indica* have also yielded the seed-bearing shoots. We have, therefore, no doubt in assigning these dwarf shoots to *W. indica*.

THE SEED OR OVULE

A number of isolated seeds, which were recovered from the maceration of the coal, have their chalazal end generally torn off. The seed or ovule (PL. 1, FIG. 3) is bilaterally symmetrical, atropous, almost flat due to compression, oval or more long than broad. The size varies from 2 to 2·5 mm. in length and 1 to 1·5 mm. in breadth in the broadest part. Three layers can be distinctly made out as is shown in Fig. 1. The outermost layer represents the integument, which perhaps forms the direct continuation of the megasporophyll. The next layer is that of the nucellus which forms the micropyle at the apex. The innermost layer is that of the megaspore.

The integument is single, free and fairly thick. The cells of the integument (PL. 2, FIG. 5) are four to six-sided, straight-walled and more long than broad. The cells in the lower and middle regions measure

ca. 51 × 16 μ, but a little below the apex the cells are broader and sometimes even squarish.

The nucellus is free and entirely enveloped by the integument, but its cuticle is rather thinner. The cells of the nucellus are small, quadrangular or polygonal with straight walls. At the apex the nucellus is drawn out into a micropyle, the cells of which are somewhat smaller and thicker. The neck is distinct and measures *ca.* 224 × 153 μ. The apex of the neck spreads out at the top but never projects beyond the integument. The cells of the nucellus measure *ca.* 38 × 43 μ and those of the neck *ca.* 11 × 14 μ. The size of the nucellus is about 2 × 1·4 mm.

Inside the nucellus is present the megaspore, which can be seen in a number of detached ovules. The megaspore is attached with the nucellus towards the chalazal end, but is free above. The wall of the megaspore is smooth, thin and may show some irregular folds. The size of the megaspore is 1·6 × 0·8 mm.

DISCUSSION

It is unfortunate that *W. indica* has not been found so far in the form of compressions and until now our attempts in that direction were in vain. There is also no record of similar fossil in the works of earlier authors (FEISTMANTEL, 1880-81; SEWARD & SAHNI, 1920; SAHNI, 1928). We have, therefore, to depend on the fragmentary material obtained from the maceration of coal for our knowledge about this interesting conifer.

The question to be decided is whether *Walkomiella* is a conifer or a taxad. It depends on whether *Walkomiella* had cones or only isolated "flowers" in the axil of foliage leaves. From the fragmentary material at our disposal it is not a question easy to decide. It all depends on the interpretation of the "flower", i.e. the position of the ovule or seed. If the seed should have been placed terminally on the axis itself, then *Walkomiella* is no conifer but a taxad.

However, there is an indication that the position of the seed of *Walkomiella* is *lateral* to the axis of the dwarf shoot, and that the seed and the sterile leaves are inserted along a simple spiral on the axis. This is borne out by the facts that there are leaves on the axis reaching a little higher up than the micropyle of the seed itself and secondly the seed does not seem to occupy exactly the centre of the shoot. *Walkomiella*, therefore, has a female "flower", or a seed scale complex, of essentially the same type as in *Lebachia* (FLORIN, 1951). The fact that the flowers have been found detached does not prevent this interpretation. In *Lebachia* as well as in *Ernestiodendron*, as Dr. Florin informs us, detached "flowers" have been found on several occasions.

Thus, it appears that *Walkomiella* perhaps had loosely constructed cones as is the case in earliest conifers. The bract in the axil of which the "flower" was situated has been lost in most instances. Being decurrent on the axis, it was more firmly attached to it than the axis of the flower itself.

We are very grateful to Dr. Florin for confirming our observations and for his helpful suggestions.

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EXPLANATION OF PLATES

PLATE 1

1. Fertile dwarf shoot. × 10.
2. A scale leaf. × 55½.
3. The ovule. × 29½. 4. A stoma. × 1485.

PLATE 2

5. Cells of the integument. × 379.
6. The nucellus. It encloses the megaspore and is drawn out into a micropyle. × 36.
7. Cells of the micropyle. × 375.
8. A portion of surface of the nucellus. × 125.
9. A scale leaf teased out. × 125.


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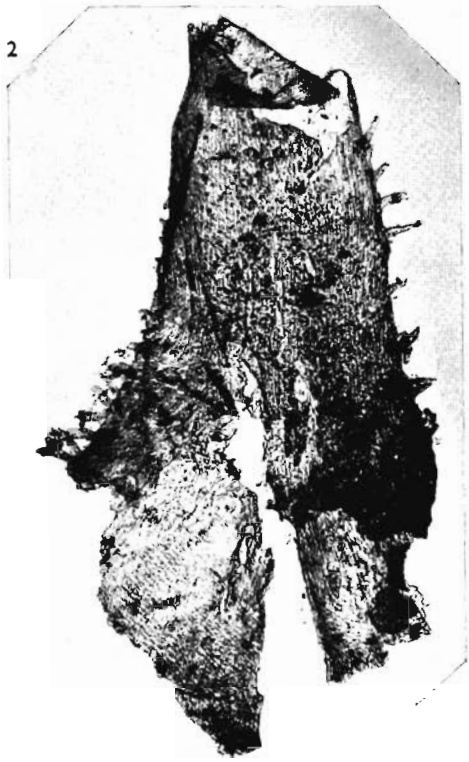
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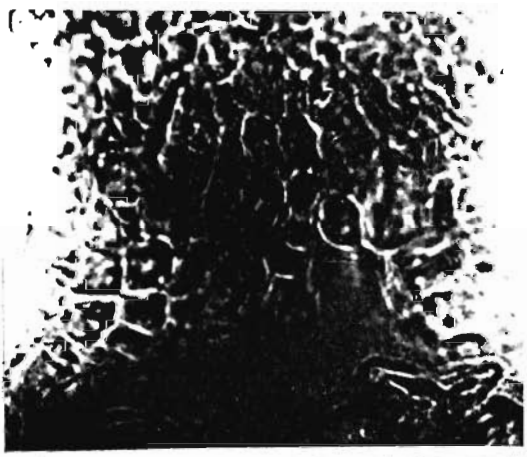
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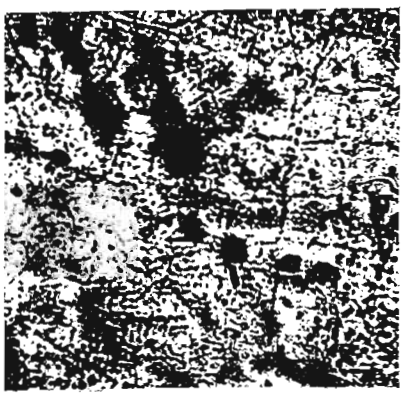
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