developed over a 15 cm stretch of the vine starting about 5 cm from the apex. During the next few days, the haustoria, arising spirally on the vine, enlarged to form conical mounds (Fig. 2) and a marked twisting of the vine was noticed (Fig. 3). Fully developed haustoria were asymmetrically located on the vine much as it would occur at the regions of contact with the host when *Cuscuta* parasitizes in nature. At a lower concentration of 0·1%, benzyladenine or kinetin reduced the growth rate and brought about radial expansion of the stem but induced only papillae-like outgrowths which did not enlarge further.

FIG. 2. Haustorial mounds seven days after BA application. Note absence of haustoria development near the apical region. Scale = 1 cm.

Anatomical observation of the well developed haustorial mound revealed the presence of a central column of radially-elongated cells capped, meristem-like, with numerous small, isodiametric cells having prominent nuclei and dense cytoplasm (Figs. 4 and 5).

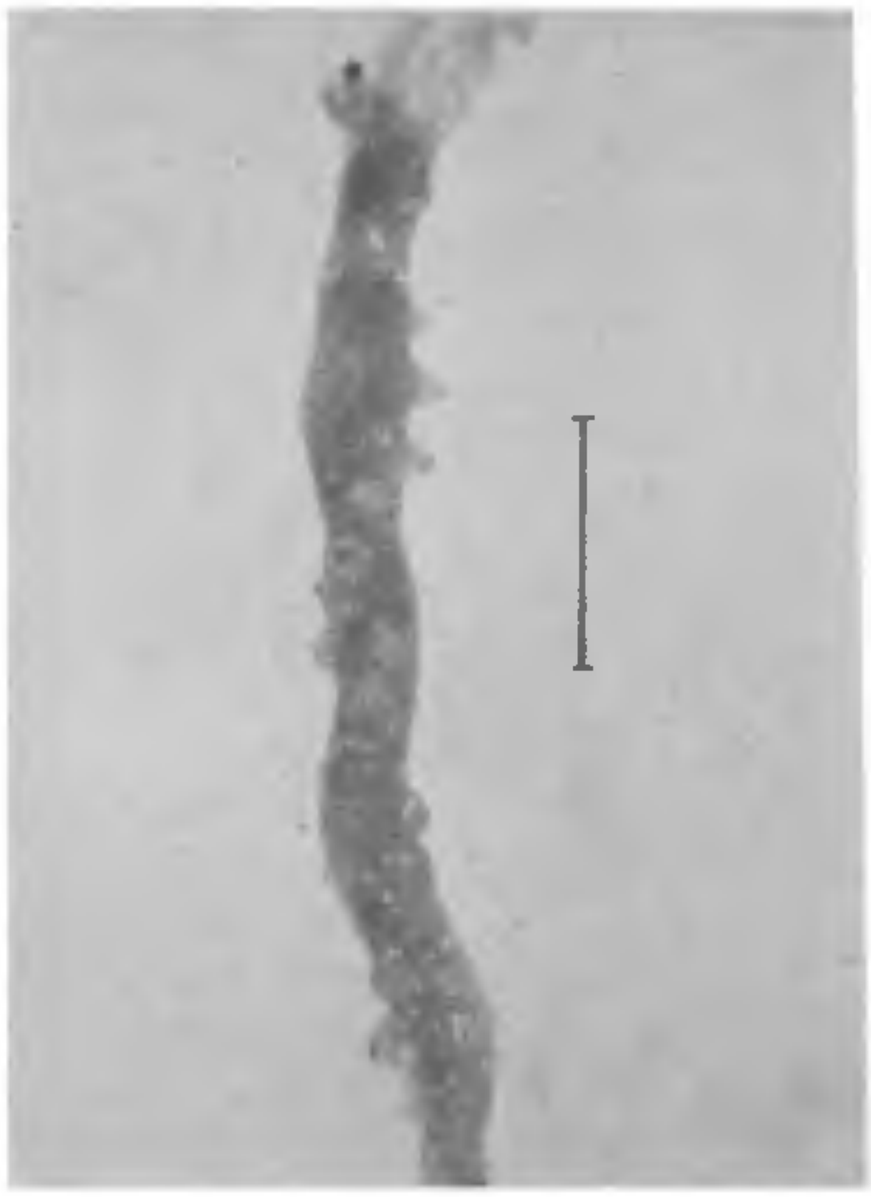

FIG. 3. Spirally arranged haustorial mounds and twisting of vine following BA application. Scale=1 cm.

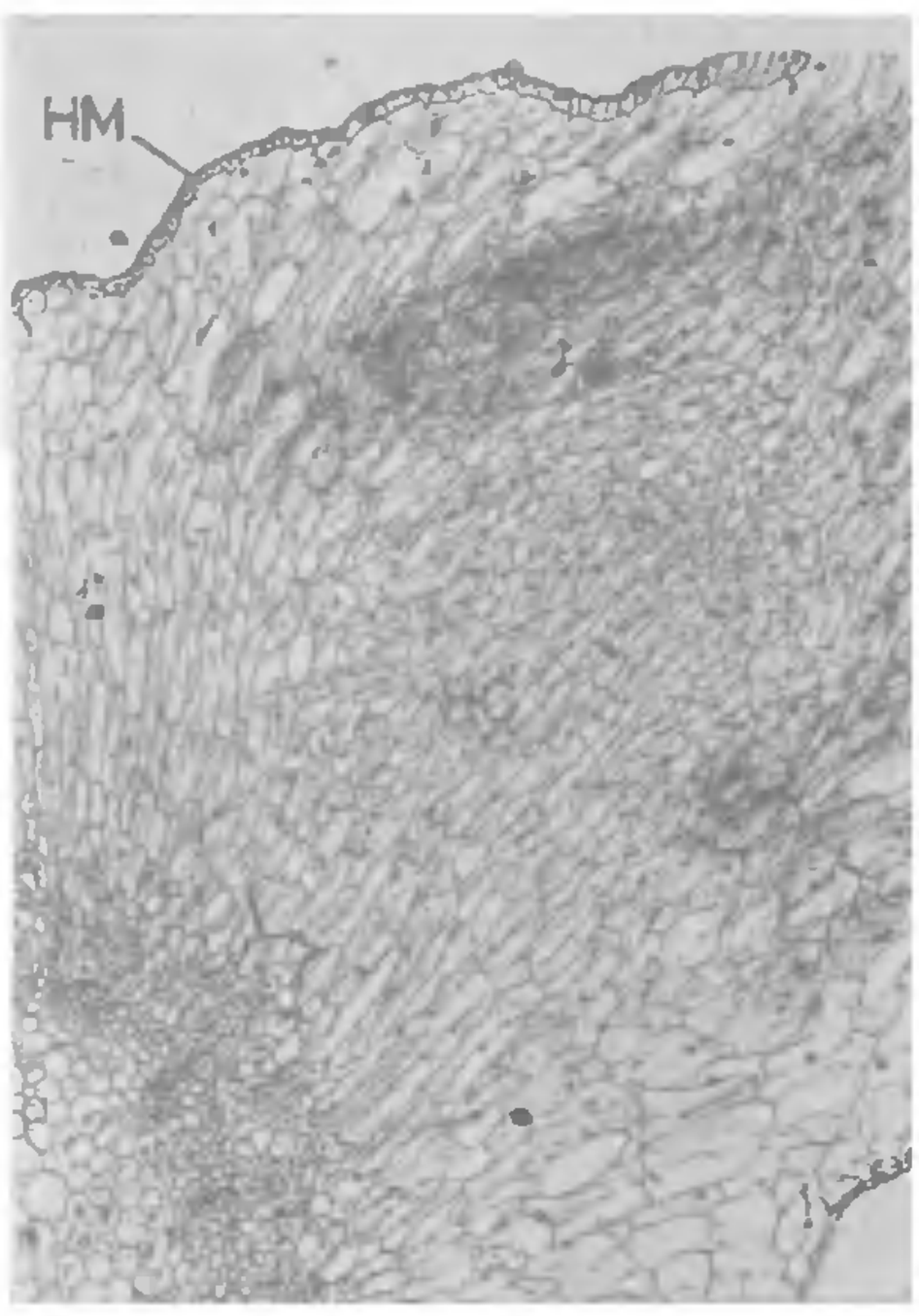


FIG. 4. T.S. of BA-treated *Cuscuta* stem. HM, Haustorial mound; HC, haustorial column, endogenously-arising, radially-elongating cells with a meristem-like cap of smaller cells (about 100 ×).

This central column which arises endogenously and (often) opposite a patch of supernumerary phloic elements (Fig. 5), represents that part of the haustorium which actually grows and penetrates the host under normal conditions. However, so far, we have not observed the penetration of *Cuscuta* epidermis by this column of haustorial cells as would happen in nature before it invades the host. This suggests the possible involvement of yet another 'developmental cue'. The cortical cells in the haustorial mounds had also radially elongated and appeared as uniform tiers of cells (Fig. 5), while the epidermis (not seen in the figures) on the top of the mound appeared flattened and consisted of columnar cells often laterally separated from each other.

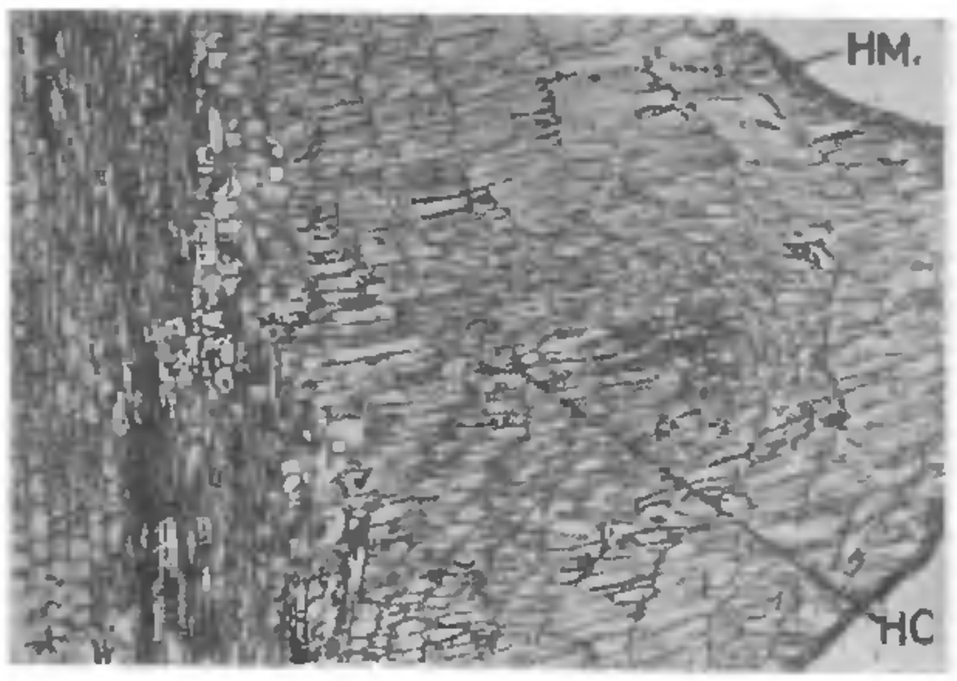


FIG. 5. L.S. of BA-treated *Cuscuta* stem.
HM, Haustorial mound; HC, haustorial column of cells; P, phloic patch (About 100 ×).

Natural formation of 'free' haustorium in the absence of a host has been observed in *Cuscuta salina*[1]. Jacob *et al.*[2] have reported the formation of 'papillae similar to early stage of haustoria' development on *Cuscuta reflexa* following treatment with kinetin (<0·1% in lanolin). The anatomical pictures in their paper do not show the development of the central column of intrusive haustorial cells within the 'papillae' and this incomplete formation of the haustorium could be due to the low concentration of cytokinin used. We have observed such papillae like haustoria formation on *Cuscuta* stem tips, aseptically cultured *in vitro* on kinetin ($2 \times 10^{-7}$ to $10^{-6}$ M) containing media[3]. Recently we have been able to induce haustoria formation in isolated internode segments of *Cuscuta* using $5 \times 10^{-6}$ M benzyladenine, which is reversed by the simultaneous application of $10^{-3}$ M auxin (IAA or NAA). However in the presence of lower auxin concentrations, the cytokinin-induced haustoria were better developed[4].

Induction of haustoria by benzyladenine application (0·5%) has been obtained in another parasitic plant, *Cassytha filiformis* (Lauraceae). Williams[5] has reported that cytokinins and gibberellins induced haustoria formation in the roots of *Striga* seedlings germinated *in vitro*. All these results are compelling enough to suggest that cytokinin be regarded as the haustorium-initiating hormone in parasitic flowering plants.

Haustoria of parasitic angiosperms have been widely regarded in the botanical literature as being modified roots[1]. However it is well known that root initiation is promoted by high auxin concentrations and inhibited by high cytokinin concentration. Our present studies clearly indicate just the opposite conditions for haustoria formation, namely, promoted by high cytokinin concentration and inhibited by high auxin conentration. Judging by this parameter alone a haustorium may not represent a modified root. If this is correct, then the evolutionary precursor for the parasitic angiosperm haustorium is still unidentified.

The authors S. Mahadevan and Ramesh Maheshwari thank the University Grants Commission for a research grant and Miss H. K. Lakshmi Murthy for expert technical help.

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*April* 26, 1978.

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## OCCURRENCE OF A BACTERIUM IN FOLIAR GLANDS OF *PEDALIUM MUREX*

WHILE studying the autecology of *Pedalium murex* Linn., we noticed the occurrence of bacteria in the foliar glands of the plant. The tri- or tetralobed glands are colourless when the plants are young and red-pigmented at mature stage of the plant. An examination of the transverse sections of the leaves also showed bacteria-containing cells. In view of the unequivocal proof of the nitrogen fixing ability of *Klebsiella* isolates from the leaf nodules of a Rubiaceous plant[1] the bacterium harbouring the foliar glands of *Pedalium murex* was isolated, characterised, and identified.