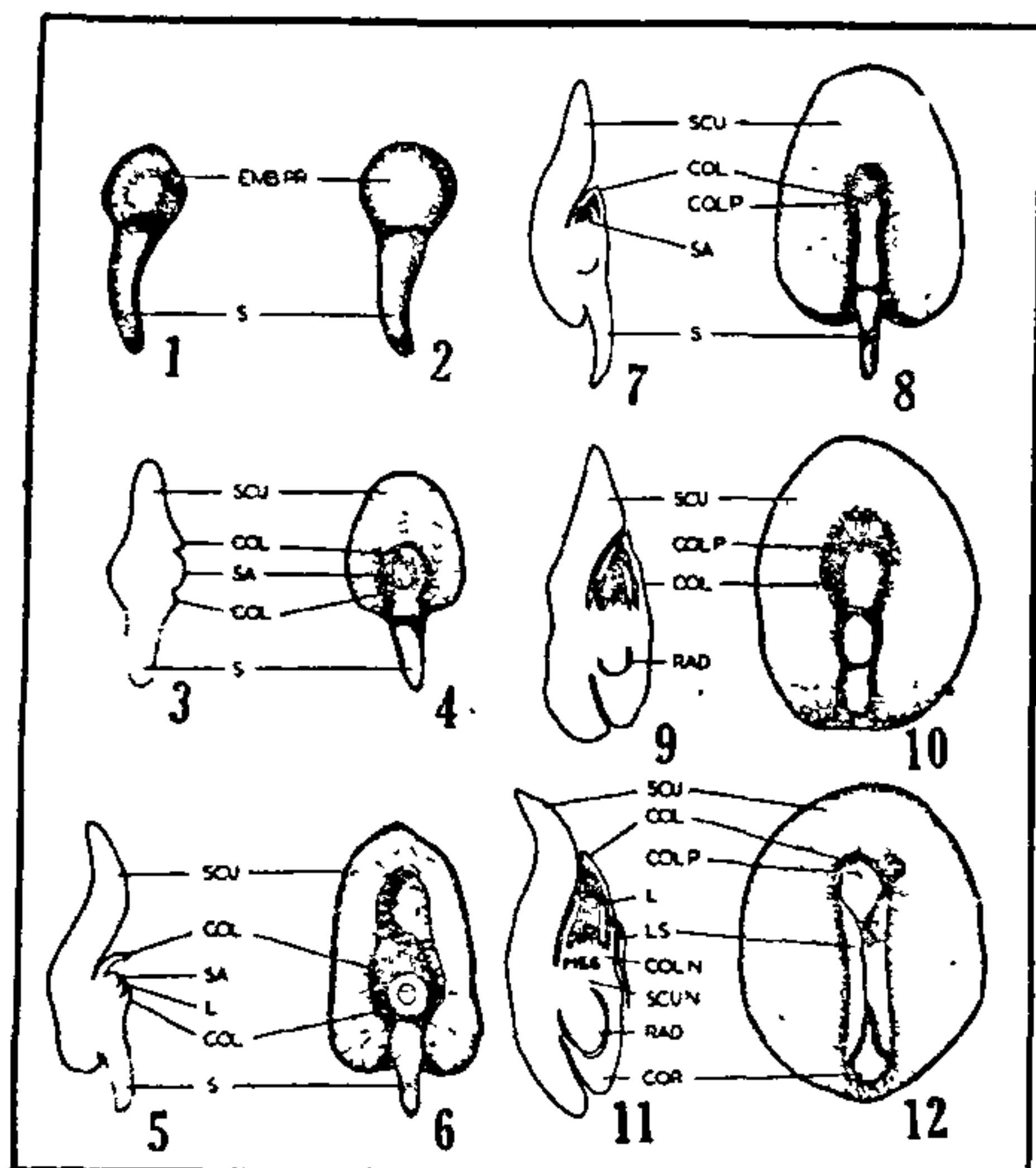


DEVELOPMENTAL MORPHOLOGY AND HOMOLOGIES IN GRASS EMBRYO

THE development of the fertilized egg into an embryo is related to an array of events resulting in structural diversity. There is considerable literature on structure and development of embryosac, zygote and young plant embryo (Ma^heshwari³). Only a few studies describe the ontogeny of the embryo from zygote to maturity (Esau¹). The difference in embryo structure between the Gramineae and other monocotyledons has attracted much attention and has caused considerable discussion as to the homology and proper terminology of its various parts. Controversy over the morphological significance of coleoptile and mesocotyl antedates by many years. O'Brien and Thimann⁴ believe that no consensus in such a controversy can be reached because it is a matter of principle rather than of facts which are involved. Hence an attempt was made to trace the morphological changes during organogenesis in grass embryo.



FIGS. 1-12. Maize embryos showing the various stages of development during the transition from globular to mature one; in each set the face view of the embryo (right) is accompanied by a slightly diagrammatic median sagittal section (left) of the same embryo. (COL, coleoptile; COL N, coleoptilar node; COL P, coleoptilar pore; COR, coleorhiza; EMB PR, embryo proper; L, leaf; LS, lateral scale; MES, mesocotyl; RAD, radicle; S, suspensor; SA, shoot apex; SCU, scutellum; SCU N, scutellar node).

Developing embryos from globular to mature ones of maize, wheat, rice, jowar and barley were used for

this purpose. Figs. 1 to 12 depict the various stages of organogenesis in maize. Observations show that globular embryo consists of uniform mass of cells. As growth continues and embryo becomes elongated differential growth occurs which is faster on the ventral side than the dorsal (Figs. 1-2). Since initiation of central axis of embryo starts at this stage, cells on the dorsal half of the embryo are small as compared to those on the ventral half. The first contour sign arises with the formation of a circular crevice on the dorsal face of the embryo opposite to the germinal spot of the future shoot meristem. This depression is shallow to begin with but increases in depth as the tissue on its margins grows out (Figs. 3-4). The cells of these are similar to those on the ventral side of the embryo. The growth of these margins is a sheath-like extension from the cotyledon. This circular welt of tissue is the coleoptile (Figs. 5-6). The small mound of cells in the centre of this crevice is the nascent shoot meristem or shoot pole which later grows fast and gets itself organised as a shoot apex. As soon as the shoot apex is organised the initiation of leaf primordium occurs and the coleoptilar rim comes closer leaving only a slit, the coleoptilar slit, at its tip.

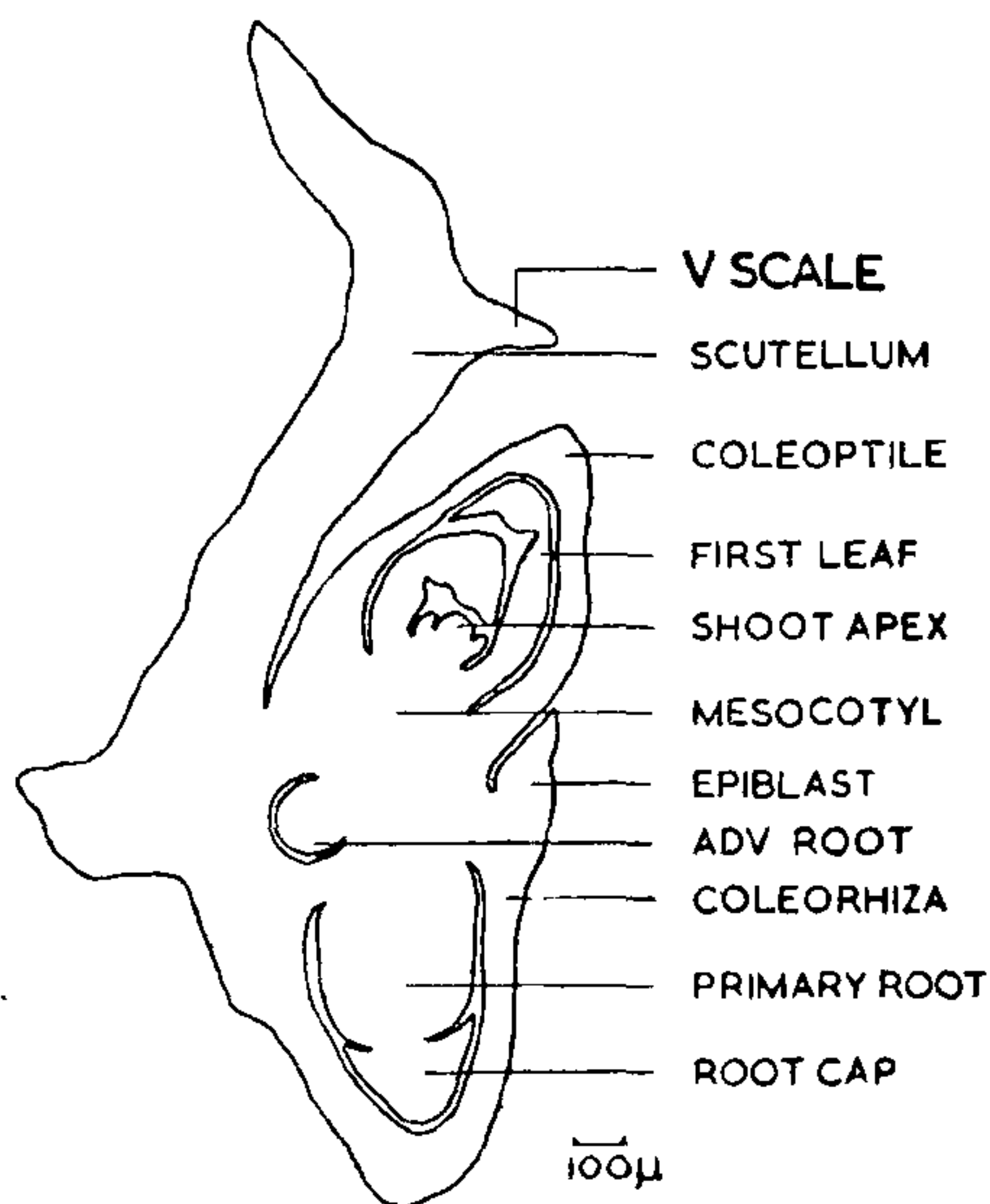


FIG. 13. L.S. of a mature embryo of oat; note the ventral scale, scutellum, mesocotyl, coleoptile, epiblast, and coleorhiza extending over the plumule radicle axis as a single structure. (ADV. ROOT, adventitious root; V. SCALE, ventral scale.)

Concomitant with the above, the initiation of radicle takes place in the central zone of the embryo at the

proximal end of the axis. The primary root gets separated from its surrounding mass of cells by schizogenous separation of cells. The radicle is encircled by the root cap which in turn is encased in the coleorhiza (Figs. 13-14). The coleorhiza differentiates from the cotyledonary mass of tissue on the lower side of the embryo and it is in continuation with the suspensor (Figs. 7-12).

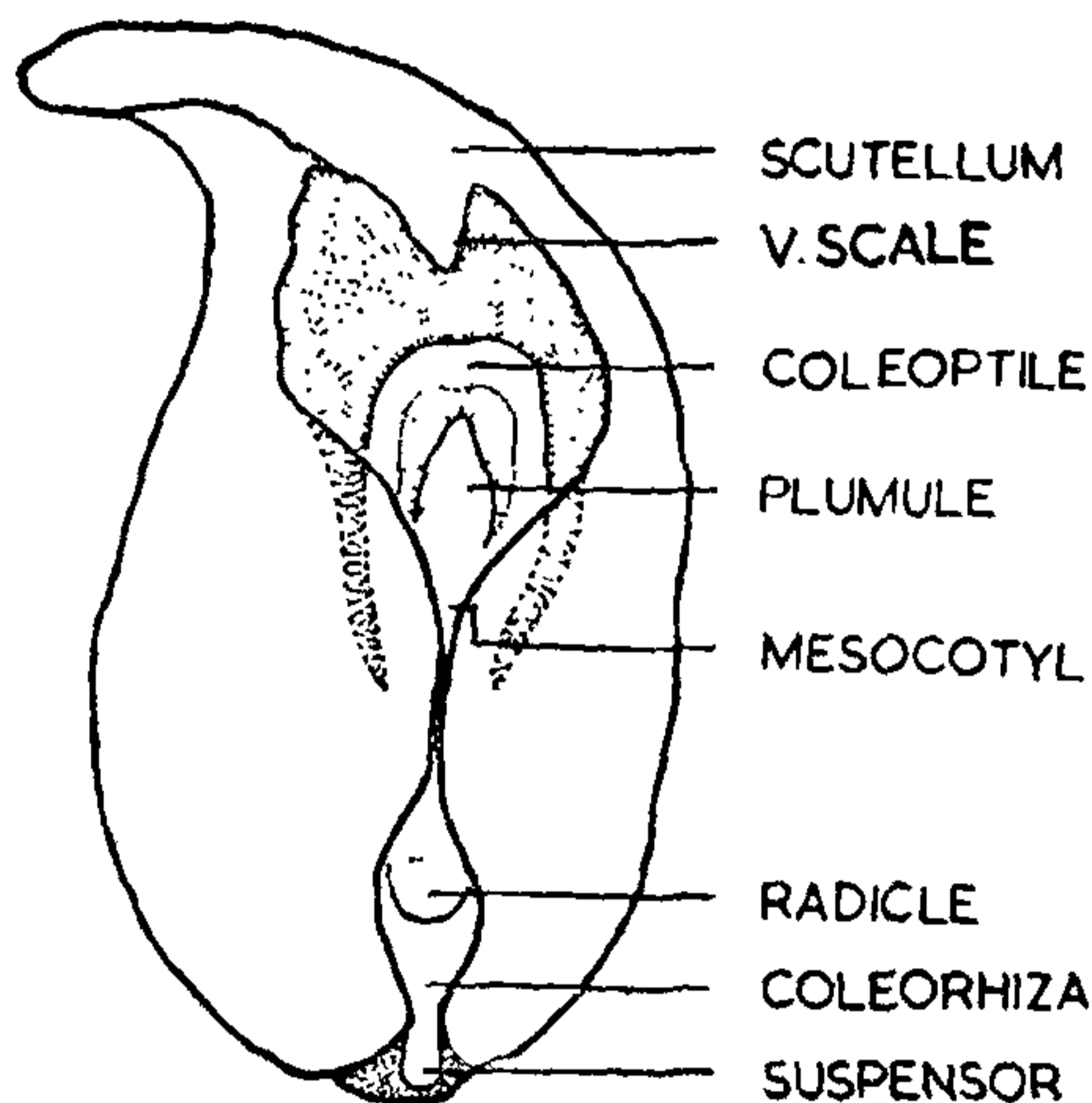


FIG. 14. Mature embryo of jowar; note the plumule radicle axis lying in the cavity of the shield-shaped cotyledon. (V. SCALE, ventral scale.)

Concurrent with the above, the ventral side of the scutellum flattens and its margins extend out. Its two lateral edges, the lateral scales (Figs. 11-12), extend over the plumule radicle axis from its sides while the ventral scale extends from the ventral side (Figs. 13-14). In certain cases, e.g., wheat and oat, the scutellar tissue on the dorsal side of the axis extends towards the dorsal surface of the plumule. This is the dorsal scale or epiblast (Fig. 13). Thus the scutellum with its ventral, lateral and the dorsal scales appears like a boat-shaped structure in the cavity of which lies the plumule radicle axis. The coleoptile and coleorhiza peep through the scutellar groove (Figs. 12-14). The axis above the scutellar node elongates and thus the mesocotyl becomes distinguishable (Figs. 11-14). The cortical portion of the mesocotyl is a continuation of the coleoptile and scutellum which are cotyledonary. Hence the coleoptile and mesocotyl are not the first leaf and internode respectively as it is interpreted.

Thus the formation of a mature grass embryo from its globular one passes through sequential events like (1) genesis of a germinal and abgerminal faces, (2) erection of a shoot root or embryonic and axis (3), differentiation of shoot apex, root apex and different

regions of the single cotyledon. A mature grass embryo consists of a plumule radicle axis and a single cotyledon. The coleoptile, cortical portion of mesocotyl, coleorhiza and scutellum with its ventral, lateral and dorsal scales form the various elevations of the single cotyledon of grass embryo. The cotyledon forms a continuous structure from its base, coleoptile, to its tip, the scutellum through the mesocotyl surrounding the plumule radicle axis.

The author (CKS) is grateful to University Grants Commission for the award of a scheme and SBS for a Junior Research Fellowship.

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 November 9, 1979.

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ADAPTATION OF *SCLEROTIUM ROLFSII* TO SYSTEMIC FUNGICIDE

DEVELOPMENT of resistance in plant pathogens to fungicides has created a serious problem in the control of plant diseases. For effective control, application of fungicides has to be repeated several times during growth period of the crop and also from season to season. This continuous use of the same fungicide over the years leads to development of resistance in plant pathogens. Dharam Vir *et al.*³ reported development of resistance in *Helminthosporium avenae* to mercury in Denmark and consequently its failure to control the disease although fungicides based on mercury were being used in that country for years. Hexachlorobenzene used in Australia against bunt of wheat was rendered ineffective⁶. In recent years, a number of systemic fungicides have been introduced in the field of plant disease control and it has been observed that development of resistance in plant pathogens to this group has increased at an alarming rate^{2,5}. Acquired tolerance of fungi to fungicides has been obtained by exposing the pathogen to increasing concentrations of fungicides^{4,8}. Studies on the adaptation of *Sclerotium rolfsii* to higher concentrations of a systemic fungicide benomyl, are reported in this note.

Various concentrations of fungicides were obtained by adding weighed quantity of benomyl [Methyl-1 (butylcarbamoyl)-2 benzimidazole carbamate] to