The Plastids of *Polytrichum commune*

I. The Capsule at Meiosis

By

Dominick J. Paolillo, Jr.

Department of Botany, University of Illinois, Urbana, Illinois

With 14 Figures

(Received February 8, 1964)

Weier (1931a) studied the capsules of *Polytrichum commune* and described the plastids of the sporogenous cells. He established that the single plastid in each of the archesporial cells divides in anticipation of nuclear division and that the daughter plastids migrate to the locations that later coincide with the poles of the mitotic spindle. The plastid of an archesporial cell was described as having a densely staining margin (plastonema) and a lightly staining interior (plastosome), as is illustrated in Figure 1a. Paolillo (1962, 1965) discovered a strikingly similar plastonema-plastosome configuration in the plastids of meristematic cells of the sporophyte of *Isoetes hexelli*. He also confirmed earlier reports (Stewart 1948, Dunlop 1949) on the polar activity of *Isoetes* plastids. The obvious similarity between the configurations observed in dividing cells of *Isoetes* and those pictured in Weier's (1931a, b) figures of *Polytrichum* prompted a comparison of the two genera.

As information on the ultrastructure of *Isoetes* accumulated, the ultrastructural basis for the plastonema-plastosome configuration of the meristem plastids of *Isoetes* became obvious (Paolillo 1962). It would be of interest to establish whether or not the analogous plastid configuration in *Polytrichum* has a similar ultrastructural basis, but even greater interest may be attached to a comparative developmental study of *Isoetes* and *Polytrichum*. In both genera, the plastids with the plastonema-plastosome configuration have the potential for developing into chloroplasts, although salient differences in the developmental histories of the plastids of the two genera have been established with light microscopy (cf. Weier 1931a, b and Paolillo 1962). The change from archesporial plastid to the chloroplast of the spore in *Polytrichum* involves a more complex developmental
sequence than does the change from meristem plastid to chloroplast in the leaf of *Isoetes*. The plastonema-plastosome configuration of the plastids in an *Isoetes* meristem is perpetuated as long as the meristem exists and may be considered the basic configuration from which all other forms of the plastids in the sporophyte are derived. One plastid per cell is the basic condition in the *Isoetes* meristem. In *Polytrichum* capsules, the archesporial plastid obtains its characteristic configuration by a modification of the simple reticulum or platework that comprises the internal structure of a plastid in the amphothecium. The condition of one plastid per archesporial cell is obtained by reduction from few to several plastids per cell in the amphothecium.

At the time of meiosis, the capsule of *Polytrichum* presents a diverse complement of plastid types. Obviously, there are diverse morphogenetic pathways that the development of a primordial plastid can follow. The description of the types of plastids that occur in the fully differentiated capsule is a prelude to the developmental studies that will be described at a later date. Although the present report concerns itself specifically with the diversity of plastid types that are found in the capsules at the time of meiosis, the data also bear on current concepts of plastid structure and allow some preliminary comparisons of *Isoetes* and *Polytrichum*.

**Material and Methods**

The data of the present report are derived from observations on field collections. Samples were taken from the midregions of capsules that contained either spore mother cells or spore tetrads. At either developmental stage of the sporogenous cells, the capsule has a multilayered wall (ca. 5 cell layer thick), a large lacuna, a spore sac, and a columella. The convoluted spore sac has a tapetal lining and is suspended from the capsule wall and columella by multicellular, branched filaments (see Parihar...