

CONIDIUM ONTOGENY IN HYPHOMYCETES  
THE PHIALIDES OF *TORULOMYCES LAGENA* AND  
*ANTHOPSIS DELTOIDEA*

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Abstract

Conidium ontogeny in *Torulomyces lagena* Delitsch and *Anthopsis deltoidea* Filipello Marchisio, Fontana and Luppi Mosca is illustrated by time-lapse photomicrography. The genera produce phialoconidia by a fixed meristem without incurring concomitant elongation or shortening of the conidiogenous cell.

Introduction

The process of conidium ontogeny has been examined by several workers since Hughes (1953) first proposed his experimental scheme for the natural classification of hyphomycetes. These studies have helped clarify the concept of conidiogenesis and also produced significant practical taxonomic 'spin-off'. Cole & Kendrick (1968), for example, merged *Backusia* Thurum, Whiteh. and Mathur with *Monascus* v. Tieghem because their method of producing conidia is identical. Also, Hashmi et al. (1972) proved on the basis of conidium ontogeny and karyology that *Monocillium indicum* Saksena is a synonym of *Torulomyces lagena* Delitsch.

This paper of a series on time-lapse photomicrographic analyses of conidium ontogeny describes *Torulomyces lagena* and *Anthopsis deltoidea*. It forms part of a continuous attempt to extend the overall concept of a hyphomycete classification based on developmental characters.

Materials and Methods

The cultures of *T. lagena* (UW 56) and *A. deltoidea* (CMT 1111.74) were obtained from the University of Waterloo, Ontario and the Istituto Botanico dell'Università di Torino, Italy and maintained on malt extract agar medium at room temperature. The procedures and techniques followed were as described by Cole et al. (1969a).

## Observations

### *Torulomyces lagena* Delitsch (1943)

Conidiogenesis in *T. lagena* is illustrated in Fig. 1. The potential conidiogenous cell in Fig. 1A shows the initial stage of differentiation where a slight swelling has already appeared. This swelling increases and the conidiogenous cell is delimited by a septum after 45 minutes (Fig. 1B). The swelling enlarges for the next 4 hours (Figs. 1C - 1E) eventually ceasing growth and becoming delimited as a spherical vesicle (Fig. 1E). After a further 35 minutes an apical protoplasmic protuberance appears, initiating the formation of the first conidium (Fig. 1F). The first conidium is fully differentiated over 5 hours covered by the next three photomicrographs in the sequence (Figs. 1G - 1I). The second initial develops, enlarges and forms the second conidium during the next 2 hours, pushing the first conidium upwards (Fig. 1J - 1H). In next 8 hours a small protuberance (the initial of the third conidium) was seen pushing the first two conidia upwards but ceased growth long before maturity. The paired arrows in Figures 1G and 1J show that the conidiogenous cell neither increases nor decreases in length during conidiogenesis. From this sequence it is clear that the formation of a succession of conidia in *T. lagena* does not involve any change in the length of the conidiogenous cell. According to the concepts of Hughes (1953), further elaborated by Cole & Kendrick (1969b) and ratified by the Kananaskis conference (see Kendrick, 1971), the conidiogenous cell of *T. lagena* is a phialide.

### *Anthopsis deltoidea* Filipello Marchisio, Fontana and Luppi Mosca (1977).

Conidiogenous cells of *A. deltoidea* vary in morphology and occupy different positions on the conidiogenous hypha. Fig. 2 illustrates three sequences of photomicrographs where conidiogenous cells of varying morphology depict the essential characters of a phialide during conidiogenesis.

In Fig. 2A, an elongate conidiogenous cell cut off by a basal septum, has ceased growth and encloses the differentiated primary conidium. Ten hours later (Fig. 2B), two conidia have matured and the third one is developing at its apex. After a further 4 hours a small protuberance (arrow in Fig. 2C), the initial of the fourth conidium ensues which creates the force responsible for driving the third conidium out of the apex. Over the next 12 hours (Figs. 2D - 2E) fifth and sixth conidia have developed and matured while seventh one is being pushed through the open neck of the conidiogenous cell which is now called a collarette (upper arrow in Fig. 2E).

Figures 2F - 2J represent another sequence where a bulbous conidiogenous cell has already produced two conidia and the initial of the third conidium (arrow in Fig. 2F) is developing within the open collarette. In further 48 hours the growth of the protoplasmic bud (Figs. 2G - 2J) has cut off seven more conidia without altering the length of the conidiogenous cell.

In Fig. 2K a terminal conidiogenous cell has produced four conidia and a pro-

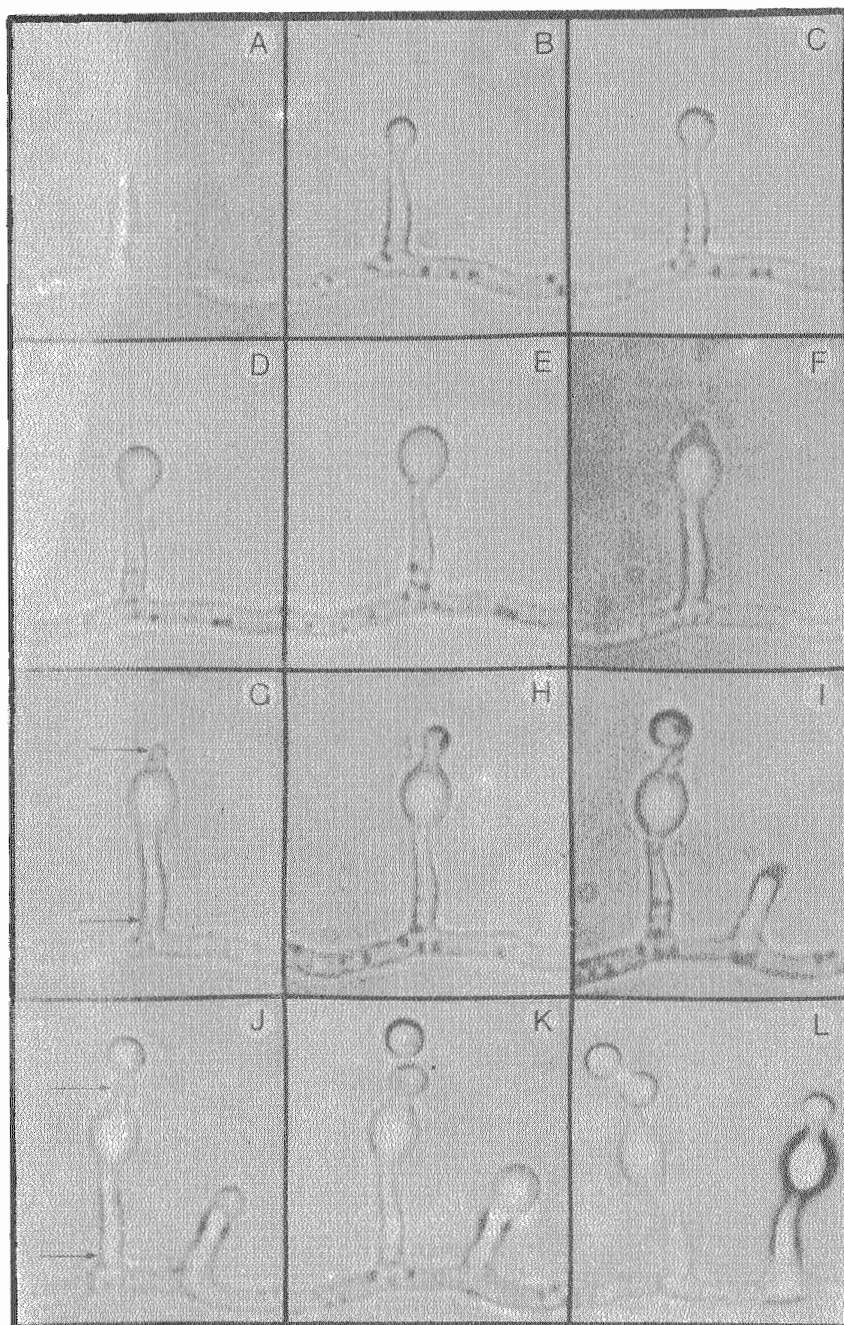


Fig. 1. A - L. *Torulomyces lagena*. 35-mm time-lapse sequence of conidium formation taken with 100X oil-immersion objective.

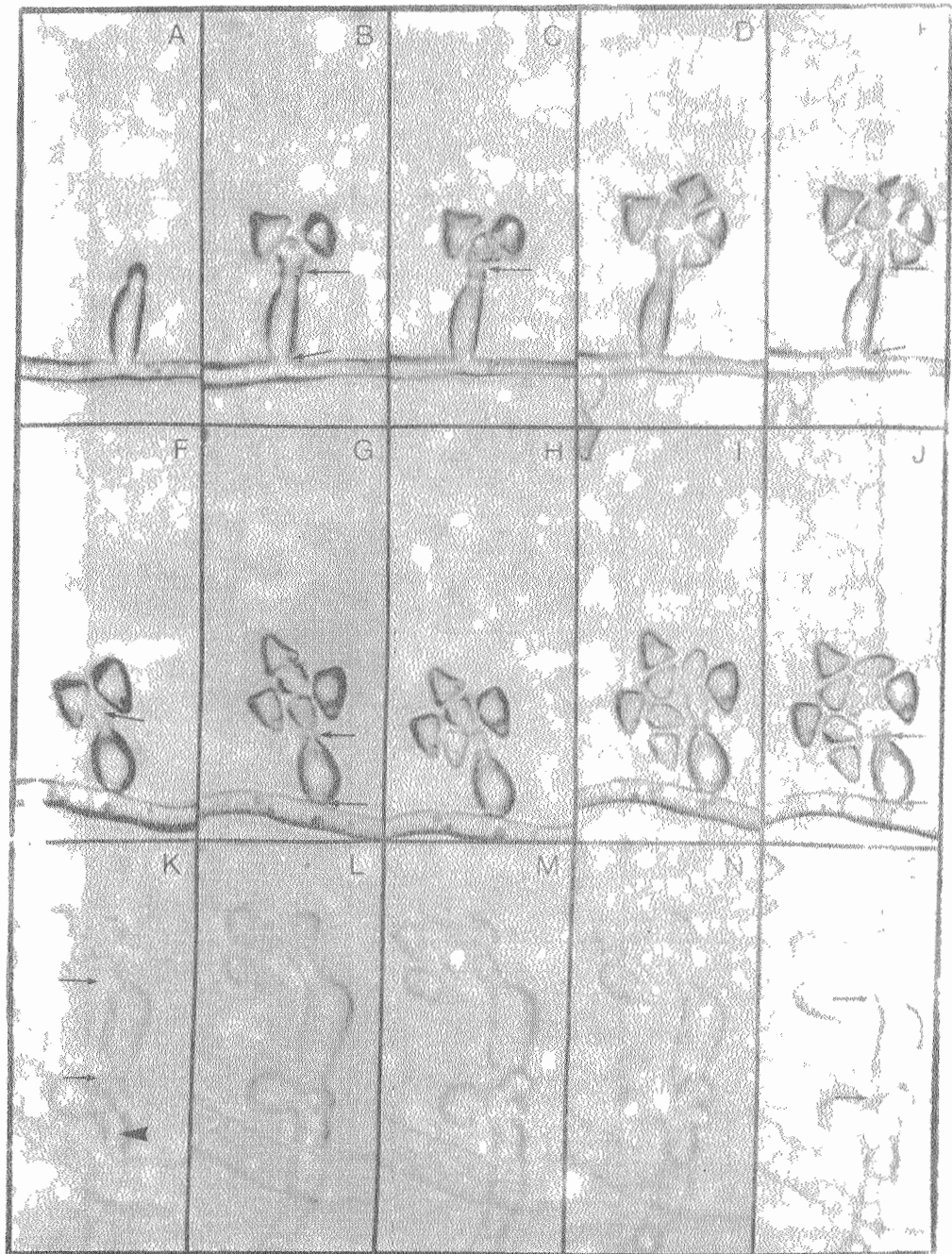


Fig. 2. A – O. *Anthopsis deltoidea*. 35-mm time-lapse sequence of conidium formation taken with 100X oil-immersion objective.

toplasmic bud, which is the initial of the fifth conidium, is just beginning to appear at its apex. Immediately below this is another ampulla shaped conidiogenous cell which is attached through its neck to the conidiogenous hypha and shows its primary differentiated conidium (arrowhead in Fig. 2K). During the next 30 hours covered by the last four pictures in the sequence (Figs. 2L – 2O) three further conidia by the terminal conidiogenous cell and two more by the ampulla-shaped cell have been produced. In the collarette at the upper conidiogenous cell in Fig. 2O, the protoplast, following secession of the seventh conidium, has retracted assuming a hemispherical shape some distance below the open end of the conidiogenous cell. A similar situation has been observed by Cole & Kendrick (1969b) in the phialide of *Phialophora lagerbergii* (Melin & Nannf.) Conant and by Morgan-Jones et al. (1972) in *Cryptocline paradoxa* (de Not.) Arx. If we now retrospectively measure the distance between the basal septum of the conidiogenous cell and arrows at the apex of the collarette in Figs. 2B and 2E and in Figs. 2G and 2J and also in Figs. 2K and 2O we find that there has been no change in length. We can, therefore, assert that the conidia in *A. deltoidea* are produced by a fixed meristem without incurring concomitant elongation or shortening of the conidiogenous cell.

### Discussion

From the above description of conidium ontogeny in *T. lagena* and *A. deltoidea*, it is evident that the conidiogenous cell in these genera is a phialide with a fixed endogenous meristem. This implies that the phialide shows no elongation once its tip is ruptured and it is actively producing conidia. Hughes (1953) in describing section IV of his ontogenetically based classification, assigned the term phialide to those "unicellular structures which are usually terminal but sometimes intercalary as well, on simple or branched conidiophores; they are oval to subcylindrical to flask-shaped or subulate often with a well differentiated basal swelling and a narrower distal neck, with or without a terminal collarette; from the apex of each phialide develops a basipetal succession of phialospores without an increase in the length of the phialide itself." More recently, Cole & Kendrick (1969b) have defined a phialide as "a sporogenous cell with only one functioning, fixed, endogenous meristem whose position is marked by the deposition of an inner or secondary wall which surrounds each of the sporogenous cell". They also suggested that different locations adopted by the sporogenous meristem are strongly correlated with the final form of the phialide.

In *T. lagena* the primary conidium initial matures exogenously after it bursts through the apex of the phialide leaving an inconspicuous collarette. When first conidium attains maturity a second initial appears below the first, then a third below the second, and so on, forming a basipetal chain of conidia. There is a continuum of the wall of first and subsequent conidia but the wall of the phialide itself does not extend over developing conidia. A similar pattern of ontogeny is seen in *Penicillium corylophilum* Dierckx (Cole & Kendrick, 1969b), *P. claviforme* Bainier (Zachariah & Fitz-James, 1967; Fletcher, 1971), *P. clavigerum* Demelius and *P. corymbiferum* Westling (Fletcher, 1971), *Aspergillus nidulans* Eidam (Oliver, 1972), *A. giganteus* Wehmer (Trinci et al., 1968) and *A. niger* van Tieghem (Tanaka & Yanagita, 1963; Tsukahara, 1970).

The phialide of *A. deltoidea* shows a different pattern of conidium ontogeny. In this case the first conidium is differentiated endogenously within the blow-out tip of the phialide. Once the 'endogenous meristem' becomes active the conidiogenous cell ceases elongation and its outer wall ruptures at the apex by the emerging conidium, leaving a collarete of variable distinctness. Then each of the conidia successively produced is shed as a separate unit, gathering at the mouth of the phialide. This method of conidium development agrees basically with that described for other phialidic genera including *Phialophora lagerbergii* (Melin & Nannf.) Conant (Cole & Kendrick, 1969b), *Phialocephala dimorphospora* Kendrick (Carroll & Carroll, 1974) and *Trichoderma saturnisporum* Hammill (Hammill, 1974).

The collarete in *T. lagena* is reduced to an inconspicuous structure (upper arrow in Fig. 1J) which is sometimes not even discernible with a light microscope. In *A. deltoidea* it appears like a small frill around the neck of the phialide (Figs. 2E and 2J) or as a distinct collarete (Fig. 20) identical to that of *P. lagerbergii*. According to Subramanian (1971) an inconspicuous collarete, as seen in *T. lagena*, *T. indicus* Hashmi, Kendrick & Morgan-Jones (Hashmi et al., 1972), *P. corylophilum* and several other hyphomycetes, may result if the wall of the tip of the phialide is easily ruptured or enzymatically dissolved allowing the initial of the first conidium to emerge from the open tip and continue development to maturity; whereas in cases like *A. deltoidea* and *P. lagerbergii*, the apical protuberance of the phialide may develop to a certain extent before its tip is ruptured or dissolved and the more delayed this rupture or dissolution the more conspicuous the resulting collarete.

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