Table 1 *Luminous bacterial density of Pteroeides sp.*

Site of sampling	Total CFU	Luminous CFU
Autozooids and peduncle	$88.7 \times 10^3/cm^2$	$7.6 \times 10^3/cm^2$
Coelomic fluid	$80.6 \times 10^3/ml$	$10.1 \times 10^3/ml$

CFU: Colony forming units

sediment and all of them were *Vibrio harveyi*. Although species of luminous bacteria such as *V. harveyi*, *V. fischeri* and *Photobacterium phosphoreum* was encountered in the gut of fish[3], interestingly enough only *V. harveyi* was recorded in *Pteroeides* sp. The fact that the luminous *Vibrio* (formerly *Beneckea*) species are nutritionally versatile than other luminous microbes[4] may account for such a distribution of this species in the biotic and abiotic environments. The occurrence of luminous microflora in the coelomic fluid of *Pteroeides* sp is interesting, since a well defined gut is absent in these organisms. Further, the body fluids of most of the invertebrates were reported to possess antimicrobial factors[5]. Hence the survival of *V. harveyi* within the gastrovascular cavity of this species is an interesting phenomenon.

It is probable that the luminous bacteria of the environmental water might have gained access into the gastro-vascular cavity of the animal since the fluid is renewed periodically by exchange with the external medium.

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THE "OPENING OUT" PROCESS IN ROOT MERISTEMS—A NEW TYPE

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THE apical organisation of roots with reference to ontogenetic reorganisation has been extensively studied[1-3]. This investigation on *Trigonella foenum-graecum* L was undertaken to obtain additional information on ontogenetic changes in apical organisation and activity. The radicular apex was dissected from mature seeds and subsequent samples were taken at 24 hr intervals from germinating seeds for the first seven days after seed wetting. The root apices were fixed, processed, sectioned longitudinally at 5 μ and stained with safranin-light green[4].

The radicular apex shows a closed type of organisation having three superposed tiers of initials at the root pole, one each aligned with the central cylinder, cortex and columella and separate initials for the epidermis-peripheral part of the rootcap. An analysis of the cell complexes helps to distinguish the central columella and peripheral region in the rootcap. The columella initials are just distal to the cortical initials and about 3–4 cells wide in median longisection. The peripheral region has cells in oblique files curving from the flanks towards the columella and arising by *Kappe* divisions from the rootcap-epidermis initials.

The cortical initials form a single tier or plate of 4–5 cells across just distal to the initials for the central cylinder as seen in medial longisections. The cells at the periphery of this plate show *Körper* divisions and the proximal derivatives form the cortex. A group of almost isodiametric cells (at the root pole) proximal to the cortical initials represents the central cylinder initials. Proximally the central cylinder differentiates from daughter cells resulting from *Körper* divisions of these initials (figure 1).

In the 2, 3, 4, 5 and 6-day old root apices a gradual process of "opening out" of the cortex and stele towards the rootcap is observed. This process results in the formation of a secondary columella and a stele-cortical-columella complex. The secondary columella results from transverse divisions of the cortical initials at the central region and oblique and transverse divisions of the cortical initials and their immediate derivatives at the pericolumnar region The former type of divisions gives rise to that part of the secondary columella which pushes the primary columella distally. The latter type of divisions results in cell configur-

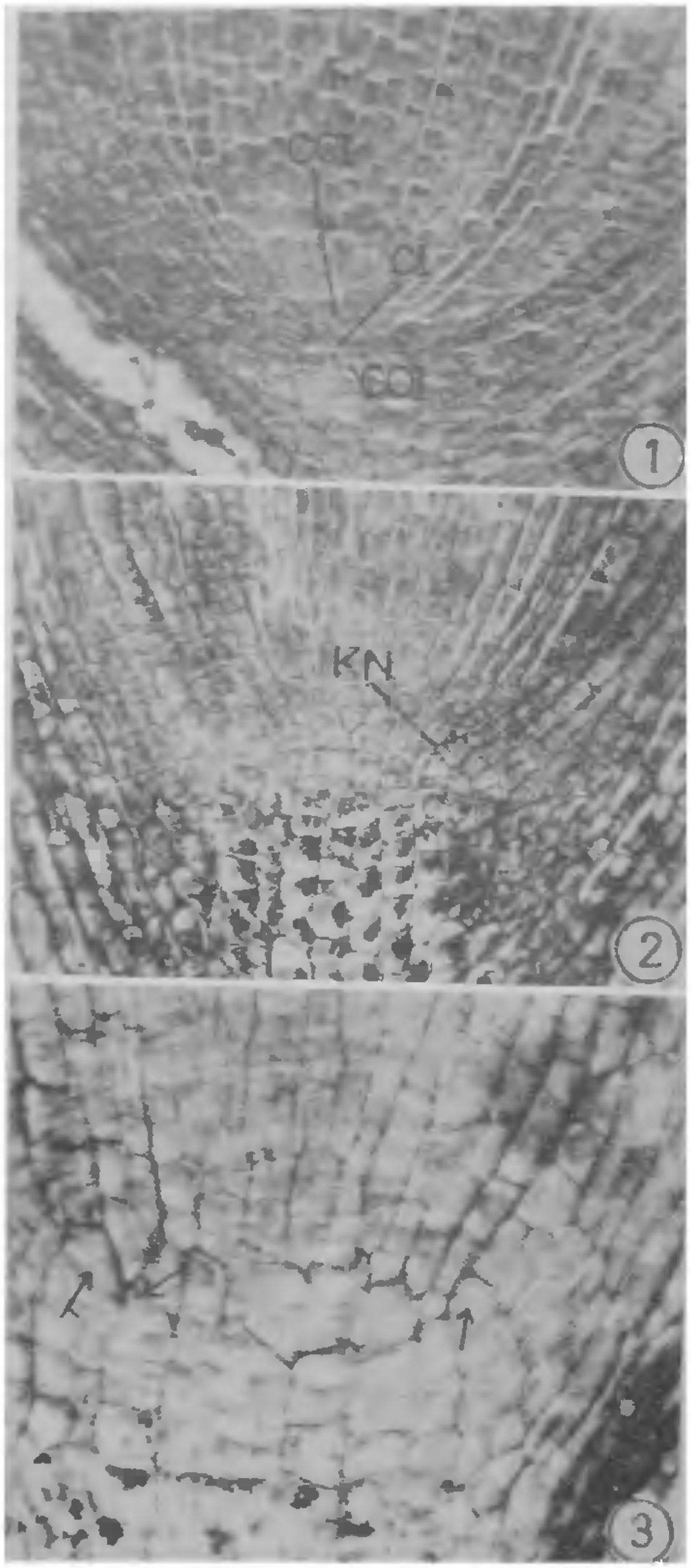

Figure 1–3. Median longitudinal sections of the root apex of *Trigonella foenum-graecum* (CCI, central cylinder initials; CI, cortical initials; COI, columella initials; KN, knee; Arrows indicate oblique and transverse division). **1.** Radicular apex showing closed organisation (× 400). **2.** 2-day old seedling root apex showing knee formation (× 400). **3.** 6-day old seedling root apex showing oblique and transverse divisions (× 700).

ations called 'knees' (figure 2)[3]. The knees and the distal extension of these cell rows widen the columella. During further growth "knee" formation takes place at the peripheral region of the stele and this results in the opening out of the stele also. Transverse divisions in the stelar initials cut off cells distally towards the columella and proximally to the stele. This results in the formation of a stele-cortex-columella complex (figure 3).

The vertical cell files of the secondary columella in the centre (and proximal to the primary columella) continue to add to the length and those on the flanks add to the width of the primary columella. Usually the primary columella runs the whole length of the rootcap whereas at the beginning secondary columella does not. The vertical extent of the secondary columella on the flanks is often marked by oblique cell walls and this widens the columella by adding more cell rows on the flanks (figure 3). With the formation of secondary columella, a ring of cells around the head of the columella takes up the function of cortical initials. The initials of the rootcap-epidermis maintain an unaltered position in relation to the other regions.

The process of opening out and knee formation has been reported in *Helianthus annuus*[3]; in *Malva sylvestris*[2] and in some members of Compositae[1]. In the above mentioned literature opening out does not affect the central cylinder and the discrete initials for the central cylinder are maintained without any change. But in *Trigonella* reported here the central cylinder initials are also involved in the process resulting in a common group of initials in the older roots. This type is being reported for the first time.

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