'Rodlet Cells' in *Catostomus commersonnii* (Teleostei: Pisces): Secretory Cell or Parasite?

During our histological studies on various tissues of *Catostomus commersonnii* Lacépède, the common white sucker, we have seen a peculiar oval, thick-walled cell containing a basal nucleus and longitudinally oriented arrow-shaped cytoplasmic inclusions. Search of the literature has brought forth a few contradictory reports of incidental observations of a similar cell in other teleosts but its identity is unknown. It has been called a 'stäbchendrüsenzell'[1], 'coarse granulocyte' of the blood leukocyte series in the mesothelium[2,3], kidney tubule[2], intestinal mucosa[2,3], and gill epithelium[3], 'pearshaped cell' in the intestinal epithelium[4], 'protozoan parasite' in the bile duct[5], 'foliacious cell' in olfactory epithelium[6], and a 'rodlet cell'[7].

The fish used in this study were netted from Canadian parts of the Lake Huron drainage basin. Formalin fixed, plastic embedded tissues (2-butoxyethanol methacrylate, Polysciences, Inc.) have been sectioned at 2 μm with a glass knife on a Porter-Blum JB4 microtome; as well, tissue imprints preparations have been made. As oversight stains, haematoxylin and eosin or orange G were used. The following histochemical tests were applied: for DNA: nucleal Feulgen reaction; to distinguish between DNA and RNA: methyl green and pyronin, and acridine orange examined with fluorescence microscopy with and without prior treatment with RNA-ase; for some polysaccharides: periodic acid-Schiff reaction[8]; for acid polysaccharides (metachromasia) 0.2% toluidine blue in 60% ethanol; for lipids, Sudan Black B; for general proteins: Fast Green FCF, pH_2.

Rodlet cells were seen in large numbers in epithelia from gills (Figure 3) and bile duct, and in smaller numbers in epithelia of kidney tubules, stomach and intestine. Varying numbers of rodlet cells were found in and underlying the endothelium of venules and capillaries in many parts of the body including portal areas in liver, as well as mesothelium. Mature rodlet cells are oriented so that their apices border a free surface; in thick epithelial membranes, the cells then lie so that their long axes are perpendicular to the free surface (Figure 4) and in thin epithelia their long axes tend to be parallel to the surface giving a lopsided appearance to the cell (Figure 2). The rodlet cells may be independent of other cells of epithelial tissue and in columnar epithelia, they appear to displace adjacent cells, distorting the epithelial cell nuclei (Figure 4).

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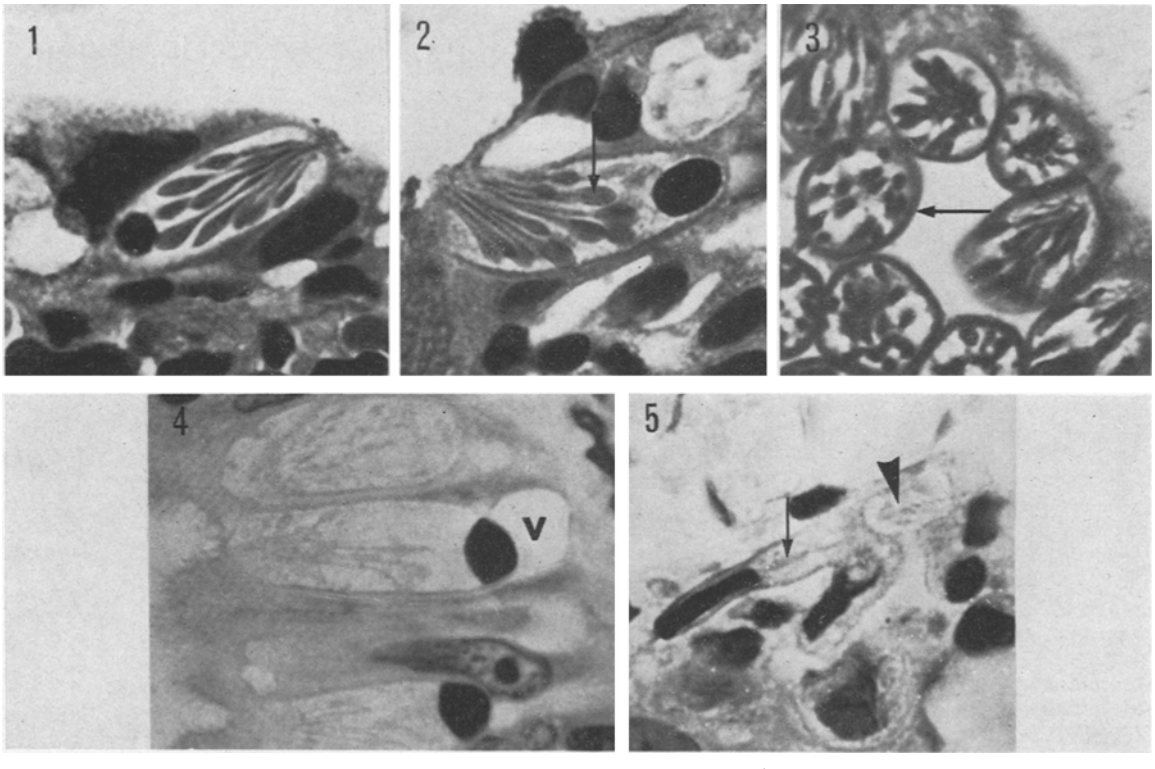

Fig. 1. Rodlet cell in gill epithelium showing basal nucleus and arrow-shaped rodlets. ×1500.
Fig. 2. Rodlet cell in gill epithelium with rodlets angled to retain the perpendicular orientation with free surface. Note 'spine' of rodlet (arrow) and extra-rodlet cytoplasm. H. & E. ×1500.
Fig. 3. Group of independent rodlet cells in gill showing thick capsule (arrow). Rodlets cut in cross section. Fast Green FCF. ×1500.
Fig. 4. Rodlet cell in epithelium of bile duct showing vacuole behind proximal end of cell (V). H. & E. ×1500.
Fig. 5. Rodlet cell in gill after discharge of rodlets. Note one remaining rodlet (arrow) in cytoplasm and laterally compressed nucleus. Discharged rodlets (broad arrow) lie near distal end of rodlet cell. H. and Orange G. ×1500.

Some histological and histochemical observations on the rodlet cells in *Catostomus commersonnii*

Stain	Material stained	Rodlet	Capsule	Nucleus
Haematoxylin	Basophilic substances	−	−	+++
Eosin	Acidophilic substances	++	++	−
Orange G	Acidophilic substances	++	++	−
Feulgen	DNA	−	−	+++
Methyl Green	DNA	−	−	++
Acridine orange	DNA, RNA	+ (orange)	−	+++ (green)
Acridine orange + RNA-ase		−	−	+++ (green)
Pyronin	RNA, Short chain DNA	+	−	−
Pyronin + RNA-ase		−	−	−
Fast Green FCF	Protein	+++	+++	++
Periodic acid-Schiff	Some polysaccharides	+	+	−
Toluidine blue	Acid polysaccharides	−	−	++
Sudan black B	Lipids	−	−	−

The mature rodlet cell (Figure 1) of *Catostomus commersonnii* measures, on the average, 19.9×9.6 μm. It is completely enclosed except at its apex by a capsule about 0.75 μm thick. At the base of the cell is seen a round-oval nucleus with condensed chromatin. Lying in the cytoplasm are up to 26 prominent arrow-shaped rodlets of different lengths radiating inward from the apex with the rhomboidal 'arrowhead', averaging 1.54 μm in width, pointing towards the nucleus. Each rodlet consists of a central, dense spine extending the length of each rodlet, covered by less dense cytoplasm (Figures 1 and 2). The rest of the cell cytoplasm is weakly staining and a faint lacy meshwork may be discernible between the rodlets (Figure 2). Very often, an unstaining space is found behind the proximal ends of the cells and is especially noticeable in the kidney tubule and bile duct (Figure 4). Frequently, rodlets are seen partly extruded from the cell or lying free on the surface of the epithelium near the apical ends of slim, vase-like cells with a thick capsule and laterally compressed basal nucleus (Figure 5).

From the Table, it is seen that the cell capsule is moderately acidophilic containing some protein and non-acidic polysaccharides. The nucleus gives the expected reactions with the stains and tests used. Of particular interest are the rodlets, which are slightly PAS-positive and acidophilic; they also contain protein, as evidenced by their reaction to Fast Green FCF. The longitudinal cores of the rodlets are Feulgen negative. After staining with pyronin, or with acridine orange followed by examination with fluorescence microscopy, the core of the rodlet reacts positively showing the presence of RNA or short-chained[8] or depolymerized[9] DNA. After removal of RNA by RNAase, the orange-red fluorescence and pyronin staining disappear, indicating that the cores contain RNA only.

The identity of the rodlet cell is unknown. It has been interpreted as a normal cell[1], a transformed coarse granulocyte[2,3], a sensory receptor or secretory cell[6] and a parasite[5].

We feel that the cell described is most likely a parasite. The number of rodlet cells per fish varies considerably although we have seen no fish without them. It is clearly not related to blood or tissue granulocytes and it is unlikely that the cell has a secretory function since it is found in such non-secretory areas as venule and capillary endothelium and loose connective tissue. Circumstantial evidence of the discharge of intact rodlets further suggests that the cell is not a secretory cell but rather a stage in the life history of a parasite. We suggest that the vase-like cell (Figure 5) may be the residuum of the 'mother cell' after discharge of the rodlets. In addition, we have seen banana-shaped cells with a less condensed nucleus surrounded by a thin capsule which may represent an early stage in the development of the cell. Although there may be a superficial resemblance of the rodlet cells to various types of sporozoan cysts, the rodlet structures cannot be related to any hitherto described sporozoan organelles. The cell appears to be widely distributed in teleosts, in both freshwater[3–6] and marine[2,4,10] species and there is little or no morphological evidence of tissue reaction to the cells; these suggest that it may be a nonpathogenic parasite.

Further investigations involving histochemistry, electron microscopy and taxonomy are in progress.

Zusammenfassung. Eigenartige Zellen mit stäbchenförmigen, cytoplasmatischen Einschlüssen wurden in verschiedenen Geweben (Epithelien der Kiemen, Gallengänge, Nierenkanälchen und Därme) des Knochenfisches *Catostomus commersonnii* gefunden. Histologische und histochemische Untersuchungen deuten darauf hin, dass diese sehr wahrscheinlich Parasiten sind.

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