Grainis gen. n. allied to *Ruthiella*, a symbiont of endemic gammarids in Lake Baikal (Ciliophora: Peritricha)

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Jankowski, A.W. 1997. *Grainis* gen. n. allied to *Ruthiella*, a symbiont of endemic gammarids in Lake Baikal (Ciliophora: Peritricha). *Zoosystematica Rossica*, 6(1/2): 1-5.

A new genus of freshwater peritrichs inhabiting some Baikalian amphipods, *Grainis* gen. n. with the single species *G. dizoon* sp. n., is described. The large thick-walled shell of this peritrich, irregularly folded and striated, is inhabited by two zooids. One of them, the primont, has a long thick unbranched myoneme inside a wide exostyle that fixes the shell to the host surface, the stem of the pleopods; this myoneme reaches the basodisc. The other zooid has its own short conical myoneme merged into the upper portion of the basostyle. The related genus *Ruthiella*, known only from the mouthparts of some amphipods in Germany, has the large shell inhabited by numerous zooids, up to 20 in one shell, each with its own myoneme that never reaches the basodisc. *Grainis* and *Ruthiella* possibly are relicts of a group of symbiotic rovinjellid peritrichs that inhabited widely distributed preglacial eurasiatic hosts.

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Introduction

Studying symbionts of invertebrates in Lake Baikal, I have noted unusual peritrichs on some small amphipods collected with trawls, confined only to the pleopods. Extended living zooids were figured on ship board during an expedition in 1981; extensive host material was fixed, and study of symbiont shells was continued after return to the coastal laboratory. Similar symbionts were found again in a trawl taken in 1982. Investigation of extensive material has enabled the establishment of a new monotypic genus; its diagnosis and comparison are given below.

Family **ROVINJELLIDAE**

Grainis gen. n.

Type species *Grainis dizoon* sp. n.

Diagnosis. Shelled forms with two zooids inside flexible, folded, thick-walled shell attached to substrate by thick conical stalk (basostyle). Primont* cell with long myoneme extending from cell base (scopula) to adhesive basodisc of the stalk. The second zooid with its own very short myoneme, contraction of both cells independent. Peristome epistyliform, not operculariform. Cell surface with concentric ribs, without net of rectangles. Macronucleus elongated and curved, C-shaped. Zooids of *Grainis* may be called dimorphic in respect to the type of myoneme.

Etymology. The generic name is given for the eminent French ciliatologist Dr. Jean Grain.

Grainis dizoon sp. n.
(Figs 1-2)

Syntypes. Slide BK-8-46, in sugar syrup, framed, permitting examination of finest details at oil immersion. This slide contains 2 isolated pleopods from a single host (*Poekilogammarus* sp.), each with numerous shells of *G. dizoon*. The host collected in midwater trawl near the Ushkan Islands, Lake Baikal.

Xenotype. Single host specimen, undissected, from which only two pleopods were taken for the syntype slide. This host is stored in a separate small vial in glycerol-formol mixture, jar BK-254, and thus cannot be accidentally dried; its permanent storage is guaranteed, for correct determination of the host

* Primont – author's term for the settled migrant that made the shell.

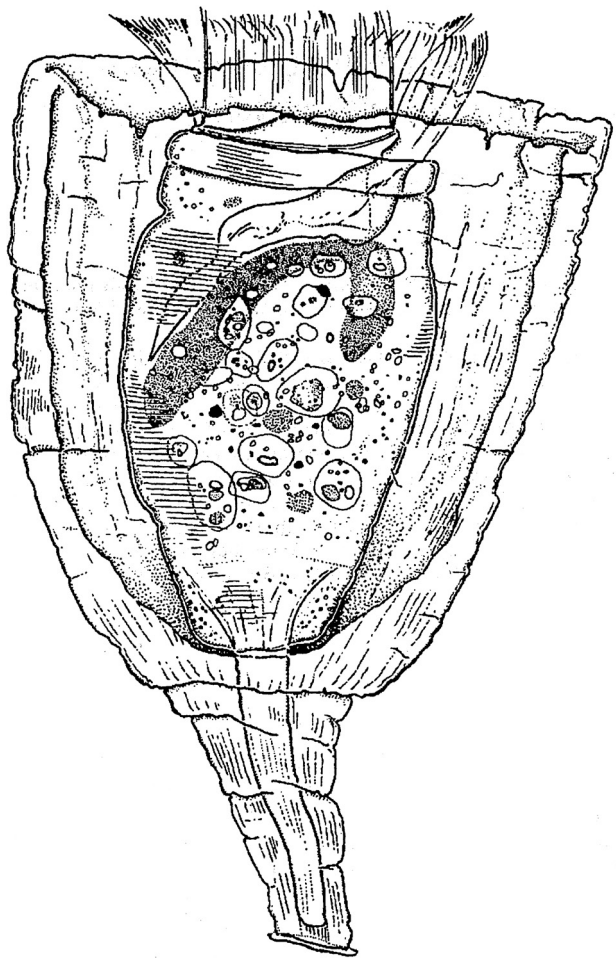

Fig. 1. *Grainis dizoon* gen. et sp. n., primont cell in large self-made shell. Drawn from life.

species and as a source of material for new slides of symbionts.

Paraxenotypes. 4 small jars with a total of 17 specimens of gammarids, taken with the xenotype.

All type material listed above is kept in the Laboratory of Protozoology, Zoological Institute, St.Petersburg.

Description. Body size 60-73 × 21-28, shell size with stalk 92-109 × 53-61 μm (10 measurements); shell about 2.5 times as long as stalk. Zooids elongated, of more or less uniform width. The wide and nearly flat peristomal disc (epidisc) is surrounded by a distinct circular rim; buccal ciliary spiral on epidisc margin not polymerized, of usual type; buccal cavity comparatively narrow and short, directed obliquely to cell axis. Pellicle finely striated, with numerous, dense concentric ribs; net of cortical rectangles absent. Contractile vacuole single, near buccal cavity. Macronucleus ribbon-like, curved, in upper half of body; cytoplasm clear and translucent, with numerous small refractile granules, mainly above the scopula.

Shell wide, slightly flattened, thick-walled; thickness of shell gradually diminishing from shell base to apex. Surface of shell irregular, oil immersion reveals numerous very fine longitudinal striations covering also entire basostyle. Shell walls and basostyle with irregular folds. Shells of *G. dizoon* strikingly differing from rigid shells with smooth surface of typical loricates, like *Cothurnia* or *Thuricola*. Basostyle not sharply separated from shell itself; simply, the shell becoming narrower from irregular apex to substrate and forming a kind of adhesive stalk. There are 1 or 2 zooids inside each shell, never more; thus the species is intermediate between solitary and branching peritrichs.

Each zooid with distinct wide refractile myoneme; myonemes of both zooids not joined, unlike *Zoothamnium*; at a touch, each zooid contracts independently unlike colonial forms with branching myonemes. Both myonemes of *G. dizoon* markedly dissimilar in shape and length. Primont with a very long myoneme merged into stalk matrix and reaching basodisc or attached to it by short fibres. Second zooid, its daughter cell, producing after fission its own short myoneme with blunt wide end not fused with that of primont. At contraction of zooids, stalk shortening insignificantly, and the shell inclining on one side to substrate. Primont myoneme with a restricted contractility, never twisted or spiralized in fixed cells. At next fission, each daughter cell leaving the shell as a metamorphic migrant.

Collection site and host. Grainis dizoon inhabits the pleopods of hosts – only the trunk of pleopods, the stem region, not its feather-

like branches. Relatively dense populations of these symbionts were noted on some host specimens, up to 15 shells on a single pleopod. The host is a small benthic amphipod determined as *Poekilogammarus* sp.; these crustaceans are common in samples taken aboard with trawls from moderate depths, 20-60 m, in mid-Baikal, near Ushkan and Olkhon Islands. None of the littoral amphipods (7 species inhabiting depths 0-1 m) or other benthic gammarids collected in Lake Baikal bears similar ciliates, although extensive material has been examined over many years. Many genera of Gammaridae, Acanthogammaridae and the recently established family Pallaseidae inhabiting the lake bottom never revealed such ciliates; the aberrant pelagic *Macrohectopus* ascribed to its own family Macrohectopidae is always free of any kind of ectocommensals in spite of its gregarious habits.

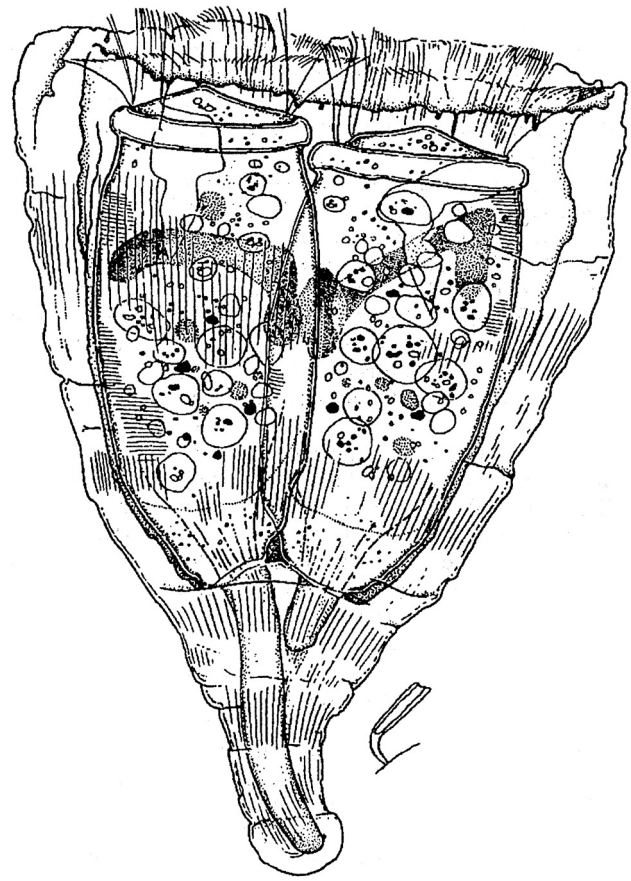

Fig. 2. *Grainis dizoon* gen. et sp. n., two zooids within definite shell. Drawn from life.

Discussion

It is evident that shell arose as a protective structure independently at least in 5-6 peritrich families. Typical loricates, family Vaginicolidae (=Bütschli's "tribe Cothurnina"), have 1-2 zooids inside the shell, and their shells are thin-walled, rigid and unfolded (Warren & Paynter, 1991). Widely known examples are the commensal and periphytonic genera *Cothurnia, Pyxicola, Thuricola, Vaginicola, Platycola*. The discoid *Lagenophrys* and its relatives have operculariid peristomes and may belong to another phylogenetic line starting from *Opercularia*. Another group of peritrichs has soft flexible folded shells that may be easily deformed; 2 or more zooids inhabit such shells. A review of all known genera of this group was published by Jankowski (1993); at present, this group includes *Craspedomyoschiston, Rovinjella, Ruthiella, Kindella, Delamurea, Nidula, Shellositon*; the new genus *Grainis* is now added to this list.

"True" loricates, like *Cothurnia*, may be descendants of this group, and if this, my hypothesis, is correct, loricates with two zooids inside the shell (*Sincothurnia*) are more primitive than those with one cell (*Cothurnia*). The loss of myonemes in evolution might result in the formation of a rigid stalk supporting the shell of loricates on the substrate; discoid forms like *Platycola* are more evolved descendants of primary loricates.

Grainis and *Ruthiella* may be considered as derivates of *Pseudocarchesium* common on freshwater amphipods, like *P. steini* redescribed by Schödel (1985a); they have similar stalks and type of myoneme (= spasmoneme, as some authors call it). There is a striking

resemblance between the myonemes of *Grainis* (Fig. 2) and those on the photograph of *P. ovatum* published by Schödel (1985b); this species inhabits *Gammarus pulex* and *G. fossarum* and makes small colonies with wide folded stalks and with 2-3, rarely up to 6 zooids per colony.

Should we include the new Baikalian species in *Ruthiella* or it is distinct enough to belong to a new genus? The genus *Ruthiella* Schödel, 1983, is monotypic, with the type species *R. gammari* inhabiting *Gammarus pulex* and *G. roeselii* (= *Carinogammarus roeselii*) and absent on the recently introduced *G. tigrinus*, now widespread in Western Europe. *Ruthiella* inhabits an extremely narrow locus on its hosts: it is restricted to lower lip (labium), being absent on other buccal appendages (mandible, maxilliped, maxilles I and II); maxillipeds of hosts are occupied by *Lagenophrys matthesi*. For illustrated morphological descriptions of *Ruthiella*, data on host specificity, distribution and ecological requirements see Schödel (1983, 1986, 1987), Rustige (1990, 1991), Rustige & Mannesmann (1991, 1993), Rustige & Friedrich (1996), Mannesmann & Rustige (1994). This genus has so far not been found outside Germany, but its hosts are distributed throughout Western Europe, thus discovery of *Ruthiella* in other countries, including western Russia, may be predicted. *Ruthiella gammari* has large, widely open, asymmetrical shells with up to 18-20, usually with 4-10 zooids inside on the shell bottom; outer stalk of the shell reaches 110 μm in length; each zooid in a colony possesses its own myoneme, conical and unequal in size; they are merged into wide upper portion of the stalk and do not exceed half of the stalk length.

I prefer to treat the Baikalian species as belonging to a new genus, intermediate between *Pseudocarchesium* and *Ruthiella*. In *Vorticella* and *Haplocaulus*, the myoneme follows the stalk at its entire length; and in *Grainis*, likewise, it is extended from scopula to basodisc. According to Warren (1988), solitary peritrichs with such "complete" myoneme (*Haplocaulus*) and those with rudimentary ones, retained only in the upper part of the stalk (*Monintranstylum*), cannot be ascribed to the same genus. This view is widely accepted and is not controversial; thus I have no reason not to follow Warren, and to distinguish a similar pair of genera, *Grainis* and *Ruthiella*, in shelled peritrichs. We also should keep in mind that doubtful or disputable genera are usually perfect subgenera; "lumpers" may include *G. dizoon* in *Ruthiella*, retaining its name *Grainis* for a subgenus.

The discovery of *G. dizoon* raises one unresolved problem: are dizoic forms colonial or not, and what is a colony? Once I separated dizoic cothurnids from monozoic ones in different genera, *Cothurnia* and *Sincothurnia*; except for this feature, the zooids and shells are identical. I followed customary taxonomic practice, when in unshelled groups solitary peritrichs are invariably separated on generic level from those with 2 or more cells on a single stalk, as in the *Rhabdostyla – Epistylis* group. Perhaps the best solution is to distinguish 3 groups of peritrichs: monozoic (1 cell), dizoic (2 cells on single stalk or base, or in a joint shell, like *Platycola* without detectable stalk or disc), and colonial ones (3-4 or more cells, usually on branching stalk). With such a subdivision, in addition to the type of myoneme, dizoic *Grainis* is generically distinct from the colonial *Ruthiella*.

Both genera may be included in the family Rovinjellidae Matthes, 1972; its type *Rovinjella* inhabits marine sphaeromatid isopods in the Adriatic Sea and has 3-5 zooids with branching myoneme inside shell (Matthes, 1972). The baikalian genus may be a relict of shelled peritrichs that inhabited gammarids in surface waters of boreal Eurasia and disappeared with their hosts during extensive and long Siberian glaciation; Lake Baikal was a refugium for such symbionts. At present, only *Gammarus lacustris* is common around Baikal, and has uninterrupted range extending to Western Europe, but rovinjellids have so far not been found on this common and ubiquitous amphipod.

Acknowledgements

This study was supported by grant No. 96-04-48381 ("Symbiofauna of Lake Baikal") from the Russian Basic Research Foundation. The work was fulfilled using scientific collections of the Zoological Institute, Russian Academy of Sciences, which obtain financial support from the Science and Technology State Committee of Russian Federation (Reg. No. 97-03-16).

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Received 10 January 1997