*Results and discussion.* The adenylate-cyclase has been localized in mucous gland cells (figure 1), in rhabdite cells (figure 2), in nerve endings (figure 3) and in intercellular spaces (figure 4) of the planarian *Dugesia lugubris.* Figure 1 shows that the membranes of mucous gland cell bodies and of the terminal tract of their glandular processes are positive to the enzymatic reaction. It is possible to assume that the adenylate-cyclase controls the early and final stages of the mucous secretion phenomenon.

The enzymic activity is also present on the lateral membranes of contiguous rhabdite cells. Its highest activity has been found along the septate junctions, suggesting that the adenylate-cyclase is important for the ionic exchange between the rhabdite cells (figure 2).

Adenylate-cyclase activity is present on the membranes of nerve endings, connected to the brain by nerve fibres, which give rise to neural cilia (figure 3). This could be interesting, since Pigon et al.[15] have localized in these clumps of neural cilia, which are concentrated in the cephalic margin, the control of the fissioning process in planarians. This enzyme activity is also present around the intercellular spaces (figure 4). Since the large intercellular clefts in planarians, in which a vascular system is absent, have been suggested to have a function in ion and water transport[16], the adenylate-cyclase could mediate the absorption of these compounds from the cells.

Therefore, considering the presence of neurotransmitters in planarians, and that Franquinet et al.[11] have recently shown that adenylate-cyclase in *Polycelis tenuis* is activated in vitro by serotonin, such enzymic cytochemical localizations give a further proof for the presence of a particular neurotransmitter-sensitive adenylate-cyclase and might provide a basis for further work to determine particular physiological roles of adenylate-cyclase in this organism.

Moreover, further work on adenylate-cyclase from planarians might be useful for understanding the central mechanism of action of this enzyme.

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## Social behaviour versus temperature in the ciliate *Colpidium campylum*

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*Summary.* When *Colpidium campylum* are put in an observation chamber, they form groups of hundreds or thousands of individuals. In a temperature gradient, these groups find their preferred temperature range within a few hours, whereas isolated individuals can achieve this in min. This difference is caused by the social tendency of these ciliates.

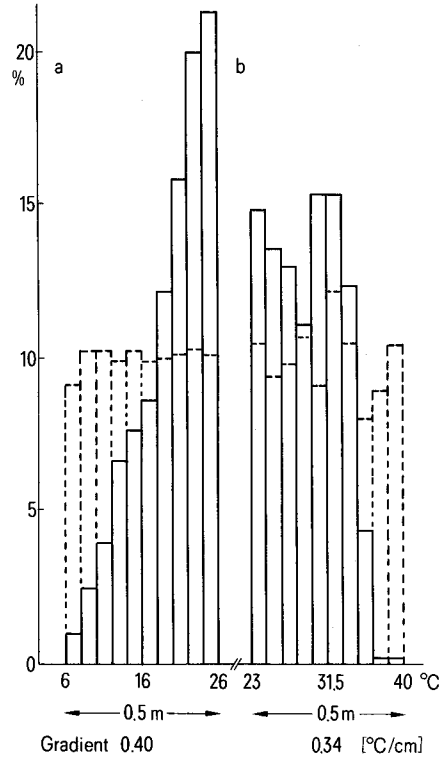
When subjected to a temperature gradient, ciliates of the species *Colpidium campylum* Bresslau 1922 search for a range of preferred temperature as other free living animals do. As these ciliates normally live in groups, we investigated the locomotion of groups in an observation vessel ($50 \times 8 \times 0.3$ cm) as well as that of isolated individuals in a glass capillary ($l = 50$ cm, $\varnothing = 1$ mm). The ciliates observed in the capillary were exposed to a linear temperature gradient from 0 to 45 °C, whereas the group-behaviour was observed in 2 temperature gradients (6–26 °C or 23–40 °C). Before setting the temperature gradient, the pattern of aggregation was determined at a homogeneous temperature of 24 °C.

When single individuals of *C. campylum* were placed in the capillary with the temperature gradient, they swam in a helical course from one end of the capillary to the other and back. At the warm end of the gradient, the turning point could be determined exactly at 42 °C, because of the phobic reaction. At the cold end, however, the speed of the ciliates decreased until they reached the ice and turned back. After they had been placed in the capillary, they swam from warm to cold through the preferred temperature range (24–28 °C) only a few times. Soon the turning points approached the 2 limits of the thermopreferendum, and after 3–5 min the individuals remained within the preferred temperature range.

The behaviour of *C. campylum* in a temperature gradient is strongly influenced by its social tendency[2,3]. This fact could be demonstrated by the following experiment: A large number of individuals ($10^4$–$10^5$) was dispersed equally in the observation vessel at a constant temperature of 24 °C. Within 2 h the ciliates formed groups with a macroscopic diameter of 1–6 mm at the bottom of the vessel. Contrary to the related ciliate, *Colpidium colpoda, C. campylum* aggretate in several layers, one upon the other[4].

At the initial homogeneous temperature, the distribution of the groups on the observation plane was equal (dotted columns of the diagram). When a linear temperature

gradient from +6 to 26 °C (0.4 °C/cm) and 23–40 °C (0.34 °C/cm), respectively, was set up within 20 min (initial homogeneous temperature 24 °C, rate of temperature change: 1.5 °C/min), all the groups migrated very slowly in the direction of the temperature preferendum. The solid line columns of the diagram show the distribution of the groups on the observation plane 2 h after the temperature gradient was set. At ambient temperatures above 38 °C, the groups of *C. campylum* dispersed, but not at lower temperatures.




Dispersion of groups of *Colpidium campylum* in the observation vessel (1 single trial out of 10 experiments). Dotted lines: dispersion in a homogeneous temperature field (24 °C) 2 h after starting the experiment. The total number of groups (a, 396; b, 297, each 1–6 mm ∅) is set as 100%. Solid lines: Dispersion 2 h after setting up the temperature gradient (a, +6–26 °C, b, 23–40 °C, number of groups in a: 172, in b: 177). The groups had moved in the direction of the preferred temperature range, but not all had already reached it. This took place after about 9 h, when all individuals were aggregated in 1 or 2 large groups within the preferred temperature range of 24–28 °C.

During migration these ciliate groups show a characteristic structure: A straight front of motionless individuals is formed in the direction of the preferendum. At the opposite end the ciliates are free-swimming, but never lose contact to the group. These individuals show a tendency to swim over the group in the direction of the preferred temperature and settle down at the front.

In the case of extremely large groups (∅ 10 mm), macroscopically speaking, it seems as if the group which may be regarded as a compact mass, protracts and retracts 'pseudopodia' in all directions. If one of them lies in the direction of the thermopreferendum, the whole group will follow. Obviously, this phenomenon can be interpreted as a system of exploration.

The locomotion of the whole group is much slower than that of the isolated individuals in the capillary; nevertheless the orientation of the whole group during migration is precise. High temperature sensitivity must be assumed in the individual given such a little temperature change per time unit[5]. Under our experimental conditions, it takes a group 2–3 h to migrate over a distance of 10 cm. After a sufficient time (about 9 h) all groups reach the thermopreferendum and form one or 2 large aggregations within that zone.

The results of 15 experiments indicate that isolated individuals of *Colpidium campylum* are able to find their thermopreferendum in a temperature gradient within a few min. Within a group, the social tendency prevents the single members from giving up contact with the other individuals, thus working against a rapid search for a more favourable environment. This does not hold true for ambient temperatures above 38 °C. In this case the avoiding tendency is predominant.

This behaviour in *C. campylum* is neither related to sexuality, food absorption, nor to abiotic factors such as light, oxygen, etc., but to the social disposition of the animals. A different kind of social behaviour has been discovered in *Colpidium colpoda*[6].

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## $Mg^{2+}$-ATPase defective mutant of *Escherichia coli* and thiamine transport

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*Summary.* $Mg^{2+}$-ATPase deficient mutant of *Escherichia coli* showed an evident dependency of thiamine uptake on the oxidative metabolism of glucose, whereas the parent strain did not. In both cells, this uptake was completely inhibited by $H^+$ conductors.

Although many studies have been reported which account for the energy requirement in the uptake of thiamine by microbial cells[2–7], the roles of intracellular ATP and $H^+$ gradients across the cell membrane have not been established. This paper describes the possibility of participation by an activated membrane state in a shock sensitive system of thiamine uptake.

*Results and discussion.* The table shows characteristics of the 2 types of mutants which were obtained. In the strain 19-1 the activity levels of $Mg^{2+}$-ATPase were within the normal variation of nonenzymatic dephosphorylation of ATP during the assay. The strain 16-1 was isolated as a low glycolytic activity mutant. The levels of glycolytic $H^+$ production and $O_2$ consumption were about 25% or less in