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Bohuslav Fott:

Šupiny chrysomonády *Mallomonas* v elektronovém mikroskopu

(Se snímkem v elektronovém mikroskopu od Dr M. Rozsívala)

Křemité šupiny chrysomonády *Mallomonas tonsurata* Teiling jeví v elektronovém mikroskopu submikroskopickou strukturu. Jsou proděravělé četnými, pravidelně uspořádanými póry, podobně jako valvy a septy sladkovodní rozsivky *Attheya Zachariasi* (Fott 1951) a mořské *Chaetoceras didymus* (Desikachary and Bahadur 1954).

Eliptičnou šupinu zpevňuje kosočtverečný rám, viditelný v světelném mikroskopu. Šupiny jsou k sobě těsně přiloženy tak, že okraje vně od kosočtverečného rámu se překrývají. Vzniká tak souvislý křemitý krunýř, pevný, ale pružný. Osten jest zasazen do kruhovitého útvaru s pevným, zdviženým okrajem. Tvar a struktura šupin jest důležitým taxonomickým znakem, podle něhož se jednotlivé druhy rozeznávají. V světelném mikroskopu bývá struktura šupiny nezřetelná a její výraznost záleží na optické mohutnosti objektivu. Elektronové snímky šupin umožní jistě bezpečné rozlišování druhů.

Poroidní struktuta křemitých šupin dokazuje, že pektinový obal chrysomonád s hustě uloženými šupinami umožňuje látkovou výměnu protoplastu s vnějším prostředím podobně jako poroidní buněčná blána rozsivek. Potvrzuje také Pascherovu domněnku, že *Chrysophyceae* a *Diatomae* náleží do kmene *Chrysophyta*.

Bohuslav Fott:

Scales of *Mallomonas* observed in the electron microscope

(With an electron micrograph by Dr. M. Rozsíval)

The cells of *Mallomonas* are characterised by possessing a thin pectic envelope in which are lodged numerous small imbricated silicified scales. Some of these bear long delicate silica bristles which are hinged. The size, form and structure of the scales and bristles are of a taxonomical value and according to their distribution the different species are distinguished. But the structure of the scales is often hardly discernible in a light microscope and depends on the magnification power of the objective used.

When examininge the scales of *Mallomonas tonsurata* Teil.) var. *alpina* (Pasch. et Rut.) Krieg. in an electron microscope, I could discern some details, not seen in the light microscope. The electron micrographs reveal that the scales are perforated by many round pores, dispersed regularly without showing any system of arrangement. The appearence of the pores is like that of the submicroscopical structure of the valves and septae of some diatoms, the frustules of which are slightly silicified and show no structure in the light microscope, e. g. *Attheya Zachariasii* (Fott et Rozsíval 1950) and *Chaetoceros didymus* (Desikachary et Bahadur 1954). The existence of a poroid structure of the scales in *Mallomonas* suggests that the envelope of *Mallomonas* is of a quite different character from that of the envelopes of the other chrysomonads. The envelope (lorica) of *Kephyrion*, *Kephyriopsis*, *Lepochromulina*, *Chrysopyxis*, *Pseudokephyrion*, *Stenocalyx*, *Epipyxis*, *Dinobryon* etc.) is a dead

exudate, in which the protoplast is freely situated. Sometimes the envelope is broadly opened (e. g. in *Dinobryon*, *Kephyrion* etc.). The wall of these loricas is either thin and structurless or thick, due to increasing rings and to the impregnation of iron salts; in the latter case the surface may be coarse. Quite another feature is the envelope of *Mallomonas*, *Synura* etc. Here the protoplast is embedded in a pectic envelope (Hülle of the German writers) in which perhaps the scales are exsuded. This pectic covering is soft and elastic, consolidated by numerous imbricated silicified scales. These scales lie in dense rows, forming a coherent armour, closely surrounding the protoplast. Owing to this arrangement the pectic covering with embedded scales affords not only a mechanic protection of the living protoplast, but also acts as a membrane with a physiologic activity. It acquires in this way the properties of a true cell-membrane. It is not unlike the membrane of diatoms, being composed of two substances: a pectic layer and an armour of silica-scales, which have a similar submicroscopical structure as the valves and septae of some diatoms (e. g. *Attheya* et *Chaetoceras*). These features bear out P a s c h e r's conception (1914, 1921) that *Chrysophyceae*, *Diatomeae* and *Heterokontae* belong to a common evolutionary unit: the *Chrysophyta*.

The electron micrographs of the scales of *Mallomonas* offers promising possibilities for the determination of the species, as the taxonomy of the genus is based mainly upon the morphology of its scales. The electron microscope reveals many details, not visible in the light microscope, and the micrographs make it possible to reconstruct the scales. H a r r i s (1953) tried to show a diagrammatic reconstruction of the scales. She distinguished three parts of each scale: the shield, the dome and the flange. In *Mallomonas intermedia* she believes that the shield is a roughly triangular plate of silica, slightly thickened at the edges and somewhat hollowed out on its outer side. The dome is a hollow silica hemisphere projecting obliquely outwards from the shield and forming a conspicuous knob in the profile view of the cell. The base of the bristle comes into contact with the dome. The flange is a delicate silica margin along the two sides of the shield, farthest from the dome (H a r r i s, l. c. p. 97).

The species of *Mallomonas*, studied by me, was identified according to the morphology, as said, in the light microscope, as *M. tonsurata* T e i l i n g var. *alpina*. Their scales are broadly elliptical plates 4.2—5 μ in length, 2.4—3.2 μ in breadth. They are perforated by numerous pores and thickened at the edge which is slightly bent. A massive rhomboidal frame (the "shield" of H a r r i s) is lying upon the scale, joined with a thickened edge by means of many connecting bands. On the other side of the frame similar short runners fix the frame-work to the plate. A round massive collar of silica is formed at the other end of the scale, where the bristle is affixed. The mode of the attachment of the bristles to the scales has not been ascertained. The bristles are denticulated at the end as the electron micrographs showed. In light microscope only when using the apochromat 2 mm of Zeiss n. A. 1.4 the teeth are hardly visible.

The submicroscopical structure of mineral scales in Chrysomonads seems to occur commonly in those cases where the scales are exsuded by a pectic envelope. Such a structure of unusual complexity and beauty was ascertained in *Mallomonas*, in various species of *Synura* (not published) and in marine Coccolothophorids (B r a a r u d, R i n g d a l, M a r k a l i et N o r d l i 1952).

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Explanation to the plate.

Above: Scales and bristles of *Mallomonas tonsurata*, photographed in the light microscope. When using the best objective (Zeiss Apochromat) the fine teeth towards the end of the bristle could be distinguished. — (Photo J. Fiala. Magnification 2500×.)

Below: The electron micrograph of a scale of *Mallomonas tonsurata*. The fresh material of the flagellate was dropped on the folie of the object support of the electron microscope and observed without any preparation. The photograph was taken by Dr. M. Rozsíval in the Institute of Physics of the Charles University with an electron Microscope Trüb, Tauber, Zürich. Our thanks are due to the Czechoslovak Chemical Works, National Corporation in Prague, the proprietor of the electron microscope. (Magnification 20.000×).

Богуслав Фотт:

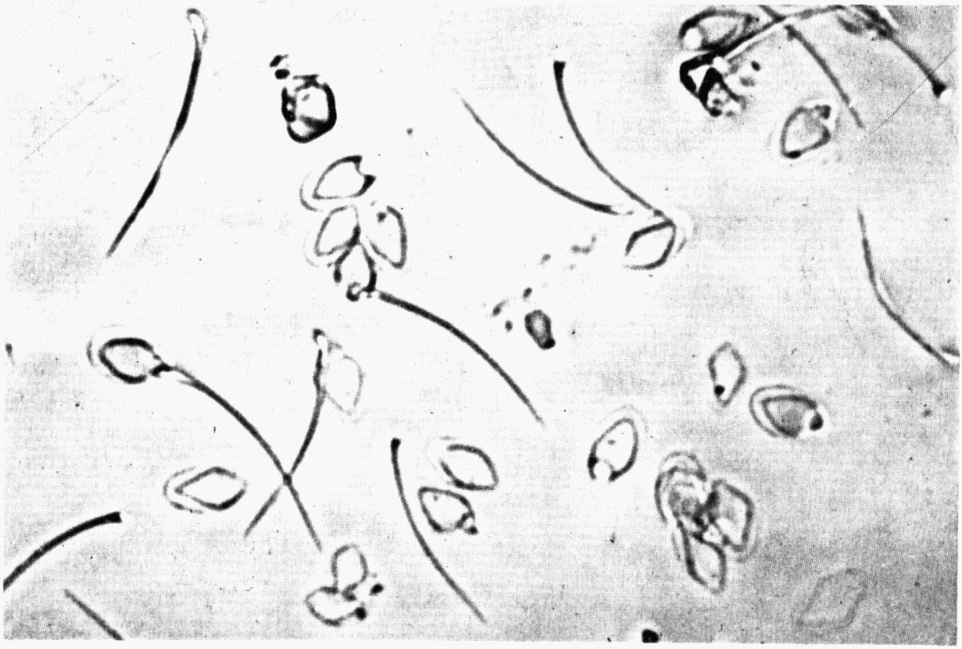
Чешуи хризомонады *Mallomonas* в электроновом микроскопе

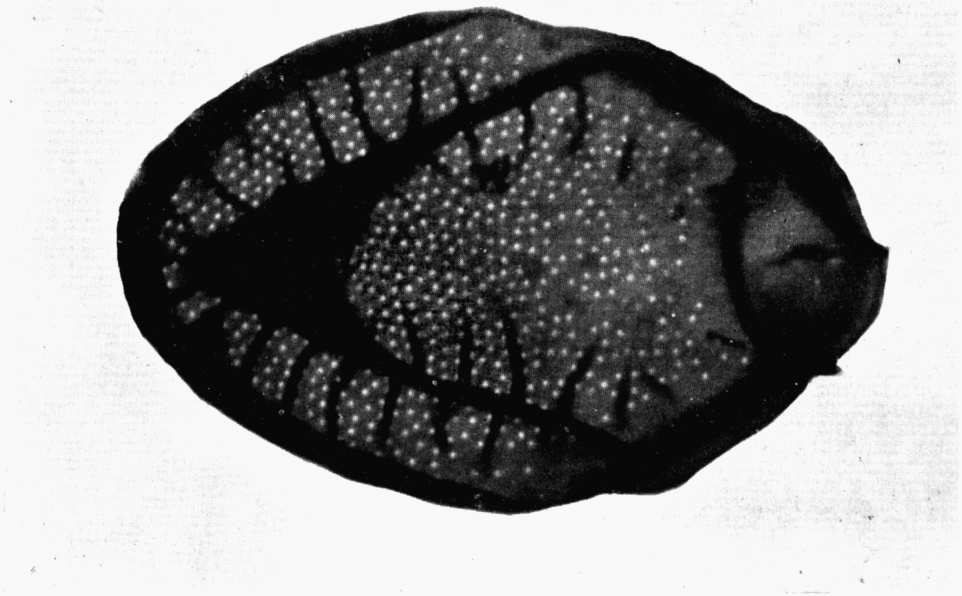
(С фотоснимком электроного микроскопа д-ра М. Розсивала)

Кремнистые чешуи хризомонады *Mallomonas tonsurata* Teiling в электроновом микроскопе обнаруживают субмикроскопическую структуру. Они пронизаны многочисленными, правильно расположенными, порами, подобно тому как вальвы и септы пресноводной диатомеи *Attheya Zachariasi* (Fott 1951) и морской диатомеи *Chaetoceras didymus* (Desikachary and Bahadur 1954).

Эллиптическую чешую скрепляет ромбовидная рамка, видимая в световом микроскопе. Чешуи так тесно прилегают друг к другу, что их края, вне ромбовидной рамке, прикрываются. Таким образом образуется связный кремнистый панцырь, твердый, но эластичный. Шип всажен в кольцообразное образование с твердым, приподнятым краем. Форма и структура чешуй является важным таксономическим признаком, по которому отдельные виды распознаются. В световом микроскопе структура чешуи бывает неясной и ее выразительность зависит от оптической силы объектива. Электроновые фотоснимки чешуй дадут возможность действительно безошибочно распознавать виды.

Пористая структура кремнистых чешуй доказывает, что пектиновая оболочка хризомонад, с густо расположенными чешуями, способствует обмену веществ между протопластом и внешней средой, подобно тому как у пористой клеточной оболочки диатомовых водорослей. Подтверждается также предположение Пашера, что *Chrysophyceae* и *Diatomae* относятся к типу *Chrysophyta*.





B. Fott: Šupiny chrysomonady Mallomonas.