

THE STRUCTURE OF THE CHELICERAE IN WATER MITES OF THE GENUS *EYLAIS* LATREILLE, 1796 (ACARIFORMES)

СТРОЕНИЕ ХЕЛИЦЕР ВОДЯНЫХ КЛЕЩЕЙ РОДА *EYLAIS* LATREILLE, 1796 (ACARIFORMES)

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ABSTRACT

The description of the cheliceral structure of adult water mites of the genus *Eylais* Latreille, 1796 is given.

Chelicerae (ch) are enclosed with a continuous sclerite ring resulting from the extension of hypostomal plicae (hpl) and their complete junction around the preoral opening (por; Figs. 1 b, c, d; 2 a, b, c). Chelicerae are two-segmented and represented by massive broadened basal segments and curved bulb-shaped apical segments (dm; Figs. 3 a–c; 4 a–d). Basal segments are joined dorsally by the film forming pseudocapitulum (pc; Fig. 1 a–c). Chelicerae possess only protractor muscles (protr. ch; Fig. 4 a); the retractor musculature is absent. Cheliceral claws are located opposite to membranous appendages (m; Figs. 3 c; 4 b–d). Movable digits are located in a hollow (hch) of the sclerite appendages of basal segments (ach; Figs. 2 a; 3 a–c; 4 b–d). The junction of a movable digit is supported by two ligaments (lg₁, lg₂; Fig. 4 b–e). The movement of movable digits takes place due to elevator (elev. dm) and depressor muscles (depr. dm), which are located in the hollow of basal segments (Fig. 4 a–d). The antagonistic muscles contract alternately and make the movable digit to perform arched oscillatory movements around the articulation by a short ligament (Fig. 4 b–d).

The water mites *E.hamata* Koenike, 1897; *E.rimosa* Piersig, 1899, and *E.setosa* Koenike, 1897 have a cavity inside a movable digit (hdm), apparently filled with a secret (sa; Fig. 4 d, e). In several cases the duct originated from within the secretory sac was found inside a movable digit (du; Fig. 4 e). This duct opens with a pore (po) in the apical part of the cheliceral claw (sdm; Figs. 1 d; 2 a–d; 3 c; 4 e).

However, further histological investigation is needed to understand completely the structure and functions of secretory formations associated with the movable digits of water mites of the genus *Eylais*.

РЕЗЮМЕ

В статье приведено описание строения хелицер имаго водяных клещей рода *Eylais* Latreille, 1796 на примере *Eylais hamata* Koenike, 1897.

Хелицеры (ch) заключены в непрерывное склеритное кольцо — результат разрастания гипостомальных складок и их полного слияния вокруг околоротового отверстия (por; рис. 1 b, c, d; 2 a, b, c). Хелицеры двучлениковые, представлены массивными расширенными базальными сегментами и загнутыми булавовидными апикальными сегментами (dm; рис. 3 a–c; 4 a–d). Базальные сегменты срастаются дорзально перепонкой, образуя псевдокапитулюм (pc; рис. 1 a–c). Хелицеры имеют мускулы-выдвигатели (protr. ch; Fig. 4 a); ретракторная мускулатура отсутствует.

Апикальные сегменты хелицер (хелицеральные коготки, подвижные пальцы, хелы) расположены в пазухах (hlh) склеритных выростов базальных члеников (ach, рис. 2a, 3 a–c, 4 b–d). Хелам противопоставлены мембранозные придатки (m, рис. 3c, 4 b–d). Присоединение хел обеспечивают две лигаментные связки (lg₁, lg₂, рис. 4 b–e), движение которых обусловлено попеременным сокращением мышц-элеваторов и -депрессоров (elev. dm, depr. dm, рис. 4a), находящихся в полостях базальных члеников. У клещей *E. hamata* Koenike, 1897; *E. setosa*

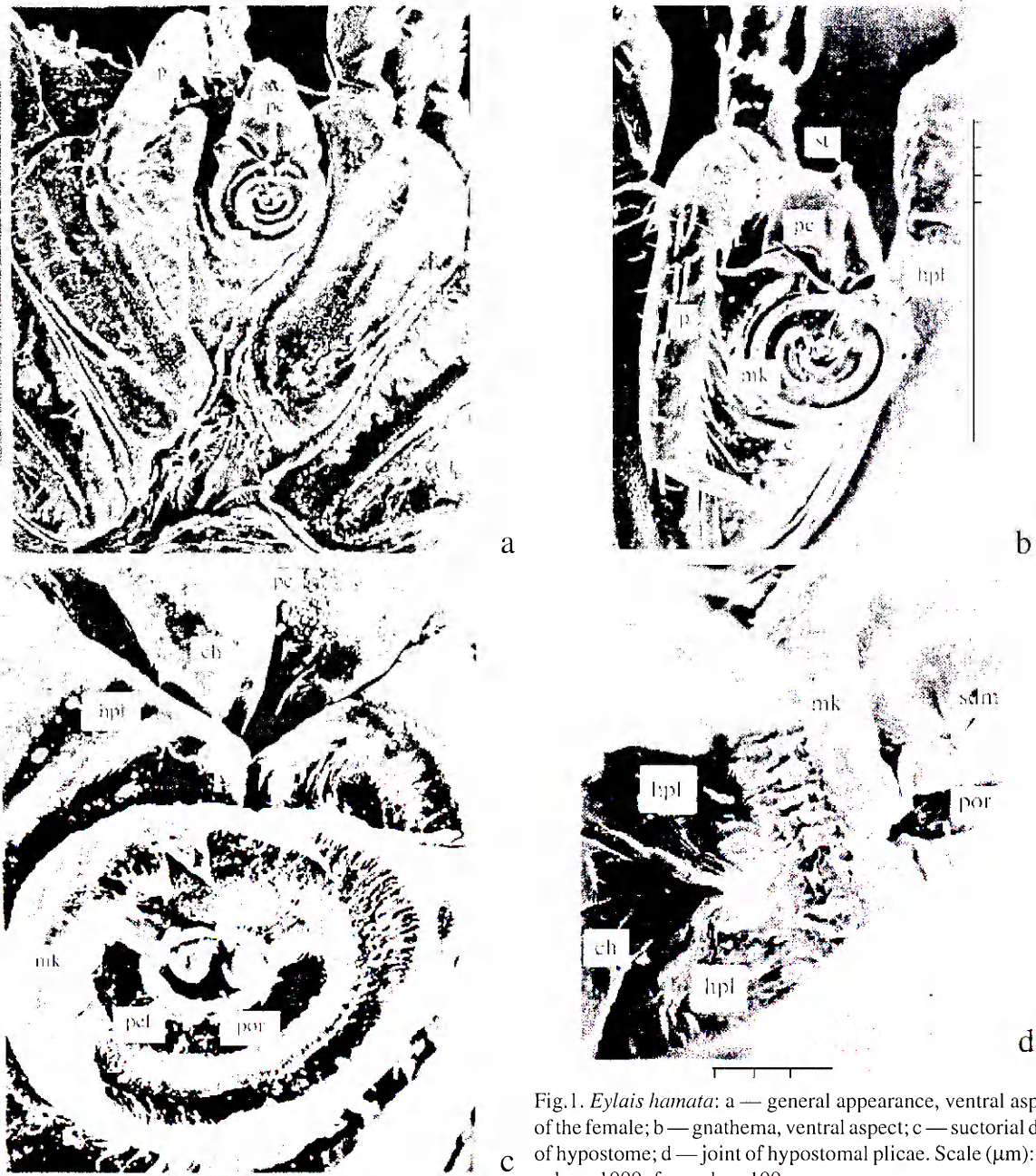


Fig.1. *Eylais hamata*: a — general appearance, ventral aspect of the female; b — gnathema, ventral aspect; c — suctorial disk of hypostome; d — joint of hypostomal plicae. Scale (μm): for a, b — 1000; for c, d — 100.

Рис.1. *Eylais hamata*: a — общий вид, вентральная сторона самки; b — гнатема, вентральный вид; c — гипостомальный присасывательный диск; d — участок сращения гипостомальных складок. Масштаб (μm): для a, b — 1000, для c, d — 100.

Abbreviations: ach — sclerite appendage of the basal segment of the chelicera; c — capsule of the gnathema; ch — chelicera; depr. dm — depressor of the cheliceral claw; dm — cheliceral claw, or chelae, or movable digit; du — duct from the secretory sac; elev. dm — elevator of the cheliceral claw; hch — hollow in the appendage of the basal segment of the chelicera; hdm — hollow in the cheliceral claw; hpl — hypostomal plica; lg₁ — short ligament of the movable digit; lg₂ — long ligament of the movable digit; m — membranous appendage of chelicera; mk — membranous collar of the hypostomal suctorial disk; or — oral opening; p — palp; pc — pseudocapitulum; pel — pellicle surrounding the preoral opening; ph — pharynx; po — pore on the top of the cheliceral claw; por — preoral opening; protr. ch — protractor of the chelicera; s — sigmoid piece; sa — secretory sac sch — subcheliceral space; sdm — top of the cheliceral claw; st — stigma.

Обозначения: ach — склеритный вырост базального сегмента хелицеры; c — капсула гнатемы; ch — хелицера; depr. dm — мышцы-опускатели подвижного пальца хелицеры; dm — подвижный палец хелицеры, хела или хелицеральный коготок; du — проток от секреторного мешочка к выводной поре; elev. dm — мышцы-подниматели подвижного пальца hch — пазуха в склеритном выросте базального членика хелицеры; hdm — выемка в основании подвижного пальца; hr — гипостомальная складка; lg₁ — короткий лигамент подвижного пальца; lg₂ — длинный лигамент подвижного пальца m — мембранозный придаток хелицеры; mk — мембранный воротничок, ограничивающий гипостомальную присоску; or — ротовое отверстие; p — пальпа; pc — псевдокапитулум; pel — пелликула, окружающая предротовое отверстие; ph — глотка; po — пора на верхушке подвижного пальца; por — предротовое отверстие; protr. ch — мышцы-выдвигатели хелицер; s — сигмоид; sa — секреторный мешочек; sch — субхелицеральное пространство; sdm — верхушка подвижного пальца; st — стигма.

Koenike, 1897; *E. rimosa* Piersig, 1899 внутри подвижных пальцев обнаружена полость (hdm, рис. 4 d–e), заполненная, вероятно, секретом (sa, рис. 4e). В некоторых случаях удалось проследить выводной каналец внутри хелы (du, рис. 4e). Выводной каналец открывается порой (po) на апикальном участке хелы (sdm, рис. 1 d, 2 a–d, 4 e). Однако для окончательного выявления строения и функций секреторных образований, связанных с подвижными пальцами хелицер клещей рода *Eylais* необходимы дальнейшие тщательные гистологические исследования.

INTRODUCTION

Water mites of the genus *Eylais* (Eylaidae) are typical inhabitants of the lentic bodies of water. The larvae of the *Eylais* are parasitic on aquatic insects whereas the nymphs and adult mites are actively swimming predators. Cladocera and Ostracoda are most frequently preyed upon by the active stages of the *Eylais* [Bottger, 1962; Smith, Oliver, 1986].

The mouth apparatus, or gnathema, in water mites is a separate complex of organs, which includes pedipalps, chelicerae, and some structures surrounding the mouth opening. While the external digestion and sucking out the alive tissues of the prey is the method of feeding, same for the whole group, the morphology of the mouthparts in water mites is species-specific. The rich diversity of the gnathema modifications is provided by the high morphological flexibility of its elements. However in all cases the general plan of the mouthpart construction stays the same and is attributive to the order Acariformes [Lange, 1962; Mitchell, 1962]. Besides, despite any modifications of the mouthparts, the chelicerae remain free and are able to penetrate the prey cuticular coverings whilst the hypostome and pharynx form the sucking organs.

The cheliceral morphology was studied by methods of light and electron microscopy. For the light microscope (MBI-6), the mouthparts were clarified in the lactic acid. The sclerite elements were washed away with the eau de Javel from soft tissues before studying the mouthparts under the electron scanning microscope (JSM-25).

RESULTS

The mouthparts of the adult *Eylais* were studied by many authors both from taxonomic and functional morphology points of view [Kroneberg, 1878; Nordenskiöld, 1898; Viets, 1949, 1950a, 1950b; Mitchell, 1962; Wainstein, 1980; Tuzovskii, 1987; Zhavoronkova, 1992].

Gnathema in *Eylais* is distinguished by the extreme complexity of the mouthparts resulting from the development of the hypostomal suctorial disc around the preoral opening (por, Figs. 1 c, d; 2 a–c). The suctorial disc functions as a pneumatic suction cup. It is formed by the outgrowth of hypostomal plicae (hpl) of the gnathema capsule (c). Lately they have become completely fused at the apical part of the hypostome (Fig. 1 a–d). The disc is surrounded by the wheel-like membranous structure, the mouth jabot (mk), that limits the suction cup cavity (Figs. 1 b–c, 2a). The chelicerae are embraced by the continuous sclerite ring (Figs. 1 b–d; 2a; 4a) that is not typical for water mites [Lange, 1962]. It is clear that the sclerite ring around the chelicerae is secondary in origin. This particular modification is an element of the vacuum suction cap that provides firm attachment of a mite to its host as well as the hermetization of the liquid food ingestion process in aquatic milieu.

The chelicerae have a unique structure. Two-segmented chelicerae are located in a pit between hypostomal plicae. They are represented by large basal segments and relatively small curved movable digits, which are also known as cheliceral claws, or chelae (dm). The membranous appendages (m; Figs. 3 a–c; 4b–d) are contradicted by chelae. The cheliceral hollow bottom and ventral surfaces of chelicerae limit the subcheliceral surface (sch; Fig. 4a). The mouth (or), which is covered by a small epistome (e), opens into the pharynx (ph; Fig. 4a). The pharynx structure is an important feature in the taxonomy of mites of the genus *Eylais*. The bases of basal segments are greatly enlarged and fused by means of the dorsal membranous structure, altogether forming a pseudocapitulum above the gnathema capsule (pc; Fig. 1 a–c). Obviously, in this case the chelicerae cannot move independently from each other. Tracheae are situated between chelicerae. They have stigmae (st) dorsally on subcapitulum (Figs. 1b, 4a). The opposite tracheal ends are included in the upper parts of sclerotized structures, sigmoids (s), where they form closed cavities.

The protraction of chelicerae is provided by the sigmoid-cheliceral complex, which is represented by sigmoid and protractor muscles (protr.ch., Fig. 4a). The retractor musculature of the chelicerae was not found. Possibly the chelicerae return to their primary position by depressing the protractor muscles.

The movable digits of the chelicerae are not connected to each other. Their apical parts (sdm)

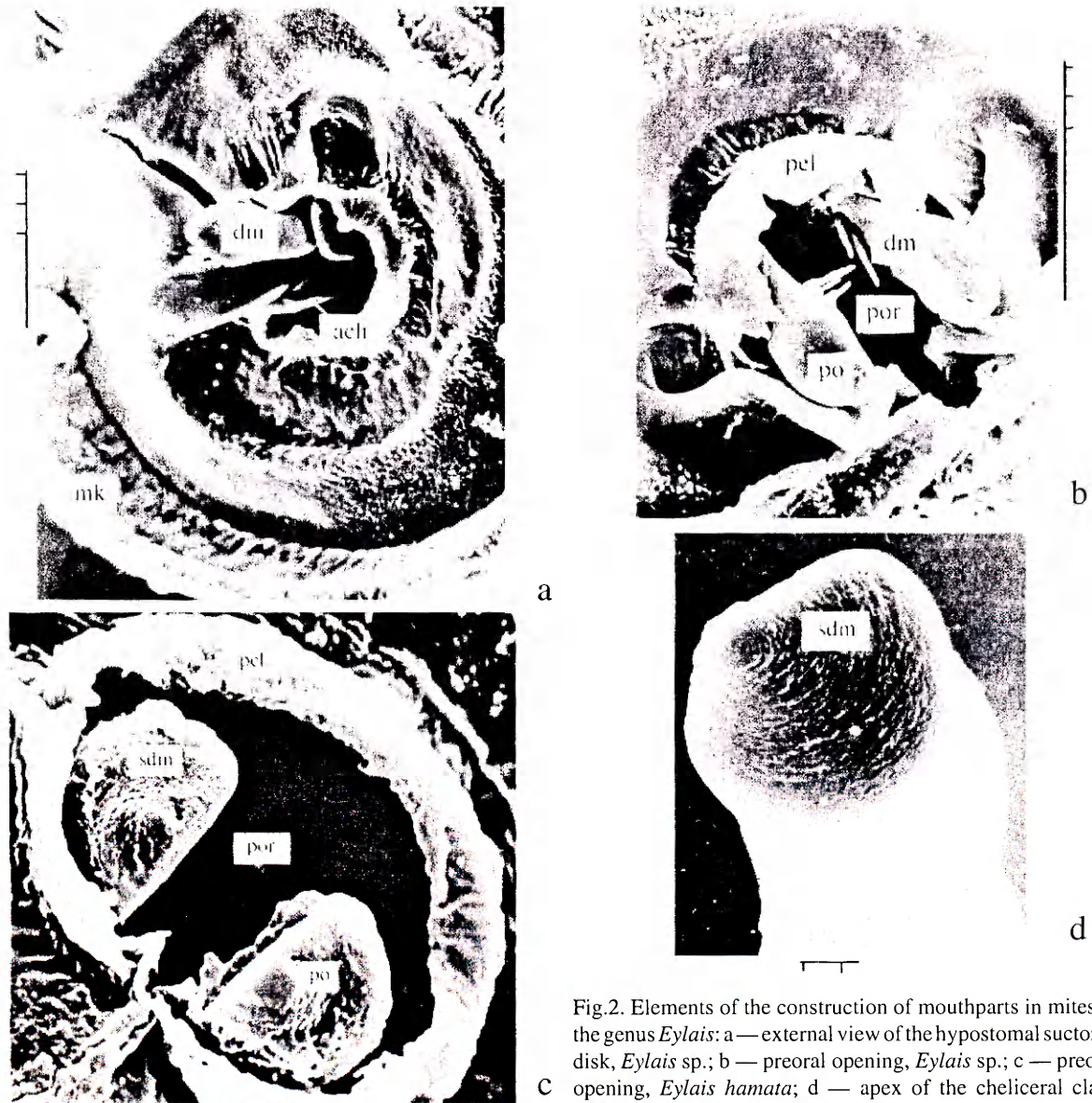


Fig. 2. Elements of the construction of mouthparts in mites of the genus *Eylais*: a — external view of the hypostomal suctorial disk, *Eylais* sp.; b — preoral opening, *Eylais* sp.; c — preoral opening, *Eylais hamata*; d — apex of the cheliceral claw, *Eylais* sp. Scale (μm): for a, b — 100; for c, d — 10. See Fig. 1 for abbreviations.

Рис. 2. Элементы строения ротового аппарата эйлайд: а — внешняя организация гипостомальной присоски *Eylais* sp.; б — предротовое отверстие *Eylais* sp.; в — предротовое отверстие *E. hamata*; д — верхушка подвижного пальца, пробивающая покров жертвы *Eylais* sp. Масштаб (μm): для а, б — 100, для в, д — 10. Обозначения см. на рис. 1.

are bulb-like, dark brown pigmented and curved regarding to their bases almost at right angle (Figs. 1d; 2a–d; 3 a–c; 4 a–e). The movable digits are located in pits (hch) of the sclerite appendages of the basal cheliceral segments (ach, Figs. 3 a–c; 4 b–d). Two connective ligaments provide the attachment of the movable digit. One of them is short (lg_1). It connects the corresponding sclerite appendage of the chela with the bottom of the hollow where the chela is situated (Fig. 4c–e). The second ligament, which is longer (lg_2), is situated between the basal part of the chela and the internal surface of the lateral external wall of the first cheliceral segment (Fig. 4 b,c,e).

The movement of chelae is provided by the work of elevator muscles (elev. dm) and depressor muscles (depr. dm) of movable digit, which occupy the internal space in the basal cheliceral segment (Fig. 4a). Periodically contracting, the antagonistic muscles force a chela to make small curve-like periodical movements by short ligament around its base. At this time the movements of the movable digit is limited by sclerotized projection of the first segment of the chelicera and, probably, by the long ligament.

In several mites of the genus *Eylais*, the hollow (hdm) within a cheliceral claws which is probably

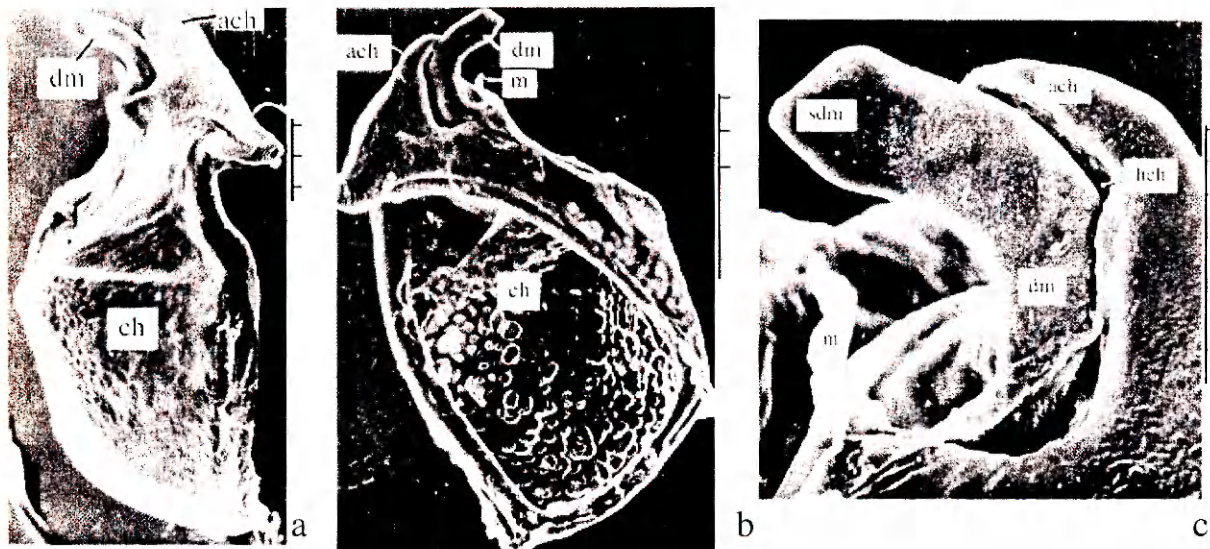


Fig.3. *Eylais hamata*, structure of the chelicerae: a — external lateral aspect; b — internal lateral aspect; c — articulation of the cheliceral claw. Scale (μm): 100. See Fig. 1 for abbreviations.

Рис.3. Строение хелицер *E.hamata*: а — внешняя латеральная сторона хелицеры; б — внутренняя сторона хелицеры; с — приращение подвижного пальца. Масштаб (μm): 100. Обозначения см. на рис. 1.

filled with a secret, was discovered. Secretory sac (sa) partially exceeds the hollow limits (Fig. 4 d,e). In some cases it the extraction canal inside the chela (du), which opens with a pore (po) was well discernible at the apical part of the movable digit (Figs. 1c, d; 2 b, c; 4e). The pore opening is microscopically small. It is located a little ventrally regarding the chela tip, which functions to pierce the victim cuticle.

DISCUSSION

The preoral glands found in the cavities of chelae together with earlier described ducts of salivary glands [Mitchell, 1962; Zhavoronkova, 1992] are the parts of external digestion apparatus. Secrets of those glands are injected into the victim body immediately after the prey is pierced by chelae. The external digestion glands and the gut in water mites are associated only physiologically and not connected topographically.

When attacking the prey the water mites of the genus *Eylais* grasp the victim with their swimming I and II pairs of legs and pedipalps (p; Fig. 1a, b) and attach themselves to its body using suctional hypostomal disc. Then the bulb-like chelae pierce and rip open the victim coverings. The secret of the preoral glands located inside chelae and the secret brought into preoral subcheliceral space by salivary gland ducts go to the wounded area. The function of secretory organs located in chelae is not yet known. It is possible that the secret injected by chelae into the victim body is necessary for immobilizing the prey.

The secretory organs, associated with the movable cheliceral digit, which were described earlier, have been found in *E.hamata* Koenike, 1897; *E.setosa* Koenike, 1897, and *E.rimosa* Piersig, 1899. However, the methods of light and scanning electron microscopy are not sufficient in this particular case for the thorough and detailed study of these morphological structures. The excretory duct and the pore at the apical end of the movable cheliceral digit are not always discernible. Further histological research is needed to explain the organization and function of these structures.

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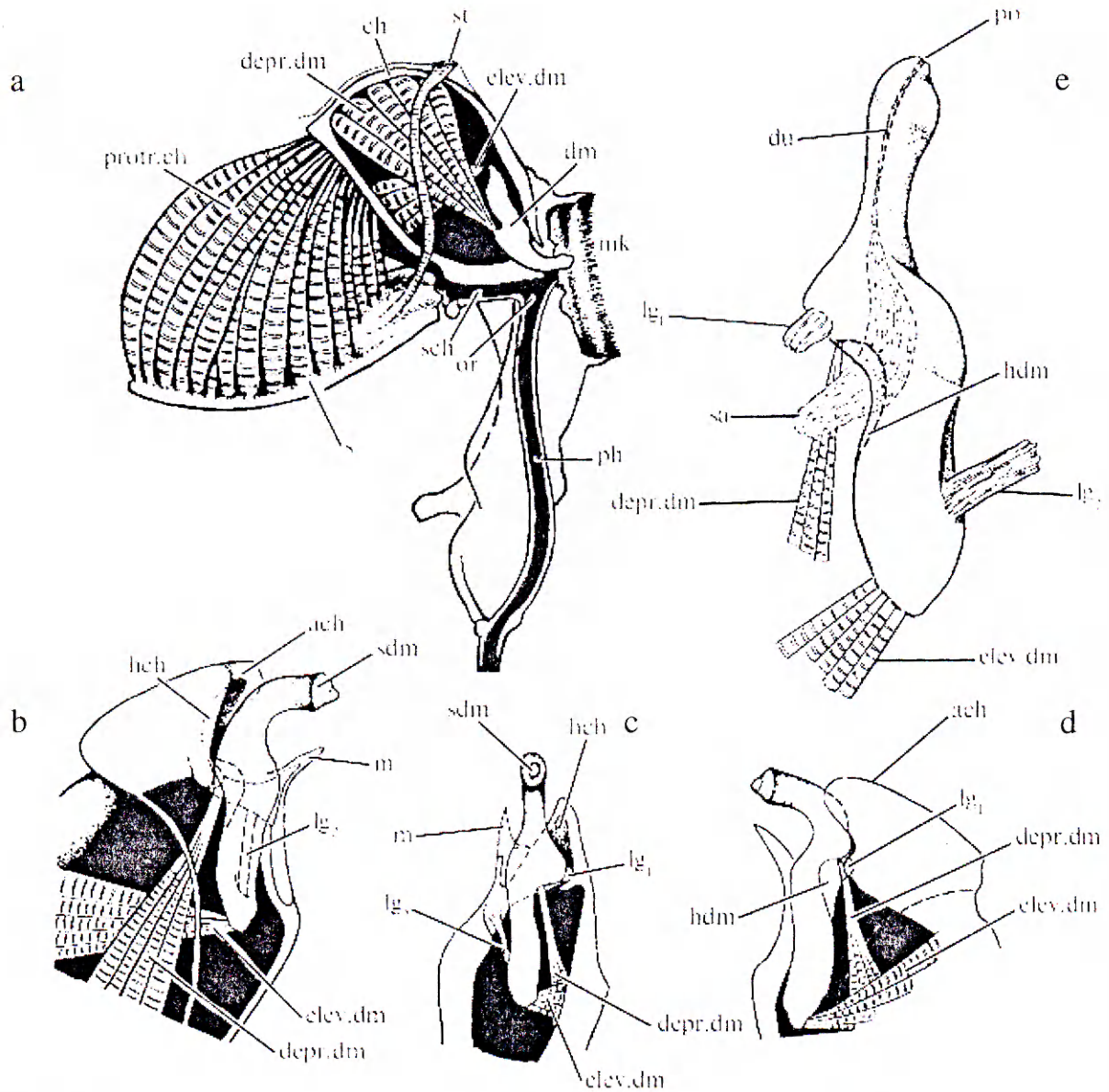


Fig.4. *Eylais hamata*, sclerite-muscular system of the chelicera and organization of the cheliceral claw: a — arrangement of the cheliceral musculature; b — articulation of the cheliceral claw, internal lateral aspect; c — articulation of the cheliceral claw, ventral aspect; d — articulation of the cheliceral claw, external lateral aspect; e — construction of the cheliceral claw, dorsal aspect. See Fig.1 for abbreviations.

Рис.4. *Eylais hamata*, склеритно-мышечная система хелицеры и строение подвижного пальца: а — расположение мускулатуры хелицер; б — приращение подвижного пальца, внутренняя латеральная сторона; в — то же, вентральная сторона; д — то же, внешняя латеральная сторона; е — строение подвижного пальца, дорсальная сторона. Обозначения см на рис.1.

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