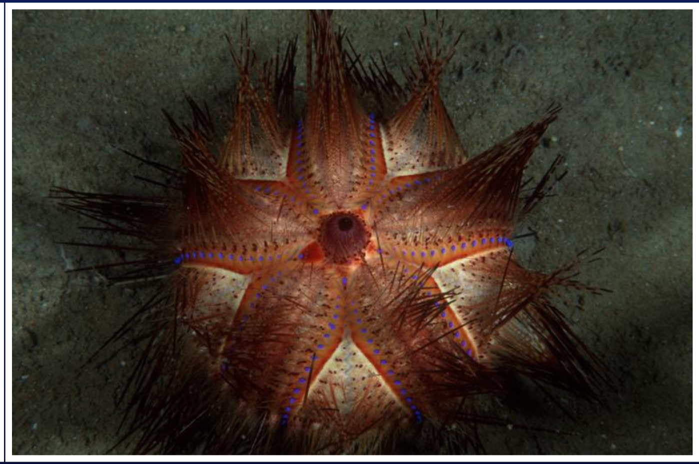
Echinodermata

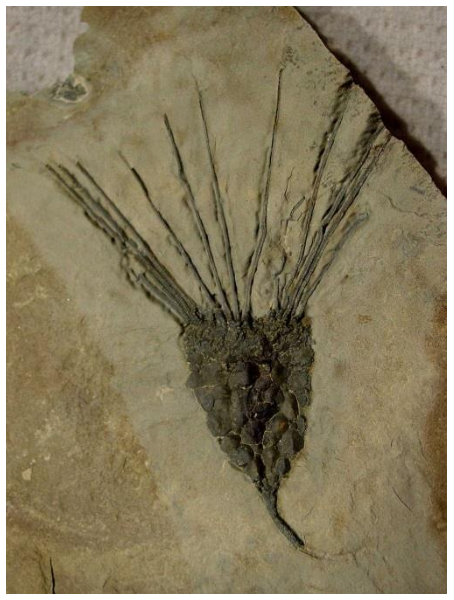




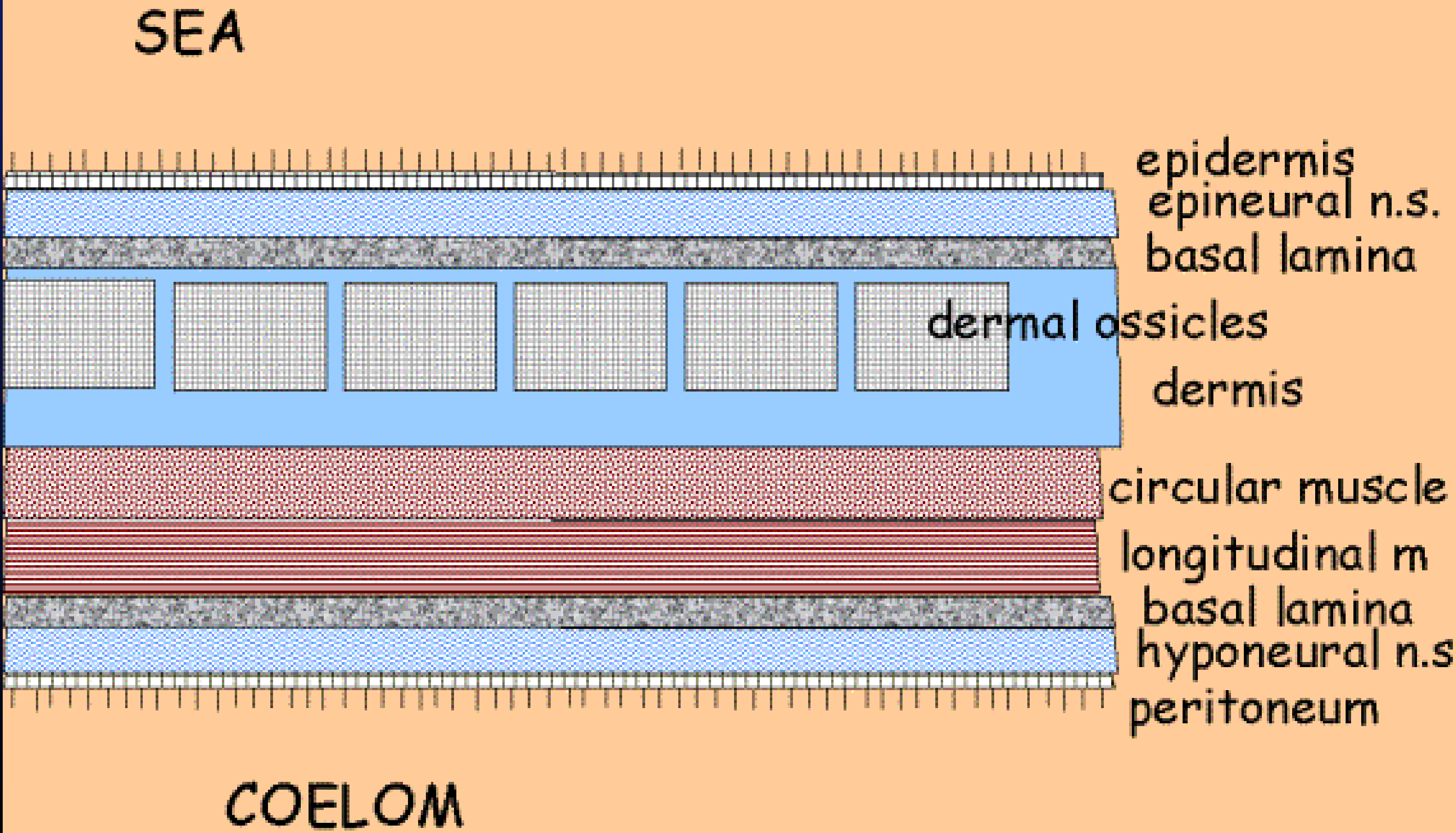

Echinodermata

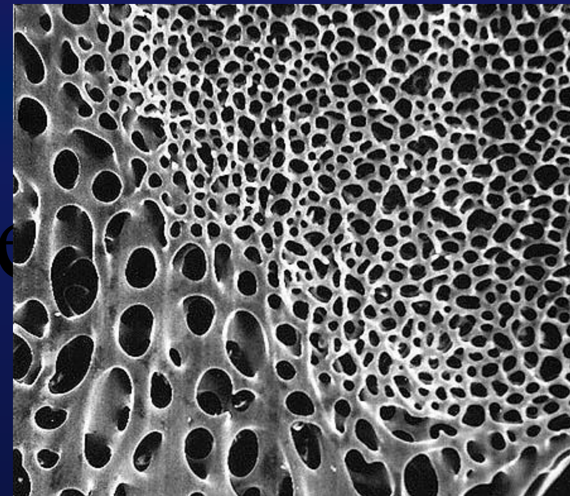



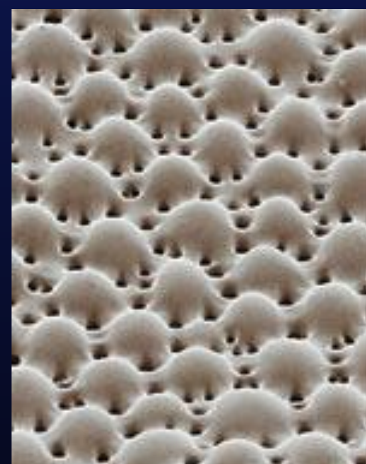


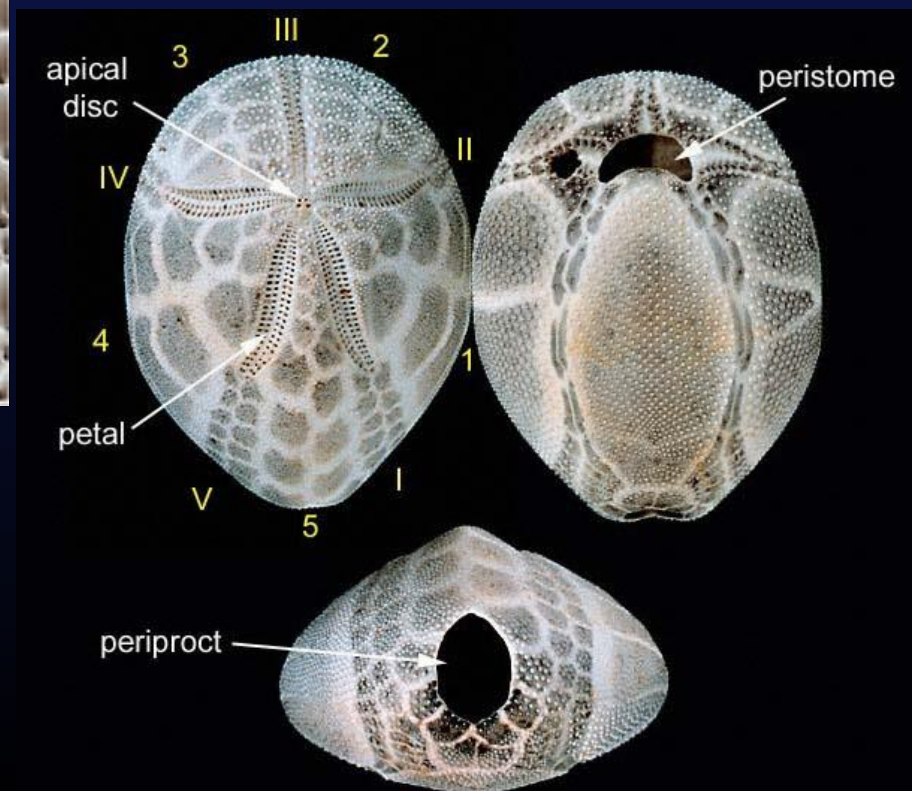


Echinoderm Body Wall





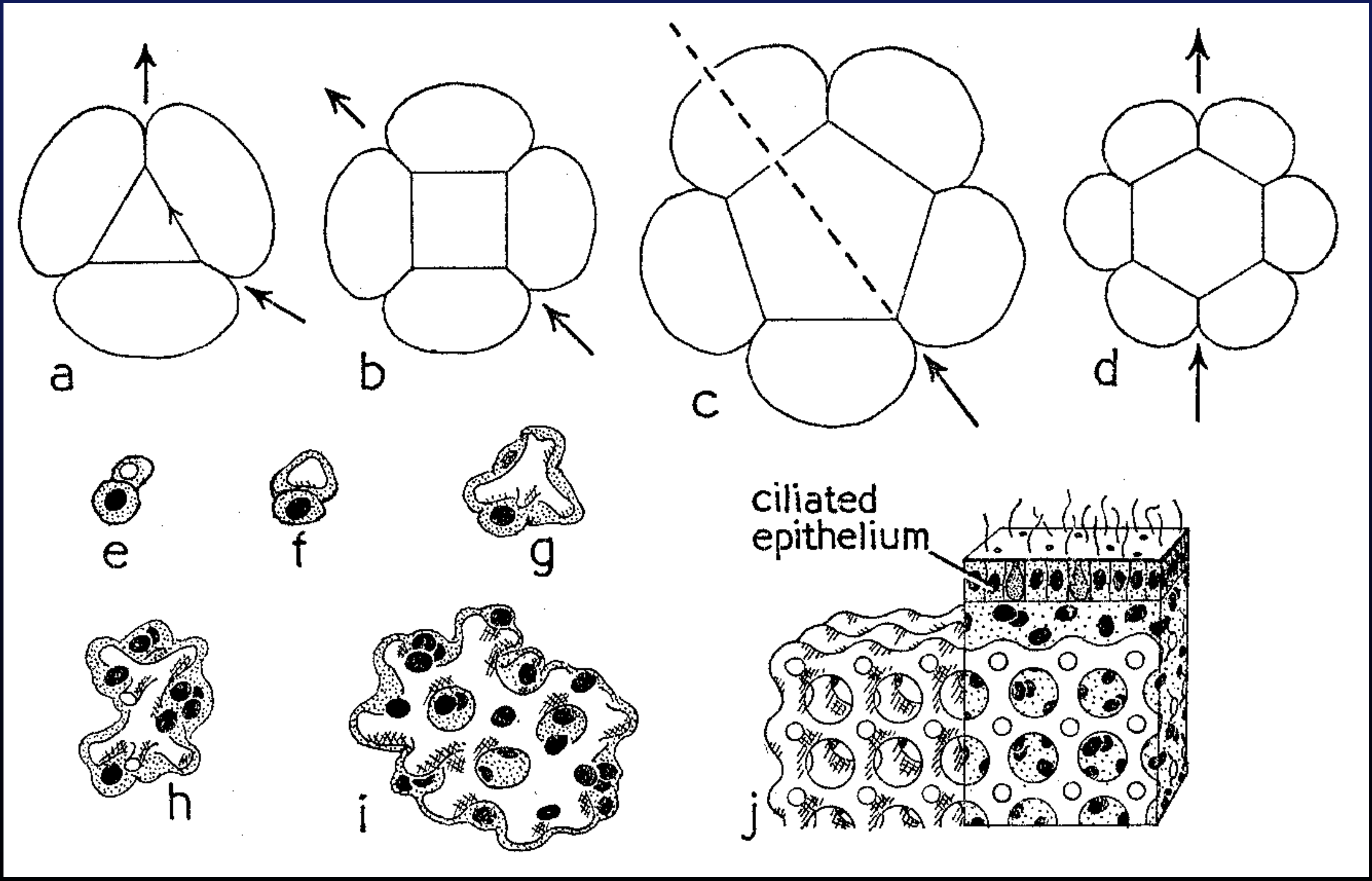




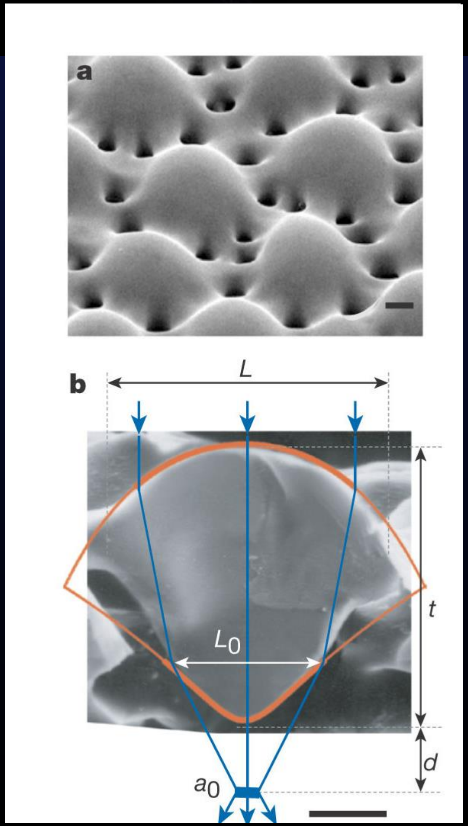
apical disc
III
3
2
II
IV
4
1
petal
V
5
I
peristome
periproct

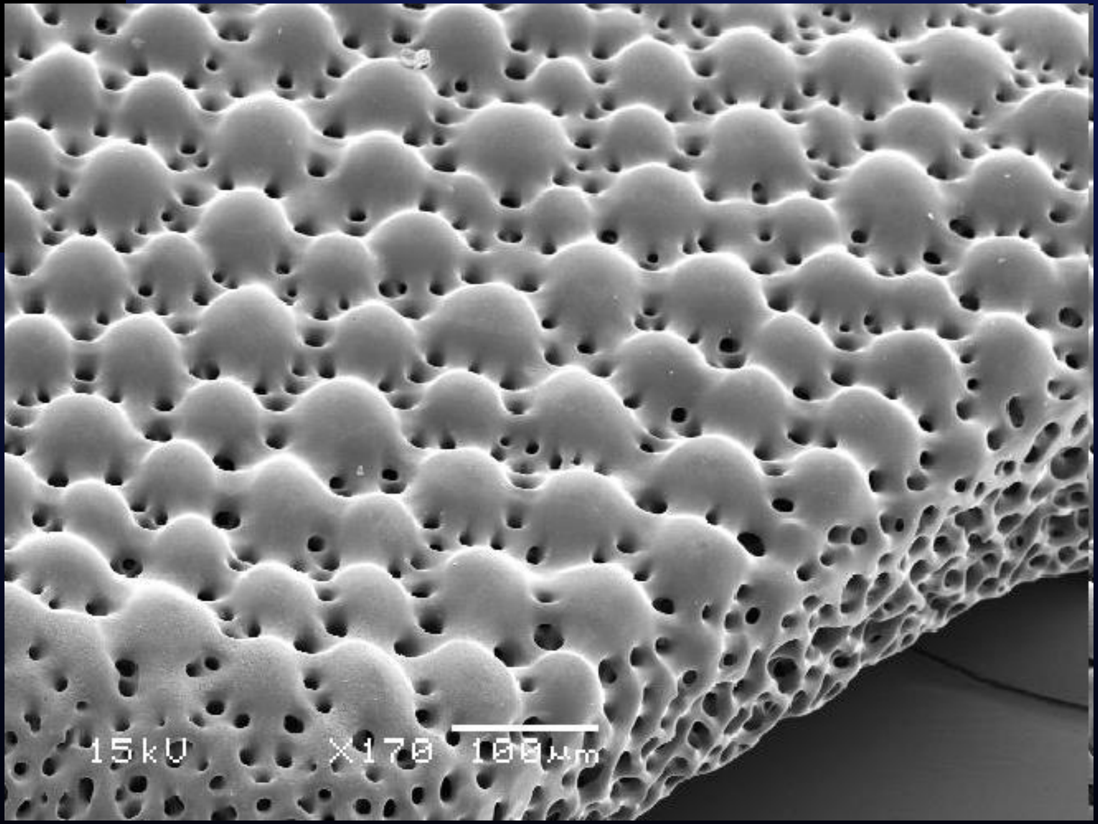
0.1 mm
0.1 mm

Скелет



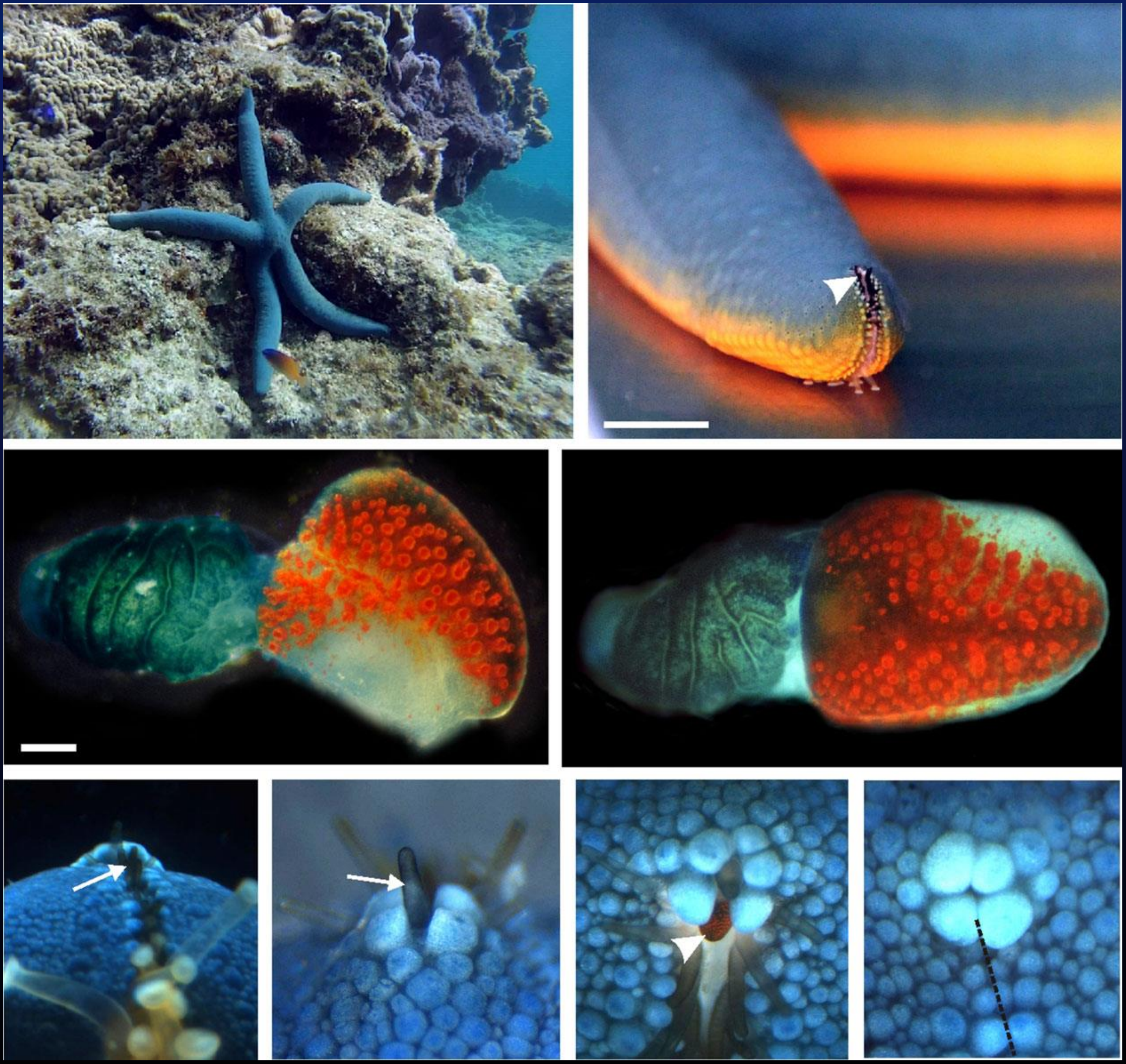
Ophiocoma wendtii





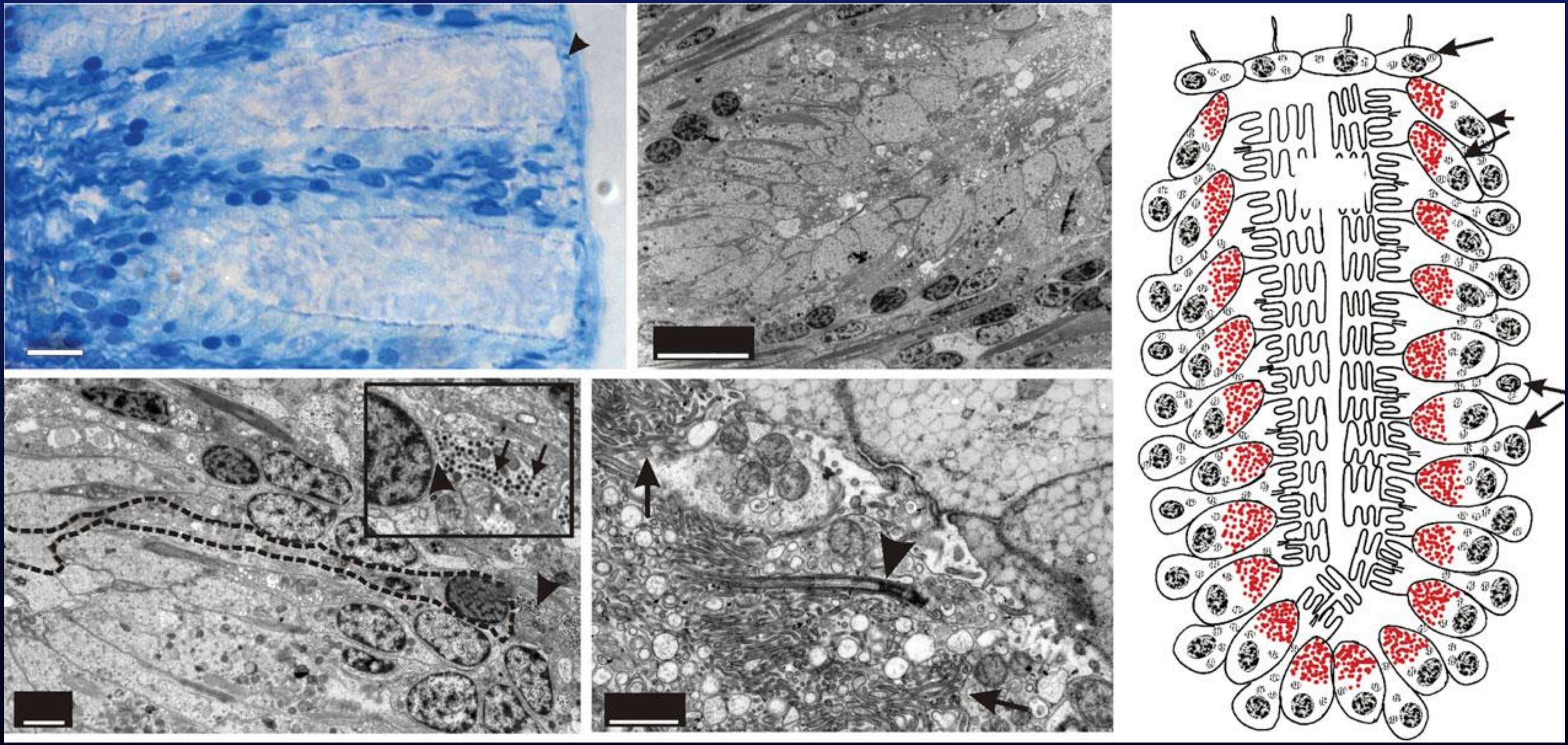
Lucent Technologies Lab, USA

Visual system of the starfish *Linckia laevigata* (Garm, Nilsson, 2014)

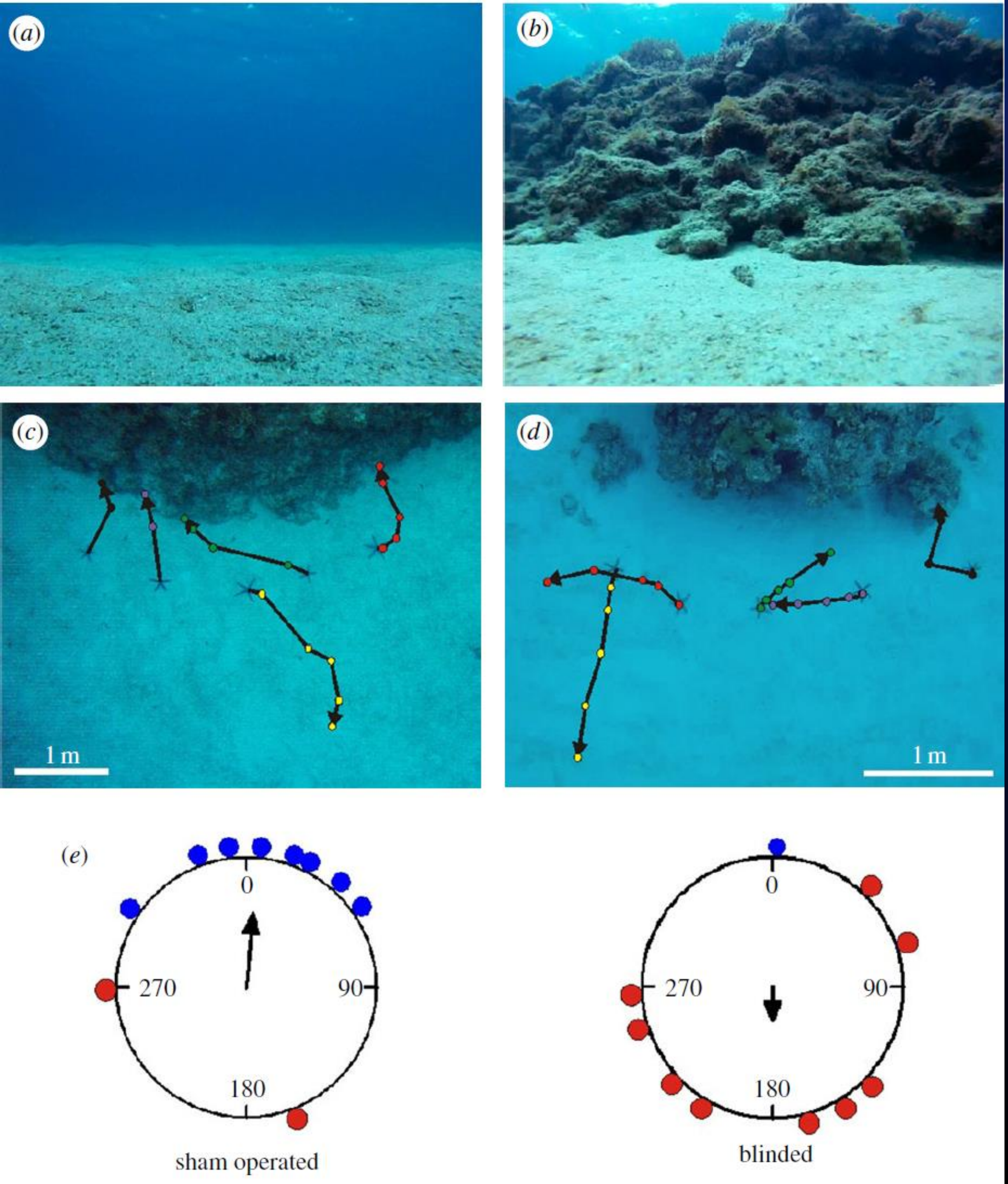


a) Linckia laevigata in its natural coral reef habitat at Akajima, Japan, where it feeds on detritus and algae.
(b) As in other starfish species, the compound eye of L. laevigata is situated on the tip of each arm (arrowhead). It sits in the ambulaceral groove which continues to the top of the arm tip. (c) Lateral view of the compound eye, also called the optical cushion, which is sitting on the base of a modified tube foot. The eye has approximately 150 separate ommatidia with bright red screening pigment. (d) Frontal view of the compound eye showing its bilateral symmetry. (e) The tip of the arm seen from below. The view of the compound eye is obscured by a double row of modified black tube feet (arrow). (f) The arm tip seen straight from above.
Note that the eye is again obscured from view by a modified black tube foot (arrow). (g) The compound eye (arrowhead) seen from 458 above horizontal in a freely behaving animal. When the animal is active, the modified black tube feet spread out to allow vision. (h) If the animal is disturbed, it closes the ambulaceral groove (broken line) at the arm tip and withdraws the modified tube feet. The compound eye is then completely covered, leaving the animal blind.

Morphology of the starfish eye (Garm, Nilsson, 2014)



(a) LM of two ommatidia sectioned longitudinally. Each of the fully developed ommatidia is composed of 100–150 photoreceptors and about the same number of pigment cells (PC). Note the thin layer of epithelial cells (EC, arrowhead) covering the outer segments (OS). The receptors are arranged in seven to eight layers perpendicular to the surface (b). (c) Longitudinal section of a photoreceptor (Pr, dashed black line). Interestingly, it receives feedback from the nervous system as indicated by afferent synapses (insert, arrowhead indicates synapse, arrows indicate synaptic vesicles). PrN, photoreceptor nucleus. (d) The outer segments of the starfish photoreceptors are morphologically a mixture of the rhabdomeric- and ciliary-type receptors. They are formed by microvilli coming both directly from the cell membrane (arrows) and from a modified cilium (arrowhead). (e) Schematic drawing of an ommatidium showing the layered arrangement of the photoreceptors and pigment cells.



Navigation experiments. In the behavioural experiments, the test animals were removed from their natural reef habitat and placed 1 m from the reef edge.
(a) The visual scene away from the coral reef habitat was the open ocean. (b) The visual scene towards the natural habitat (coral reef) at a distance of 1 m. (c) Trajectories from the sham-operated animals tested at locality 1 (reef front to the east). Most of the animals quickly found their way back to the habitat. (d) Trajectories from the eyeablated animals tested at locality 2 (reef front to the south). They moved at the same pace as the intact and sham-operated animals but in random directions. (e) Circular statistics of the behavioural experiments show that the direction of movement of the sham-operated animals differed significantly from random and correlated with the direction to the reef front. The direction of movement of the eye-ablated animals did not differ significantly from random. Blue dots represent animals reaching the reef within the 25 min, red dots represent animals that did not. See experimental procedure for details of the statistical analysis.

Brisinga sp.

Podosphaeraster sp.

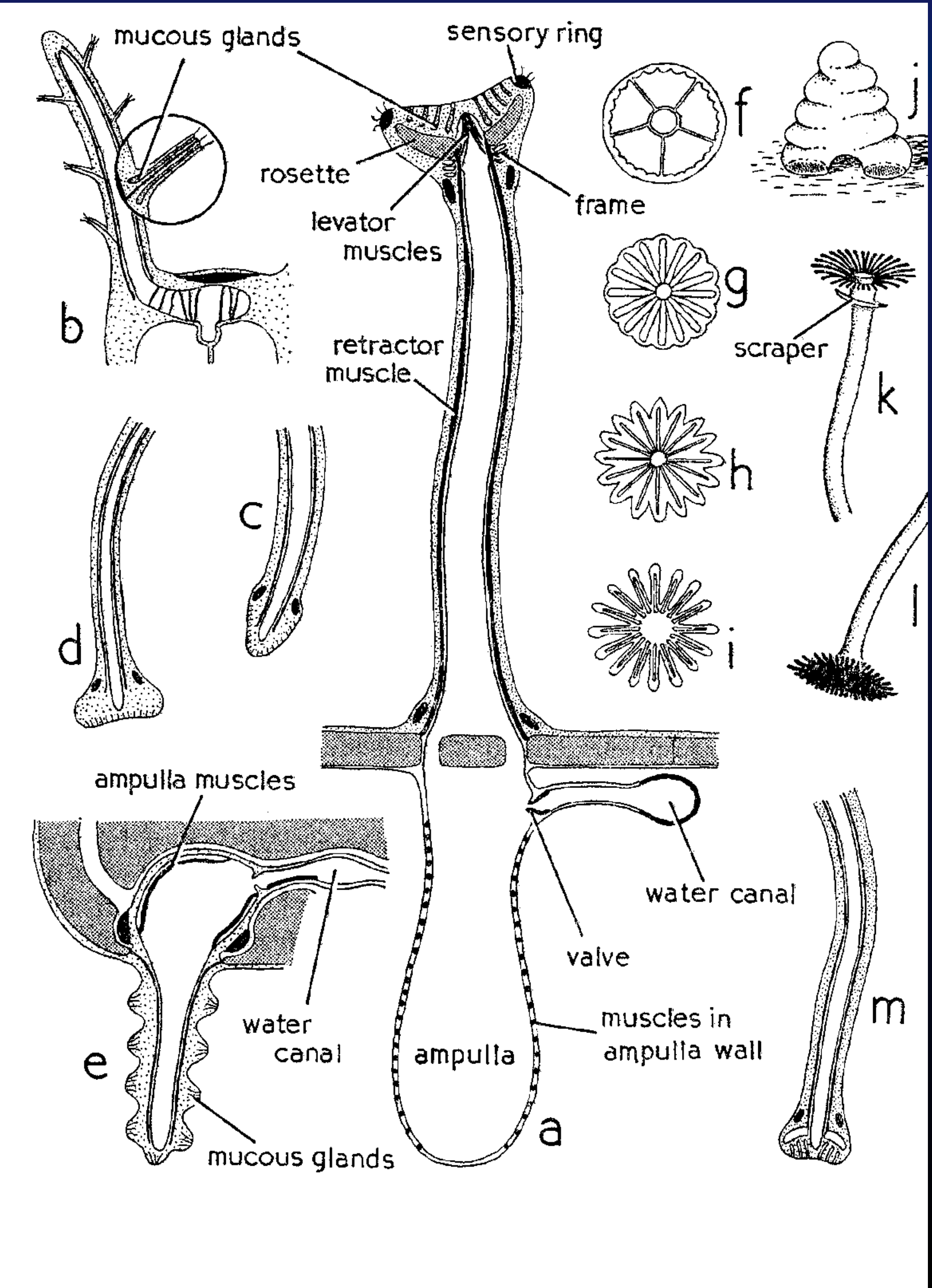
Patiria sp.

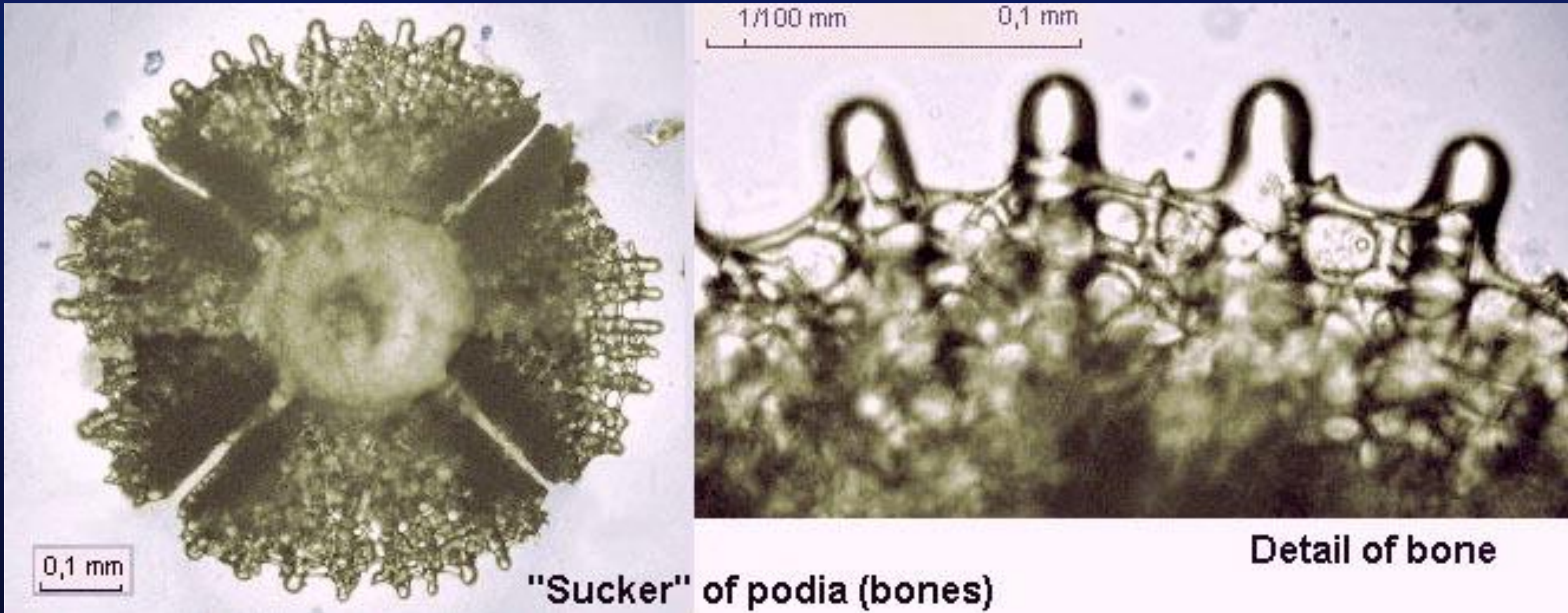
Culcita novaeguineae

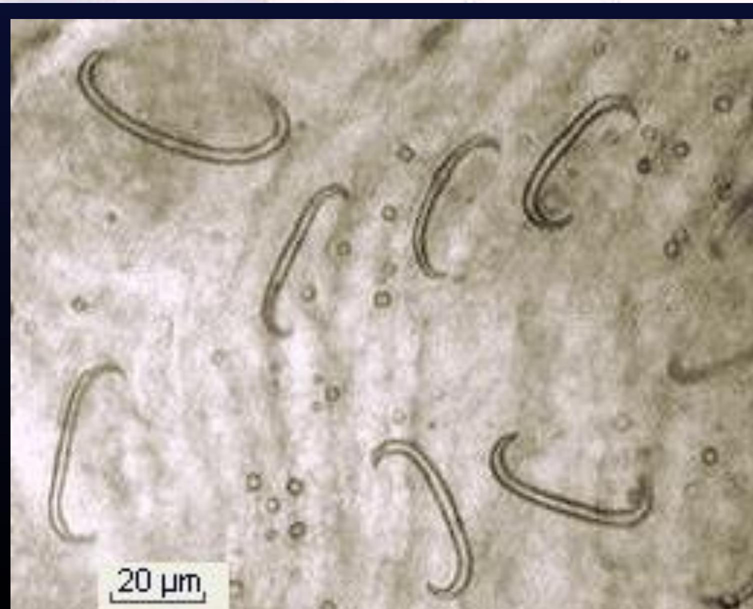
Heliaster helianthus

Амбулакральные ножки

Амбулакральные ножки

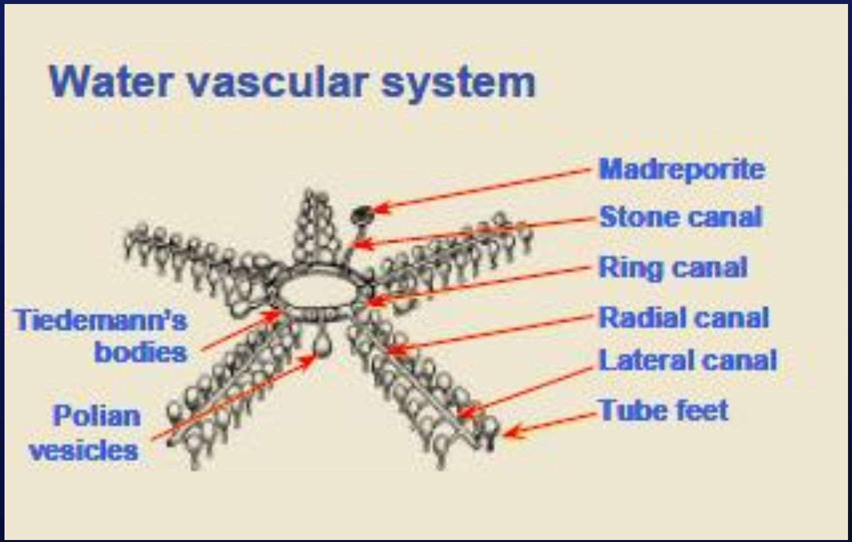


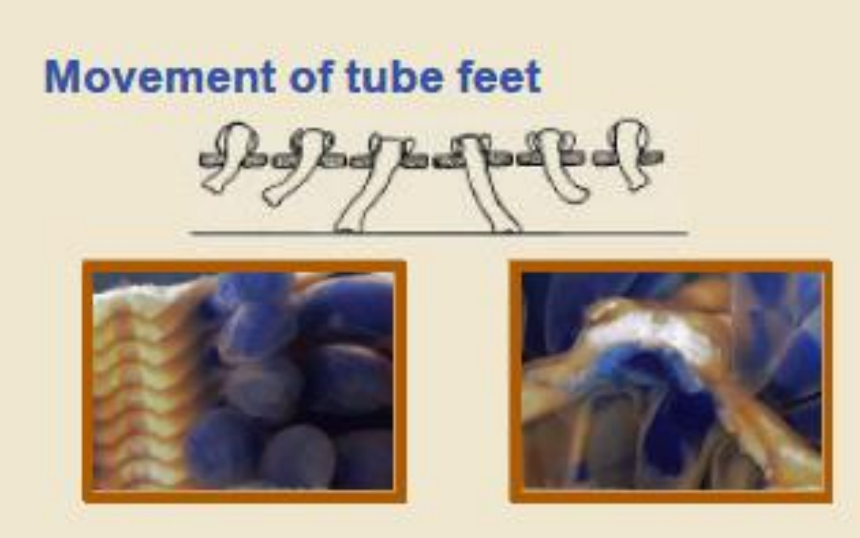


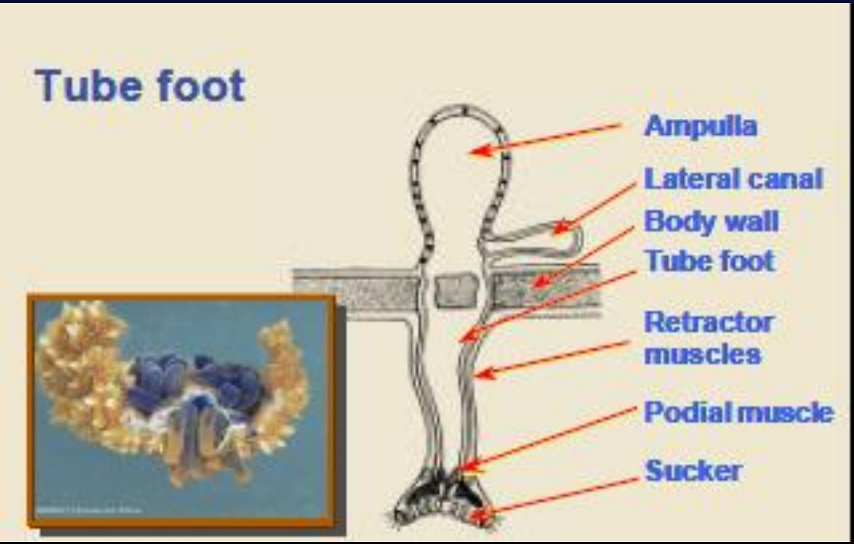


Скелет амбулакральных ножек морских ежей

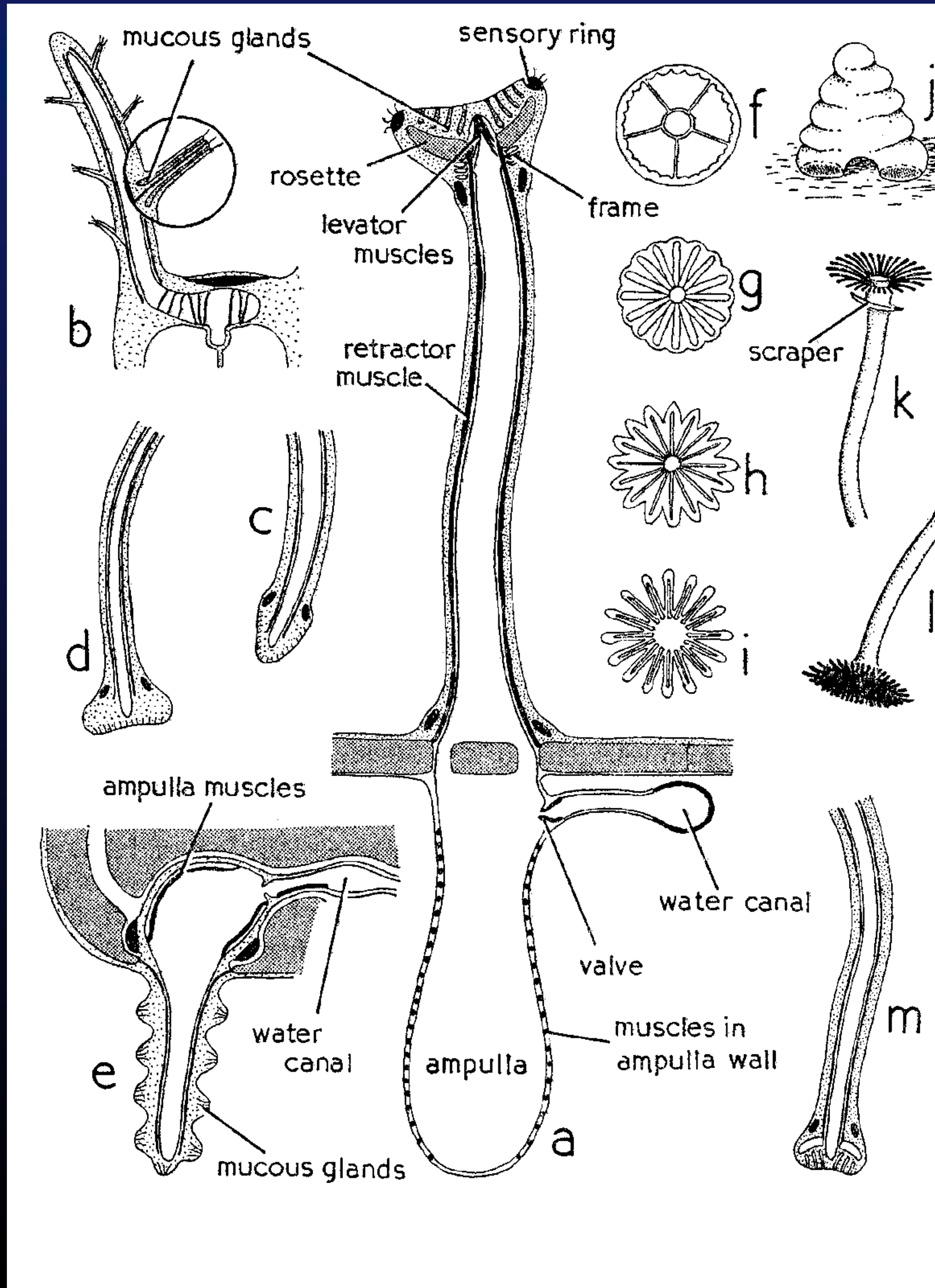
Водно-сосудистая система







Амбулакральные ножки

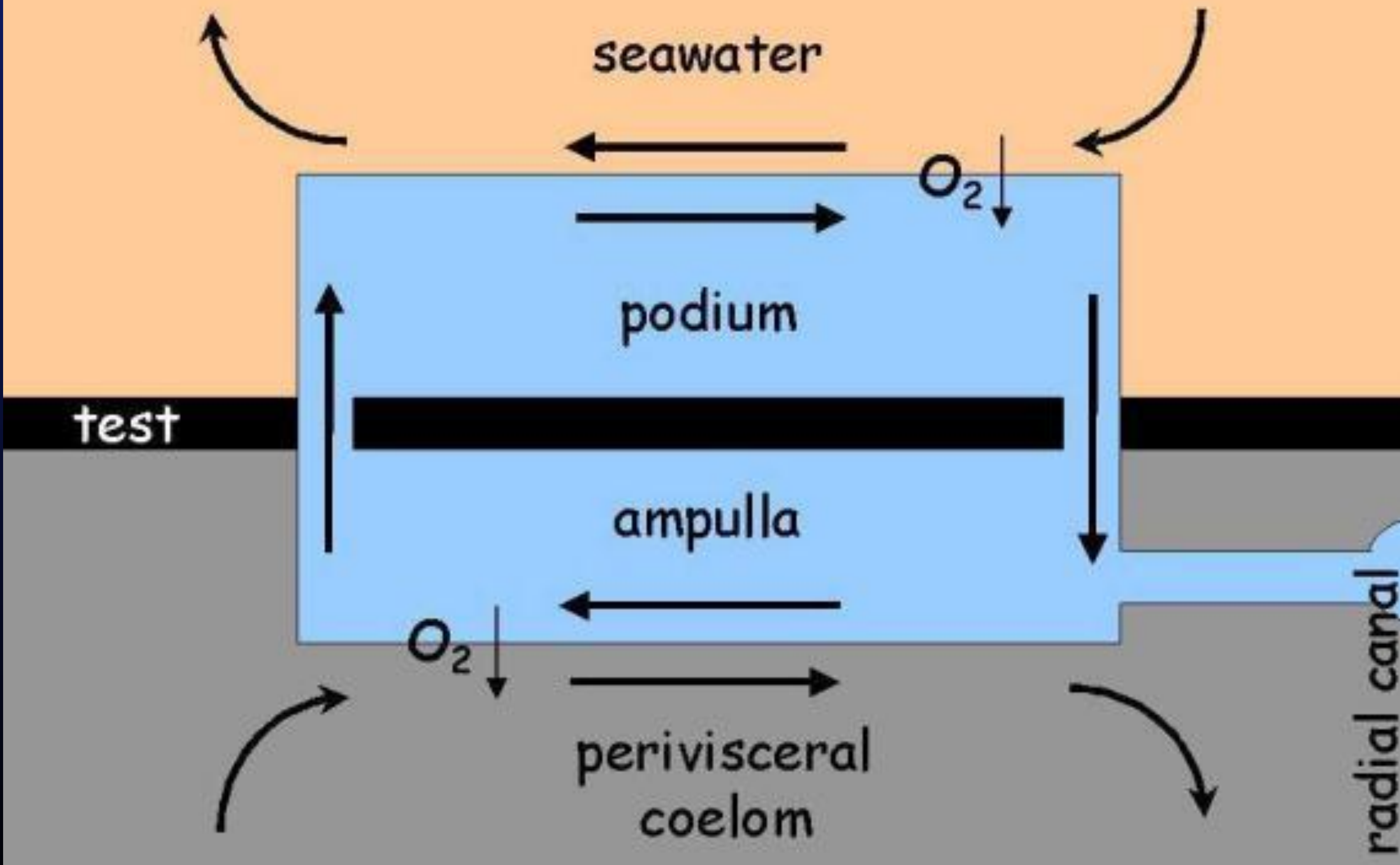


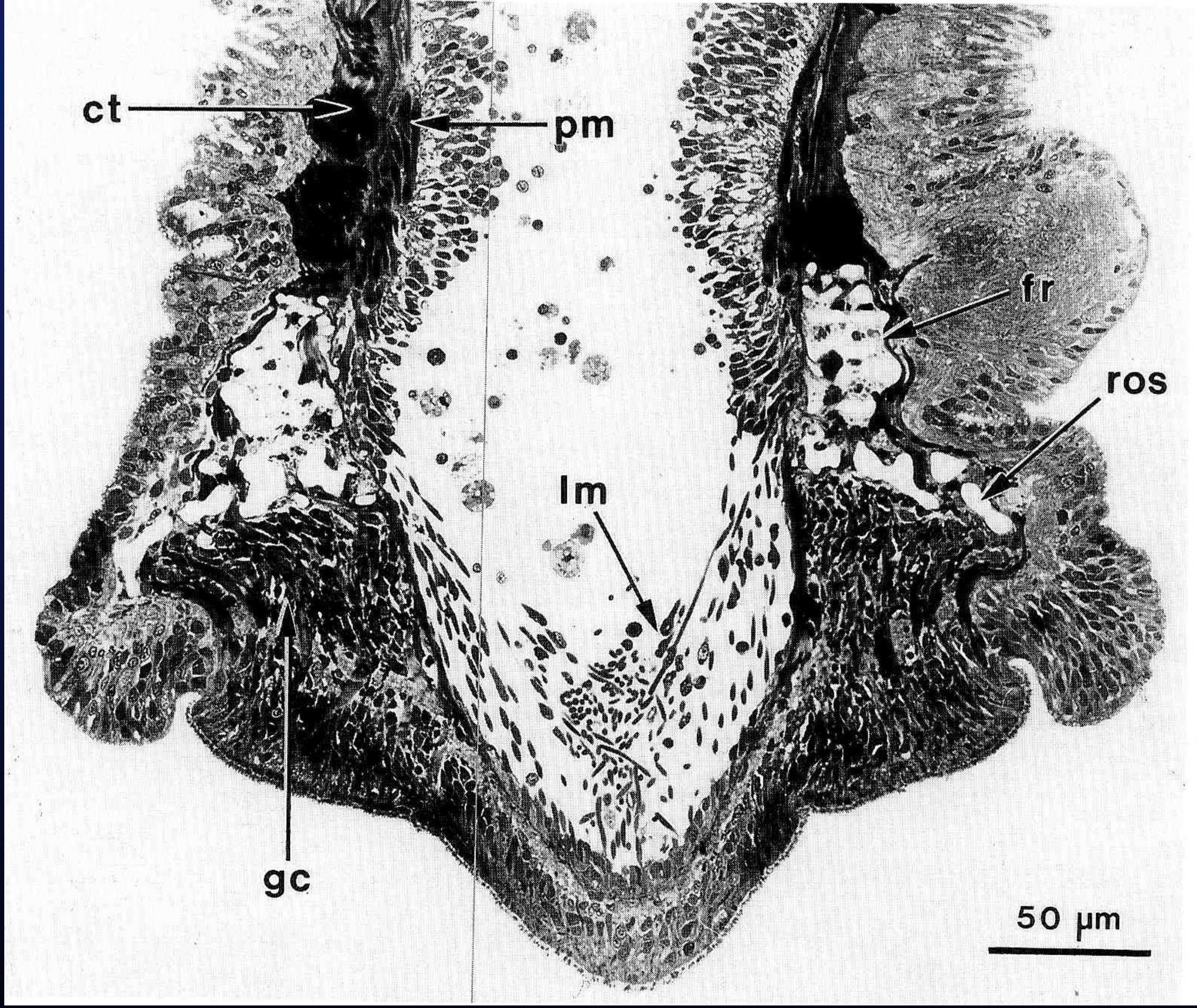
Амбулакральные ножки иглокожих:

- a - схема продольного среза через присасывательную ножку Echinus.
- b - ловчая ножка криноидов (Antedon). Одна из папилл увеличена.
- c - копательная ножка морских звезд (Phanerozona).
- d - локомоторная ножка морских звезд (Spinulosa).
- e - ножка офиур. Показано ампулообразное расширение амбулакрального канала.
- f-i - амбулакральные ножки морских ежей. Вид со стороны подошвы ножки. Показана эволюция скелетных элементов ножек спатангоидов: f - Echinus, g - Brissopsis, h - Schizaster, I - Echinocardium.
- j - дыхательная ножка спатангоидов.
- k - роющая ножка спатангоидов. Показан скребок и слизепродуцирующие папиллы.
- l - питающая ножка спатангоидов.
- m - локомоторная ножка голотурий.

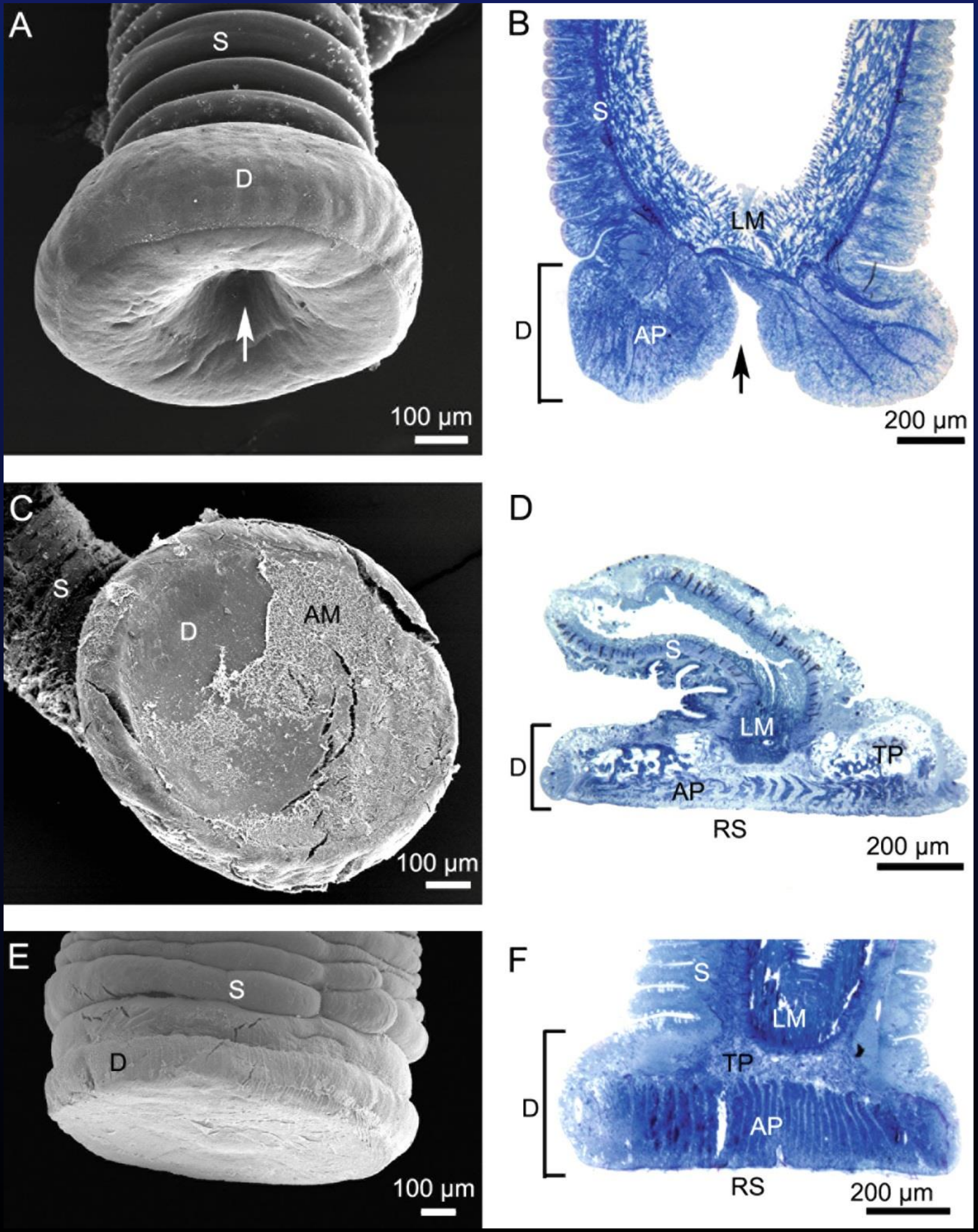
(Nichols, 1969)

Echinoid Respiratory Podium





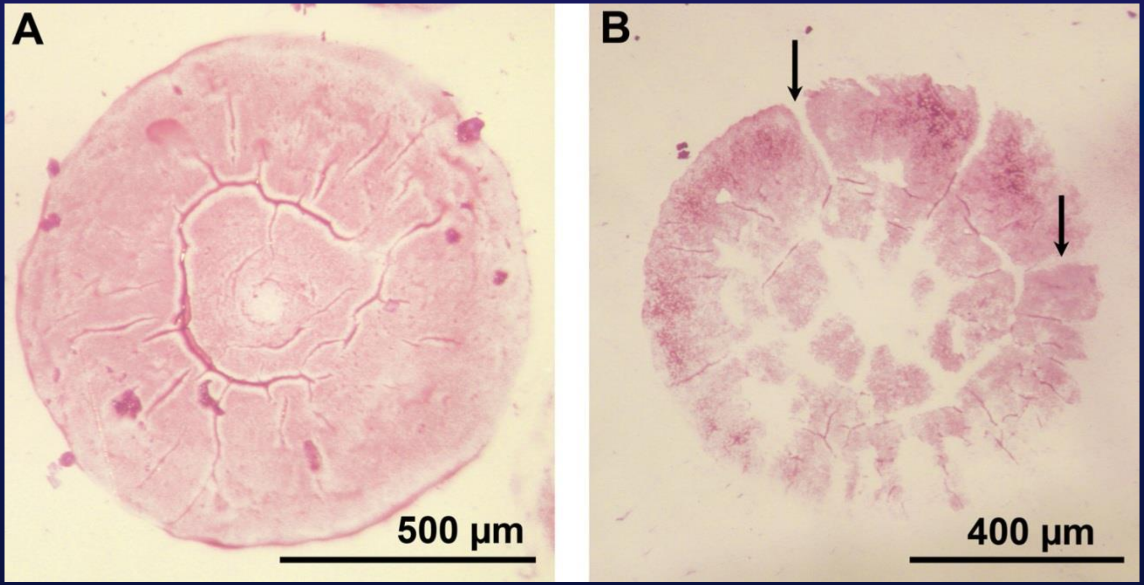
Protracted tube foot of the sea urchin *Diadema* (longitudinal section). The terminal region of the podial shaft and the adhesive disc are shown. ct, connective tissue cylinder; fr, frame (base of a skeletal ossicle); gc, glandular cells; lm, elevator myocytes; pm, podial myocytes (in the myoepithelial lining of the hydrocoel); ros, rosette (ossicle elements). (From Cavey and Markel, 1994).



Echinoderms don’t suck: evidence against the involvement of suction in tube foot attachment

Morphology of unattached (A, B) and attached tube feet (C–F) of the sea star *Asterias rubens* (B, E, F) and of the sea urchin *Paracentrotus lividus* (A, C, D). A and B: Unattached tube feet from both species consist of a proximal cylinder, the stem (S), connected to an apical disc (D), which presents a central depression (arrow). In B, the levator muscle (LM) can be observed at the junction between the stem and the disc. C and E: SEM images of tube feet cryofixed while attached to a smooth glass surface. In C, some adhesive material (AM) is visible on the surface of the disc. D and F: LM views of longitudinal sections through tube feet attached to a smooth epoxy resin substratum (RS). The soft adhesive pad (AP), supported by the connective tissue terminal plate (TP), lies flat against the substratum.

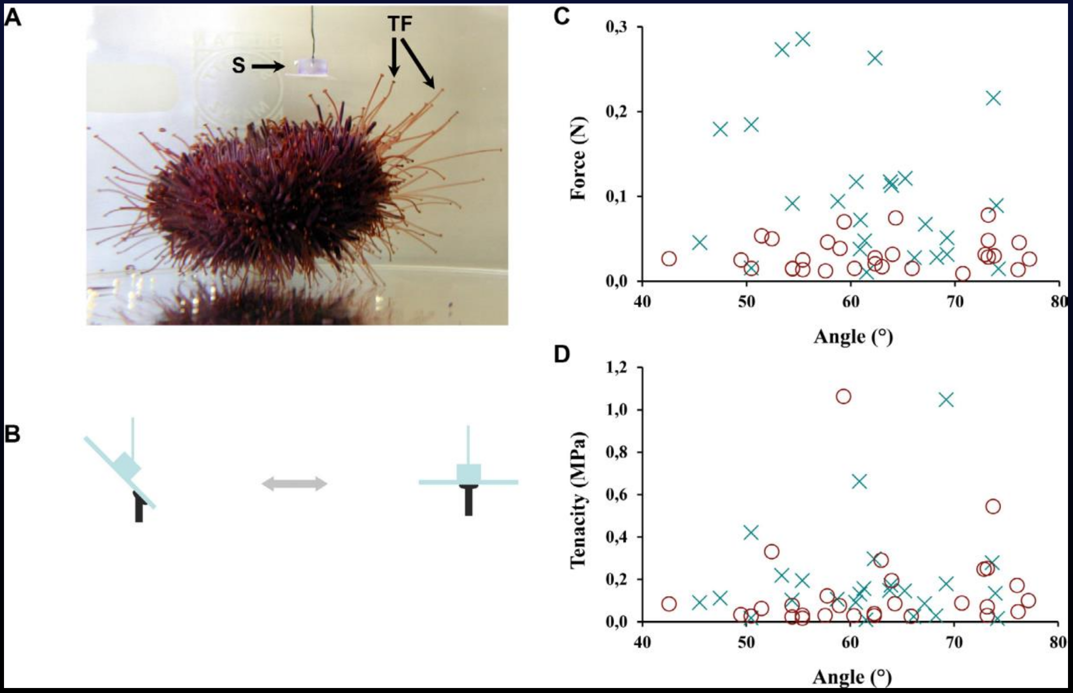
(Hennebert et al., 2012)



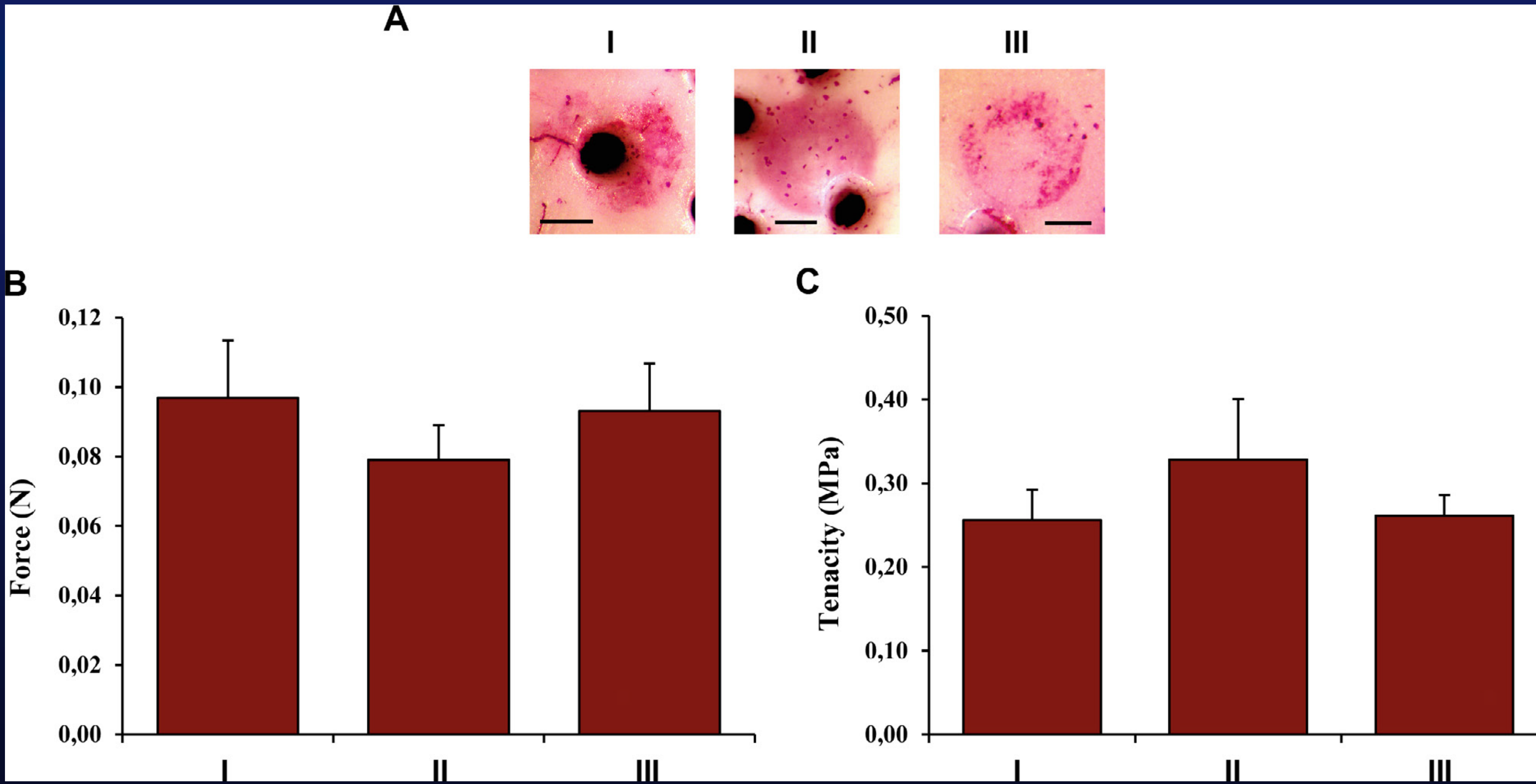
Photographs of a complete footprint of *Paracentrotus lividus* (A) and of a footprint of *Asterias rubens* (B) presenting radial channels devoid of adhesive material (arrows). Both footprints were stained with a 0.05 % aqueous solution of the cationic dye crystal violet.

Echinoderms don't suck: evidence against the involvement of suction in tube foot attachment

(Hennebert et al., 2012)



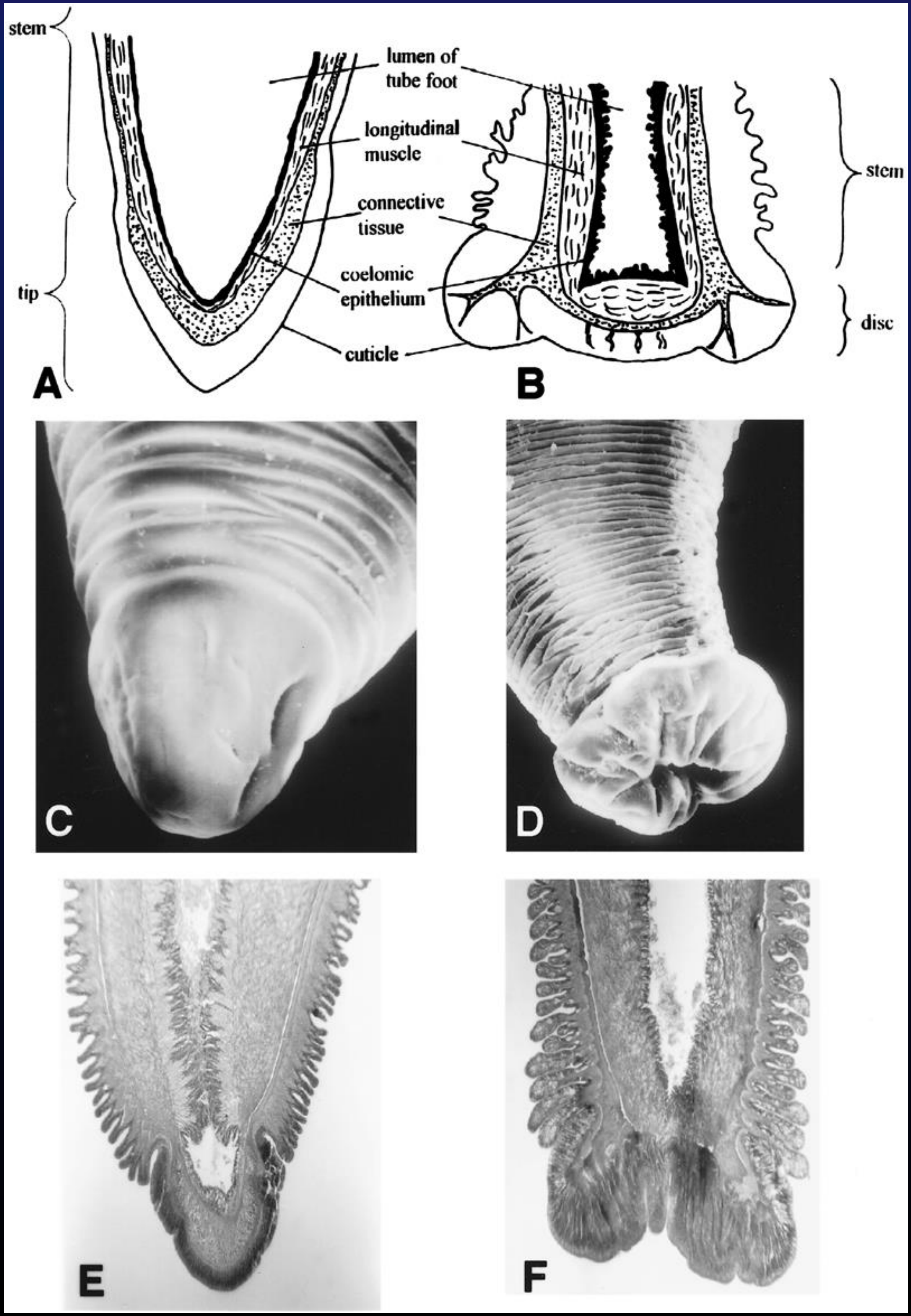
Variation of tube foot attachment strength with angle of pull. A: Photo showing a glass substratum (S) presented to the tube feet (TF) of an individual of *Paracentrotus lividus*. B: Diagram illustrating the experimental procedure used to vary the angle of pull in function of the place where the tube foot (in black) attaches to a glass surface (in grey, see text for details). C and D: Relationships between tube foot detachment force or tenacity and angle of pull for the sea star *Asterias rubens* (crosses) and the sea urchin *P. lividus* (circles).



Effect of leaks on the attachment strength of tube feet. A: Illustration of the grouping of adhesion measurements on the perforated polystyrene film according to whether the footprint covers a hole, totally (group I) or partially (group II), or not (group III). B and C: Mean values (+SD) of detachment force and tenacity measured on this perforated substratum for the tube feet of the sea urchin *Paracentrotus lividus*. Scales bars in A = 0.5 mm.

(Hennebert et al., 2012)

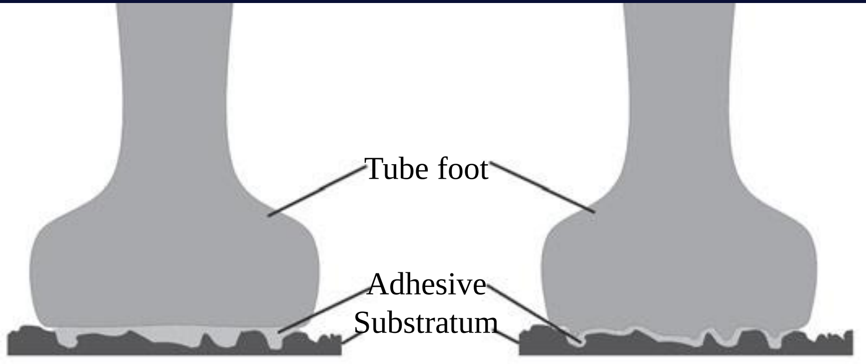
Echinoderms don't suck: evidence against the involvement of suction in tube foot attachment



Comparative Morphology of Tube Feet Among the Asteroidea

A. Schematic diagram of the pointed, non-suckered tube foot of *Astropecten* sp. (modified after Engster and Brown, 1972). B. Schematic diagram of the flat-tipped, suckered tube foot of *Asterias vulgaris* (modified after Paine, 1929). C. Scanning electron micrograph of the pointed, non-suckered tube foot of *Psilaster charcoti*. D. Scanning electron micrograph of the flat-tipped, suckered tube foot of *Diplasterias brucei*. E. Paraffin section of the pointed, non-suckered tube foot of *Luidia foliolata*. F. Paraffin section of the flat-tipped, suckered tube foot of *Pycnopodia helianthoides*. Scale bars: C–F, 200 mm.

(Vickery, McClintock, 2000)

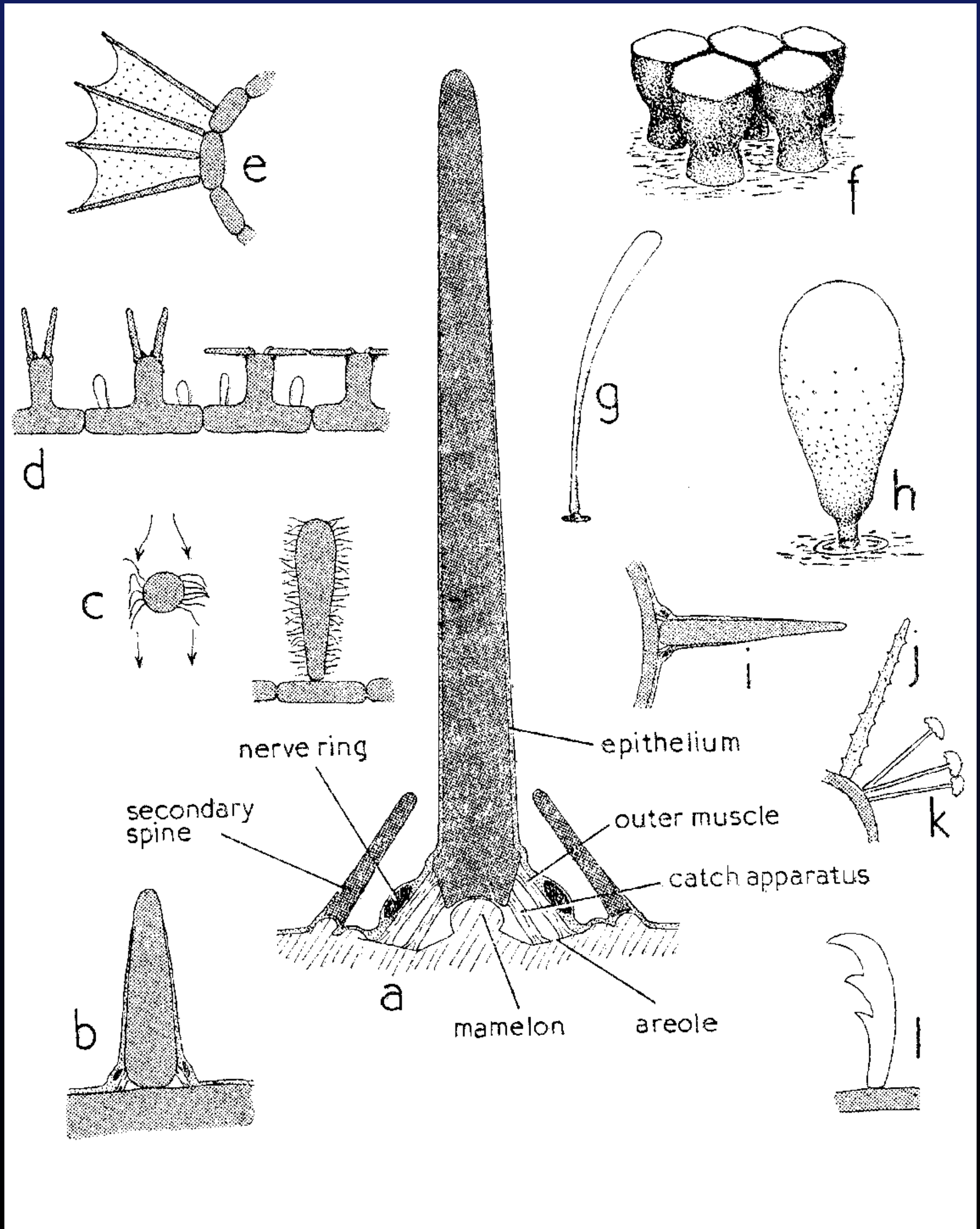


Diagrammatic representations of the two models proposed for tube foot adhesion to rough surfaces. (A) The tube foot disc remains flat and the adhesive substances are secreted to fill the gaps between surface irregularities or (B) the disc deforms to match the substratum profile and the adhesive is released as an evenly thin film.

(Santos et al., 2005)

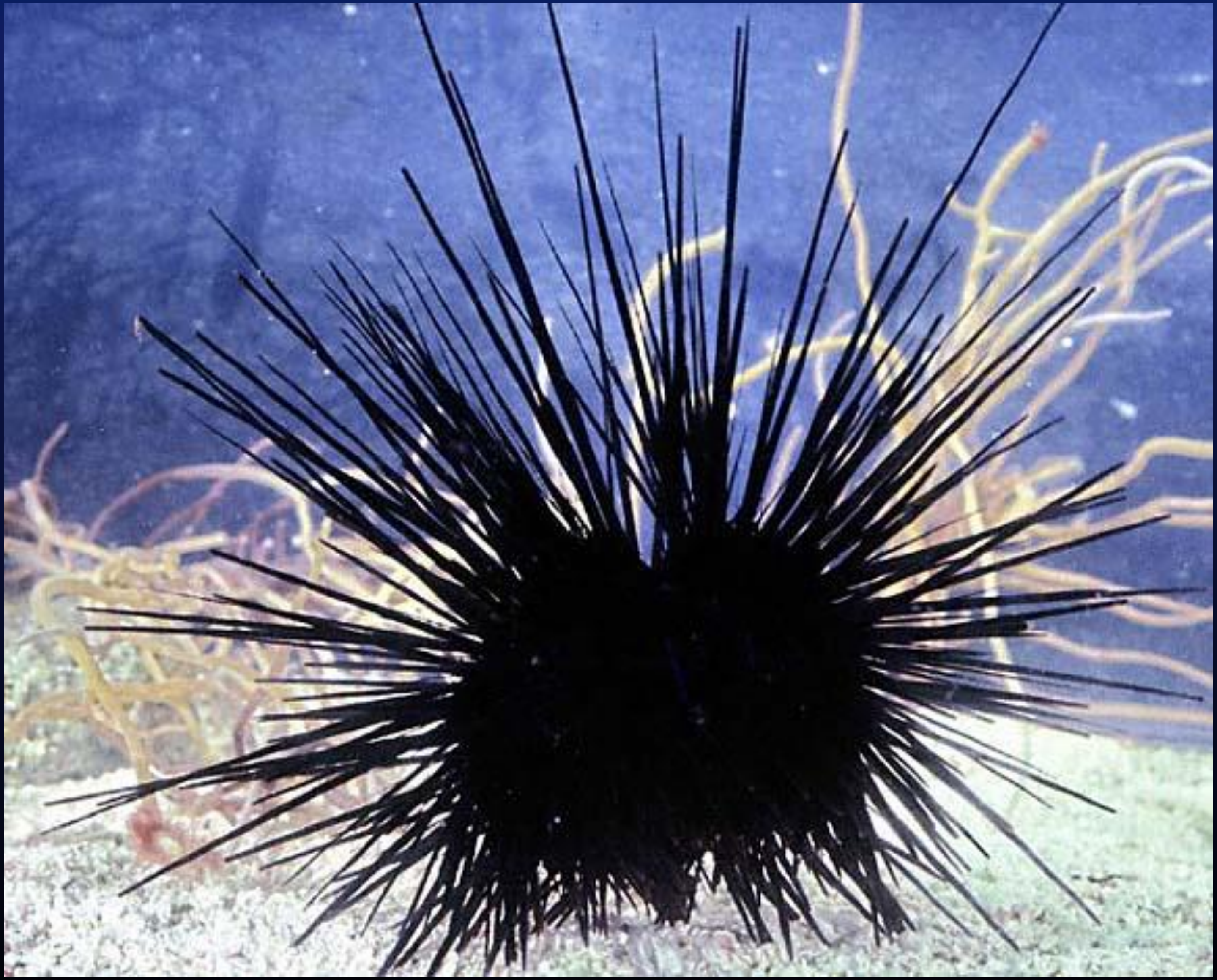
Иглы и педицеллярии

Иглы



e
f
g
d
h
c
i
j
epithelium
nerve ring
k
secondary
spine
outer muscle
catch apparatus
a
b
mamelon
areole
l

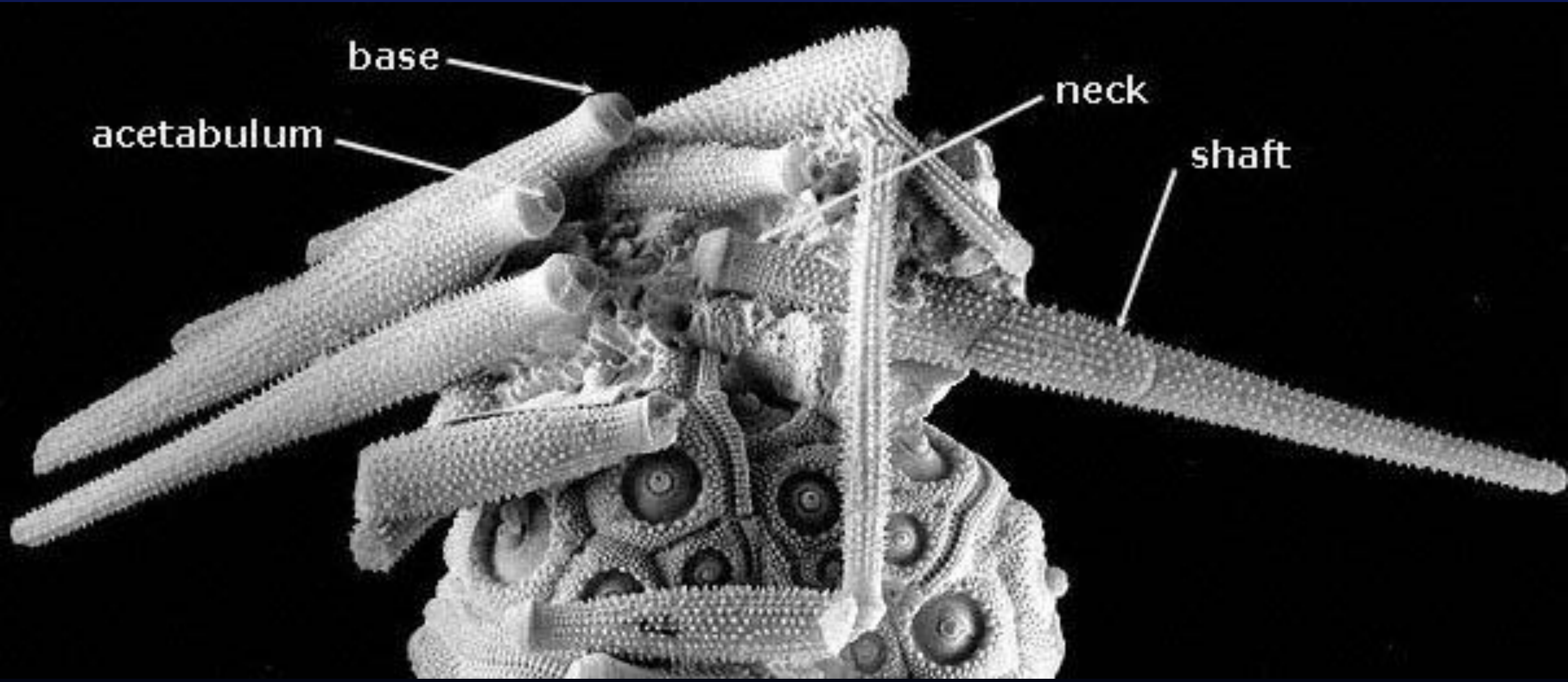
Иглы морских ежей: *Cidaris sp.*



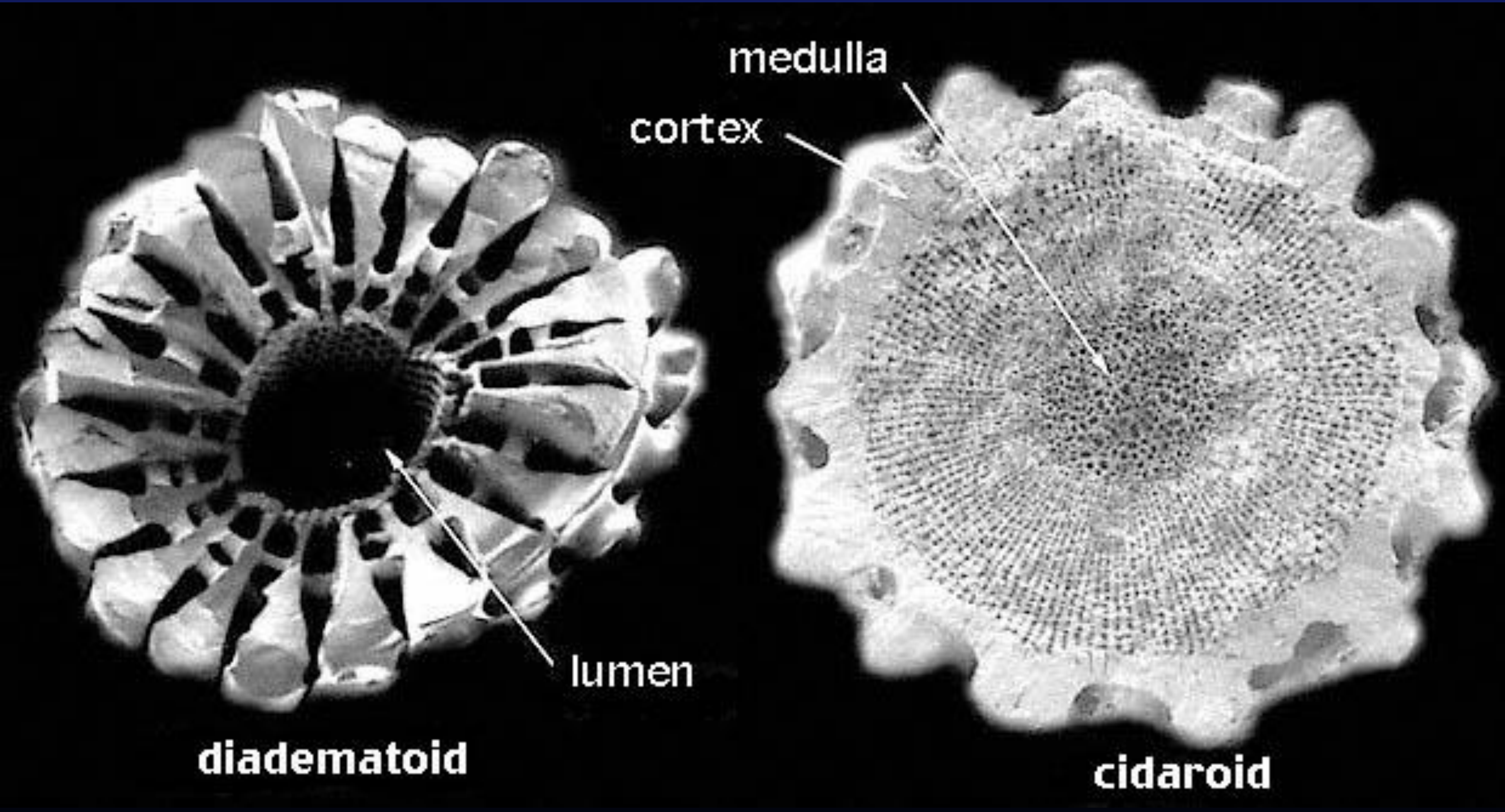
Иглы морских ежей: *Diadema sp.*

Иглы морских ежей: *Podophora sp.*

Иглы морских ежей



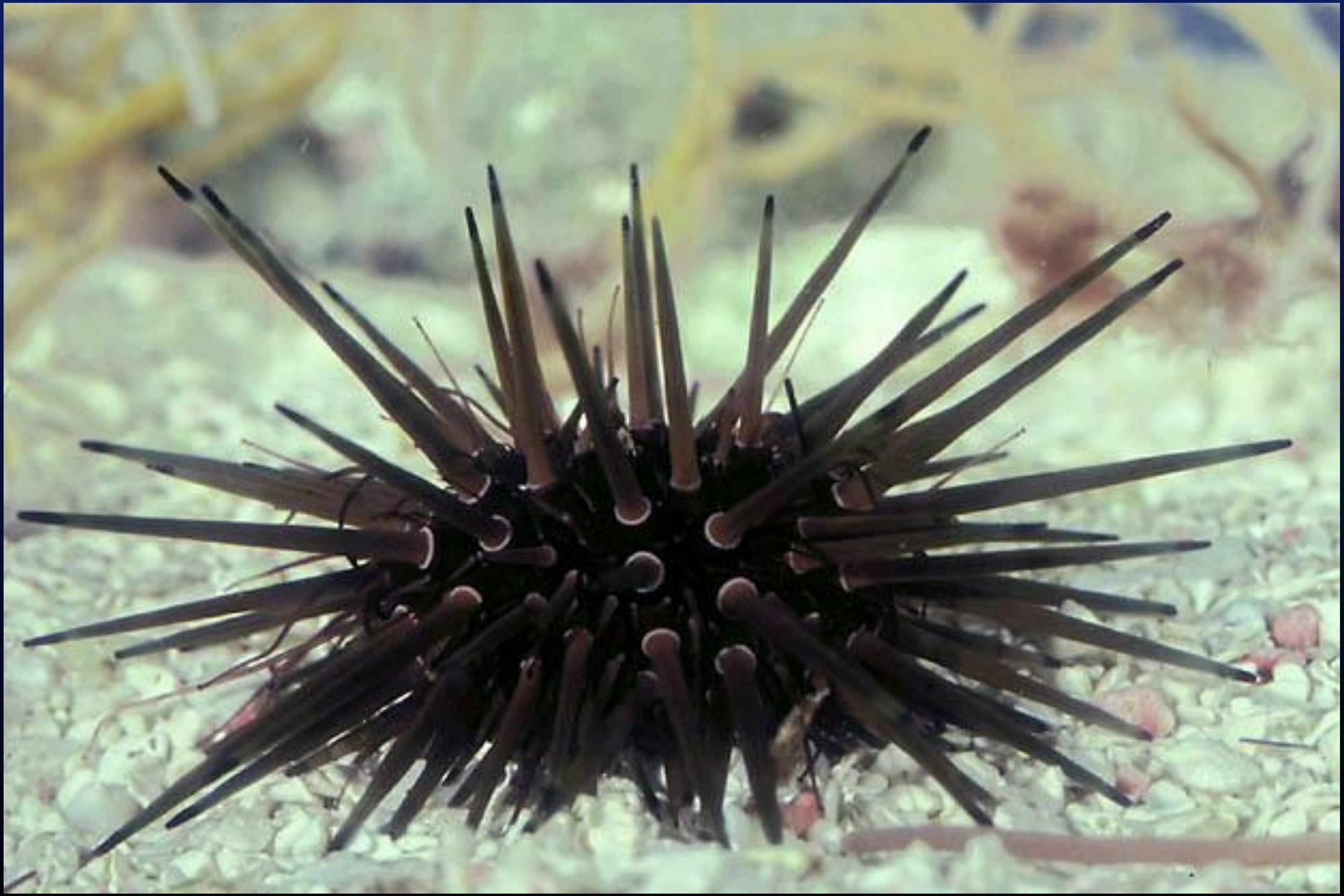
Строение игл: морфология



Строение игл: поперечный срез

Зарывающиеся ежи: *Echinocardium*

Mellita quinquiesperforata



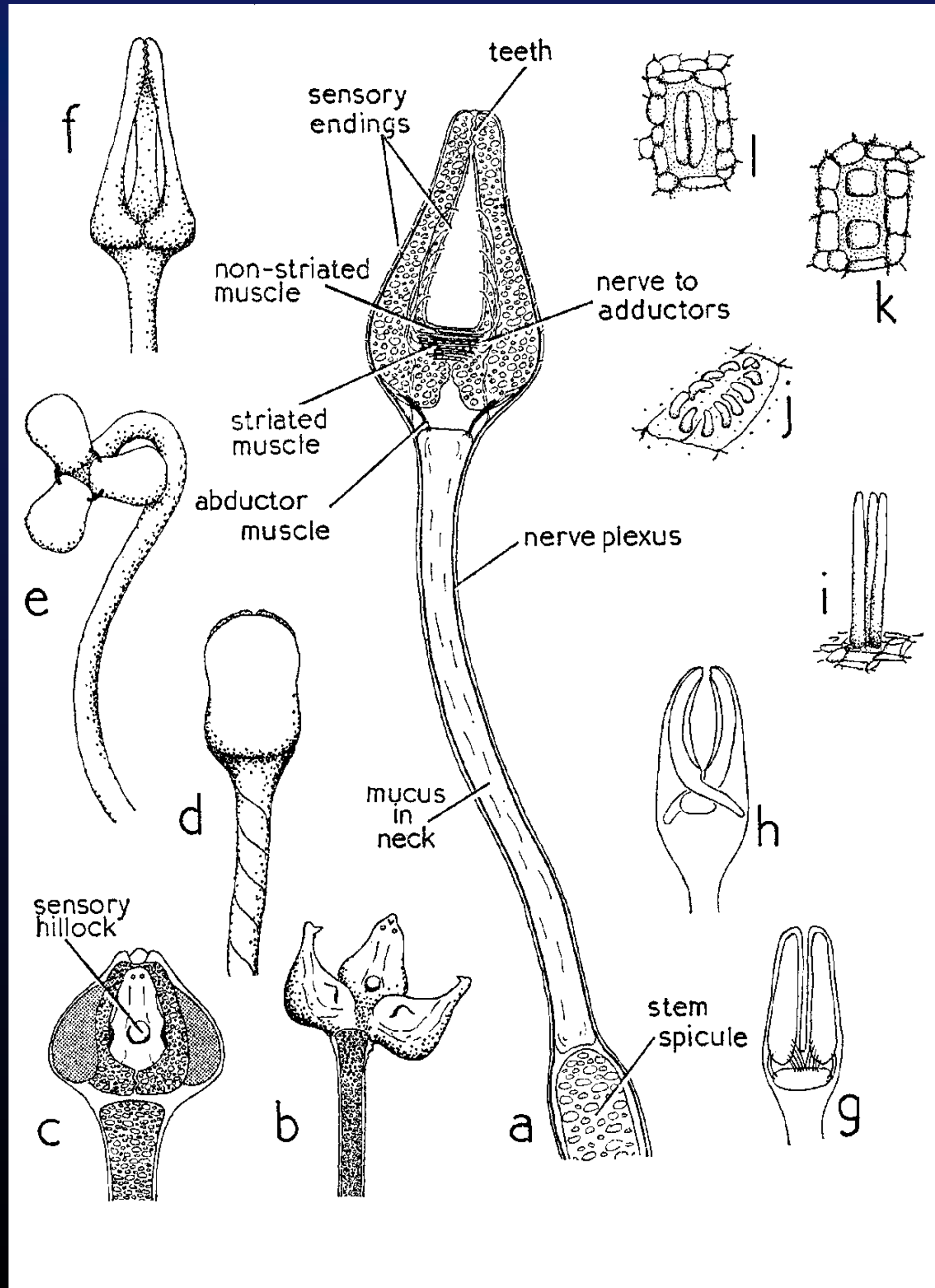
Защитные иглы: *Echinometra*

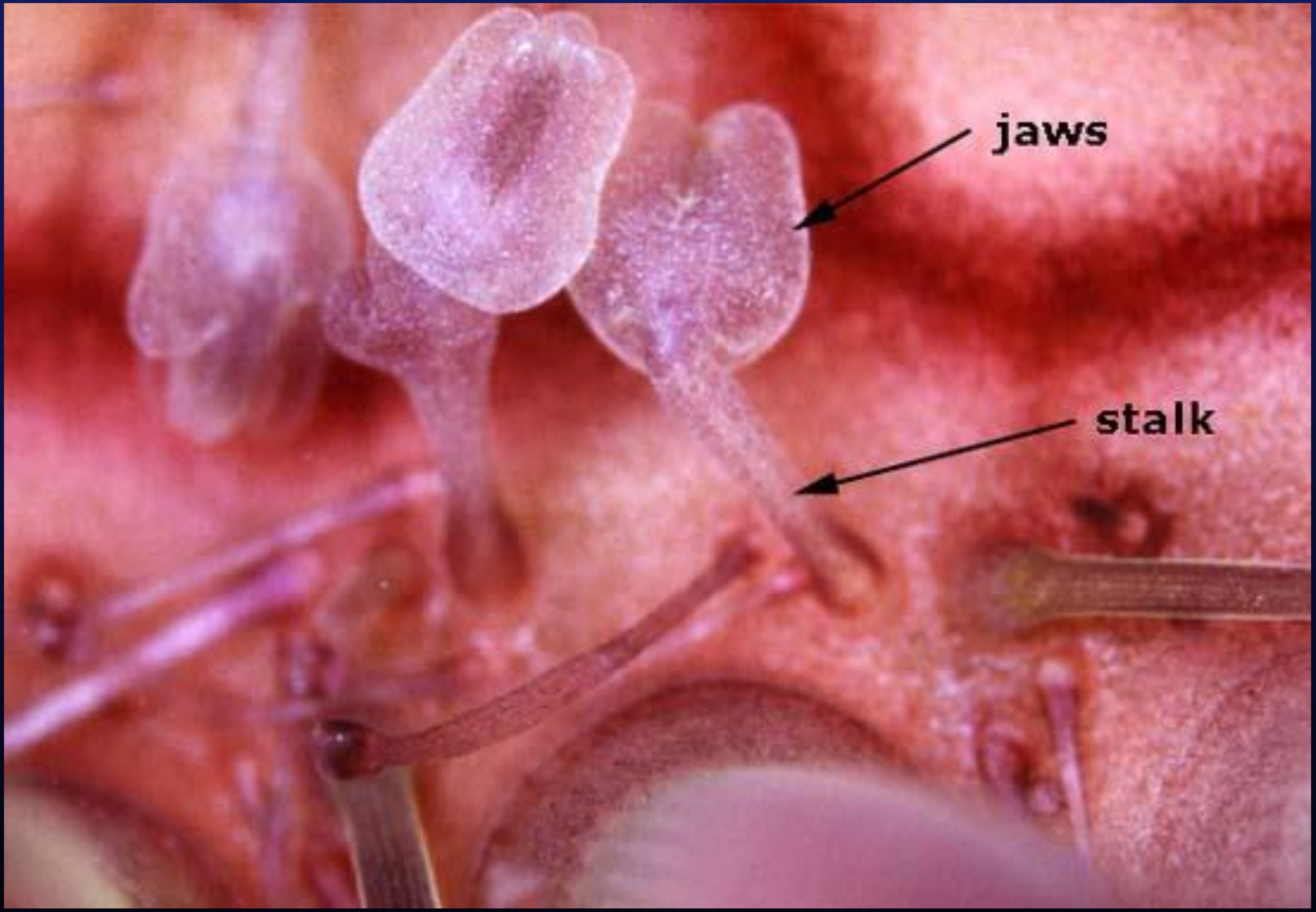
Камуфляж: *Eucidaris*

Маскировка

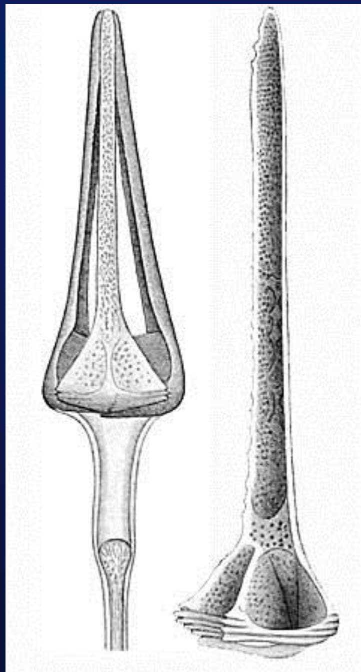
Питание ежей: *Echinosigra paradoxa*

Педицеллярии

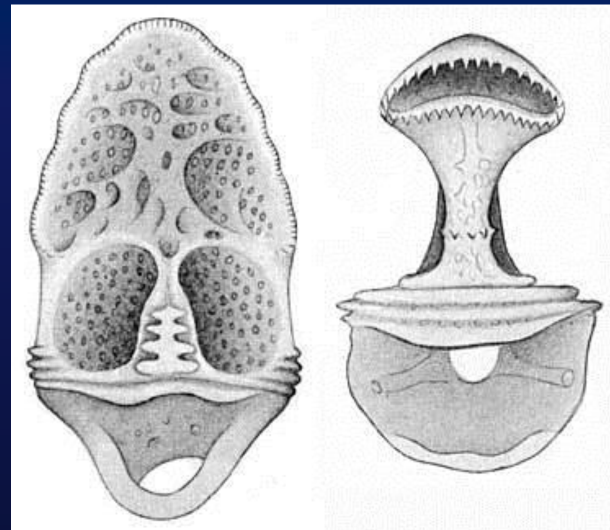




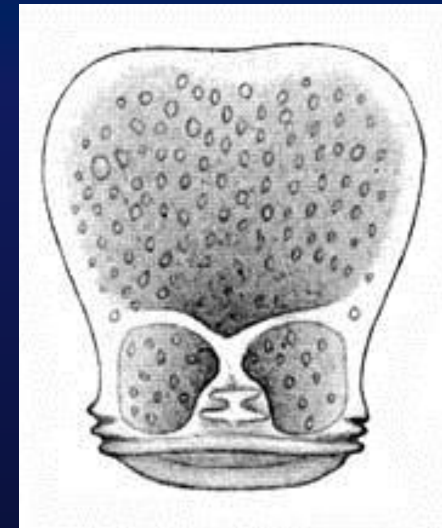
Педицеллярии



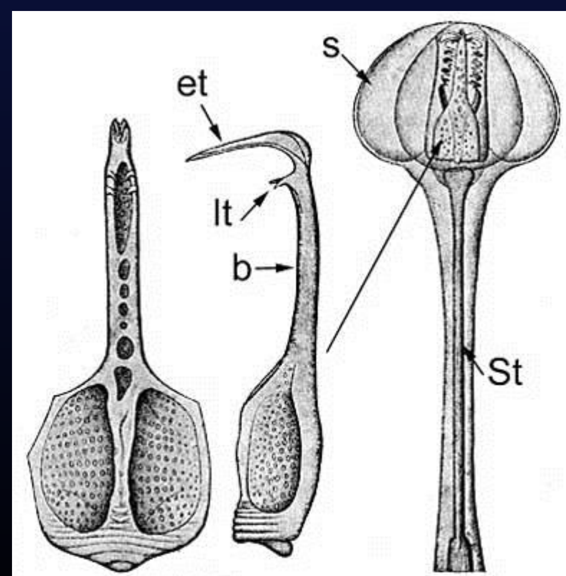
тридактилос



официфалос

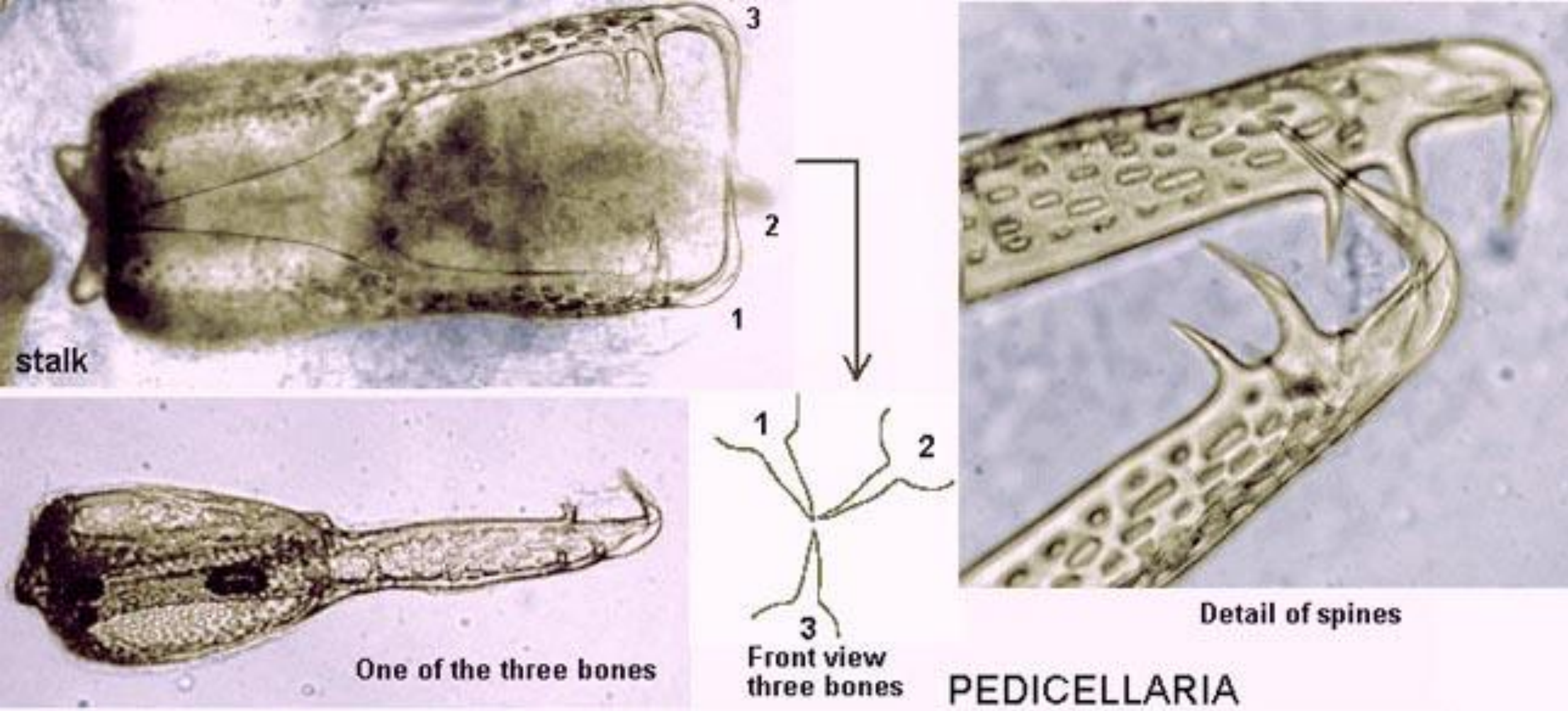


трифилос

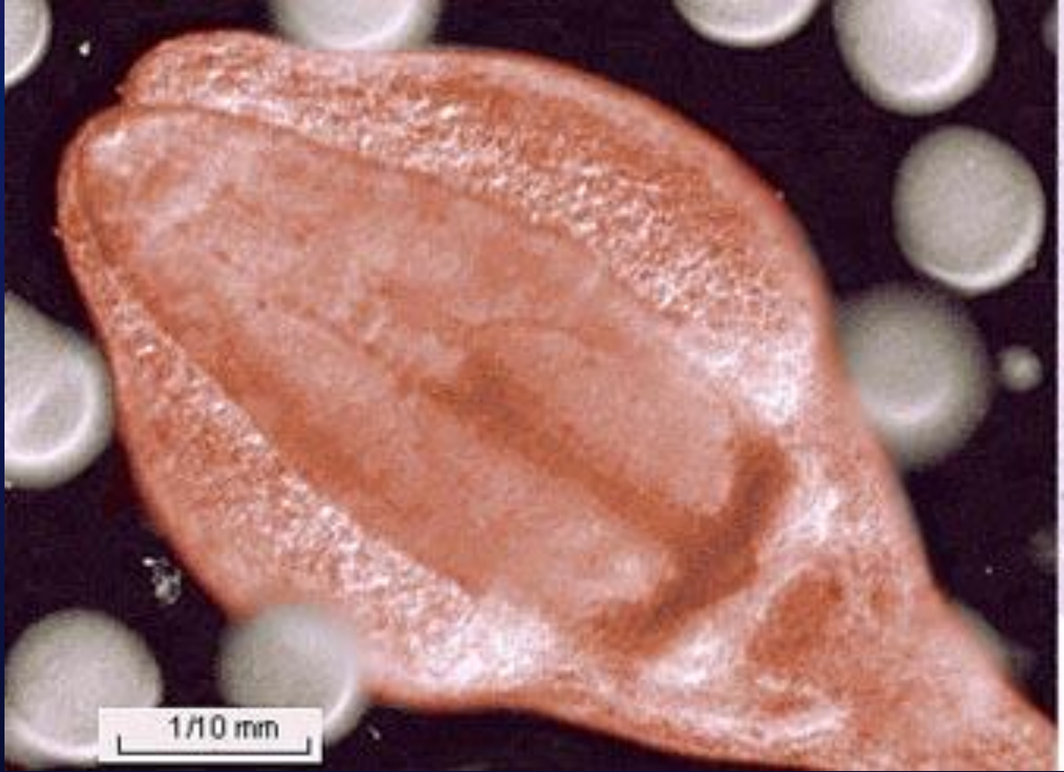


глобифирос

Разные виды педицеллярий



Строение трехстворчатых (трехзубых) педицеллярий

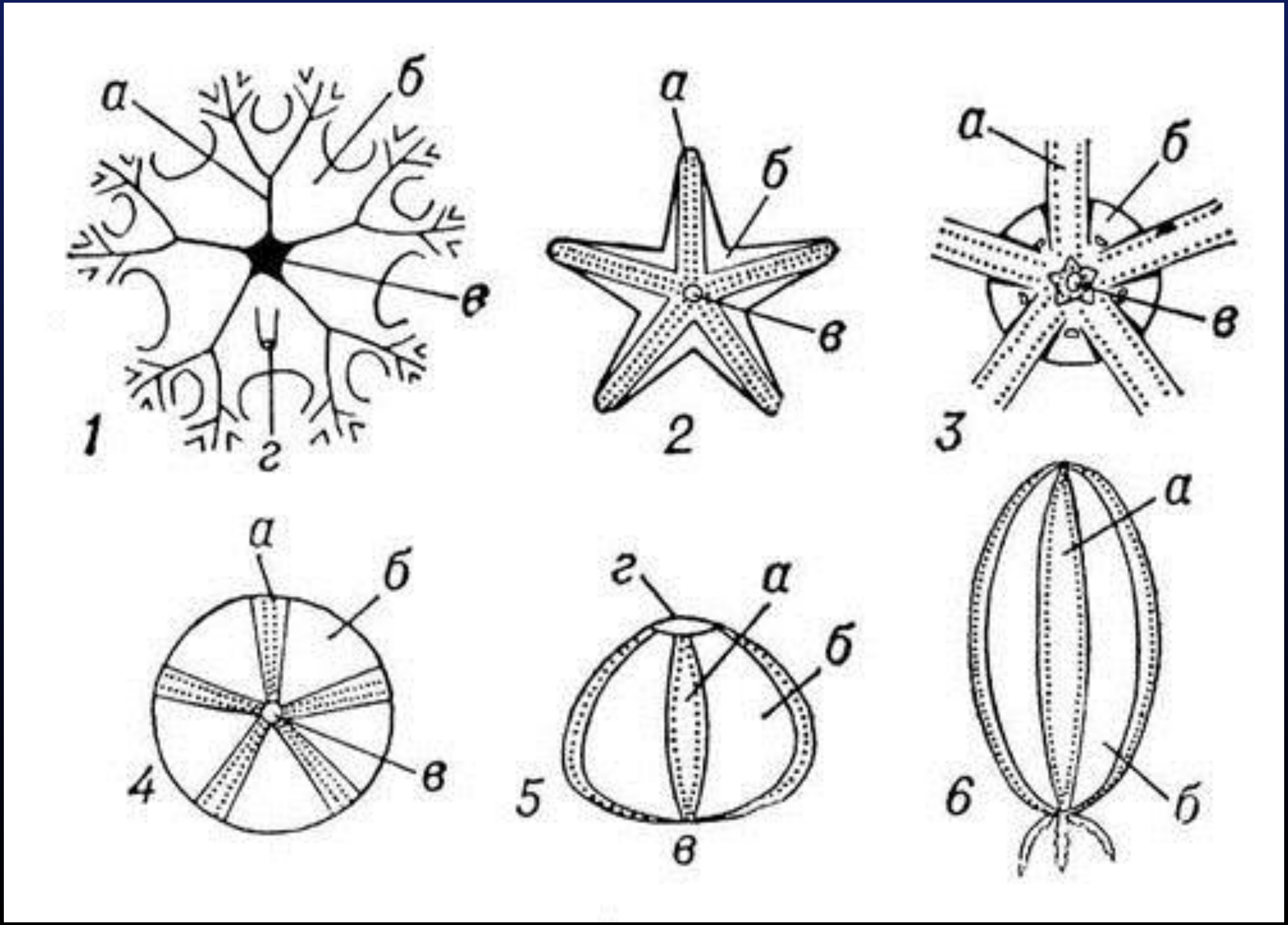


Note the structure inside upper jaw into the left picture

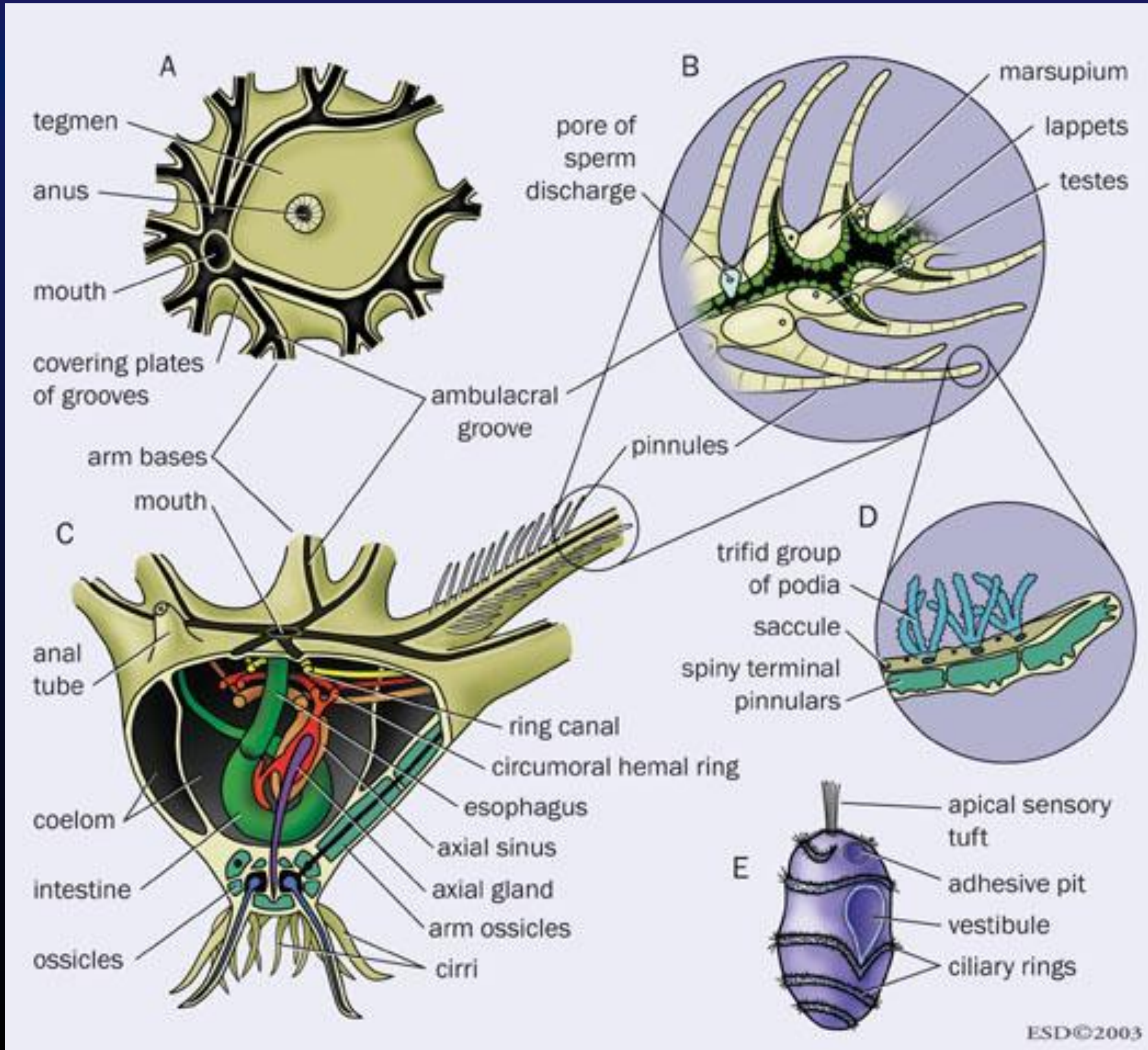
Open Pedicellaria

Работа трехстворчатых педицеллярий

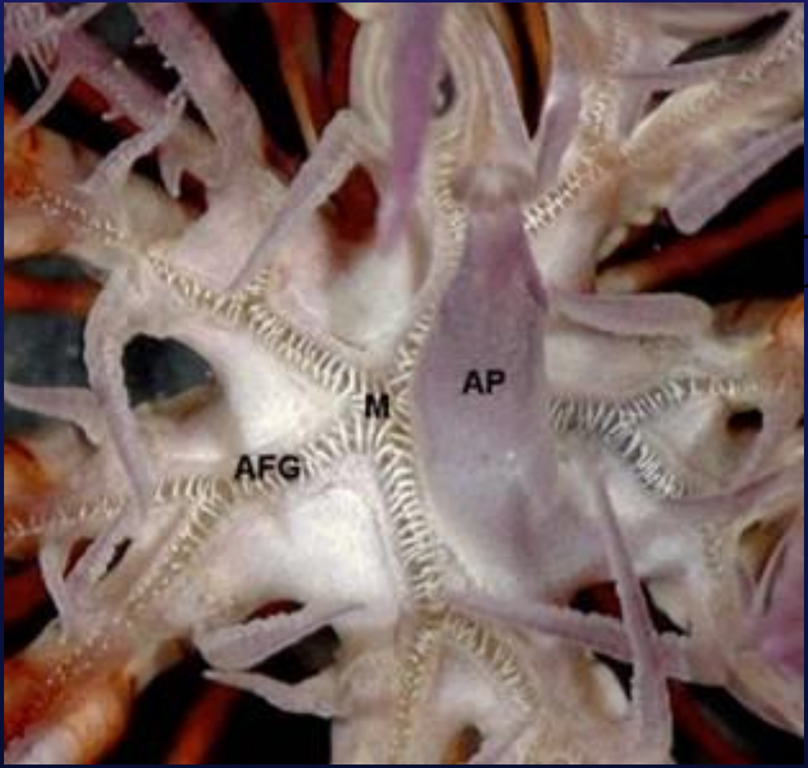
План строения

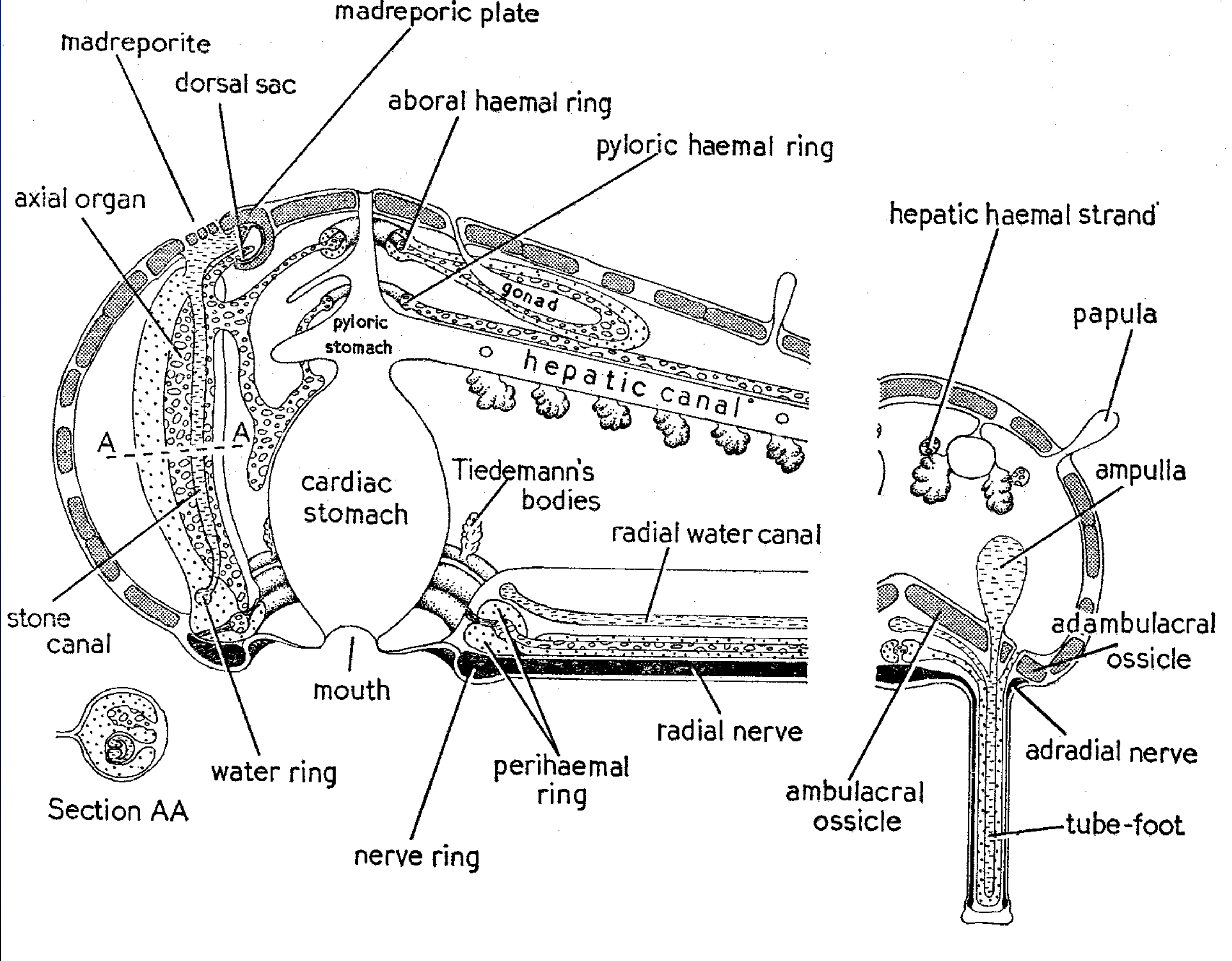


Морские лилии: строение



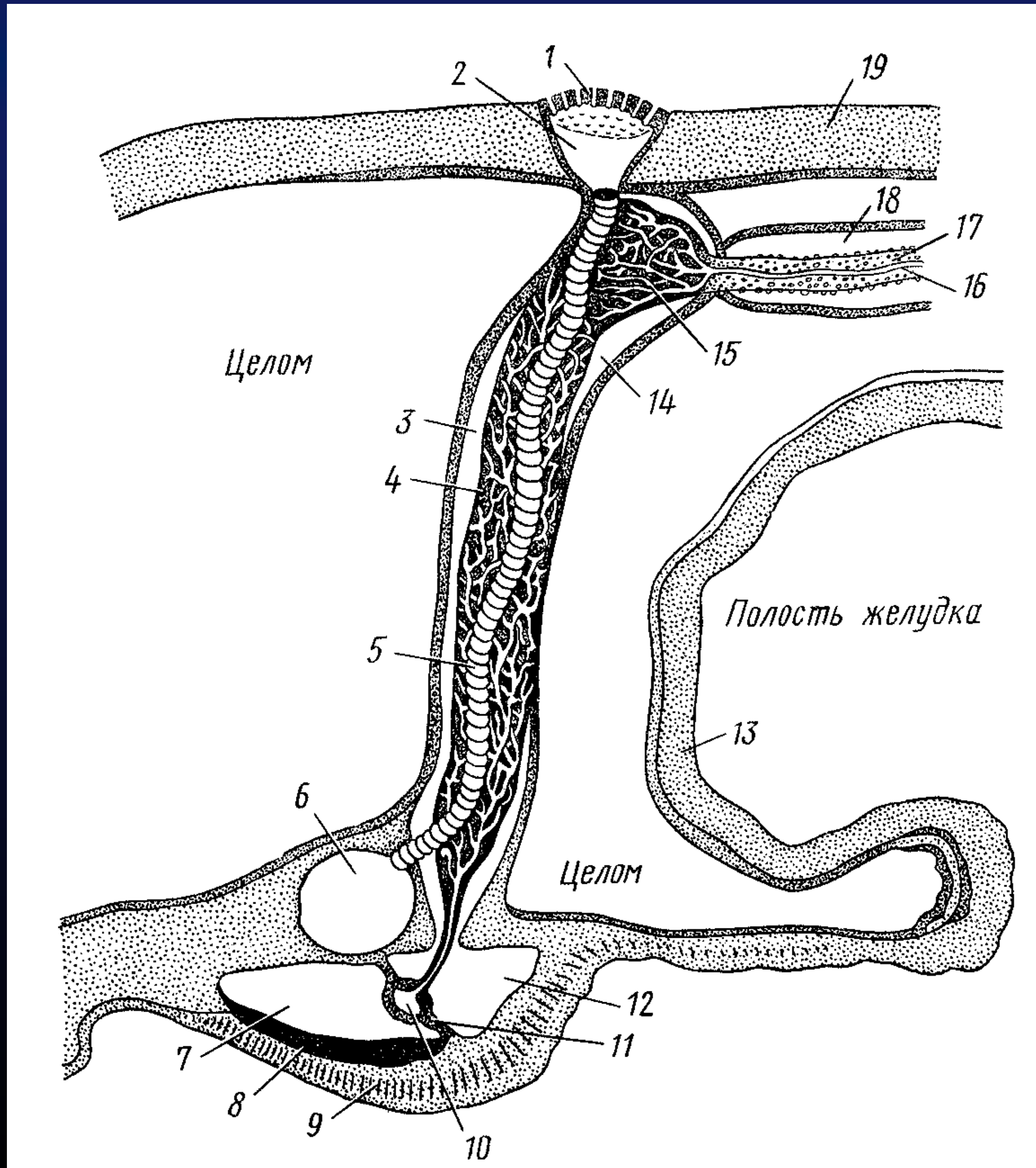
ии: мо



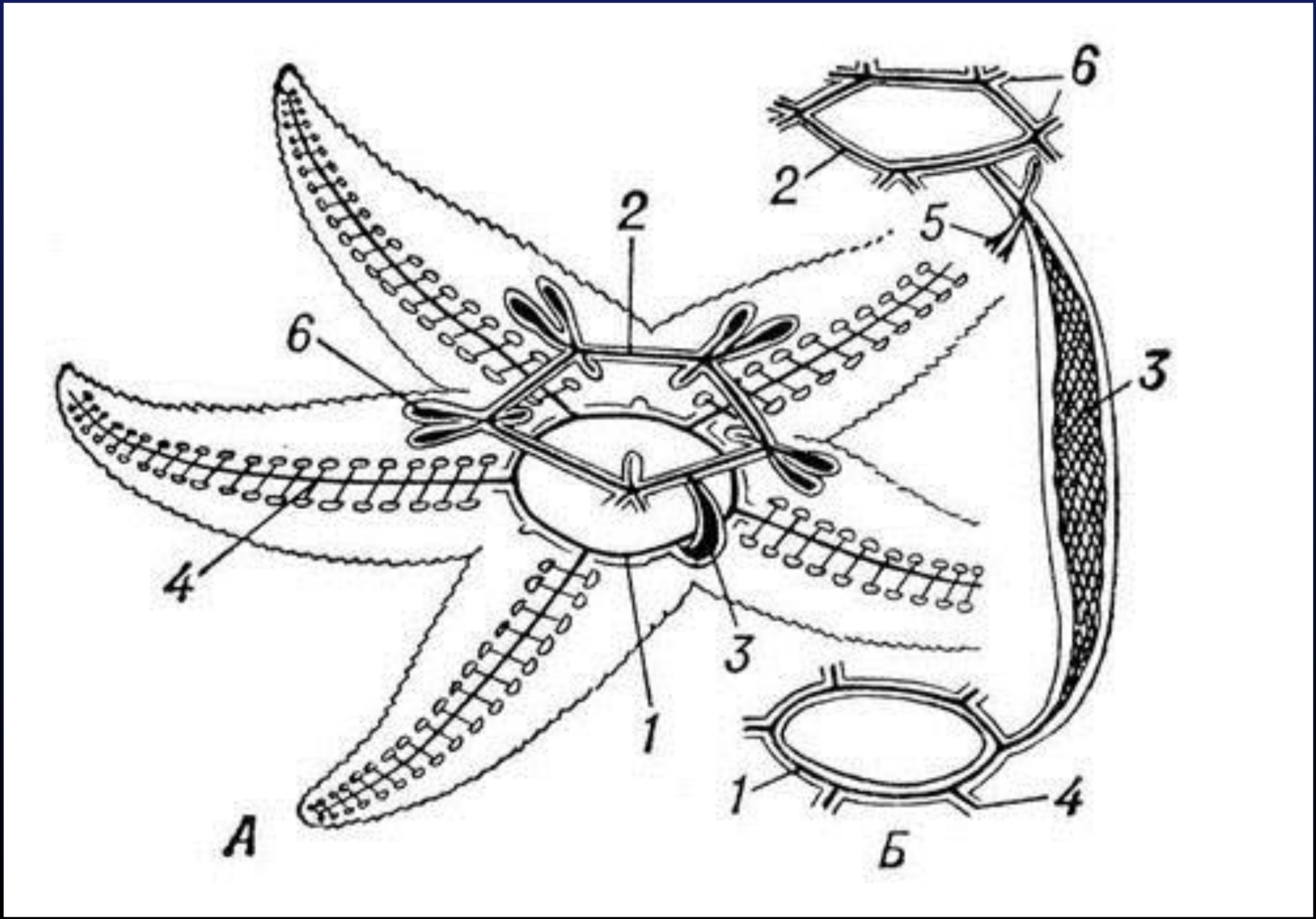


madreporic plate
madreporite
dorsal sac
aboral haemal ring
pyloric haemal ring
axial organ
hepatic haemal strand
gonad
pyloric stomach
papula
hepatic canal
A
A
ampulla
cardiac stomach
Tiedemann's bodies
radial water canal
stone canal
adambulacral ossicle
mouth
radial nerve
adradial nerve
water ring
perihaemal ring
Section AA
ambulacral ossicle
tube-foot
nerve ring

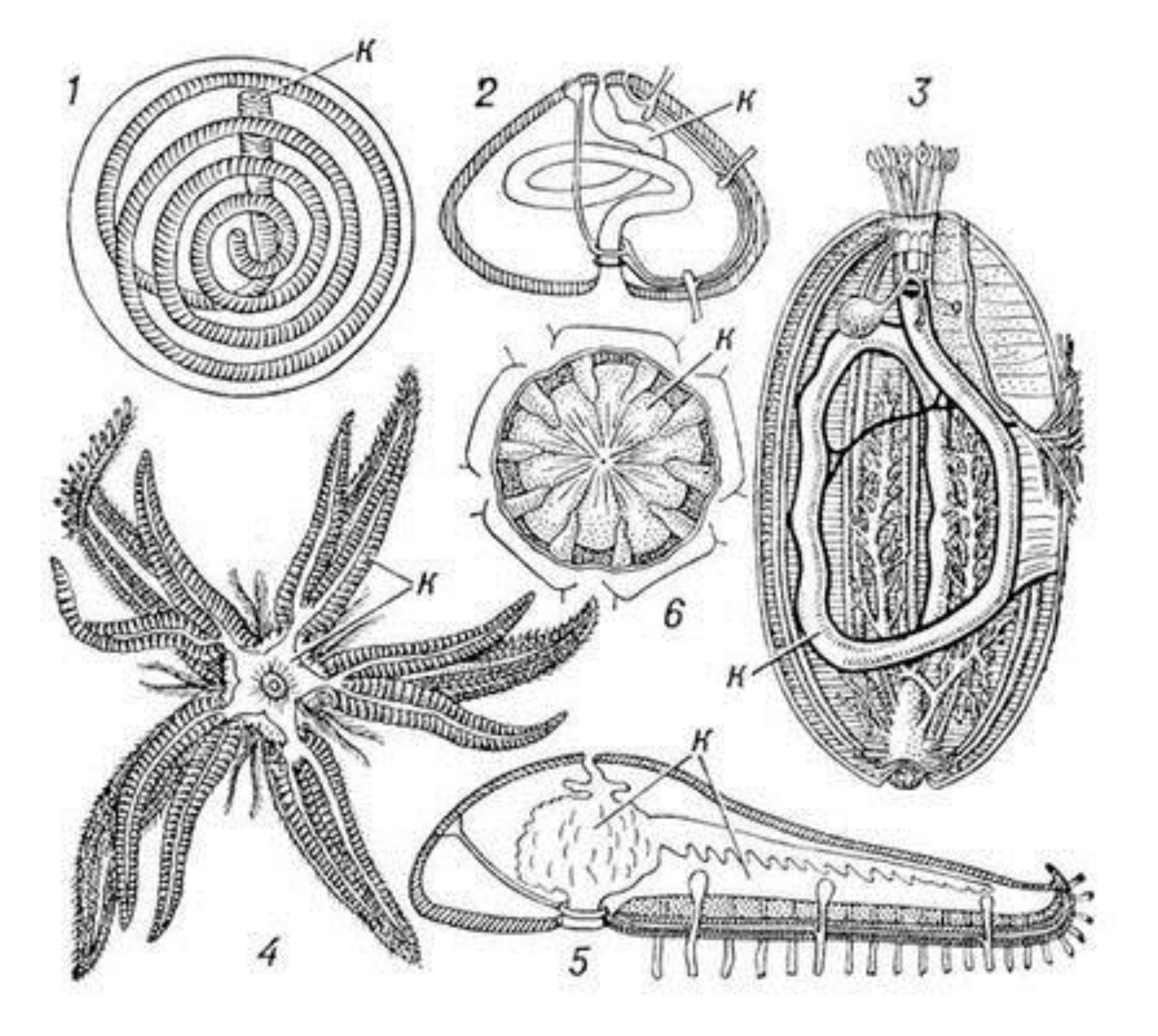
Осевой комплекс органов



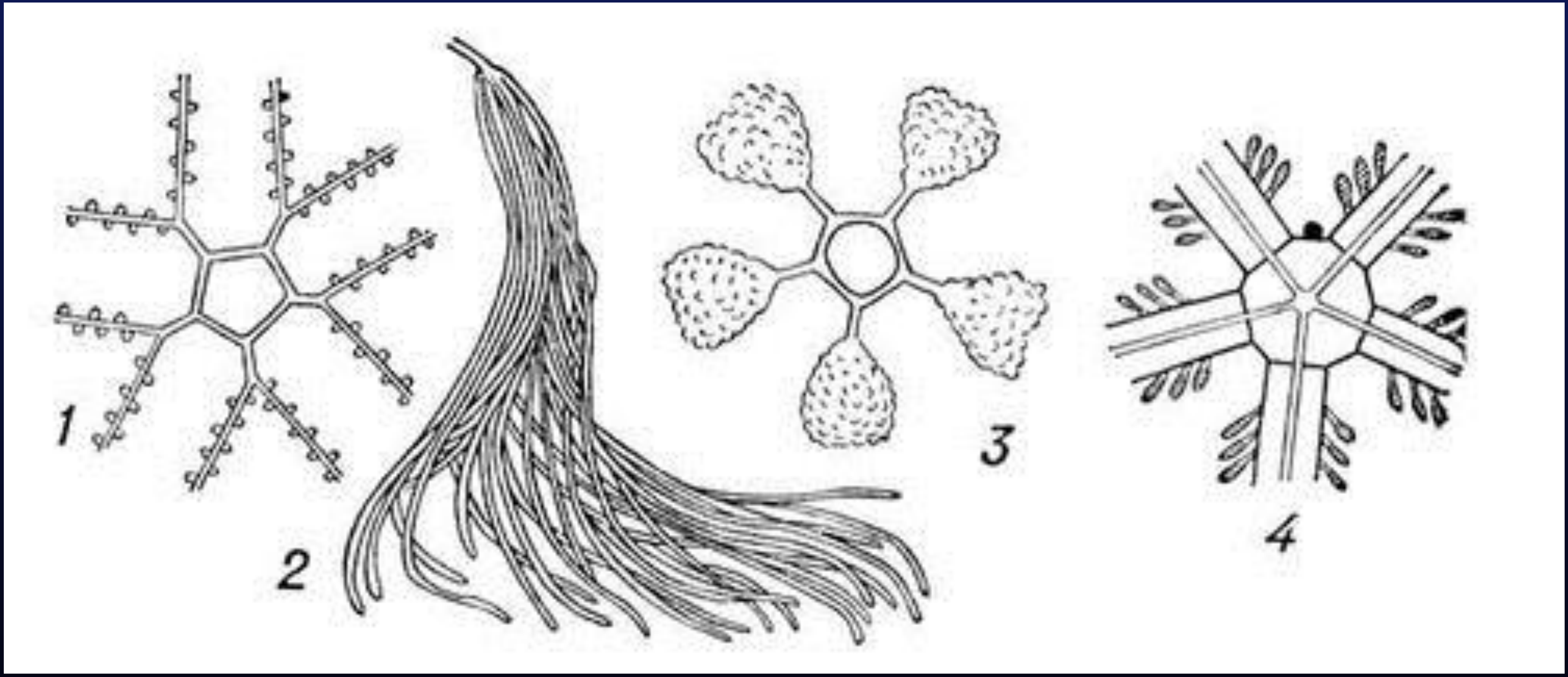
Кровеносная система



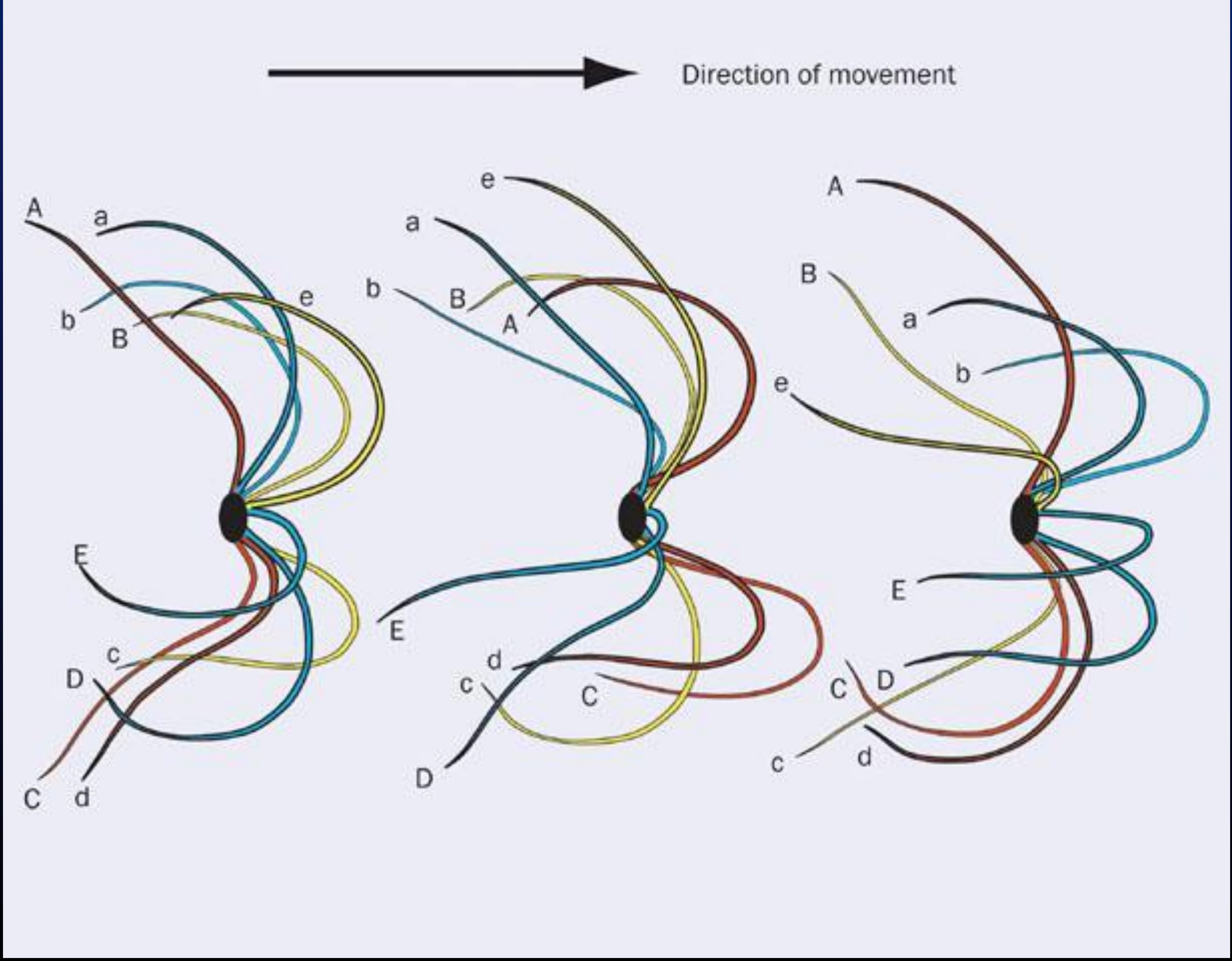
Пищеварительная система



Половая система

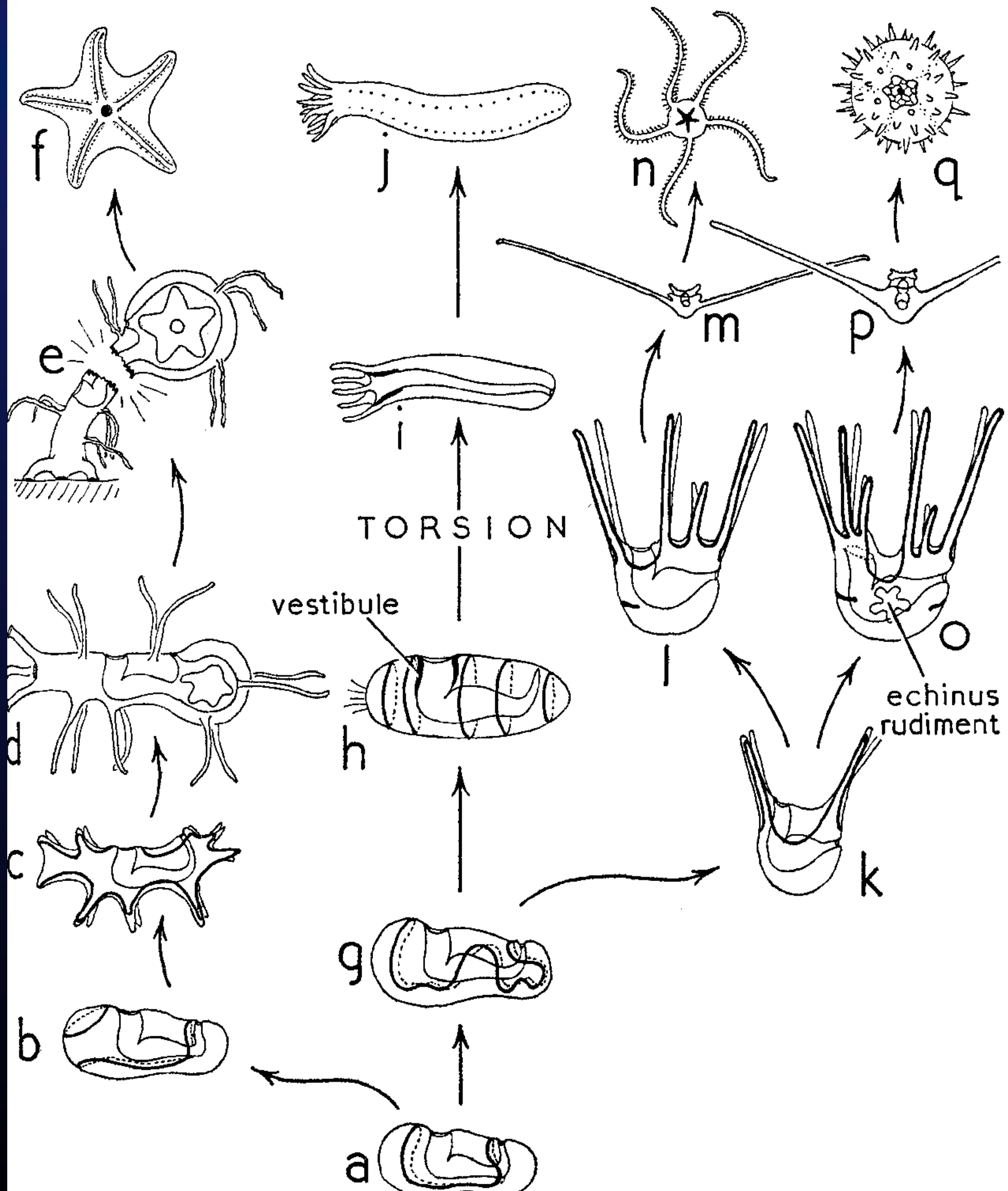


Локомоция



Гаструла

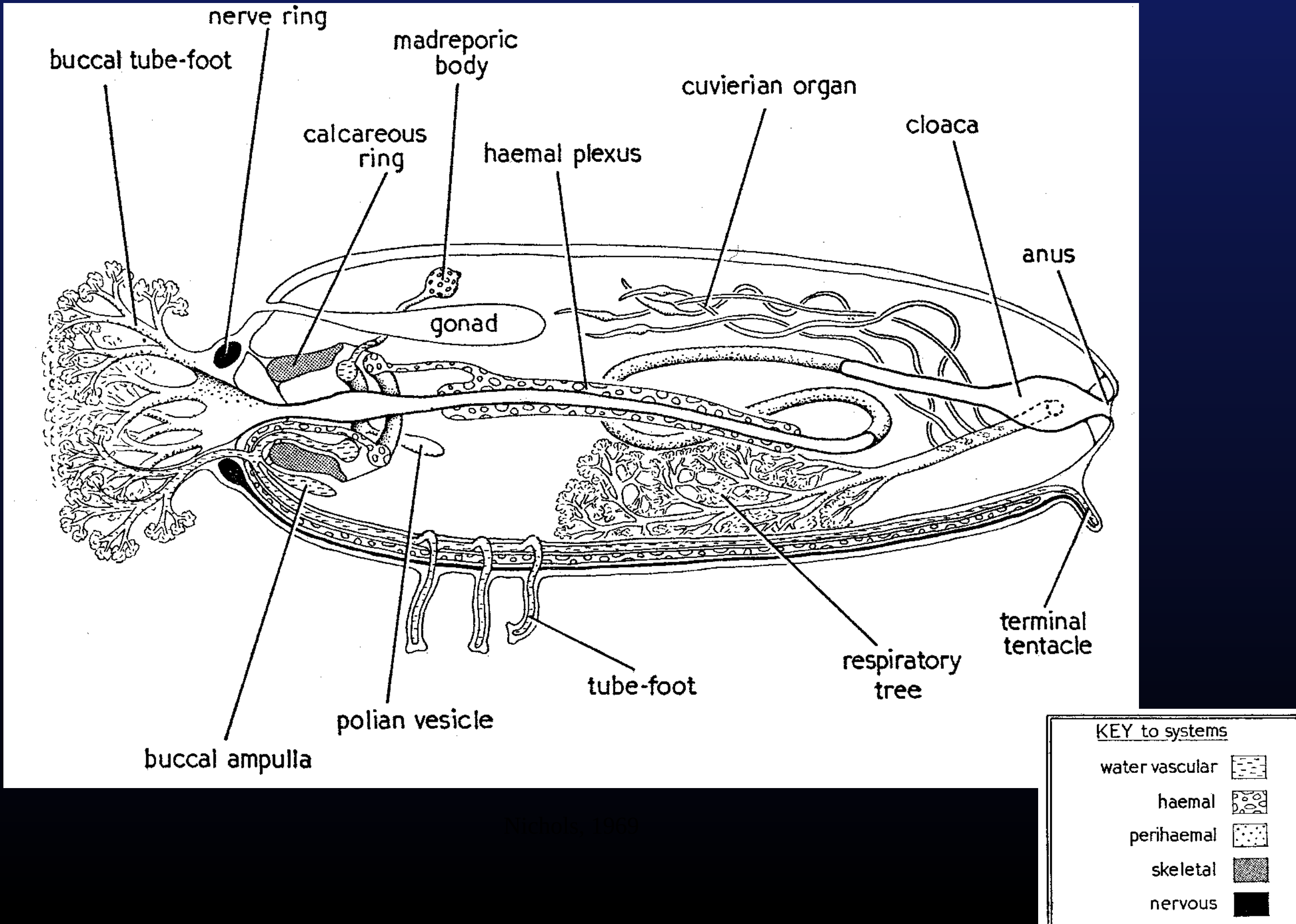
Развитие



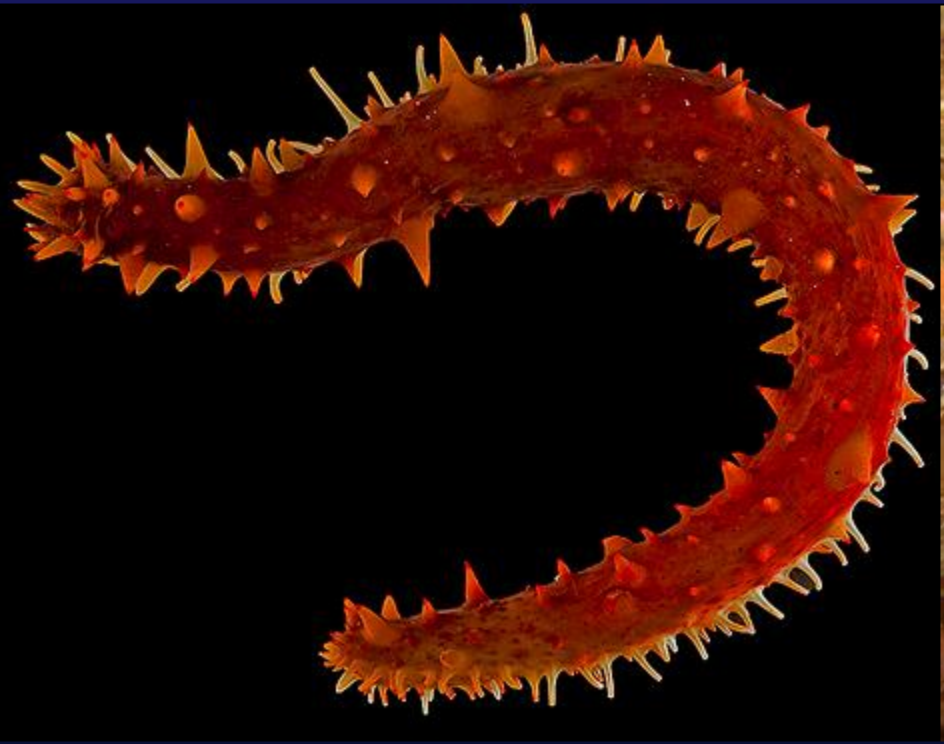
Echinoderms: the ultimate animals

https://www.shapeoflife.org/video/echinoderms-ultimate-animal

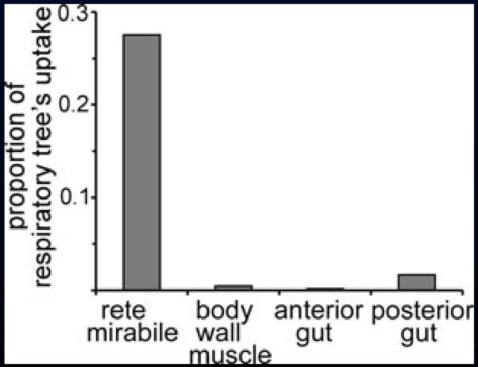
Anatomy of Holothuroidea



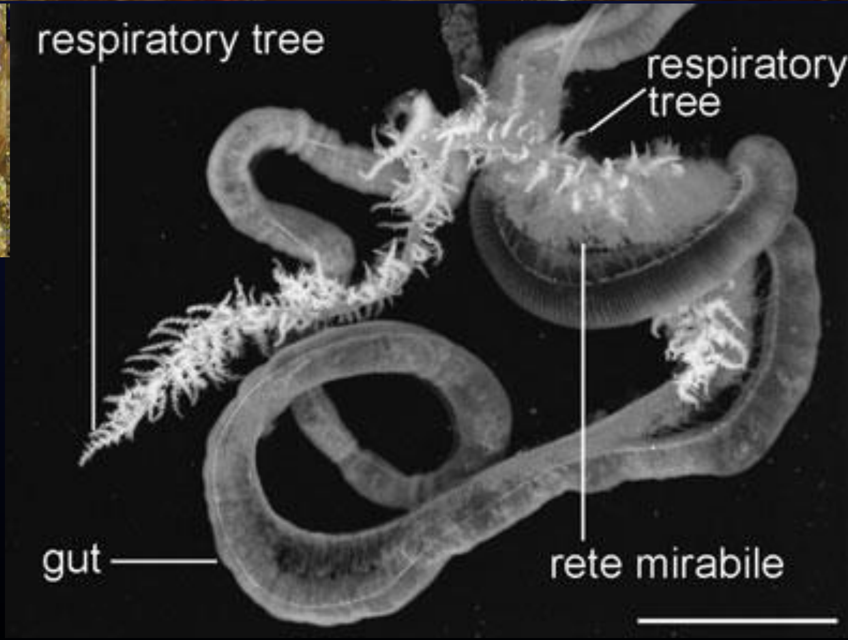
Nichols, 1969



Holothurians with respiratory trees are nutritionally bipolar; the anus serves as a second mouth.



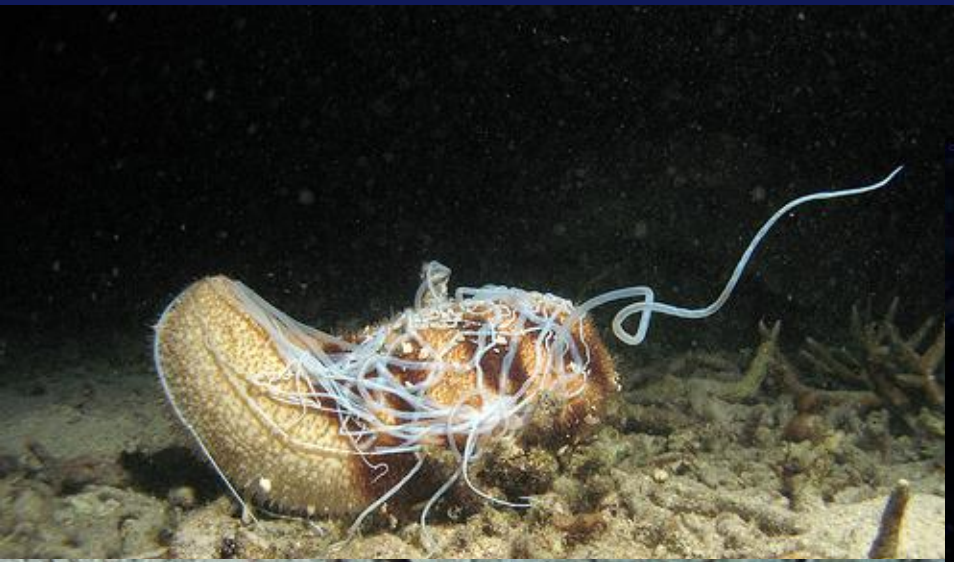
Amount of label (nmol ^{14}C g wet weight $^{-1}$), expressed as a proportion of the label in the respiratory tree, in the rete mirabile, body wall muscle, anterior digestive system, and posterior digestive system of an adult of *Parastichopus californicus* incubated with ^{14}C-labeled cells of *Rhodomonas sp*. for 7.6 h.



Viscera of *Parastichopus californicus*, with respiratory tree and hemal system. One branch of the respiratory tree is associated with the rete mirabile of the hemal system. Scale bar=3 cm.

Carapus boraborensis is coming out from
a seacucumber *Bohadschia argus*

Sticky Cuvierian Tubules



Sea cucumber fights with Guts: Cuvierian tubules

https://www.youtube.com/watch?v=wXf_YodWw40

Отряд Elasipodida

Psychropotes longicauda

Scotoplanes sp.

https://www.youtube.com/watch?v=m-H1J7ukGsU

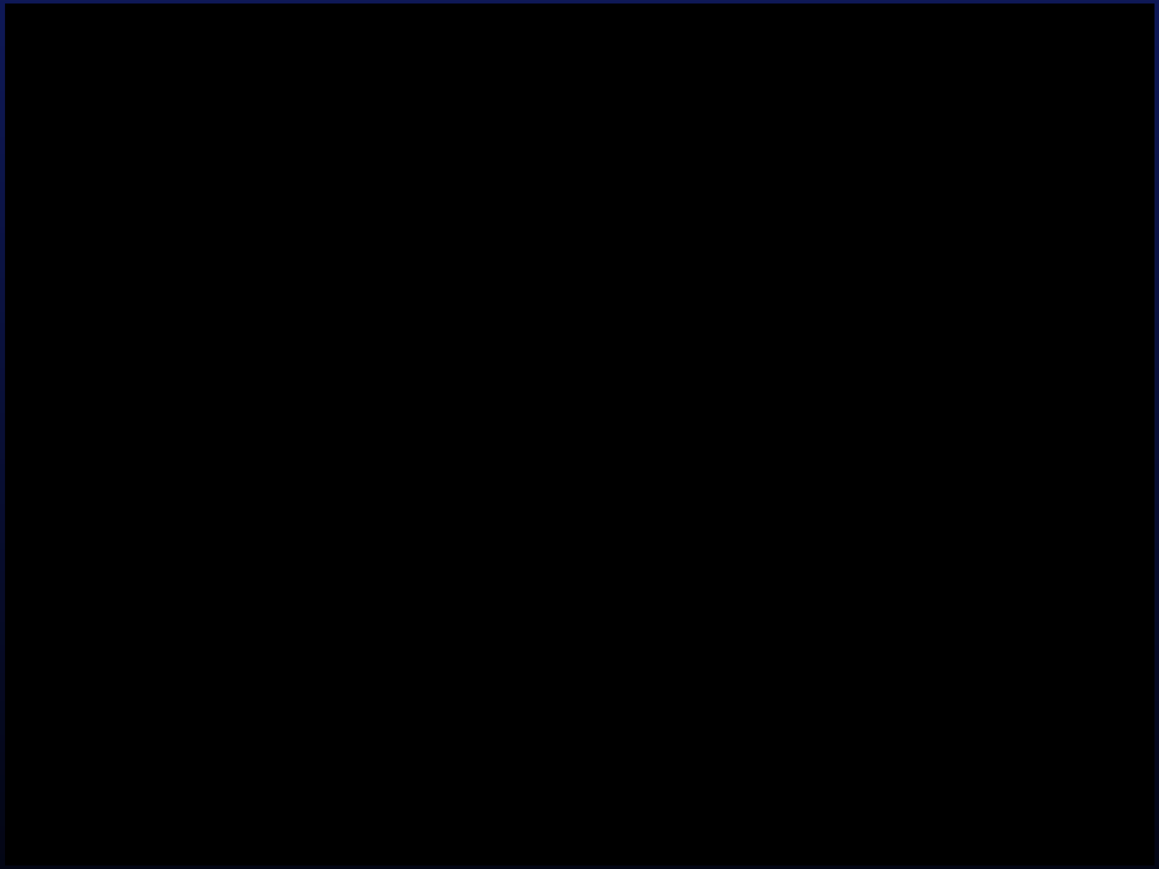
Отряд Elasipodida

Pelagothuria sp.

Benthodytes sp.

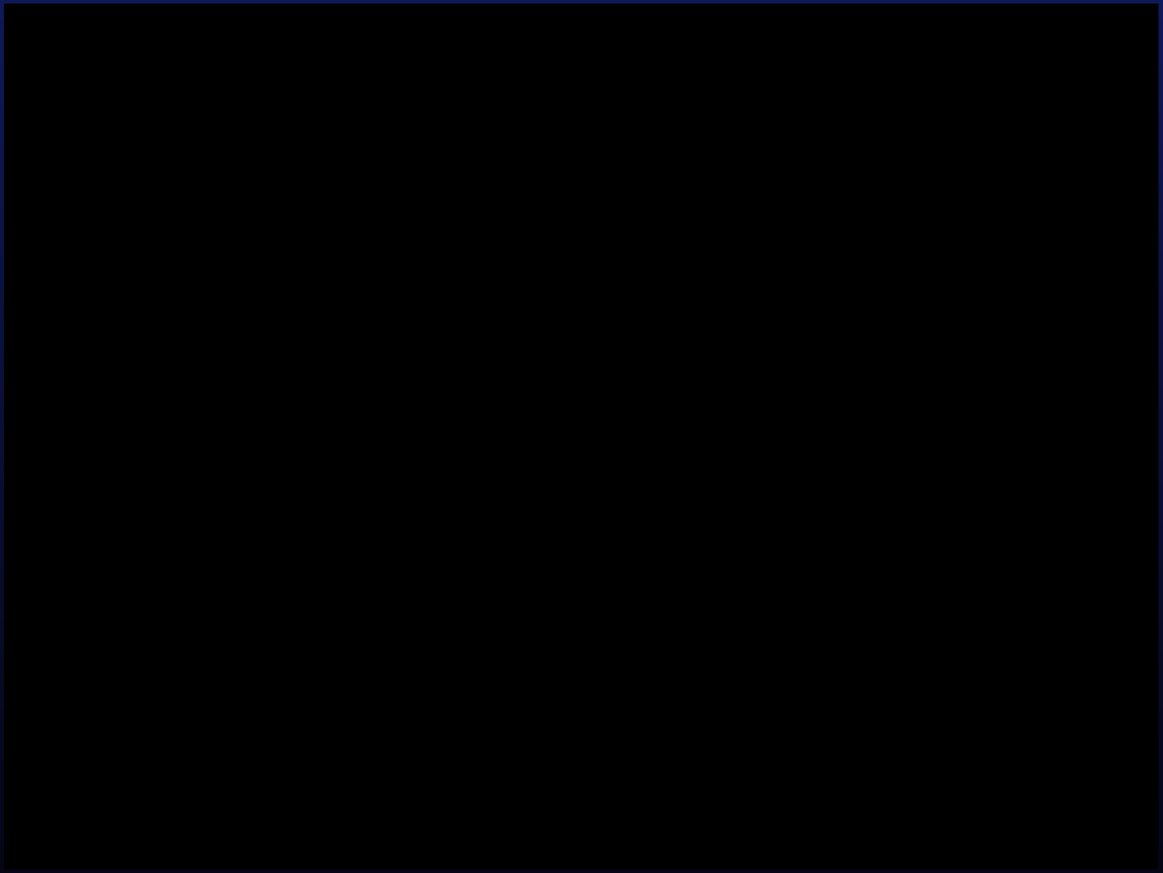
Enypniastes sp.

Enypniastes sp.



Enypniastes sp.

https://www.youtube.com/watch?v=Ph9lEECUvNs



Enypniastes sp.

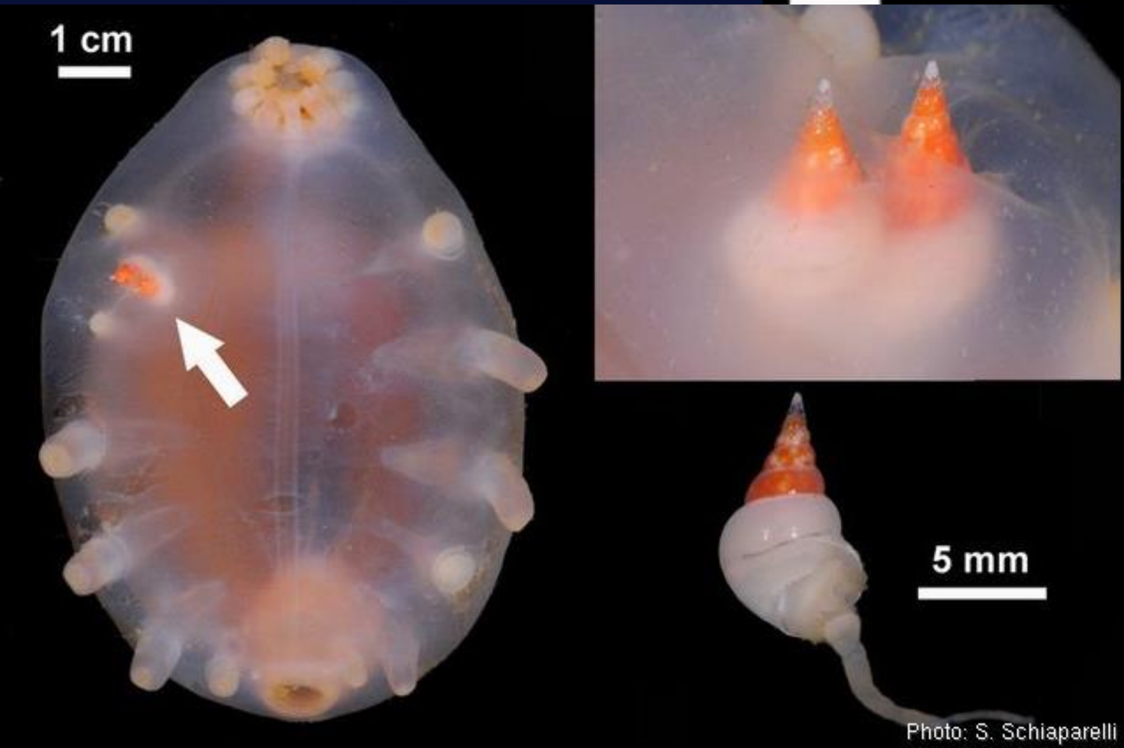
https://www.youtube.com/watch?v=E-T8mebeJuI

Psychropotes sp.

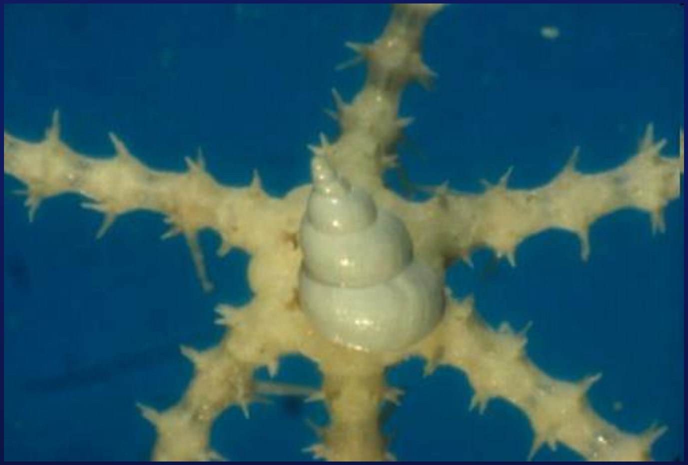
https://www.youtube.com/watch?v=f2hzP4hXrl4

Отряд Elasipodida

Parasitic association between *Mirandotanais sp*. (a small crustacean of the Order Tanaidacea) and the sea pig *Scotoplanes*.



Parasitic association between *Stilapex (*snail) and *Scotoplanes* (holothurian ‘sea pig’).



Ophiacantha dallasi with parasitic snail, *Stilapex sp.*

Snails of the familly Eulimidae are often found on echinoderms and many species are very host-specific, parasitizing only on a particular species of echinoderm or a few closely related species. The eulimids are parasitic, and are usually associated with species of echinoderms. The animal has a long proboscis with which it can excavate deeply into the body of its prey, and since there is no radula it is assumed that they feed primarily upon body fluids.

Eulimid shell, *Apicalia* sp., on a sea basket star

Отряд Apodida (Synaptida)

Chiridota sp.

Chiridota hawaiiensis

Synapta maculata

Жизненные формы и среда обитания голотурий