
VII INTERNATIONAL
CONGRESS OF
PROTOZOOLOGY
NAIROBI 22-29 JUNE 1965
7/- KENYA


R.P. ROMÎNA
55 BANI
POSTA
Dr VICTOR
BABES
1854
1954


4.50


REPÚBLICA PORTUGUESA
2$50
ANGOLA


MALAYSIA 25c
ULANG TAHUN KE 75
IMR


پست ایران
IRAN
2R.


SWAZILAND
7½c
25th ANNIVERSARY of the W.H.O.


40F
+5F
REPUBLIQUE POPULAIRE DU CONGO


Brasil 80
4,00


czwarty międzynarodowy kongres parazytologów
POLSKA
6,00


VII INTERNATIONAL
CONGRESS OF
PROTOZOOLOGY
NAIROBI 22-29 JUNE 1965
5/- KENYA


RSA 27c


ALGERIE
الجزائر
البريد
الجزائر
1981
2,00


$1.00
LE DÉ
AUHURAS
CORREO URUGUAY
COMISION NACIONAL DE HIDATIDOSIS - M.S.P.


AR EGYPT
20
INT. CONF. ON
SCHISTOSOMIASIS


U.A.R.
10M
THEODOR BILHARZ
1862-1962


DESCOBERTA E IDENTIFICAÇÃO DO
SCHISTOSOMA MANSONI
BRASIL
CORREIO
Cr$ 2,50
PIRAJÁ DA SILVA
1908—1958


PREVENTION DE LA CECITE
50F
REPUBLIQUE TOGOLAISE


EXAMINATION
FOR SIGNS
OF RIVER
BLINDNESS
WORLD
HEALTH DAY
7th April 1976
FORESIGHT PREVENTS BLINDNESS
GHANA
7p


REPUBLIQUE DE HAUTE-VOLTA
CONTRE CONJONCTIVITE
40F
POSTES


NIGERIA
10k


Haemonchus spp.
1
Cuba
DESARROLLO MEDICINA VETERINARIA


Ancylostoma
caninum
2
Cuba
DESARROLLO MEDICINA VETERINARIA

Základy humánní parazitologie

Doc. RNDr. Milan Gelnar, CSc.

Ústav botaniky a zoologie
oddělení parazitologie
Přírodovědecká fakulta MU
E-mail: gelnar@sci.muni.cz

Základy humánní parazitologie

Základní údaje o předmětu:

přednáška: čtvrtek, od 9 do 11.50 hodin,

budova A11, místnost 306

zkouška (ústní) se bude konat v kampusu MU Bohunicích v pavilonu Ústavu botaniky a zoologie A31 v místnosti 332 – bude info mailem

studijní materiály na IS

Základy humánní parazitologie

- Struktura přednášky:

- Úvodní část přednášky, základní parazitologické pojmy
- Protozoologie
- Helmintologie
- Arachnoentomologie
- Kombinace orgánového přístupu a systematiky

Z historie parazitologie I

Egypt: (1250 – 1000)	Schistosoma hematobium
	Taeniarhynchus saginatus
	Ascaris lumbricoides
	Dracunculus medinensis
Řecko a Řím:	Plinius starší
	Aristoteles
	Galén
	Hippocrates

Z historie parazitologie II

- Čína — Ascaris lumbricoides

- Amerika — helminti
  Tunga penetrans
  Pediculus humanus
  Malárie (Plasmodium)
  Leishmanióza (Leishmania)

Z historie parazitologie III

- Evropa (1200 – 1650)
  - 1379: Fasciola hepatica
  - 1592: Diphyllobothrium latum
  - 1674: Eimeria
  - 1681: Giardia intestinalis
  - 2. pol. 17.stol – Francesco Redi – „otec parazitologie“ - redie

Z historie parazitologie IV

- Středověk – mnoho falešných představ o cizopasnících

- Rudolphi: Nematoidea
  Acanthocephala
  Nematoda
  Cestoda
  Cystica

- 1773: cerkarie (Muller)
- 1816: cerkárie – motolice (Nitzch)
- 1842: životní cyklus motolice (Thomas, Leucard)

- 19. století – parazitologie jako věda (Zeder, Rudolphi, Frolich, Butschli, Dolfein, Dujarden, von Sielbold, Schaudin, Loos aj.)

Z historie parazitologie V

- Rozvoj parazitologie u nás:
- Do 1. světové války: Praha – Dušan Lambl, Stanislaw Prowazek

- Mezi válkami: Praha: Briendl, Komárek, Jírovec – otec naší parazitologie
  Brno: Rašín

- Po 2. světové válce: Akademie věd - ČSAV, SAV, AV ČR,
  Parazitologický ústav AV ČR v Českých Budějovicích
  Univerzity (UK, ČZU, JčU, MU, MENDELU, VFU)
  Veterinární a hygienická služba
  Armáda, nemocnice, referenční laboratoře
  Soukromé firmy a diagnostické laboratoře

Z historie parazitologie VI

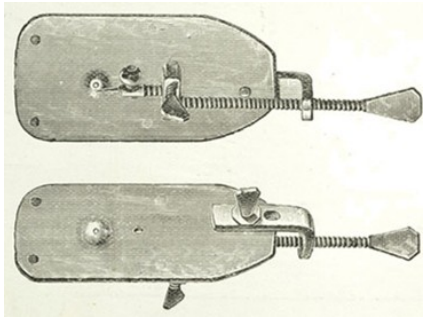
- 20. století – parazitologie vyhraněná vědní disciplina
- Fauna cizopasníků
- Morfologie, taxonomie a systematika
- Životní a vývojové cykly
- Biologie a ekologie
- Fyziologie, biochemie, imunologie
- Epidemiologie a matematické modelování
- Genetika a molekulární biologie
- Evoluční biologie a fylogenetika
- Genomika a transkriptomika

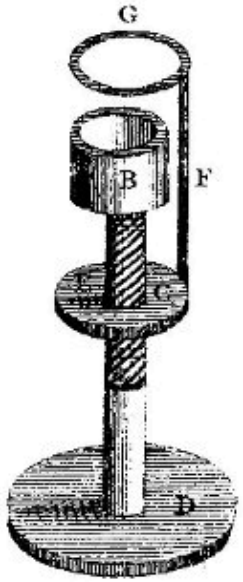
- Histologie, histochemie, imunohistochemie
- Ultrastruktura a anatomie
- SCAN, TEM, CLSM

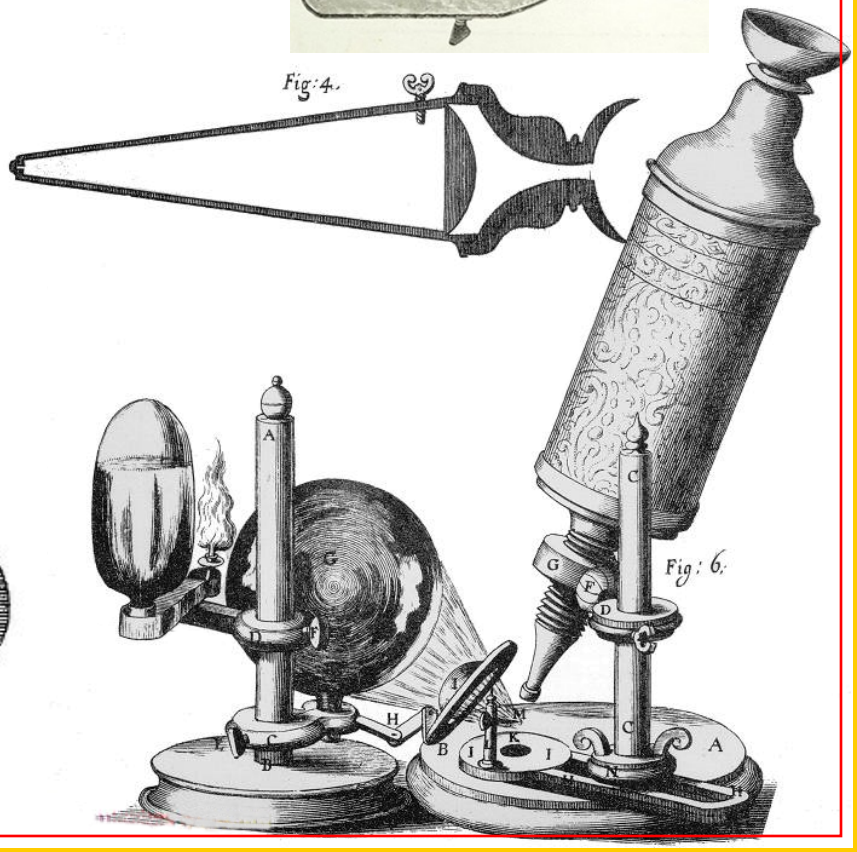
Přehled základních mikroskopických technik

Small drop has a nearly perfect spherical shape, and so it can se as a lens.

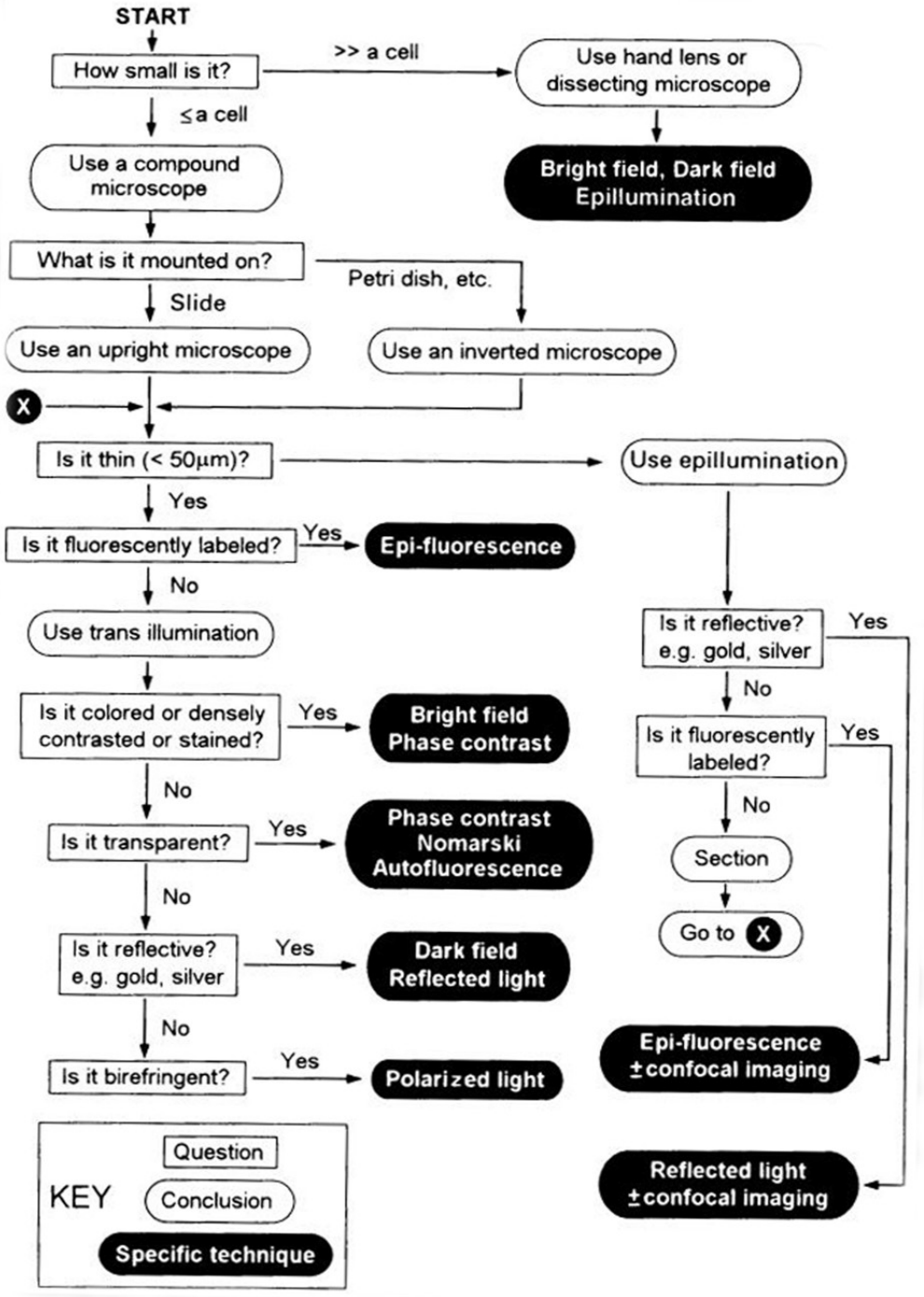
17th century - Stephen Gray use water drop as a lens for a microscope he built

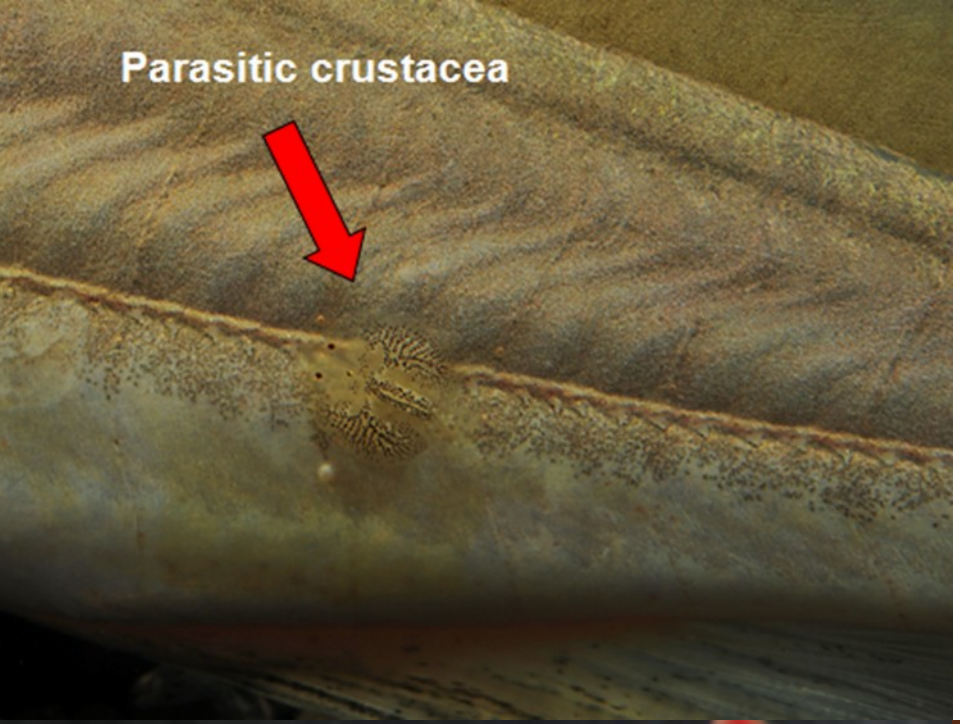






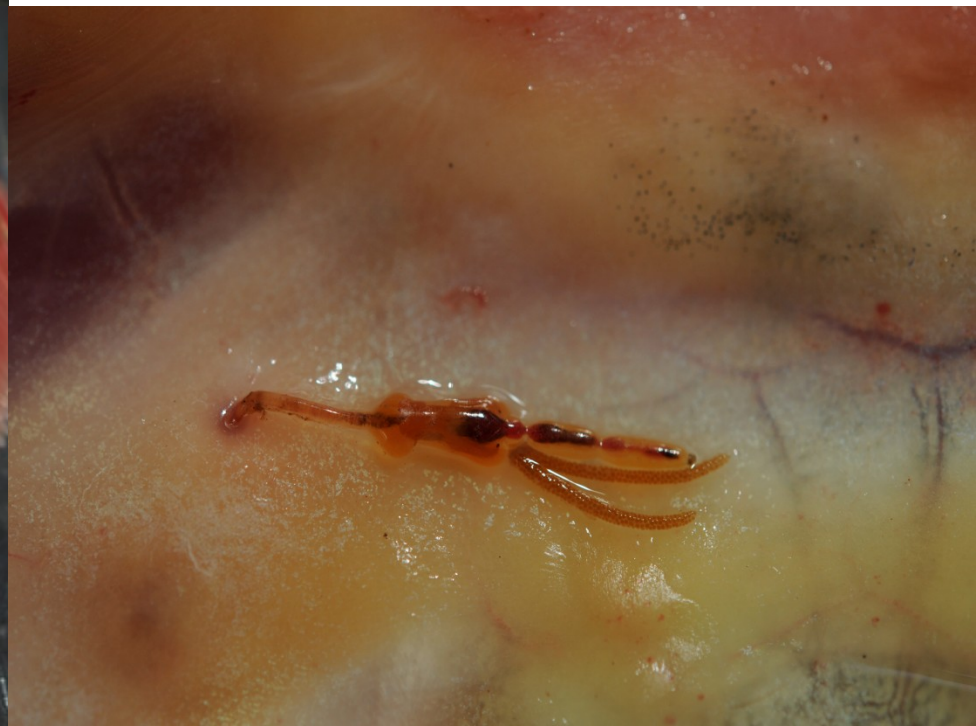
Jak vybrat správnou mikroskopickou techniku ?





ECTOPARASITES

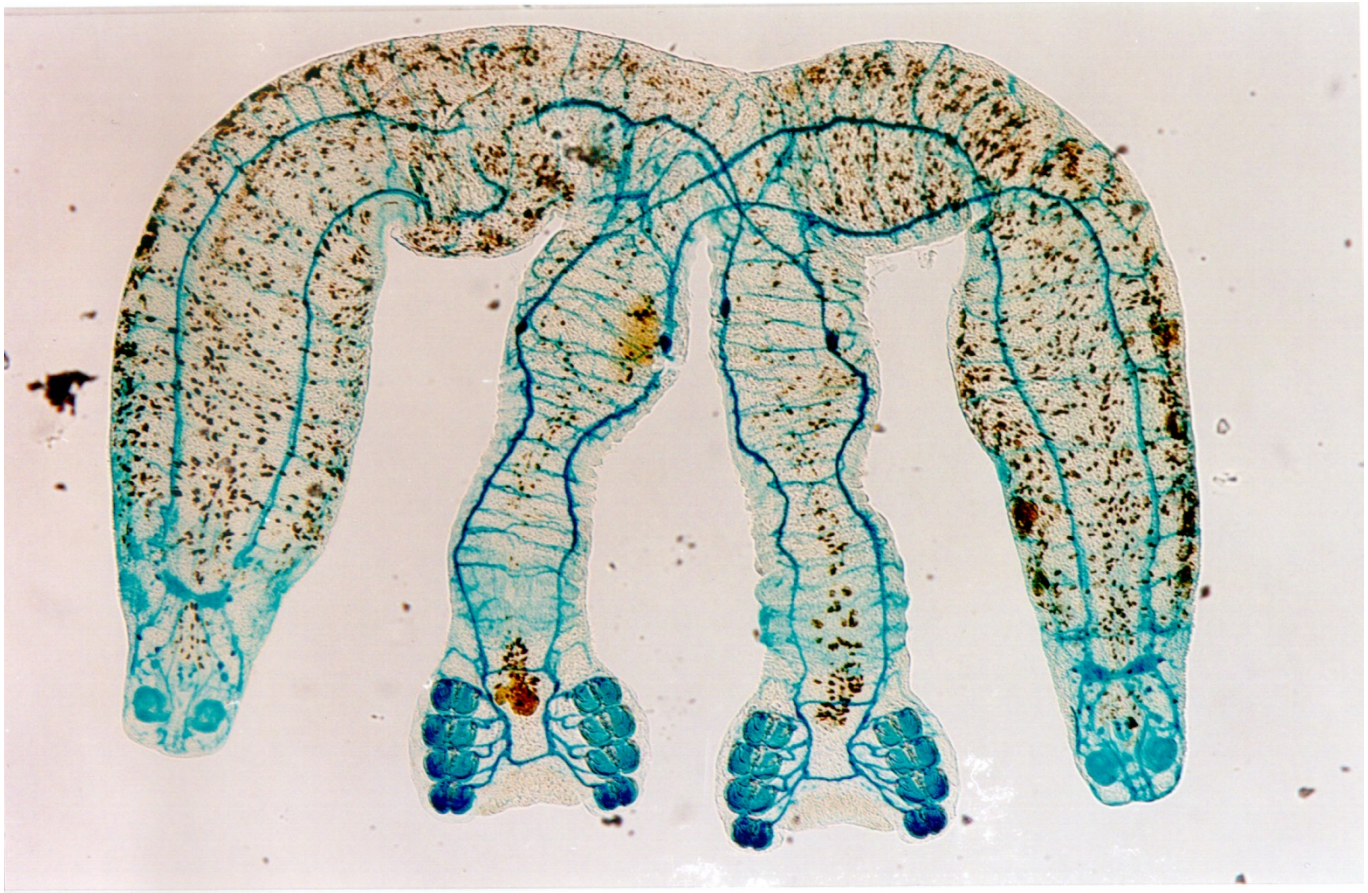
Parasitic crustaceans, leeches - found externally:
usage of hand lens or dissecting microscope



Oddělení parazitologie - infrastruktura

Bright field

Eudiplozoon nipponicum



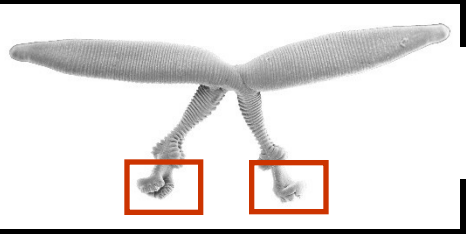
- Acetylcholine visualised with 5-bromo-chloro-indolyl acetate

(Zurawski T.H. et al., 2001)

Gomori Trichrom Staining

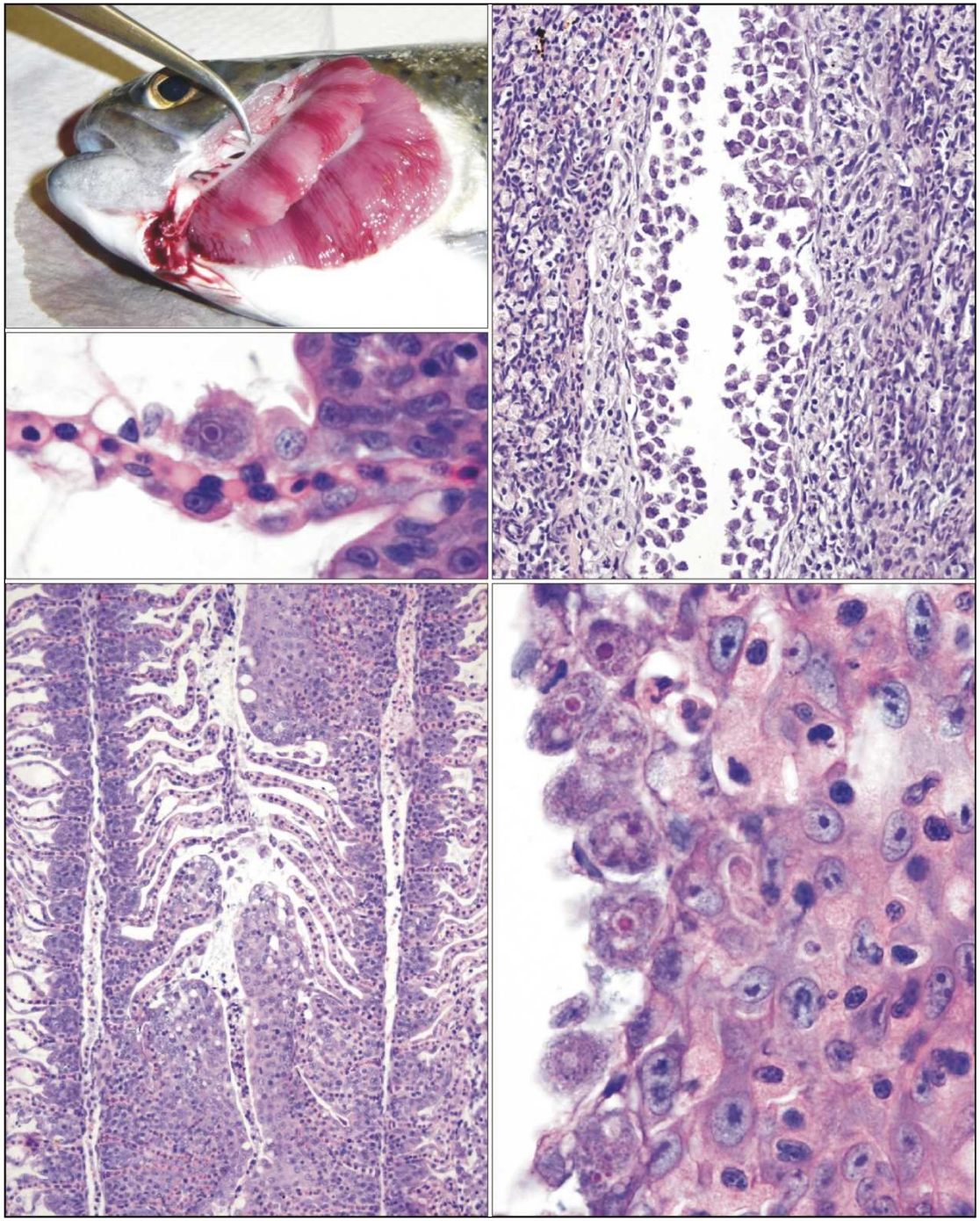
E. nipponicum

P. homoion

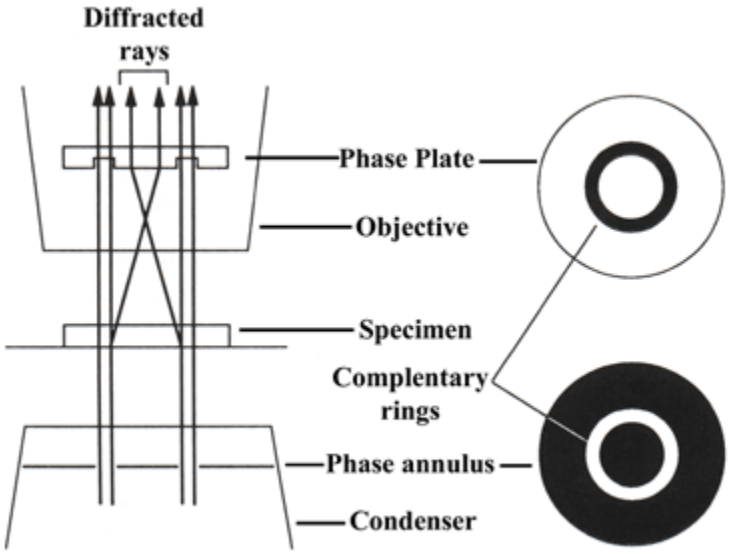


E. nipponicum - histology

LM (Histological sections, Masson´s trichrome)



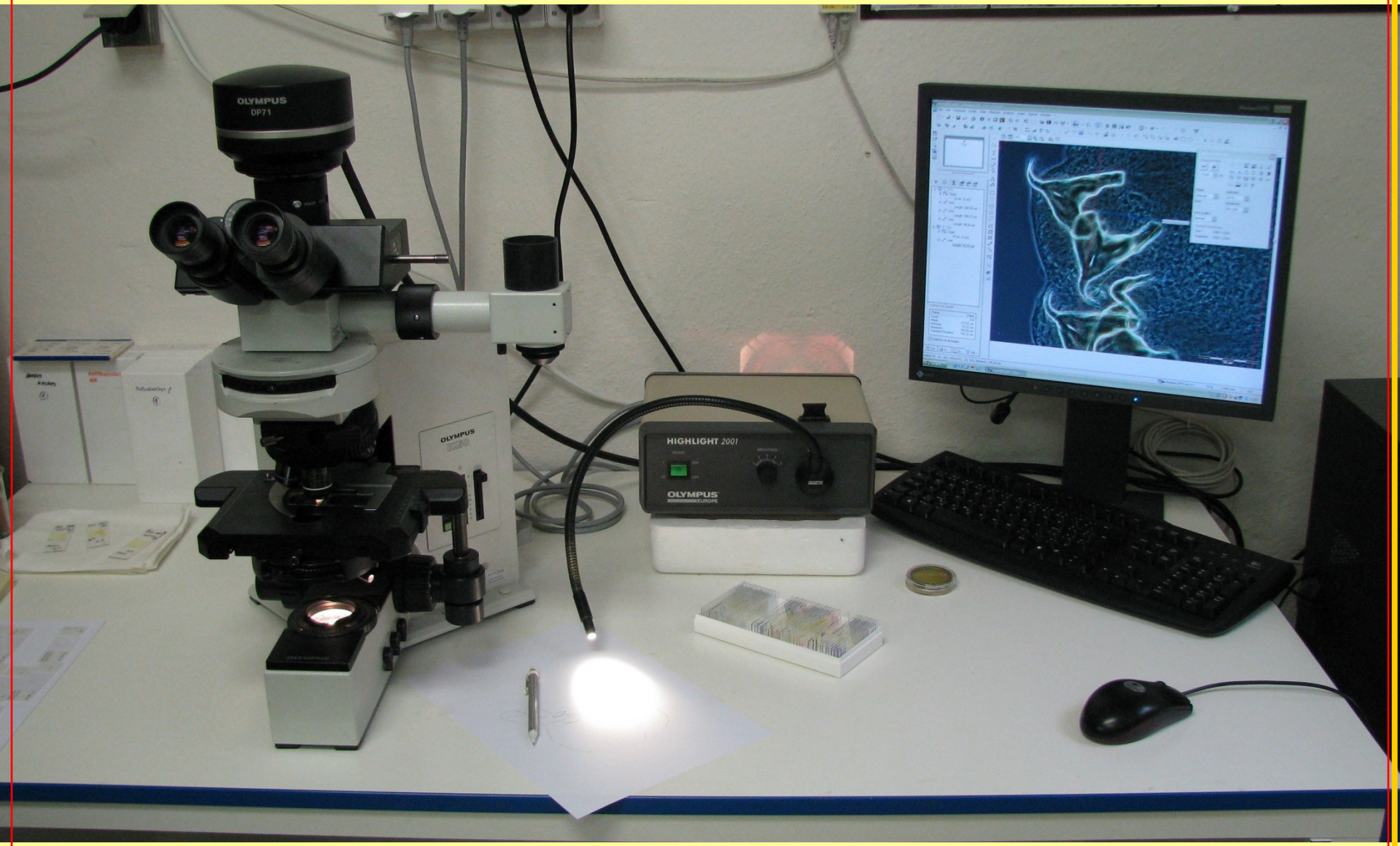
Phase contrast (P



- PC enhances contrasts of transparent and colorless objects by influencing the optical path of light
- Light passing trough a transparent part of the specimen travels slower and, due to this is shifted compared to the uninfluenced light

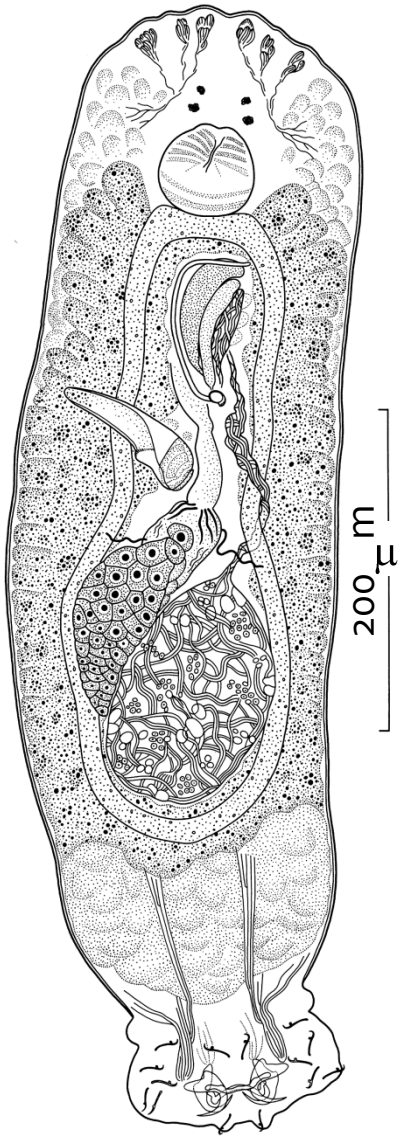
- Difference in phase is not visible to the human eye → change in phase can be increased to half a wavelength by a transparent phase-plate in the microscope and thereby causing a difference in brightness
- Transparent object becomes shining out in contrast to its surroundings

I. Organismal and structural diversity - species identification

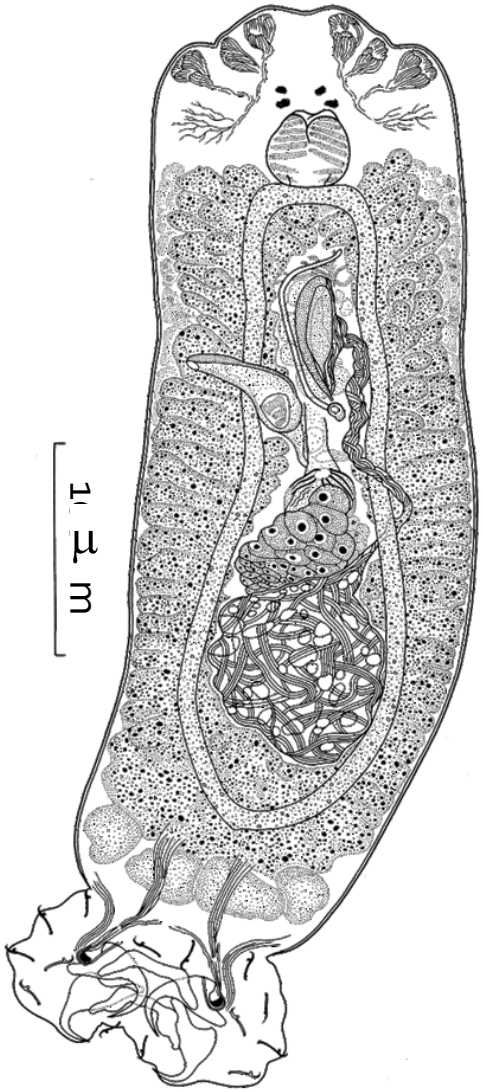


Drawings: microscope Olympus BX 50 equipped with a phase contrast optics and drawing tube; **Measurements:** Digital Image Analysis

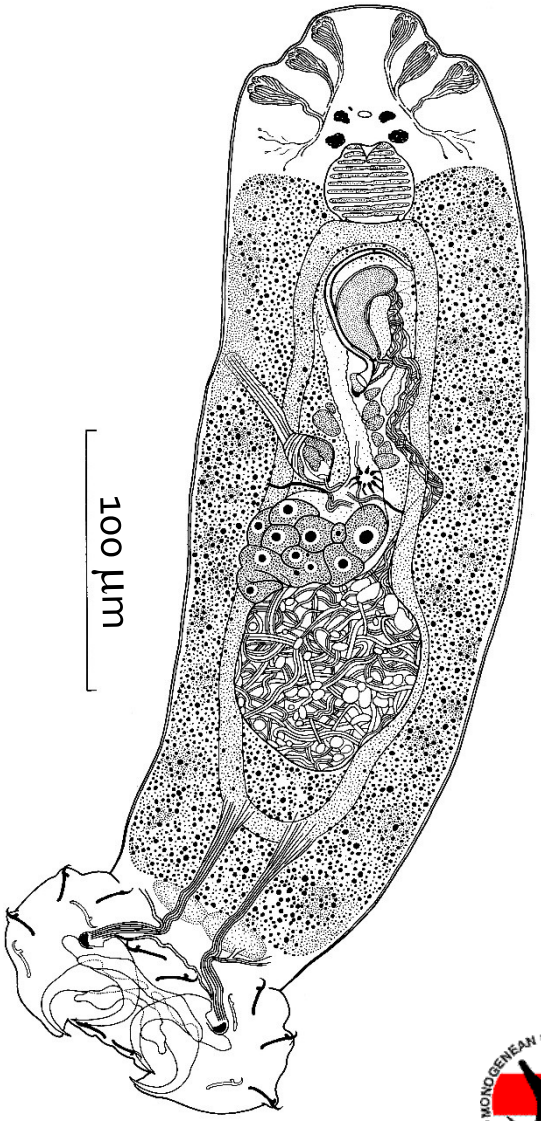
Thylacicleidus serendipitus



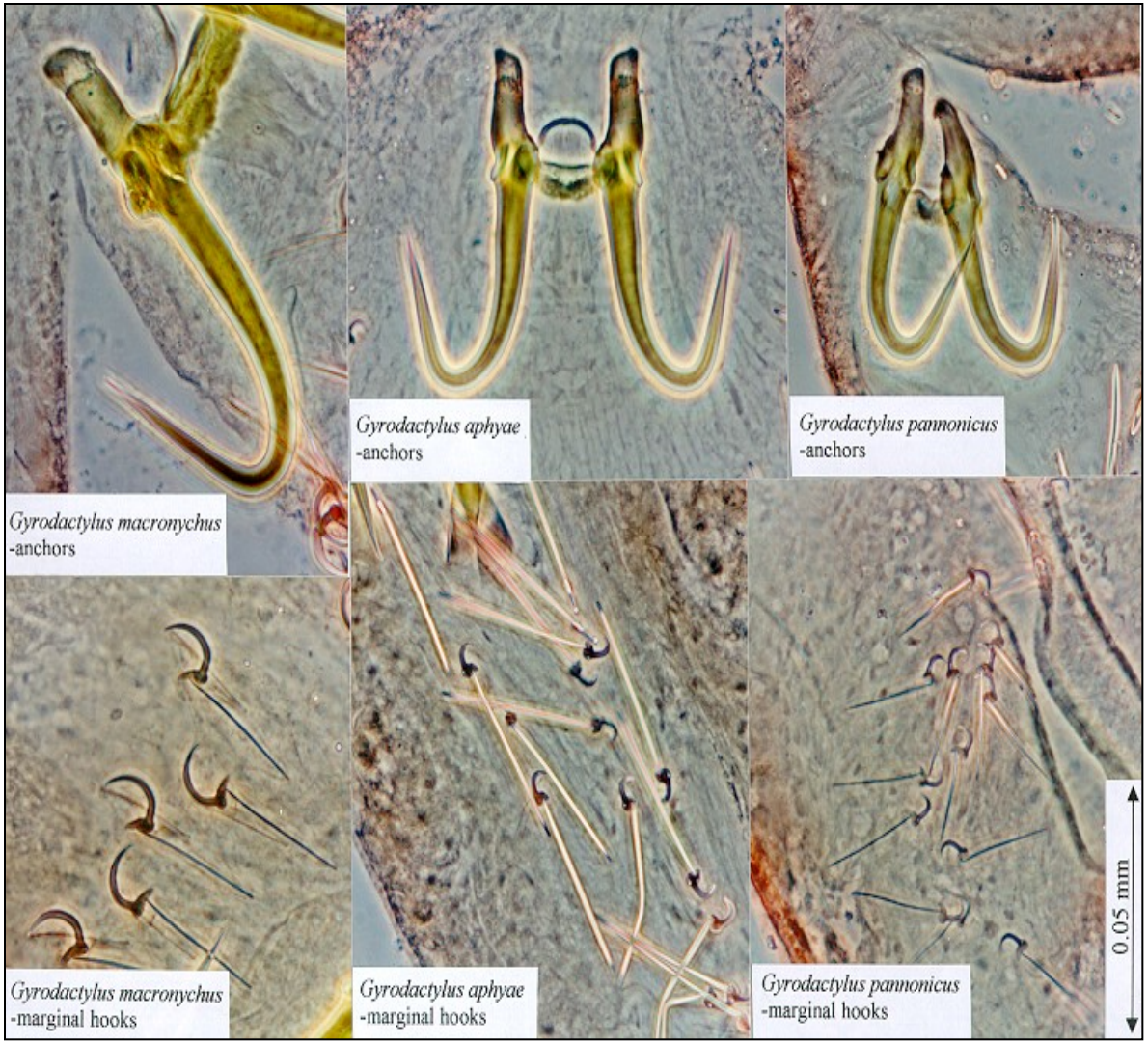
Thylacicleidus sp. 1



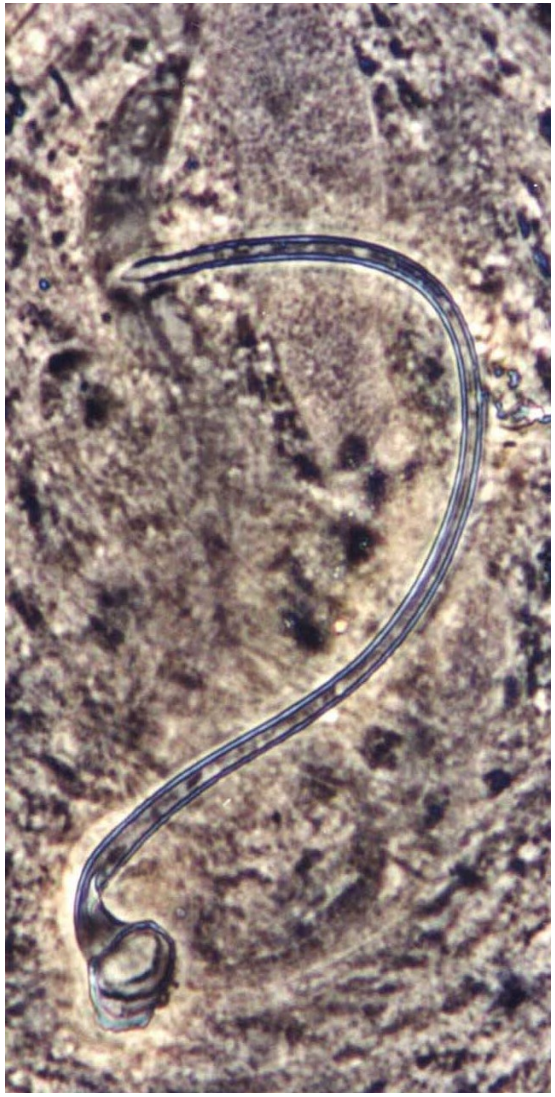
Thylacicleidus sp. 2



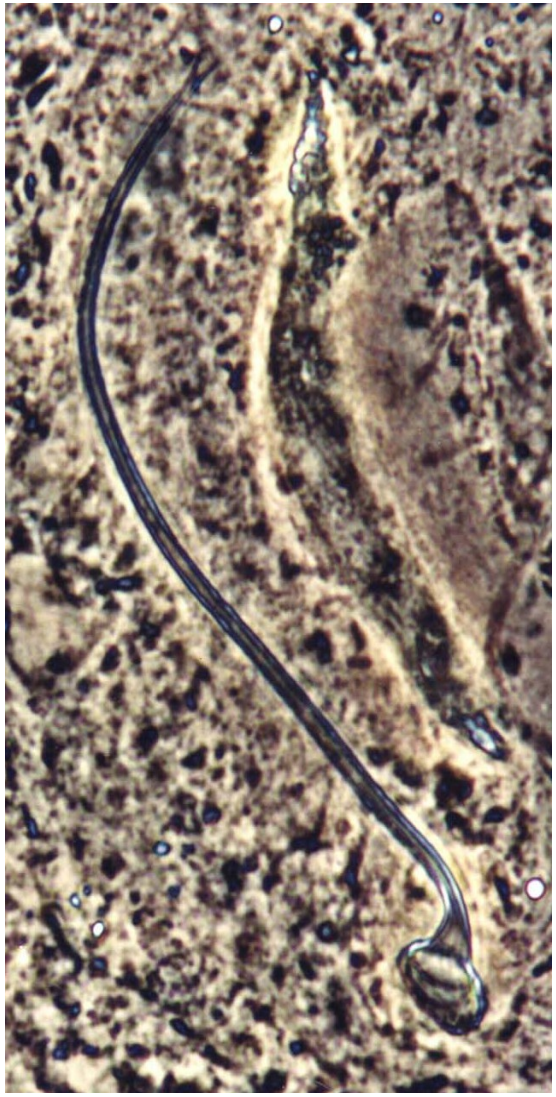
Laboratoř speciální mikroskopie
Fázová mikroskopie



Thylacicleidus serendipitus



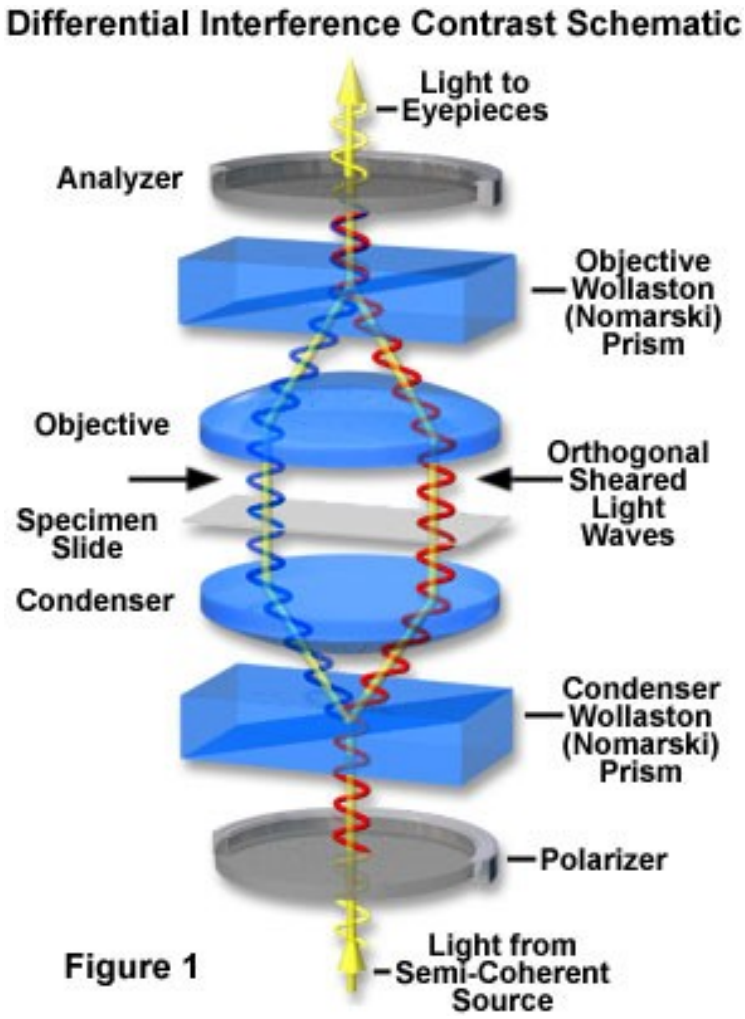
Thylacicleidus sp. 1



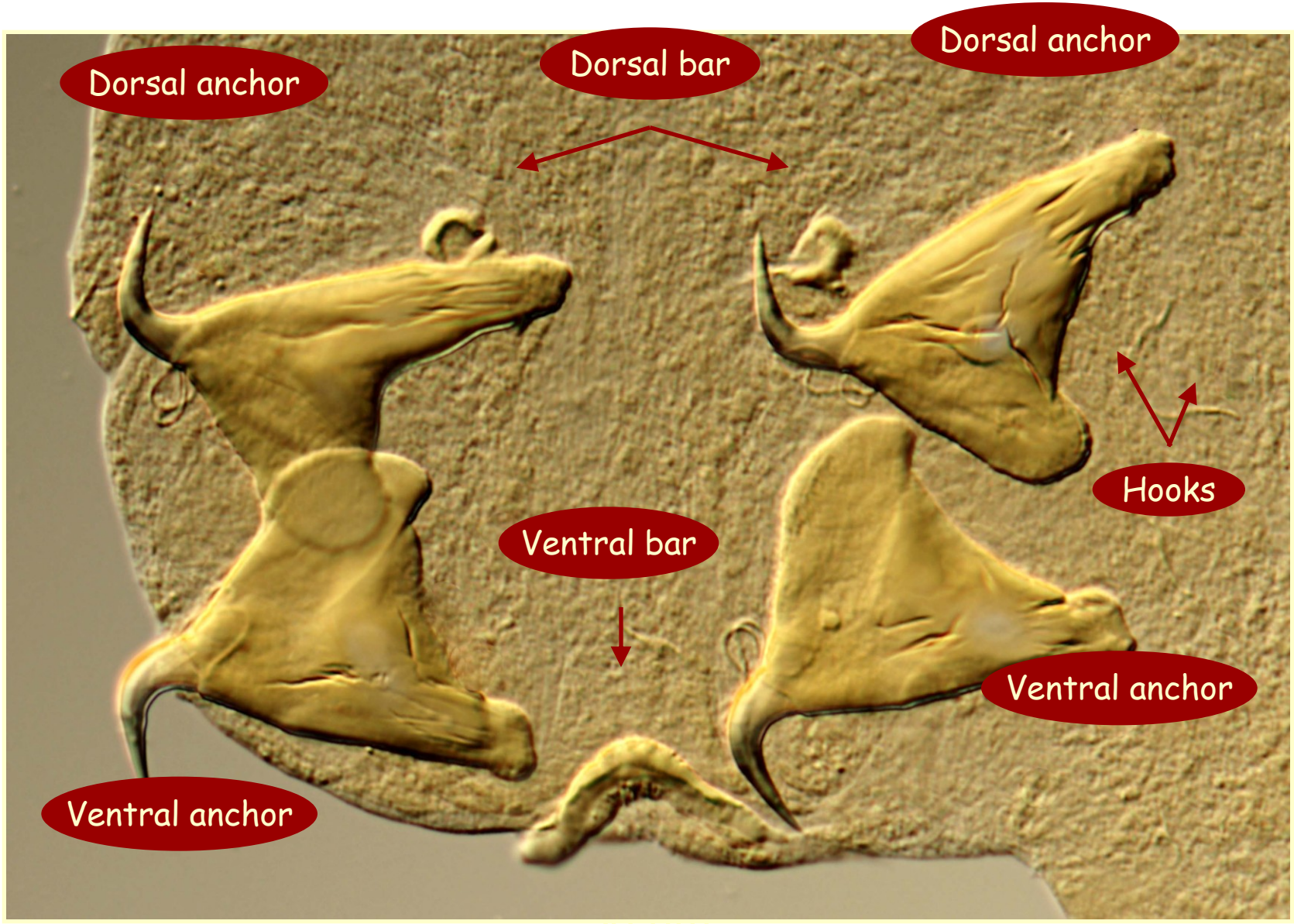
Thylacicleidus sp. 2

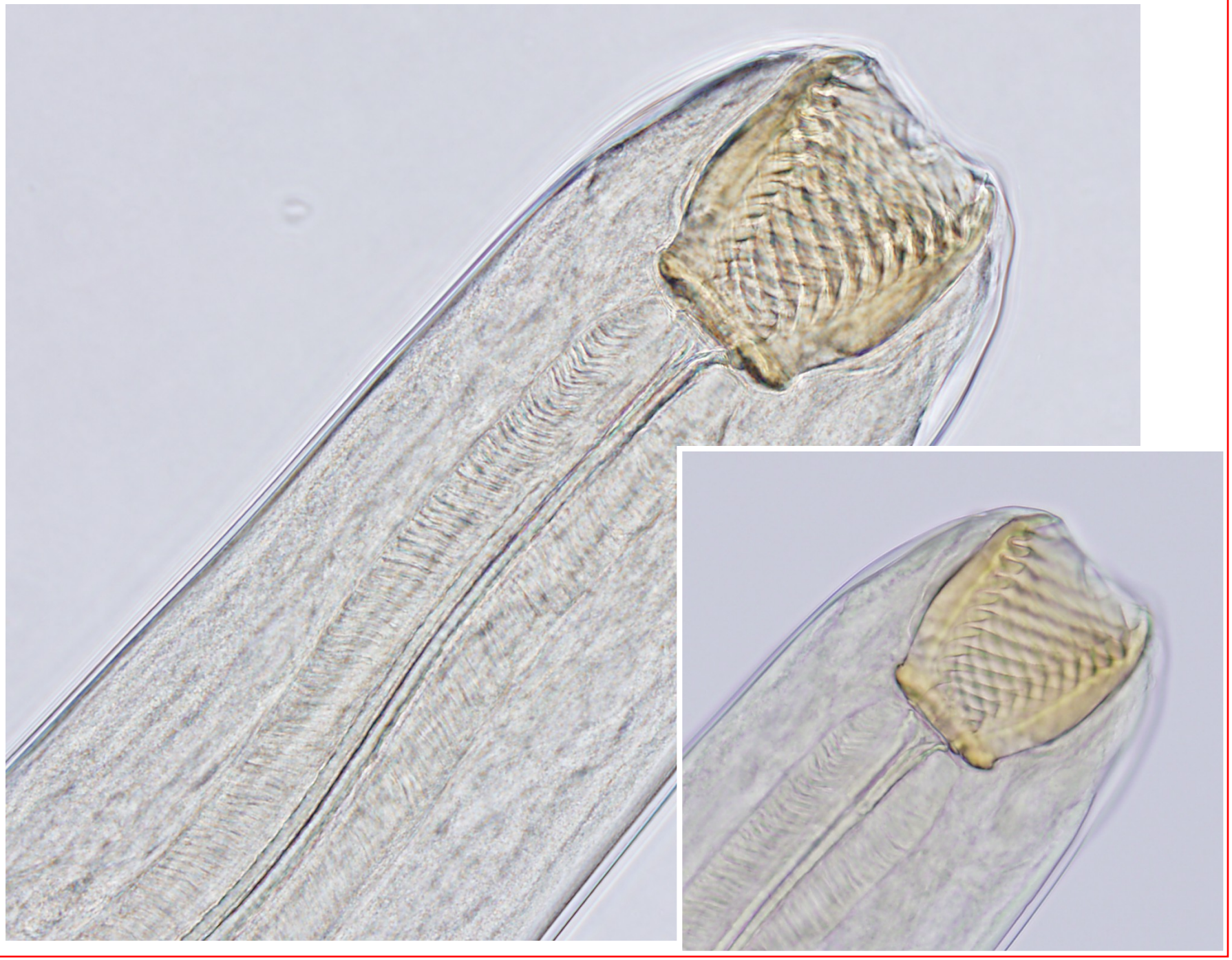
Nomarski differential interference contrast

- DIC Nomarski
- mid-1950s - Georges Nomarski modified the Wollaston prism
- Living or stained specimens, which often yield poor images when viewed in brightfield illumination, are made clearly visible by optical rather than chemical means

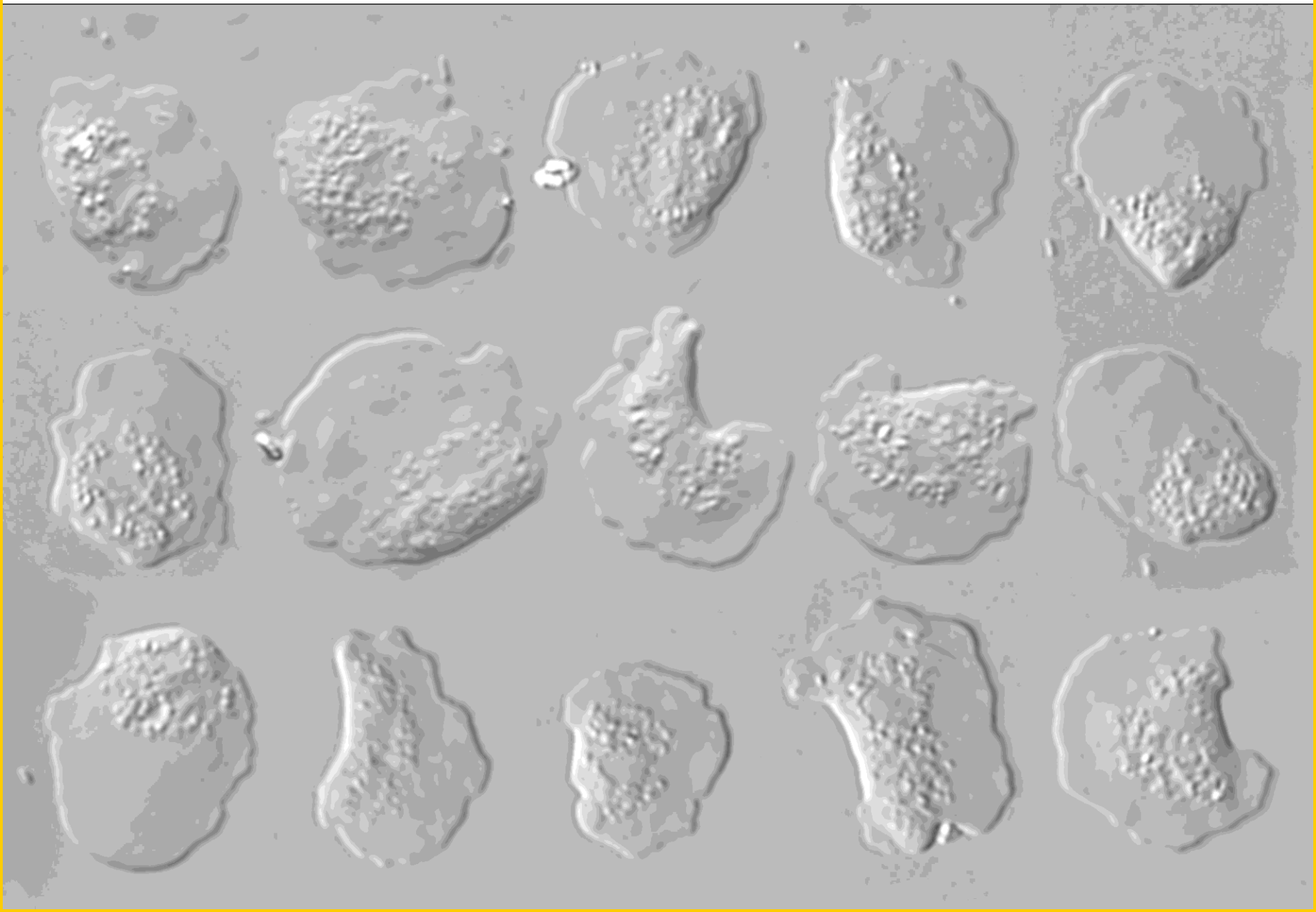


Laboratoř speciální mikroskopie (DIC Nomarski)





Model parasites group: free living amoebae



Fluorescent illumination

- emission of light by a substance that has absorbed light or other electromagnetic radiation of a different wavelength
- emitted light has:
  - longer wavelength
  - lower energy

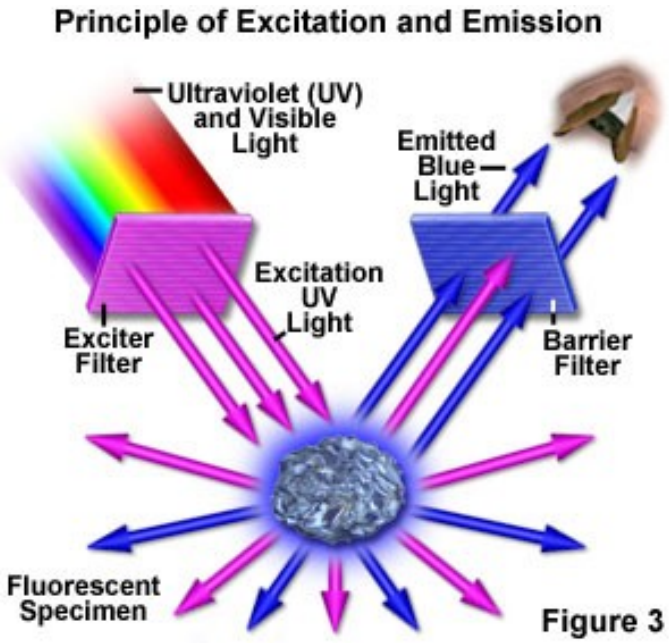
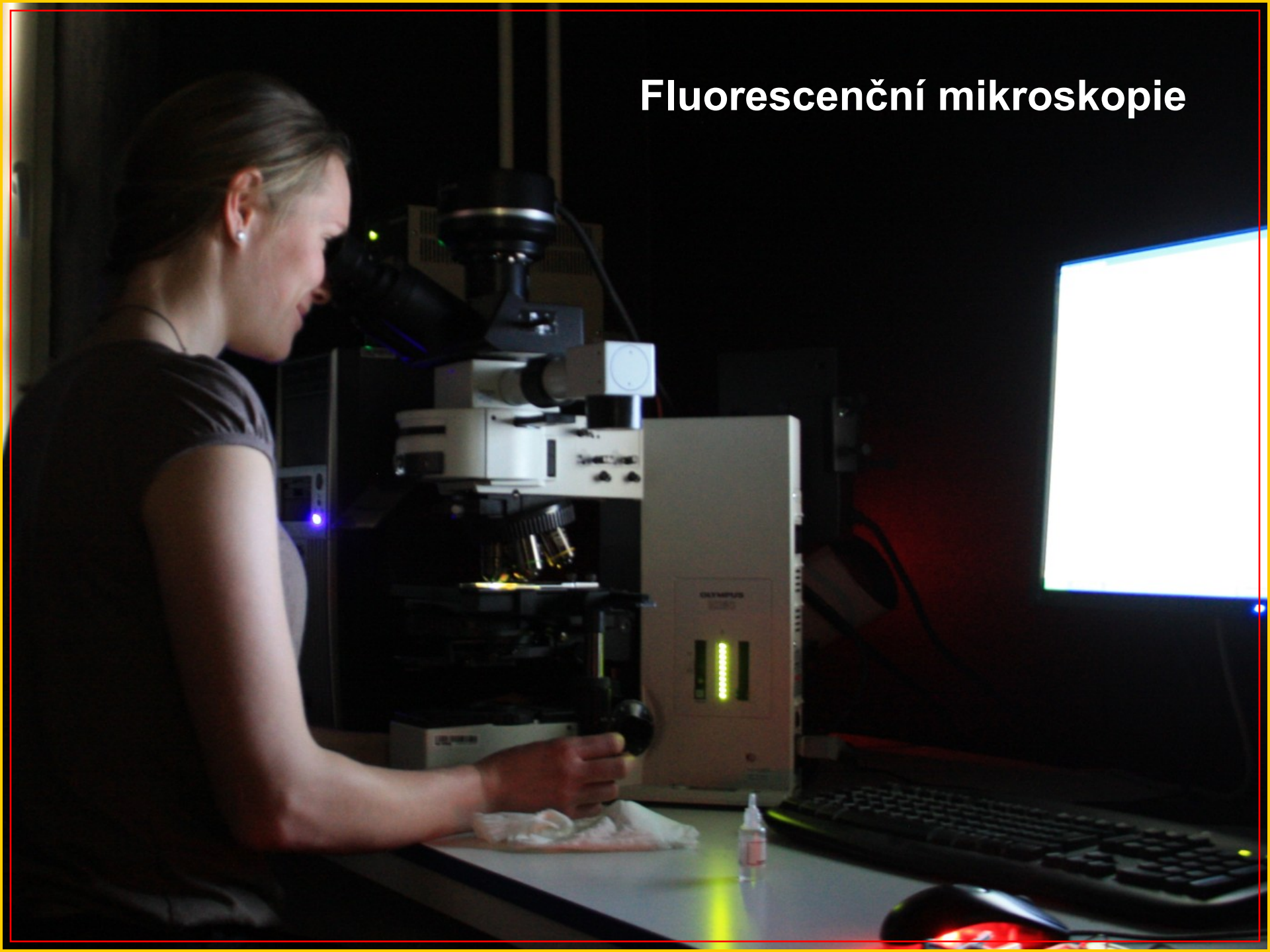
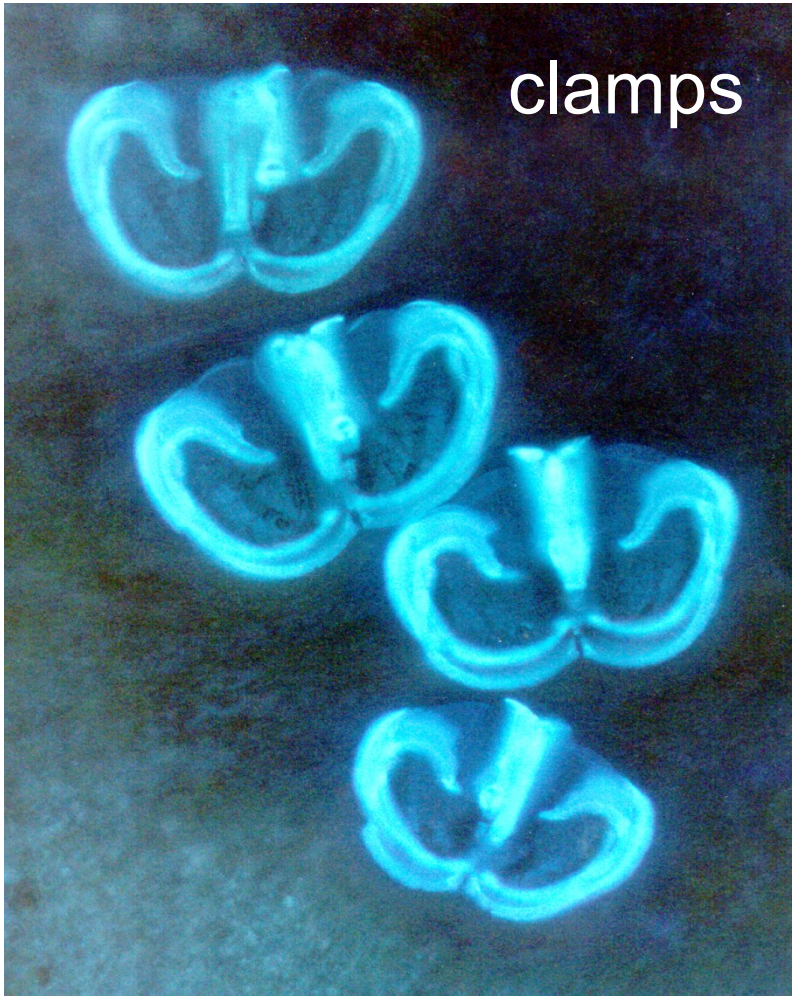
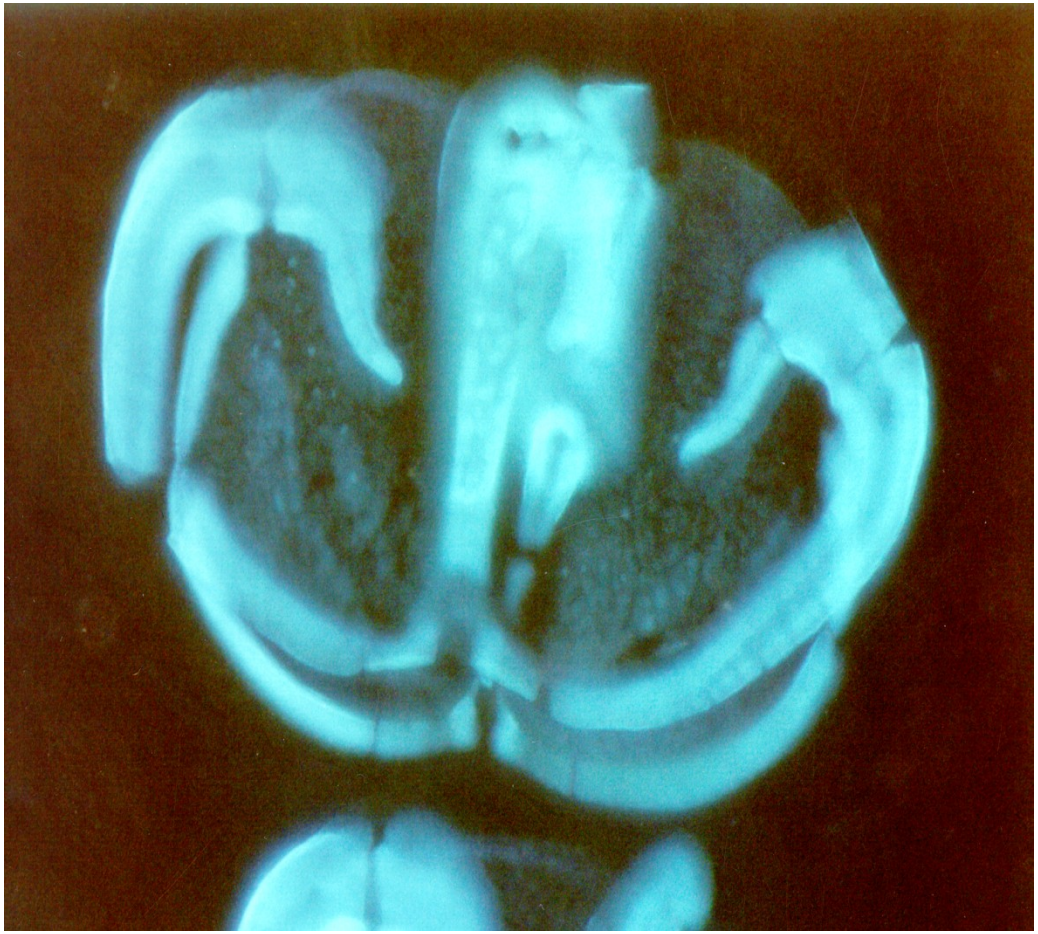


Figure 3


Fluorescenční mikroskopie

Fluorescent illumination



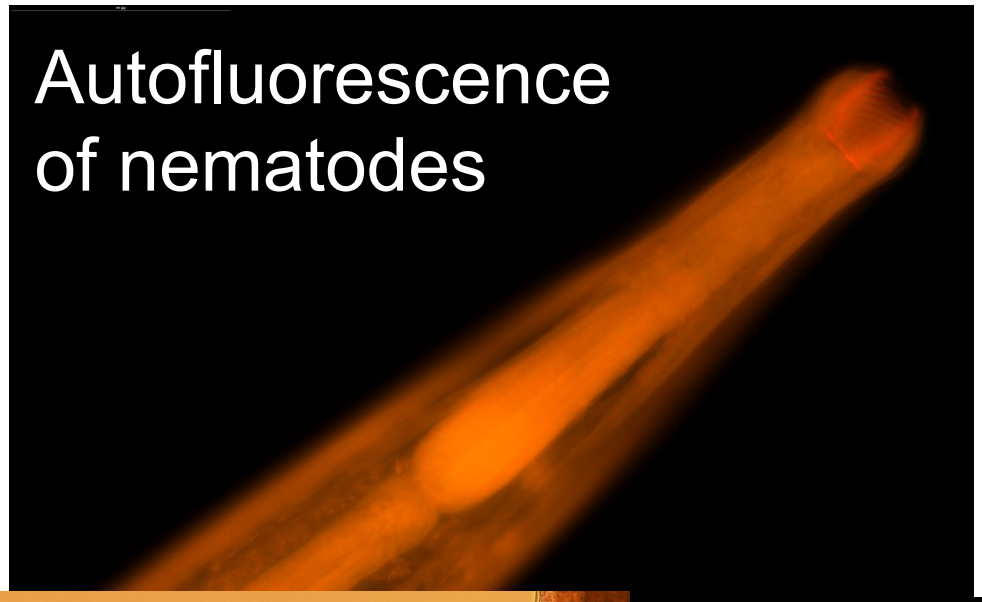


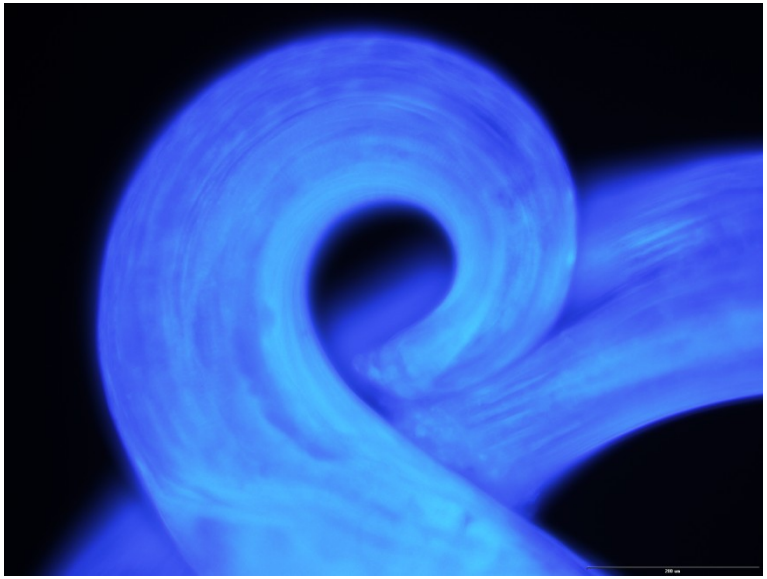
Fluorescent illumination

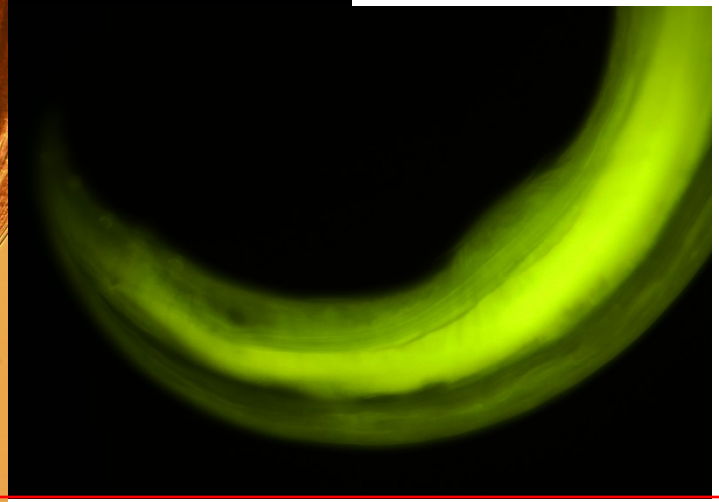
MONOGENEAN RESEARCH GROUP
MASARYK UNIVERSITY BRNO

Fluorescent illumination

Autofluorescence of nematodes

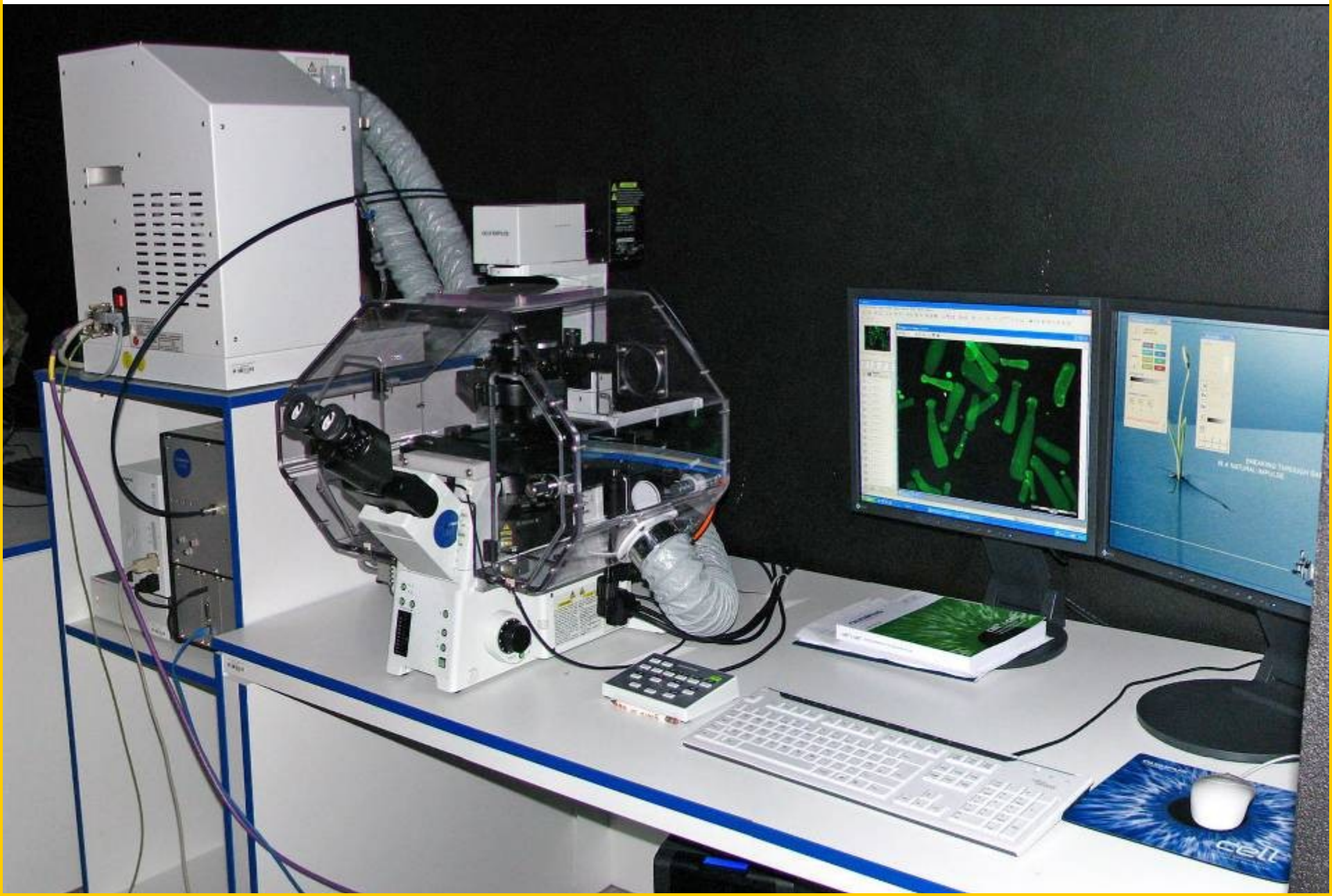


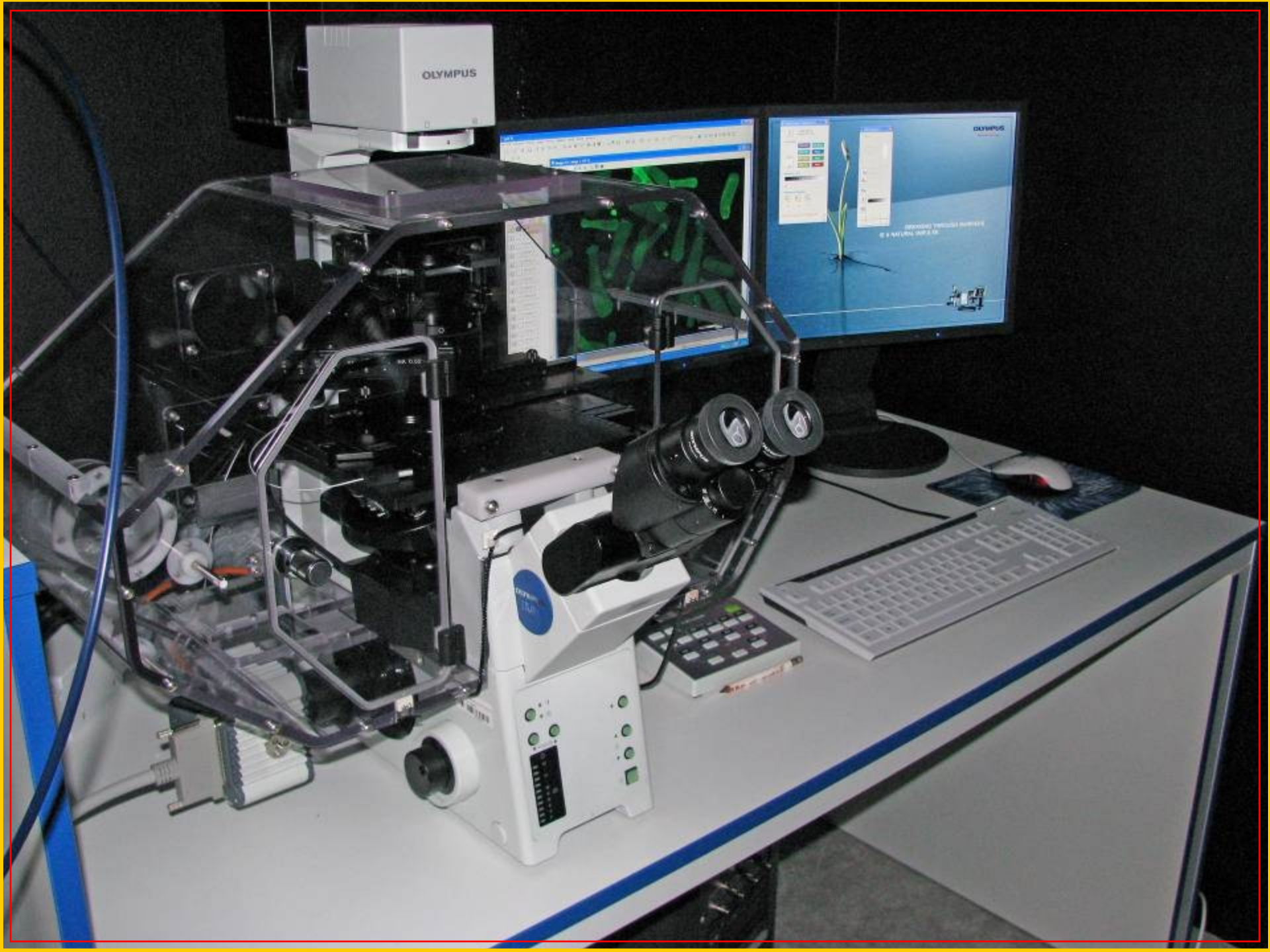




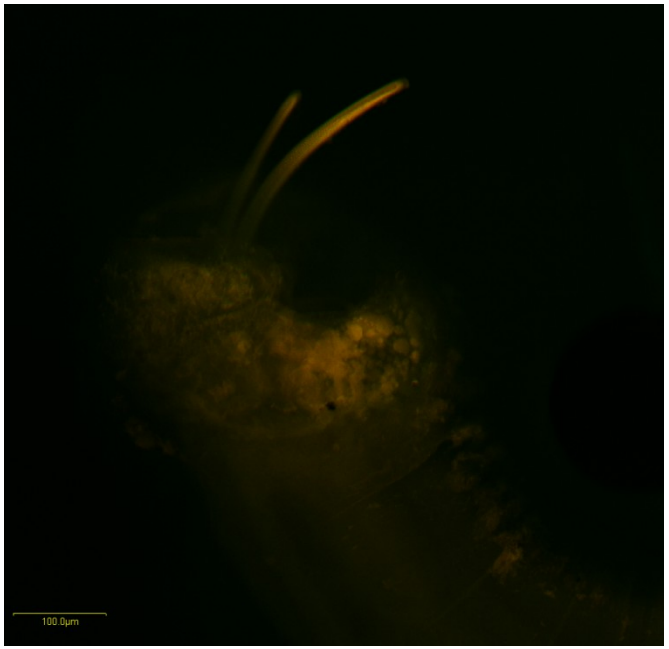
MONOGENEAN RESEARCH GROUP • MASARYK UNIVERSITY BRNO •

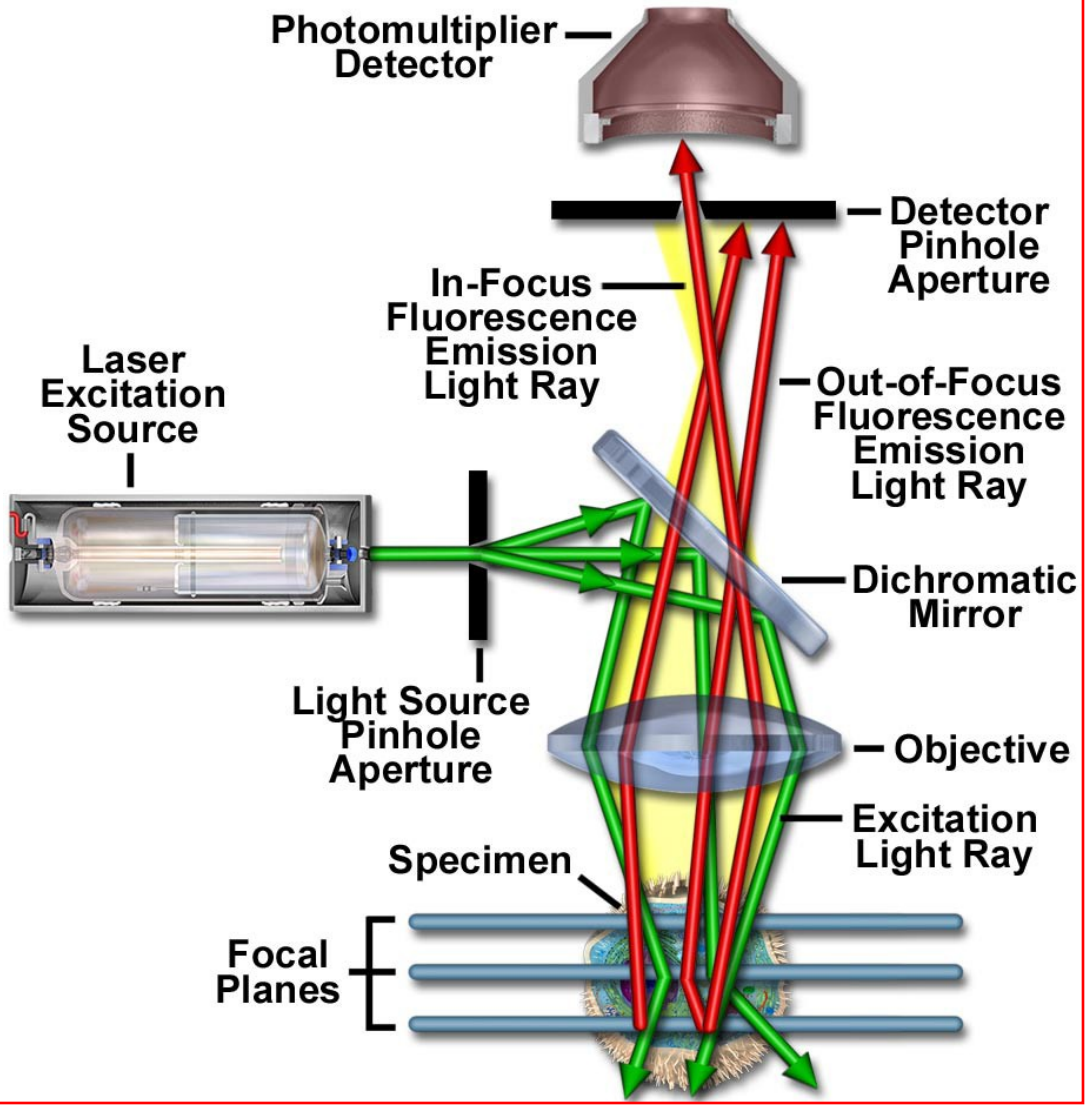
Olympus Cell^{R} - motorizovaný invertovaný mikroskop se systémem rychlé fluorescence pro sledování procesů v živých buňkách




OLYMPUS

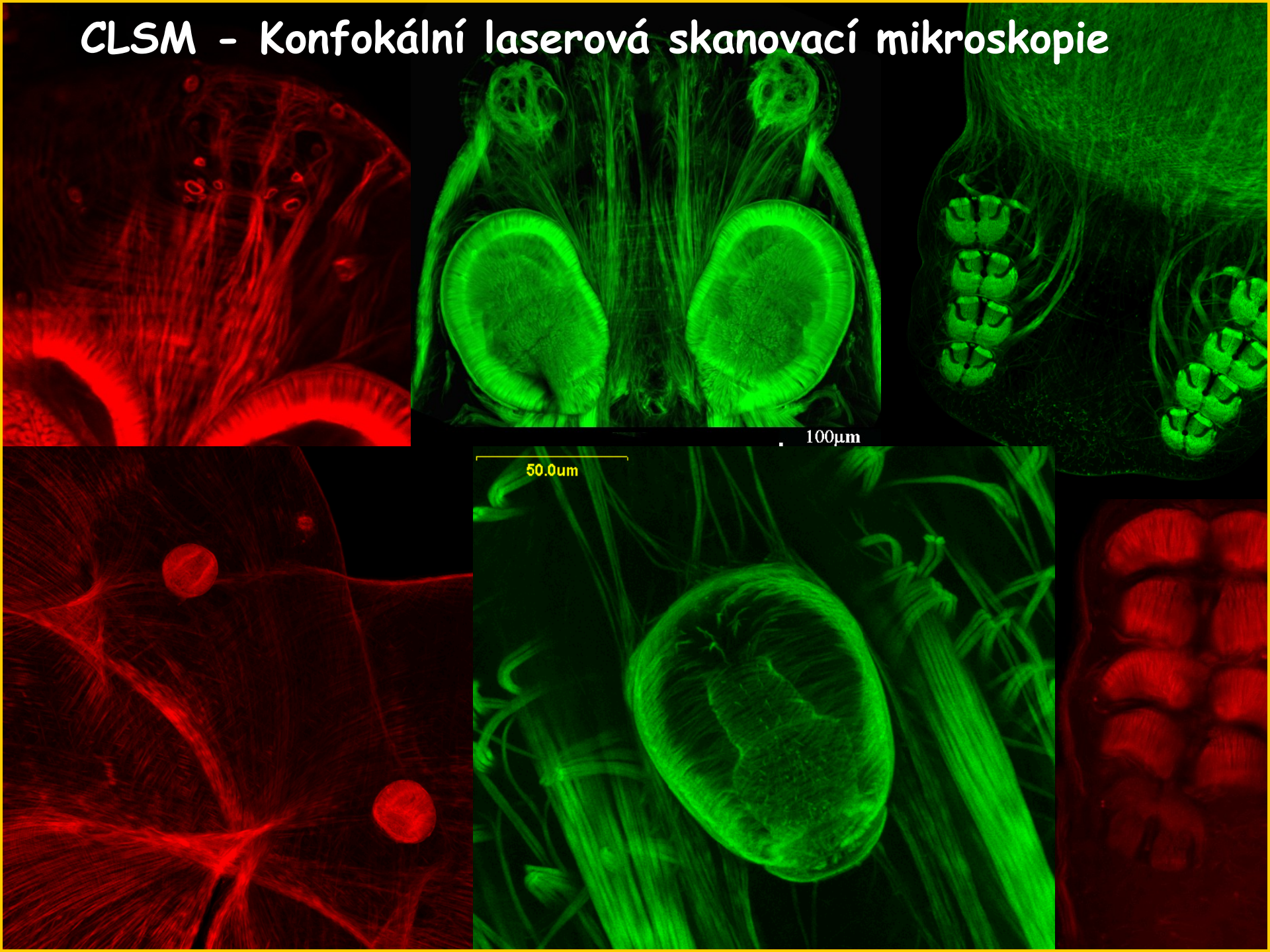
Confocal Laser Scanning Microscopy



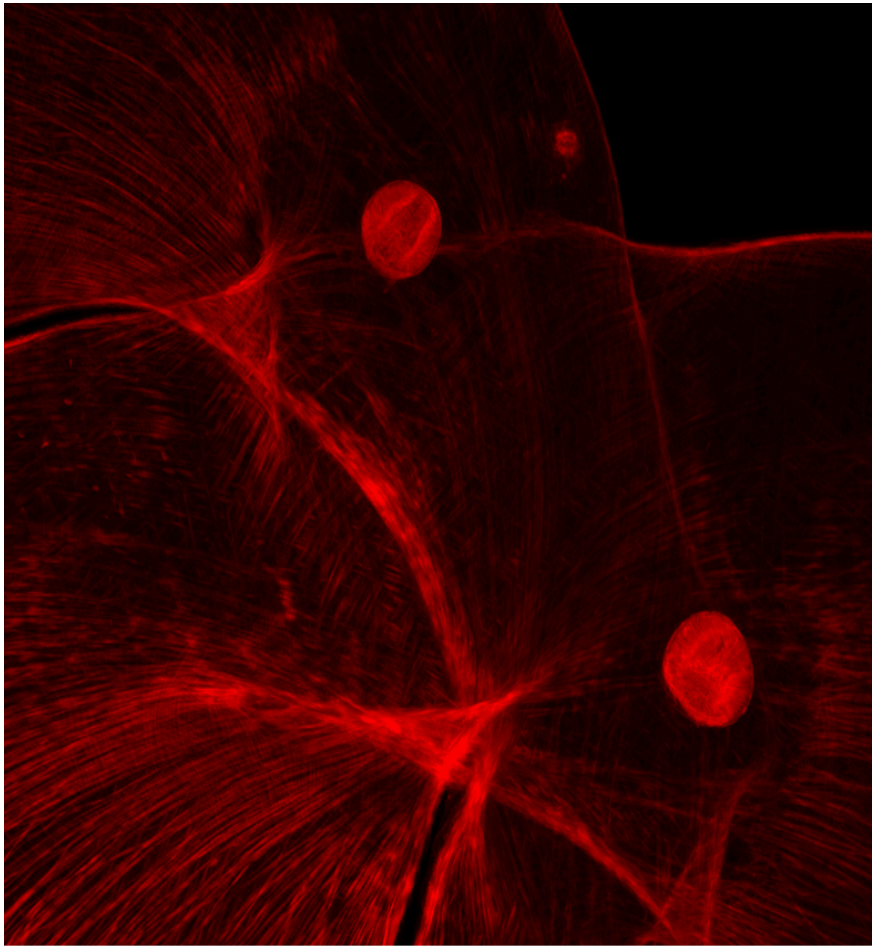


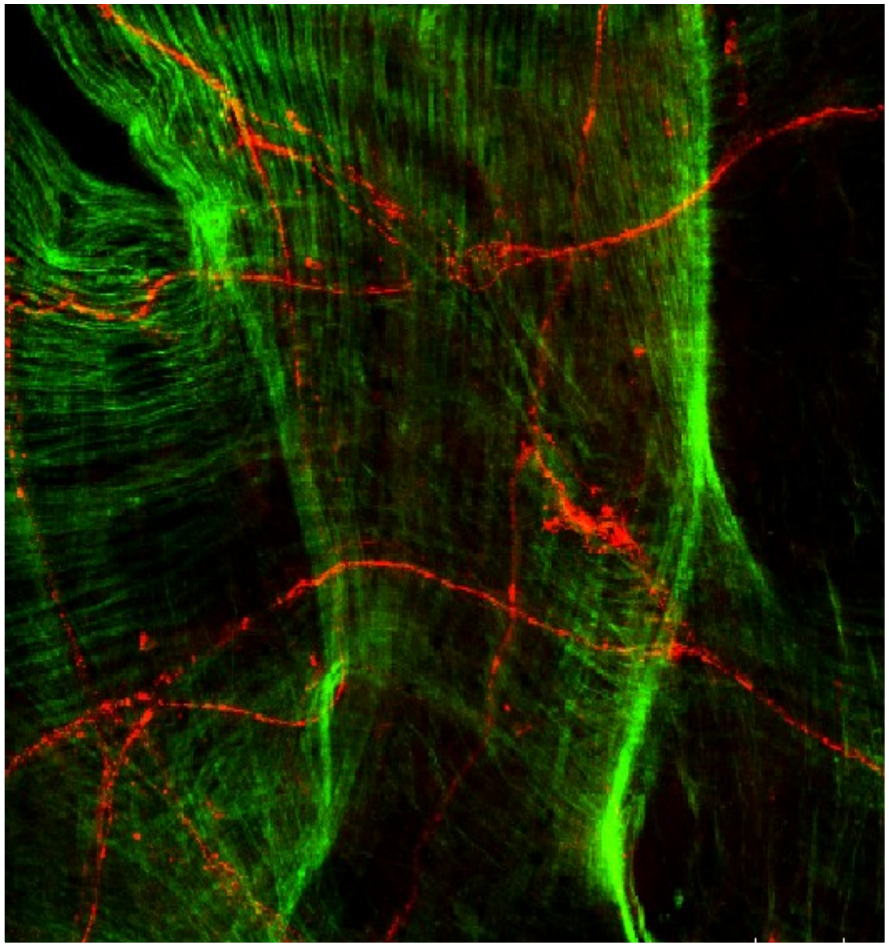

CLSM

CLSM - Konfokální laserová skanovací mikroskopie

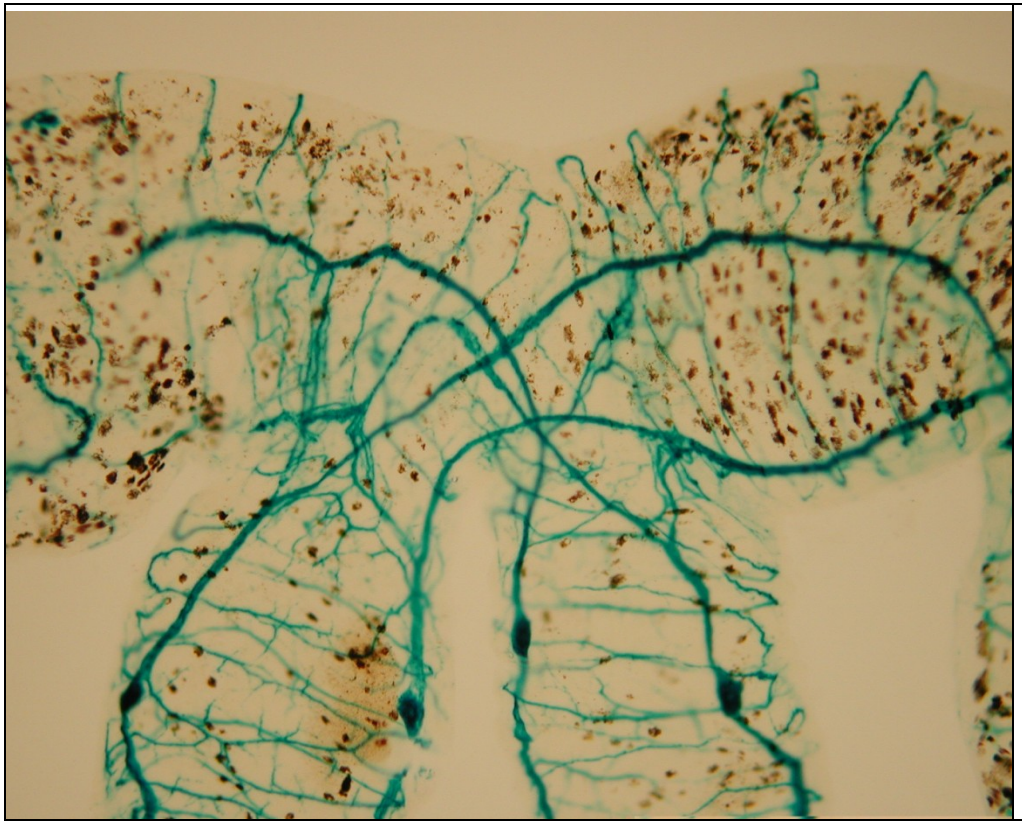


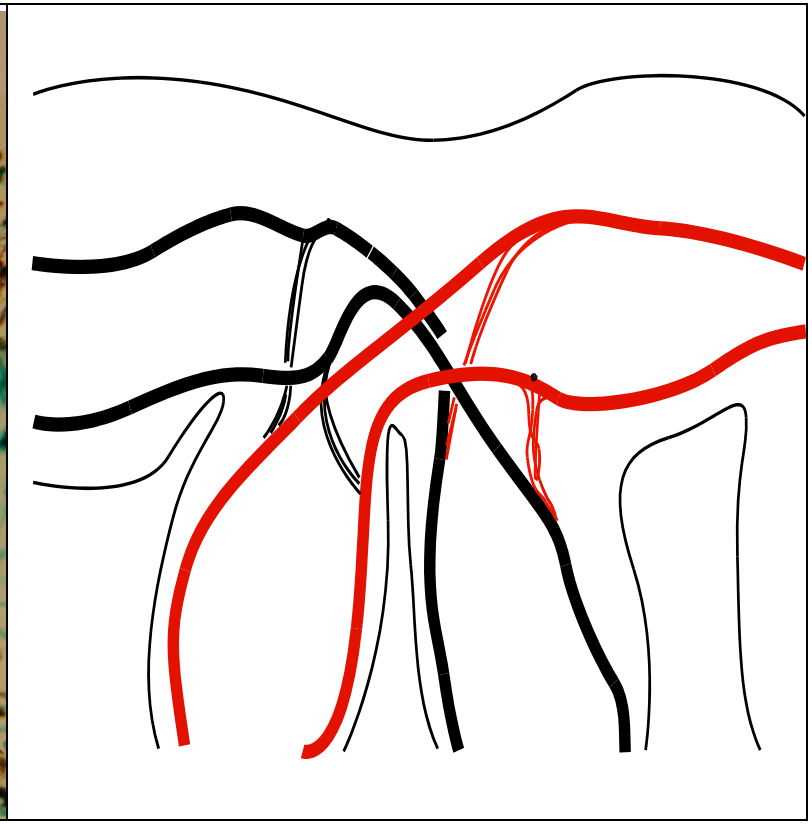
Možnost kombinace barvících technik





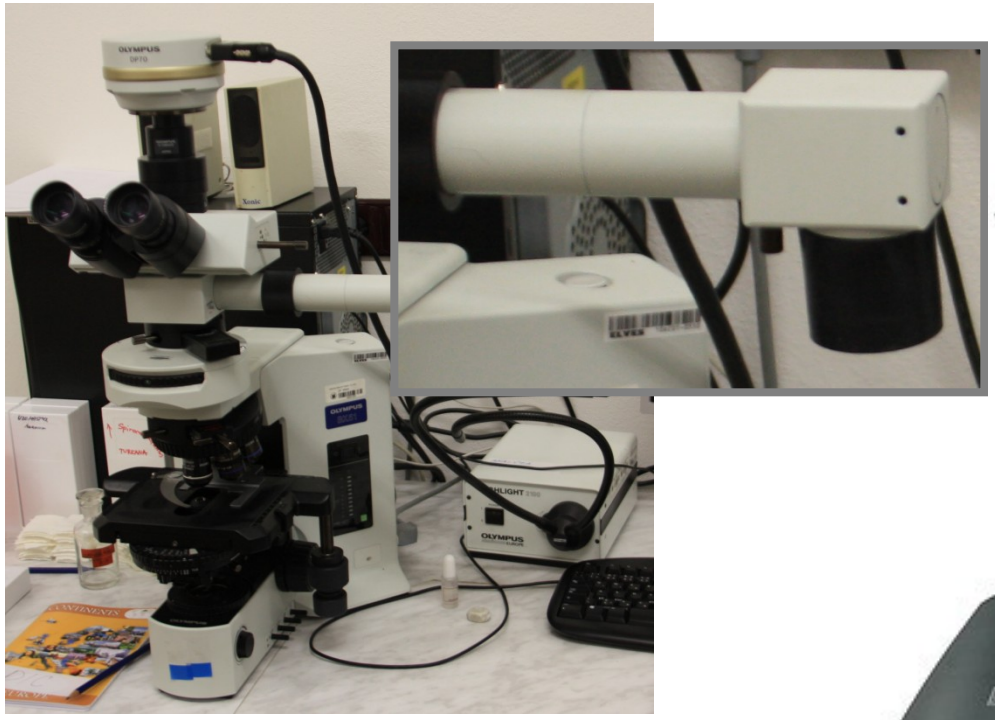
Schematic illustration of neuronal interspecific connectivity between 2 heterogenic CNS





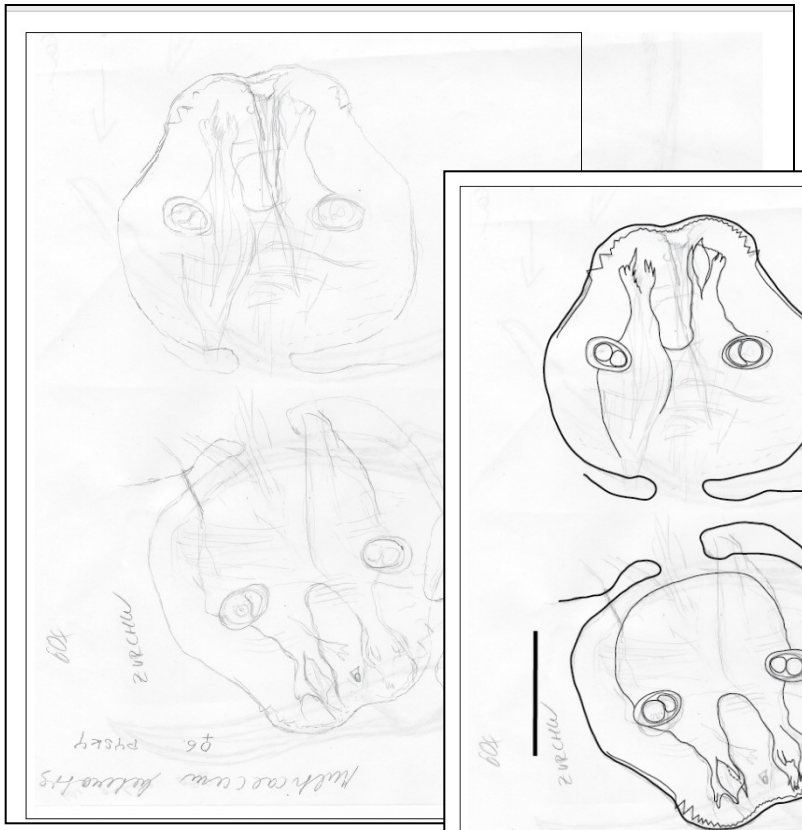
Zurawski T.H. et al., 2003: Microscopic evaluation of neural connectivity between paired stages of *Eudiplozoon nipponicum*. J. Parasitol 89:198-200

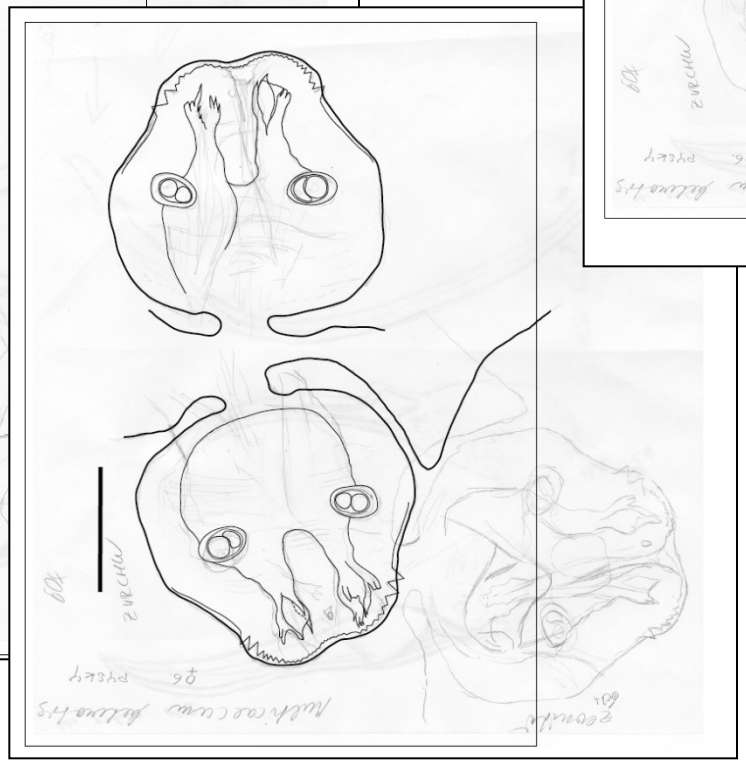
Line-drawings

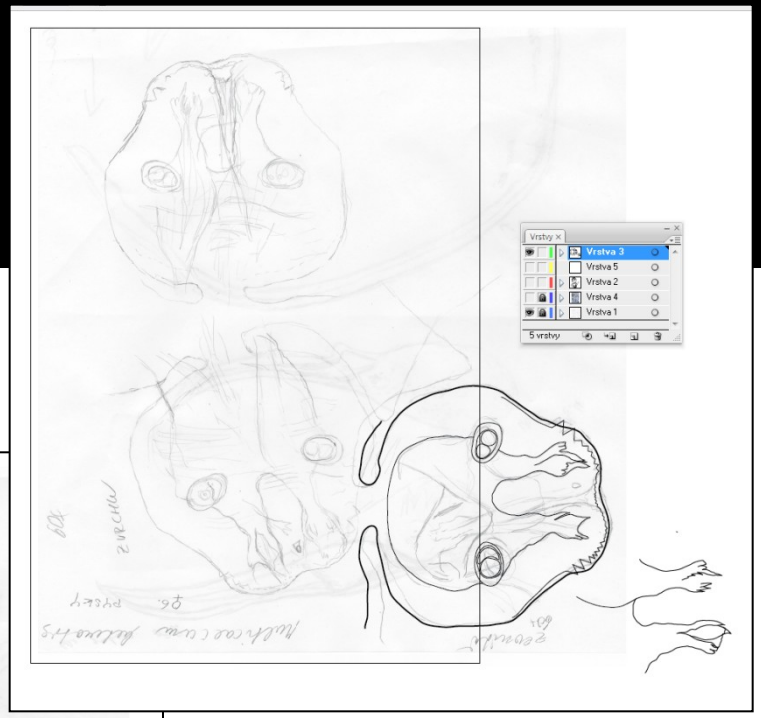


MONOGENEAN RESEARCH GROUP
MASARYK UNIVERSITY BRNO

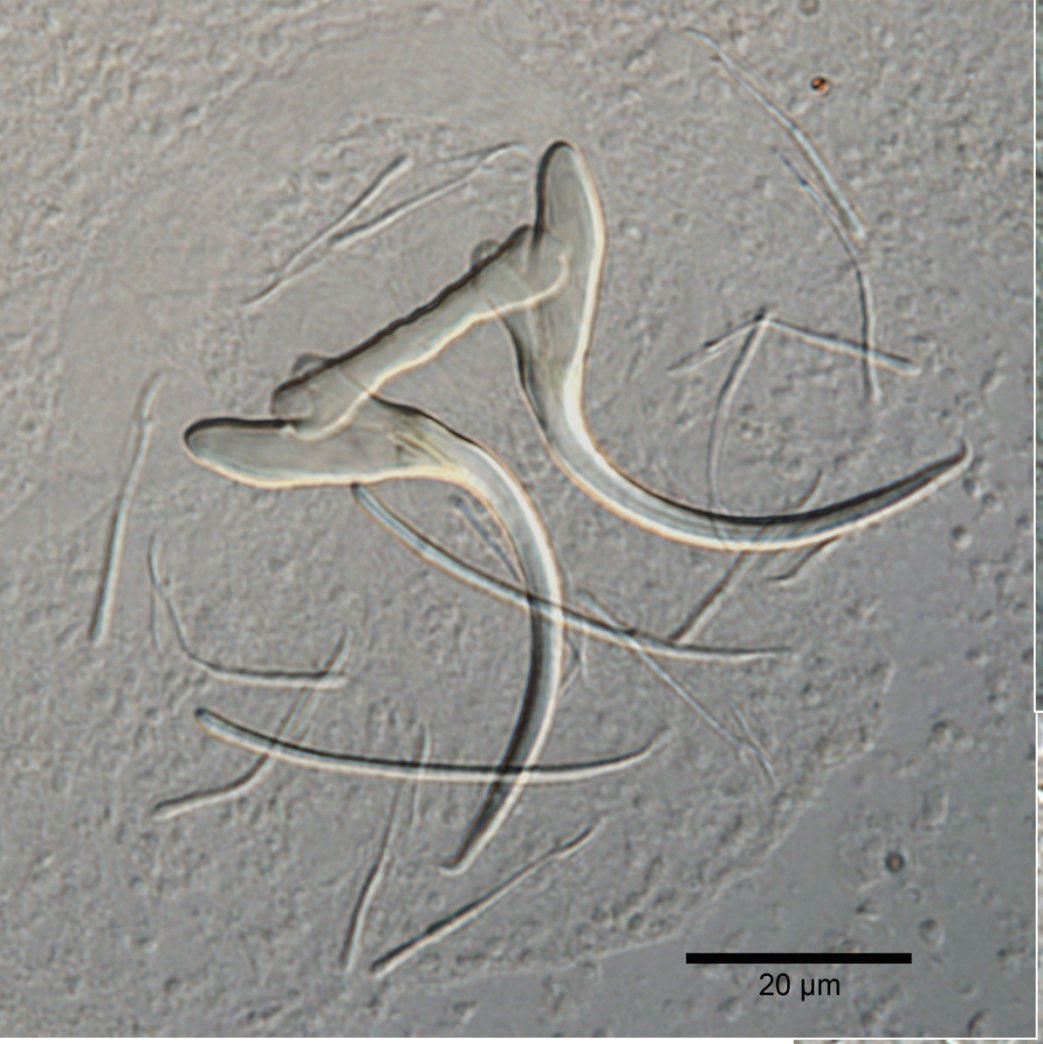
Line-drawings

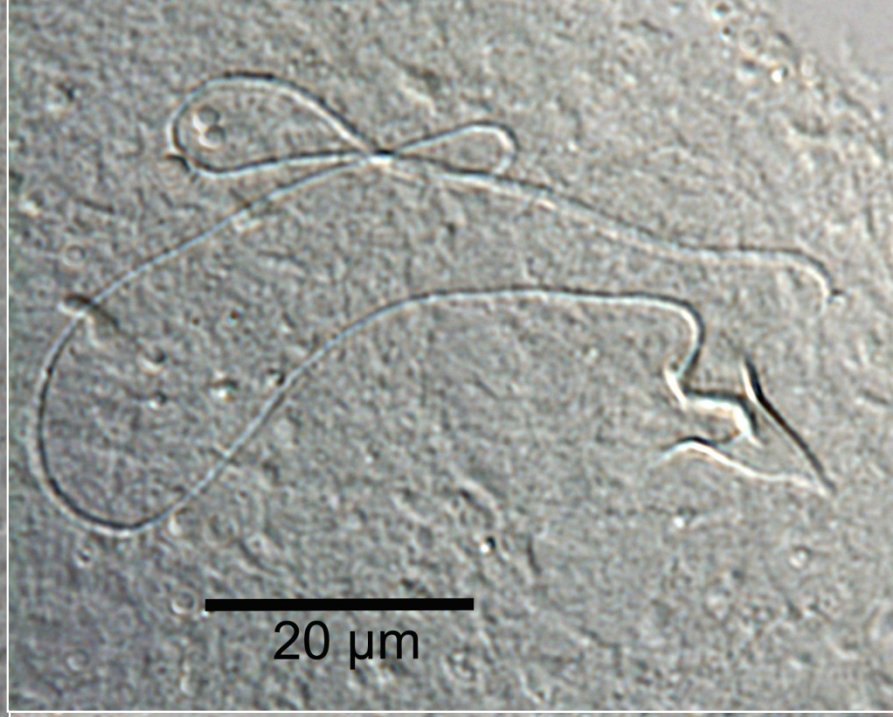


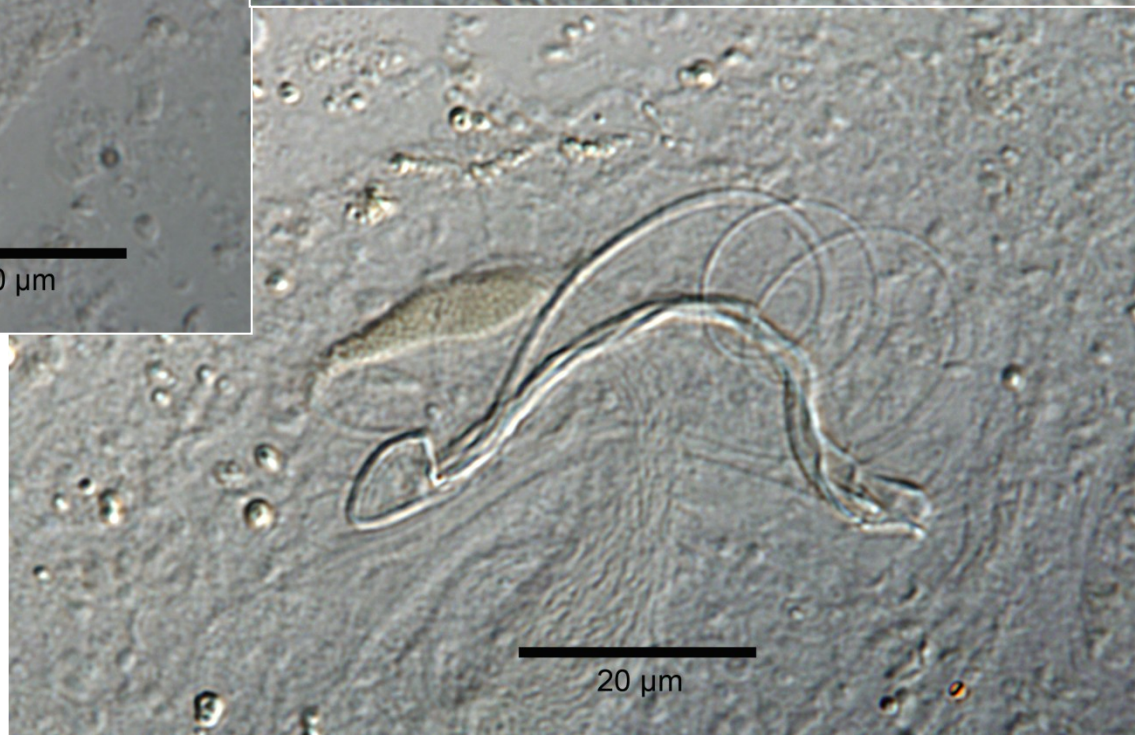




MONOGENEAN RESEARCH GROUP
MASARYK UNIVERSITY BRNO



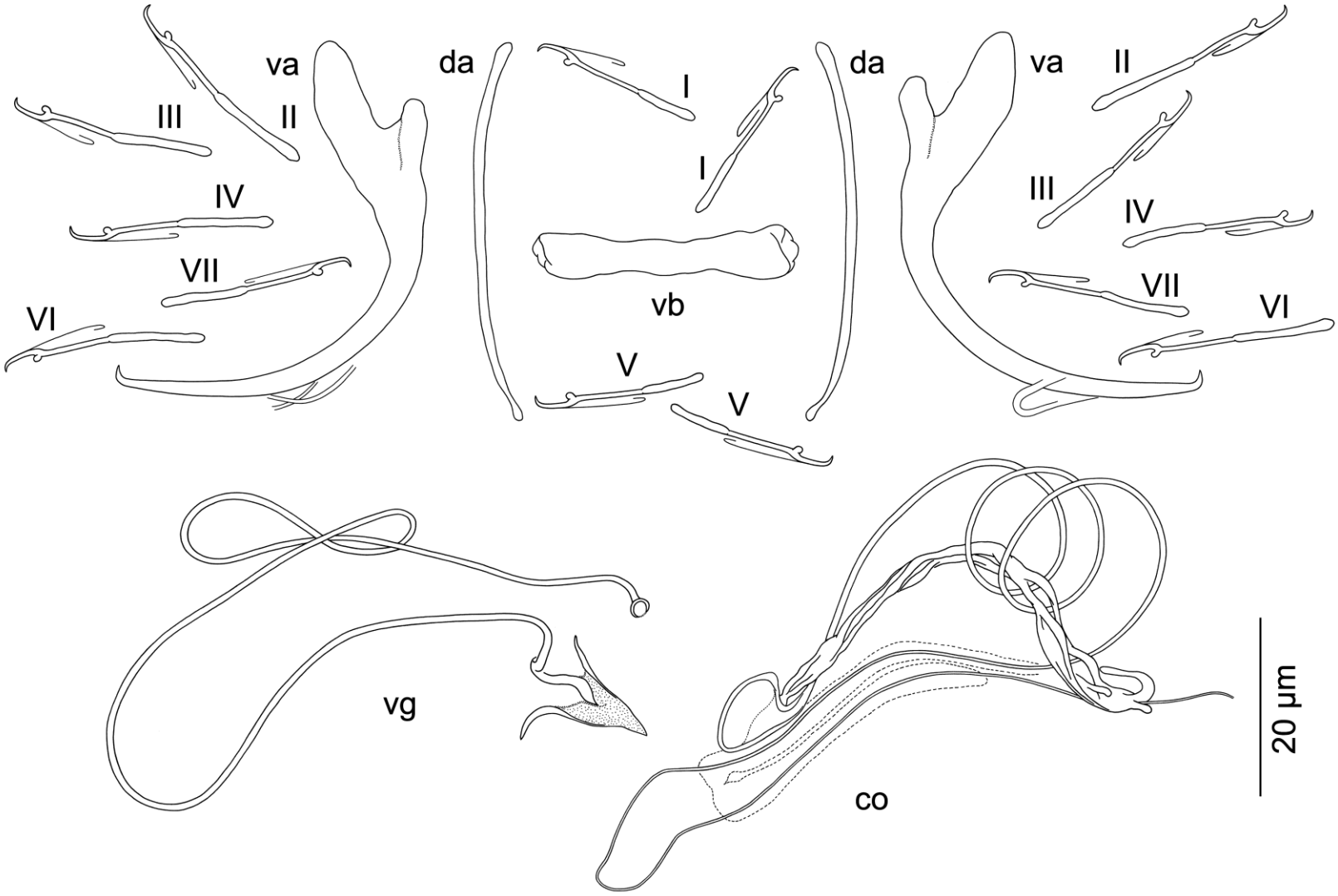




Nanotrema niokoloensis n.sp.

Host: *Citharinus citharus citharus*

Locality: Niokolo Koba River near Pont Suspendu Niokolo-Koba National Park, Senegal



Sclerotised structures of Nanotrema niokoloensis sp.nov.: va = ventral anchor, vb = ventral bar, da = dorsal anchor, I-VII = pairs of hooks, co = copulatory organ, vg = vagina

Sampling of parasite individual

Variety of monogenean body shapes and haptoral morphology

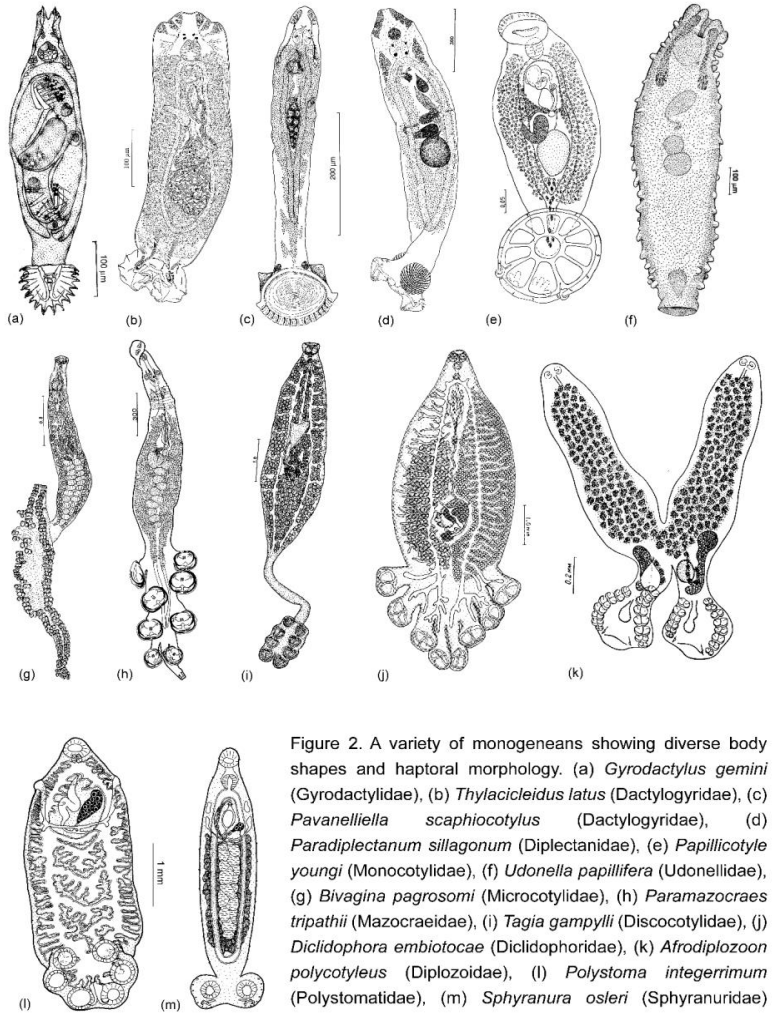
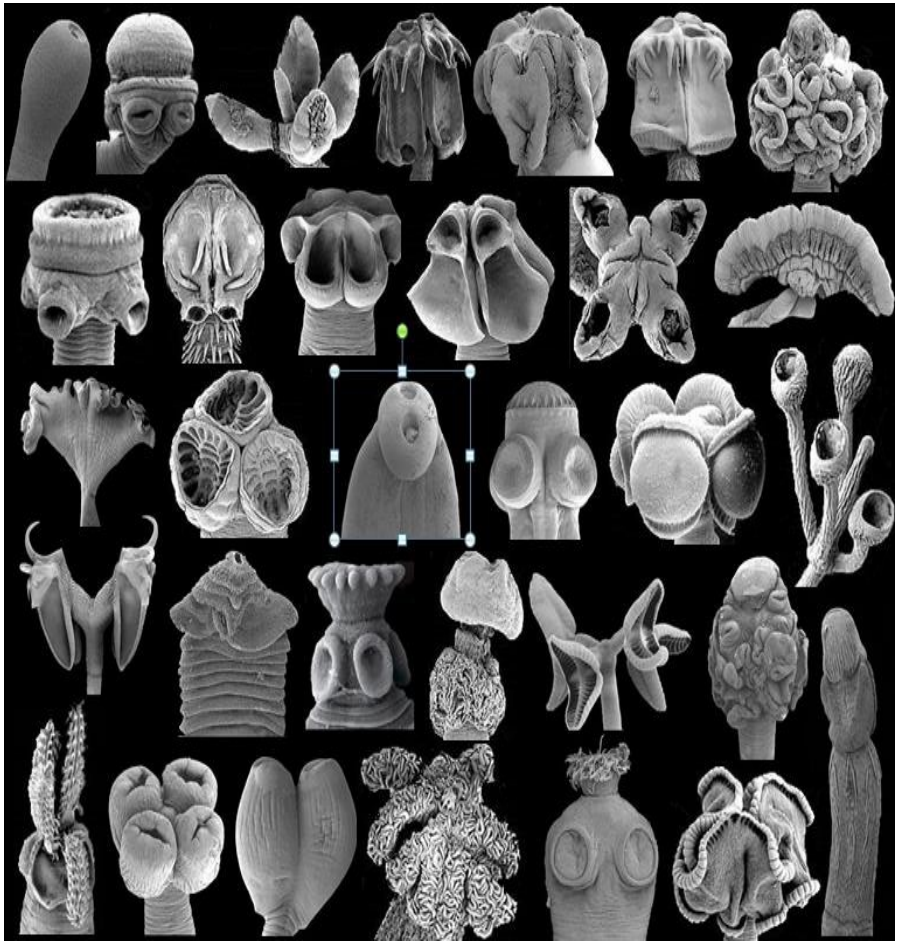


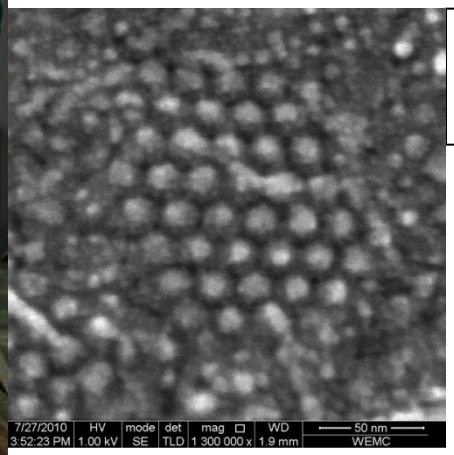
Figure 2. A variety of monogeneans showing diverse body shapes and haptoral morphology. (a) *Gyrodactylus gemini* (Gyrodactylidae), (b) *Thylacicleidus latus* (Dactylogyridae), (c) *Pavanelliella scaphiocotylus* (Dactylogyridae), (d) *Paradiplectanum sillagonum* (Diplectanidae), (e) *Papillicotyle youngi* (Monocotylidae), (f) *Udonella papillifera* (Udonellidae), (g) *Bivagina pagrosomi* (Microcotylidae), (h) *Paramazocraes tripathii* (Mazocraeidae), (i) *Tagia gampylli* (Discocotylidae), (j) *Diclidophora embiotocae* (Diclidophoridae), (k) *Afrodiplozoon polycotyleus* (Diplozoidae), (l) *Polystoma integerrimum* (Polystomatidae), (m) *Sphyranura osleri* (Sphyranuridae)

Variety of types of scolexes of cestodes



Ultra High Resolution SEM

Magellan (FEI).

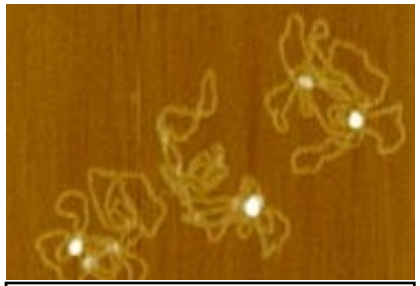


resolutions below one nanometer

www.fei.com

AFM

Example of AFM image is shown below where the shape of single DNA and protein molecules are seen. (http://nano.uib.no/AFM.php)



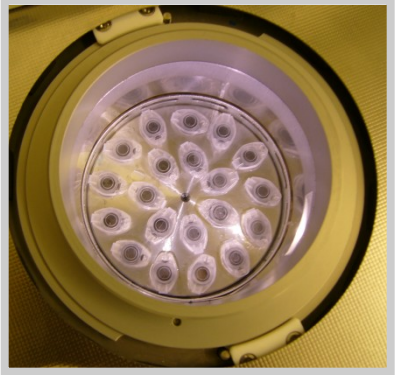
AFM determines the topology of a surface with a resolution down to 0.8 nm.

Electron microscopy

- Transmission electron microscopy (TEM)
- Scanning electron microscopy (SEM)
- Environmental scanning electron microscopy (ESEM)

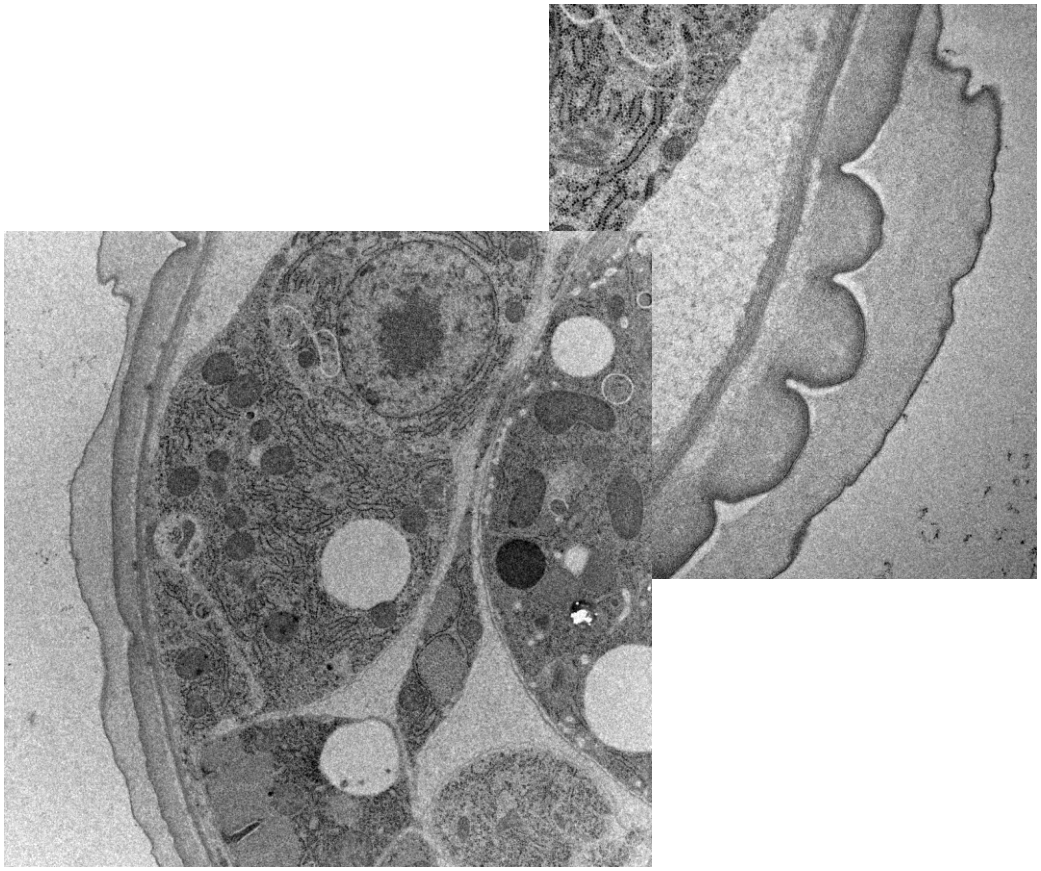
TEM - Sample preparation

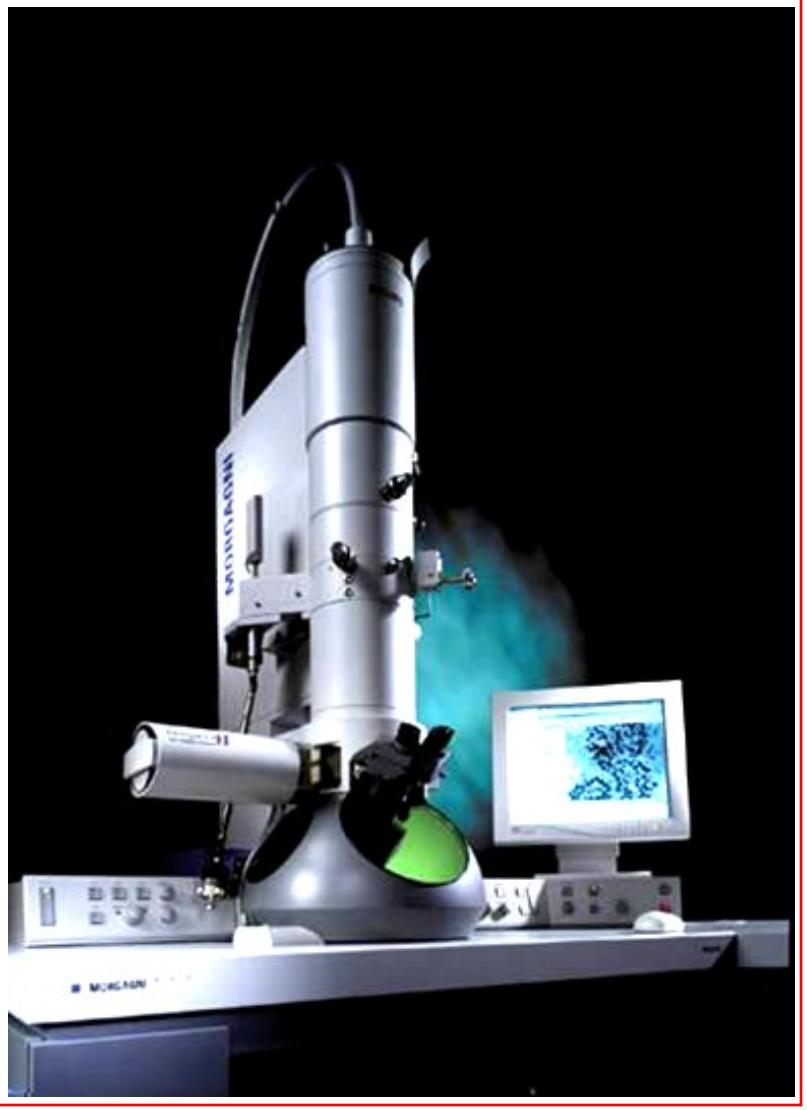
- Fixation
  - Cryo: High-pressure freezing
  - RT: Chem. fixation
- Dehydration
  - Cryo: freeze-substitution
  - RT: ethanol substitution
- Embedding
- Thin sectioning
- Staining
- TEM



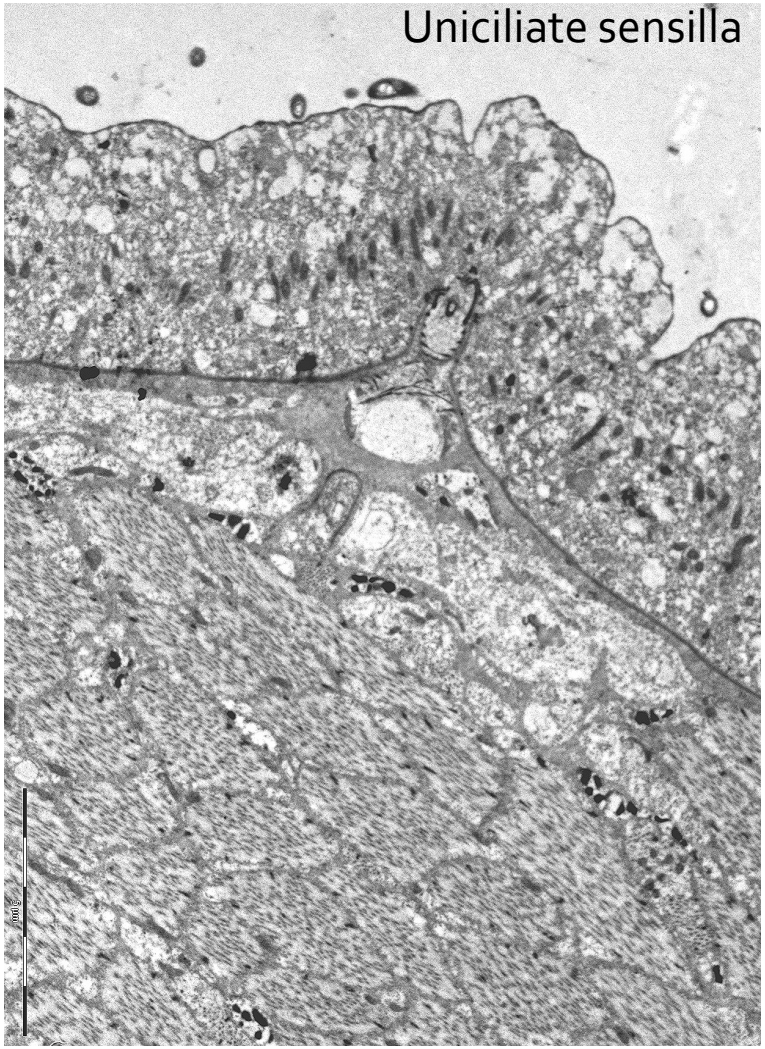
TEM

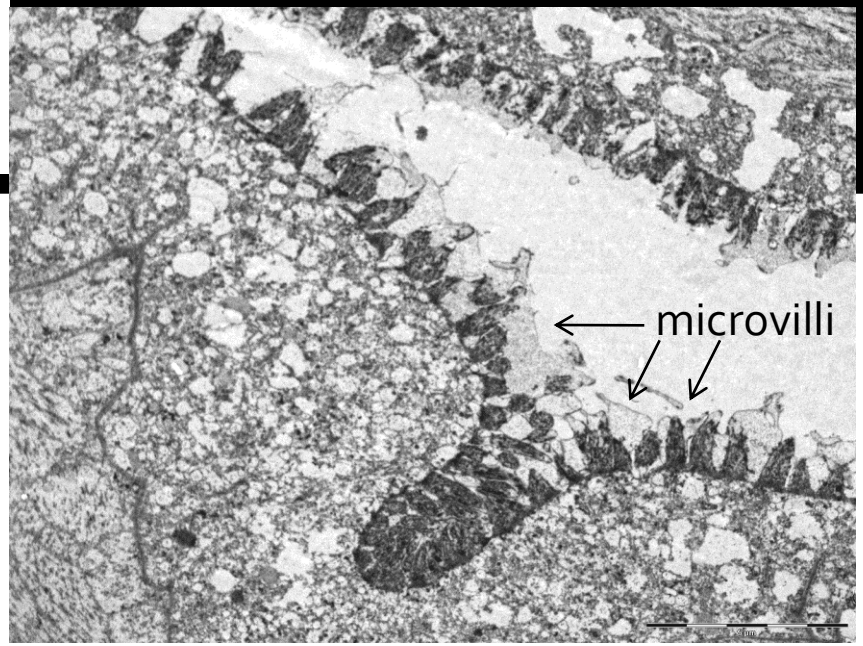
- Philips Morgagni

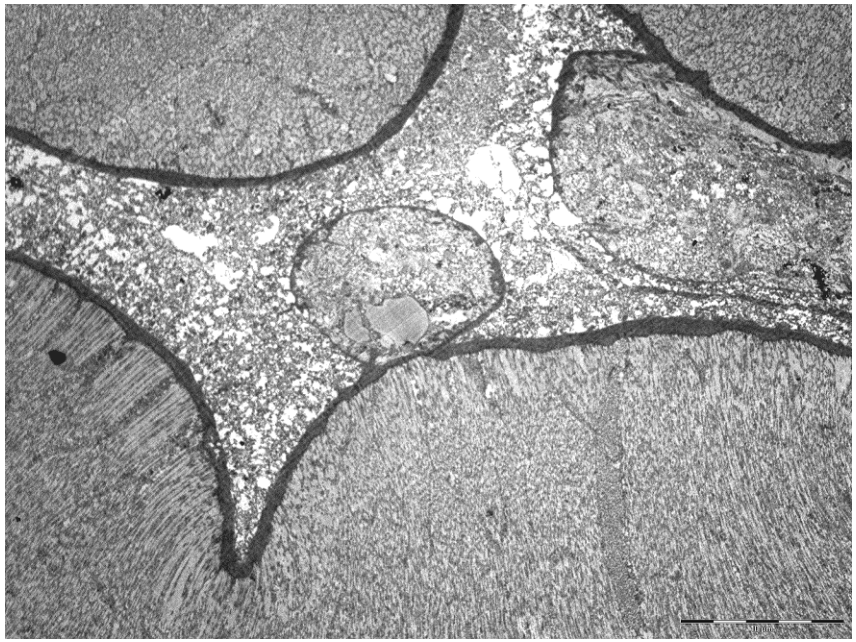




TEM – *E. nipponicum*



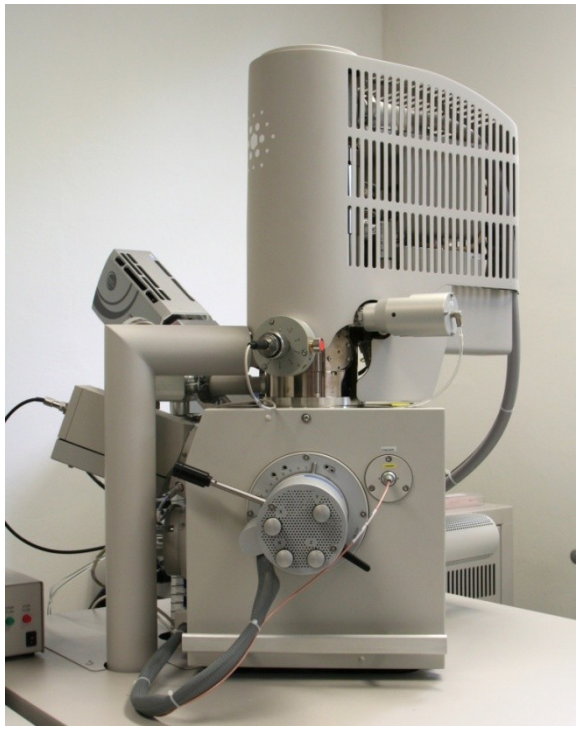




Muscle tissue

SEM

- FEI Quanta™ 3D FEG



Fixation

↓

Dehydration

↓

Critical point drying

↓

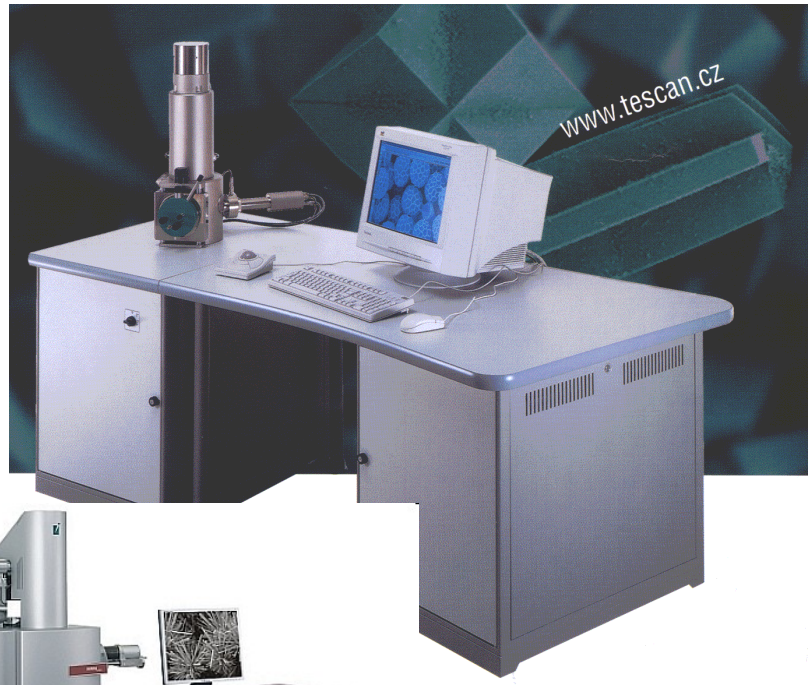
Mounting

↓

Gold coating

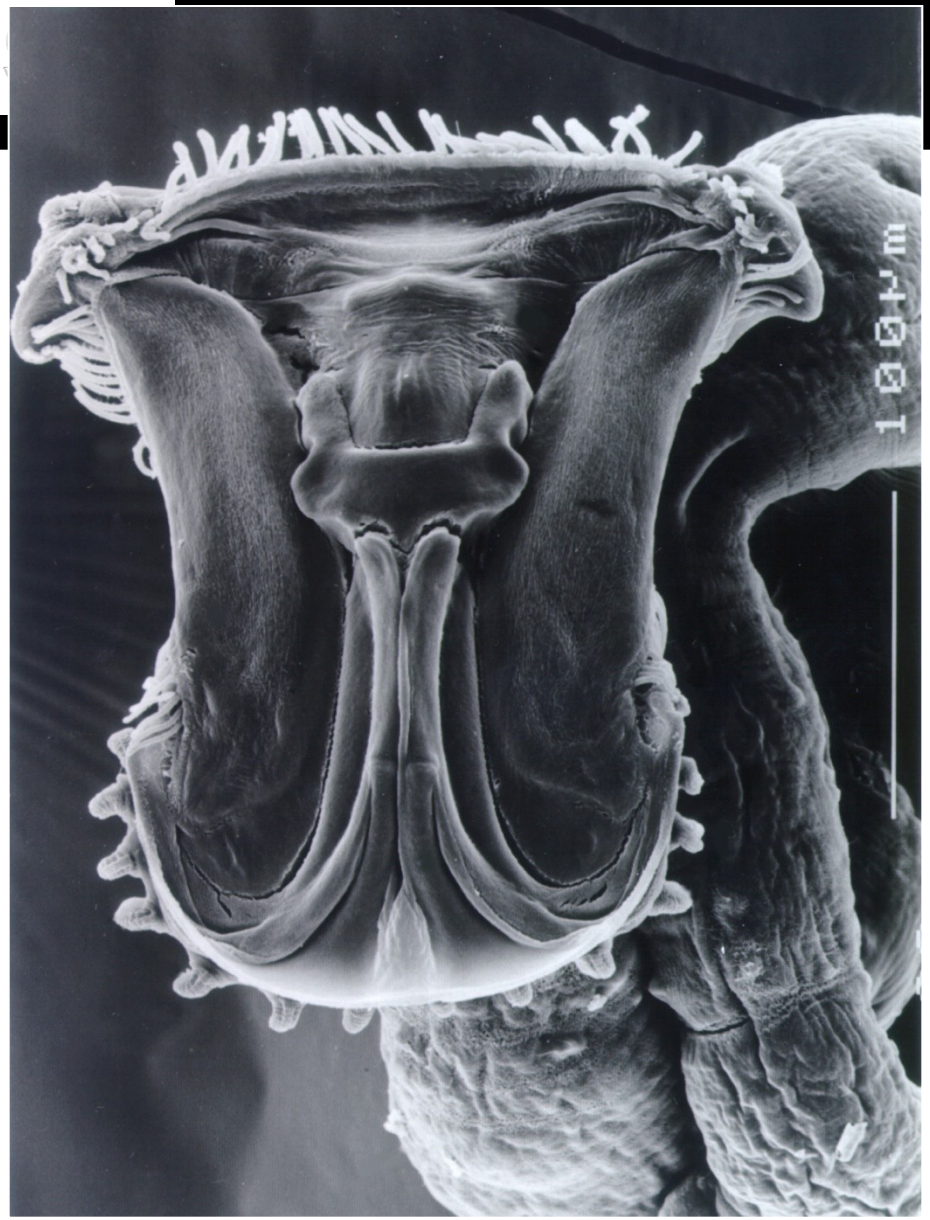
↓

SEM observing



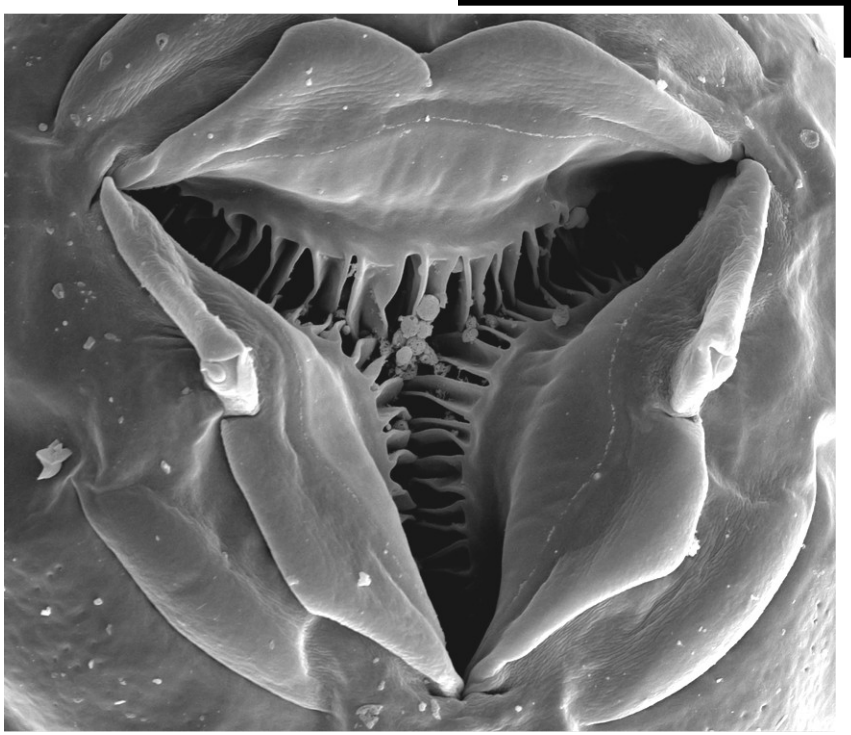
- Tescan vega and Mira

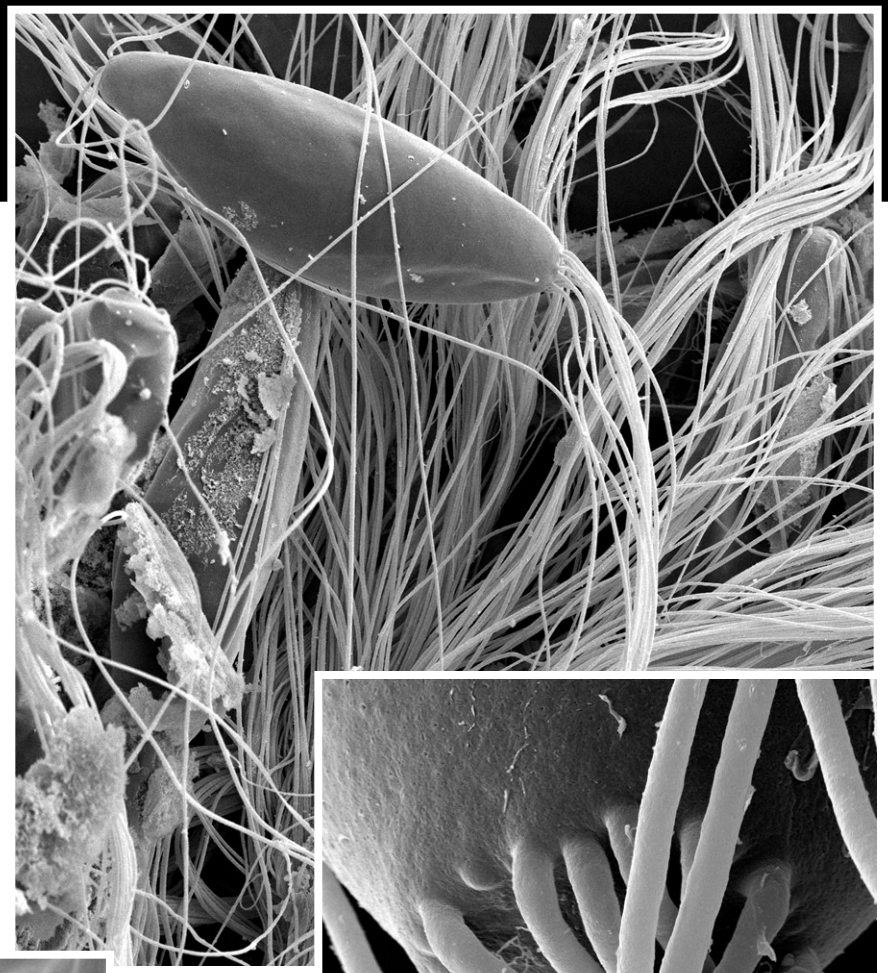
SEM - example

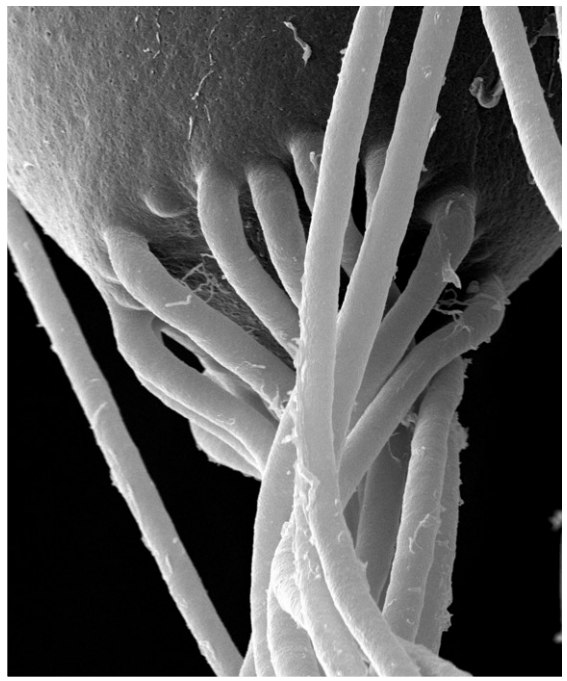


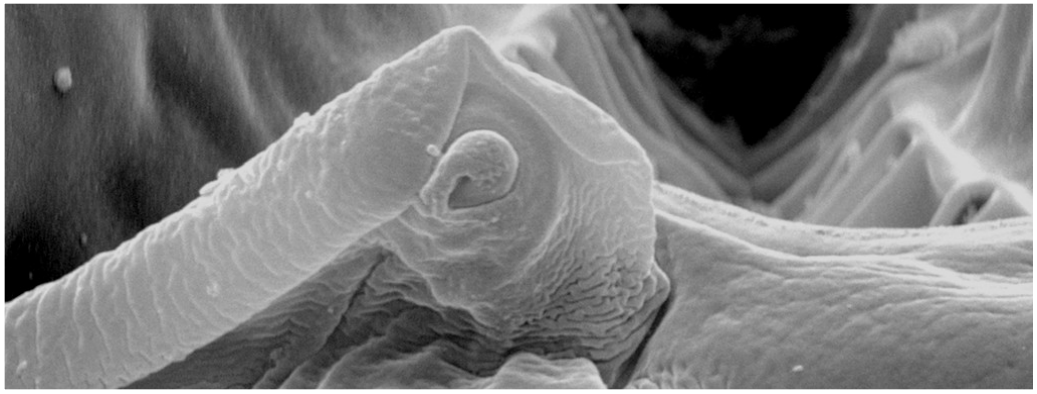
MONOGENEAN RESEARCH GROUP
MASARYK UNIVERSITY BRNO

Citharinella khalili

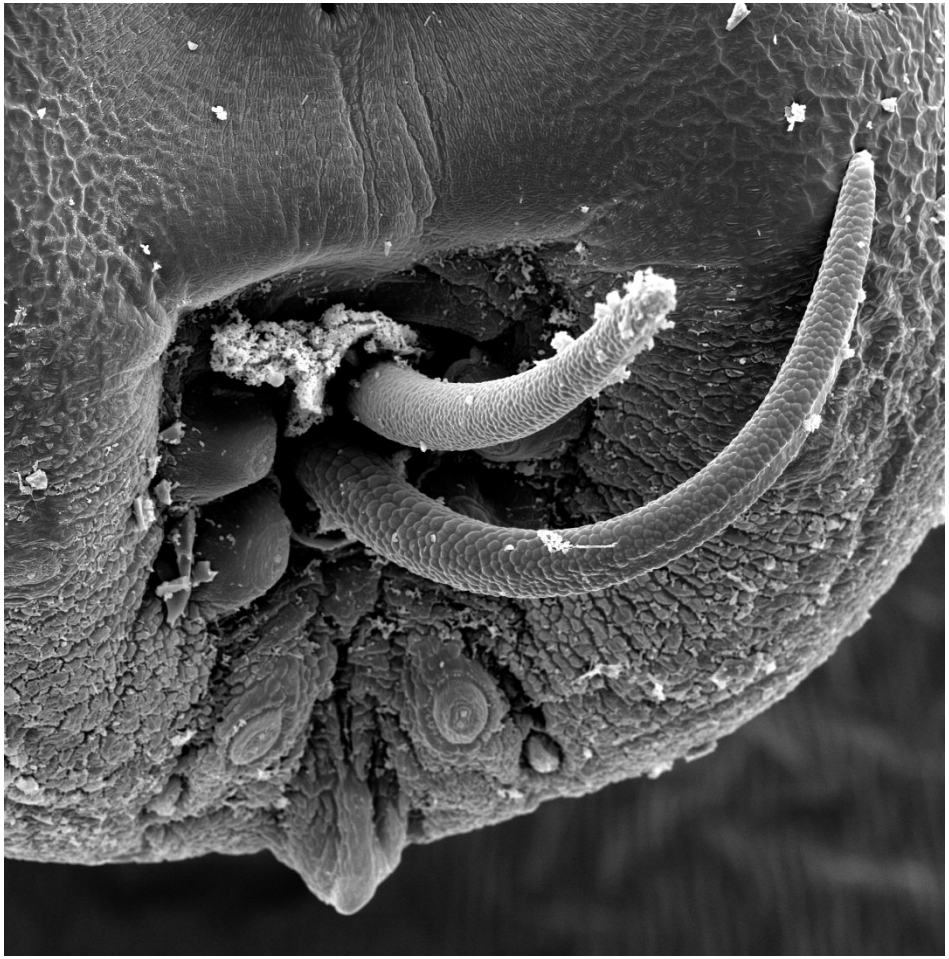




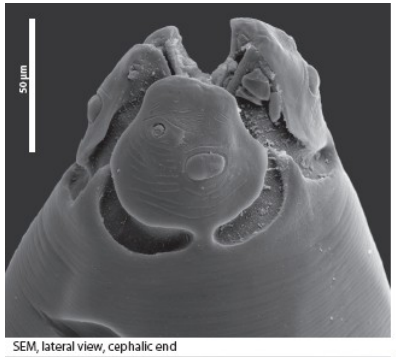




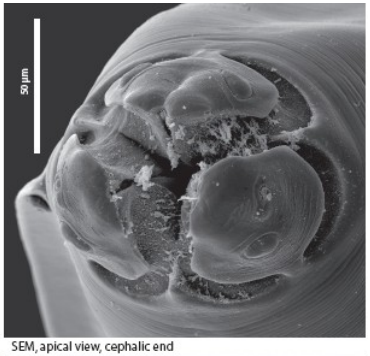
Strongyluris brevicaudata



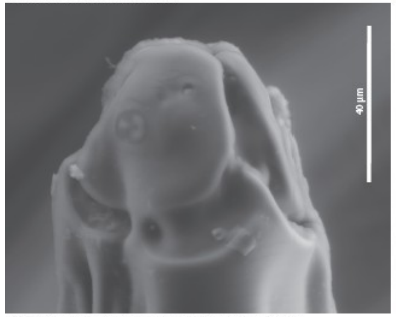
ESEM



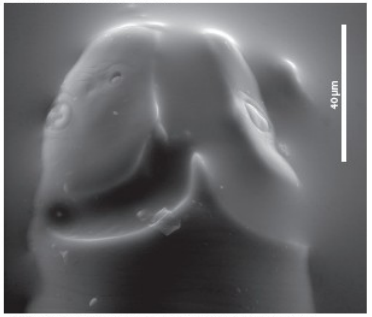
SEM, lateral view, cephalic end



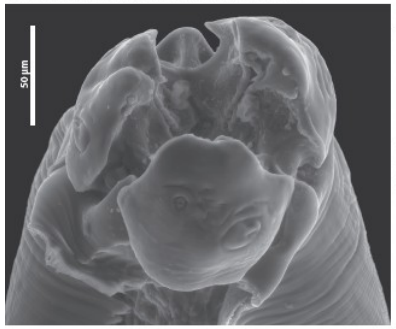
SEM, apical view, cephalic end



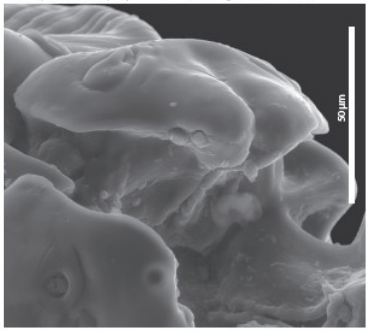
ESEM, lateral view, cephalic end with remains of water



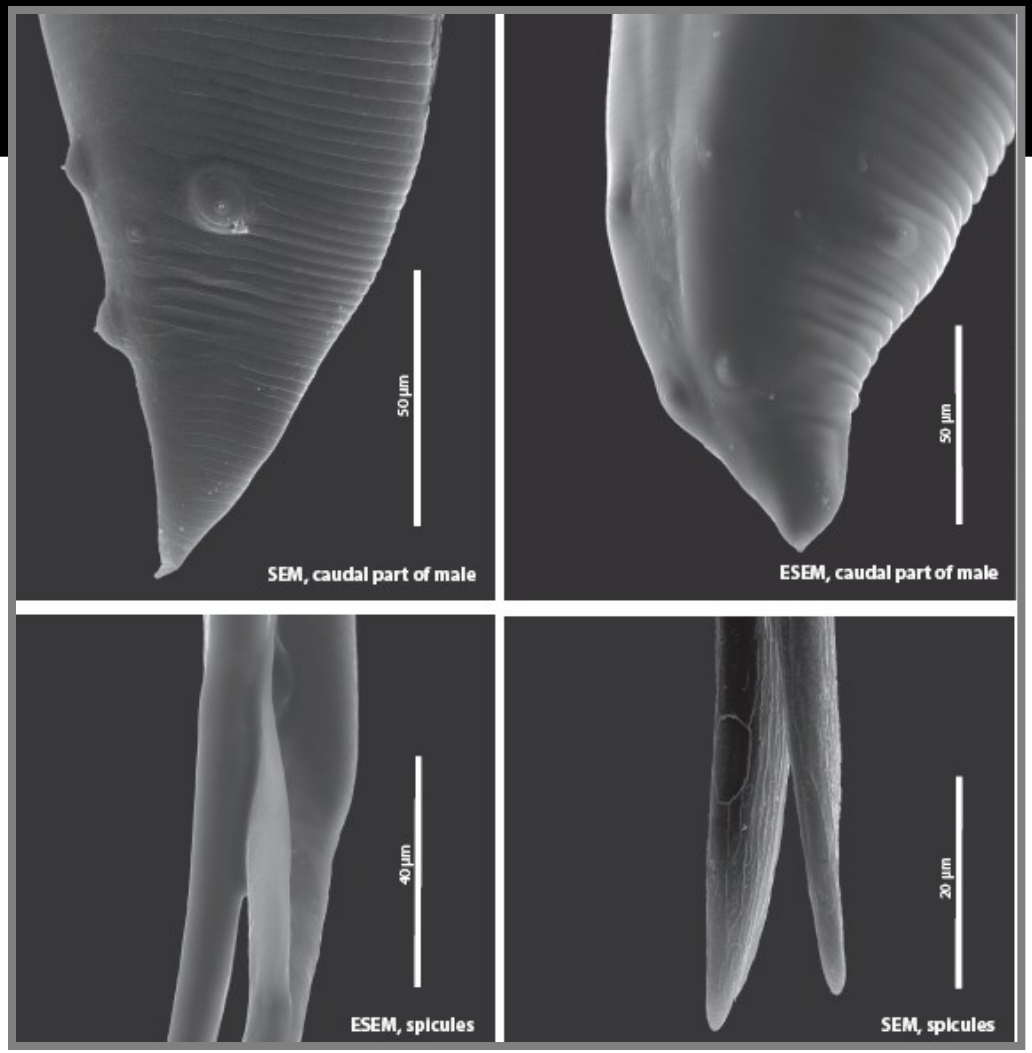
ESEM, lateral view, cephalic end submerged in the water



ESEM, cephalic end



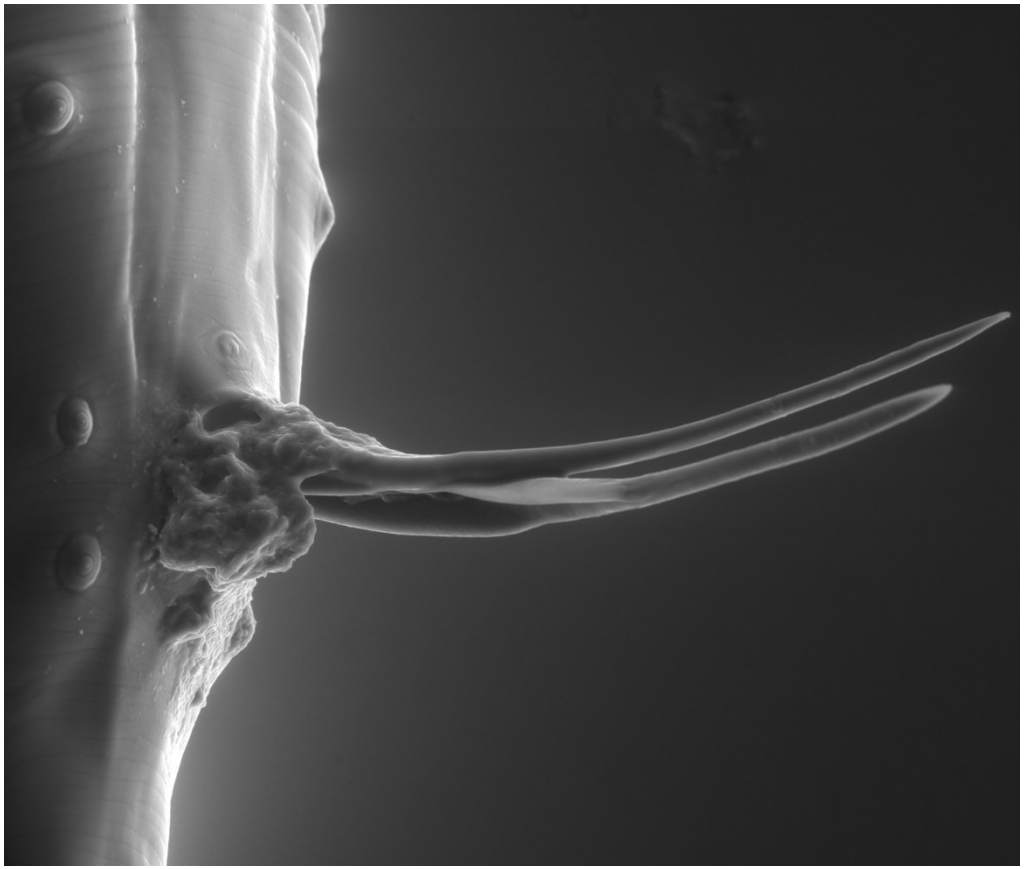
ESEM, dorsal lip with denticles

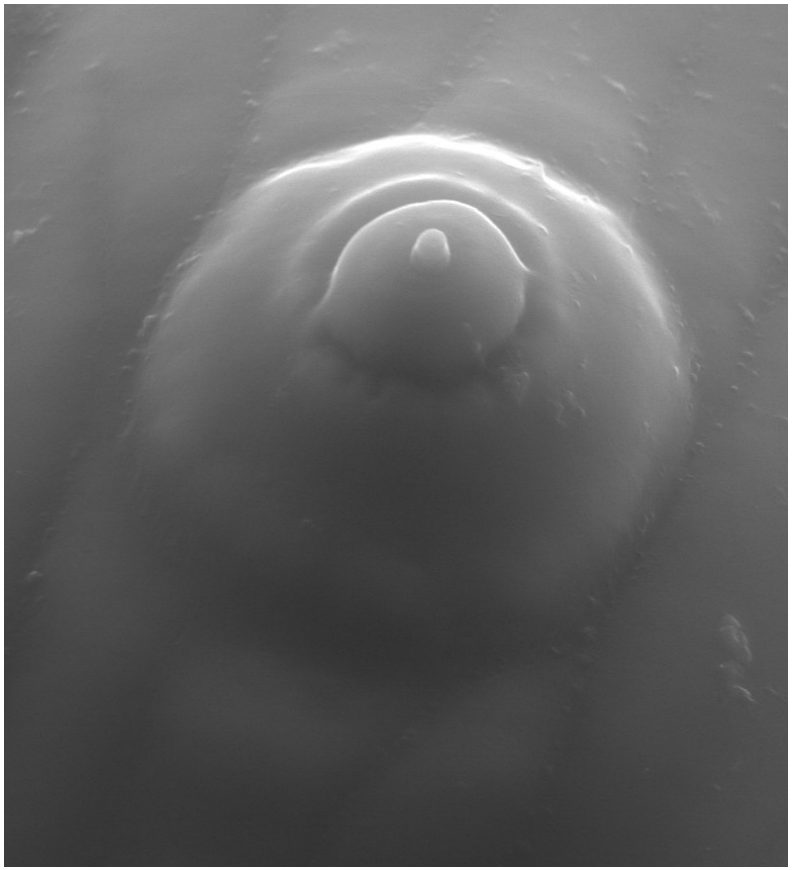


ESEM & SEM
comparision

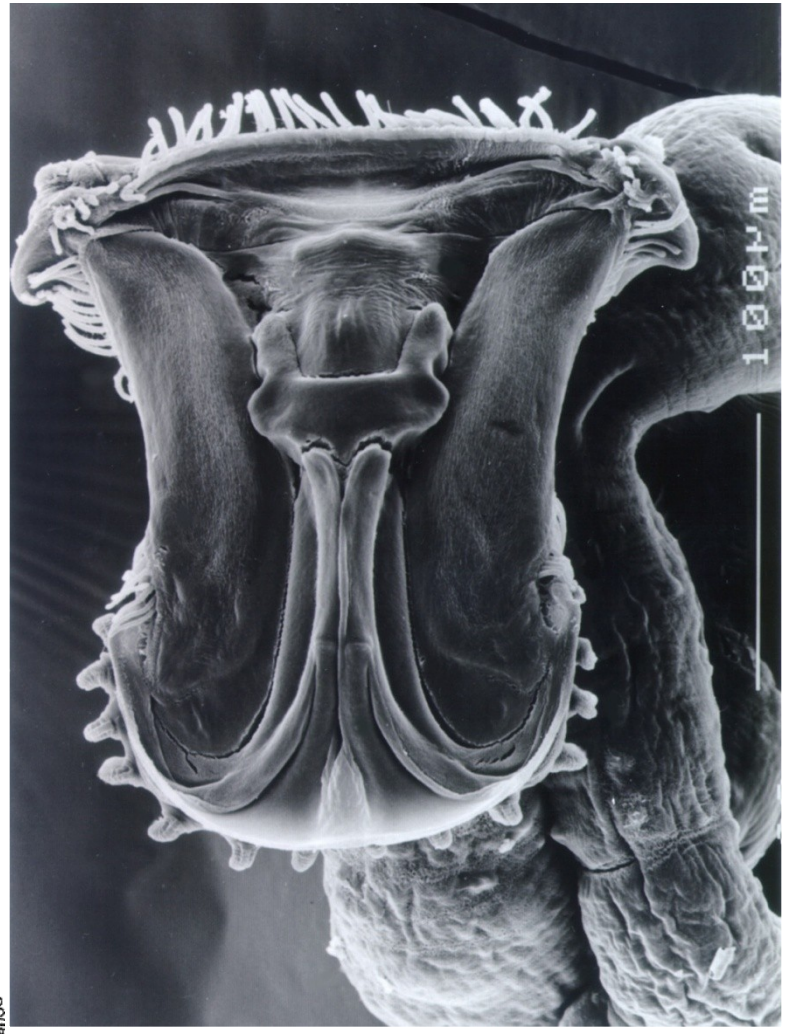
Multicaecum heterotis

ESEM -examples





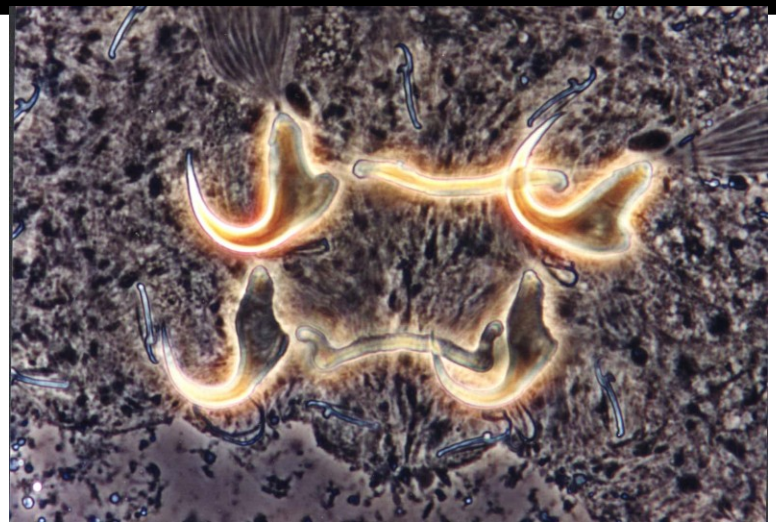
Combinations of techniques



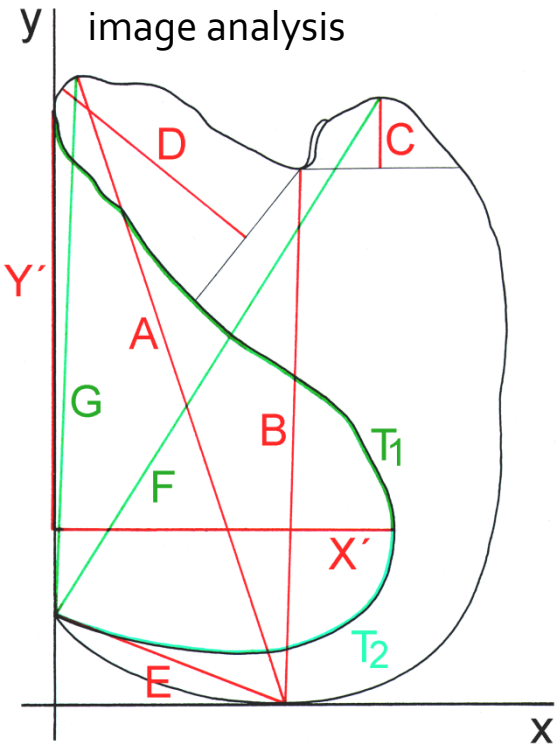
Macrogyrodactylus polypteri Malmberg, 1957

Dokumentace monogeneí

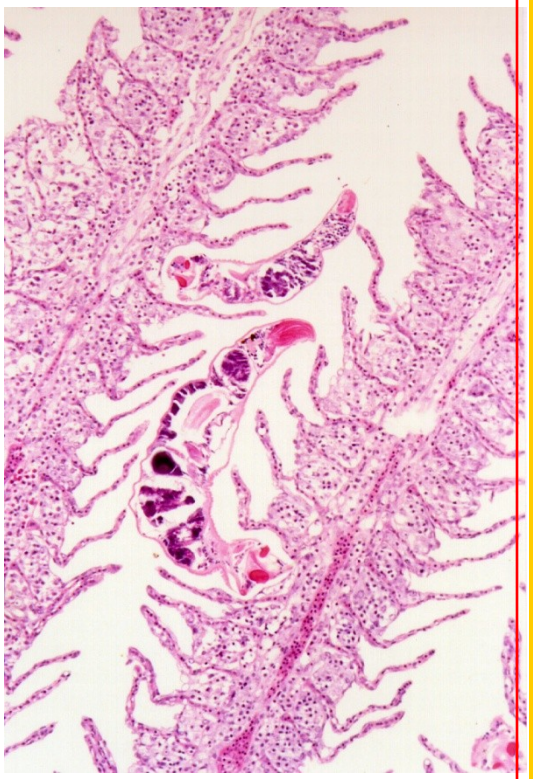
Phase contrast



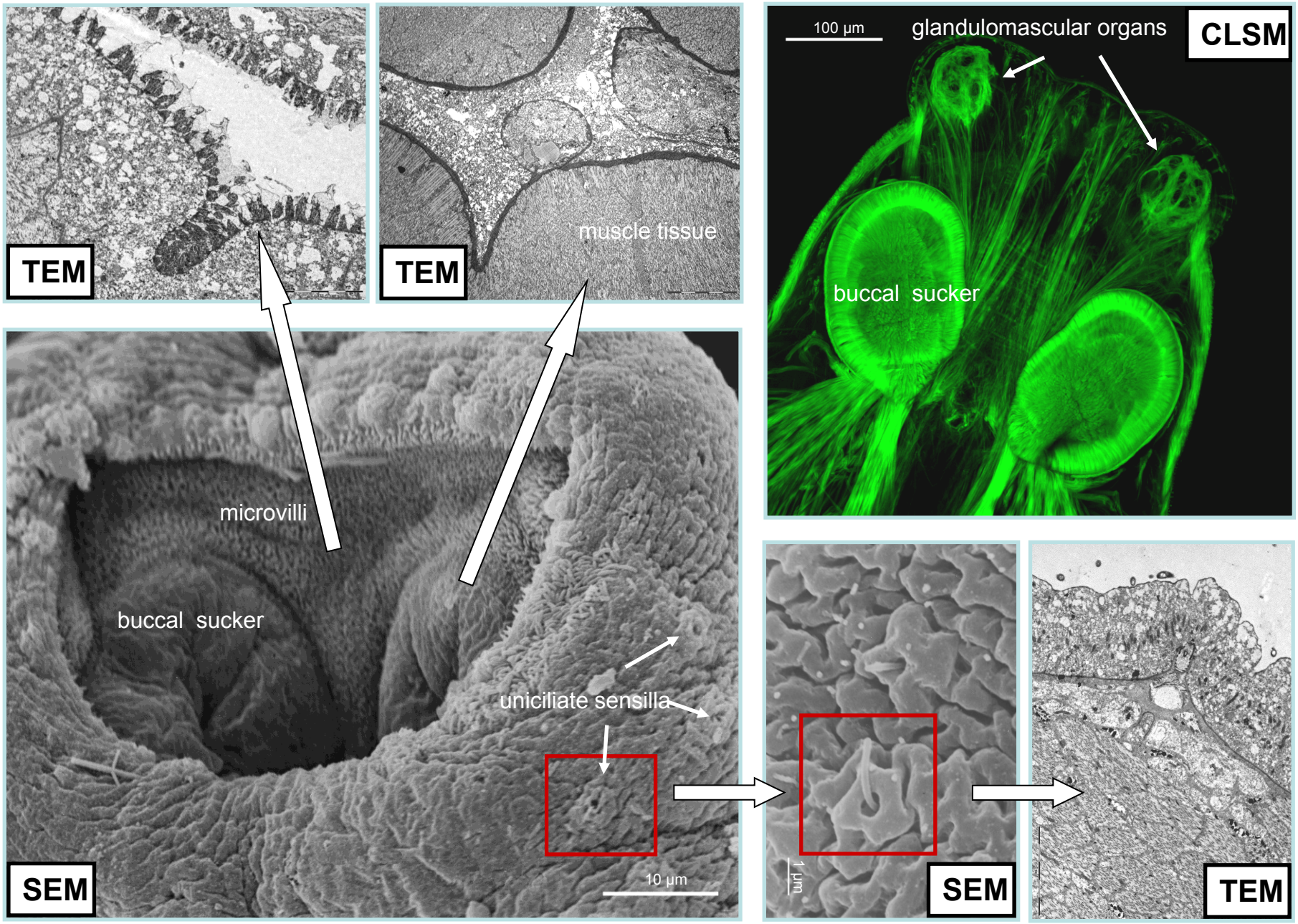
Morphometry- digital image analysis

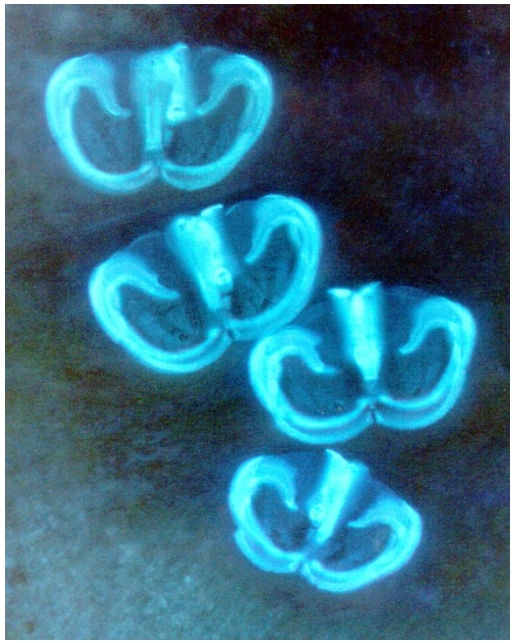


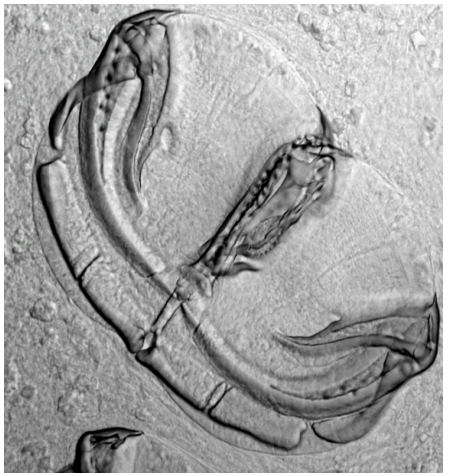
Histology (BF)

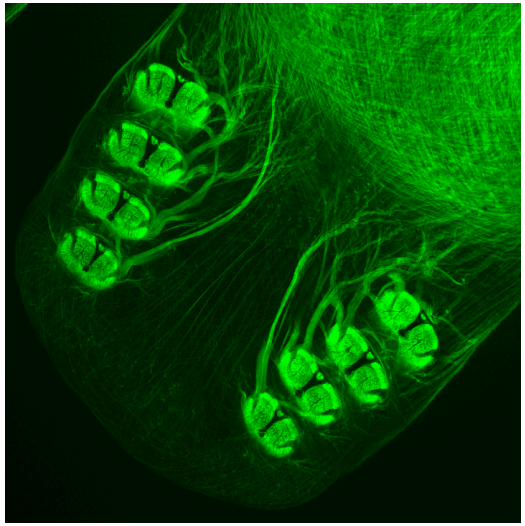


SEM


TEM
TEM
muscle tissue
100 µm
glandulomascular organs
CLSM
buccal sucker
microvilli
buccal sucker
uniciliate sensilla
10 µm
SEM
1 µm
SEM
TEM







Eudiplozoon nipponicum

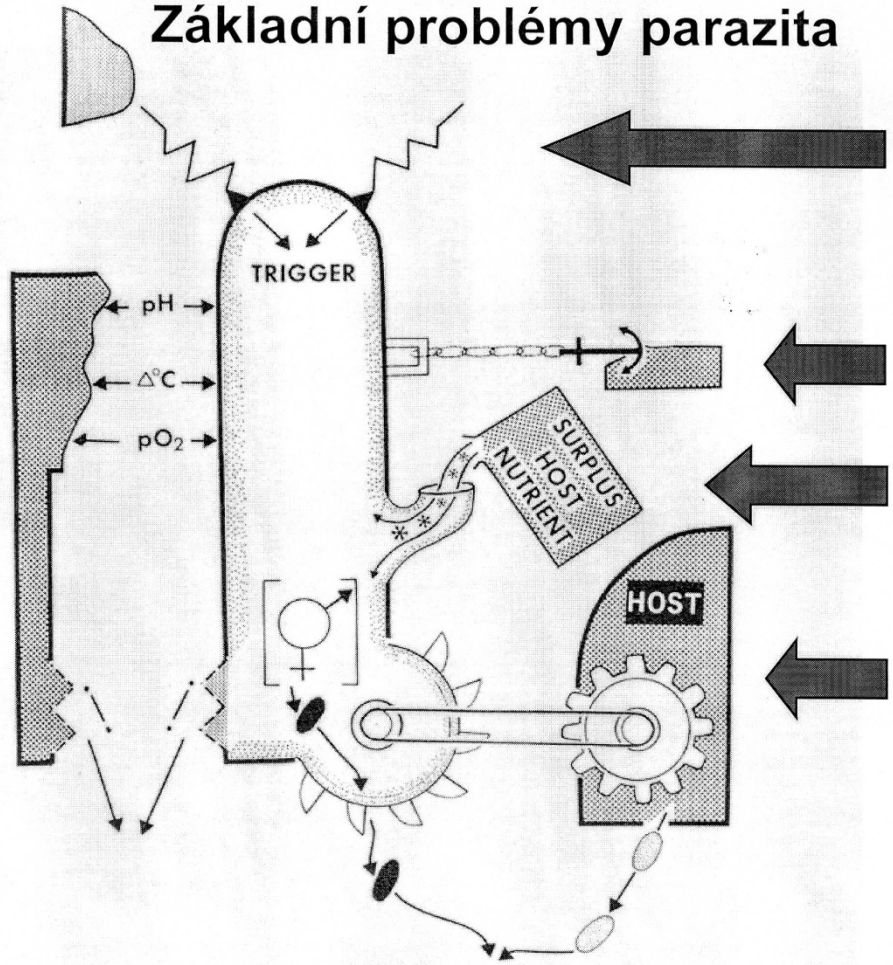
Typy prostředí: Voda
Půda
Atmosféra

Organismy → **Paraziti**

Co je to parazit ?

Raison d´etre for parasitologists.

Základní problémy parazita



Rozpoznání habitatu

Fyzikálně-chemické prostředí

Přichycení

Výživa

Molekulární mimikry

Synchronizace s hostitelem

(upraveno podle Smytha 1994)

Jak se stát úspěšným parazitem ?
Co je potřeba umět ?

- Musí mít strategii vyhledávání hostitele
- Způsob jak proniknout do hostitele a přichytit se na/uvnitř jeho těla
- Schopnost se adaptovat na fyzikálně-chemické podmínky uvnitř organismu hostitele
- Schopnost se v těle hostitele uživit
- Schopnost se bránit vůči obranným mechanismům organismu hostitele (imunita)
- Schopnost se množit a šířit na další hostitelské organismy

Být parazitem není jednoduché !

Je to ale terno !!!

Výhody parazitismu

- (1) Po dosažení hostitele není nutno vyhledávat dalšího
- (2) Stálá dostupnost potravy
- (3) Redukovaná nezbytnost složitého získávání a zpracovávání potravy
- (4) Ochrana proti extrémům vnějšího prostředí
- (5) Ochrana proti predátorům a nemocem
- (6) Redukované mechanismy sloužící k pohybu (zajišťuje hostitel)
- (7) Vyvinutější pohlavní orgány ve srovnání s volně žijícímu příbuznými (obrovská plodnost cizopasníků)

Nevýhody parazitismu

- 1) Extrémní hostitelská specifičnost zvyšuje riziko vyhynutí parazita
- 2) Nezbytnost vyhledávání optimálního habitatu na/v hostiteli – často složité ontogenetické migrace cizopasníků
- 3) Nezbytnost být adaptován na podmínky uvnitř organismu hostitele
- 4) Nezbytnost se bránit vůči imunitnímu systému hostitele
- 5) Distribuce cizopasníka je limitovaná rozšířením jeho hostitele
- 6) Riskantní šíření tj. mnoho cizopasníků zahyne ještě před dosažením vhodného hostitele

Fenomén parazitismu

Typy vztahů mezi organismy	A	B
Parazitismus	**+**	**-**
Predace	**+**	**-**
Kompetice	**-**	**-**
Protokooperace	**+**	**+**
Mutualismus	**+**	**+**
Komensalismus	**+**	**0**
Amensalismus	**-**	**0**
Neutralismus	**0**	**0**

Parazitismus = forma symbiosy

Co je to parazitismus ?

- Parazitismus – vzájemný vztah, při kterém jeden organismus (druh) získává výhodu, zatímco druhý je tímto vztahem poškozován.

- Je parazitismus symbiosa ?

Co je to symbiosa ?

- Symbióza – jakýkoliv vztah nebo soužití dvou nebo více druhů organismů, ať prospěšné nebo neprospěšné.

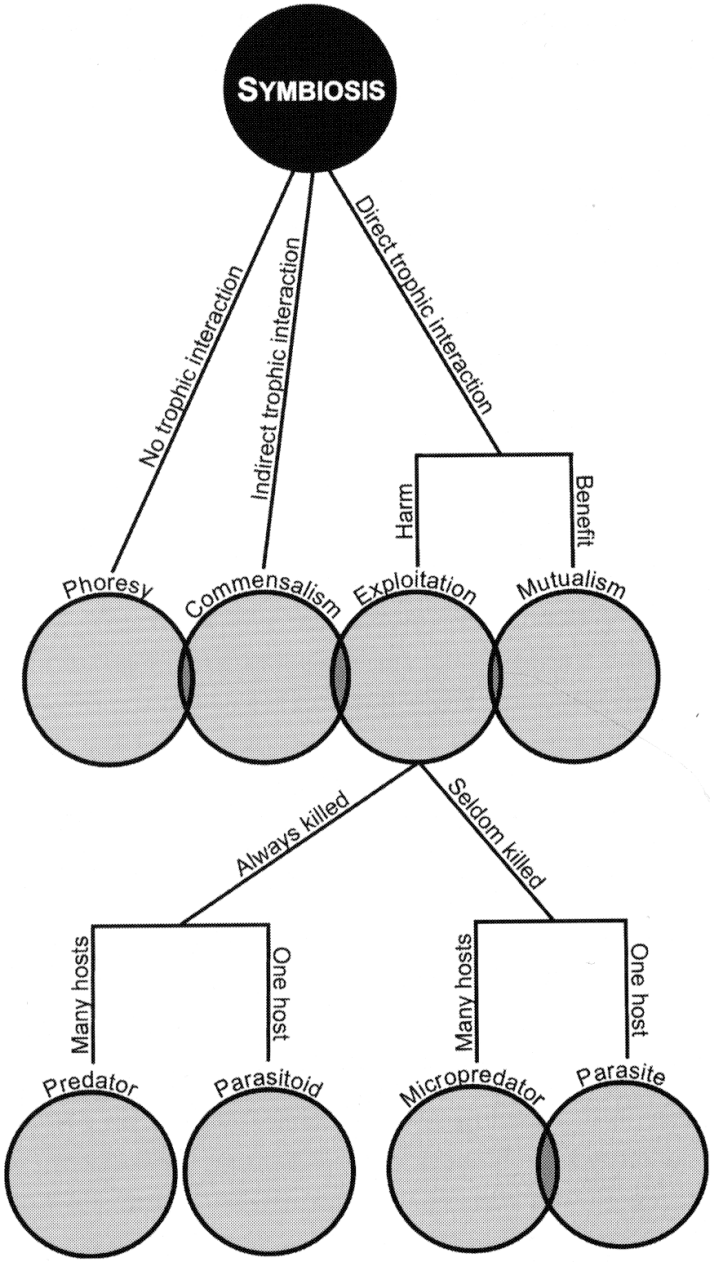
Typy symbiósy

Forezie Komenzalismus Parazitismus Mutualismus

Parazit - symbiosa

- Celý život nebo alespoň jeho část žije na povrchu nebo uvnitř těla svého hostitele

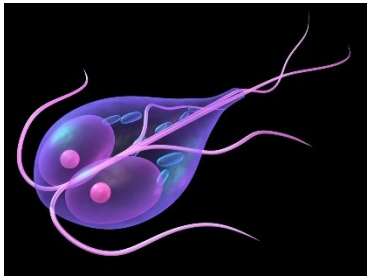
- Živí se na jeho úkor (exploatace) → tento efekt však může být i zcela zhoubný (pro jedince hostitele - patogenita)



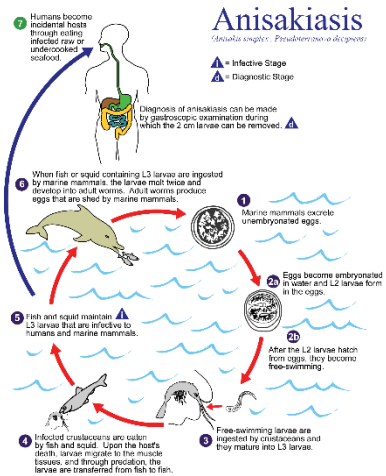
Typy parazitismu

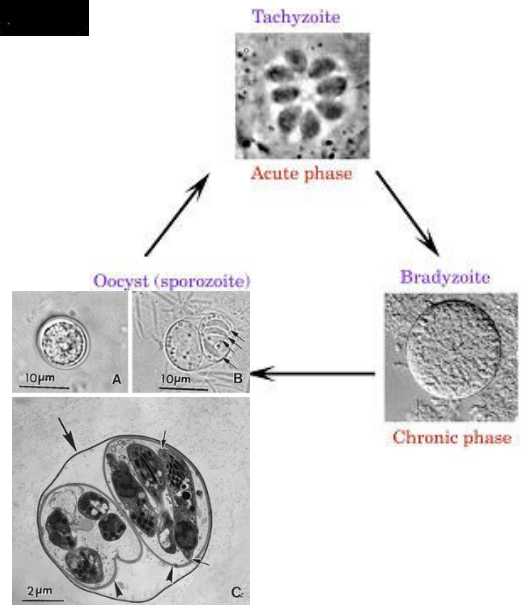
- Parazit
- Predátor
- Parazitoid
- Mikropredátor
- Parazitický kastrátor
- Parazitičtí obratlovci
- Parazitické rostliny
- Hnízdní parazitismus
- Sociální parazitismus u hmyzu

Jak vypadá typický parazit ?



- Napadá jednoho hostitele a má slabé nebo žádné patogenní působení
- Hostitel přežívá
- Andreson & May (1979) :
  typický parazit – závislý na intenzitě infekce (makroparazit)
  patogen – nezávislý na intenzitě infekce (mikroparazit)





!!! Troficky přenosný typicky parazit nebo patogen vyžaduje usmrcení hostitele - častá manipulace chováním hostitele

Parazitoid

- Napadá jednoho hostitele
- Usmrcení hostitele je nezbytné
- Parazitické larvy hmyzu, např. Diptera (Tachinidae) a Hymenoptera (Chalcidoidea, Braconidae), fyziologické adaptace (endosymbiotické viry)
- Samičky kladou vajíčka do hostitele, kde se pak vyvíjí parazitická larva

Parazitický kastrátor

- Energie původně určená pro reprodukci hostitele je využita ve prospěch parazita
- Parazitický kastrátor - zabíjí svého hostitele v evolučním smyslu
- Částečný kastrátor – přechod mezi typickým parazitem a parazitickým kastrátorem

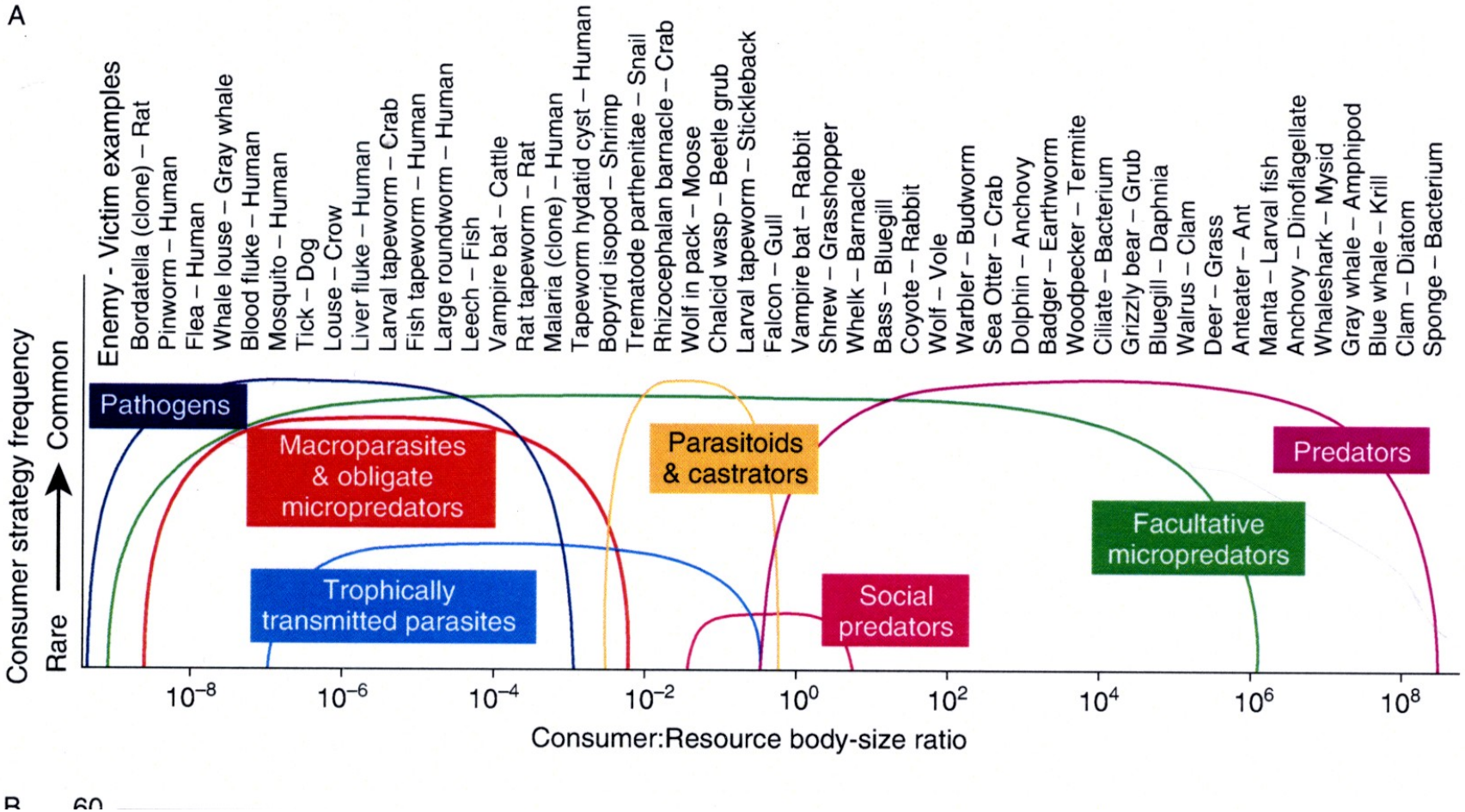
Ekologické vymezení parazita I

Effect on fitness	Number of hosts/prey attacked		
	1 host		> 1host/prey
	Death of host not required	Death of host required	
< 100%	Typical parasite	Tropically transmitted typical parasite	Micropredator
100% (prey has 0 fitness)	Parasitic castrator	Parasitoid	Predator

Ekologické vymezení parazitismu II

Effect on host fitness	Number of hosts/prey attacked		
	1 host		> 1host/prey
	Death of host not required	Death of host required	
< 100%	typical parasite / pathogen	trophically trans-mitted typical parasite / trophic trasmitted pathogen	micropredator / harvest regeneration
100% (prey has 0 fitness)	partial castrator / parasitic castrator	trophically trans-mitted castrator / parasitoid	social predator / predator

Frekvence poměru relativní velikosti těla konzumenta a hostitele



Ekologická klasifikace parazitů

- Association with host
  - obligate (Monogenea, Digenea, Cestoda)
  - facultative (nematoda *Micronema*)
  - hyperparasitic – *Udonella* on parasitic Crustacea
- Time of parasitic lifespan
  - permanent (*Plasmodium*, *Entamoeba*)
  - temporal (*Argulus*, *Ixodes*)
  - periodic – developmental stages (glochidie Mollusca, larvae Diptera), generation (*Rabdias bufonis*)

Ekologická klasifikace parazitů

- According to the life cycle

  monoxenous – life cycle in one host (Monogenea)

  heteroxenous (euryxenous) – life cycle in more than one host (Digenea, Cestoda)

- According to the range of food items (host specificity)

  monophagous (stenophagous) – only one host species (*Eudiplozoon nipponicum*) (strictly host specific)

  polyphagous (euryphagous) – more than one host species (*Posthodiplostomum cuticola*, *Ergasilus sieboldi*)

Klasifikace hostitelů

- Hostitel definitivní
- Mezihostitel
- Vektor
- Rezervoárový hostitel
- Paratenický (transportní) hostitel

Typy hostitelů

- Definitive host – host, in which parasite reach maturity, produce eggs or larvae

- Intermediate host – important for the development of larval stages, invasion stage → definitive host

  one or more intermediate hosts (Digenea, Cestoda)

  human as intermediate hosts (*Echinococcus*, *Taenia*)

Typy hostitelů

- Paratenic (transport) host – parasite does not develop, but retain the ability of invasion, not necessary for life cycle of parasite

  i.e. Mollusca for the larvae of nematodes usually occuring in short-living crustacea

- Reservoir host

  = source of infection in ecosystem, parasite lives in the conditions unsuitable for common host, epidemiological significance

  i.e. rats and carnivora for *Trichinella*, *Schistosoma japonicum*

- Vector – usually transfers other pathogen on its hosts, i.e. mosquitos – facultative parasite, micropredator

Rozmanitost parazitů