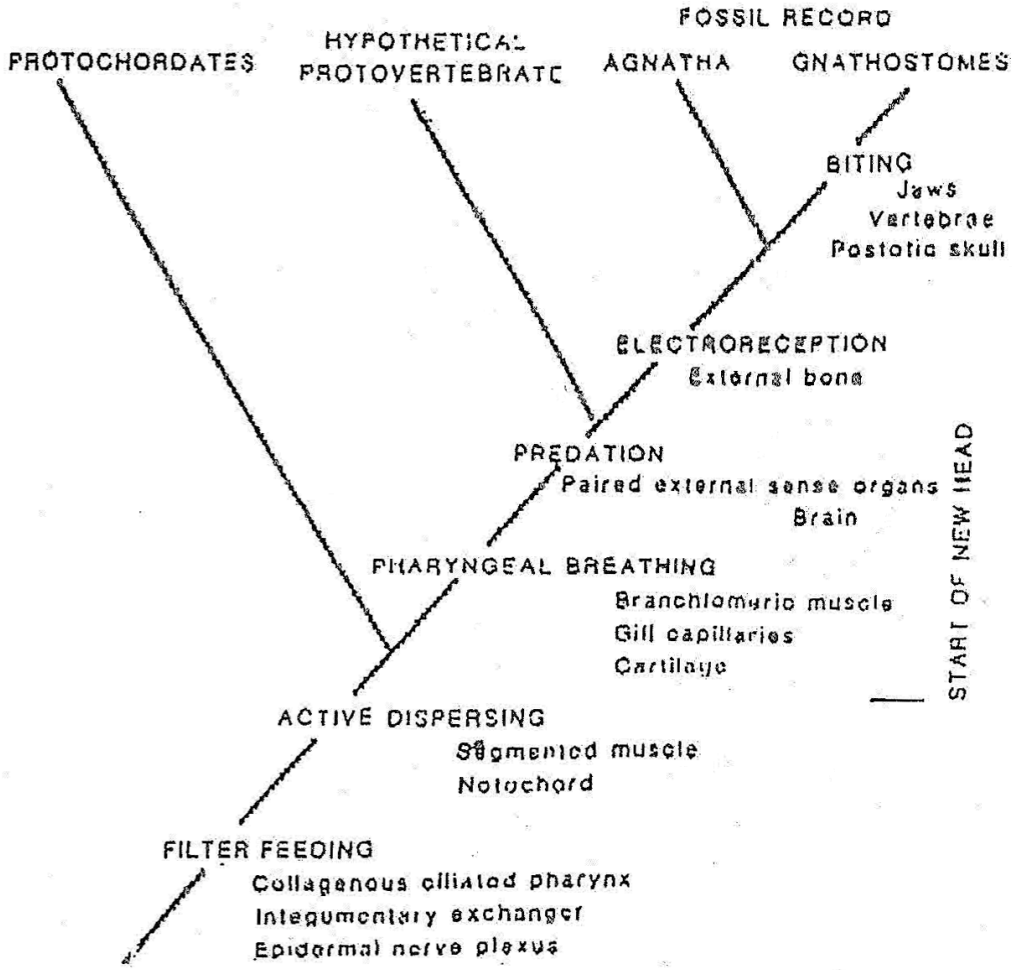
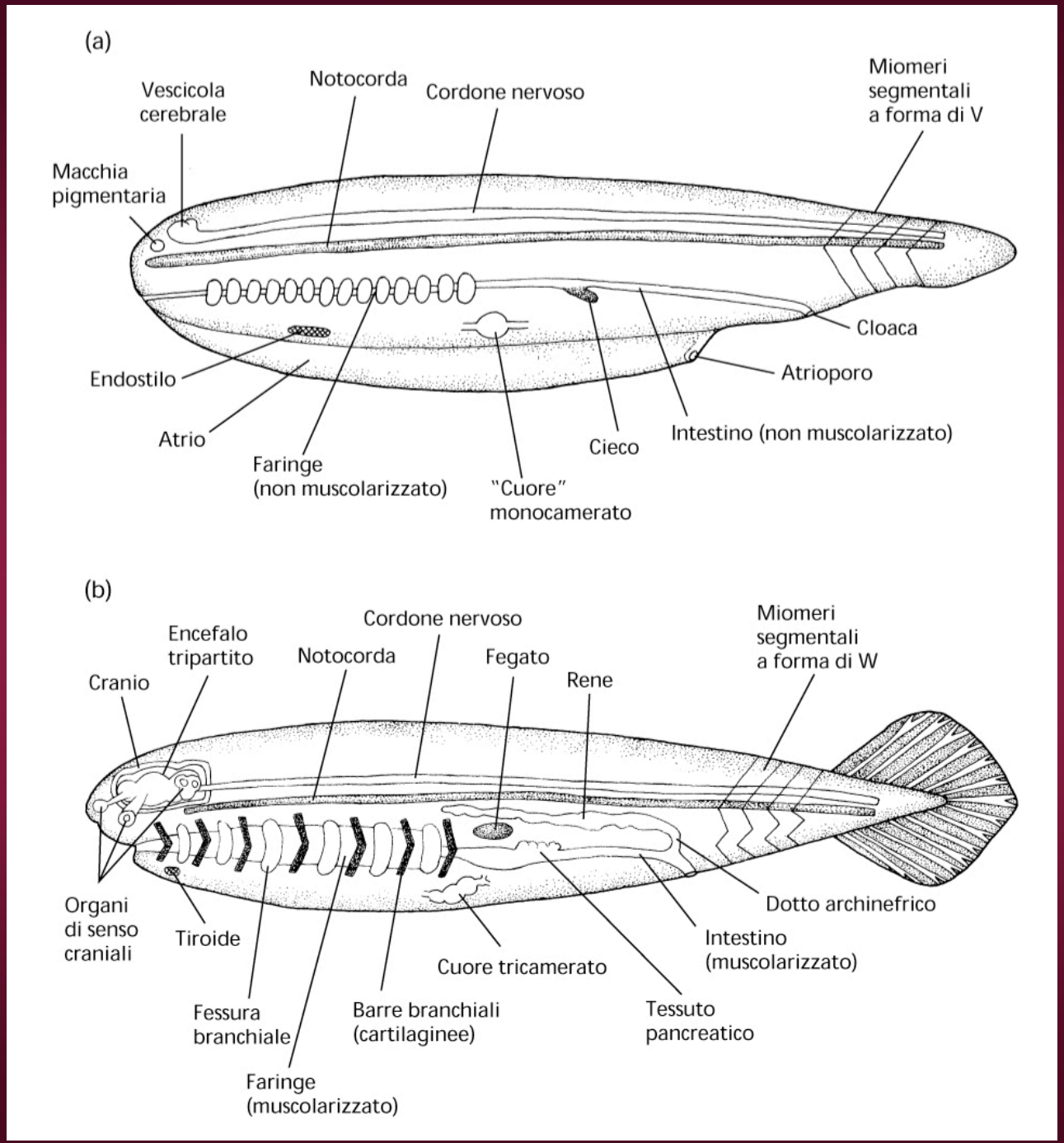
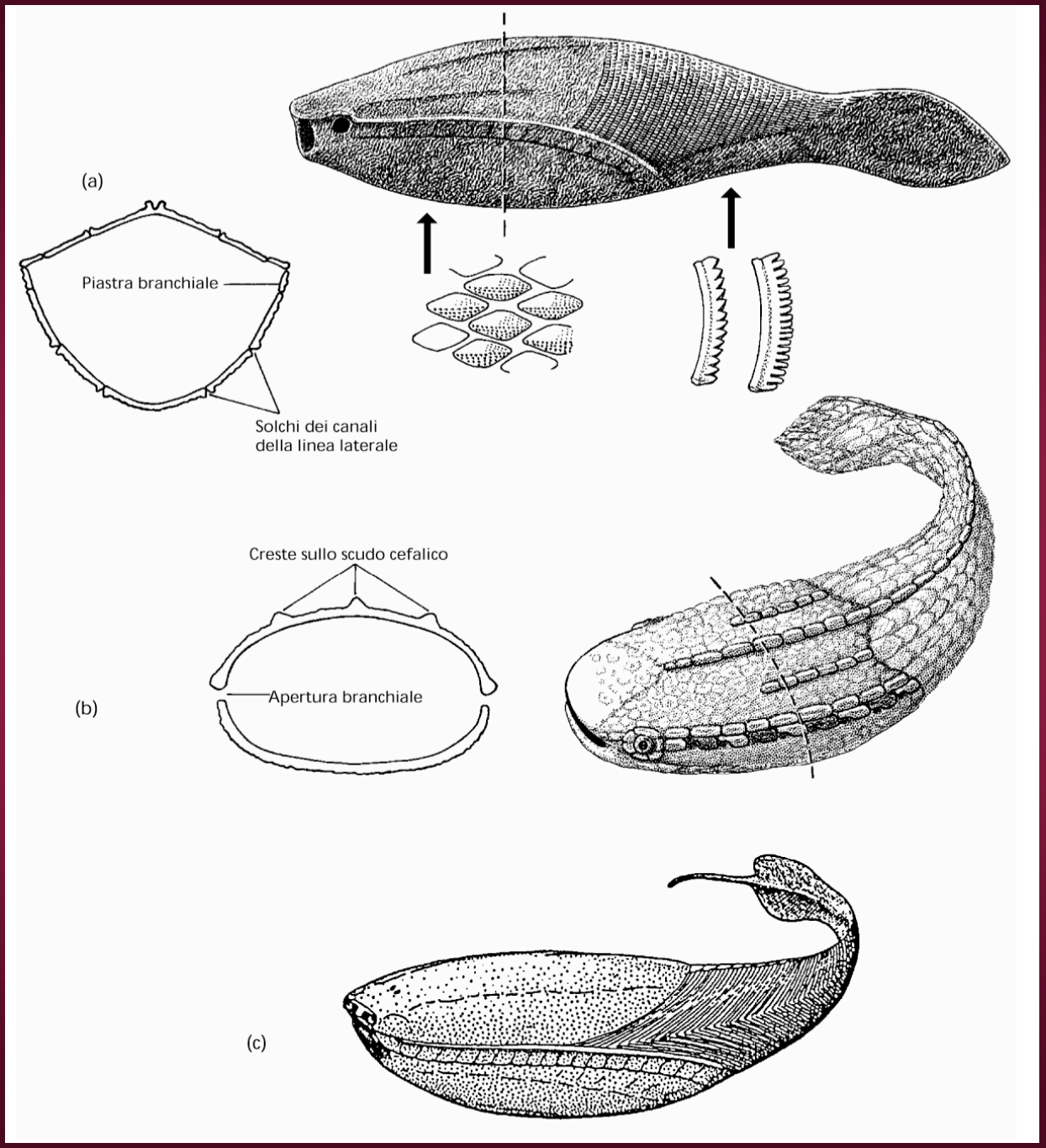
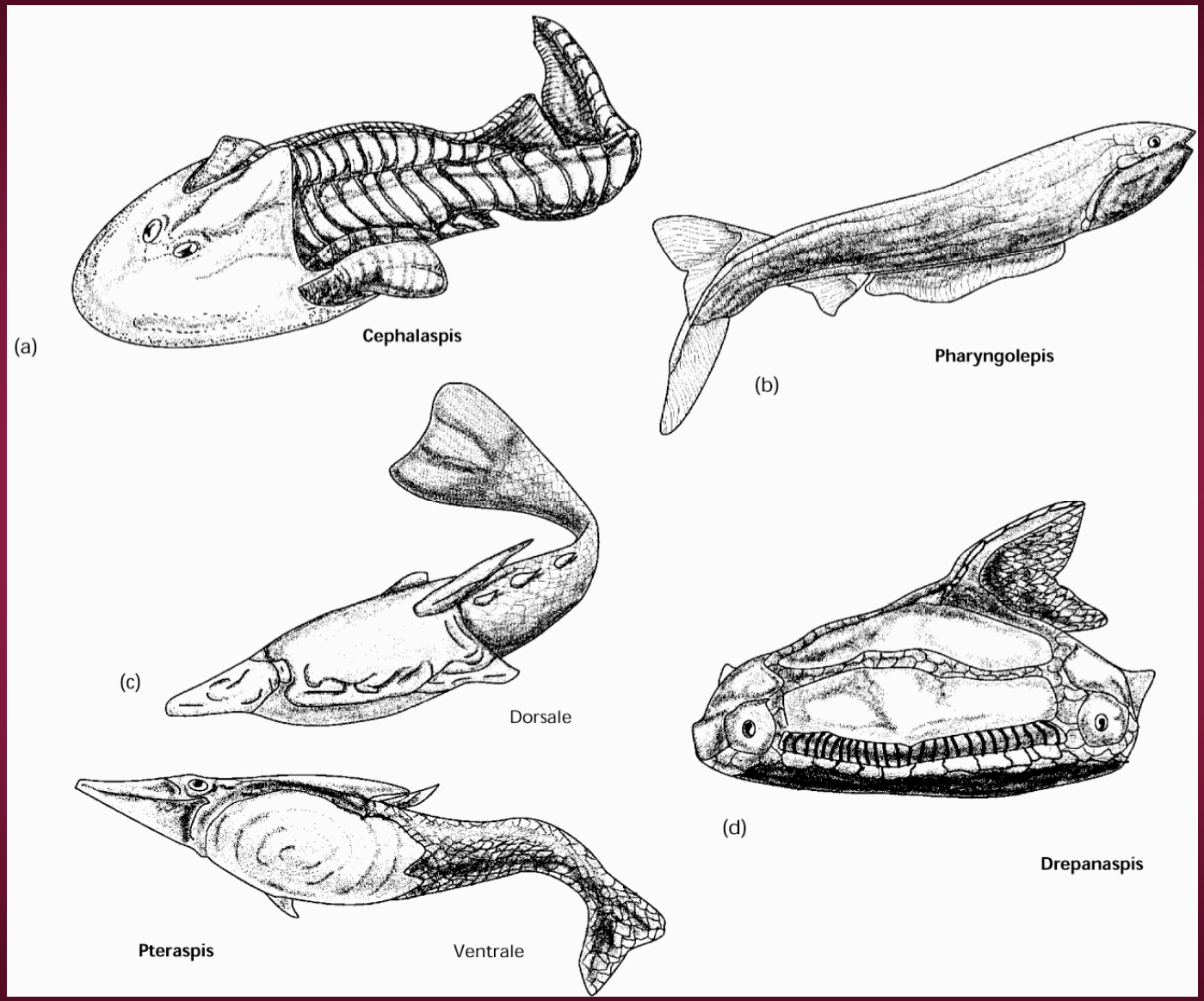
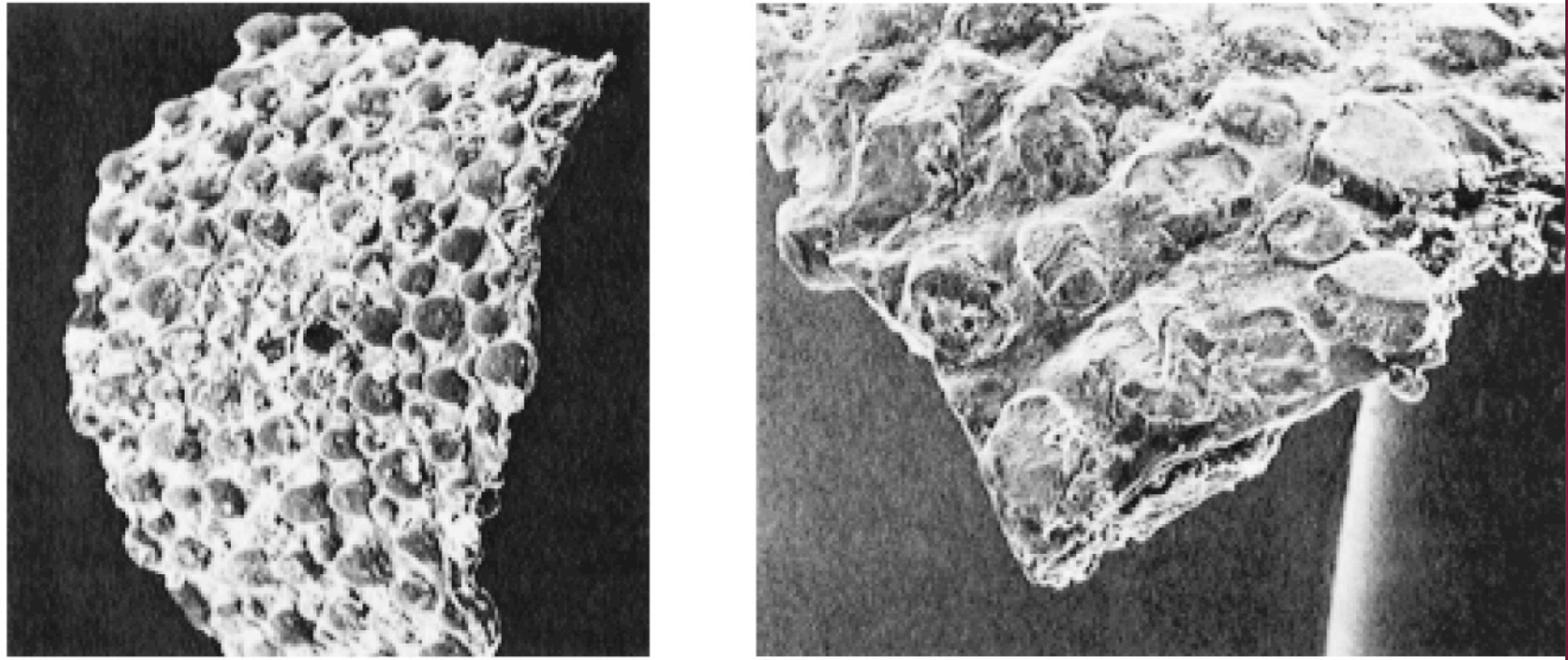


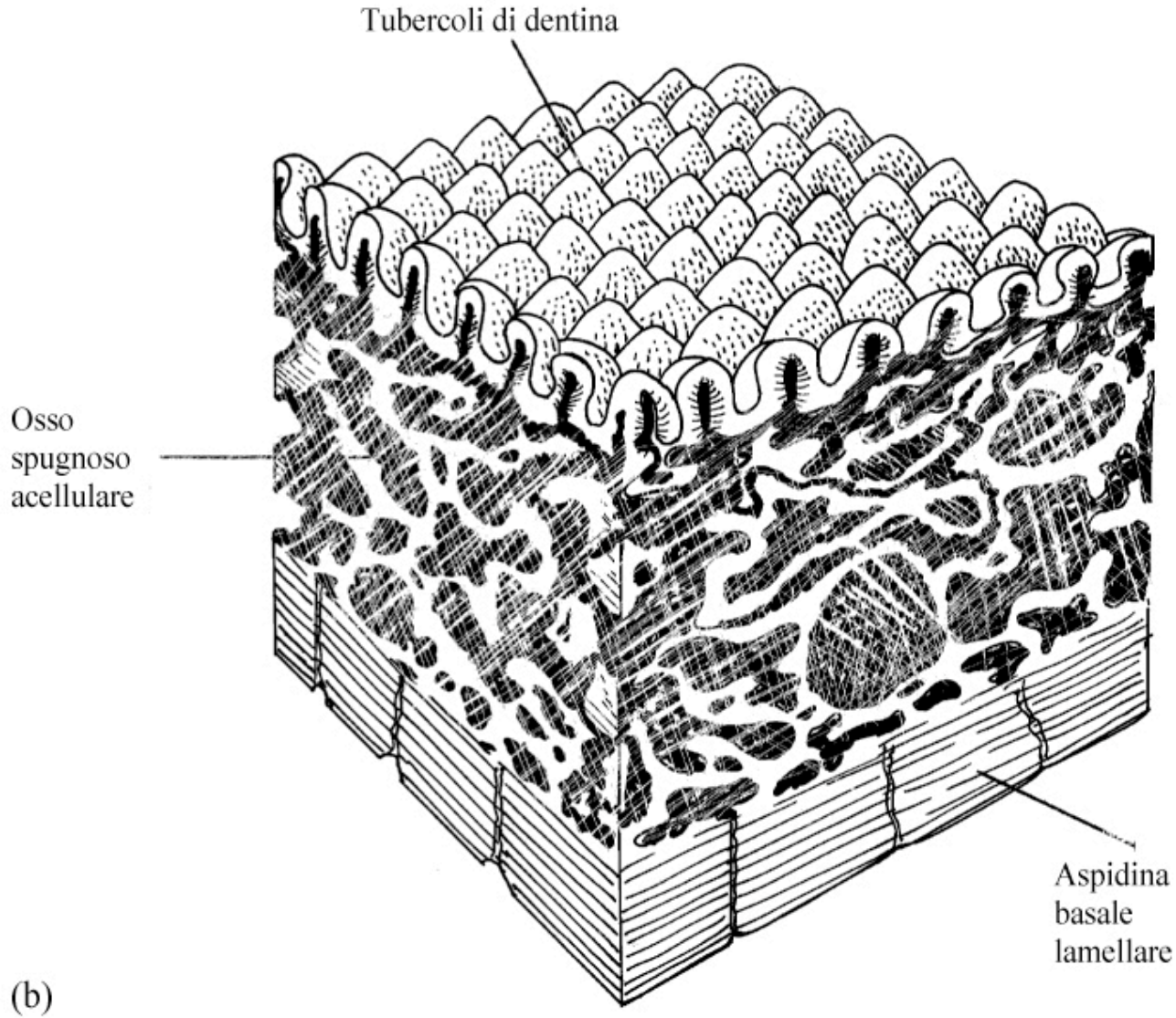
Fig. 1. Hypothesized structural and functional transitions in vertebrate evolution. The postulated functional states (capitals) precede the modified structures (lower case letters) involved with them.

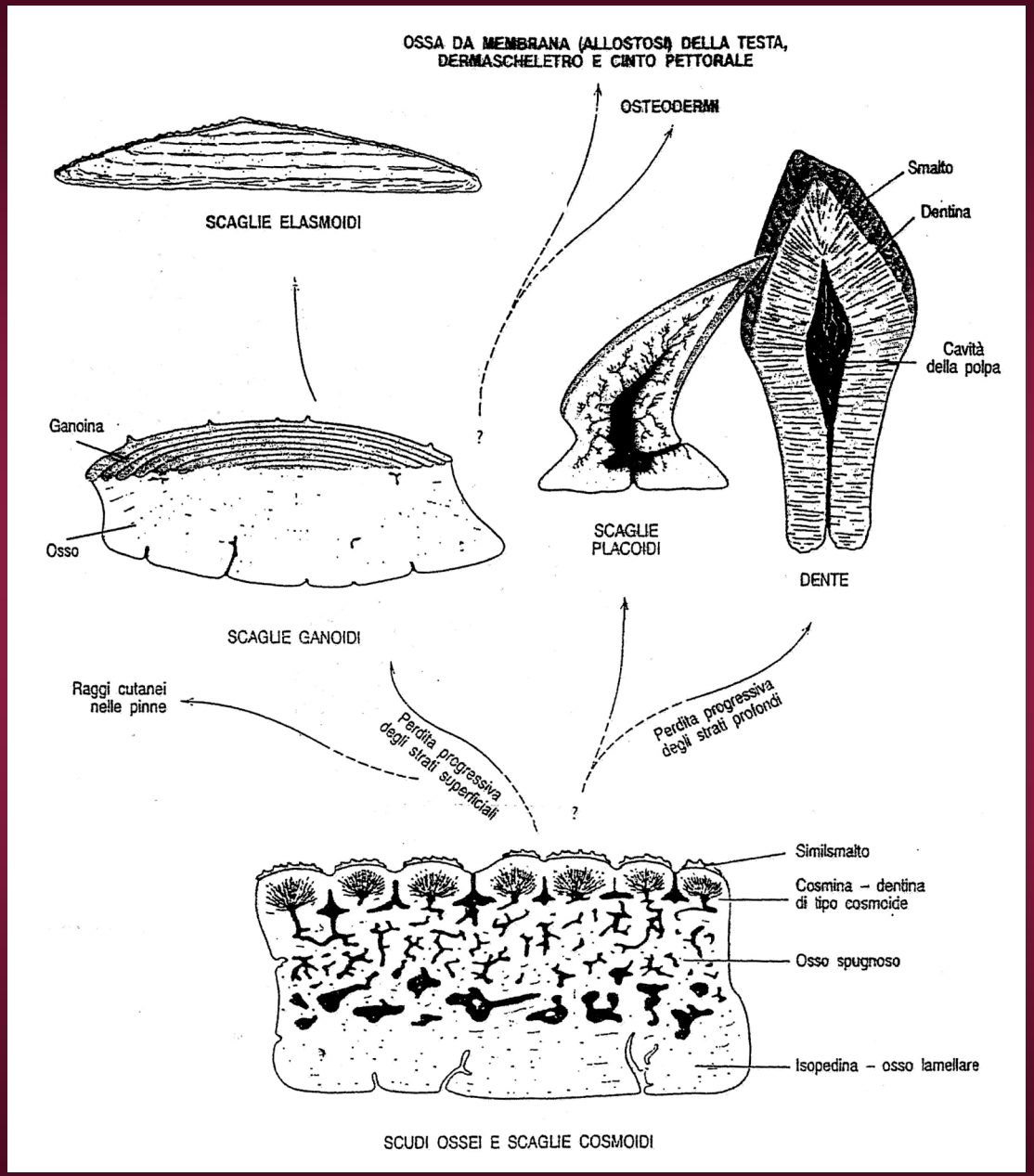

(a)
Vescicola cerebrale
Notocorda
Cordone nervoso
Miomeri segmentali a forma di V
Macchia pigmentaria
Cloaca
Endostilo
Atrioporo
Atrio
Faringe (non muscolarizzato)
"Cuore" monocamerato
Cieco
Intestino (non muscolarizzato)
(b)
Encefalo tripartito
Cordone nervoso
Miomeri segmentali a forma di W
Cranio
Notocorda
Fegato
Rene
Organi di senso craniali
Tiroide
Dotto archinefrico
Intestino (muscolarizzato)
Cuore tricamerato
Fessura branchiale
Barre branchiali (cartilaginee)
Tessuto pancreatico
Faringe (muscolarizzato)


(a)
Piastra branchiale
Solchi dei canali
della linea laterale
Creste sullo scudo cefalico
Apertura branchiale
(b)
(c)


(a)
Cephalaspis
(b)
Pharyngolepis
(c)
Dorsale
Pteraspis
Ventrale
(d)
Drepanaspis




Tubercoli di dentina
Osso
spugnoso
acellulare
Aspidina
basale
lamellare
(b)

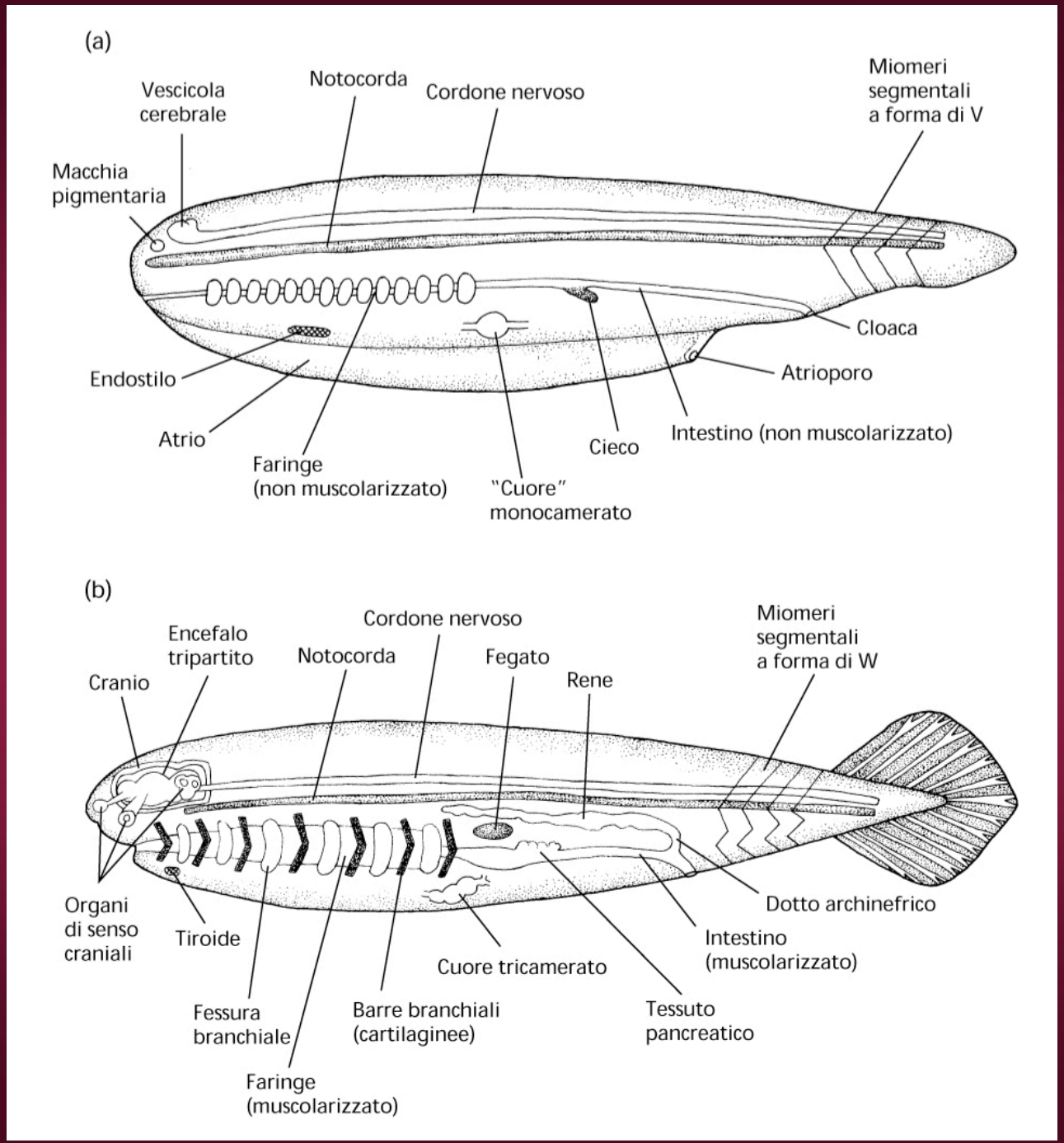

OSSA DA MEMBRANA (ALLOSTOSI) DELLA TESTA, DERMASCHELETRO E CINTO PETTORALE
OSTEODERMI
SCAGLIE ELASMOIDI
Smalto
Dentina
Cavità della polpa
Ganoina
Osso
SCAGLIE PLACOIDI
DENTE
SCAGLIE GANOIDI
Raggi cutanei nelle pinne
Perdita progressiva degli strati superficiali
Perdita progressiva degli strati profondi
Similsmalto
Cosmina – dentina di tipo cosmoide
Osso spugnoso
Isopedina – osso lamellare
SCUDI OSSEI E SCAGLIE COSMOIDI

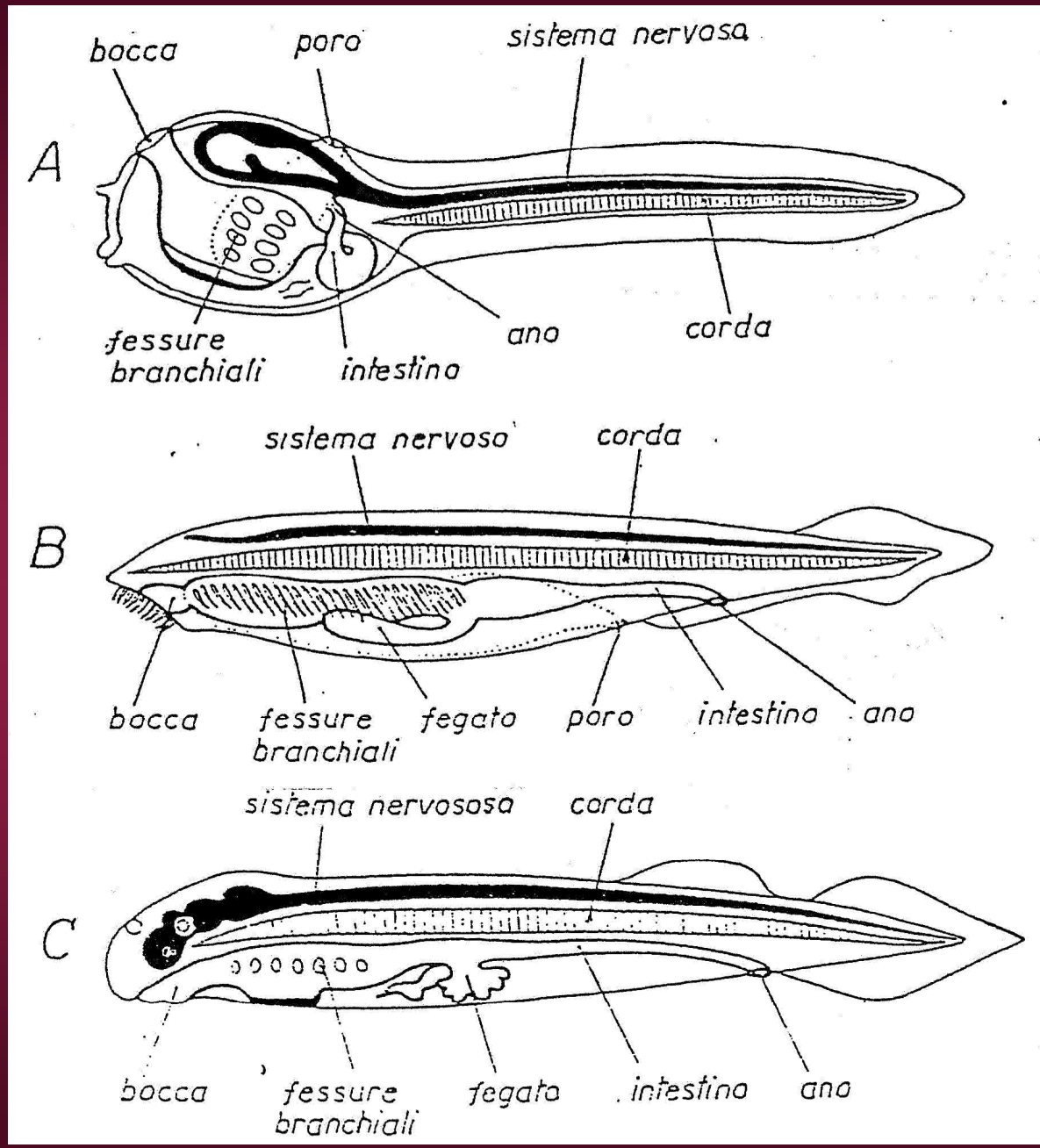
ESOSCHELETRO

-DENTELLI, ARMATURA DEL CORPO, DENTI E LEPIDOTRICHI DELLE PINNE

-TRE STRATI FONDAMENTALI: SMALTO, DENTINA, OSSO DI ATTACCO (ODONTODE) CHE SI SOVRAPPONGONO A OSSO SPUGNOSO E AD OSSO COMPATTO (CELLULARE O ACELLULARE)

- TUTTE LE COMPONENTI DELL'ESOSCHELETRO DERIVANO DALLE CELLULE DELLA CRESTA NEURALE AD ECCEZIONE DELLO SMALTO A DERIVAZIONE ECTODERMICA (AMELOBLASTI) IN SEGUITO AD INDUZIONE DA PARTE DEGLI ODONTOBLASTI (CELLULE DELLA CRESTA NEURALE)

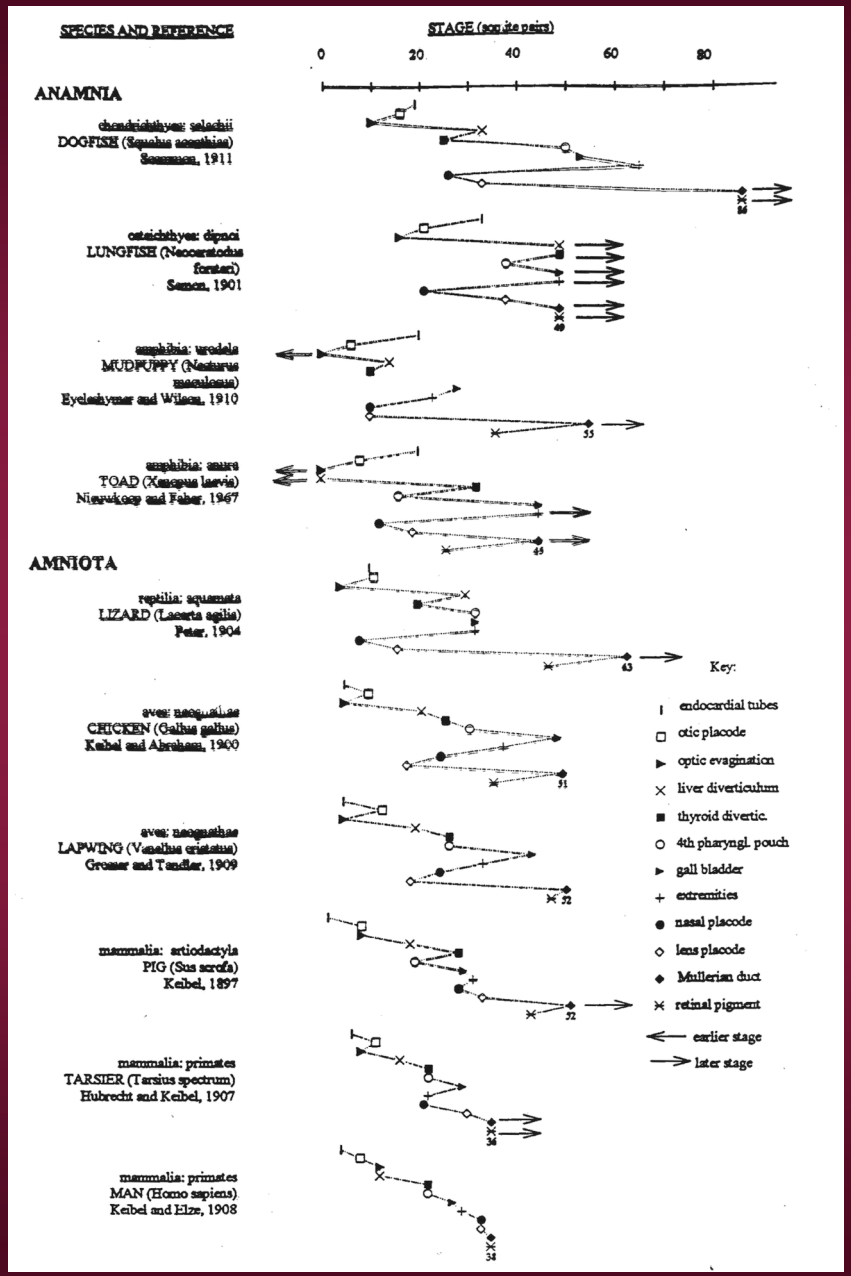

(a)
Vescicola cerebrale
Notocorda
Cordone nervoso
Miomeri segmentali a forma di V
Macchia pigmentaria
Cloaca
Endostilo
Atrioporo
Atrio
Faringe (non muscolarizzato)
"Cuore" monocamerato
Cieco
Intestino (non muscolarizzato)
(b)
Encefalo tripartito
Cordone nervoso
Miomeri segmentali a forma di W
Cranio
Notocorda
Fegato
Rene
Organi di senso craniali
Tiroide
Dotto archinefrico
Intestino (muscolarizzato)
Cuore tricamerato
Fessura branchiale
Barre branchiali (cartilaginee)
Tessuto pancreatico
Faringe (muscolarizzato)

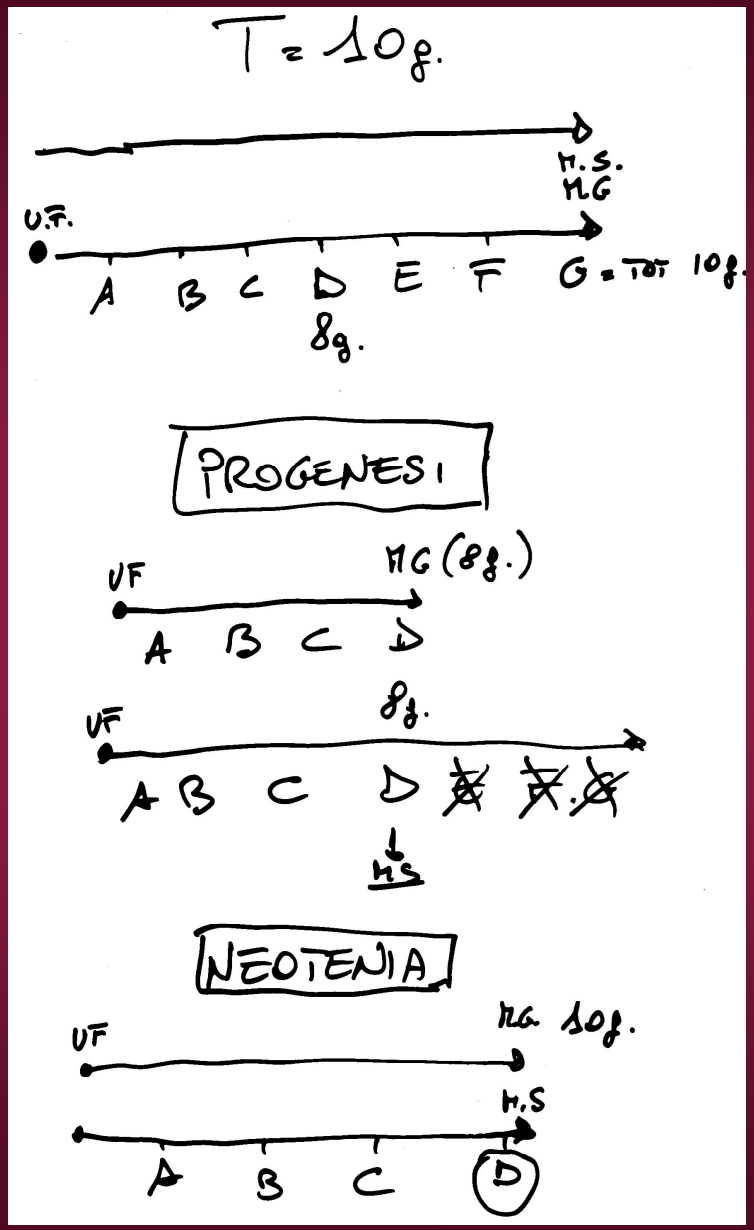

A
bocca
poro
sistema nervosa
fessure branchiali
intestino
ano
corda
B
sistema nervoso
corda
bocca
fessure branchiali
fegato
poro
intestino
ano
C
sistema nervososa
corda
bocca
fessure branchiali
fegato
intestino
ano

ETEROCRONIA

- QUALSIASI CAMBIAMENTO NELL'ORDINE RELATIVO DEGLI EVENTI IN UNA SEQUENZA DI SVILUPPO. CIOE' QUALSIASI CAMBIAMENTO NEL TEMPO RELATIVO DI COMPARSA DI UN DATO CARATTERE DURANTE L'ONTOGENESI.

- LA COMPONENTE CENTRALE E' LA COMPARAZIONE DELLA CRESCITA SOMATICA O MORFOGENESI CON L'INIZIO DELLA MATURITA' SESSUALE


SPECIES AND REFERENCE
STAGE (somite pairs)
0
20
40
60
80
ANAMNIA
chondrichthyes: selachii
DOGFISH (Squalus acanthias)
Scammon, 1911
osteichthyes: dipnoi
LUNGFISH (Neoceratodus forsteri)
Semon, 1901
amphibia: urodela
MUDPUPPY (Necturus maculosus)
Eycleshymer and Wilson, 1910
amphibia: anura
TOAD (Xenopus laevis)
Nieuwkoop and Faber, 1967
AMNIOTA
reptilia: squamata
LIZARD (Lacerta agilis)
Peter, 1904
aves: neognathae
CHICKEN (Gallus gallus)
Keibel and Abraham, 1900
aves: neognathae
LAPWING (Vanellus cristatus)
Grosser and Tandler, 1909
mammalia: artiodactyla
PIG (Sus scrofa)
Keibel, 1897
mammalia: primates
TARSIER (Tarsius spectrum)
Hubrecht and Keibel, 1907
mammalia: primates
MAN (Homo sapiens)
Keibel and Elze, 1908
Key:
endocardial tubes
otic placode
optic evagination
liver diverticulum
thyroid divertic.
4th pharyngl. pouch
gall bladder
extremities
nasal placode
lens placode
Mullerian duct
retinal pigment
earlier stage
later stage

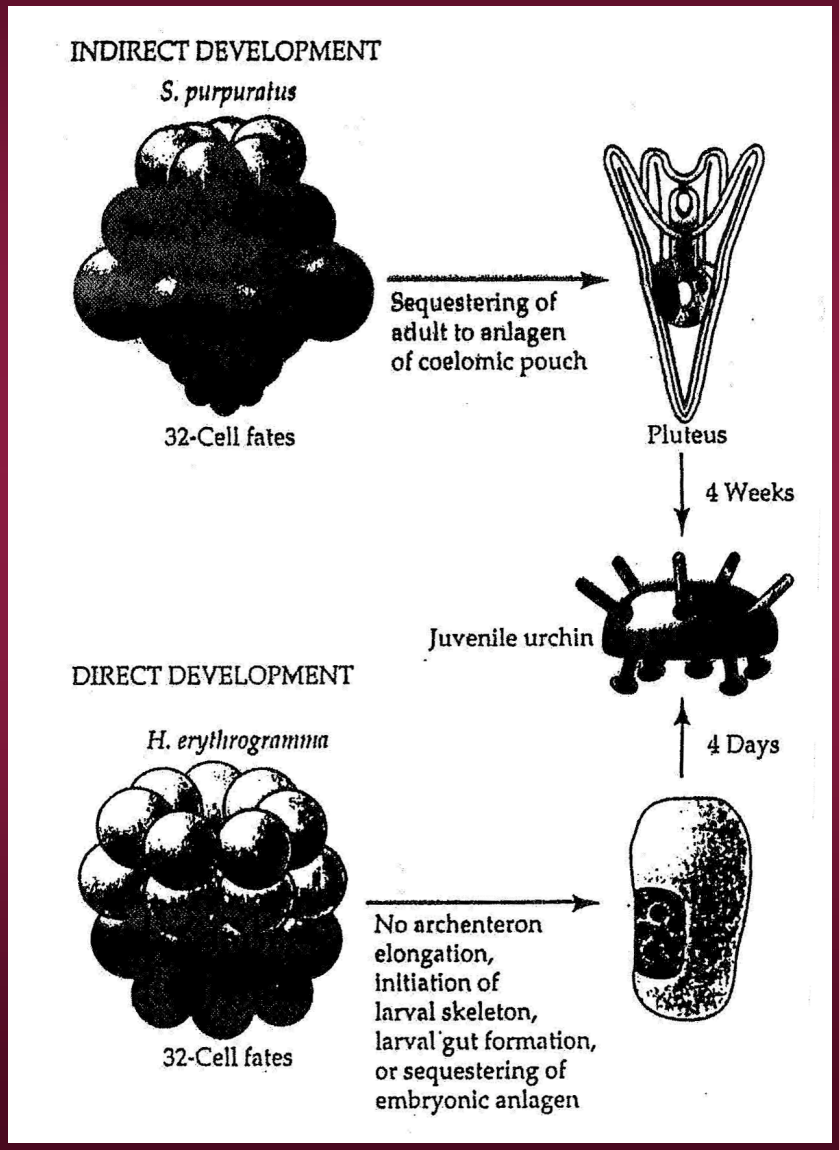

T = 10g.
M.S.
M.G
U.F.
A B C D E F G = TOT 10g.
8g.
PROGENESI
UF
MG (8g.)
A B C D
UF
8g.
A B C D
M.S
NEOTENIA
UF
MG. 10g.
M.S
A B C D

PERAMORFOSI

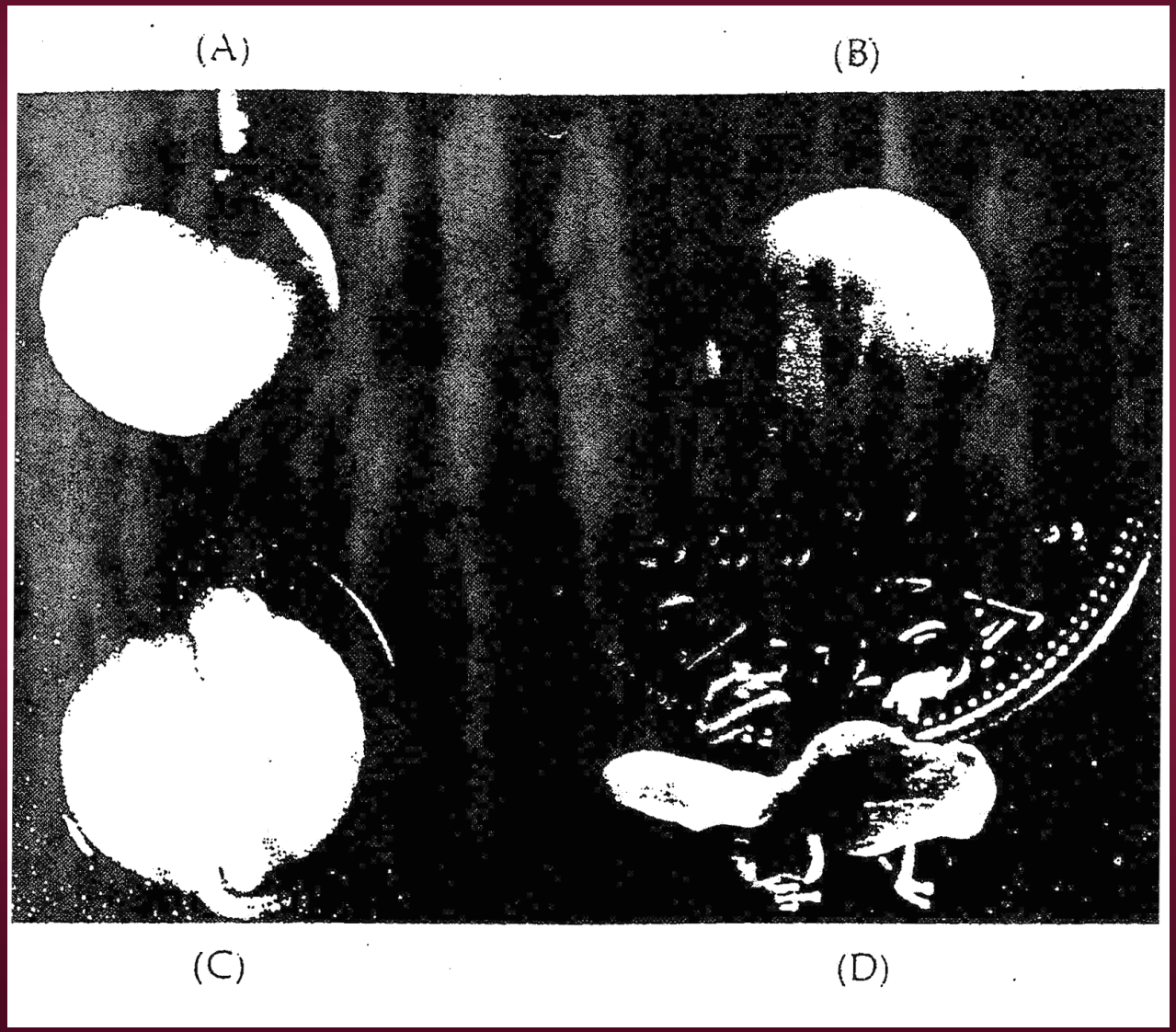
- ADULTI LA CUI MORFOLOGIA PROGREDISCE OLTRE QUELLA DEI PROPRI ANTENATI (SVILUPPO DIRETTO) TRAMITE:

1) RALLENTAMENTO DELLA MATURAZIONE DELLE GONADI
2) ACCELLERAZIONE DELLA MATURAZIONE SOMATICA

PERAMORFOSI



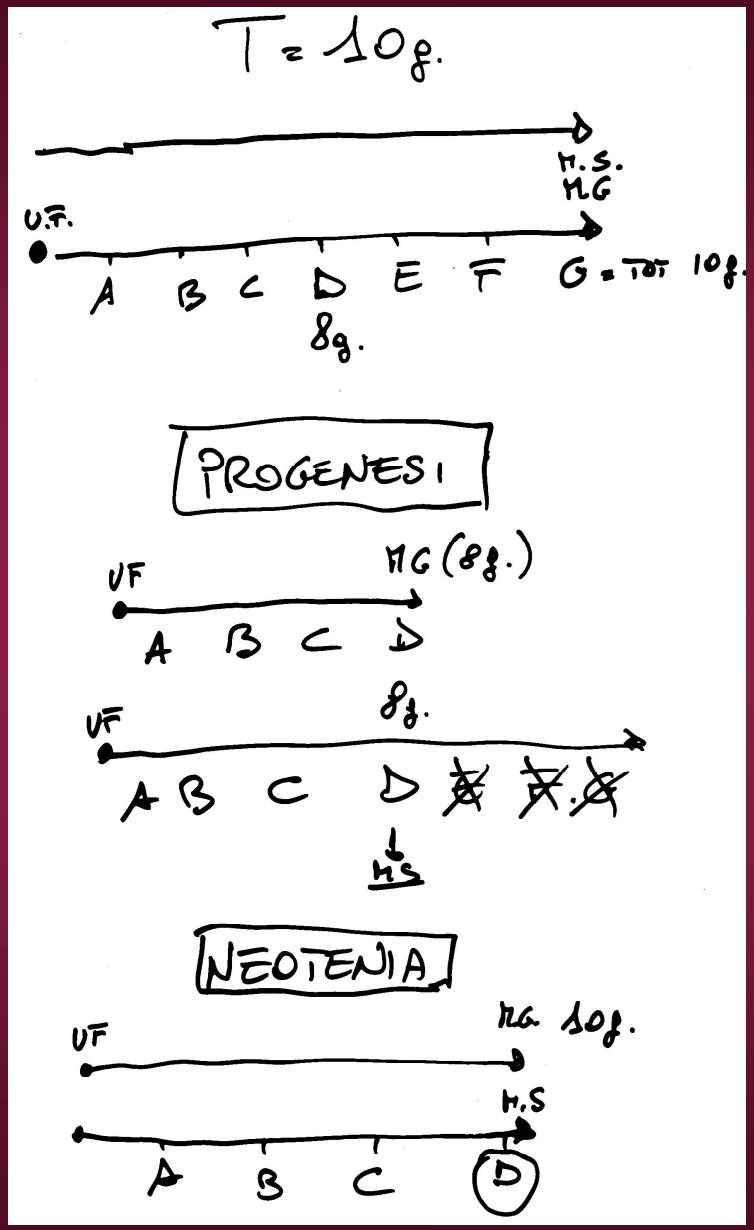
PERAMORFOSI 2

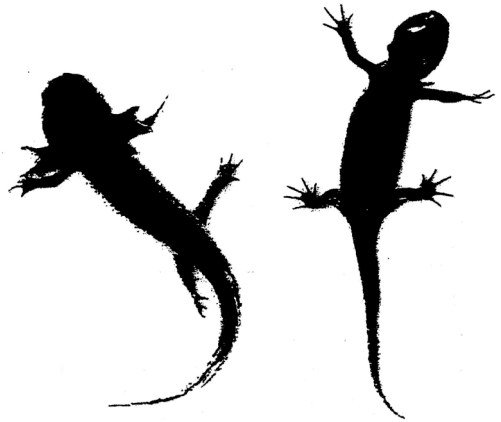


PEDOMORFOSI

- ADULTI CHE RICORDANO GLI STADI GIOVANILI DEI PROPRI ANTENATI TRAMITE:

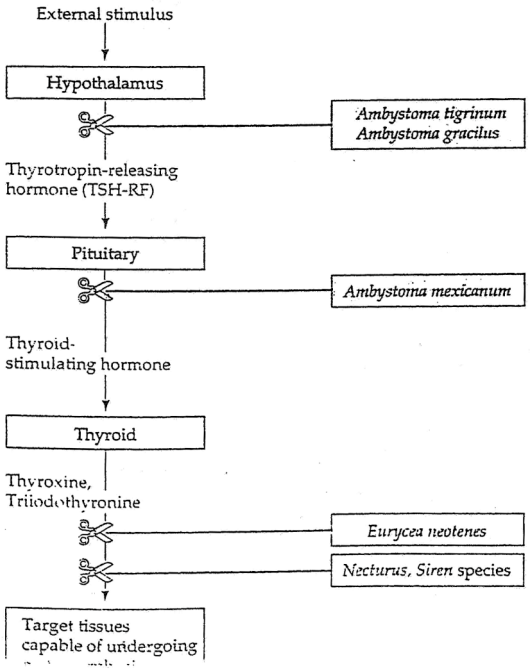
1) ACCELLERAZIONE DELLA MATURAZIONE DELLE GONADI (PROGENESI)
2) RALLENTAMENTO DELLA MATURAZIONE SOMATICA (NEOTENIA)


T = 10g.
M.S.
M.G
U.F.
A B C D E F G = TOT 10g.
8g.
PROGENESI
UF
MG (8g.)
A B C D
UF
8g.
A B C D
M.S
NEOTENIA
UF
MG. 10g.
M.S
A B C D



(A) (B)

FIGURE 20.9
Metamorphosis induced in the axolotl. (A) Normal condition of the axolotl. (B) Specimen treated with thyroxine to induce metamorphosis. (Courtesy of G. Malacinski.)



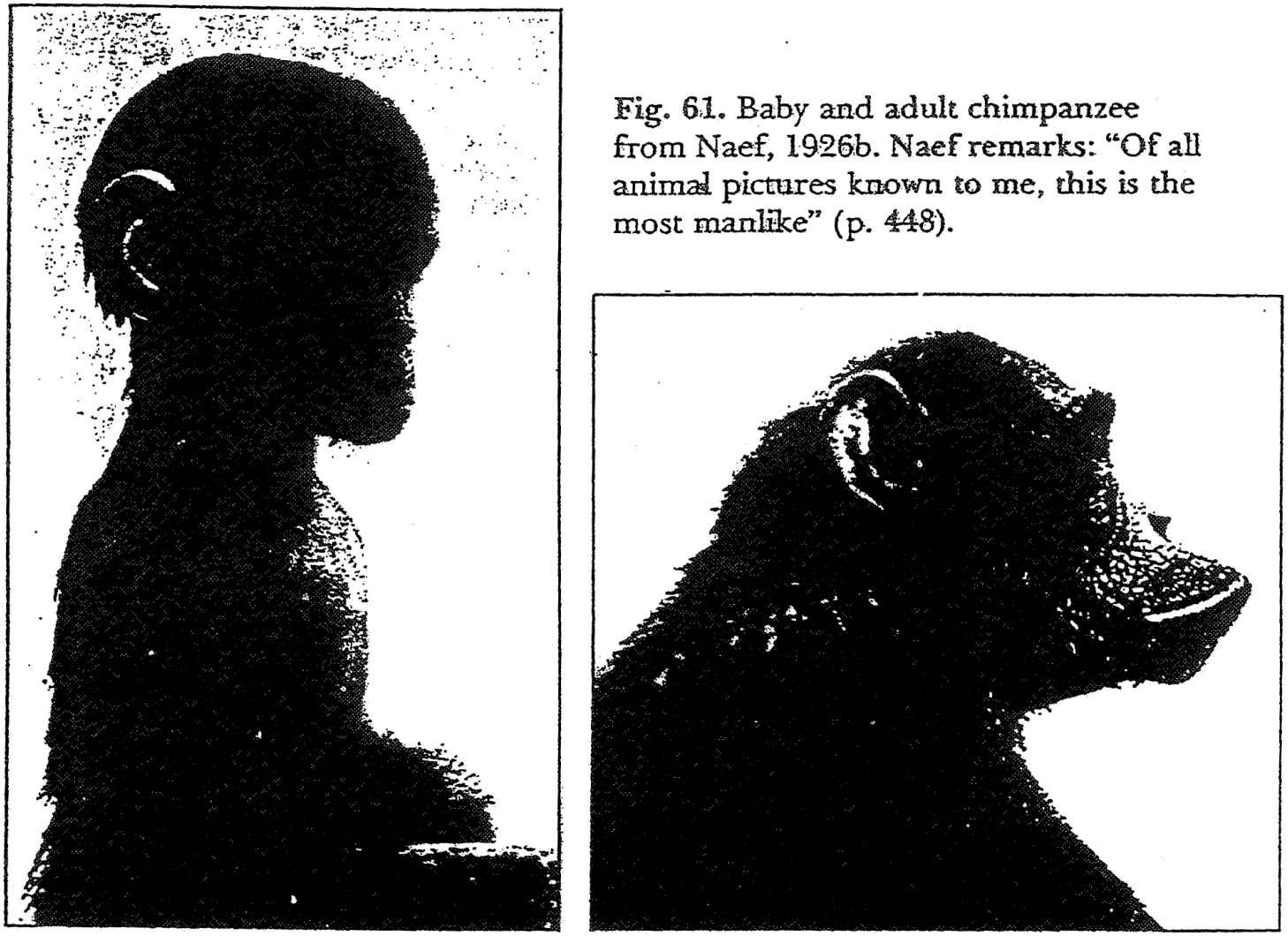
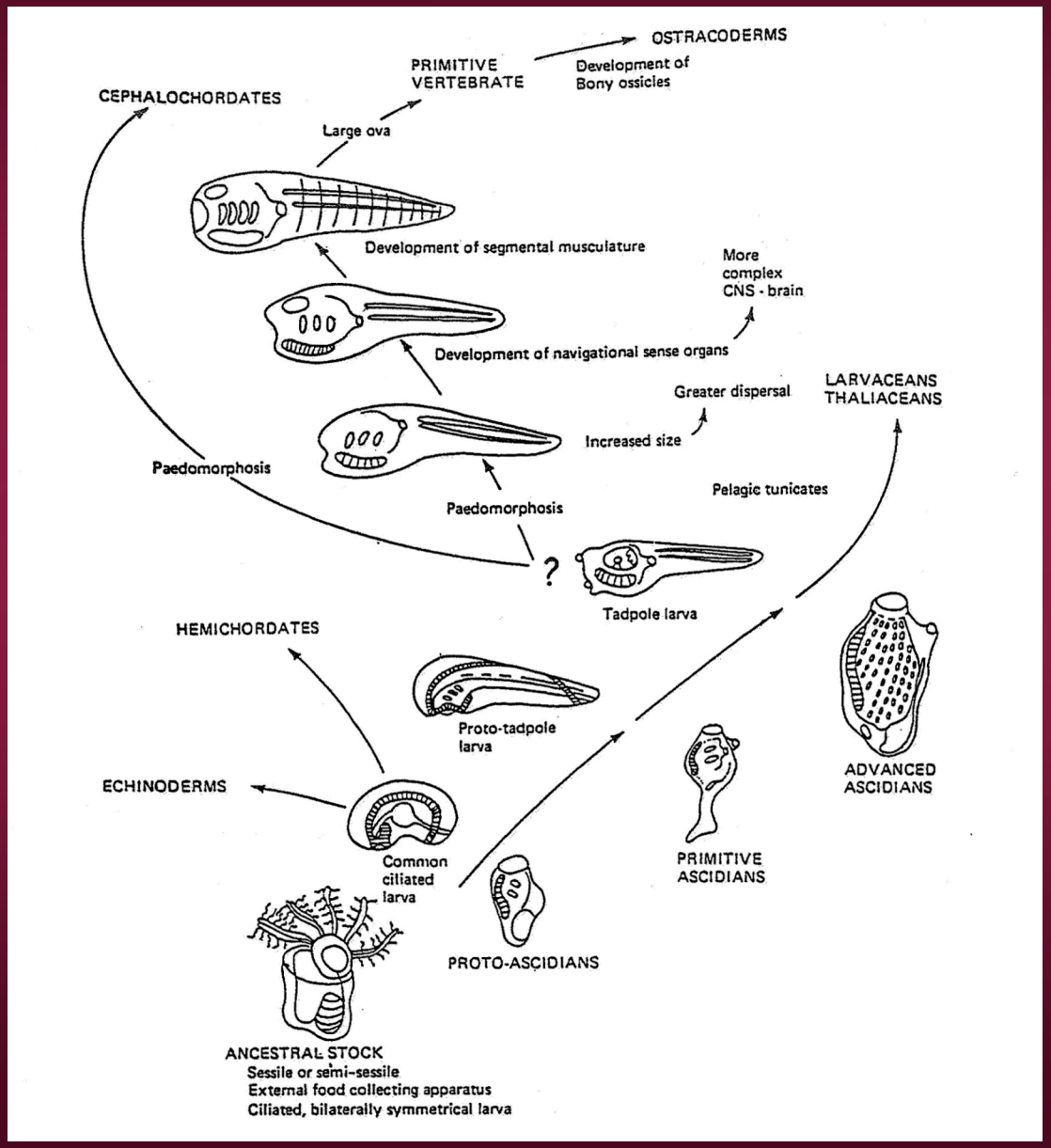
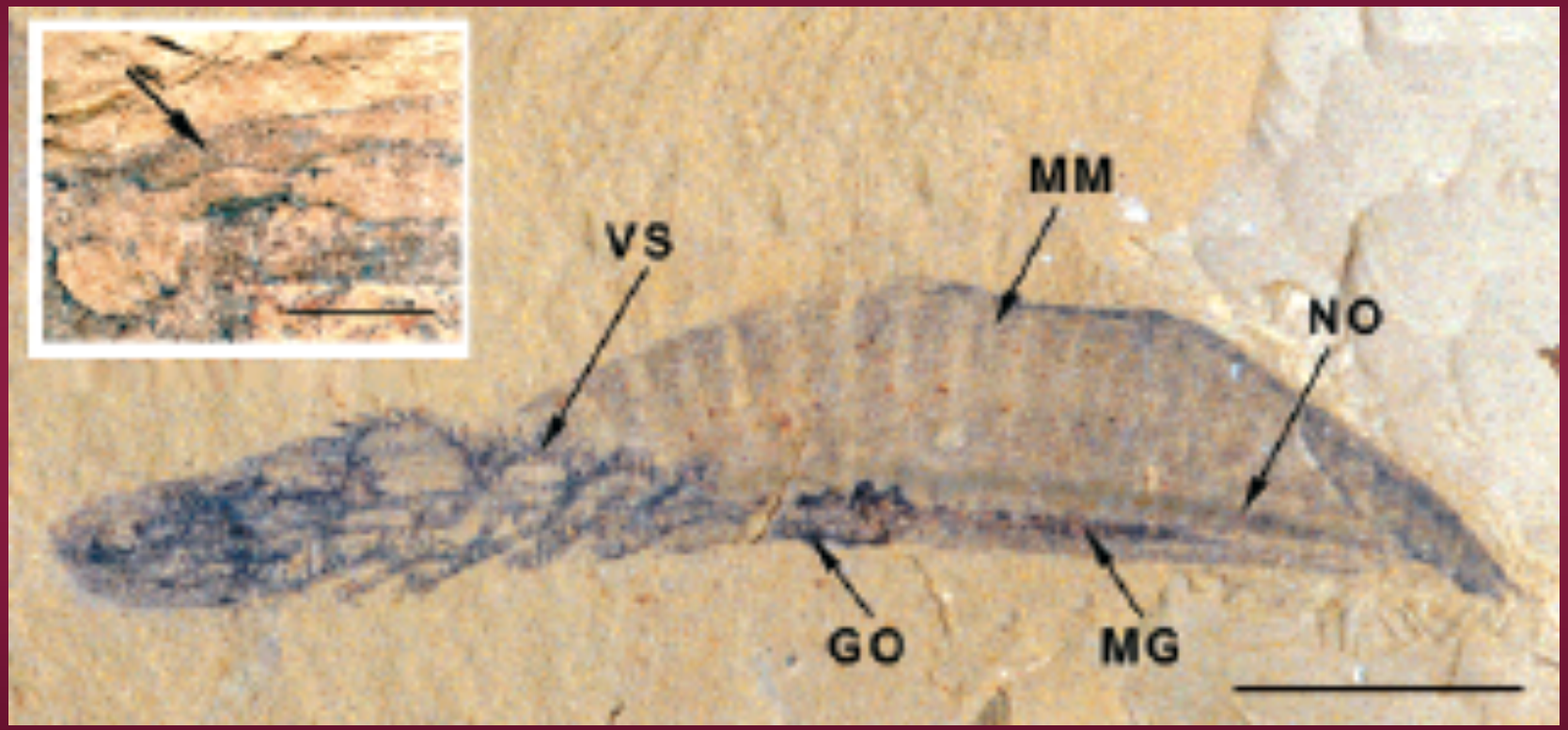


Fig. 61. Baby and adult chimpanzee from Naef, 1926b. Naef remarks: "Of all animal pictures known to me, this is the most manlike" (p. 448).

TEORIA DI GARSTANG



HAIKOUELLA: SISTER GROUP DEI VERTEBRATI



HAIKOUELLA

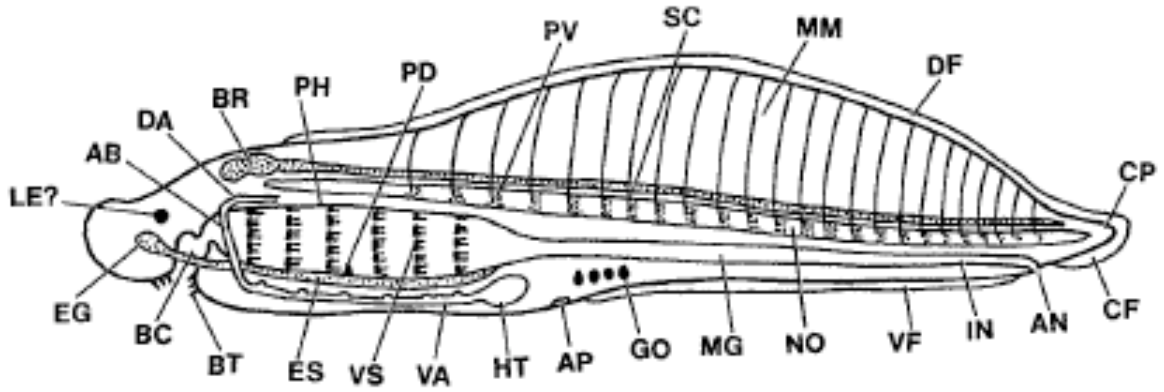
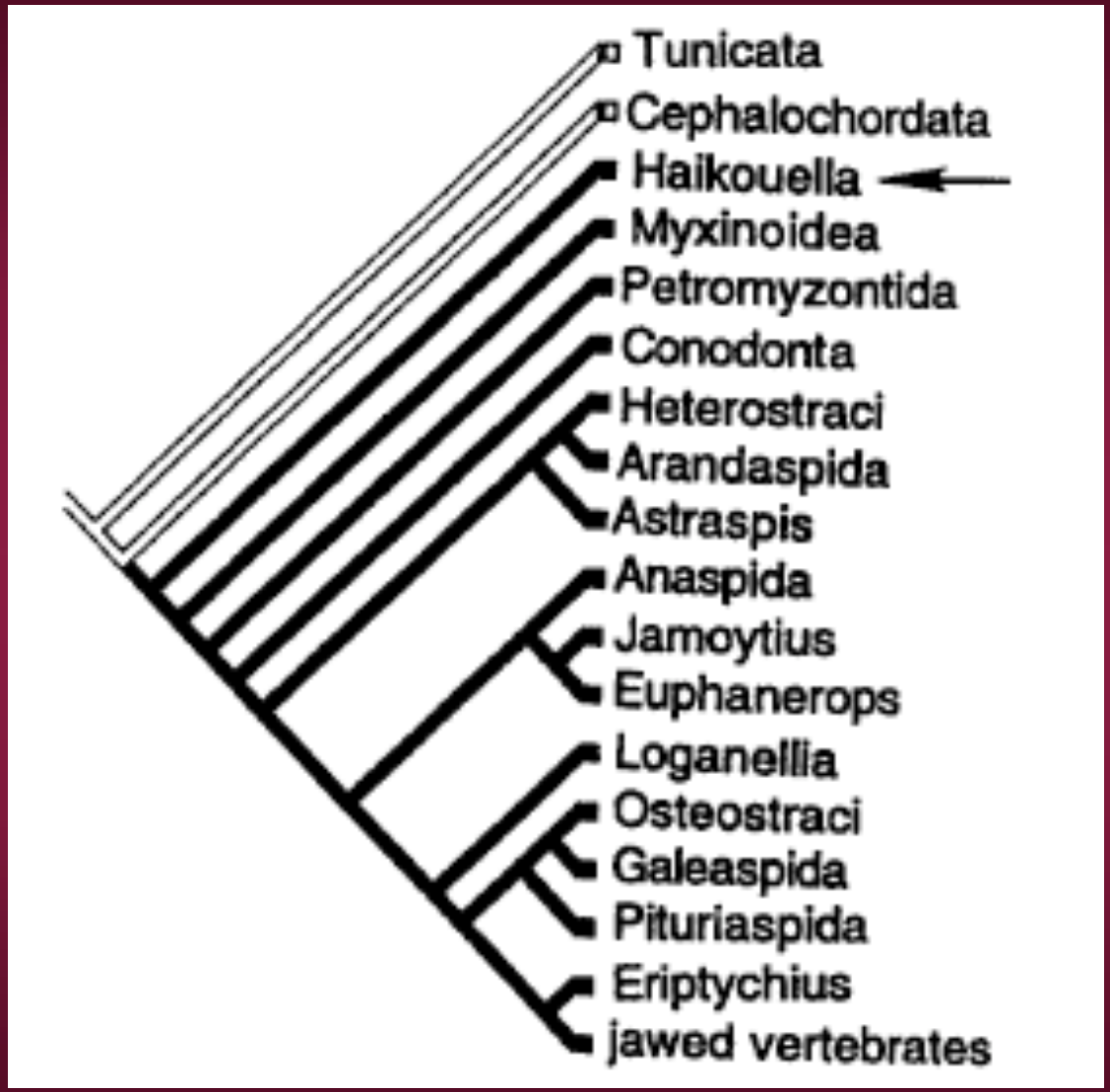
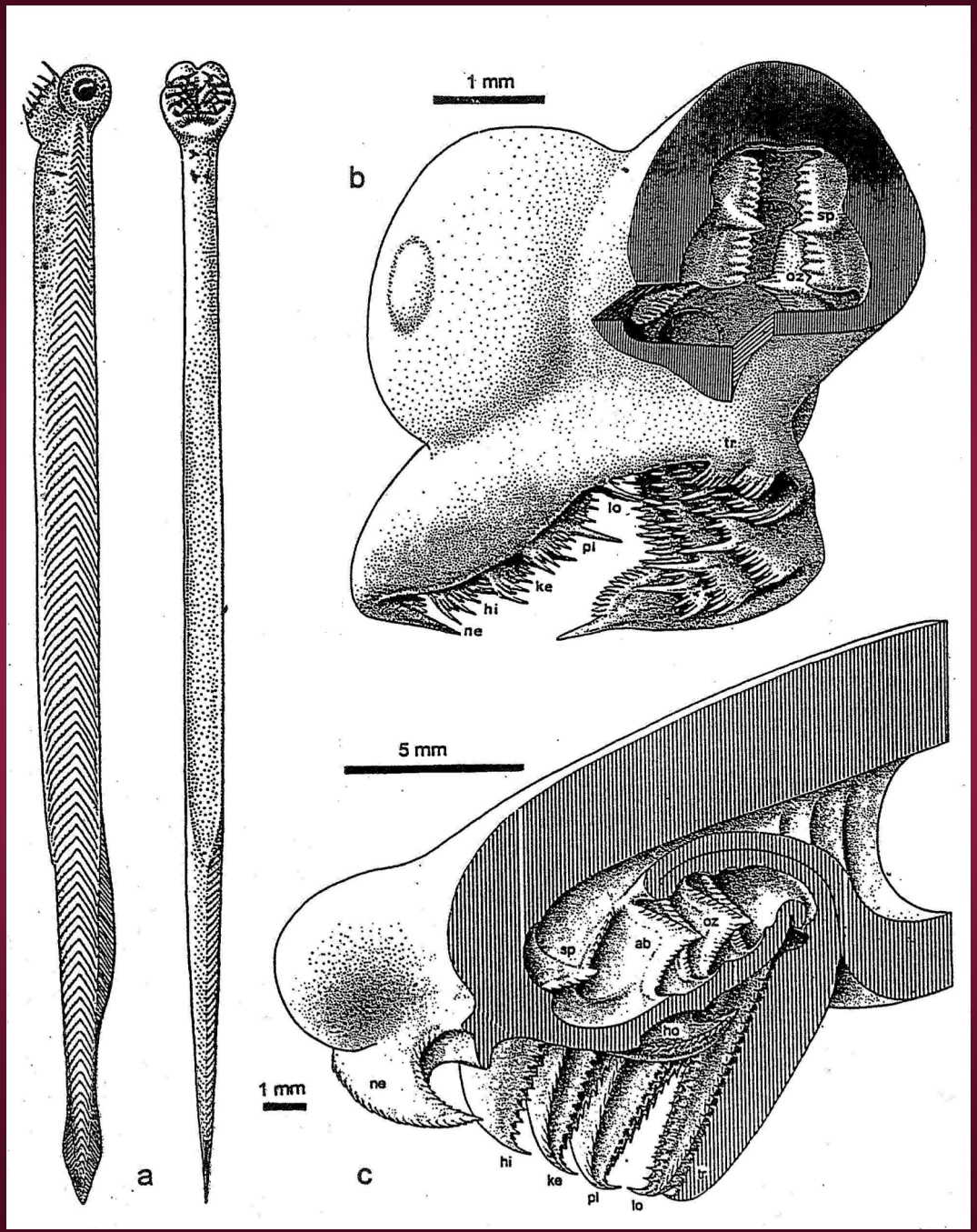


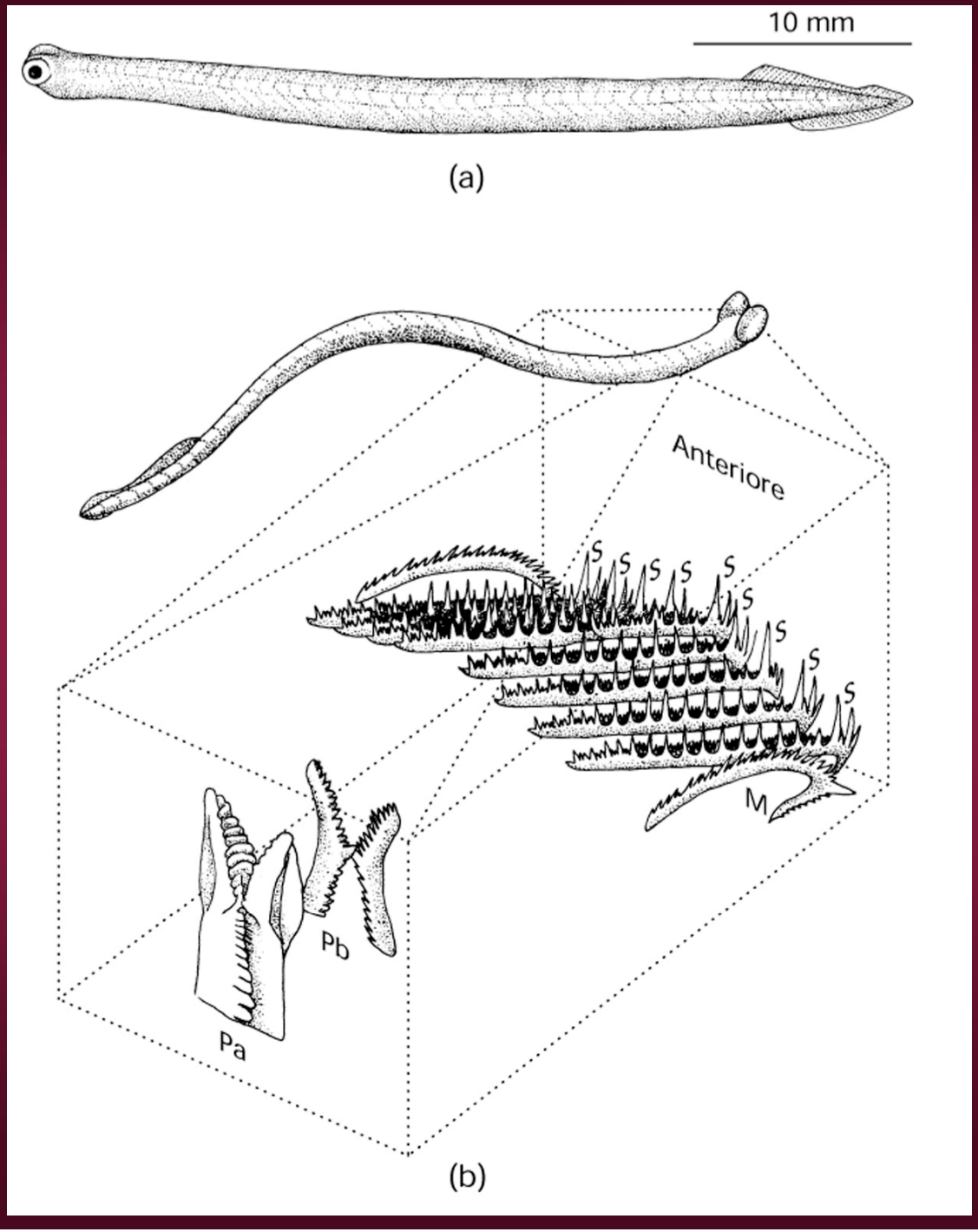
Figure 3. Diagrammatic side view of *Haikouella* (somewhat exaggerated in the dorsoventral dimension) with anterior toward the left. AB, anterior branchial vessel; AN, anus; AP, atriopore (limits of atrium not shown); BC, buccal cavity; BR, brain; BT, buccal tentacle; CF, caudal fin; CP, caudal process; DA, dorsal aorta; DF, dorsal fin; EG, endostyle gland; ES, endostyle; GO, gonad; HT, heart; IN, intestine; LE?, lateral eye?; MG, midgut; MM, myomere; NO, notochord; PD, pharyngeal denticle; PH, pharynx; PV, possible protovertebrae; SC, spinal cord; VA, ventral aorta; VF, ventral fin; VS, visceral arch skeleton. In comparison to *Haikouella*, *Yunnanozoon* differs in the following ways: the nervous and circulatory systems are not visible; there is no caudal process; the presumed buccal cavity is extended as a short flared proboscis (anterior organ) not fringed with buccal tentacles; there is an inconspicuous velum-like structure posteriorly in the buccal cavity; no anterior glands have been found associated with the endostyle; there are seven pairs of pharyngeal arch skeletons with cross banding but lacking the posterior fringe of stubs; the pharyngeal denticles are located near the posterior end of the pharynx; and there are thirteen pairs of metamerically arranged gonads.

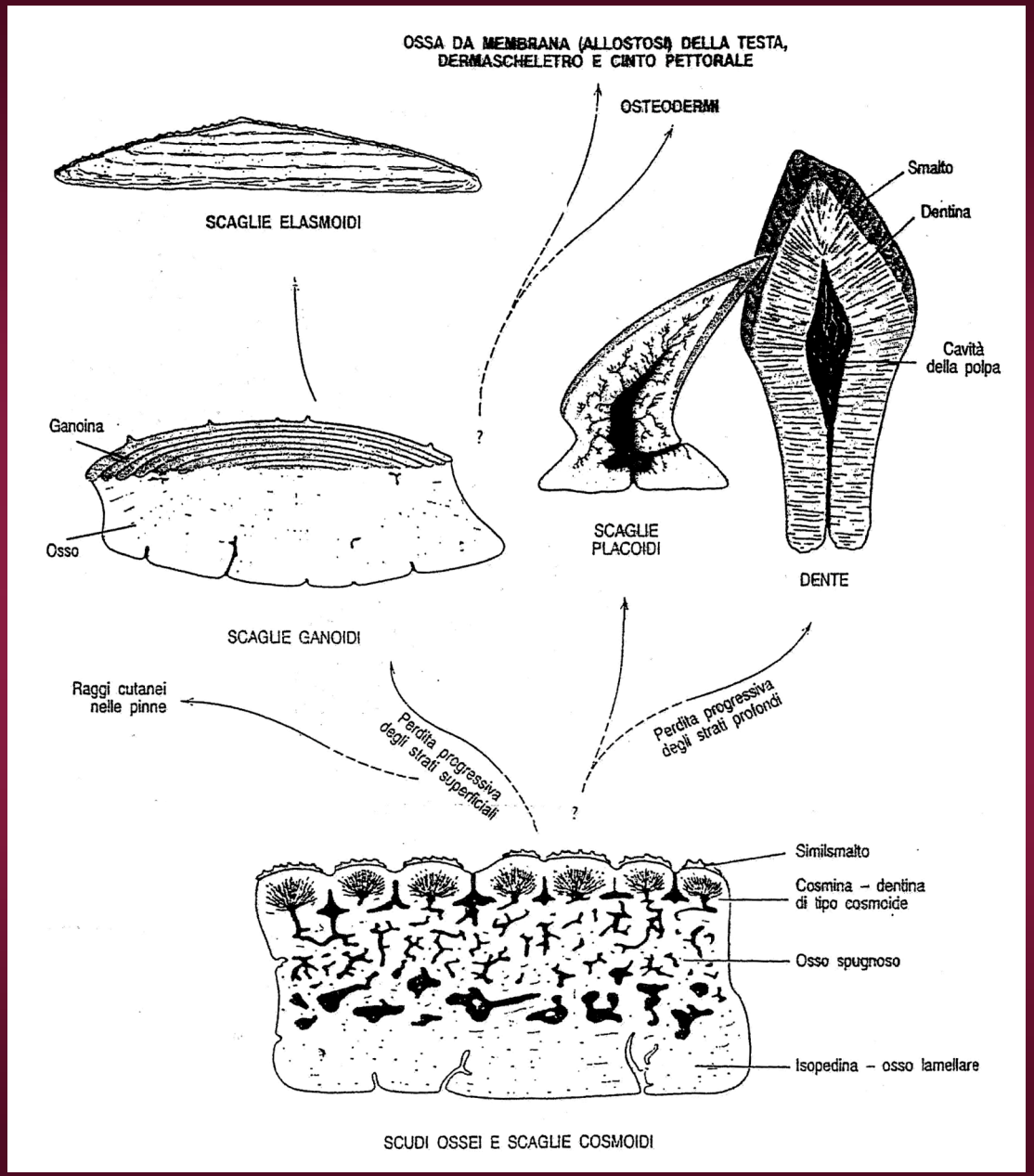

Tunicata
Cephalochordata
Haikouella
Myxinoidea
Petromyzontida
Conodonta
Heterostraci
Arandaspida
Astraspis
Anaspida
Jamoytius
Euphanerops
Loganellia
Osteostraci
Galeaspida
Pituriaspida
Eriptychius
jawed vertebrates

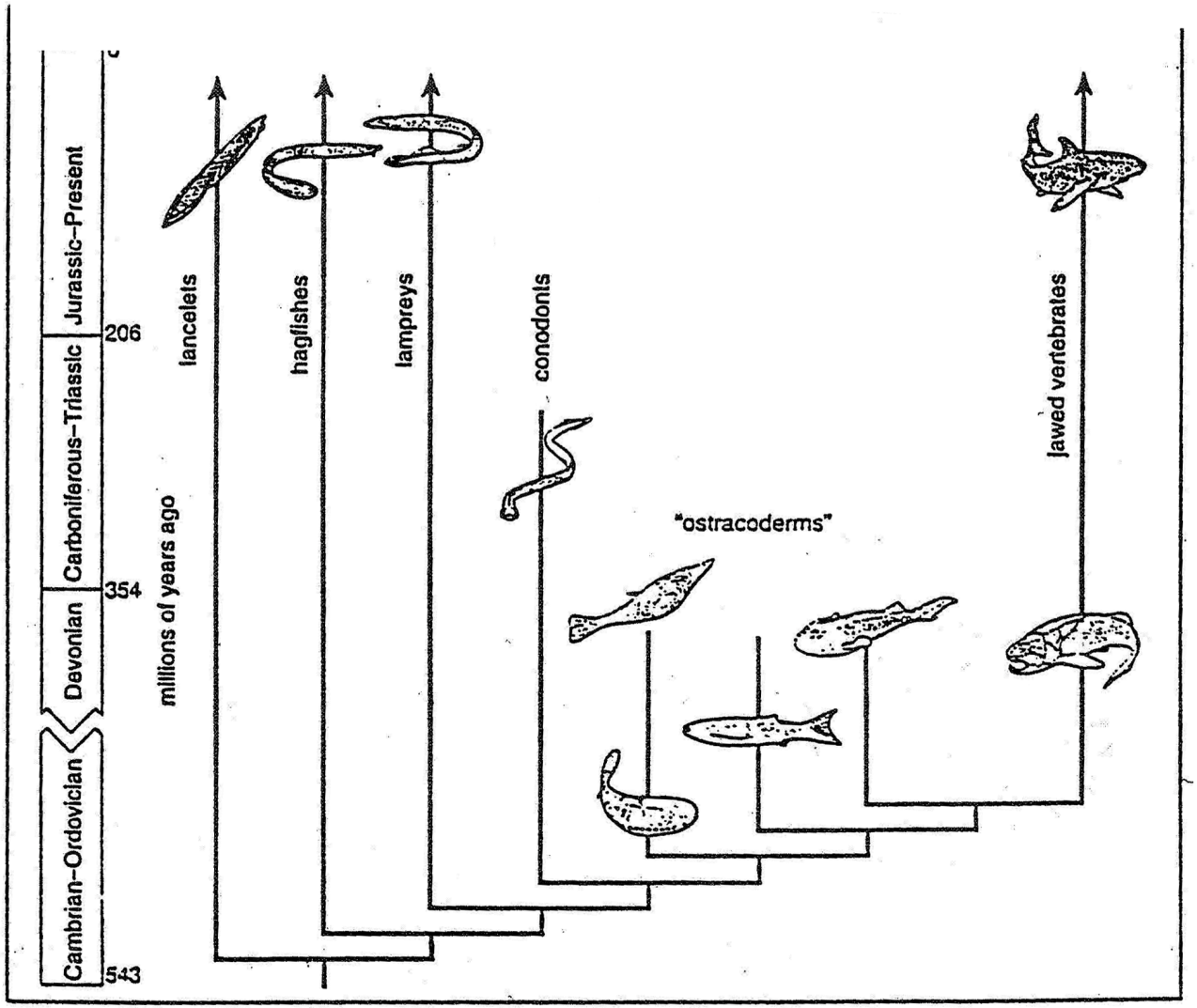
CONODONTI

- OCCHI BEN SVILUPPATI (ANELLI CARTILAGINEI)
- MIOMERI A W
- NOTOCORDA
- DENTELLI BOCCALI E FARINGEI
- ODONTODE PRIMITIVO: SMALTO, DENTINA (?) OSSO DI ATTACCO

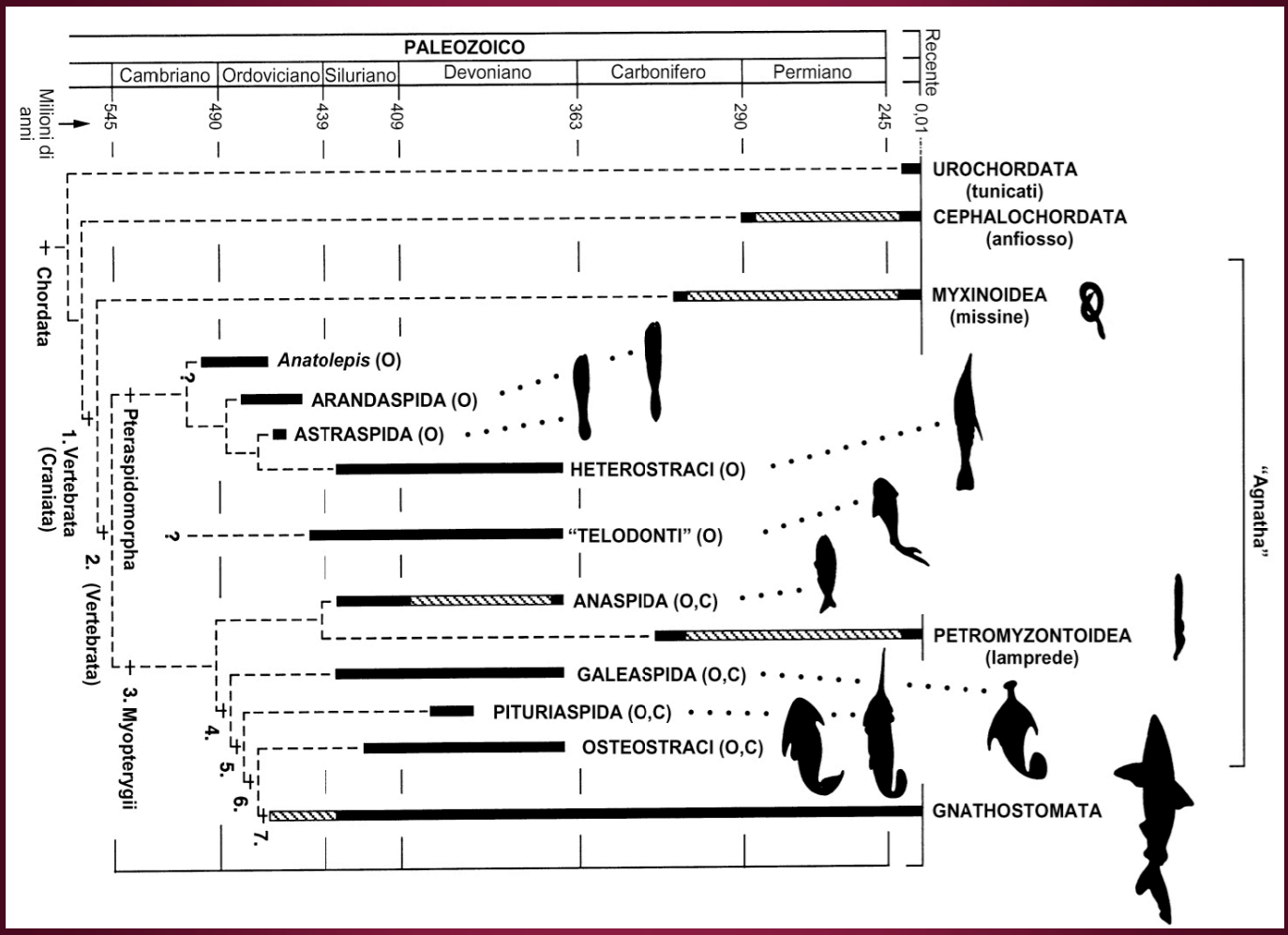

a
1 mm
b
sp
oz
tr
lo
pl
ke
hi
ne
5 mm
1 mm
c
oz
sp
ab
ho
ne
hi
ke
pl
lo
tr


10 mm
(a)
Anteriore
S
S
S
S
S
S
S
S
S
M
Pb
Pa
(b)


OSSA DA MEMBRANA (ALLOSTOSI) DELLA TESTA, DERMASCHELETRO E CINTO PETTORALE
OSTEODERMI
SCAGLIE ELASMOIDI
Smalto
Dentina
Cavità della polpa
Ganoina
Osso
SCAGLIE PLACOIDI
DENTE
SCAGLIE GANOIDI
Raggi cutanei nelle pinne
Perdita progressiva degli strati superficiali
Perdita progressiva degli strati profondi
Similsmalto
Cosmina – dentina di tipo cosmoide
Osso spugnoso
Isopedina – osso lamellare
SCUDI OSSEI E SCAGLIE COSMOIDI



Shaking the vertebrate tree. A new analysis finds conodonts to be full-fledged vertebrates, whereas hagfish are primitive members of the group.


PALEOZOICO
Cambriano
Ordoviciano
Siluriano
Devoniano
Carbonifero
Permiano
Recente
Milioni di anni
545
490
439
409
363
290
245
0,01
UROCHORDATA (tunicati)
CEPHALOCHORDATA (anfiosso)
MYXINOIDEA (missine)
Anatolepis (O)
ARANDASPIDA (O)
ASTRASPIDA (O)
HETEROSTRACI (O)
"TELODONTI" (O)
ANASPIDA (O,C)
PETROMYZONTOIDEA (lamprede)
GALEASPIDA (O,C)
PITURIASPIDA (O,C)
OSTEOSTRACI (O,C)
GNATHOSTOMATA
"Agnatha"
+ Chordata
1. Vertebrata (Craniata)
2. (Vertebrata)
3. Myoptergii
Pteraspidomorpha
4.
5.
6.
7.
?
?