Phylum Chordata

SUBPHYLUM VERTEBRATA

Metameric chordates

Linear series of cartilaginous or boney support (vertebrae) surrounding or replacing the notochord

Expanded anterior portion of nervous system

THE FISHES

SCALES & TAILS

SCALE TYPES

1. COSMOID (most primitive) First found on ostracaderm agnathans, thick & boney
   - composed of: Ganoine (enamel outer layer)
     Cosmine (thick under layer)
     Spongy bone
     Lamellar bone
   Perhaps selected for protection against eurypterids,
   but decreased flexibility

2. GANOID (primitive, still found on some living fish like gar)
3. PLACOID (old scale type found on the chondrichthyes)
   Dentine, tooth-like
4. CYCLOID (more recent scale type, found in modern osteichthyes)
5. CTENOID (most modern scale type, found in modern osteichthyes)

TAILS

HETEROCERCAL (primitive, still found on chondrichthyes)

ABBREVIATED HETEROCERCAL (found on some primitive living fish like gar)

DIPHYCERCAL (primitive, found on sarcopterygii)

HOMOCERCAL (most modern, found on most modern osteichthyes)

Agnatha (class) [connect the taxa]

Cyclostomata (order)

Placodermi (class) Acanthodii (class) Chondrichthyes (class)

Osteichthyes (class)

Actinopterygii (subclass) Sarcopterygii (subclass)

Dipnoi (order) Crossopterygii (order)

Ripidistia (suborder)

Coelacanthiformes (suborder)

Chondrostei (infra class)

Holostei (infra class)

Teleostei (infra class)

CLASS AGNATHA ("without jaws")

Most primitive - first fossils in Ordovician

Bottom feeders, dorsal/ventral flattened

Cosmoid scales (Ostracoderms)

Pair of eyes + pineal eye - present in a few living fish and reptiles - regulates circadian rhythms

Nine - seven gill pouches

No paired appendages, medial nosril

ORDER CYCLOSTOMATA (60 spp)

Last living representatives - lampreys & hagfish

Notochord not replaced by vertebrae

Cartilaginous cranium, scaleless body Sea lamprey predaceous - horny teeth in buccal cavity & on tongue - secretes anti-coaggulant

Lateral Line System

No stomach or spleen

5 - 7 year life span - adults move into freshwater streams, spawn, & die. Ammocoete larvae develop & feed in stream bottom - look and act like amphioxus. After 2 years, become adults and move to new habitat & diet.

[Early jawed fish in Silurian/Devonian Periods; latter Age of Fishes. Bewildering array of early jawed fishes]

CLASS ACANTHODII (extinct)

First to have jaws and paired fins

Jaw arises from visceral arches

Mandibular Arch (I)

Hyoid Arch (II) - gives support

Branchial Arches (III - VII)

Ganoid scales

CLASS PLACODERMI (extinct)

Heterocercal tail, heavily armored

CLASS CHONDRICHTHES (750 spp) sharks & rays

First appeared in E. Devonian - not sure if from ostracoderms or placoderms)

Cartilaginous skeleton

Jawed, Paired fins

Placoid scales - teeth derived from scales

No pineal eye, No swim bladder

Heterocercal tail, Five gill pouches

Paired nostrils

Primitive heart (2-chambered), blood to gills first

No operculum

Short GI tract (spiral valve)

Primitive Opisthonephric kidneys

Electroreception (Ampulary organs on head) & lateral line system

Internal fertilization (Oviparous & Viviparous)

Claspers on _ pelvic fin

CLASS OSTEICHTHYES (24,000 spp)

Boney skeleton

Pineal eye in primitive species

Lungs or swim bladders

Homocercal tail (Abbreviated heterocercal tail in primitive species)

Operculum

No spiral valve - GI tract is lengthened

Ganoid scales (primitive spp.)

Cycloid scales (circuli) & Ctenoid scales (most advanced)

Lateral line system

Electroreception in in primitive species

Most species Oviparous w/ external fertilization

Subclass Sarcopterygii (lobe finned fish)
Order Dipnoi (lung fish)

Order Crossopterygii
suborder Coelacanthiformes (Latimeria only living member)
suborder Rhipidistia (group begetting amphibians, long extinct)

Rhipidistian and Ichthyostega characteristics in common:

1. both with a dorsal, transverse, endocranial hinge
2. both with labrinthodont, peg-like teeth
3. both with choanae (preadaptation to breathe with mouth closed)
4. Ichthyostega had remains of opercular bones
5. rhipidistian with primitive lung/esophagous connection
6. rhipidistian with robust vertebrae (heavily ossified)
7. both had large canal for a large notochord
8. both with cosmoid scales (though only on belly of Ichthyostega)
9. rhipidistian with pectoral and pelvic girdles
10. robust limbs in rhipidistians with many bones homologous with those of Ichthyostega
11. Ichthyostega had remains of a caudal tail fin, similar to a diphycercal tail
12. both carnivorous, living in shallow freshwater habitat
13. Ichthyostega was late Devonian and contemporary with the most similar rhipidistian forms; 1-3 feet long

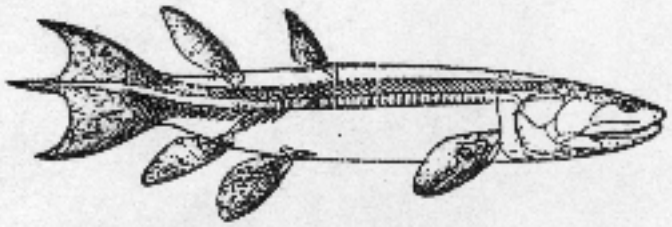

FIG. 99.—The skeleton of the Upper Devonian rhipidistian crossopterygian *Eusthenopteron*; average specimens 1 to 2 feet long. (From Gregory and Raven.)

FIG. 118.—The oldest known amphibian skeleton, *Ichthyostega* of the late Devonian, about 3 feet long. (From Jarvik.)

FIG. 117.—A, The pectoral girdle and fin of the Devonian crossopterygian *Scuirpterus* (after Gregory); B, diagrammatic representation of a tetrapod limb placed in a comparable position. Abbreviations: *h*, humerus; *r*, radius; *u*, ulna; for other abbreviations cf. Figure 111.

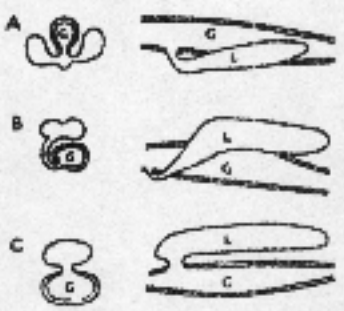

FIG. 73.—Diagram to show the development of lungs in fish and tetrapods. *Left*, Cross-sections of gut and lungs: *right*, longitudinal sections. *G*, Gut; *L*, lung. *A*, Paired ventral lungs, found in tetrapods, African and South American lungfish, and *Polypterus*; *B*, lung dorsal but duct ventral, as in Australian lungfish; *C*, single dorsal lung—air bladder—with dorsal duct, as in most actinopterygians.

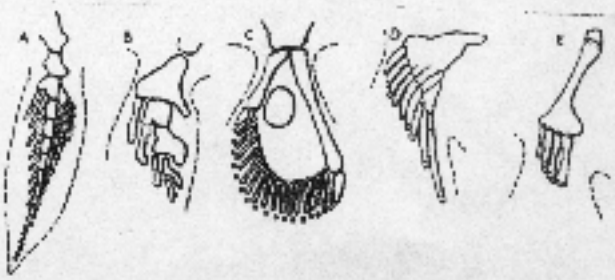

FIG. 72.—The paired fins of bony fishes. Pectoral fins of: *A*, *Epiceratodus*, a modern lungfish; *B*, *Eusthenopteron*, an Upper Devonian crossopterygian; *C*, *Polypterus*, a modern relative of the palaeoniscoids. Pelvic fins of: *D*, the sturgeon, *Scaphirhynchus*; *E*, *Polypterus*. (Mainly after Goodrich.)