

Comparative Anatomy & Evolution of Vertebrates



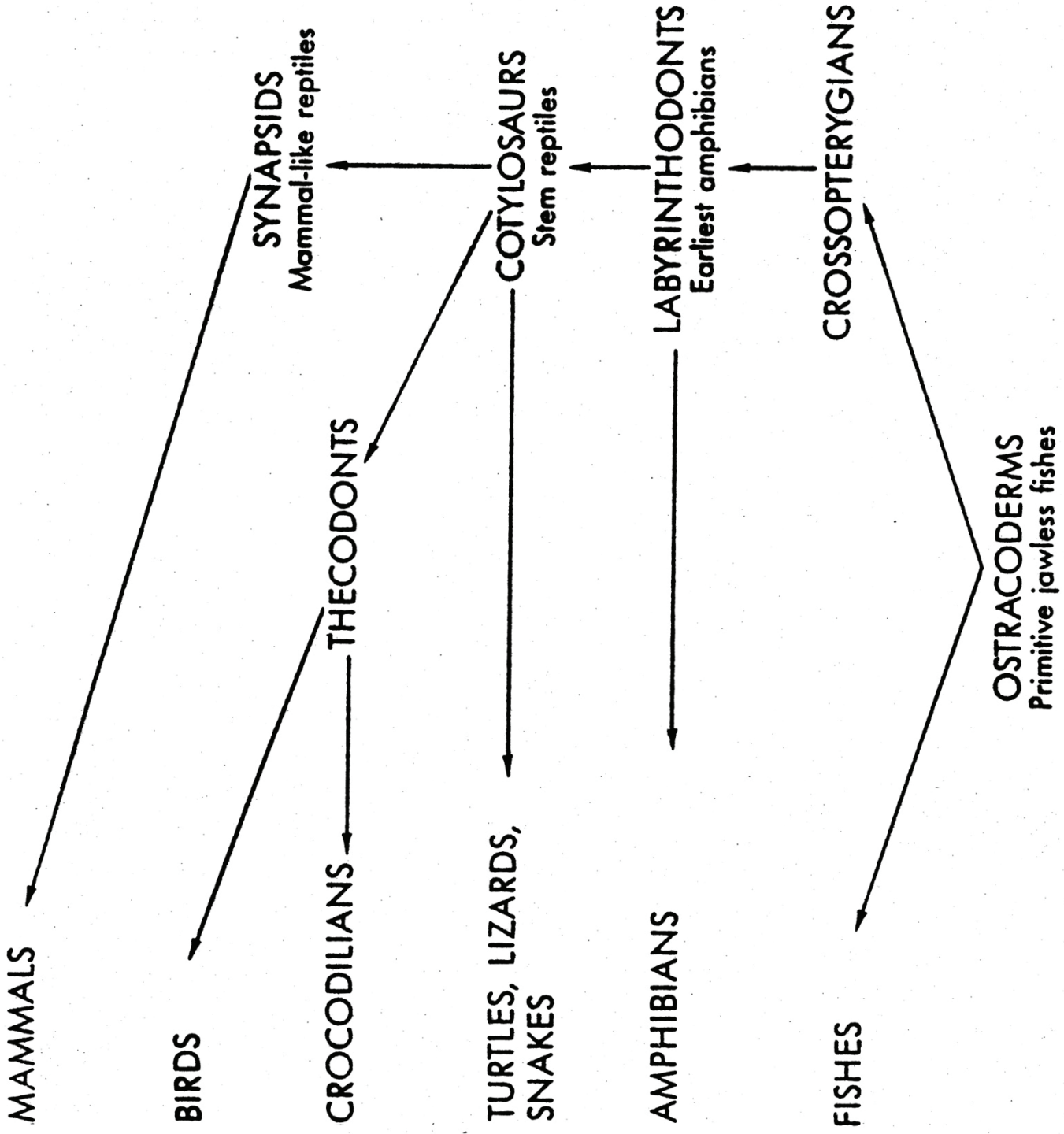


FIGURE 43. General Evolutionary Trends of the Vertebrates.

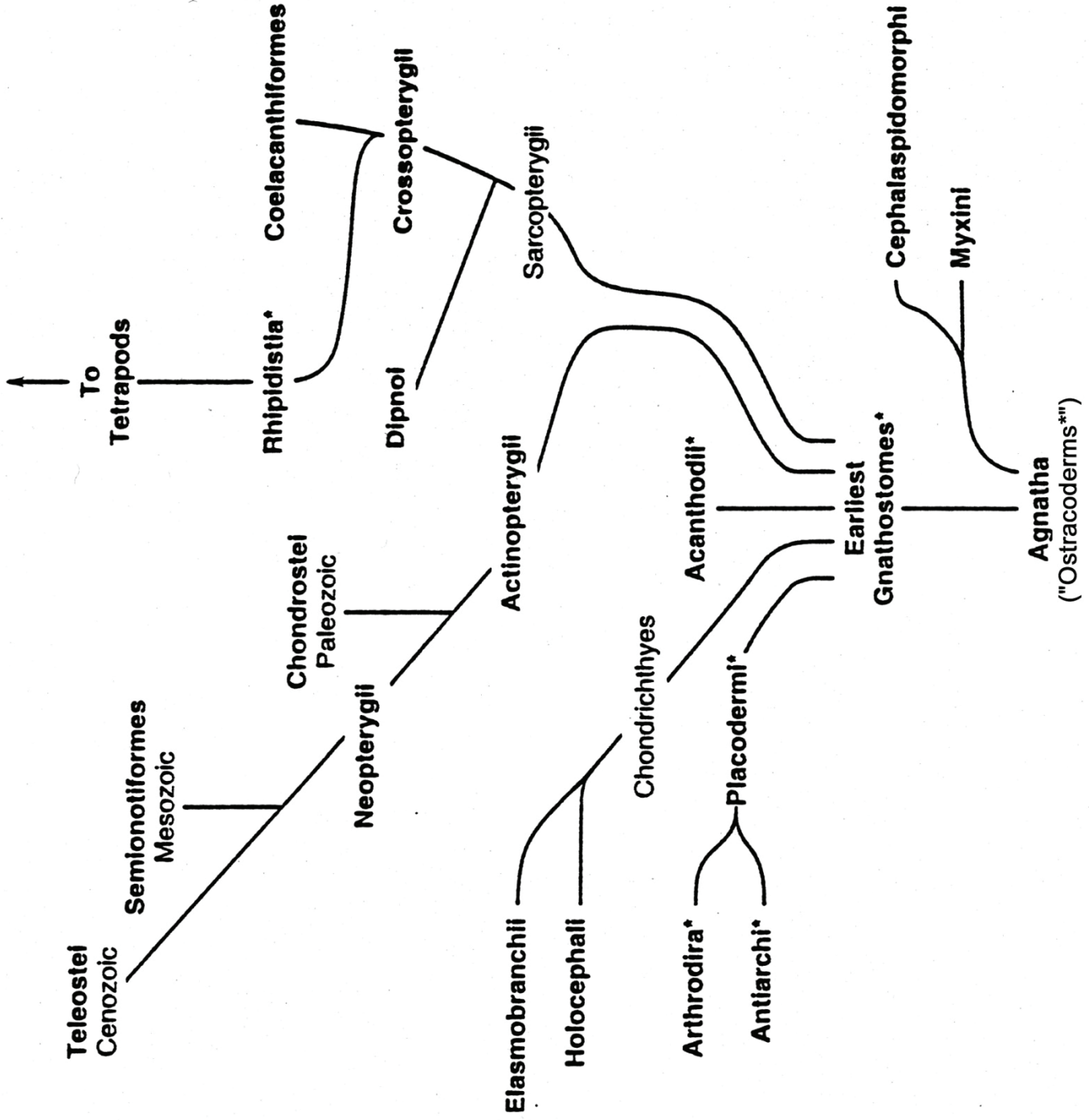


FIGURE 44. Ancestral Lineage of the Fishes. Extinct groups are marked by an asterisk.

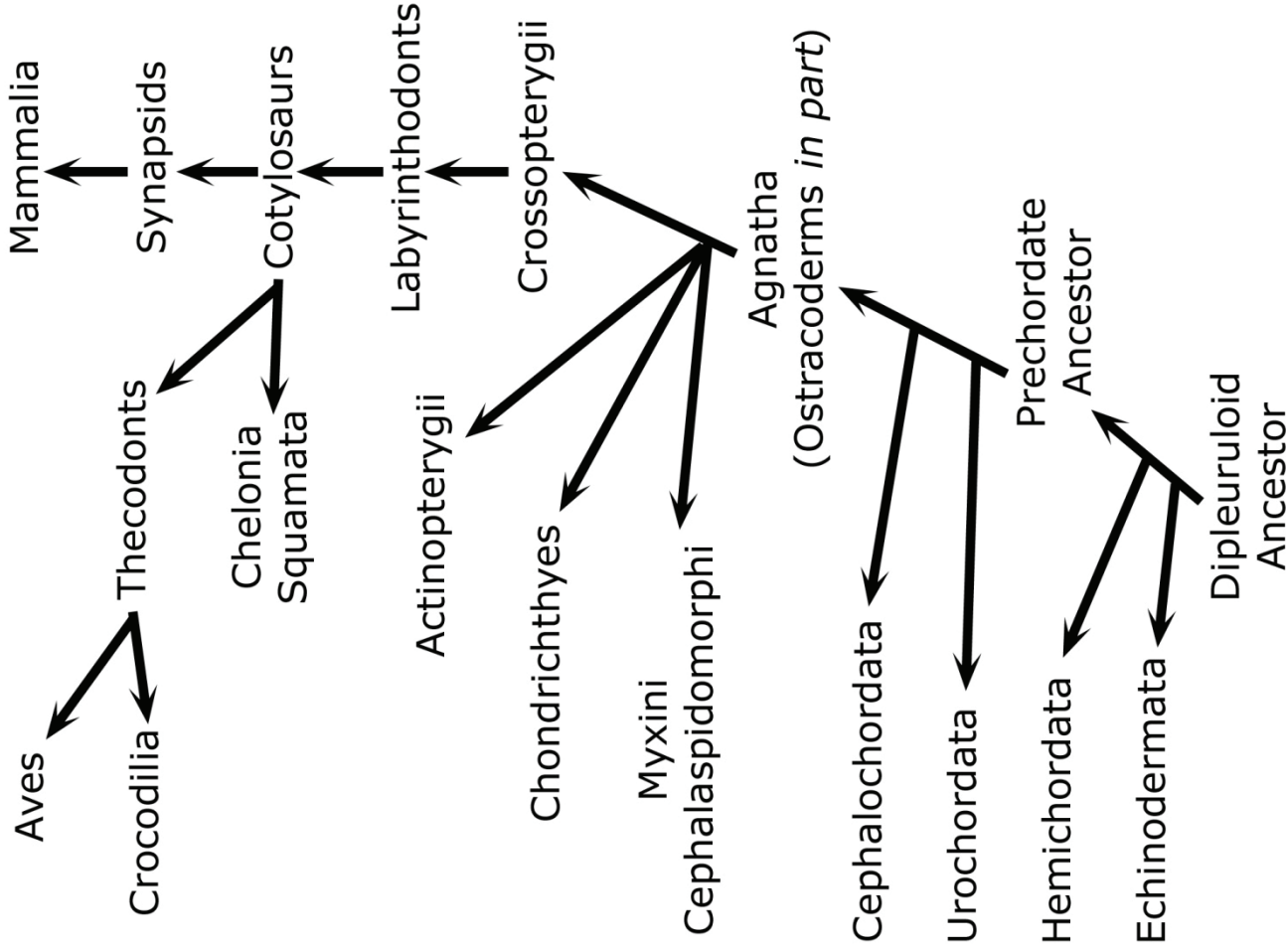


FIGURE 45. General trends in chordate evolution. Based on the dipleuruloid rise of the chordata. Several related non-chordate groups are included for reference.

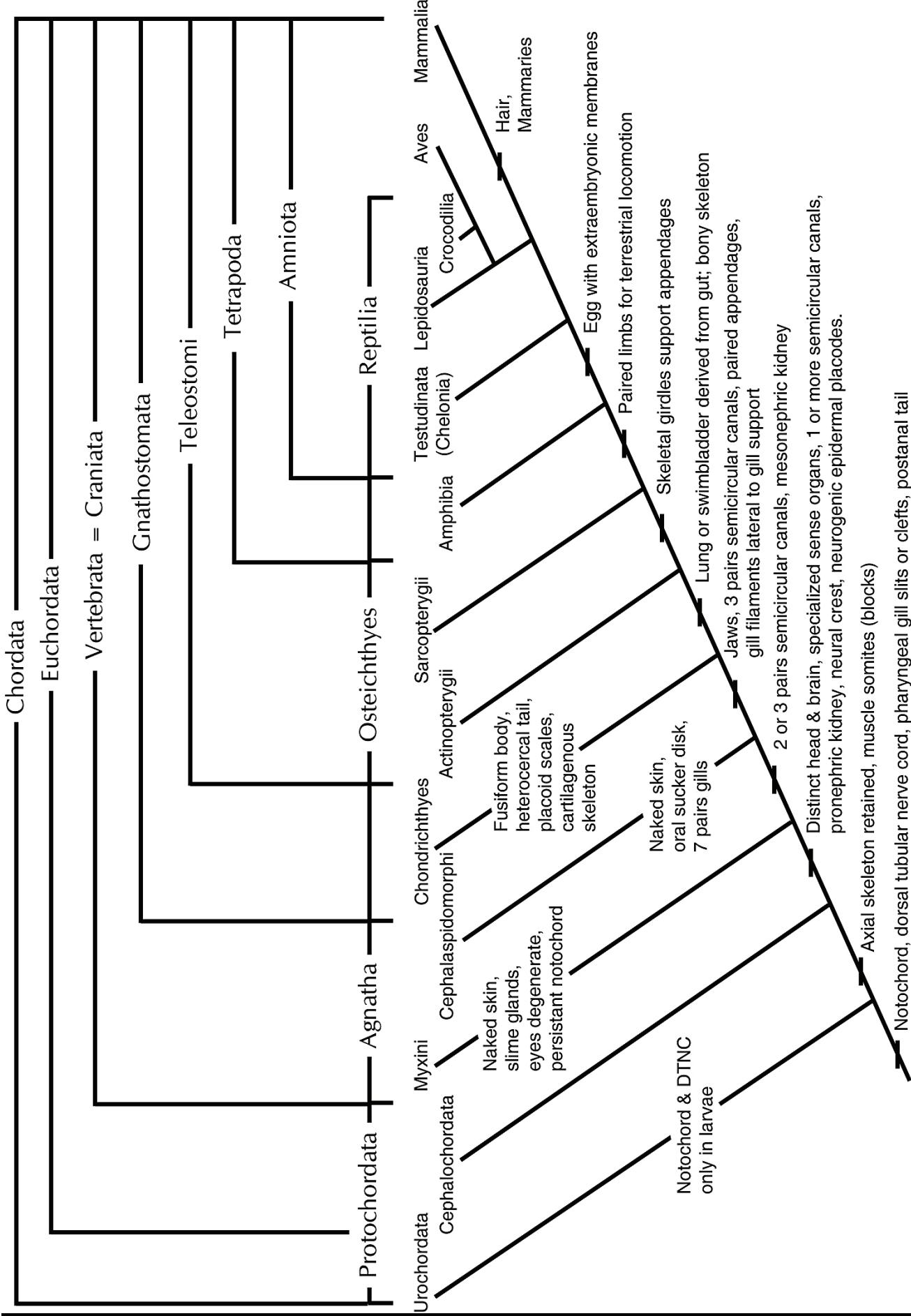


FIGURE 46. Cladogram of the living vertebrates. Functional group arrangements are depicted above the cladogram.

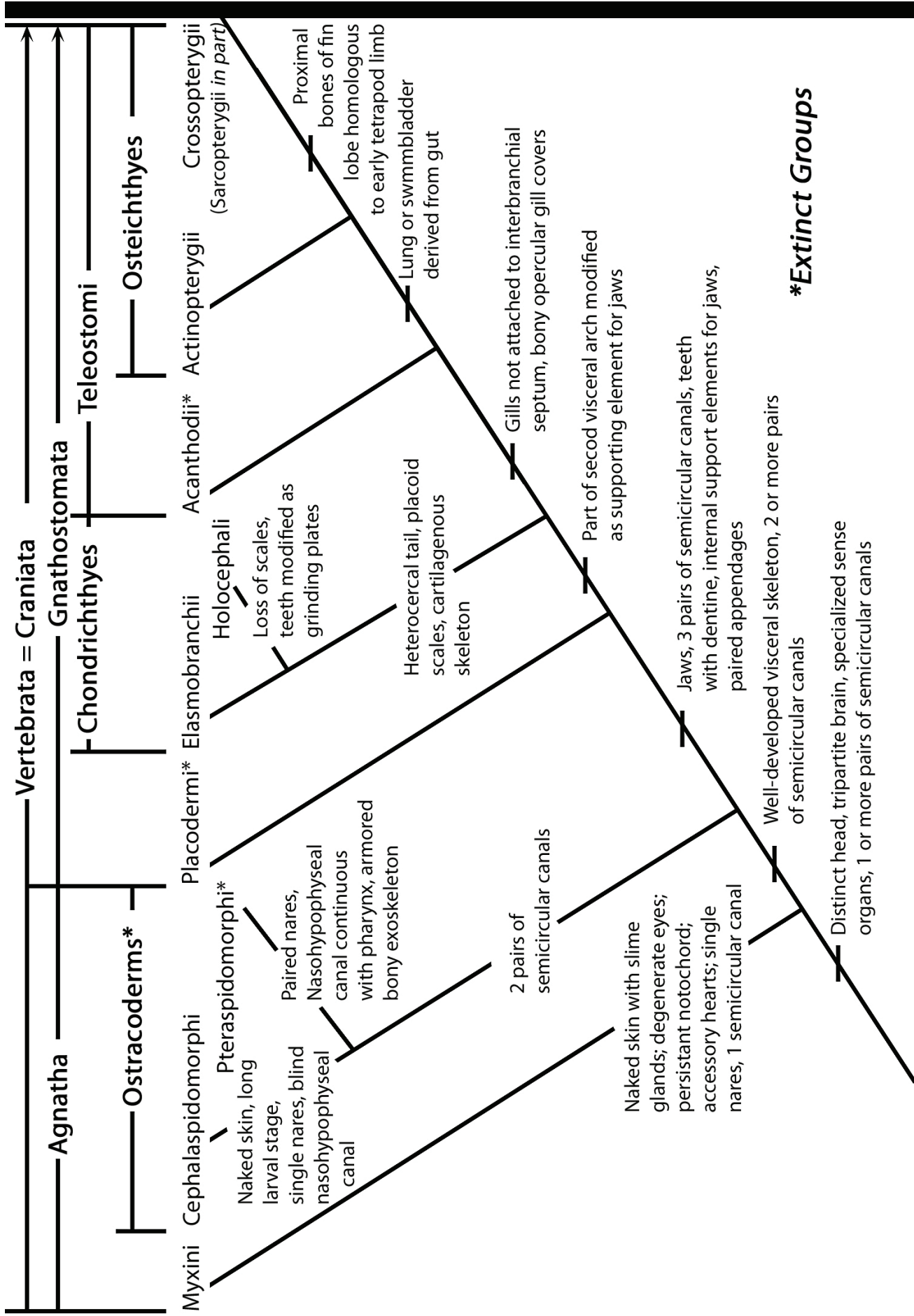
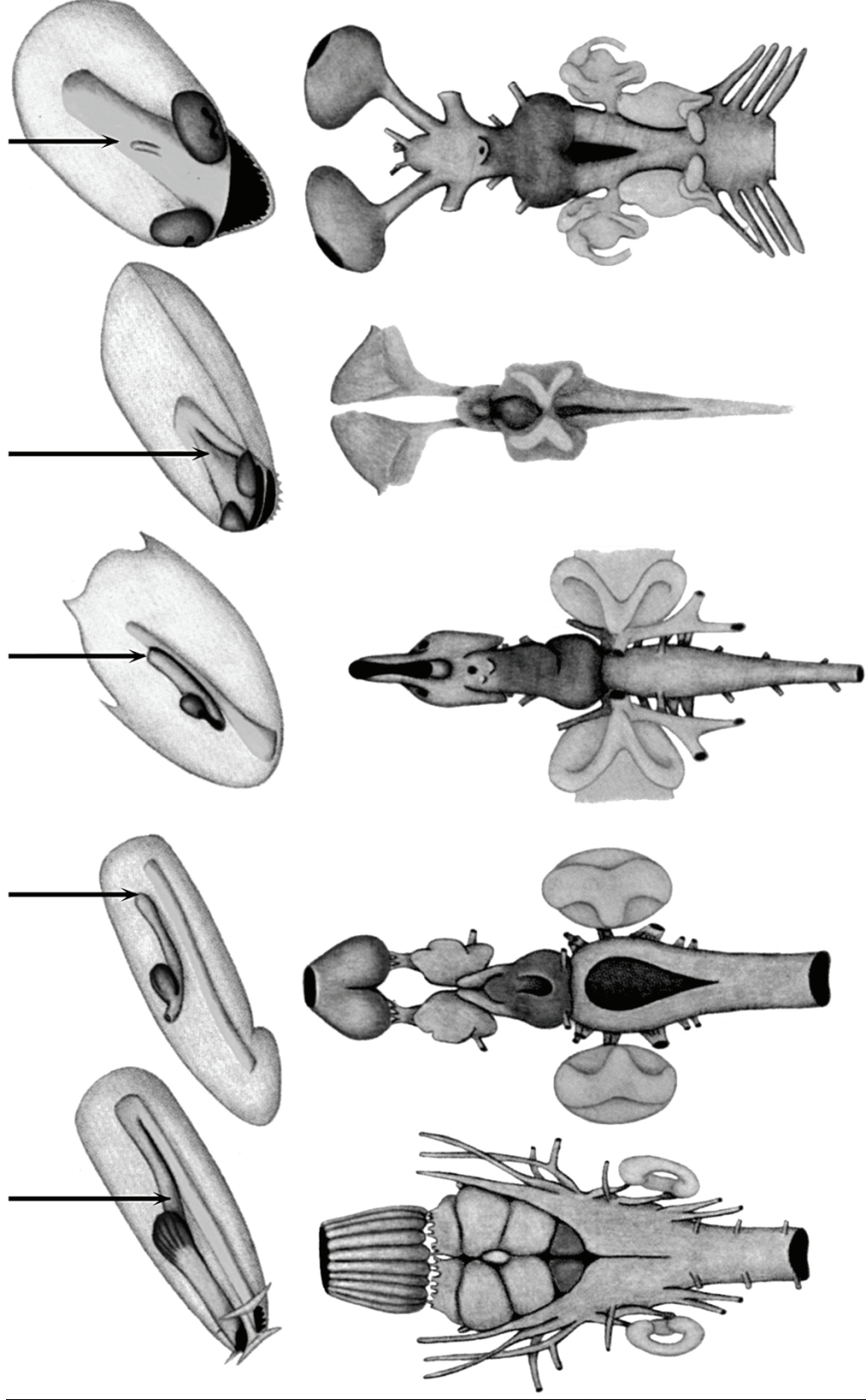


FIGURE 47. Cladogram of the Fishes. Functional group arrangements are depicted above the cladogram. The ostracoderms are extinct and include extinct members of the Cephalaspidomorphi.



Hagfish Lamprey Osteostracan Heterostracan Primitive Gnathostome

FIGURE 48. Comparative reconstructions of internal head structures of living and fossil vertebrates. Top row: Relationship of nasal sacs, related ducts, and hypophysis or pineal gland (arrow). In lampreys and osteostracans the nasohypophyseal ducts end as blind sacs while in some other groups they are directly connected to the pharynx. The anterior prenasal sinus is apparently the pleisiomorphic state for vertebrates. **Bottom row:** Brains of primitive vertebrates show increasing complexity of the cerebellum and certain sensory structures such as the nasal capsule and the semicircular canals.

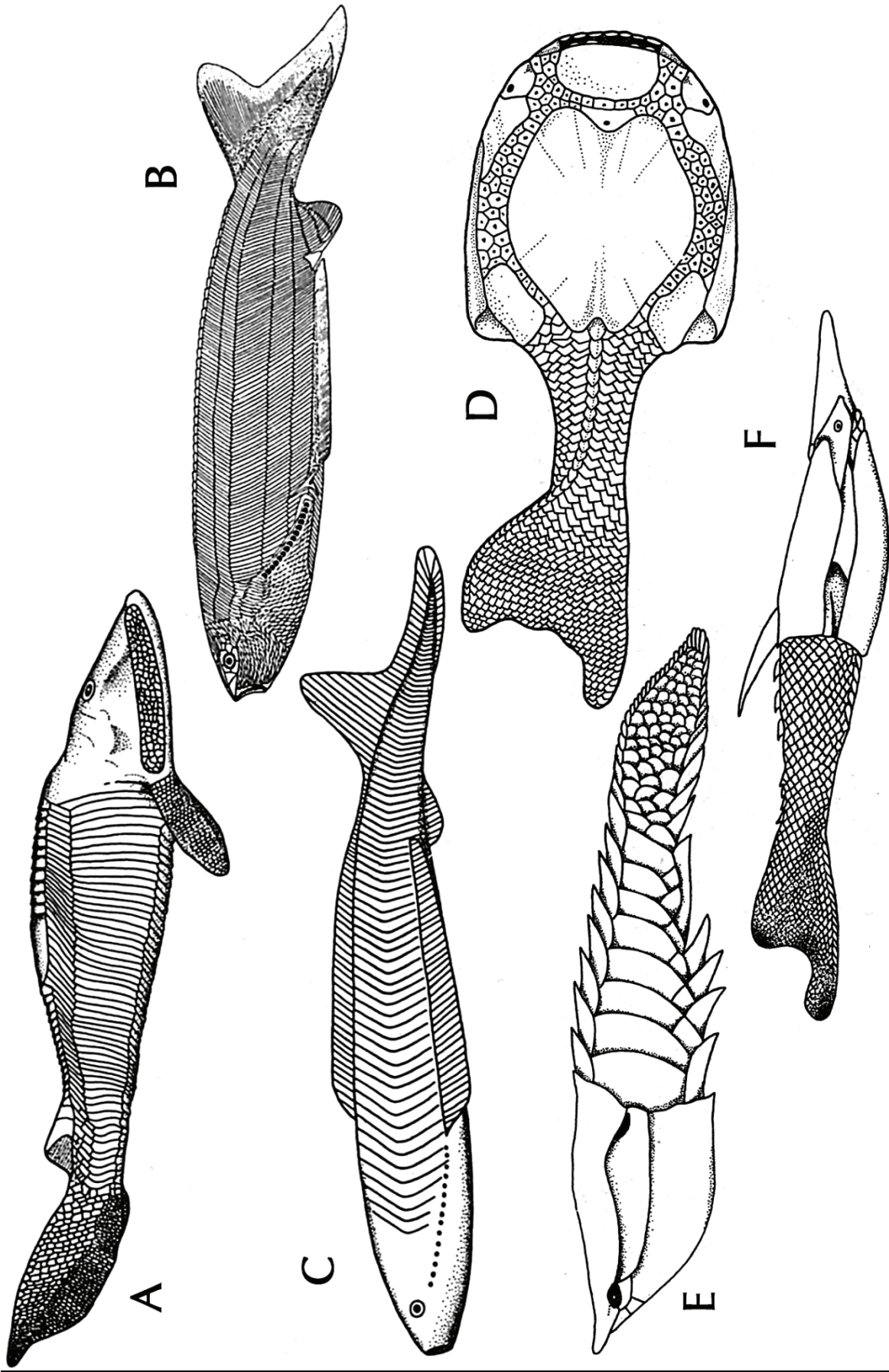


FIGURE 49. Fossil Ostracoderms. A. *Hemicyclaspis* (Osteostraci). B. *Jamoytius* (Anaspida). C. *Pharyhgolepis* (Anaspida). Figures A-C illustrate ostracoderms with a single median nostril indicating their membership in the class Cephalaspidomorphi. D. *Drepanaspis* (Heterostraci). E. *Anglaspis* (Heterostraci). F. *Pteraspis* (Heterostraci). Figures D-F illustrate ostracoderms with paired nostrils, indicating their membership in the class Pteraspidomorphi.



FIGURE 51. Atlantic hagfish, *Myxine glutinosa* (Class Myxini). All 42 species of hagfishes are carnivores scavenging on dead and dying fish or acting as predators of marine invertebrates.







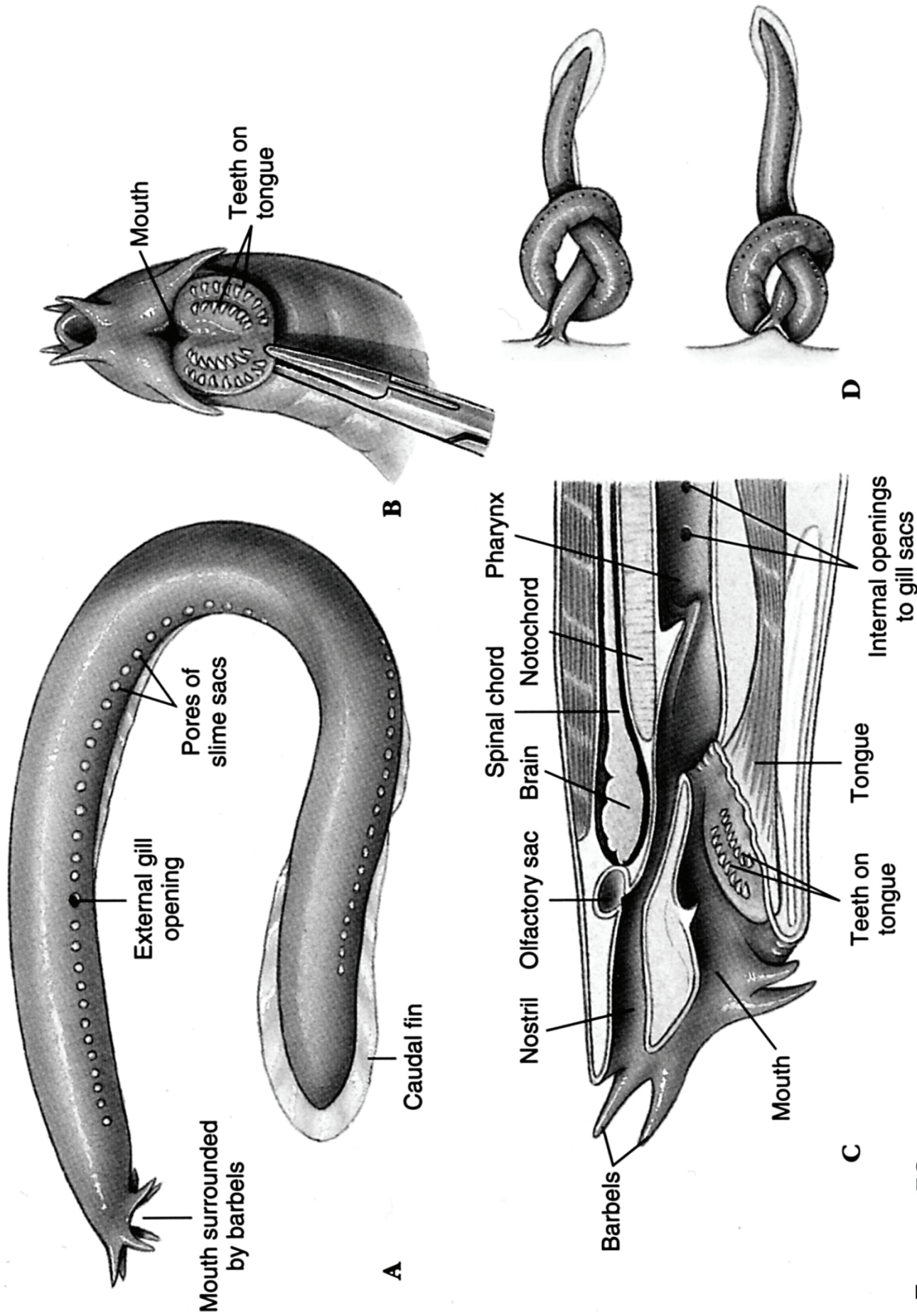


FIGURE 52. The Atlantic Hagfish, *Myxine glutinosa* (Class Myxini). **A.** External Anatomy. **B.** Ventral view of head showing horny plates. **C.** Sagittal section of head region. **D.** Hagfish knotting behavior, used to obtain leverage from a body without appendages.



FIGURE 53. The Sea Lamprey, *Petromyzon marinus* (Class Cephalaspidomorphi). About 40 species of lampreys inhabit fresh water of marine habitats, acting a parasites of other fish. They attach to another fish, rasp away the flesh with a protruding, horny tongue and consume body fluids and internal organs.



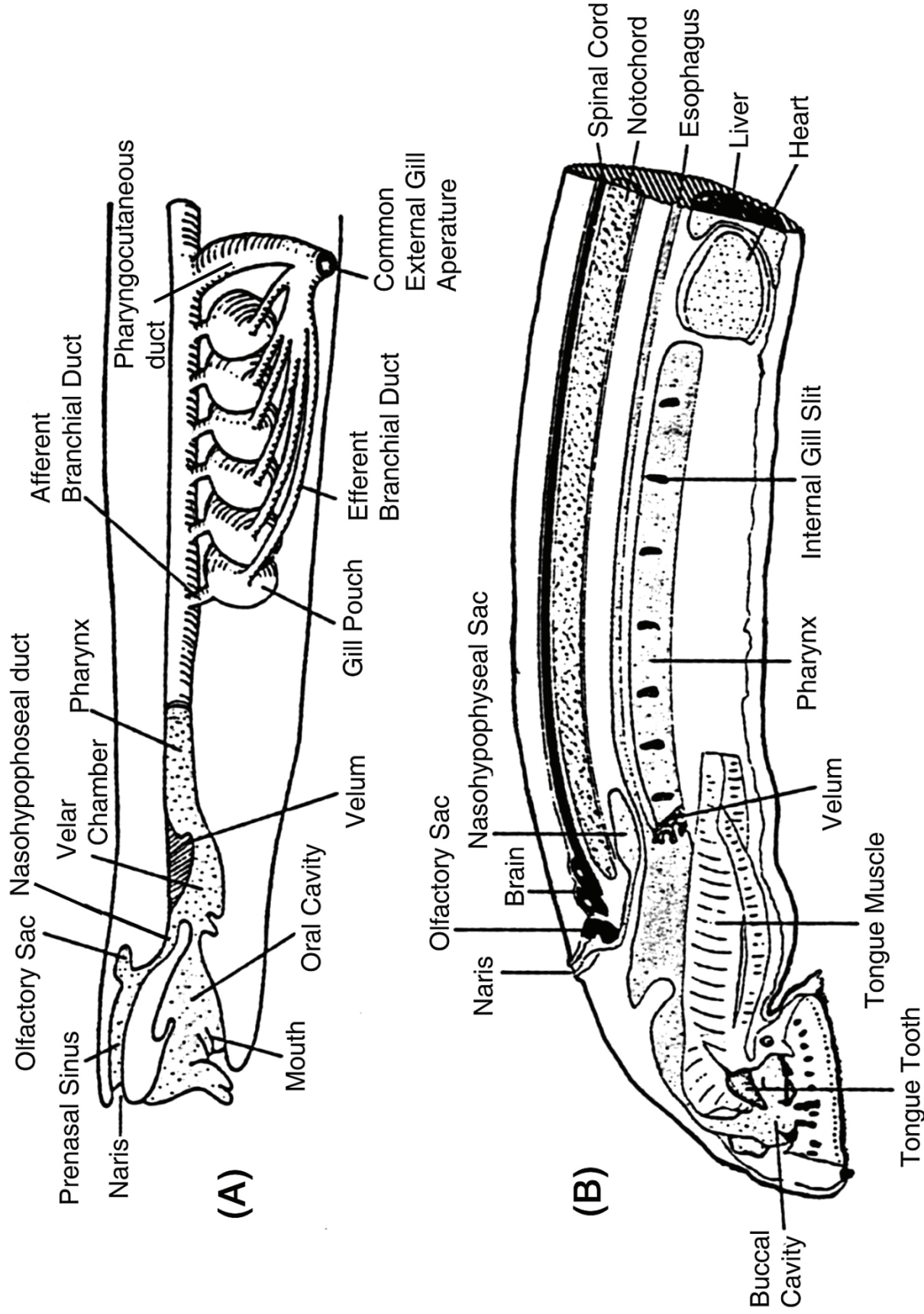


FIGURE 54. Comparative anatomy of the head and pharyngeal regions of (A) the hagfish, *Myxine glutinosa*, and (B) the sea lamprey, *Petromyzon marinus*. (Note that the myxine pharyngocutaneous duct is present on the left side only, while the common gill aperture is a paired set of structures occurring on both sides of the head.)

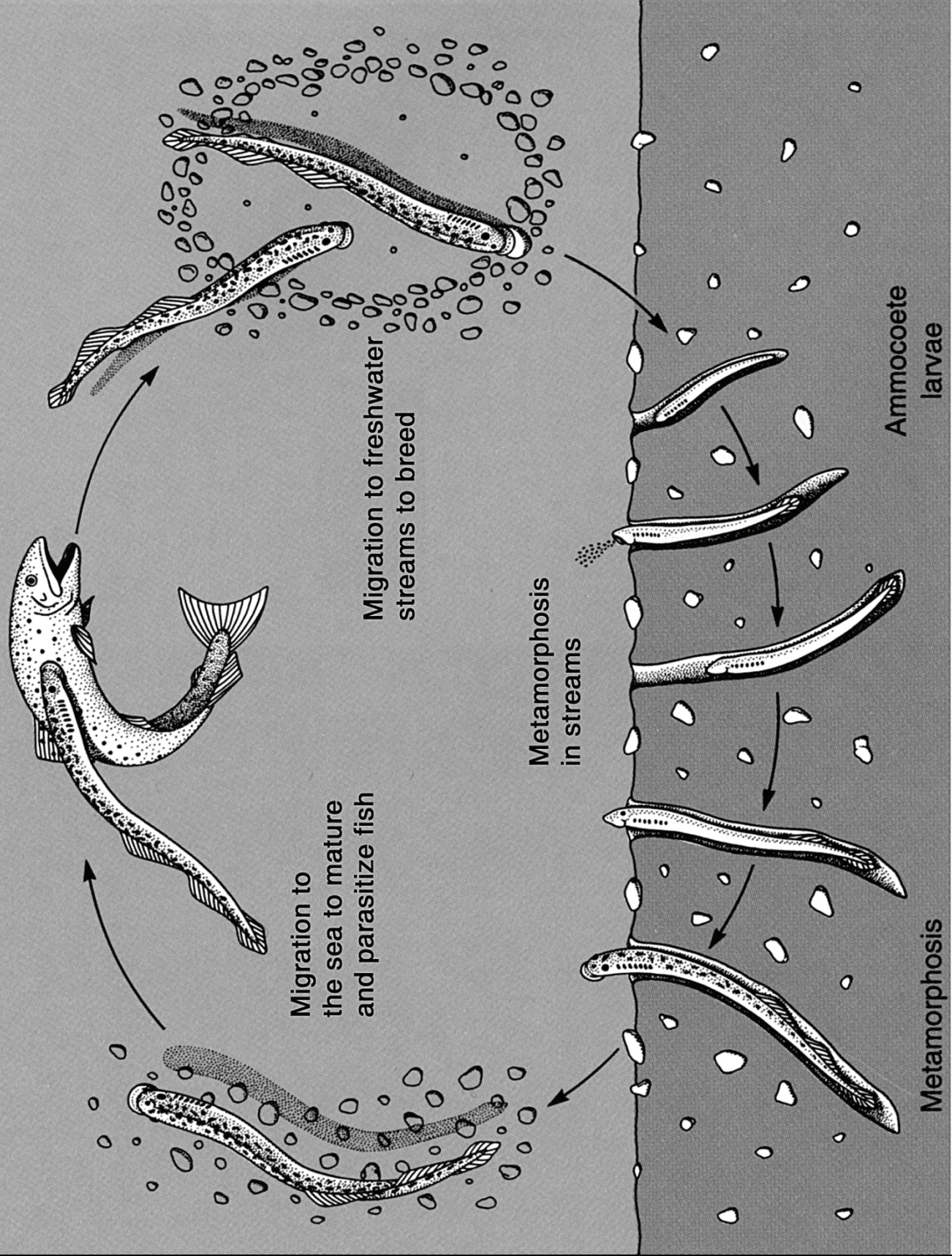


FIGURE 55. Life cycle of the sea lamprey *Petromyzon marinus*.

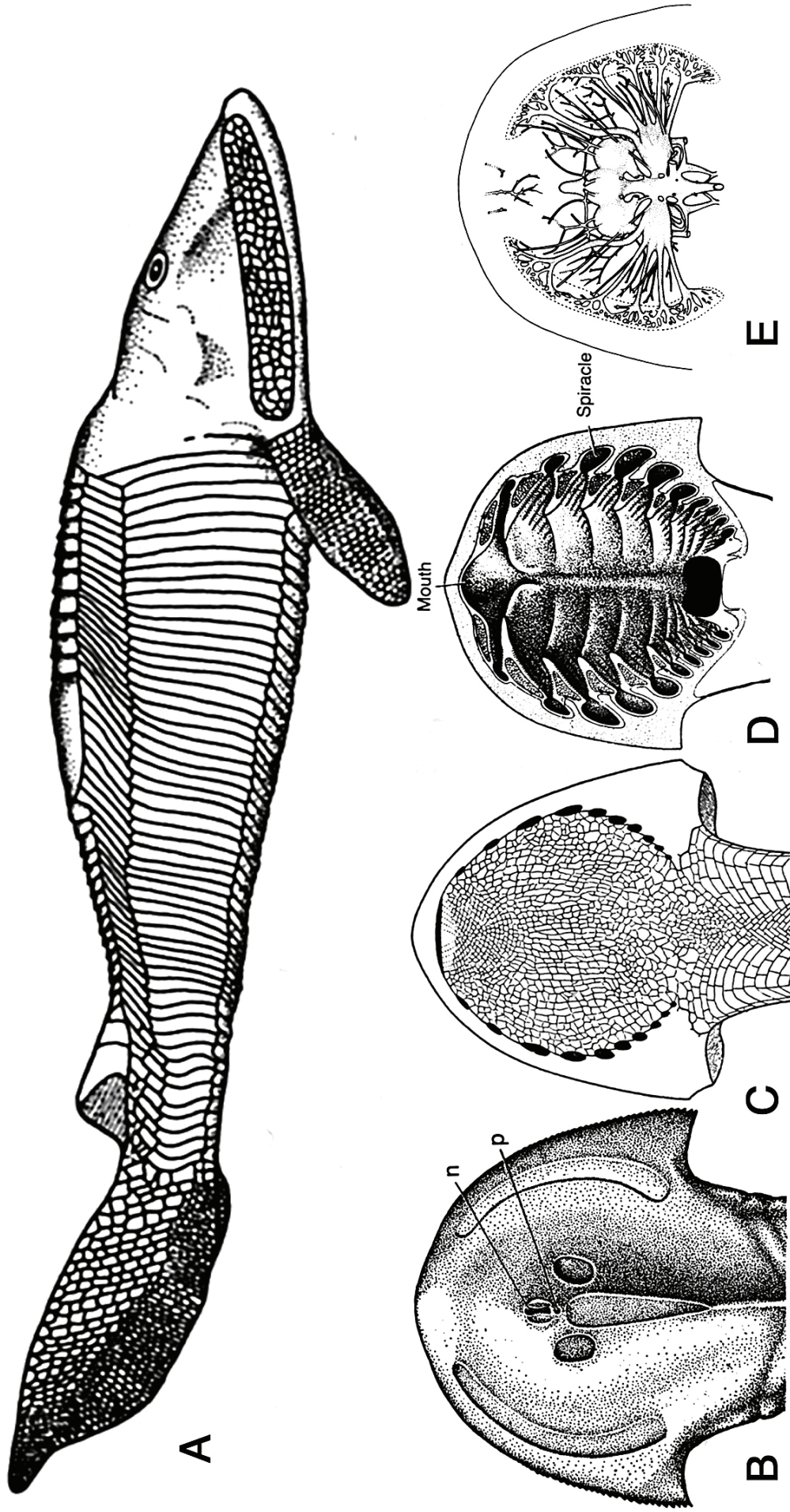


FIGURE 56. Fossil ostracoderms of the order Osteostraci (Cephalaspidomorphi).
 A. Full reconstruction of *Hemicyclaspis*. B - E. Head region of a fossil ostracoderm, *Cephalaspis*. B. Dorsal. C. Ventral. D. Internal cavities. E. Cast of branchial system.

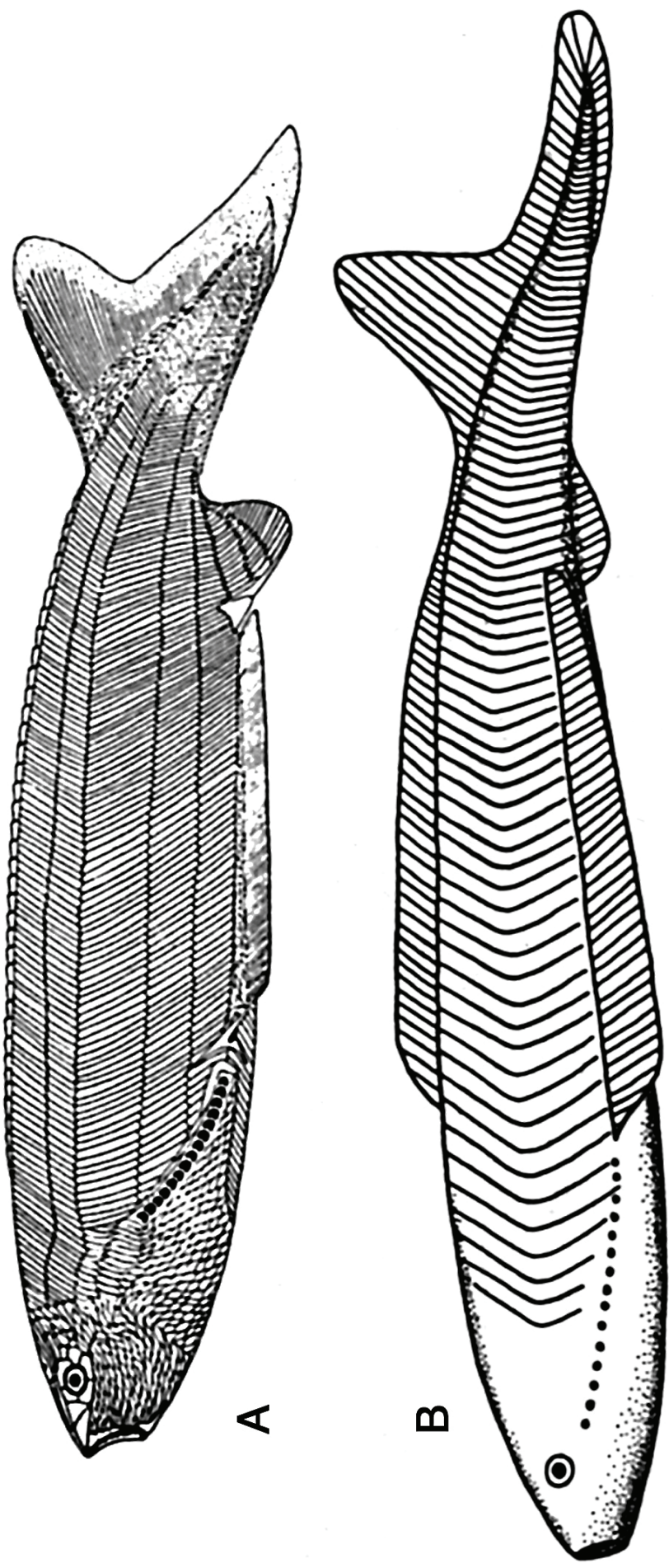


FIGURE 57. Fossil ostracoderms of the order Anaspida (Cephalospidomorphi).
A. *Jamoytius*. B. *Pharyngolepis*.

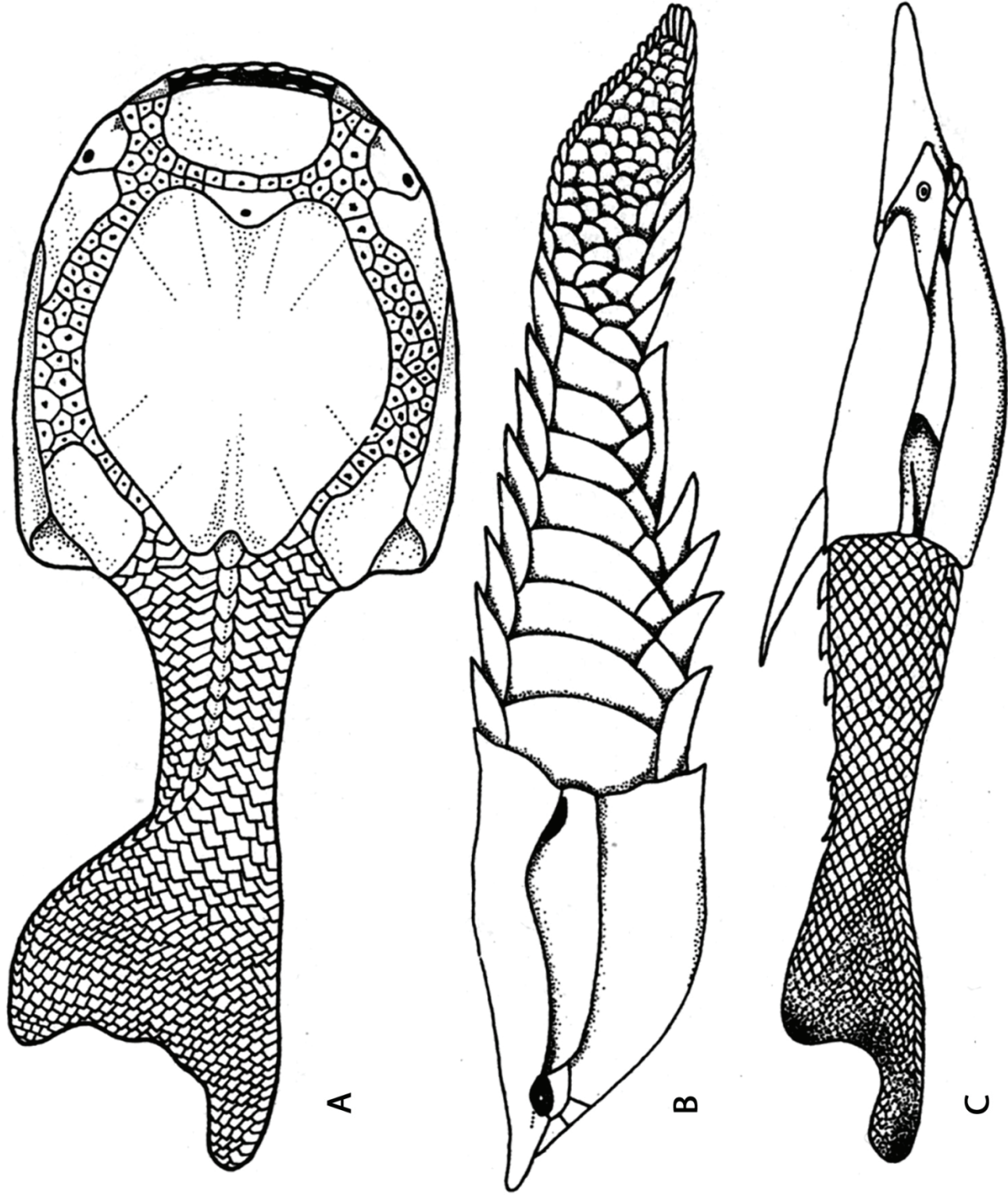


FIGURE 58. Fossil ostracoderms of the order Heterostraci (Pterospidomorphi).
A. *Drepanaspis*. B. *Anglaspis*. C. *Pteraspis*.

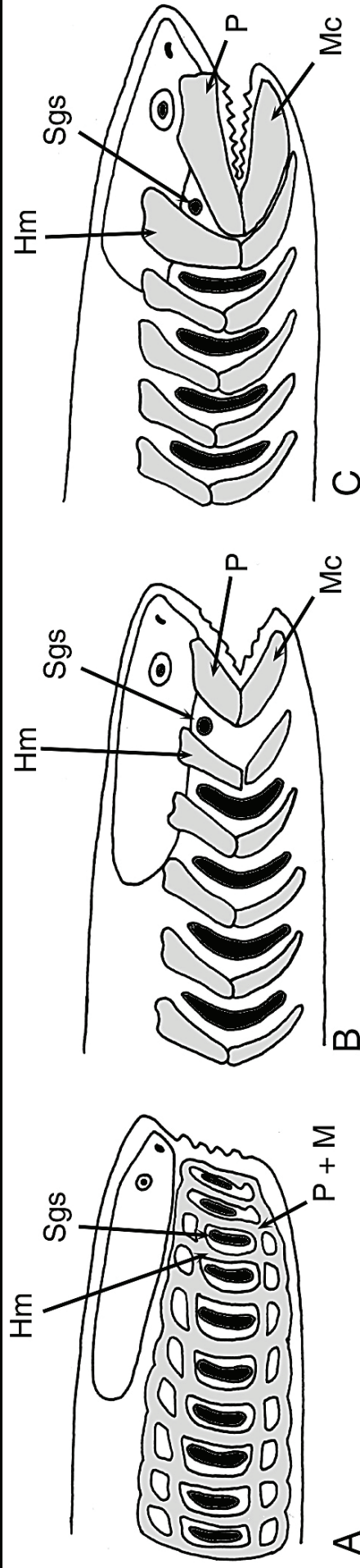


FIGURE 59. Evolution of the vertebrate jaw and hyoid arch. A. Primitive jawless condition. Primitive Silurian fish converted anterior gill slits into a spiracular opening on the upper head, allowing water to be drawn into the pharynx without fouling the gills. B. The spiracular gill slit (Sgs) has been reduced and primitive jaws have formed, the hyomandibular arch (Hm) remains unspecialized. Palatoquadrate or pterygoquadrate (P) bone forms the upper "jaw"; mandibular bone or Meckel's cartilage (M) forms the lower jaw. C. Condition seen in primitive jawless fishes: hyomandibular arch has become a jaw support and intervening gill slit reduced to a dorsolateral spiracle. Gill slits in black, pharyngeal elements in gray.

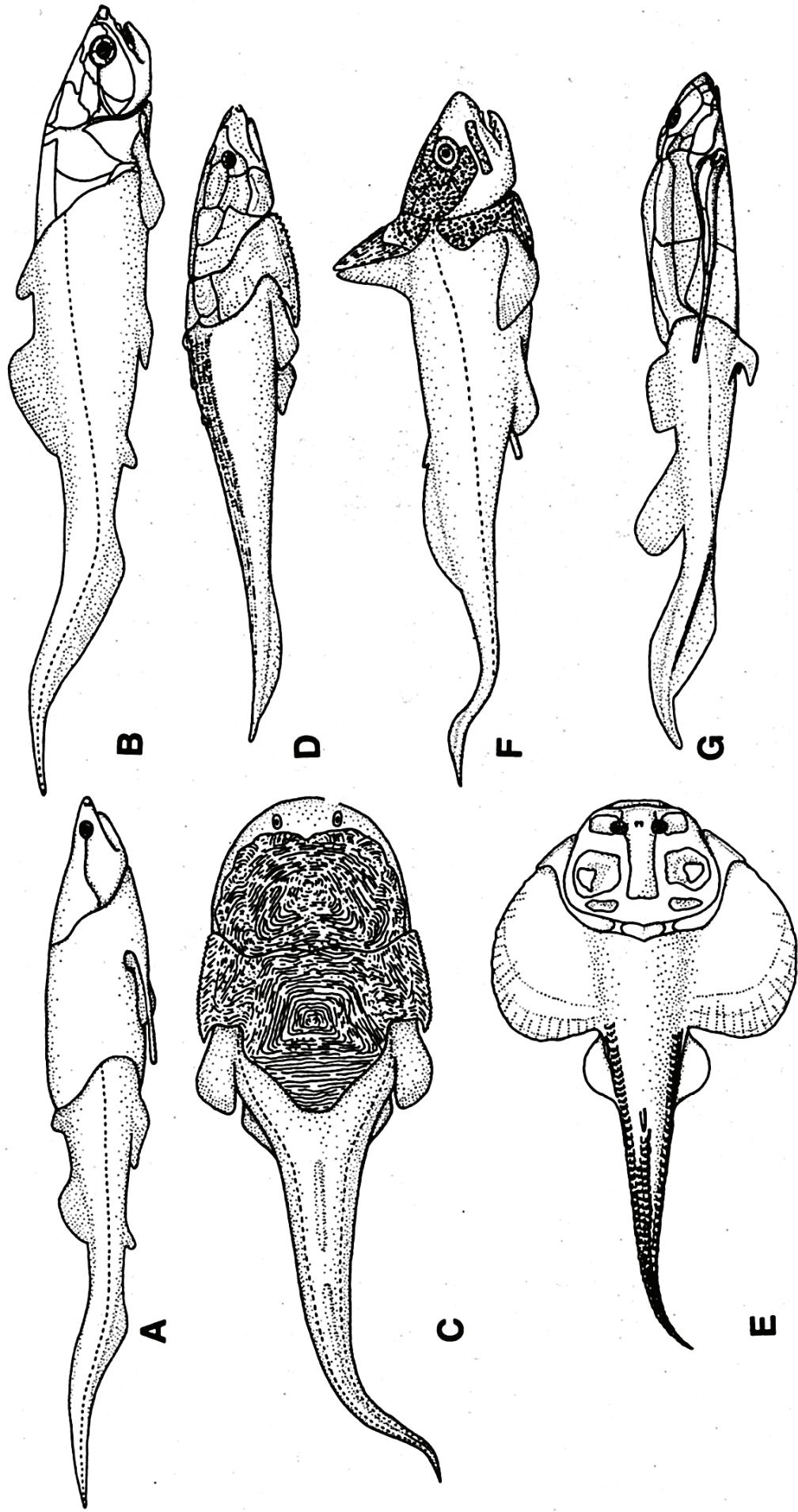


FIGURE 60. Representative placoderms (Gnathosoma: Placodermi). A. *Arctolepis*. B. *Coccosteus*. C. *Phyllolepis*. D. *Lunaspis*. E. *Gemuendina*. F. *Rhamphodopsis*. G. *Bothriolepis*. C & E in dorsal view, all others in lateral view. (After Stensio).



