LOWER CHORDATES
AND THEIR ROLE IN VERTEBRATE ORIGINS

CERTAIN LIVING FORMS SHARE ENOUGH VERTEBRATE FEATURES TO HAVE BEEN CLASSED WITH THEM IN THE PHYLUM CHORDATA.

MANY THEORIES OF CHORDATE EVOLUTION HAVE BEEN PROPOSED– AND MOST DISCARDED. ONE SUCH THEORY IS ALONG THE FOLLOWING LINES.

TUNICATES (UROCHORDATA). THESE LITTLE SACLIKE SESSILE MARINE ANIMALS ARE DEGENERATE CHORDATES. TINY TADPOLE-LIKE LARVAE SWIM ACTIVELY, AND HAVE A TAIL AND NOTOCHORD; ADULTS RETAIN GILL SLITS AND CILIATED FEEDING ORGANS.

A TUNICATE, MOLGULA

UROCHORDATA

AMPHIOXUS (CEPHALOCHORDATA). THIS CLASSIC LABORATORY LOWER CHORDATE LACKS SKELETON OR ARMOR. IT HAS ALL ESSENTIAL CHORDATE FEATURES AND A CILIATED LARVAL STAGE. IT SEEMS RELATED TO TUNICATES BUT NOT TO THE VERTEBRATES.

CEPHALOCHORDATA

AMPHIOXUS

DREPANASPIS

HETEROSTRACI

VERTEBRATES ARE KNOWN FROM THE ORDOVICIAN ON. HETEROSTRACI (CASE TO RIGHT), THE EARLIEST GROUP, COULD HAVE EVOLVED DIRECTLY FROM MITRATES. CALCAREOUS ARMOR HAD TO BE REPLACED BY BONE, LATERAL TAIL MOVEMENT STRENGTHENED FOR SWIMMING, AND VARIOUS ANATOMICAL ADVANCEMENTS MADE.

MITRATE, MUCH ENLARGED

CORNUTE, MUCH ENLARGED

ECHINODERMS (SEE ELSEWHERE AMONG INVERTEBRATES)

CHORDATES

FOSSIL MITRATE, AND CASE

MITRATES

CORNUTES

THE **CARPOIDS** (CALCICHORDATA) ARE SMALL FOSSIL FORMS, KNOWN FROM THE CAMBRIAN TO THE DEVONIAN, AND CONSIDERED THE BASAL SUBGROUP OF CHORDATES, BY SOME.

CORNUTES AND MITRATES ARE BOTH FLATTENED, WITH CALCAREOUS ARMOR, A JOINTED TAIL, AND MANY INTERNAL FEATURES SUGGESTING VERTEBRATE ORGANIZATION. THE CORNUTES WERE ASYMMETRICAL, WITH LONG SPINES AND A MOUTH IN FRONT. MITRATES WERE NEARLY SYMMETRICAL, LACKED THE SPINES, AND HAD THE MOUTH LOWER. BOTH BOTTOM DWELLERS, THEY MUST HAVE PUSHED OR JERKED THEMSELVES ABOUT BY MOVEMENTS OF THE TAIL. PRESUMABLY THERE WERE SWIMMING CILIATED LARVAE.

CALCICHORDATA

GRINOZOA

TUBE PTEROBRANCH, MUCH ENLARGED

TUBE PTEROBRANCHS

FREE PTEROBRANCHS

FREE PTEROBRANCH, MUCH ENLARGED

ENTEROPNEUSTA

THE **ACORN WORMS** (ENTEROPNEUSTA). THESE ABERRANT MODERN HEMICHORDATES BURROW IN THE OCEAN BOTTOM. ADULTS HAVE A PROMINENT PROBOSCIS, A COLLAR, AND AN ELONGATED TRUNK WITH MANY GILL SLITS.

ACORN WORM

HEMICHORDATES ARE NOW RECOGNIZED AS A SEPARATE PHYLUM ANCESTRAL TO BOTH CHORDATES AND ECHINODERMS. CILIATED SWIMMING LARVAE SETTLE AND TRANSFORM INTO ADULTS.

DENDROID GRAPTOLITES

FOSSIL GRAPTOLITE

GRAPTOLITES ARE KNOWN