INTRODUCTION AND HISTORICAL REVIEW

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The study of the development of the skull is bound up with the recognition of the two materials, cartilage and bone, of which the skull is mainly composed, and with the theories concerning the relations of these tissues to one another, both anatomically and developmentally.

According to De Beer (1937) the earliest attempt for the distinction between cartilage and bone as skeletal materials appears to be that of Aristotle who contrasted the Chondrichthyes with the Osteichthyes. However, it was a long time before closer study of developmental stages revealed that the fact that some bones were preceded by cartilaginous structures of similar shape which they replaced, while other bones arose directly from connective tissue membranes without cartilaginous precursors. The former are customarily refferred to as cartilage bones, and the latter as membrane bones.

The cartilaginous skull, or chondrocranium, as a whole was recognized for the first time by Arendt (1822), then Von Baer (1826) put forward the view of "inner" and "outer" skeleton, based on his studies of fishes. The "inner skeleton" was composed of the chondrocranium together with its embedded bones and covering bones, and was contrasted with the " outer skeleton" represented by the bony dermal scales.

The existence of a chondrocranium in early stages of all vertebrates was recognized by Reichert (1838), who followed the development of the visceral arch skeleton, and further distinguished between cartilage bones (or replacing bones), and membrane bones. The next advance was made by Agassiz (1844) who classified the bones of fish skulls into ossifications of the chondrocranium and protective plates, which latter include not only the superficial dermal ossifications but also the more deeply seated bones surrounding the chondrocranium, and therefore represent the entire category of membrane bones.

A synthetic description of the mechanical units forming the skull has been made by Verraes (1973), who classified the skeletal elements in the 97 mm juvenile stage of the teleost fish Salmo gairdneri into seven units; viz., the neurocranium (including sensory capsules), the suspensorium (= the cartilaginous upper jaw + hyosymplectic and their associated bones + preopercular bone), the operculum (the opercle , subopercle and interopercle bones), the secondary upper jaw (premaxilla, maxilla), the lower jaw (Meckel's cartilage and its associated bones + secondary lower jaw bones), the hyoid (ventral elements of the hyoid arch) and the branchial arches.

The development of the skull of a number of species representing different families of bony fishes has been a subject of various investigators. Thus, Norman (1926) studied

Omarkhan (1950) studied the development of the chondrocranium of Notopterus chitala (family Notopteridae) in comparison with that of Salmo and of Gymnarchus. The study showed that Notopterus has no close resemblance to Gymnarchus but is more like the generalized clupieform chondrocranium of Salmo. The same author stated that, in the chondrocranium of Notopterus, the myodomes are absent, and there is no interorbital septum.

Srinivasachar (1953), described the chondrocranium of eight stages of Ophicephalus gachua commencing from the first day to the twenty fifth day after hatching. He stated that, the trabecula and parachordal arise independently. The rostral cartilage is developed independently, it is not fused with any part of the ethmoid plate. The same author found that the basicapsular fenestra and the metotic foramen are separated by the basivestibular commissure, there is no tectum posterius. The quadrate is fused with the hyomandibular and the pterygoid process of the palatoquadrate is discontinuous with the quadrate.

Abdel Aziz(1957)studied the development of the chondrocranium of Tilapia zilli (family Cichlidae). She found that, the neurocranium is typically " tropibasic" and is developed earlier during ontogeny than the splanchnocranium. The same author stated that the trabeculae,polar cartilages and parachordals arise as independent structures while the auditory capsules appear in continuity with the parachordals.

extending from the auditory capsule up to the ethmoid region on each side of the neurocranium. He also established that, the infrapharyngobranchials of the first four branchial arches are fused together to form a single cartilaginous plate.

Pashine & Marathe (1977) studied the chondrocranium of some stages of Cyprinus carpio (family Cyprinidae). They showed that, the chondrocranium is of the " tropitrabic " type, and the parachordals are connected to the auditory capsules by means of basicapsular and basivestibular commissures. The same authors added that the basihyal and the basibranchials form a common copula which breaks up into two copulae.

Ismail (1979) studied, from a functional view point, the postembryonic development of the skull of the cichlid fish Haplochromis elegans which represents a generalized insectivorous Haplochromis from the east - African lakes, Edward and George, in comparison with other teleost fishes, especially Salmo gairdneri (family Salmonidae; Verraes, (1974 b) . The study revealed that the neurocranial floor is of the " tropitrabic" type and that the neurocranial pharyngobranchiad apophysis, which is characteristic of the cichlid neurocranium, is developed as a ventral projection of the neurocranial base in the otic region. The fourth hypobranchials are absent. An interorbital septum is present. The taenia tecti medialis posterior originates anatomy of head constituents in some bony fishes (Ismail, 1979; Verraes & Ismail, 1980; Huysseune et al., 1981 ; Ismail & Elshabka, 1982 and Ismail, 1984) .

In the present work, the development of the chondrocranium of Gambusia affinis affinis is studied in detail. Attention is given to the change in shape, position, and relative size of the chondral parts during ontogeny and to the relation between the developing chondral parts and cephalic sensory organs such as the brain, eyes, olfactory organs and membranous labyrinth. The osteocranium, however, is partially described among the chondrocranium especially those bones of the 19 mm larval stage. Comparison with other fishes is also made. The morphological description of the studied parts of the skull during ontogeny is mainly based on graphical reconstructions as well as on serial sections of the studied specimens.