The before-mentioned threefold division of the sternum is normal in Mammals, and also exists, though more obscurely, in Birds and Reptiles. Even in Mammals it is not universal ; the manubrium only may be present, as in the Greenland Whale, or the manubrium and xiphisternum without any mesosternum, as in the Dugong.

In Tailed Amphibians and the Slow-Worm *(Anguis)* we have a single sternum, which may be mesosternum only, while in many Frogs and Toads we have only the latter and the xiphisternum. The manubrium may develop a median keel, as in Bats, the Mole, and Armadillos; or the mesosternum, as in the Tamandua ; or the mesosternum and xiphisternum, as in most Birds.

The xiphisternum may assume various forms, but attains its maximum development in Birds, where it forms the part of the sternum posterior to the attachment of the ribs, and may consist of a median and four lateral processes, as in the Fowl. It bears the greater part of the keel.

In the Monotremes there is a median ossicle in front of the manubrium, which is often called the episternum. It is really a part of the appendicular skeleton.

*Ribs.—*Mammals possess a greater or less number of ribs, which are mostly long, slender, curved bones, extending downwards from the transverse processes or bodies of the vertebræ, the more anterior of them forming a junction with the sternum. The part of the skeleton formed by the rib-bearing vertebræ, the ribs, and the sternum is called the thorax. In Man (see Anatomy) there are twelve ribs (on each side of the body), whereof the first seven join the sternum by the intervention of cartilages, and are called “ true ribs.” The other five, which do not join the sternum, are called “ false ribs.” Each rib (except the last two on each side) has a double attachment to the spinal column. At its proximal end it has a rounded “ head ” or “capitulum,” which articulates with the capitular surface of a dorsal vertebra. At a little distance from the capitulum is another rounded articular prominence called the “tubercle” or “tuberculum,” which joins a vertebral tubercular surface. The part of the rib between the head and the tubercle is called the “ neck.” At its distal end each rib has attached to it an elongated cartilage called “ costal.” Those costal cartilages which do not join the sternum either end freely or blend with the costal cartilage next in advance.

Frogs and Toads have no ribs, nor can they be said to exist in some Fishes *(e.g.,* the Chimæra, the Seahorse, the Lamprey and its allies) ; but in the immense majority of Vertebrates there are cartilaginous or osseous ribs, attached by their proximal ends to the vertebral column, and tending to surround the trunk.

All rib-bearing animals have both “ true ” and “ false ” ribs, save Serpents, Fishes, and Chelonians, which can have no true ribs since they have no sternum, and Tailed Amphi­bians, in which, though there is a sternum, no ribs join it. There may, however, be but a single pair of true ribs—as in the Whalebone Whales. The ribs are exceptionally broad in the Two-toed Anteater, where they overlap one another. The number of ribs has already been indicated under the head of “ dorsal vertebræ,” though in Birds we may have short ribs attached to the cervical vertebræ, and others coming from vertebræ which are generally counted as “sacral.” There may be as few as five or six pairs, as in *Amphiuma;* or the numbers may reach 320, as in some Pythons. In many Reptiles, as in the Crocodiles, there may be cervical ribs ; and there may even be caudal ribs, as in *Menobranchus.*

The function of aiding respiration is one which the ribs possess in the higher *Vertebrata,* but quite other purposes may be subserved by them in addition to, or instead of, respiratory action—namely, locomotion, change of form, or

bodily protection as armour. Thus the ribs may form a solid case for the safe keeping of the parts within, co-oper­ating in this office with other skeletal structures so as to form the “ carapace ” of Tortoises already noticed. Ribs may be the main agents in locomotion, as in Snakes, which glide along by the successive application to the ground of the edges of their ventral scales, which is brought about by the motions of the ribs, the ends of which are connected with the inner surface of such scales. In the little flying Lizard *Draco* certain much elongated ribs serve to support a parachute-like flying membrane, and in the Cobra it is certain ribs which sustain its “ hood ” when distended.

The presence of a distinct “ head ” and “ tubercle ” is a general but not constant character, and the head of the ribs may be connected with two vertebræ or only with one vertebra. The ribs may bifurcate proximally into two equal diverging branches, one representing the “head” and the other the “ tubercle.” A small backwardly- projecting structure termed an “ uncinate process ” may be given off from the ribs and may ossify as a distinct bone, as in most Birds and in the Crocodile.

Sometimes (as in Monotremes and many Lizards) a third segment may be intercalated between a rib and its sternal cartilage, and sternal cartilages may be represented by bones, as in Birds and Armadillos. In some Lizards the sternal cartilages of opposite ribs are continuous in the mid ventral line. There may be no representative of a sternal rib, as in Fishes and Batrachians.

Rarely, as in the Crocodile, there may be ventral rib-like structures in the wall of the abdomen, which meet and are attached ventrally, but are “ free ” at their dorsal ends. These cannot, however, be counted as true ribs. Fishes have often two series of ribs on each side of the body, and in *Polypterus* some vertebræ may have four ribs on either side. In Fishes the ribs may also be in part attached to the neural spines above or to the hæmal spines below the vertebræ.

*Cranial Skeleton.*

By the cranial skeleton we mean the skull, or that part of the axial skeleton which serves to shelter the brain (or anterior expanded end of the central part of the nervous system), together with solid structures continuous or more or less directly connected therewith. Such a structure exists in every Vertebrate animal, except the *Amphioxus,* which has no brain. Nothing of the kind is known to exist in any Ascidian or in any Invertebrate animal,— unless that cartilage of Cuttlefishes which serves as an investment of the nerve centres and a support for the optic and auditory organs may be deemed a true cranial skeleton, since its portions just enumerated make it, as we shall shortly see, very analogous to a true skull.

The cranial skeleton is, of course, at first composed entirely of soft mesoblastic tissue, parts of which always become cartilaginous and generally also osseous, while more or less of its structure may remain in the condition of mere membrane. The bones which generally, as just said, enter into its framework may arise directly in the membrane or may be preceded by cartilage which ossifies, a circumstance which divides the cranial bones into two categories—“membrane bones” and “cartilage bones.”

The cranial skeleton of Vertebrates is made up of three sets of parts:—(1) parts devoted to enclosing and protect­ing the brain; this is the cranium proper; (2) parts sheltering the organs of sense situated in the head— namely the optic, auditory, and olfactory capsules ; these skeletal parts consist of the bones, cartilages, and mem­branes of the orbit, the internal ear, and the nose respec­tively, or the perioptic, periotic, and perirhinal bones and cartilages ; (3) parts continuous or more or less directly