shackle joint has been already noticed under the head of “ Scutes.”

axial skeleton.

The whole axial skeleton—including both the cranium and the spinal skeleton—apart from the notochord, is formed from the mesoblastic tissue bordering the medullary groove of the embryo. As the essential part of the axial skeleton is the spinal column, so the essential foundation of this column itself is what is known as the “notochord.” This is an elongated cylindrical rod of soft tissue running along the antero-posterior axis of the body immediately subjacent to the central portion of the nervous system. Its mode of origin from the germ-layers of the embryo has yet to be finally determined. It is said by Balfour@@1 to be developed, in most if not all cases, as an axial differentia­tion of the hypoblast. The cells of the notochord form a tissue resembling cartilage, and it becomes surrounded by a more or less dense fibrous sheath. Such an organ is found to exist, temporarily or permanently, in certain lower creatures—Ascidians—which in most other respects widely differ from Vertebrate animals. Some few of these animals are furnished with a tail throughout the whole of life, while others are furnished with such an organ only in their larval or immature condition. It is alone in such permanent or temporary tail, and not in the body of As­cidians, that a structure of this kind is met with.

In every Vertebrate animal the notochord is the first part of the skeleton to appear, and it extends throughout the whole length of the body, as well as of the tail. In every such animal, except the Lancelet *(Amphioxus),* it becomes arrested anteriorly in the midst of that second­arily formed skeletal region which becomes the skull. In *Amphioxus,* however, in which no skull is ever formed, the notochord extends to quite the anterior end of the body. It is enclosed in a strong sheath, within which its substance is segmented so as to resemble a longitudinal series of coins@@2 or counters. The only other representatives of the internal skeleton in this animal are—(1) longitudinal ligaments (strengthening the sheath of the notochord above and below) ; (2) fibrous septa which pass out laterally from it between the muscles of the body, to the fibres of which they give attachment ; (3) a longitudinal membranous sheath of the central part of the nervous system, forming an elongated antero-posteriorly directed cylinder above the notochord ; (4) two vertical septa,— one dorsal, ascending medianly from such neural sheath, and one ventral, descending medianly from the sheath of the notochord in the region of the tail ; (5) two jointed cartilaginous filaments which lie one on each side of the longitudinal slit which serves the lancelet for a mouth ; and (6) certain cartilaginous filaments which strengthen the sides of the branchial cavity between the intervening vertical fissures of the walls of that cavity.

In all other Vertebrate animals the axial skeleton is divis­ible into that of the head, or the cranial skeleton, and that of the axial skeleton behind the head, or the spinal skeleton.

*Spinal Skeleton.*

In all Vertebrate animals except the Lancelet, the axial skeleton is complicated by a longitudinal series of addi­tional hard parts—cartilaginous or osseous—which serve to protect the spinal cord, or marrow, above it, or the great blood-vessels beneath it, and which hard parts support, encroach upon, or replace the notochord itself. Neverthe­less, the notochord persists throughout the whole of life in certain Fishes both of the lowest and highest types of piscine organization, but it does not persist in its entirety in any adult Vertebrate which is not a Fish.

@@@1 *Comparative Embryology,* vol. ii. p. 449.

@@@2 Owen’s *Anatomy of Vertebrates,* vol. i. p. 31.

In the Lamprey the notochord persists, but a longitudinal series of small, similarly shaped cartilages strengthen the sides of the more anterior part of the membranous dorsal canal which encloses the spinal marrow. In the Chimaera these are more developed, while numerous circular cal­cifications appear in the notochordal sheath. In the most anterior part of the trunk the cartilaginous elements unite to form a continuous investment of the notochord. Amongst the Ganoid Fishes, the notochord persists un­constricted and cylindrical in the Sturgeon and the Lepidosiren, but cartilaginous or bony parts appear about it and form a longitudinal series of arches above and below it for the protection respectively of the spinal marrow and sub-vertebral blood-vessels. In different kinds of Sharks further complications arise, and the notochord becomes encroached upon, in different modes, by chondri­fication and calcification, till it becomes segmented by the intervention of a series of thus formed hard parts called “ bodies ” or “ centra,” between which relics of the notochord still remain. By this process of segmentation there come to be formed what are called vertebrae, the presence of which in the overwhelming majority of Fishes, as well as in all the higher classes of animals, has led to the whole group being called *Vertebrata.*

In the vertebræ of most Vertebrates we have a solid body or centrum, from the dorsum of which there arises on each of its two sides a neural plate, which then bends inwards to meet its fellow of the opposite side, thus form­ing an arch (the neural arch) for the protection of the spinal cord, or marrow, which passes through it. From the dorsal side of such neural arch a process called the neural spine very commonly ascends. From the sides of the centrum or neural arch, or of both, a single process, or two superimposed processes, may jut outwards, which are known as the transverse process or processes, to which the ribs are generally articulated when ribs are present. Inferiorly directed processes, single or double, may descend from beneath the centrum, or may be developed in the intervals between adjacent centra, and are generally related to the protection of large blood-vessels, though they may only serve for muscular attach­ment.

Adjacent vertebræ are commonly connected together by special modifications of the neural arches or the centra, or of both. Mostly the opposed margins of the neural arches develop special processes for attachment called articular processes or zygapophyses, and there may be additional interarticulations. There may be as few as ten or as many as four hundred vertebræ.

Vertebræ may be divisible, as in the highest animals, into five categories:—(1) cervical, or those of the neck; (2) dorsal, or those of the back ; (3) lumbar, or those of the loins ; (4) sacral, or those with which the pelvic limbs are connected ; and (5) caudal, or those which are posterior to the sacral vertebræ, or which support the tail when such an organ is present. There may be only two categories (dorsal and caudal), as in Fishes.

In most Fishes and some exceptional Reptiles the body or centrum of each vertebra is so imperfectly ossified as to remain biconcave or amphicoelous,—that is to say, it presents a deeply concave cup-like form both in front and behind. The space thus enclosed by the adjoining cups of each pair of successive vertebræ is filled up by a soft, spheroidal remnant of the notochord, which thus serves as an intermediate connecting substance. The cups may become filled up by ossification, as in Man and Beasts, the flattened surfaces being connected by what are called inter­vertebral disks. Each such disk is made of fibrous lamellæ which surround a soft elastic central portion which is a last remnant of the notochord. Often the vertebræ may