

This stage is succeeded by that of the **cartilaginous vertebral column**. In the fourth week two cartilaginous centers make their appearance, one on either side of the notochord; these extend around the notochord and form the body of the cartilaginous vertebra. A second pair of cartilaginous foci appear in the lateral parts of the vertebral bow, and grow backward on either side of the neural tube to form the cartilaginous vertebral arch, and a separate cartilaginous center appears for each costal process. By the eighth week the cartilaginous arch has fused with the body, and in the fourth month the two halves of the arch are joined on the dorsal aspect of the neural tube. The spinous process is developed from the junction of the two halves of the vertebral arch. The transverse process grows out from the vertebral arch behind the costal process.

In the upper cervical vertebræ a band of mesodermal tissue connects the ends of the vertebral arches across the ventral surfaces of the intervertebral fibrocartilages. This is termed the **hypochordal bar or brace**; in all except the first it is transitory and disappears by fusing with the fibrocartilages. In the atlas, however, the entire bow persists and undergoes chondrification; it develops into the anterior arch of the bone, while the cartilage representing the body of the atlas forms the dens or odontoid process which fuses with the body of the second cervical vertebra.

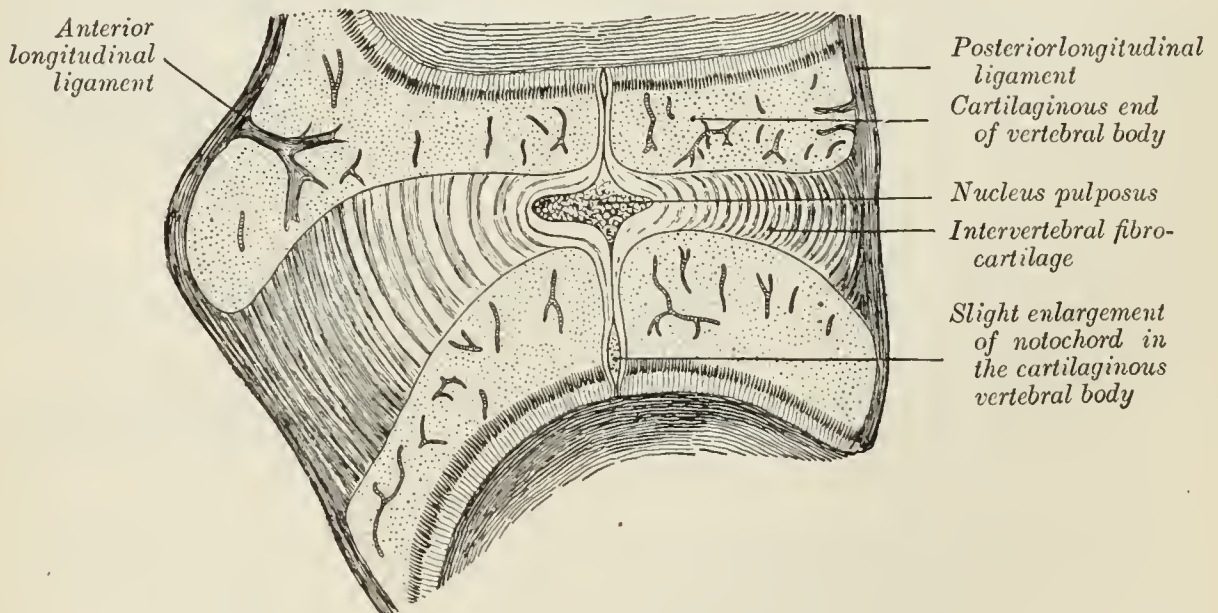


FIG. 66.—Sagittal section through an intervertebral fibrocartilage and adjacent parts of two vertebræ of an advanced sheep's embryo. (Kölliker.)

The portions of the notochord which are surrounded by the bodies of the vertebræ atrophy, and ultimately disappear, while those which lie in the centers of the intervertebral fibrocartilages undergo enlargement, and persist throughout life as the central **nucleus pulposus** of the fibrocartilages (Fig. 66).

The Ribs.—The ribs are formed from the ventral or costal processes of the primitive vertebral bows, the processes extending between the muscle-plates. In the *thoracic region* of the vertebral column the costal processes grow lateralward to form a series of arches, the **primitive costal arches**. As already described, the transverse process grows out behind the vertebral end of each arch. It is at first connected to the costal process by continuous mesoderm, but this becomes differentiated later to form the costotransverse ligament; between the costal process and the tip of the transverse process the costotransverse joint is formed by absorption. The costal process becomes separated from the vertebral bow by the development of the costocentral joint. In the *cervical vertebræ* (Fig. 67) the transverse process forms the posterior boundary of the foramen transversarium, while the costal process corresponding to the head and neck of the rib fuses with the