spaces. In an ordinary microscopic section, viewed by transmitted light, they appear as fusiform opaque spots. Each lacuna is occupied during life by a branched cell, termed a **bone-cell** or **bone-corpuscle**, the processes from which extend into the canaliculi (Fig. 76).

The **Canaliculi** are exceedingly minute channels, crossing the lamellæ and connecting the lacunæ with neighboring lacunæ and also with the Haversian canal. From the Haversian canal a number of canaliculi are given off, which radiate from it, and open into the first set of lacunæ between the first and second lamellæ. From these lacunæ a second set of canaliculi is given off; these run outward to the next series of lacunæ, and so on until the periphery of the Haversian system is reached; here the canaliculi given off from the last series of lacunæ do not communicate with the lacunæ of neighboring Haversian systems, but after passing outward for a short distance form loops and return to their own lacunæ. Thus every part of an Haversian system is supplied with nutrient fluids derived from the vessels in the Haversian canal and distributed through the canaliculi and lacunæ.

The **bone cells** are contained in the lacunæ, which, however, they do not completely fill. They are flattened nucleated branched cells, homologous with those of connective tissue; the branches, especially in young bones, pass into the canaliculi from the lacunæ.

In thin plates of bone (as in the walls of the spaces of cancellous tissue) the Haversian canals are absent, and the canaliculi open into the spaces of the cancellous tissue (medullary spaces), which thus have the same function as the Haversian canals.

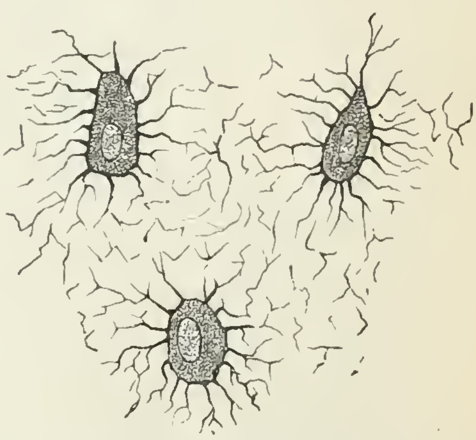

Fig. 76.—Nucleated bone cells and their processes, contained in the bone lacunæ and their canaliculi respectively. From a section through the vertebra of an adult mouse. (Klein and Noble Smith.)

Chemical Composition.—Bone consists of an animal and an earthy part intimately combined together.

The animal part may be obtained by immersing a bone for a considerable time in dilute mineral acid, after which process the bone comes out exactly the same shape as before, but perfectly flexible, so that a long bone (one of the ribs, for example) can easily be tied in a knot. If now a transverse section is made (Fig. 77) the same general arrangement of the Haversian canals, lamellæ, lacunæ, and canaliculi is seen.

The earthy part may be separately obtained by calcination, by which the animal matter is completely burnt out. The bone will still retain its original form, but it will be white and brittle, will have lost about one-third of its original weight, and will crumble down with the slightest force. The earthy matter is composed chiefly of calcium phosphate, about 58 per cent. of the weight of the bone, calcium carbonate about 7 per cent., calcium fluoride and magnesium phosphate from 1 to 2 per cent. each and sodium chloride less than 1 per cent.; they confer on bone its hardness and rigidity, while the animal matter (*ossein*) determines its tenacity.

Ossification.—Some bones are preceded by membrane, such as those forming the roof and sides of the skull; others, such as the bones of the limbs, are preceded by rods of cartilage. Hence two kinds of ossification are described: the **intramembranous** and the **intracartilaginous.**

Intramembranous Ossification.—In the case of bones which are developed in membrane, no cartilaginous mould precedes the appearance of the bony tissue. The membrane which occupies the place of the future bone is of the nature of connective tissue, and ultimately forms the periosteum; it is composed of fibers and granular cells in a matrix. The peripheral portion is more fibrous, while, in the