

a certain amount of cytoplasm about it, so that the mother cell is now represented by a cluster of hæmoglobin containing daughter-cells. These masses of cells have been spoken of as blood islands. As the stages of the development of these early blood cells can be definitely traced from the endothelial lining of the primary vessels there appears little doubt that the early nucleated red blood cells are specialized descendants of endothelial cells. To this view Goette is a strong opponent; he believes that the blood cell has its origin in the yolk, while the endothelial cells arise from mesoderm.

The secondary vascular areas develop within the embryo, and give rise to blood cells from their endothelial lining, in a manner similar to that noted in the extra-embryonic vascular zone. Schaeffer has noted the development of blood corpuscles from the connective tissue cells of the new-born rat. These corpuscles can be distinguished by their decided reddish tinge, while in some the red matter is condensed in the form of globules varying in size from tiny specks to spheroids having the diameter of the blood cell. The connective tissue cells become vacuolated and the blood cells gradually accumulate within the vacuole, until a cavity is formed within the cell, which later communicates with similar spaces in other cells. In this way a capillary network with blood cells within it is developed.

The primitive form of the red blood cell is probably spherical or spheroidal, and the characteristic shape is not assumed until later. In the early stage of development the protoplasm of these cells enlarges for several days, while at the same time there is a progressive diminution in the size of the nucleus. Three types of the red cells can be distinguished during their development: 1, Young cells with very little protoplasm; 2, old cells with much protoplasm and granular nuclei; 3, cells with shrunken nuclei which stain darkly.

Multiplication of the red blood cells by division has been recorded by Remak, Bizzozero and others. The division is indirect and takes place by the formation of nuclear spindles. These divisions occur abundantly in the blood of the chick of 3 to 5 days, and it is safe to assume that the same process is typical for all vertebrates. The number of the red cells is further increased by additions arising directly from the primary vascular areas. The nucleated red cells form the permanent red blood corpuscles in all the vertebrates except the mammals. In mammals, they disappear in embryonic life, or soon after birth. How these cells disappear is not known, though some authors have maintained that they are transformed into the non-nucleated variety.