1898

The Life History of an Animal Cell

William Ferguson Harley
University of Rhode Island

THE LIFE HISTORY OF AN ANIMAL CELL.

The first glance at the highest species of animal and vegetable life reveals a vast difference and they seem to have nothing in common. But microscopic examination fails to show the distinction between some forms of the vegetable and animal kingdoms. It does, however, make plain that every living object from man to the Amoeba, from the largest to the tiniest plant, is composed of cells.

A cell is generally spoken of as a unit of structure, just as a single brick is called a unit of structure. It is regarded as an individual organism. A cell is not, as one might infer from the word, a hollow cavity surrounded by solid walls, but a "closed vesicle with homogeneous and striated walls." The study of a single cell in a Metazoön is almost impossible; but fortunately there is a Protozoön, the Amoeba, which is accessible to the investigator, and this has been of the greatest value to him.

It is a jelly like, structureless substance, and for all physiological purposes, cannot be distinguished from any active cell. The Amoeba is able to move about by thrusting out lobe like prolongations (pseudopodia). Occasionally one will find a pseudopod cutting itself off from the rest of the body and possessing all the properties of its parent. All organic

matter is built up by the addition of particles of matter derived from without and transformed into the new substance. So an Amoeba in order to live absorbs nutritive materials found in the surrounding media, and oxygen, which in combination with Carbon is agian excreted as Carbon-Dioxide. The Nitrogen is excreted in some antecedent form of Urea. It is interesting to note that out of nearly seventy chemical elements, four- oxygen, hydrogen, carbon, and nitrogen- are certainly essential to all life. We conclude from these facts that cells are irritable, conductive, contractile, respiratory, nutritive and reproductive.

Protoplasm is a substance of which all organized bodies are composed. It is divided in the cell into two parts; a nucleus, called nucleoplasm, and cytoplasm. The nucleus is the determining structure of an individual cell, causing the cell to act as it sees fit. Its outline bears no relation to the shape of the cell itself. It is seperated from the cytoplasm by a very thin membrane. Without a nucleus, a cell would be deprived of its power of assimilation and growth, and hence could live only a short time. Contained in the nucleus are two substances; a network, or chromatin, and a transparent mass surrounding the chromatin called linin. The cytoplasm is also divided into two constituents; the endoplasm, in which

the nucleus lies; and the exoplasm, from which the cell membranes may take their origin. The nucleoplasm and cytoplasm possess a very complicated structure similar to that of a sponge. The solid part of sponge or reticulum and intestices are filled with a liquid called enchylemma. Situated near the nucleus and occasionally found in the linin of nucleus itself is a small body, a centrosome, enclosed by an attraction sphere. This body has been the subject of much discussion of late, and is regarded by many as more important in the process of cell division than the nucleus. It is known as the special organ of cell division. Besides all these cell organs, so to speak, are found many lifeless bodies known as metaplasm; such as, food granules, oils, excretory matters. The cell itself is nearly circular in shape, although the form is greatly modified by mutual, pressure or unequal growth or perhaps by active movement. A true cell cutting the nucleus and centrosome in halves exhibits a definite polarity having both sides symmetrical. This polarity of cells is a great problem to Cytologists.

After the structure of a single cell has been studied, the question naturally arises, How are new cells formed? It has taken generations to determine the exact process of cell division. In the highest forms of life the indirect division,

or Mitosis, occurs. It is a complicated process, passing through a series of changes; the prophase, which is preparatory; metaphase, which effects a change in the nucleus; anaphase, during which the nucleus substance is distributed; and last of all, the telophase, in which the cells divide forming daughter cells. As the cell prepares for division the chromatin revolves itself into a quanity of threads known as a skein, which soon breaks transversely into a number of chromosomes having a rod or curved shape. "The number of chromosomes found in man is 16." The membrane of the nucleus breaks away leaving the chromosomes naked in the cell. The centrosome, which is surrounded by a centrosphere, divides into halves. Around each centrosome an aster is formed, looking very much like "the arrangement of iron filings in the field of a horseshoe magnet." The asters are held together by a spindle or shaft. As this process goes on the chromosomes pass through the spindle, forming what is known as the equatorial plate. Each chromosome splits longitudinally into halves, which diverge to opposite poles of the spindle. This is perhaps the most important step in cell division. It shows that each new cell will receive an equal amount of chromatin. After the chromosomes have split, they become crowded in a mass near the centre of the aster. They are not separated en-

tirely, because as they diverge connecting fibres are formed streching across the interval between them. Then the whole cell is seen to divide, each new cell obtaining an equal portion of chromosomes, spindle, and aster with its centrosome. The chromosomes mass themselves together to form a new nucleus. It is interesting to note that if new cells receive unequal amounts of chromosomes the nuclei will be unequal. It is held by many that the formati n of the asters and spindle (amphiaster) due to the influence of the centrosome is perhaps the most important stage in cell division. The division of chromosomes is due to the contraction of the two sets of connecting spindle fibres to which each is attached.

The process of cell division is very much more rapid in the early part of life. It has a limit, and division gradually ceases as the limit is approached, although in many cases cell division goes on throughout life replacing other cells broken down from different agencies. Cell division is consequently not always uniform over the entire body. The question, Why does a cell cease to grow? may be thus answered. So long as surface which absorbs nutriment for maintenance, of cell is adequate to that maintenance, so long will it grow; but when the content is greater than the capacity of absorbing surface, the cell must stop growing and one of

three things must occur. The cell will remain stationary, it will divide, or it will die. It generally divides. All the essential activities of life are combined in each individual organism just as much in a Protozoön as in a Metazoön. We might say that life, is a constant struggle against forces trying to destroy. Cells are held together by mutual cohesion or by excretory matters secreted by them. All division is due to excess of growth upon excess of nutrition. The two must go hand in hand. Life perhaps could be sustained for a very long period, if no agencies, of a destructive nature interfered with the nutrition and growth of the cells. Life, then, is a ceaseless change.

Wm. F. Harley.