Reyburn (R.)

LAWS OF GROWTH OF THE CELL APPLIED TO HUMAN ANATOMY.

BY ROBERT REYBURN, A. M., M. D.

Reprinted from the MARYLAND MEDICAL JOURNAL, October 7th, 1893.

29

LAWS OF GROWTH OF THE CELL APPLIED TO HUMAN ANATOMY.

BY ROBERT REYBURN, A. M., M. D.

Reprinted from the MARYLAND MEDICAL JOURNAL, October 7th, 1893.

LAWS OF GROWTH OF THE CELL APPLIED TO HUMAN ANATOMY.*

BY ROBERT REYBURN, A. M., M. D.,
Professor of Physiology and Clinical Surgery, Medical Department Howard University, Washington, D. C.

Reprinted from the MARYLAND MEDICAL JOURNAL, October 7th, 1893.

The human ovum from which all the tissues and organs of the adult human body are built up is, in the earliest stages of the embryonic life, nothing more than a simple cell or mass of protoplasm.

These masses of protoplasm or cells (which form the ova) are practically identical in all animals, and consist of a fecundated living germ, which has surrounding it a limited supply of food yelk or nourishment. This serves to nourish the embryo, until other structures are developed, which carry on the process of nutrition during the entire period of fœtal existence.

As the human ovum or egg is directly transformed during the process of development into the adult human body, it is self obvious that the laws governing the growth of the human ovum must be identical with, and furnish the key to, the laws governing the growth of the organs and structures contained in the human body in its adult or completed form.

What, then, are these laws? Or rather the causes and conditions which modify the growth of cells?

The first of these conditions here to be specified is, that cells grow in size by

*Read before the Section of Anatomy, Pan-American Medical Congress, September 6, 1893.

layers of nutriment applied on the outer surfaces of the cells. This is always accompanied by a nearly equivalent amount of waste material absorbed from their inner surfaces. So long as the amount of nutritive material absorbed and deposited upon the outer surfaces of the cells is greater than the waste from their inner surfaces, the cells continue to grow and increase in size until the time of maturity is reached.

Just at this point the forces of waste and destructive assimilation are balanced by the powers of the organism to absorb and assimilate nutriment.

After the period of maturity has been reached the retrograde process begins. The individual cells and in consequence the body as a whole, gradually cease to absorb and assimilate as much of nutritive material as is required to supply the waste, hence the inevitable result is death, the great and pitiless law that rules the organic world.

How then does the human body as a whole grow from infancy to maturity? Precisely as the individual cells of the body do.

Take, for instance, the development of the great arterial trunk of the body, the aorta. In the new-born child the aorta is a small tube, the lumen of which will measure perhaps three-eighths of an inch across; when this same child shall have reached adult manhood his aorta will have become a great tube an inch or more in diameter.

This increase in size, it is very evident, must have been produced in the way above described. As years pass on, numberless layers of microscopic tenuity have been piled upon the outer surface of the aorta, thus increasing the thickness of its walls. Along, and indeed simultaneously with this process, goes on the absorption and waste from the inner surface of the blood-vessel, in this way increasing its internal dimensions. This same law is applicable to the growth and development of the intestinal canal with the stomach and accessory organs of digestion to the development of the Haversian canals and medullary cavities of bone to the growth of the shafts of the long bones of the extremities, and the growth of the limbs. Not only is this law of growth true of every organ and structure found in the body, but it is just as truly applicable to the growth of the human body as a whole.

The second of these causes which modify the shape of living is their tendency to grow in the direction in which they can find the most abundant supply of nutriment. Living cells, when found free or floating in the liquids of the body, are always found to be circular in shape. As found in other parts of the body they vary greatly in form and size. Take, for instance the lacunæ or bone cells as found in human bones; these were originally circular or ovoidal cells; as the process of transformation of cartilage into bone goes on, the cells become incased by layers of earthy matter surrounding them. This would prevent the possibility of their absorbing sufficient pabulum to provide for their nourishment; in order to overcome this difficulty the cell in its process of growth absorbs certain portions of the earthy walls enclosing them, and thus the myriads of canaliculi or fine tubes which connect the bone cells and the Haversian canals are formed. The canaliculi are of course too fine to admit the passage of the red or white corpuscles of the

blood, and their nourishment is carried on by the liquid plasma.

Many illustrations of this second law are to be met with in the body; it is only necessary here to mention the rapid repair of fractures of the long bones of the body, when the fracture occurs just below the point where the nutrient artery enters the bone, as compared with the slowness of repair when it occurs just above, thus partially cutting off the circulation of the blood in the part.

The more perfect ossification of the bones of the cranium, as compared with the other bones of the body of the newborn child, is probably due to the position of the fœtus, which usually lies suspended with the head downwards in the uterine cavity.

In fact, it is generally admitted that the growth and development of every tissue and organ in the body is directly proportioned to the amount of the blood supply.

The third cause modifying the form of the cells is that each cell, under favorable conditions, tends to reproduce the same type of parent cell from which it sprang. Bone tends to reproduce bone, muscle reproduces muscle, and so in like manner do all the tissues and organs of the body. In pathological growths we do find alien and foreign tissues in the diseased parts of the body. Bone, for instance, is often developed in epidermoid cysts, and in parts of the body which in health are composed of cartilage and muscle.

One important fact, however, is to be noted in studying the constituents of pathological growths, and that is that all growths are histologically true to the kind of tissues which are formed by the layer of the embryo from which they originally came. As is well known, the human embryo primarily divides into two layers, the ectoderm or epiblast and the endoderm or hypoblast. A third layer is afterwards developed between these, which is called the mezoderm or mezoblast. Tissues therefore which originally sprang from the ectoderm or endoderm layer of the embryo do not either in normal or pathological growths tend to reproduce the tissues which were originally formed from the mezodery or middle layer of the embryo.

The fourth cause modifying the shape of organic forms is the pressure of other cells upon them during their earlier period of development. The flattened shape of the cells found in the epidermis, in the hair and many other parts of the body, is evidently due to this cause, and the same result is seen from pressure in the multiform shapes of the cells of the tissue invaded by cancerous tumors.

So numerous are the instances to be found in the body of these changes of shape produced by pressure, that it is unnecessary further to dwell upon them.

After maturity the retrogressive change or metamorphosis immediately begins in the tissues of the body, the powers of assimilation of nutriment become gradually insufficient to keep up with the waste of all the structures of the organism, and hence the body as a whole tends to emaciate. Not only is this the case, but the power of the individual cells to separate the waste material which is formed as the result of their nutrition becomes impaired. These waste materials as a consequence accumulate, and cause thickening of the cell walls of all

parts of the body. One of the most striking of the results of this process is to be seen in the hardening and calcification of the arteries which is so commonly found in persons of advanced age. The tissues themselves tend to degenerate in old persons. Muscle becomes degraded into fat, and the same process invades all the connective and other tissues of the body; a familiar example of this is seen in the arcus senilis or fatty degeneration of the cornea, which is one of the surest signs of the aging of the tissues.

It may perhaps seem necessary to apologize for presenting to the readers of the JOURNAL such an elementary sketch of the growth and development of the human body, yet it is a necessary preliminary to my chief object, which is to call attention to what I believe to be our unscientific method of teaching human anatomy.

The ordinary way of teaching human anatomy in our medical schools and colleges is to begin by teaching studying the bony framework of the adult human body. This has always seemed to me to be an entirely erroneous method, for it adds unnecessary complexity to the study and prevents the student from grasping the real simplicity of the idea of man's structure, when it is studied from the point of view of its being simply a development of the human ovum.

If we take up the study of chemistry, for instance, we never begin by studying the more complex compounds first; on the contrary, we first master the elements out of which the complex bodies are formed, and thus proceed from simplicity to complexity.

This same statement is true if we take up the studies of botany, mineralogy, geology, or in fact any of the branches of the natural sciences.

Why, then, do we adopt a different study of human anatomy from the one we use in the study of all the other branches of natural science ?

My idea, then, of the true way to teach human anatomy would be to begin by demonstrating the human ovum or cell, then the fluids, such as the blood and lymph in which the cells are found free and floating. After this, study the changes produced in the ovum by impregnation, the segmentation of the ovum with the development of the blasto-dermic membrane, and its further division into its external and internal layers.

Study, then, the tissues and organs formed from these layers in their order of development, then take up the study of the development of the third layer of the embryo, with the organs and tissues formed from it. The study of human anatomy carried on by this method gives to it a simplicity and beauty that renders it worthy of being numbered among the exact sciences.

It may be here remarked that this method is not a new or untried one, for several years Professor Piersol, of the University of Pennsylvania, has taught anatomy by a method similar to the one above mentioned, and the writer a number of years ago, when teaching anatomy in the Medical Department, Georgetown University, adopted with success the same plan.