ART. III.—*Elements of the General and Minute Anatomy of Man and the Mammalia, chiefly after original researches.* By FR. GERBER, Prosector in the University of Bern. To which are added Notes, and an Appendix comprising researches on the Anatomy of the Blood, Chyle, Lymph, Thy-mous fluid, Tubercle, &c. By GEORGE GULLIVER. F. R. S. With an Atlas containing 34 plates. 8vo., pp. 390, pp. 106 of Appendix, and pp. 71 of Explanation of Plates. London, 1842.

THE microscope has of late years opened up a completely new field of inquiry; and to it the anatomist, physiologist, and pathologist are looking with the most eager anticipations for the solution of many of those phenomena, which, in the present state of our knowledge, are left unexplained.

Of the many applications of the compound achromatic microscope, that to the examination of the minute structure and atomic constitution of the fluids and textures of the animal body is to the physiologist and pathologist the most important, whether we look to the mysteries in action and function which it may disclose, or to fertility of its results in illustrating the origin and nature of morbid action and morbid changes. Some idea of the fertility of the results obtained by the proper use of this instrument in able and competent hands may be obtained by considering how much has been learned in this department during the last ten years, by the labours of Ehrenberg, Müller, Berres, Henle, Mandl, Schleiden and Schwann, Allen Thomson, Purkinje, Valentin, Martin Barry, Retzius, Nasmyth, Owen, and Goodsir, and the present author. Of all this inquiry, however, one effect is manifest. Much if not all that we have hitherto learned of the anatomy of texture, or general anatomy, requires to be rectified and new modelled. Our knowledge, however correct, so far as it goes, or carefully obtained, must to a certain extent be imperfect and deficient, while we cannot penetrate into the mysteries of the minute structure of the textures. In carrying forward, therefore, the science of general anatomy to the present time, it is requisite to embody in it all that has been ascertained by the use of the most perfect instruments, and all that is confirmed by the united testimonies of different observers.

The present work is a valuable addition to our stock of knowledge of the minute structure of animal bodies, containing as it does many original researches of the intelligent author, and also valuable notes by the translator, who has already signalized himself by his diligence in microscopic pursuits. We are at present

in possession of too few facts to enable us to decide on the comparative accuracy of the statements of the various authors who have written on the microscopic appearances of the various solids and fluids of the animal body; it would be a vain task, therefore, to compare these together, or, out of the confused, discordant, and often contradictory statements, to endeavour to decide as to the comparative merits of each. It appears that our purpose would be better answered by giving a short, and as succinct account as possible of the contents of the present volume, leaving it with our readers to judge of the value of the statements.

After a short introduction, in which the advantages of a correct knowledge of the structure and functions of the body is pointed out as the foundation of all medical science, Mr Gerber shows that, though the object of the anatomist and chemist be different, their labours tend to illustrate the same point. The organic constituents of the animal body are divided by the author into proximate or compound, and remote or simple, and he instances the blood corpuscle as "a proximate or compound organic element of the blood, the outer coverings and the nuclei of these bodies a remote or simple organic element of the same fluid." As he also adheres to the chemical division of bodies into simple and compound, perhaps he might have chosen terms which would be less liable to misapprehension than those he has selected.

The author then enters into a review of the chemical constituents of the animal body, and endeavours to show, that whilst inorganic matter is distinguished by the peculiarity of having its elements always associated in twos, or forming binary combinations, vegetable matters are composed of three elements, and animal matters of four. He holds that this is the cause, why the elements which form vegetable substances have a greater tendency to enter into new combinations, or are more obnoxious to decomposition than minerals, and animal matter again more than vegetable. We pass over, however, the author's theories on this subject, based as they are on a seemingly erroneous notion of the ultimate elements of which the animal tissues are composed. This will be apparent to every one when it is stated that he quotes the horny tissues as those "in which azote is almost wanting," when every chemist knows that they contain that element in at least equal proportion to fibre itself, and instances the brain as being the most highly azotized of all, whereas it is notorious that it contains a considerably lesser proportion of that element than most others.

We pass then to Mr Gerber's statements relative to the transformations and interchanges of organic matter. Fibrin, albumen, and gelatin are the most important proximate principles, and though during life they possess peculiar properties, they are so

closely, allied that, under the influence of the vital force, the one is readily changed into the other; fibrin seeming to hold the middle place between the other two. All the principles of animal bodies are capable of being appropriated by plants as nourishment, undergoing transformation into vegetable matter; and the elements of plants, when consumed by animals, undergo new transformations, and are converted into animal principles. Organic matter, therefore, he assumes, is in a state of perpetual change, ever assuming new and appropriate forms. Liebig has fully proved the fallacy of such a statement; but, as an abstract of his researches is given in the present number, we refer to what is there stated.

After shortly mentioning that he divides the fluids of the body into the watery or serous, the oily, and those of a mixed nature, the author proceeds to enumerate shortly the various solids which are produced from these fluids. Under the first head, "Unorganized Solid Parts," he enumerates drops, as oil in saliva, oil in milk, various solid precipitates, crystals, and all calculous deposits, concretions, &c. Under the second head, "Imperfectly Organized Constituent Elements," which he characterizes as being a hyaline or vitreous substance, forming a considerable constituent element in the animal body, and as amorphous in itself, is ranged the crystalline lens, the pulp of the umbilical cord; and that the same hyaline substance exists as an intercellular substance, or an elastic bond of union in the cellular cartilage, cartilage of bones, canalicular or tubular structure of the teeth. Under the third head, "More highly Organized Constituents," fibrin and organic granules are included. Fibrine is the general formative element, or blastema, and is held dissolved in the serum of the blood. Fibrine in coagulating consolidates into a determinate hyaline substance, which, in the greatly debilitated, or in the dead body, falls into granules, or forms an aggregate granular mass. Plastic fibrine has, therefore, according to Mr Gerber, two forms, that of a vitreous substance, and that of granules. Other coagulating matters have the same properties; thus albumen, which he states is a more highly assimilated substance, when it sets gradually within or without the body, forms organic granules, which are not capable of a higher organization; but when it sets quickly, it forms a coherent mass, which shows no trace of organization. The fibrine of the blood forms, in setting, a true hyaline substance, which encloses the blood globules, precisely as that of cartilage encloses the cartilage corpuscles. When it coagulates in contact with the interior of the living body, immediately higher organic principles are proclaimed in the formation of compound corpuscles, which either swim free in the fluid, as the globules do in the blood, or appear as isolated bodies dis-

seminated through a hyaline substance, or variously arranged without any common bond of union, and so attain their final development. Lastly, they present themselves as mere transition forms of more highly organized products, which, on the completion of development, entirely disappear. These corpuscles, it is stated, are the primary types of all higher formations in vegetable as well as in animal bodies; they are and were the universal organized condensations of the living plastic fluids. To these corpuscles the terms nucleolated nuclei, cell-germs or cytoblasts, and encased nuclei, have been applied.

In illustration of his particular views regarding the elements of organization, the relation which they hold to each other, and the supposed organization or evolution of the elements of animal bodies out of the cell germ, a very curious table is appended by the author; but for this we must refer to the work itself.

The granules so universally met with in the animal body, the author regards as composed of albumen. There is scarcely a watery or mixed animal fluid without its granules; wherever albumen in solution is met with, there are granules present. In the chyle, so long as it is contained in vessels beyond the mesenteric glands, granules only, from the 500th to the 400th of a line in diameter, are discovered, but after the fluid has passed through these glands, it is found to contain cell germs or lymph corpuscles. In all transudations of the *liquor sanguinis* upon internal surfaces, or into the tissues, cell germs are produced, and wherever cell germs perish, there appears to be a retrograde tendency to the formation of granules. From the exudation globule is formed the pus globule, which very speedily falls into its constituent granules. Granules are often seen collected into heaps or masses, when they form aggregation corpuscles. The elementary granules are then held together by a fluid, and separate when this is attenuated in any way. When granules unite in rows like strings of beads, a granular fibre is produced. Several of these fibres lying parallel and in apposition form a granular fibrous cord if cylindrical, or a granular fibrous bundle if flat. When the same fibres are seen in two directions, they form a granular membrane.

The fourth head is necessarily the most important, as being devoted to the consideration of the "completely Organized Constituent Elements, parts endowed with inherent life, and capable of peculiar evolution." And first, of the cell germ, encased nucleus, or cytoblast. This structure, which has been long known as a general constituent part of the structure of vegetables, has been also of late said to be equally common in animal structures.

The author describes the cell germ as in the beginning a lenti-

cular or cake-like corpuscle of a yellowish-white or dull-red colour, which encloses a nucleus, and is perpetually produced in the shape of an organic precipitate in the fibrinous vital fluids, the blood and lymph. The size of this organ seems to bear a general relation to that of the blood globules, according to Gerber; but in a note Mr Gulliver states that such is not the fact, as, in most animals he has examined, these fibrinous globules were of equal size, though the blood globules of the different animals were of very various sizes. The cell germ either remains as it has been described, or there is a vesicle developed upon and around it, which is called a cell. In the chyle and blood this body floats at liberty; it is, however, commonly met with as a principal ingredient of consistent exudations. When the cell flattens, the cell germ occupies the middle as a nucleus, or there is a nucleolus evolved within a nucleus. The cell either remains as such, or it is a mere transition form into other and more highly organized products.

The author next passes to the consideration of the chyle, and states, that if we follow this fluid from the moment of its appearance, with an eye directed at once to its chemical and microscopic analysis, and mark the various changes which its chief constituents undergo, until they appear as cytoblasts, we perceive they advance from binary to quaternary combinations of elements. Near the intestine, the author states that the chyle consists of water, in which a little albumen and salts are dissolved, whilst its white colour is owing to a multitude of oil globules suspended in it. This appearance is differently accounted for by Mr Gulliver, whose researches on chyle will be noticed afterwards. As the chyle approaches the mesenteric glands, the quantity of fibrine appears to increase partly at the expense of the albumen, partly of the oil globules, so that at these glands there is remarked a commencing precipitation of albuminous granules. It is inferred, that in the mesenteric glands some of the albumen becomes changed into fibrine, as the chyle when drawn from the vessels, after passing these ducts, separates into a solid coagulum and a serous fluid. The central lacteal vessels at a short distance from the glands contain a number of extremely delicate, scarcely coloured lymph corpuscles, which are in fact cytoblasts or blood-globules in process of formation. These go on increasing in number, consistency, size, and red colour in their progress through the thoracic duct,—the coagulability of the chyle, and the firmness of the coagulum increasing in the same proportion.

Lymph is described very shortly as being of still more various constitution than the chyle, and as being viscid in consequence of its containing the dissolved elements of the system. Albuminous and oil globules are sometimes present, sometimes ab-

sent altogether, and it only coagulates if there should be any fibrine present.

The blood next engages the author's attention, and, after enumerating the known properties of that fluid, stating that it appears with the earliest traces of life in the embryo, enumerates the various organic elements met with in that fluid, viz. blood globules, separated nuclei of blood globules, and albuminous granules, and in the frog minute entozoa.

In all the vertebrata the blood globules are flat, rounded, or elliptical discs, and, like all cytoblasts, contain a nucleus in their centre of the same general form as the globule itself. Generally speaking, the blood globules and their nuclei are rounded in the mammalia, elliptical in birds, reptiles, and fishes. The nucleus is described as projecting on either side of the disc in the frog, and in the spider the author observed the blood globule to have the form of a meniscus. The size of the blood globules vary in different classes of animals. In the human subject their diameter is from the 300th to 250th of a Paris line; that of the nuclei being about the 400th of a Paris line.

The cell or capsule of the blood-globule is, like the nucleus, transparent, and includes the hæmotosin or red-colouring matter. The author asserts that it is this capsule which is the bearer of the carbon from all parts of the body to the lungs, and of the oxygen from the lungs to every part of the body. The experiments on which this statement is founded are not however given.

The nucleus of the blood-globule is described as the most puzzling part of all the structure, as "not only is it of different sizes absolutely, but it is so relatively to the shell or capsule even among mammals." One or two instances are given of this, and as the most striking, that of the foetus of the mammalia, whose blood-globules, as well as nuclei, are comparatively larger than in the adult animal.

Several circumstances are stated relative to the number and character of the blood-globules in different diseases, as the loss of colour in the chlorotic; their paucity in anemial states of the system; their increased proportion after exudations of the *liquor sanguinis*, or of serum, &c.; a few circumstances are also mentioned with regard to the exudation, true pus, and ichor corpuscles; but, as the subject is treated more at large afterwards, it seems unnecessary to notice what is here stated.

The author then enters on the most important part of his subject,—the "origin, evolution, and ultimate structure of the living constituent elements of animal bodies, and of the animal tissues." In order to render his meaning more intelligible, he prefaces this part of his subject by a few general considerations regarding the

motion of fluids, the gravitation of fluids, hydrostatic or passive congestion, and active congestion. Mr Gerber, after briefly stating that nutrition, secretion in glands, &c. takes place by a normal endosmotic transudation of fluids through the coats of the vessels, passes on to the consideration of the morbid escape of fluids by exudation from the vessels. Three forms of exudation he allows to be caused by inflammation,—watery or serous matter, plastic matter, and sanguinolent matter, which last forms the transition to hemorrhage.

In the serous exudations, albuminous granules are stated to be of frequent occurrence. In the plastic exudations a yellowish turbid fluid is found in the affected cavity, having fine flocculi of a pale yellow colour floating about in it, or adhering to the boundary parietes. It is stated that, if the coagulable lymph is in large quantity, it is a sign that the exudation has been rapid, and that if death occur, this hyaline substance quickly becomes granular or even dissolved in the serous fluid. Mr Gerber differs from Mr Gulliver and other observers, in stating that true pus globules are never met with in shut cavities unless there be some external wound. The pale-yellowish bodies which are met with in the serous fluids of shut cavities, he regards as “corrupted fibrine, a sign of approaching death.”

If the inflammation ends with the exudation, and the animal recover, the loose floating particles of fibrine become dissolved in the serum, and are removed by absorption along with it. Those masses, however, which are attached, assume a bright-yellow colour, and are stated by the authors to consist of connected exudation globules, which form in from twenty-four to thirty-six hours after the exudation. These corpuscles he describes as in every respect the same as the lymph corpuscles, and from being laid over each other in superimposed layers, constitute membranes bearing a strong resemblance to tessellated epithelium, especially when the connecting medium of the corpuscles has disappeared, and allowed them to press against each other. Some hours after this, a tendency to the formation of a fibrous structure is observed; the globular parts arrange themselves in lines, each acquiring a spindle-shape, being lengthened in the direction in which they form the fibre. The nucleus of the exudation globule still remains visible in each, and either subdivides into several granules, or has a new nucleolus evolved within it. An interposed hyaline substance still remains interposed between the fibres. The author states that occasionally the organization just described remains stationary, or undergoes no further development, as it is seen to do in the sheaths of the soft nerves, and more delicate vessels; but, in other cases, the cellular fibrils are transformed into round filaments. As this

process goes on, the intercellular fibrils get longer, whilst the fusiform nuclei get smaller, and at length entirely disappear.

Even before the formation of the round filaments, the author states, blood-vessels may be seen forming a capillary net-work through the effused plastic lymph. Mr Gerber is not very explicit as to how these vessels are produced. We gather, however, that arborescent streaks, which inosculate with one another, appear, but, before being completed, pale-coloured cytoblasts are produced within them, which are afterwards pushed, by the current of blood from the neighbouring artery, into the nearest vein. Such, then, is the process which Mr Gerber states the plastic lymph undergoes during its transition to a vascular membrane. The same exact process, he says, lymph undergoes whenever it is thrown out, whether on the surface of membranes, between different organs, or in the walls of shut cavities.

The "formation of pus, and the reproduction of organization in suppurating wounds or sores" are next noticed. Clean incised wounds are described as healing in a few hours by the first intention, in virtue of an effusion of fibrine, which fills up the accidental hollows between the cut edges, producing cytoblasts, which again are transformed into cells, and these again undergoing their final organization. Wounds, however, with a loss of substance, heal by suppuration and cicatrization, the process in which case is described shortly as follows: "After having bled to a greater or less extent, the wound becomes stiff and painful and dry; an exudation of the *liquor sanguinis* is then established from the entire extent of surface, and this goes on incessantly till the injury is repaired. The fibrine as it coagulates on the surface forms exudation globules or cytoblasts, many of which cohere in layers, and compose the false membrane that finally invest the entire superficies of the sore. The layers of globules in most immediate contact with the living tissues become cells, which then undergo farther transformation in accordance with the nature of the structure to be reproduced; those layers of globules again, which are more remote from the living parts, become pus-globules, and then mingled with a small quantity of serum compose true or laudable pus." P. 90.

A number of radiating lines are described appearing on these pus globules, appearing to divide the globule into six or eight segments, whilst the nucleus appears to fall into from two to four pieces. When pus is kept it is stated that it gradually falls into those granular elements of which it is composed. Pus globules are usually larger than those of the blood. From the author's chemical analysis it results that the younger the pus, the larger is the quantity of fibrine it contains, and the more mature the pus, the larger the quantity of fatty matter. He hence infers that pus

stands in direct contrast with chyle, in point both of organic and chemical constitution. As we before remarked, however, no weight need be placed in the author's chemical statements, or reasonings founded thereon, as he has formed very generally erroneous views of the elementary composition of the tissues and fluids of animal bodies.

Under the head of "false pus," the author includes all those purulent-like secretions which do not appear in connection with the reproductive process. He says the form of this kind of pus differs from true pus; but he neglects to inform us in what that difference consists; whilst, on the other hand, he allows that true pus globules occur in close cavities, in secretions from the kidney, lungs, breasts, &c. The fluids of *bullæ*, *phlyctenæ*, and pustules he does not allow to consist of true pus, but of "a serum with albuminous granules;" true pus only appearing if the skin is so deeply injured as to require the reproductive process for its renewal.

The ichorous discharge from unhealthy sores is described as consisting of the altered constituents of the blood. The *liquor sanguinis* coagulates in granules, and the blood globules becoming puckered, corroded, and broken down, constitute the ichor corpuscles.

The various granular-looking and fluid matters occasionally formed in cysts are described as differing from true pus, and as being in general composed of exudation corpuscles, which lose their serous fluid, and then form a dry substance, which is much disposed to run to suppuration, but is also convertible into fibrous tubercle.

The author describes very minutely the process by which the cicatrization of the sore is effected, which is, generally speaking, the same as that above noticed relative to the organization of plastic lymph, with the exception that the cytoblasts most remote from the surface of the wound burst, fall into granules, and become transformed into pus globules as above described. The granular appearance of a cicatrizing sore is attributed to the convolutions of the new blood vessels and nerves beneath the newly formed plastic layer.

The various appearances which the ovum presents, from its first appearance in the foetus, till its full development in the adult, and its impregnation, are minutely described, and the addition of its various component parts traced. The general development of the impregnated ovum is then very briefly yet succinctly described, showing that the process of evolution appears to consist in evolution from cells.

After shortly pointing out the analogy which late researches

seem to show exists between animal and vegetable development, both appearing to arise from cells, Mr Gerber proceeds to describe the different constitutions of these bodies, such as the position of their nucleus or cytoblast, their fluid albuminous contents, the appearance of granules in this fluid, the origin of the nucleolus within the nucleus, the different forms of cells, their elongation into fibres, or tubes, &c. As the result of the present amount of our knowledge on this subject, he quotes from Schwann the following classification of the animal tissues,—an arrangement, however, which he does not follow in the present volume.

“*1st Class.*—Isolated independent cells. To this class belong especially the cells of the various fluids, lymph corpuscles, blood corpuscles, mucus corpuscles, purulent matter corpuscles, &c.

“*2d Class.*—Independent cells united into continuous tissues. To this class belong the whole of the horny tissues and the crystalline lens.

3d Class.—Cells, only the walls of which blend together. Cartilage, bone, teeth.

4th Class.—Fibrous cells or cell-fibres. Cellular tissue, sinewy tissue, elastic tissue.

“*5th Class.*—Cells, the walls and cavities of which are alike blended and united. Muscles, bones (?) capillary vessels.”—P. 131.

Mr Gerber commences his description of the tissues with that of the *pigmentum nigrum*, which he states consists of minute granules which appear pretty evenly dispersed through a hyaline substance. In the choroid coat these granules, either form aggregation-corpuscles, or are enclosed in cells to which they give their dark colour. These pigmentary cells, either form groups, as in the skin, or continuous membranes, as in the choroid coat, where they assume polyhedral forms. It is also stated that these pigmentary cells often undergo elongation into hollow fibres. Nucleoli often appear within the nuclei, but both these disappear in horn.

The fat vesicles or cells, with their nuclei, are shortly described, and an important physiologico-chemical fact is stated, viz. that ether removes the fat from its vesicles without rupturing them.

The horny structures, of which the epidermis is the most important, are described as consisting of several layers of cells, which are produced upon the corion, as a consequence of an uninterrupted process of exudation, accompanied by a like continuous formation of cytoblasts and cells. Those in contact with the corion are spherical, but flatten as they approach the surface. Inter-cellular matter is said rarely or never to be met with between

the cells of the cuticle. Hoofs, claws, nails, horns, &c. are more strikingly developed portions of this tissue, whilst cutaneous glands and hair are regarded by the author as involutions of the same.

The sebaceous glands are stated to be merely involutions of the epithelium or cuticle, serving the double purpose of excretory canals, and sheaths for hair. In some the excretory duct is described as having a cork screw twist in its passage through the thick cuticle and terminating in the corion in one or two moriform or botryoidal glands.

The sweat glands again project into the subcutaneous cellular tissue, their excretory duct simply piercing the skin. It seems not to be well ascertained whether they too consist of involutions of the cuticle. The secreting part of the apparatus consists of a congeries of sacculi of an irregular mulberry form, and the excretory ducts are generally straight.

Hairs are epidermic threads implanted in the substance of the corion, or horny cylinders produced by involuted and revoluted processes of the epidermis. The epidermis is described as being reflected funnel-wise into the substance of the corion, so as to form the excretory duct both of the sebaceous gland and of the hair. That destined to form the sheath of the hair, however, passes deeper into the corion, where it becomes expanded, so as to form an oval-shaped cavity, becoming again contracted below. At this point it is reflected, when it again swells out and forms the proper capsule of the hair-bulb, receiving in its interior by the opening left below, the nerves and vessels which penetrate the pulp. The reflected epidermis then forms the shaft of the hair, which, advancing through the excretory duct, appears on the surface as the hair. It is at the point where the epidermis suffers the reflection that the cells are added whose development and contraction form the hair. Each hair thus appears to be a horny tube, enclosing a central medullary thread, the appearance or character of which is not described.

The tactile hairs or whiskers of animals differ in nothing but in lying deeper, generally in the subcutaneous cellular substance, and being surrounded by a hollow nervous bundle.

Nails, claws, &c. are described as being formed essentially in the same way as hair, and as consisting of a congeries of polyhedral nucleated cells without intercellular matter; as they become exposed to the air they harden, when the nuclei and nucleoli of the cells disappear. When these parts are coloured pigmentary cells are disposed through them with a tolerable degree of regularity. The posterior ends or roots of the nails are enclosed between duplicatures of the corion, and it is here the filiform pa-

pillæ, which are the source of the growth of the hair, are met with. No sebaceous matter is poured along the sheath of the nail; its sheath consequently remains adherent to its surface. In man this adhesion would stop the growth of the nail, were it not that new cells are continually being added by all the surface of the sheath adherent to the nail, so that, as it advances forwards, the nail is continually receiving new supplies of matter to its thickness.

The hoofs of animals are described as having the same general mode of growth as the nails, only that as those parts are destined to support the weight of the body, a peculiar arrangement occurs by which the formative papillæ and vessels are secured from the effects of injurious pressure, and fine canals, which seem to be the ducts of sebaceous follicles, run through the length of the hoof from its crown to its bearing edge. They are stated to be filiform and spirally twisted in the horse, but the spinal canals have a straight course.

The horns of the ox, sheep, &c. are stated to have the same structure and same mode of development as the hoof of these animals; vessels, however, are seen to run from the point of the bony core to the extremity of the horn, through the horny substance. The walls of the horn are composed of concentric laminæ, with longitudinally disposed ridges and intervening furrows. Sebaceous glands, however, have not been discovered in them.

Recent investigations have shown that all the naturally free surfaces of the body are covered with a cuticle, which has been termed epithelium. This epithelium is composed of cells, the nuclei of which do not, however, disappear. The forms presented by these cells are very various, and have led to the subdivision of these into tessellated, cylindrated, and ciliated.

The tessellated epithelium is stated to cover all the more delicate membranes of the internal surface of the body, as the finer mucous, the serous, and synovial. It is composed of lenticular cells, imbedded in an intercellular substance, and containing nucleolated nuclei in their interior. This form of epithelium lines all the blood-vessels and lymphatics, and may be easily demonstrated on the walls of the heart and great vascular trunks. When mingled with the blood, they are said to be difficult of detection, as their size and form corresponds so accurately with that of the blood-globule. In the serous and synovial membranes, however, the cells are stated to be of larger size. Those lining the ventricles of the brain are said to be in addition furnished with ciliæ, which are attached along the edge of the cell to little warty-looking excrescences.

The cylindrated epithelium has only been met with on mucous surfaces, the cylinders being placed in a position perpendicular to the plane they cover. Their form and size seem to vary according as they contain one or more nuclei. Their mode of develop-

ment is described to consist of the cells from which they are formed becoming raised, like hemispheres, above the general surface. This enlargement goes on till they assume an ovoid form, when the base becomes pediculated, after which the corpuscle becomes campanulate and then cup-shaped. Ciliary prolongations are often seen covering the crown of the cup of these cylinder epithelium cells. They are met with in many parts of the body, as in the nasal cavities, palate and fauces, larynx, bronchi, vagina, uterus, &c. The margin of the cylinder on which the cilia are fixed is generally, thickened, and the author thinks the cilia owe their motion to fine muscular fibres.

It is shortly stated that the mucous and other glands opening on the surface of mucous membranes, receive, like those of the surface of the skin, a lining of epithelium, and that the mucous glands, in point of structure and general appearance, are almost identical with the sebaceous glands of the skin.

Cartilage next engages the author's attention, and this he divides into permanent, or that which remains as such during life, and ossific, or that which becomes transformed into bone. Three kinds of structure exist in these : 1. Cellular cartilage, composed of cells or cartilage corpuscles, as he calls them, scattered through a hyaline or intercellular substance. 2. Reticular cartilage, the cells or corpuscles being scattered between the meshes of a reticulated fibrous matter. 3. Fibrous cartilage, composed of a net-work of fibres and fasciculi. The cartilage cells lie most closely together, when the cartilage is of recent formation.

In permanent cellular cartilage, it is stated that the first appearance the structure presents is an apparently uniform granular aggregation of cytoblasts, which become changed into nucleated cells. At first intercellular matter is only seen where the rounded cells leave spaces between them, but rapidly increases, and in greater proportion too than the cells themselves. The cells are thus separated from each other and assume irregular shapes. The capsule of the cell cannot then be distinguished from the intercellular vitreous or hyaline substance. The cartilage cells, then called cartilage corpuscles, are seen to be filled with a softer substance, in which nuclei are visible. It is stated that new cells are evolved from the parent cell, and also that cells are seen to arise in the hyaline substance, whose origin cannot be traced. Cartilage of the ribs, the ensiform cartilage of the sternum, alæ, and septum of nose, are examples of this form of cartilage.

In the formation of reticular cartilage it is stated that, as soon as an isolating intercellular substance is visible, new cells are evolved in the primary or parent cells, and between these new cells a new hyaline substance. The primary intercellular substance is at the same time transformed into an elastic reticular net-work, in the

meshes of which lie completely formed cells, and older and younger nuclei. The root of the *concha auris* and the epiglottis are examples of this form of cartilage.

The fibrous cartilages, as consisting of parallel fibres, are noticed in another part of the work.

The author's views of the ossification of cartilage are, that the process is the same as that which occurs in the bones of the embryo, and in the renovation and repair of broken bones. To throw light, therefore, on the early process, he first details what occurs during ossification of the costal cartilages. At the point where ossification commences the cartilage cells are found collected in clusters, in all other parts regularly disseminated through the cartilage. These clusters are ever more and more distinctly surrounded and enclosed by a delicate line, probably, the author thinks, indicating the boundaries of the primitive cell. The homogeneous intercellular substance becomes opaque, from the deposition of earthy salts. Bone corpuscles then make their appearance; the cartilage corpuscles disappear, and bone cells are produced in their place.

The author states that all bones of the body have cartilaginous bases or rudiments, but Mr Gulliver, in a note, adds, that certain flat bones, and the shafts of the long ones, never appear cartilaginous before ossification, but that the ossification commences in a soft membranous basis. Ossification, according to the author, proceeds in the foetal bone-cartilages exactly in the same manner as above-noticed relative to the costal cartilages of the adult. The cartilage corpuscles, ever more and more crowded together and compressed, cede the space they formerly occupied to the increasing osseous substance; this grows more and more opaque, from the deposition of earthy salts, bone corpuscles make their appearance, then vessels, and the bone is complete.

A delicate slice of a cylindrical bone exhibits parallel canals, which anastomose with each other, and contain the blood vessels. The spaces between these, constituting the proper bone substance, consist of bone cells, the nuclei of which are termed bone corpuscles. The bone corpuscles are elongated, but have no obvious nucleoli. Fine radiations extend from these on every side to the confines of the cell. The bone cells do not appear to have any vitreous substance between them, but surround the vessels in concentric laminæ, and lie betwixt them with a more or less parallel arrangement. In flat bones, again, the vessels form a common net-work. The spongy bones in general consist of a reticulation of compact bony structure which encloses cavities full of fat cells. No nerves seem to exist in bones other than those which penetrate alongst with the blood-vessels, and seem to belong to them.

The chemical analysis of bone is given, to which Mr Gulliver,

n the form of a note, gives some valuable additions, showing that as yet we know little or nothing of the laws which regulate the relative proportions of earthy and of animal matters, the jaw of a fœtus and of a child yielding as great or a greater proportion of earthy matter than that of the adult. Several general details regarding the bones are given, but on these it seems unnecessary to enter.

The teeth next engage the author's attention, but as we have so lately in this Journal noticed the most recent investigations on this subject, and as Mr Gerber has not only added no new facts, but seems unaware of several of the later discoveries, it is unnecessary to enter into details. It is sufficient to state, that he recognizes them as evidently appertaining to the cuticular formations, and bearing a close affinity to the nails and hair.

The author then takes up the subject of the tissues,—a term which he restricts to those structures which are made up of fibres and filaments, but excludes therefrom those denominated hyaline structures, or structures formed of cells. Under the proper tissues he includes the elastic, fibrous, and filamentous tissues, the last of which he subdivides into the cellular, tendinous, ligamentous, fibro-cartilaginous, contractile, and muscular.

After detailing the chemical and physical properties of the elastic tissue, the author states that its mode of development differs essentially from that of the other fibrous tissues, bearing a great affinity to that of the ossific cartilages. It is stated, that, in the embryonic mass of cells, from which this tissue is developed, stratifications are observed; the cells suffer elongation in the direction of the future fibrillation, and become flatly fusiform, but do not cohere; they remain isolated, with sharp pointed extremities, amidst the consolidating intercellular substance. New secondary cells are abundantly produced in the parent cells of the original tissue. The intercellular substance becomes independently organized, and the cells either disappear or are dissolved, or remain for life. In the mode of connection of its fibres this tissue is said to bear the strongest resemblance to the capillary vascular net-work. When fully developed the fibres consist of prismatic rigid fibres from the 550th to the 400th of a Paris line in diameter, and inosculate at all angles. In the *ligamentum nuchæ* the meshes are so long relatively to their breadth, that they only resemble a slit; in the coats of the arteries, however, the meshes are polygonal or round. This tissue occurs wherever a high degree of mobility and elasticity is required, and the fasciæ, skin, mucous membranes, fibrous cartilages, and many even of the cellular cartilages, ciliary ligament, iris, veins, &c. are mentioned as structures in which it is always present, in addition to those better known.

After a brief detail of the physical properties and general appearance of cellular tissue, the author states, that, in addition to

its division into the fibrous and fascicular, it may with propriety be subdivided into the investing and connecting cellular tissue, and the intimate or component cellular tissue. The perfectly developed cellular tissue consists of extremely fine and transparent smooth cylindrical fibres from the 1600th to the 1200th of a line in diameter, which commonly run in fasciculi of wavy lines. Eight different forms are mentioned in which the fibres of this tissue are compounded, forming flat cords, parallel fibres, membranes, net-works, &c.

The investing cellular tissue is the substance which connects one organ with another, and forms the areolæ which contain the fat vesicles, &c. It is stated that the same substance enters as an essential element into the structure of the parenchyma of many organs, connecting the several particles together so as to form a whole, such as binding the glomeruli of glandular structures into glands, the primary muscular fibres and bundles into muscles, and the primary nervous tubuli into nerves. Mr Gulliver adds in a note, that with regard to one muscle at least, viz. the heart, he has satisfied himself that no cellular substance binds its fibres together, that organ being composed entirely of muscular fibres, without visible intermixture of any other tissue whatever.

The cellular substance is often met with in its transition state from the cell to the filament, in which state it remains stationary in some organs, as around the finer blood-vessels and the tubuli of nerves. The fibres then present regular varicose dilatations at pretty regular intervals.

All the serous and synovial membranes are formed of densely compacted membranes of cellular tissue, which only differ from the smaller cavities of the looser investing cellular substance, in having their free surfaces overspread with a tessellated epithelium. Schwann had previously remarked that the cellular fibre was divisible into a plurality of fibrils; but the author states that he has never been able to see this distinctly.

Tendon is stated to differ little from cellular tissue excepting in its greater opacity, the more invariable parallelsim of its fibres, its greater consistency and rigidity. In its development it resembles cellular tissue, for the minute details regarding which the author refers to what he stated of the development of fibrine. The tendons in the fœtus are said to be formed at an earlier period than the cellular substance. In the long tendons the fibres are "more immediately and intimately in contact," but in other places they are plentifully mingled with cellular substance. When the tendinous fibres unite in cords or bundles and cross each other, they form the tendinous structures, as sheaths, fasciæ, membranes, and ligaments.

The author divides the Tendinous structures into, 1. Long ten-

dons or sinews, which serve as the origin and insertion of muscles and have their fibres parallel to the length of the muscle. Where the tendon meets the muscle the primary muscular bundle is conically pointed, and the fine tendinous fibres arise from the whole cone. 2. Tendinous expansions, aponeuroses or fasciæ, which are the tendinous continuations of flat or membraniform muscles, cover and enclose other organs. These are either entirely tendinous, and the fasciculi run in one and the same direction, as in the oblique muscles of the abdomen, or the fasciculi cross in different directions, as in the diaphragm, or they are mixed with elastic tissue, as in the external oblique. 3. Tendinous sheaths composed of a dense net-work of fasciculi, as in the fasciæ of fore-arm, thigh, &c. 4. Tendinous membrane strengthening the serous and synovial membranes. 5. Peculiar fibrous membranes which surround different organs, generally composed of an admixture of tendinous fibres and elastic tissue. The fibrous structure of erectile organs, the *dura mater*, *tunica albuginea*, periosteum, &c. are examples of this class. 6. Fibrous bands or ligaments, as the ordinary, the round, crucial, &c. ligaments. 7. Fibro-cartilage, consisting of a dense intercrossing of fibres with a considerable intermixture of elastic tissue. This structure unites all the bones which are articulated by synchondrosis, as the vertebræ, &c.

Under the head Contractile Fibrè or contractile tissue the author includes those fibres situated immediately under, and even, he states, in the skin itself, which, on the application of cold, and under the influence of mental emotions, cause the corrugation of the skin and the erection of the hair. He regards this structure as the transition form between muscle and the tendinous structures.

The Muscles are treated by the author under three heads,—those belonging to organic life, those belonging to animal life, and those of a mixed nature. After noticing the usual characters of the organic or involuntary muscles, he states that they consist of yellowish-red transparent fibres, which, though cylindrical when single, are flat or prismatic when united in bundles, from the pressure of the other fibres. They seldom run in straight directions, but are usually bent sinuously, and under the mucous membranes the fibres and bundles open and close so as to form plexuses or meshes in which mucous glands lie imbedded. The fibres lying in the same plane form continuous membranes, but, as the layers over these have their fibres running in opposite directions, a kind of net-work is produced. These fibres have in general a granular appearance, and at the torn ends fibres of cellular substance may be seen connected with the granular fibres. The muscular coats of vessels rarely present this granular appearance, but resemble the contractile tissue above alluded to so much, that Valentin thinks they ought rather to be placed under that head than under the muscular tissue.

The author places the muscle of the heart and œsophageal muscles near their ventricular end under a separate head, as standing in a certain relation to the animal as well as the organic system. The red muscles of the heart are described as consisting of fine transversely streaked, and often waved primary fasciculi, from the 100th to the 80th of a line in diameter, which divide again and again like the prongs of a fork, and combine in the manner of a net. The muscular fasciculi of the œsophagus are also transversely streaked. In the immediate vicinity of the stomach, however, the transverse striæ are stated to diminish in distinctness, and then finally disappear, at the same time losing their colour. The primary fasciculi are then seen less widely separated, and appear to consist of granules from the 400th to the 300th of a line in diameter, united into difficultly separable granular fibres.

The voluntary muscles are stated to be composed of firmer and finer fasciculi, the older and better bred the animal is. The finest or elementary part of the voluntary muscle consists of a delicate granular fibre or fibril, the granules of which are from the 700th to the 400th of a line in diameter. From fifteen to twenty of these primary muscular fibres united parallel to each other, composed primary muscular fasciculi. The granules of the primitive fibre in the relaxed muscle are stated to have an elliptical form, but become flattened on their contingent surfaces during contraction. An amorphous hyaline substance is stated often to exist in the middle of the primary muscular fasciculus, surrounded by the primary fibres. Broad transverse striæ are often seen on longitudinally streaked primary fasciculi, by which they appear to be sinuously bent, and the muscles of the living frog, when in action, are actually thrown into ziz-zag bendings. From several circumstances which he states, he draws the conclusion that each primary fasciculus is enveloped in a transversely streaked sheath, and he mentions, that in the dog the fibres of this sheath actually run spirally round the primary bundles. He suspects the sheath consists of granular fibres, which may by possibility be separated in two directions, according as the union of the granules is more intimate in the one direction than the other. He has seen convoluted fibres within the muscles of the horse, the uses of which he is ignorant of.

Regarding the evolution of muscle, it is stated that they consist at first of nucleoli and cytoblasts, which form a finely granular substance. From this arise transparent embryonic cells, which arrange themselves as fibres, the somewhat flattened cells coming together in the same way as the blood discs do when they form piles. A single column of cells of this kind forms a primary fasciculus. The septa between the cells shortly after this disappear, the nucleolus disappears or becomes confounded with the granules

formed within the fasciculus. With the evolution of these granules, the transversely striated appearance is produced. Delicate cellular fibres arise between the primary fasciculi in small numbers, and between the secondary fasciculi in greater numbers, but it is yet unknown what substance unites the primary bundles or the primary fibres. He has not been able to determine whether at the point of junction between tendon and muscle there be a transition of the primary muscular fibre into the tendinous fibre, or merely an intimate union of the two.

Several other circumstances are mentioned regarding muscles, such as their mode of contraction, being thrown into z z-zags, the angle of bend being the point at which the nerves cross their chemical constitution, their sensibility and contractility, and their division into long, short, broad, and orbicular or annular muscles.

The tubular or hollow filamentous tissues, the author regards as "probably products or self-organized interstitial substances of the primary cells; in other words, inter-cellular net-works of hollow-elastic tissue." He regards the primary muscular fibres as the transition structure between the true tubular structures and the solid fibres, and states that the peripheral layer of the primary muscular fibre is to be viewed as a continuous tubular membrane, the inner portions of the same fibre as "an organized soft included matter." This leads directly to the structure of the nerve, its contents being of a tenacious consistence immediately on death at least.

Relative to the Nervous System, the author states that he regards the gray matter of the brain as the inherently active matter; in fact, as the peripheral ganglionic substance; and the white as the tubular or conducting substance which is contained in the nerves, and distributes sensation and motion to every part of the body.

After mentioning the division of the nervous system into the cerebro-spinal and ganglionic, and detailing the characters of each, he describes minutely the microscopic appearance of the nerves. These consist of fine hollow tubes, filled with a matter which coagulates on death, separating into a granular and a fluid portion. The fine elementary tubes are connected to each other by an amorphous matter, or by a more highly developed cellular substance, and form the filaments or cords, which, involved in denser sheaths, constitute the nerves as usually seen. He states he has been able to discover that each fine tube is lined with a fine ciliary epithelium, the cilia of which lie obliquely, and apparently in spiral lines. After death, from the coagulation of the contents, the tubes assume a moniliform aspect; but he says, that this would seem to be their natural condition at their origin in the brain and spinal marrow. In the brain he thinks the roots of the

nerves may form loops, and it is stated, "that there they are surrounded by the finest albuminous granules of the cineritious substance, which, indeed, in some parts seem to adhere to them like berries on a stalk." The mode in which the nerves leave the brain and spinal marrow, the coverings they receive from the *dura* and *pia mater*, the piercing of the *dura mater* in single fasciculi, the mode in which the ganglion is formed on the posterior roots of the nerve, the subsequent union of the filaments proceeding from that ganglion with those of the anterior root, are all minutely described. It is only important to note, that the nerves of sensation are not found to differ in the slightest degree in their structure from those of the nerves of voluntary motion. The nerves arrived at the organs to which they are to be distributed, form loops of net-work, alternately giving and receiving tubes and bundles from different branches. They never, however, anastomose; the ultimate tubes merely form loops or circles; they never end; they either join some neighbouring fibre or fasciculus, or return upon themselves to proceed to the central system again. After stating that five different forms of plexuses or reticular unions of nerves exist, and giving instances of each, the author describes minutely the mode in which the peripheral terminations or expansions of nerves are formed, showing that the nervous sensitive papillæ are composed "of a single greatly convoluted nervous fibre." The various modes in which these fibres are convoluted are also minutely described.

Of the ganglionic nerves, he remarks, that, unlike the others, they are always in close alliance with the trunks and branches of blood-vessels, and have hence been termed nerves of the vascular system. As he has observed that persistent cellular fibres surround the oftentimes scantily distributed nervous tubes in these nerves, he thinks these fibres may "serve as subordinate means of conducting the nervous influence." It is also stated that the nuclei of these cellular fibres are granular, and that when the tubes of the nerve form their terminal plexuses, the cellular fibres may be seen forming a net work between them. The expansion of the optic nerve is stated to differ in structure from other nervous terminations, in as much as it expands in the form of a hollow sphere, which consists of two layers, viz., a granulated fibrous reticulated layer, and a layer of dispersed granules. The olfactory nerve also differs from other nerves in consisting of a flat extremely delicate and finely meshed terminal plexus without any apparent final loopings of primary fibres.

In the gray nervous matter, what are called ganglionic globules are met with. These are large granular cells enclosing granular eccentric nuclei and nucleoli. These are found mixed with albuminous granules, gray organic or naked fibres, the nascent roots of nerves, and blood-vessels. These bodies vary in form and size, being

from two to five times larger than the blood discs. They are immediately surrounded and connected by a tissue of organic fibres, and in the ganglia they are included between the meshes of the interlaced fibres of the white and gray nerves. These ganglionic globules are stated to occur in three situations, the gray matter of the brain and spinal cord, the point of union between the nerve of motion and that of sensation, and in the ganglia.

The nerves are stated to be developed "essentially in the same manner as the round filaments and primary bundles of muscles. The embryonic cell-substance arranges itself into cell fibres, and from the very finely granulated intercellular filaments, which are not yet white, but of a reddish gray and transparent, like Remak's organic fibres, arise the primary fibres of the nerves." The delicate outer covering remains some time pulpy, and is to be regarded as the intercellular hyaline matter, or cysto-blastema, in which the cellular cysto-blasts and cellular filaments arise, which connect the nervous fibres together.

Of the chemical analysis of nervous matter, Berzelius's analysis of cerebral matter is alone given, no notice being taken of the later analyses.

The Vessels of the body the author classes under three heads, absorbent vessels, as lymphatics and lacteals, blood-vessels, and secreting and excreting vessels. It is stated that, generally speaking, blood-vessels form net-works in the periphery, lymphatics form convolutions in their course called lymph glands, whilst secreting and excreting vessels present no such appearances. That the "blood and lymphatic vessels are lined in their interior with the same serous membrane, a simple, and in the embryo tessellated epethelium," whilst the secreting and excreting vessels are "either inversions of the corion or mucous membranes, or of their epidermis or epithelium."

From his observations the author deduces that the lacteals originate not in open mouths, but in closed nucleated vesicles, and that the chyle is in reality a secretion. From his description it would appear that the nuclei of the pyriform cylinder-epithelium, which covers the villi of the intestines, present themselves in the guise of hollow pediculated vesicles, the cavities of which appear to communicate with larger lymph vessels, which not unfrequently hang together and inosculate in the manner of the meshes of a thick net. It is from these net-works the finest lacteals proceed.

The afferent lacteals, as seen in the mesentery, he states to consist of three coats, the serous or inner tunic, the middle tunic consisting of spirally disposed reddish coloured fibres, similar to the contractile or muscular tissue, and an outer cellular coat. The numerous valves on their vessels give them a knotted appearance, and these valves are described as consisting of semilunar duplica

tions of the inner membrane having contractile fibres in their interior. The mesenteric glands consisting of convoluted or plexiform masses of lacteals, blood-vessels, and nerves, connected by means of cellular substance, seem to favour assimilation, by bringing the chyle more immediately under the influence of the organic nerves, and in intimate contact with a large amount of living organic surface. It seems unnecessary to follow the author in his minute subdivision and description of the various forms of the lymphatic glands, or ganglia, interglandular lacteals, or even central chyloferous vessels. Even on the lymphatic vessels and glands it seems unnecessary to enlarge, as the author states, that they are in all respects identical in appearance, structure, &c. with the lacteals and mesenteric glands. Regarding the origin and development of these organs, he states that little or nothing is known.

The sanguiferous system of vessels is next described. After a short statement of the uses of the circulation, the distribution of the vessels, the connections between the arteries and veins by means of the capillaries, the net-works and festoons which these form, &c., the author states that arteries are provided with three layers or coats. 1. An internal serous coat, covered with a simple epithelium, which frequently passes into a cellulo-fibrous epithelium, constituting the sole walls of the capillaries. 2. A middle thick tunic of elastic substance, which surrounds the vessel in several layers, and gives elasticity and strength to the vessel; and 3. A cellular external tunic, which also serves to connect the vessel with the neighbouring parts. It is remarked, that the simple and compound festooned or looped vascular arrangements are always the more remarkable, the more sensitive and active the parts are, and that in their general distribution they bear a close analogy with the corresponding terminal plexuses and meshes of nerves.

The nervous capillaries are stated to be capable of being distinguished from the arterial, even at their very origin, by their larger diameter, so that wherever the arterial and venous net-works form distinct strata, the one is readily distinguished from the other. The veins are, besides, more numerous, and not so regularly cylindrical, and this not from the presence of valves, but from being of actually different diameters in different parts of their course. Some veins are stated even to have normal dilatations or varices, which, under the influence of pressure from the neighbouring muscles, assist the circulation in the same way as the lymphatic heart of reptiles. The venous tissue consists of three coats, but the middle one differs from the artery, in not being composed of elastic tissue, but of fibres of muscular or contractile tissue, twisted spirally. The different modes in which the valves are formed in the veins by duplications of the inner coat by the smaller vessel projecting within the larger, or by a fold of membrane lying

over the oblique entrance of the smaller into the larger vessel, are also minutely described.

A separate section is devoted to the consideration of the erectile vessels and organs. Attention is directed to the fact of the peculiar contractile tissue being present in all erectile organs. The peculiar form of the arteries observed in these organs, and of the veins, the one appearing as helicine or tendril-like spirals, or the *retia mirabilia*, the other, short-knotted vessels freely anastomosing, or as tortuous interlaced vessels forming a vascular net-work, are minutely described.

The author shows that erection is accomplished in the erectile organs, not simply by a more rapid distension of blood-vessels, but by the agency of the nervous system causing a tonic contraction or spasm of the contractile tissue, which exists in all these organs, and which prevents the free escape of the blood.

A short digression is here made to account for the formation of tuberculous matter, and two theoretical opinions are started, upon which the whole reasoning is founded. The first is, that a partial coagulation of the fluid occurs from some cause; the other, that the capillaries, from pressure or other circumstances, are diminished in size. When either of these occur, he states that the circulating fluid will be stopped; in the one case from the blood globules not being able to pass through the contracted capillary; in the other from the coagula filling up the capillary. The consequence of this, he asserts, will be, that the *liquor sanguinis* escapes into the neighbouring tissues, where it coagulates; and when the neighbouring vessels have removed the serum, fibrinous or tubercular matter is found remaining. He divides tubercles, therefore, into three classes,—albuminous tubercles, fibrinous tubercles, and those of a mixed nature. The albuminous tubercle is described as consisting of an unorganized mass of granules, which vary in size from the 1000th to the 200th of a line in diameter, but mingled with nuclei, nucleoli, and cells. The fibrinous tubercle he subdivides into five heads, according to the state of development which the effused matter has acquired; thus he has the hyaline tubercle, where no structure is very apparent, the cytoblast tubercle, the cell tubercle, the cellulo-fibrous tubercle, and the filamentous or organized tubercle.

Regarding the mode in which blood-vessels are developed, much appears to rest on pure conjecture. Mr Gerber, indeed, seems to speak on the subject more from the statements of others than from his own observation, since he quotes Schwann's descriptions of their mode of origin. Schwann states that certain special cells are produced, which are first arranged into cellular fibres and then become fused together to form hollow tubes; but Mr Gerber says in a note, that "blood-vessels only arise between or among cells;"

and in another place, "the vessels themselves, in all probability, arise out of the newly formed intercellular substance." The author relates his observations on the ossification of cartilage in proof of the correctness of his statements, and as an abstract of these was given above, it is unnecessary to repeat them here.

The secreting vessels, which the author shows to be branched sacculated involutions of the mucous membrane or its epithelium, or similar involutions of the corion or its epidermis, terminate in blind pediculated vesicles, into which the peculiar secretion distils or percolates from the blood circulating in the neighbouring organs.

Various other subjects are touched on in this work, on which our space will not permit us to enlarge, such as the evolution of mucous cavities from the mucous lamina of the embryo; general remarks on the structure of the skin and mucous membranes, and the division of glands.

The work contains a good and condensed view of the modern theories regarding the origin, formation, and minute structure of the animal tissues and fluids, and is well worthy of a most careful perusal. It contains, indeed, such an amount of matter, that our greatest difficulty has been to give anything like a condensed view of its contents. Many interesting and instructive notes are added by the able translator, to whose appendix we now turn, as containing much additional and valuable information on points to which he has more especially devoted his attention.

Mr Gulliver's first paper is entitled *Observations on the Blood Corpuscles of Mammiferous Animals*. From the table which he gives at the end of his paper, it would appear that he has measured the size of the blood corpuscles in no fewer than 175 mammalia, so that his remarks on this point are of extreme value. He remarks that the corpuscles vary in size in the same species at the same age; that it is not uncommon to see the majority of the discs of two distinct sizes, one about half or two-thirds larger than the others. The larger only seem to be the regular corpuscles, and run into the characteristic piles, which the others do not. The small corpuscles scarcely ever present the swollen edge or the cup-shaped appearance of the larger ones. The discs also often shrink or become puckered after extravasation.

It is stated that, though it be a general rule in the mammalia, that the blood corpuscles of the embryo are larger than those of the adult, this is not always the case, as he has seen them at a later stage of utero-gestation smaller than those of the mother, and also of the same size.

His tables show that there is no relation between the size of the animal and that of the blood corpuscle, but he thinks that there is

a kind of relation of this kind in the species of the same family, and that the measurement in his tables bear him out, generally speaking. They do not, however, appear to us susceptible of such a generalization. Thus the domestic cat, Norway lynx, and serval, have larger blood globules than the larger species of the same genus, the puma and ocelot. The ass, the dshikketai, and Bur-chell's zebra, have larger blood globules than the larger species; the horse; the axis, and fallow deer have them larger than the roebuck; the common and Brahmin cow have them larger than the Cape buffalo; the common mouse larger than the common rat, &c. Mr Gulliver justly remarks, that there seems to be no necessary connection between the size of the corpuscle and the kind of food on which the animal feeds.

Mr Gulliver then goes over in detail the various classes of mammalia, individually pointing out the peculiarities of the blood discs of each. He found the elephant to possess the largest blood discs, and the Napu-musk deer the smallest of all the mammalia.

The blood corpuscles are described as being generally flat circular discs with rounded edges, the thickness being about equal to a fourth of the breadth. In general the discs are flat, sometimes depressed in the centre, at other times tumid, and occasionally cup-shaped. Two or three central particles are occasionally visible in the centre. In the camelidæ the discs are oval. Oblong, pear-shaped, polygonal and sigmoid forms are often assumed by blood discs, and granulated or mammillated discs may be seen in the blood at all times. These Mr Gulliver found always present in the blood of puppies and kittens. They are rather smaller than the common discs, irregular in shape, slightly flattened or nearly globular, with attached granules or molecules estimated at from the 30,000th to the 10,000th of an inch in diameter. Angular particles abound in blood, and granules could often be detected projecting from their angles. In the young embryo the corpuscles were found lenticular or spherical in form. The fact of the corpuscles being seen to alter their forms under the microscope is noticed.

Mr Gulliver says the colouring matter may be removed from the blood corpuscles by washing them with water, when the central spot disappears. He therefore attributes that appearance to the colouring matter being accumulated chiefly at the circumference. When the colouring matter was removed the jagged appearance of the corpuscle was not noticed; he therefore thinks that appearance was produced merely by a division of the colouring matter. He has never been able to satisfy himself of the presence of a nucleus in the blood corpuscle of the mammalia, but in the lower vertebrate animals the nucleus was distinctly visible.

Besides blood corpuscles, Mr Gulliver states that white globules occur, to which M. Mandl has given the name fibrinous globules. These globules have an average diameter of the 2900th of an inch. They are spherical, semitransparent, and granular on their surface, or smooth; acetic acid exhibits two or three nuclei in them. These globules seem of the same size in all animals, and to have no relation to the size of the blood corpuscles. It is stated that it has not been satisfactorily proved what is the nature of these white globules. Mandl regards them as fibrine, Wagner and Muller as lymph. In order to compare these globules with the fibrinous cells and their nuclei, the measurements of a few of the cells and nuclei of fibrine are given. He thinks the lymph globules and white globules of the blood are the same in reptiles, because they may even be seen circulating in the blood, but he doubts if they are the same in the higher animals. Mr Gulliver attributes the presence of these globules in the blood to disease, as they are more numerous during inflammatory and suppurative diseases. From the strong resemblance to the purulent matter corpuscle Mr Gulliver states he elsewhere described them as such.

Spherules of white matter are also described as occurring in the blood of animals who had died of various diseases. He found milky serum to depend on the presence of spherical particles so exceedingly minute that the highest magnifying power was required to distinguish them. These particles were apparently identical with the molecular base of the chyle. He has also met with corpuscles resembling those of the spleen and supra-renal capsules. Nothing satisfactory is stated regarding the use or formation of the blood corpuscles. He mentions, however, that he has seen minute spherules detach themselves from the granulated particle, and project into the serum; but more frequently minute spherules attach themselves to the irregular and jagged corpuscles.

Mr Gulliver's next paper is on the Blood-corpuscles of Birds. He has given, in tables, the long and short diameters of the blood corpuscles of no fewer than 204 birds, from which it appears, that there is much less variation in their size than in those of the mammalia. The short diameter, in general, comes nearly to the diameter of the mammalian blood disc. Their long diameter is less than twice their breadth, and their thickness about a third of their breadth. All are oval, but the form of the oval varies. They are, in general, flat, without either depression or elevation in their centres. Nuclei are visible in every corpuscle. It is stated that if a drop of acetic acid be added to the blood corpuscles of birds, the field of vision is instantly filled with the nuclei.

Mr Gulliver's observations on tubercle are rather in the form of a note to Gerber's statements than a distinct paper. He states that before he saw his work, he had arrived at the same general conclusions.

He states that frequently the nicest examination can detect nothing more than granular matter, minute spherules, and shapeless flakes or fragments. Sometimes the fragments are more distinct, but still unlike cells or nuclei, and the minute spherules are seen attached to them. In smaller tubercles, corpuscles are seen having the character of cells and their nuclei, their envelopes being either absent, or blended with a minutely granular base. But that it is only in minute and recently formed tubercles that perfect cells exist. He thinks it probable, therefore, that tubercular matter originates from cells, but differs essentially from the matter of plastic exudations, as its primitive cells can only retrograde and degenerate, not multiply and evolve organized germs like the lymph.

Chyle and the fluids of the thymus and lymphatic glands form the subject of Mr Gulliver's next paper. The chyle is described as a compound fluid, composed, 1. of extremely minute spherical particles, which constitute the molecular base of the fluid; 2. globules; 3. blood corpuscles; 4. oil globules; 5. minute spherules of unequal size. The minute spherules constituting the molecular base have a diameter between the 36,000th and the 24,000th of an inch, requiring the best instruments to render them visible. The chemical properties of this base are stated to be, that no change is apparently effected on the particles by alkaline or earthy salts, nor by alkalies, nor by acetic, muriatic, citric, or tartaric acids,—the acetic merely clustering the molecules into masses. It is apparently dissolved by ether, but the particles are seen floating in it unchanged. He regards this molecular base, then, of the chyle as a peculiar matter, remarkable as being composed of excessively minute particles, which are soluble in ether, and which remain unchanged by numerous agents which affect the chyle globule. This matter he has often discovered in the blood when it was abstracted during digestion.

The chyle globules are described as minutely granulated spherical bodies of various sizes, seldom exhibiting any nuclei, but sometimes two or three central molecules. Muriatic acid is said to reduce these globules to particles of extreme minuteness. The chyle from the thoracic ducts in coagulating, aggregates together the whole of the chyle globules, so that none remain in the expressed fluid. He mentions it, however, as a remarkable circumstance, that, in the clot, the globules appear of a less regular shape, whilst they are increased in number.

The blood corpuscles of the chyle are stated to be frequently irregularly indented at the edges or granulated, and many have the "little spherules so regularly arranged as to render it probable that the outer coloured part of the blood corpuscle was thus being formed." They were also generally smaller than blood-discs from the heart.

The minute spherules found in the chyle he regards as albuminous. They are not soluble in ether, and are of very various sizes.

When an animal fasts, it is stated that the fluid of the mesenteric glands loses its molecular base, and becomes apparently identical with that of the lymphatic glands, viz. semitransparent, and of a light-brown tint, containing many globules. The thymous fluid, from having these globules very numerous, assumes a creamy and opaque hue. The chemical and microscopic details of the characters of these globules of the thymous and lymphatic fluids are given, by which it appears that they are "probably identical." From observing that the globular particles are especially abundant after the fluid has passed through these glands, he regards the mesenteric, thymus, and lymphatic glands as probably "organs of nutrition, in which the effete matter taken up by the absorbents, and the chyle by the inferent lacteals, may undergo a second digestion or elaboration, so as to be modified and prepared to aid in the growth and preservation of the animal." Several circumstances are mentioned, which would appear to corroborate this view of the subject, such as the wasting of the body when these parts become affected, the impoverishment of these fluids under bad nourishment, and the shrinking of these glands, &c. He thinks these globules are in most respects analogous to the nuclei of primary cells, and that they probably will prove to be so many germs for the formation of those cells which appear to be intimately connected with the development of the animal tissues generally.

The pulp of the supra-renal gland is described as composed of an infinity of minute oil-like spherules, varying in diameter from the 24000th to the 6000th of an inch. It is mentioned that these minute bodies do not appear to be affected by mineral acids, by alkaline, earthy or metallic salts, nor by ether. In many ruminants, it is stated that these minute spherules are less abundant, their place being supplied by corpuscles resembling lymph corpuscles, which are probably cells or nuclei. In the blood from the venous sinus of the supra-renal gland, he has often detected minute spherules which could not be distinguished from those of the gland. He thinks, therefore, the veins may be the excretory ducts of the gland. He has noticed the same spherules abundantly in the pulp of the supra-renal glands of some birds and reptiles.

We cannot close our notice of this work without adverting to the valuable plates by which it is accompanied. Twenty-seven of these are illustrative of the text of Mr Gerber, the remainder, of the notes and appendix of Mr Gulliver; and though it will appear a defect to many that Mr Gerber's drawings exhibit a harshness and distinctness of outline not to be met with in nature, and which Mr Gulliver has perfectly succeeded in avoiding, they do not seem

the less worthy of praise, as they appear to be correct representations of the objects he means to represent.

In the present state of General Anatomy, Mr Gulliver has rendered to the profession a great and important service, in introducing with such ability the present work to the English reader. Mr Gerber may regard himself as fortunate in obtaining the assistance of one so competent to do justice to the subject. By the publication of his own researches also, and all their results, Mr Gulliver has provided the student of the anatomy of texture with a large store of new and valuable information; and the present work may be justly recommended as one which will both require and reward attentive perusal.

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- ART. IV.—1. *The Fifty-fifth Report of the Visiting Justices of the County Lunatic Asylum at Hanwell.* London, 1840, post 8vo, pp. 31 and 93.
2. *The Fifty-ninth Report of the Visiting Justices of the County Lunatic Asylum at Hanwell.* London, 1840, post 8vo, pp. 55 and 69.
3. *Second Annual Report of the Crichton Institution for Lunatics.* Dumfries, 11th November 1841.
4. *Annual Report of the Managers of the Royal Edinburgh Lunatic Asylum for the year 1841.* Edinburgh, 1842.
5. *Twenty-eighth Annual Report of the Directors of the Glasgow Royal Asylum for Lunatics, submitted in terms of their Charter to a General Meeting of Contributors, 6th January 1842; with the First Report of the Physician.* Glasgow, 1842, 8vo, pp. 58.
6. *Statistics of the Retreat, near York; consisting of a Report and Tables exhibiting the Experience of that Institution for the Insane, from its establishment in 1796 to 1840.* York, 1841. Post 8vo, p. 62.
7. *Report upon the Mortality of Lunatics.* By WILLIAM FARR, F. S. S. (Read before the Statistical Society of London, 15th March 1841.) 8vo, pp. 17.
8. *Observations on the Admission of Medical Pupils to the Wards of Bethlem Hospital for the purpose of studying Mental Diseases.* By JOHN WEBSTER, M. D., &c. 2d edition. London, 1842. 8vo, p. 32.

No department of medical therapeutics has undergone improvements so great and so advantageous, as that which relates to the