the other remedies it will suffice if I enumerate chloride of potassium, sulphate of zinc, oxide of zinc, sulphate of copper, chloride of gold, nitrate of silver, and phosphorus, as remedies which have had their day and which are still occasionally of service; while the list of vegetable remedies is simply legion. Valerian, camphor, the camphor monobromate, asafœtida, musk, castor, opium, belladonna, aconite, indigo, turpentine, and conium are among the most prominent of these.

In many cases of epilepsy, especially when it is suspected that the attacks are due to the absorption of toxic material from the intestines, it will be found that persistent and systematic antisepsis will do much good. The benefit obtained from the administration of salicylate of soda, naphthalin, and calomel, and from intestinal flushing is often very great.

Galvanism is the only form of electricity that ever does any good, and this only in exceptional cases. The current from no more than ten or fifteen Leclanché cells should be used, one electrode being placed anteriorly and the other posteriorly upon the head. Static electricity is useless; chloroform and ether may be resorted to when the status epilepticus is found, but unless the convulsion be very severe, I prefer to administer nitroglycerin or the amyl nitrite.

The lighter attacks are very obstinate, and are not helped to the same extent as are the more severe ones. Belladonna, ergot, and hyoscyamus have all been tried with various degrees of success. I have found nitroglycerin to be of great benefit in some cases, and it should be prescribed with the idea of producing a continued state of moderate cerebral hyperæmia.

An important indication is the provision of remedies for the abortion of attacks. When the aura is of a sensory character and begins in an extremity, the use of an encircling blister or ligature about the arm will, if the paroxysms are frequent, or if the patient has time to take preventive measures, stop the progress of an attack. One of my patients, whose aura often begins in the arm, provides himself with a rubber band which he hastily slips over his hand. Brown-Séquard recommends forcible flexion of the wrist. The inhalation of ammonia or of nitrite of amyl, or the prompt resort to a tablet containing from gr. $\frac{1}{100}$ to $\frac{1}{75}$ of nitroglycerin, will ward off the fits. A glass of sherry or some alcoholic stimulant will also often act very promptly. It is well for the patient to keep such a draught by his bedside, to take as soon as he awakens, if he has morning seizures.

The diet of the epileptic should be of a vegetable nature. Meats are highly injurious, but the *moderate* use of game, poultry, fish, and oysters is to be advised. Fresh vegetables, fruit—except grapes,—milk and cold bread, should form the chief articles of diet. Stimulants are, of course, out of the question in most cases, but coffee, which is usually denied the patient, is (if mild) by no means so hurtful a thing as it is ordinarily supposed to be.

Friction, cold baths, and exercise are to be insisted upon, and mild intellectual labor is good for the subject. Steam or furnace heat is responsible as an exciting cause in many cases, and if possible open fires, properly guarded, should be placed in the patient's room.

Surgical measures have been of avail, if we are to believe all the reports; yet the experience of many successful surgeons, who have watched their cases for a long time, is against their efficacy. If they are to be used it should only be in cases in which the evidence of a traumatic origin is very clear.

Dr. W. Briggs[12] seems to have had extraordinarily favorable results from trephining, for of 30 cases of the traumatic variety in which he performed the operation, 25 were cured, 3 relieved, 1 was not helped, and 1 died. Walsham's[13] results were not quite so favorable. Of 130 cases of traumatic epilepsy operated upon, 75 were cured, 18 improved, 7 not helped, and 30 died.

In some examples it will be found that the aura proceeds from a cicatrix upon the scalp, and the exsection of this, even if no removal of bone is undertaken, may be sufficient. In such cases as those reported by Lande,[14] in which a neuritis was the cause of the convulsion, exsection or nerve-stretching might do good, but of course such hopeful results are problematical.

Dr. Frederick Petersen has summed up his conclusions relative to the care and colonization of epileptics as follows:

"All are to be treated in accordance with the usual regulations as to diet, hydrotherapy, and medicinal agencies, with the hope that in this way beween one and six per cent. of them may be cured, and the disorder in a larger percentage ameliorated.

"Out-of-door employment in agriculture and kindred pursuits is to be provided in abundance. All manner of trades and occupations are to be carried on in an epileptic community, organized on the village plan. Facilities for education are to be afforded to almost every extent.

"Amusement and entertainment and the enjoyment of social intercourse are to be privileges from which no epileptic will hereafter be debarred.

"In this way the happiness of a large number of these miserable creatures will be materially increased, in spite of the distressing disease which they are called upon to suffer, usually for the whole of their lives; and though remedial agents applied to their malady may prove inefficient, their fate can never be as wretched or hopeless as it has been throughout the world heretofore."

Allan McLane Hamilton.

[1] Traité de l'Epilepsie, p. 55.
[2] Archives of Medicine, iv., 1, 1880, p. 1.
[3] N. Y. Med. Jour. and Obstet. Review, June, 1882.
[4] West Riding Reports, vol. iii., p. 315; vi., p. 266; Brain, iii., 2, p. 192.
[5] Untersuchungen über die Lokalisation der Functionen der Grosshirnrinde des Menschen, p. 63.
[6] *Loc. cit.*, p. 11.
[7] Archives of Practical and Scientific Medicine and Surgery, Philadelphia and New York, 1873, i., 360.
[8] Annales Méd.-Psych., 1852.
[9] On Epilepsy, etc., 1870.
[10] The Medulla Oblongata, etc.
[11] Archives de Méd., Dec., 1869.
[12] American Practitioner, July, 1884.
[13] St. Bartholomew's Hospital Reports, vol. xix.
[14] Mém. et Bulletin, Société de Méd. et Chirurgie de 1874, i., 56–65.

EPITHELIOMA. See *Carcinoma*.

EPITHELIOMA OF THE SKIN, MULTIPLE, BENIGN, CYSTIC.—(Synonyms: Epithelioma adenoides cysticum [Brooke]; Acanthoma adenoides cysticum [Unna].)

Symptomatology.—The affection is characterized by the presence of numerous pale-yellow, pearly, or pinkish-colored nodules, from the size of a pin's head to that of a pea. The small growths are quite firmly embedded in or project above the skin. Some of the tumors are translucent and closely resemble vesicles, while others are made up of milium-like bodies and are traversed by minute capillaries. The face, scalp, neck, upper parts of the back and chest are the sites of predilection. In general the growths are discrete, but they tend to group themselves about the root and alæ of the nose, the eyebrows, and the mouth. The confluence of several nodules has been noted.

In the majority of cases heretofore reported the affection has been observed at or before the age of puberty.

The small, pinhead-sized growths increase slowly in size until they attain the size of a split pea, seldom larger, and in very exceptional cases they only undergo ulceration or disappear spontaneously.

They impair in no way the general health nor do they give rise to subjective sensations of any kind. The entire course of the disease, except in the case reported by Dr. White,[1] is so free from any evidence of malignancy that the word *benign* has been employed to qualify the term *epithelioma* used to designate this singular eruption. White's patient, in addition to numerous small nodules of the usual type, presented three or four open epitheliomatous ulcers involving the entire thickness of the skin.

Single, hemispherical, brownish-red, or translucent nodules have been removed from the ala of the nose, the eyelids, or other parts of the face and have been found

to have a structure identical with or closely allied to that of the multiple benign tumors in question. They may develop in early adult life or in older individuals, but they pursue a relatively benign course.

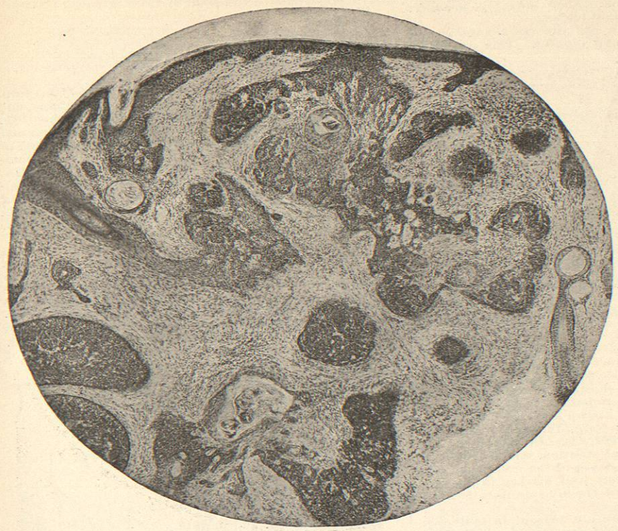

Fig. 1922.—Multiple Benign Cystic Epithelioma showing Down Growth of Surface Epithelium. Spencer, one inch; ocular, one inch and one-quarter. (Original.)

The cause of the affection is obscure. In Brooke's[2] and my own cases[3] a distinct hereditary history was obtained. The onset of the affection at the age of puberty may depend in some manner on the general stimulus to which all epithelial tissues are subjected at this time. The view has been held by some that these tumors depend on misplaced embryonic epithelial cells which remain latent until puberty or later in life.

Pathology and Morbid Anatomy.—In the earlier descriptions of the affection the cases described by Jacquet and Darier[4] as "Hydradénomes eruptifs," by Török[5] as syringo-cystadenoma, and by other writers with designations of similar meaning, were considered to be of the same general nature.

Unna[6] has, however, wisely separated the class of cases described by Jacquet and Darier, Török and others from those of Balzer, Brooke and myself; the first group of cases being, in his opinion, adenomata of the coil ducts, to which he gives the name "syringadenomata," while the second group undoubtedly originate in the epidermis and are called by him "acanthoma adenoides cysticum."

The microscope shows these benign epithelial growths to be made up of proliferating masses and narrow tracts of small epithelial cells corresponding to those in the lowermost layer of the epidermis and external root sheath of the hair follicles. The origin of the new growth from the epidermis and hair follicles is shown in Fig. 1922, which represents a section from the original case described by me.[7] Similar observations have been made by Brooke[8] and by Bowen (in White's case).

The epithelial masses and tracts on their outer side are usually surrounded or defined by a well-marked layer of cylindrical cells, a condition which characterizes many benign epithelial growths. Atypical "pearl bodies," enclosing horny or colloid tissue as well as colloid degeneration of individual epithelial cells, have also been met with. The connective tissue between the new cell growths is somewhat condensed and the seat of a moderate infiltration of lymphoid cells.

Treatment. — Some of the small tumors can be removed by incising the overlying epidermis and expressing them by moderate pressure. If this method is not successful the dermal curette may be employed. The resulting wound readily heals with a small depressed scar.

The use of caustics is not advocated, as it is possible by their improper use to evoke a latent malignancy.

John A. Fordyce.

[1] Jour. Cutaneous and Gen.-Urin. Dis., p. 477, 1894.
[2] British Journal of Dermatology, p. 271, 1892.
[3] Journ. Cutaneous and Gen.-Urin. Dis., p. 459, 1892.
[4] Ann. de Dermat. et de Syph., p. 317, 1887.
[5] Monatsheft f. prakt. Dermat., p. 116, Bd. viii.
[6] Histopathology of Diseases of the Skin, p. 117.
[7] Jour. Cutaneous and Gen.-Urin. Dis., p. 459, 1892.
[8] Brit. Jour. of Dermat., p. 289, 1892.

EPITHELIUM.—Epithelial tissue is composed of cells placed close to each other, the intercellular substance being reduced to a minimum.

The cells, as a rule, are soft, yielding readily to press-

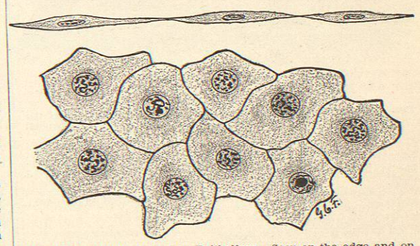

Fig. 1923.—Simple Squamous Epithelium. Seen on the edge and on the flat.

ure, and consequently they show a great diversity in their shapes. The cytoplasm may be either clear, or finely or coarsely granular. Each cell has a nucleus, which is embedded in the cytoplasm. There are a few instances in which the cells are without nuclei.

All epithelium rests on a structureless membrane, the *basal membrane* or *membrana propria*. This membrane

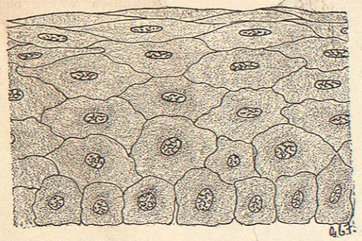

Fig. 1924.—Stratified Squamous Epithelium. Section of epithelium lining the œsophagus.

is believed to be of connective-tissue origin, though by some it is considered a product of the epithelial cells.

The free surface of some epithelial cells, especially those of the cylindrical type, shows a sharp differentiation from the remainder of the cytoplasm. This appears as a thickened free border and is known as the *cuticula*. The cuticulæ of adjoining cells form, through fusion, the *cuticular membrane* (Fig. 1927, *A*). In some cells the cuticula shows a longitudinal striation, which is caused by prolongations of fine processes of the cytoplasm into it. This striation is especially well marked in the epithelial cells on the surface of the mucous membrane of the small intestine.

As a rule blood-vessels are not present in epithelial tissue. Recently they have been found in the epithelium of some of the lower animals, and they are known to be

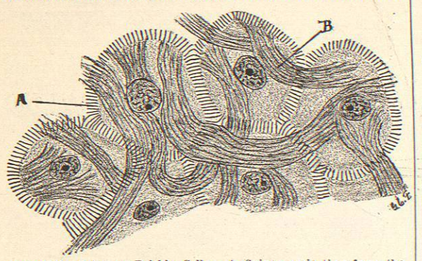

Fig. 1925.—Spine or Prickle Cells. *A*, Spines projecting from the edges of the cells; *B*, filaments of the cytoplasm passing from cell to cell.

present in one place in the body of the higher animals—the stria vascularis of the cochlea. The nerve supply is rich.

Classification.—The epithelia are classified as follows:

1. Simple—consisting of one layer of cells.
(*a*) Squamous.
(*b*) Cylindrical or columnar.
2. Stratified—consisting of several layers of cells.
(*a*) Squamous.
(*b*) Transitional.
(*c*) Cylindrical or columnar.
3. Modified.
(*a*) Ciliated.
(*b*) Mucous.
(*c*) Pigmented.
4. Specialized.
(*a*) Glandular epithelium.
(*b*) Neuro-epithelium.

Simple Squamous Epithelium.—The cells of this form of epithelium are thin, scale-like, irregular in shape, and are laid down in a single layer. A surface view (Fig. 1923) shows them arranged in the form of an irregular mosaic; when seen on the edge they show a bulging of the cytoplasm at the situation of the nucleus, with a thinning out of the same at the edges of the cell (Fig. 1923).

This type of epithelium occurs as a lining to the capsule of Bowman in the glomerulus and in the descending arm of Henle's loop in the kidney; also as non-nucleated cells—respiratory epithelium—in the terminal bronchi, infundibula, and air vesicles of the lung.

Simple Cylindrical Epithelium.—The cells of this form of epithelium are long and narrow, with the base of the cell rounded off (Fig. 1927, *A*). The nucleus, oval in shape, is embedded in the cytoplasm near the base of the cell. The cuticula is well developed in the cells of the small intestine. The height of the cells varies in different situations, sometimes being high, sometimes low. In some instances the diameters of the cell are about equal. Such cells when seen in section have the appearance of

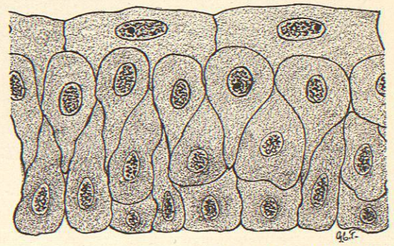

Fig. 1926.—Transitional Epithelium. Section of the epithelium lining the bladder.

small squares, with the nucleus embedded in the central portion of the cytoplasm. This form of epithelium is known as cuboidal.

Simple cylindrical epithelium occurs on the surface of the mucous membrane of the stomach, of the small and large intestines, and of the membranous and penile portions of the male urethra, in tubular glands, in portions of the uriniferous tubules, and in the ducts of compound glands. Cuboidal epithelium is seen in the small bronchi, in portions of the uriniferous tubules, and in the smaller ducts of compound glands.

Stratified Squamous Epithelium (Fig. 1924).—In this type of epithelium the cells are laid down in two or more layers, the cells of the various layers differing greatly in shape. The cells of the deep layer are cuboidal or low cylindrical; those of the middle layers polyhedral; those of the surface, alone, flat or scale-like.

The large cells of the middle layers give off short, fine processes, which join similar processes of adjoining cells (Fig. 1925, *A*), the *spine* or *prickle cells*. These spinous processes are also known as the *intercellular bridges*, and they enclose spaces in the intercellular substance, the *intercellular spaces*. It is through these spaces that the fluids for the nourishment of the cells circulates. By some these interceliular bridges are believed to be fila-

ments of the cytoplasm which pass from cell to cell (Fig. 1925, *B*).

Stratified squamous epithelium rests on a connective tissue which is thrown up into conical-shaped projections

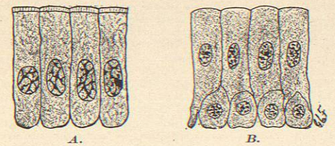

Fig. 1927.—*A*, Simple Cylindrical Epithelium; *B*, stratified cylindrical epithelium.

—the papillæ—which are covered by the basal membrane. These papillæ project into the epithelium in such a manner as to form a series of hills and valleys. The papillæ contain a rich capillary network of blood-vessels from which the nourishment of the overlying epithelium is derived.

The cells of the deeper layers, receiving the greatest amount of nourishment, increase rapidly by mitosis, and pushing outward they replace the cells of the outer layers, the surface cells being thrown off.

In the epidermis of the skin, where the surface cells are horny, there are developed, beneath these, cells which pass through the intermediary stages of cornification. This type of epithelium is found on the surface of the skin, and on the surface of mucous membranes which become continuous with the skin, as that of the buccal cavity, vagina, etc.

Transitional Epithelium (Fig. 1926).—Transitional epithelium is stratified, consisting of from four to six layers of cells, and lies on connective tissue which is unprovided with papillæ. The surface cells are large and flat, with a convex free border, their under surface being pitted. This pitting is caused by the underlying cells pushing their heads into the soft cytoplasm of the sur-

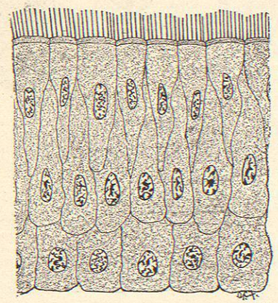

Fig. 1928.—Stratified Cylindrical Ciliated Epithelium. Section of the epithelium lining the trachea.

face cells. The cells of the deeper layers are irregularly cuboidal; those of the middle layers pyriform or polyhedral in shape.

This type of epithelium is found on the surface of the mucous membrane of the urinary bladder and of the pelvis of the kidney.

Stratified Cylindrical Epithelium (Fig. 1927, *B*).—In this type of epithelium the surface cells alone are cylindrical in shape, their basal ends being pointed or branched.

The cells of the deeper layers are irregular in shape, and those of the basal layer cuboidal or low cylindrical. In most instances the cuticula is well developed.

This form of epithelium is found lining the largest ducts of glands; it covers the palpebral conjunctiva, portions of the mucous membrane of the male urethra, and the mucous membrane of the vas deferens.

Ciliated Epithelium.—Ciliated epithelium occurs in both the stratified and the simple forms, the ciliated cells, in man, being of the cylindrical type. In the stratified form the arrangement of the cells is similar to that of stratified cylindrical epithelium; in the simple form it consists of a single layer of ciliated, cylindrical cells.

The free surface of ciliated cells has a well-marked cuticula, from which seem to spring hair-like structures—the cilia (Fig. 1928). The length of the cilia varies with the situation of the cell. In the trachea and bronchi they are short, while in the epididymis they are long, about ten times the length of those in the trachea. The number of cilia to a cell also varies, being from twelve to

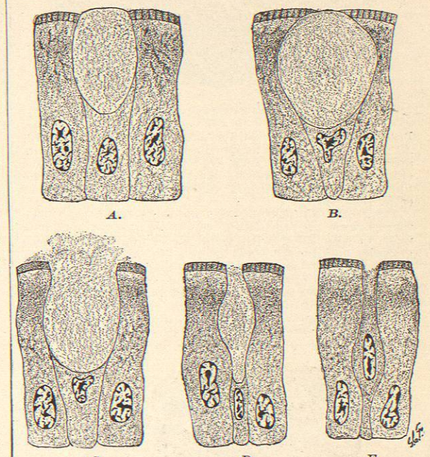

Fig. 1929.—Mucous or Goblet Cells. *A*, Early stage of the formation of the mucin; *B*, cytoplasm nearly all converted into mucin; *C*, cell discharging its contents; *D*, collapse of the mucous cell; *E*, regeneration of the cell.

twenty-five. They are now regarded as filamentous prolongations of the cytoplasm which pass through and project beyond the cuticula.

The movement of the cilia is automatic, not being under the control of the nervous system. The movement of a single cilium resembles that of a whip-lash, the number of vibrations being estimated at ten per second. The beats of the cilia do not take place at the same time in all cells, one cell after another taking up the movement, which passes through a series of cells in successive waves. The rapidity of the vibrations is increased by warmth, up to a certain point. Cold, chloroform, and an increase of temperature up to 50° C. may cause the movement to cease.

Mucous Epithelium.—The mucous epithelial cell is re-

garded by some as an unicellular gland. It is found distributed throughout the epithelium of the intestinal tract, trachea, and bronchi. Owing to its shape it is commonly called a goblet cell.

Mucous cells are formed from cylindrical epithelial cells, the most of the cytoplasm of which is gradually converted into mucin. The process begins at the free surface of the cell (Fig. 1929, *A*), and progresses until the cytoplasm, excepting a small portion containing the nucleus, is changed. The latter becomes crowded to the

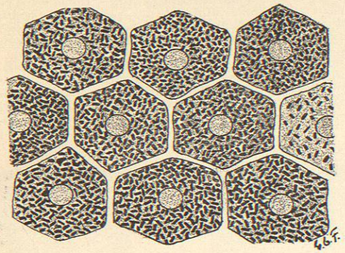

FIG. 1930.—Pigmented Epithelial Cells from the Retina.

base of the cell. The cell increases in volume (Fig. 1929, *B*), finally it ruptures at its free surface and its contents are discharged (Fig. 1929, *C*). The cell then collapses (Fig. 1929, *D*), and from its basal part which contains the unchanged cytoplasm and nucleus, a new cell is formed (Fig. 1929, *E*).

Pigmented Epithelium.—In some parts of the body there occurs an epithelium, the cytoplasm of which is more or less filled with granules of pigment. These granules may be spherical or rod-like in shape and of a color varying from light brown to black.

This type of epithelium forms one of the layers of the retina (Fig. 1930) and is also found in the deep layer of the epidermis of the colored races.

Glandular Epithelium.—This form of epithelium lines the alveoli or secreting portion of glands. The shape of the cells varies in different glands, in some being cylin-

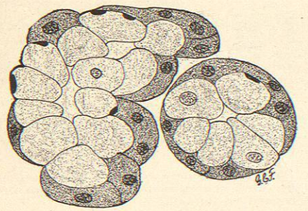

FIG. 1931.—Glandular Epithelium. Mucous acini from human submaxillary gland. The light central cells are the mucous cells; the dark cells form the crescents of Gianuzzi.

drical, in others polyhedral or irregular. In some glands two types of cells occur. Many of the mucous glands have an internal layer of cylindrical cells with a moderately clear cytoplasm, and between these and the membrana propria a second type, viz., granular cells (Fig. 1931). These granular cells form the crescents of Gianuzzi or demilunes of Heidenhain. The cardiac glands of the stomach also contain two types of cells, the internal or chief cells and the large granular peripheral cells—the acid cells.

The microscopic appearance of gland cells varies with their state of activity. The resting cell is generally granular and dark in appearance, the granules staining intensely, and the volume of the cell is reduced. As the cell passes into the active state its granules cease to stain; small vacuoles appear in the cytoplasm, which becomes clearer; and the volume of the cell increases. After the cell has discharged its secretion the cytoplasm may become nearly clear and the cell returns to the resting state. In some glands (for example, the mammary gland) a portion of the external part of the cytoplasm is used up in the process of the formation of the secretion, the basal part with the nucleus remaining unaltered. From this portion the cell is reconstructed. In other glands the entire cytoplasm is used up and a new cell takes its place.

Many gland cells discharge their secretion not only from their free surfaces, but also from all sides. In such cases the cells are surrounded by a network of canaliculi, which take up the secretion and convey it to the lumen of the gland by a "duct."

Neuro-epithelium.—Neuro-epithelium is a highly differentiated type and occurs in the sense organs. The

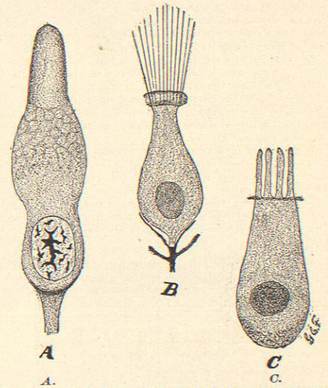

FIG. 1932.—Neuro-epithelium. *A*, Cone from the retina; *B*, hair cell from the crista acustica; *C*, hair cell from the organ of Corti of the cochlea.

rods and cones (Fig. 1932, *A*) of the retina; the hair cells of the organ of Corti of the cochlea (Fig. 1932, *C*); and the hair cells of the macula and crista acusticæ (Fig. 1932, *B*) are examples.

Neuro-epithelial cells consist of two portions: the basal, containing the nucleus, and which is in close contact with the nerve terminations; and the outer or perceptive portion, which usually terminates in the form of thick, hair-like processes.

Mesothelium and Endothelium.—These two types of cells, on account of their characteristics, are now classified by many as simple epithelium. If we trace them back to their origin in the blastoderm it is found that they are both derived from the mesoderm or middle layer, but from different cells. Mesothelium, which lines the cavities of the peritoneum, pleura, and pericardium, is derived from the cells which line the original body cavity —the cœlom. At the suggestion of Minot the term mesothelium has been applied to them.

Cells of a similar type form the capillaries, and line the interior of blood and lymph vessels, synovial spaces, bursæ, tendon sheaths, and the anterior chamber of the

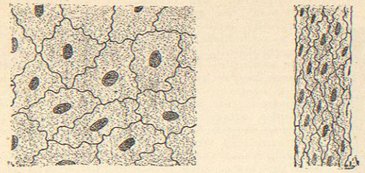

FIG. 1933.—*A*, Mesothelium Covering the Surface of a Serous Membrane; *B*, endothelium lining a blood-vessel.

eye. These are differentiated mesochymal cells (Minot) and the term endothelium is alone applied to them.

Mesothelial cells (Fig. 1933, *A*) are thin, flat cells, the cytoplasm of which is slightly granular. Their nuclei may be either oval or spherical in shape and they project above the surface of the cytoplasm. The general shape of the cells is polyhedral with more or less wavy edges, and they are united by an exceedingly slight amount of intercellular substance.

Endothelial cells (Fig. 1933, *B*) are, as regards structure, like the mesothelial. Their shape is an irregular oblong one with markedly serrated edges.

These two types of cells are always laid down in a single layer. *George C. Freeborn.*

EPULIS. See *Sarcoma*.

EQUILIBRIUM AND EQUILIBRATION.—The term equilibrium is used to indicate a state in which all the muscles of the body are under such nervous control that when called upon they can execute some co-ordinate movement or resist the force of gravity. Equilibrium is of great importance in animal life, as can be readily understood, and it is by no means a simple phenomenon. That the motor apparatus may act properly it is necessary that it should receive sensory impressions informing it of the position of the body at any moment, and every known sense appears to contribute the necessary information. A combination of these sensations constitutes the sense of equilibrium.

Before discussing equilibrium and equilibration with regard to its nervous control or how it is maintained in the human body, it is necessary that we should have a clear idea of the position of the centre of gravity of the body and how the position of this centre may vary in different postures. It is mainly owing to the researches of the Weber brothers, Barellus, Harless, and Meyer, and more recently Braune and Fischer, that the position of the centre of gravity of the body has been determined.

In the *erect posture*, roughly speaking, the centre is situated between the pubes and buttocks, and is farther from the sole of the foot than from the crown of the head. A variation may be pointed out here, viz., that the position of this centre will vary according to a man's build. A man heavily built in his shoulders and arms will naturally have his centre of gravity higher than a man with narrow shoulders, light arms, but powerful legs and buttocks. Meyer's method for determining the centre of gravity in the antero-posterior plane was as follows:

A soldier standing at "attention" leaned forward so as to throw the weight of the body upon the front of his feet. A line plumb to this point would pass through his centre of gravity. The man then extended his limbs at the ankle-joint until he nearly lost his balance backward. A vertical line from his heels again passed through his centre of gravity which lay naturally where these two lines crossed one another. This was found to be in the region of the body of the second sacral vertebra.

Braune and Fischer's method was more complex and their experiments were performed upon the cadaver. For a full account of this I would refer the reader to their original articles. According to their method the centre of gravity for the whole body was about 4.5 cm. above a horizontal line joining the centres of the heads of the two femora, or on a level with the third sacral vertebra (upper border).

These observers have claimed that the centre of gravity of the body is found to fall in the same frontal plane as that in which all the axes of rotation of the joints lie. It can be readily understood from this that anatomical variations will very considerably alter this statement, this being particularly true of women in pregnancy or of abnormally stout men. In such persons, when in the erect position, the centre of gravity must lie well away from the plane containing these joints, the abdominal weight necessitating an arching of the spine, the shoulders being thrown back, bringing the centre posterior to the normal plane.

It has been pointed out by the Weber brothers, that the fact that the various centres of gravity of the body form a vertical line when the body is in an erect position, is sufficient to maintain the body in an erect position without any muscular effort. (According to Braune and Fischer the centre of gravity for the head was plumb above the atlanto-occipital joint.) According to them the centre of gravity plumbs behind the hip, in front of the knee and through the ankle-joint. Meyer claims that the centre plumbs in front of the ankle-joint. If this is so the calf muscles would have to act toward the support of the body. In bending forward or backward the centre of gravity will fall either forward or backward, as the case may be (see Fig. 1934).

In the most comfortable standing position the centre plumbs really in front of the ankle. When it falls farther forward than this, as for instance when it falls over the ball of the great toe as in the military position of "attention," there is a sensation of straining and this posture cannot be long supported. In fact there is no erect position of the body which can be maintained for many minutes without exhaustion, although it has been claimed that muscular action is not necessary to maintain the body in the erect position. It may be noted that we instinctively

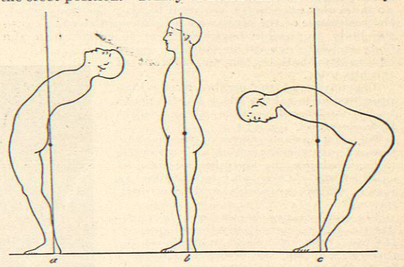

FIG. 1934.—The Position of the Centre of Gravity is Indicated by a Dot in Each of the Postures *a*, *b*, and *c*. In *a* and *c* it lies outside the body altogether.

and frequently change our position and so ease the various sets of muscles when standing for any length of time.

Walking and Running.—In these modes of progression there are certain forces which have to be so balanced that the speed of progression is neither diminished nor increased, and also that during locomotion the body shall remain erect. Three forces may be considered: first, the weight of the body to be supported; second, atmospheric