be an alteration in the function of the respiratory centre. The theory is that there is a periodic diminution in the excitability of the respiratory centre, or that the excitability of the medulla oblongata becomes exhausted. *Biot's respiration* is probably a modification of Cheyne-Stokes breathing, with the same significance.

Pulmonary symptoms are quite common in uræmia; in fact, spasmodic dyspnœa is the first and sometimes the only symptom for a long time. Later, the renal symptoms become pronounced, pointing to the nature of the disease.

Dyspnœa in Special Diseases.—*Asthma* is a form of paroxysmal dyspnœa, dependent most often upon nasal, bronchial, and gastro-intestinal reflexes. It is a striking picture of air hunger, and suggests the following alteration in the lines from "The Ancient Mariner," "Air, air everywhere and not a bit to breathe." There are diminished respiratory movement and prolonged expiration. The frequency of respiration is diminished sometimes to one-half the normal rate; the rhythm is altered, inspiration is short and gasping. A natural consequence of an asthma of long duration is the advent of *emphysema*, when the dyspnœa becomes more constant. The dyspnœa is proportionate to the degree of emphysema and is aggravated by the coexistence of bronchitis, asthma, and eccentric hypertrophy of the right ventricle (which are frequent complications in long-standing cases). When emphysema is only moderate, dyspnœa is not complained of, except on climbing or walking briskly, or after a hearty meal, but when it is great, the dyspnœa is constant, interferes with all exertion, frequently necessitates orthopnœa and prevents continuous speech.

In *Aortic Aneurism* and mediastinal tumors, dyspnœa is a frequent symptom, and is due chiefly to pressure.

In *Capillary Bronchitis* of infancy, respirations may be as many as 60 to 80 per minute. Dyspnœa is more or less constant, but becomes urgent in paroxysms, and the patient may have to be propped up in bed to breathe. It is expiratory. Inspiration may be free and easy or difficult, but expiration is always difficult and prolonged.

Gastric Disease.—Dyspnœa occurs in many cases of dyspepsia, if the subject is the victim of asthma, anæmia, or cardiac disease. In asthma it is usually reflex. In anæmia it is due to atony of the stomach and gaseous accumulation. In cardiac disease it is mechanical, from the pressure of a stomach distended with gas.

In *Hydrophobia*, the spasmodic contraction of the larynx may become so strong as to excite urgent dyspnœa, with the emission of curious sounds.

Hysteria sometimes explains obscure cases of dyspnœa. Such cases have been reported by physicians of the German army. In the fall of 1898 a soldier entered the University of Michigan hospital, suffering with a continuous dyspnœa, so severe at times that it compelled the orthopnœic position. Very careful physical and clinical examinations failed to reveal any adequate cause for the dyspnœa. It was perhaps hysterical.

In *Nephritis* dyspnœa may be a pronounced symptom, due either to uræmia or to œdema of the glottis, to effusions into the pleura, or to bronchitis. If dilatation of the heart occurs, dyspnœa may arise, due to that or the secondary œdema of the lungs.

In *Phthisis* dyspnœa is almost constant. The degree varies with the association of fever; when the latter is present, dyspnœa is more pronounced. It is also more pronounced in acute cases. In miliary tuberculosis the frequency of respiration is out of all proportion to the physical signs. In this form cyanosis is more marked. In chronic localized phthisis the dyspnœa may occur only on exertion, after eating, or upon excitement. In later stages the dyspnœa is constant and in proportion to the extent of involvement of the lungs and the degree of fever.

In *Pneumonia* frequent respirations—40 to 60 in adults, 60 to 90 or more in children, per minute—is a characteristic symptom. It is panting in character, particularly when pneumonia occurs in old subjects; both inspiration and expiration are brief, though sometimes separated by a rather long pause. Expiration is usually accompanied by an audible grunt, indicating great oppression. Dyspnœa may be absent, or, as the case progresses, may become either increased or greatly diminished, according to the severity of the type.

The chief causes of dyspnœa in pneumonia are involvement of lung, bronchitis, pericarditis or extensive pleurisy, cardiac failure, collateral congestion with œdema, *fever*, and the intense pain in the side. That, in a frank case of pneumonia, irritation of the respiratory centre by toxins or warm blood, is the chief cause of dyspnœa, and not the lung involvement, is proved by the fact that synchronous with the crisis and the fall of temperature (while the consolidation of the lung still exists) the dyspnœa disappears.

In *Pneumothorax* developing in the course of a tuberculosis, severe dyspnœa and frequently cyanosis, are among the first symptoms. The difficulty in breathing is often accompanied by a sense of impending suffocation. The stress of the dyspnœa depends upon the amount of air that suddenly gains entrance into the pleural cavity. If the orifice be large and valvular, the air cannot escape and rapidly accumulates, and forces all of the air out of the lung by compression, and the respirations become frequent, 60 or more per minute.

In *Tetanus*, thoracic oppression, dyspnœa, and more or less cyanosis follow interference with the respiratory function, especially if there is spasm of the glottis.

The treatment of dyspnœa is the treatment of the various diseases with which it is associated.

James Rae Arneill.

EAR: ANATOMY OF THE TYMPANIC MEMBRANE AND OSSICLES.—The tympanic membrane, membrana tympani, or drum membrane, is composed of three layers: viz., the external or dermoid layer, the middle or fibrous, and the inner or mucous layer.

The dermoid or skin layer of the membrana tympani is a continuation of the skin of the external auditory canal. In this layer, however, there are no hairs nor follicles, as are found elsewhere in the cutis of the auditory canal. In other respects it is true skin, but extremely thin and transparent. The outer or skin layer of the membrana tympani is the only one of the three component layers of the drum membrane which can be inspected directly from without. When the auditory canal is illuminated and a normal membrana examined from without, several prominent features in it attract the observer's attention: viz., its almost circular shape, and peculiar polish and color; its vertical and horizontal inclinations; the ridge formed in one of its radii by the handle of the hammer bone; the short process at the upper end of the latter; the folds of the membrana; the flaccid portion of the tympanic membrane, the portion above the short process of the hammer, the so-called Shrapnell's membrane; the white, tendinous periphery of the membrane; and, finally, the bright, triangular reflection of light in the antero-inferior quadrant of the membrane, running from the lower end of the malleus, at the centre of the membrane, the umbo, toward the periphery. This reflection is called the "pyramid of light" (see Fig. 1678). Generally a delicate plexus of vessels can be seen in the region of the folds and in the membrana flaccida, and one or two delicate arterioles can be traced downward along the manubrium of the malleus.

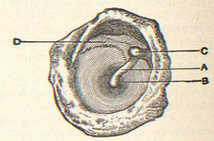

Fig. 1677.—View of Outer Surface of Membrana Tympani. (Gruber.) *A*, malleus, manubrium; *B*, lower end of manubrium; *C*, short process; *D*, posterior fold of the membrana.

For purposes of convenient description, the membrana tympani is called circular in shape. Its form, however, varies between that of an ellipse and an irregular oval, while in some cases, in which the lateral portions of the

annulus tympanicus are especially curved outward, it assumes a heart shape. Strictly, it may be considered an ellipse, the long diameter of which, amounting to 9 or 10 mm., runs from above and in front downward and backward, and the shortest diameter of which runs from below and in front, upward and backward. The proportion between these diameters is 4.3‴: 4.0‴ (Von Troeltsch and Hyrtl). Since the difference between them is so slight, and their inclinations are so nearly vertical and horizontal, the outline of the tympanic membrane is considered circular, and is divided into quadrants by the horizontal and vertical diameters, which greatly aids in locating points to be described.

Fig. 1678.—The Normal Membrana Tympani.

Color.—The normal color of the membrana tympani is not constant, because it varies, just like the color of the teeth, with the individual. As the latter varies from a bluish to a yellowish-white, so the drum membrane varies, in a perfectly normal condition, from a bluish to a yellowish-gray, the former being the commoner tint. This color is generally spoken of as a "pearl color," but, whatever color the tympanic membrane possesses, it is always modified by the physical conditions incident to stretching a nearly transparent membrane over a darkened cavity.

The color of the membrana tympani is furthermore modified by the color it transmits from the tympanic cavity, the latter factor being modified by the varying degrees of tenuity of the membrana, as well as by the varying conditions and colors of the mucous lining and the contents of the tympanic cavity. That part of the membrana tympani behind the lower end of the manubrium, and over the promontory of the cochlea, is rendered yellowish-gray by the rays of light reflected from this part of the inner wall of the tympanic cavity.

The membrana tympani owes its peculiar lustre to the delicate and shining epithelium of the skin layer. The slightest maceration, exfoliation, or thickening of this delicate epithelium deprives the membrane of its beautiful gloss. The dermis of the membrana is thickest in children, and hence their membranæ rarely shine as brightly as those of adults.

The Inclinations.—Another important feature attracting the eye of the observer is that the membrana tympani, in its normal condition, is inclined outward in its vertical plane at an angle of 45°, and in its horizontal plane ten degrees toward the right on the right side and ten degrees toward the left on the left side. If the planes of both membranæ be extended downward until they intersect, the angle they will then form will be equal to from 130° to 135°. Of still greater importance than this, however, is the direction of the walls of the auditory canal from the plane of the membrana tympani. Thus if a perpendicular be drawn from the upper pole of the drumhead to the inferior wall of the auditory canal, it will strike the latter about 6 mm. from the inferior pole of the membrane. A similar result will be obtained by drawing a perpendicular from the middle of the posterior periphery of the drum membrane to the anterior wall of the auditory canal, from which it is manifest that the lower anterior part of the membrana is farther from the external opening of the canal than the posterior upper part is. The membrana tympani is inclined the most in very young children, being almost horizontal in the early years of life. As the osseous canal does not exist at this early period of life, the upper part of the membrana tympani lies very near the external meatus at this time.

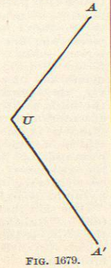

Fig. 1679.

In some instances there is observed a physiological variation in the obliquity of the membrana tympani, and a filling in of the segment of Rivinus (the region of the membrana flaccida) with osseous tissue. Hence on inspection it is found that a large portion of the field at the fundus of the canal is taken up by the upper wall of the canal, which seems to dip down to join the membrana tympani on a line with its folds. In such cases there is very little or no membrana flaccida. This condition is observed in the feeble-minded with other cranial defects in development. Moos and Steinbrügge observed in a cretin, with defective cranial development, a difference of 40° in the inferior angle of the membrana tympani, on each side. In such cases the difference may be from 10° to 50° greater than normal.

The Handle of the Malleus.—Running from above downward and backward to the centre, or umbo, of the tympanic membrane is seen the ridge formed by the *manubrium* or handle of the hammer. This slightly elevated ridge, entirely opaque and decidedly whiter than the surrounding membrana tympani, is in the diameter which divides the tympanic membrane into two unequal parts, the anterior being the smaller and the posterior the larger. At the upper end of this ridge is the short process of the malleus, projecting sharply outward, somewhat above the general surface of the handle of the hammer. In general appearance it is not unlike a pimple with pale-yellowish contents. The lower end, or tip of the ridge, which curves slightly forward, is flatter, broader, and yellower than the rest of the outer covering of the manubrium. This is due to the fact that the bone at this point is spade-shaped, and also because the radial fibres of the middle layer, the *membrana propria*, centre at this lower end of the handle. The lower end of the hammer draws the membrana tympani very markedly inward, and forms the depressed centre of the membrane called the *umbo*. The concavo-convex shape of the drumhead from the tip of the manubrium outward toward the periphery is due to the comparatively large number of circular fibres at a point between the umbo and periphery, which constrict, as it were, the radial fibres so as to form a kind of funnel.

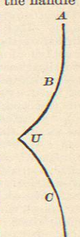

Fig. 1680.

Pressure or traction applied to the centre of a membrane stretched over a ring tends to draw the former into a conical shape, a vertical section of which is represented by the line *AUA'* in Fig. 1679. But if a smaller concentric ring be placed at *BC*, in Fig. 1680, so as to resist the indrawing force at *U*, the curve assumed by the membrane will be represented by the line *AUA'* in Fig. 1680, and the whole membrane will be drawn into a concavo-convex surface, the line *AUA'*, Fig. 1680, representing on the right-hand side the curve of the tympanic membrane on its outer surface.

The yellow spot at the end of the handle of the malleus, in the centre of the umbo, is a purely physiological condition. It is, in fact, part of the cartilaginous structure at the end of the manubrium of the hammer.

Trautmann[1] concluded that: 1. Its physiological significance is the same as that of an epiphysis of a long bone. 2. The diagnostic value of the yellow spot is apparent in cases of thickening of the membrana tympani, as the former will disappear much sooner than the sharp edge of the malleus. 3. Opacities of the membrane with thickening change the color of the yellow spot. 4. When the malleus is twisted on its long axis the form of the spot will be altered. 5. If the spot does not move during alterations in the atmospheric pressure in the canal induced by the pneumatic speculum, it is fair to conclude that either ankylosis of the malleus or its adhesion to the inner wall of the drum cavity has occurred. In the latter instance, the differential diagnosis is aided by the necessary foreshortening of the handle of the hammer.

Folds of the Membrana Tympani.—From the short process of the manubrium of the malleus two delicate ridges may be seen, one passing forward, the other backward to the periphery. These are the so-called folds of the mem-

brana tympani. They are formed by the pressure outward of the short process of the malleus, and constitute important topographical as well as diagnostic points in the tympanic membrane. Above these folds is the so-called membrane of Shrapnell, or the membrana flaccida. It owes its flaccidity to the small quantity of fibrous tissue entering into its composition, and to the loosely stretched cutaneous and mucous layers of the membrana tympani which here come together. In the upper part of this flaccid membrane there was once *said* to be a normal opening, the *foramen Rivini*, named after the supposed discoverer in 1717. Its existence finally was denied by Hyrtl, and his conclusions are now universally accepted.

Pyramid of Light.—The pyramid of light is the name applied to the beautiful triangular reflection of light emanating from the antero-inferior quadrant of the normal adult membrana tympani. The apex of this triangular reflection touches the tip of the manubrium of the malleus, and its base lies on, or near, the periphery of the membrana tympani. It forms, with the handle of the hammer, an obtuse angle anteriorly, that becomes greater as the inclination of the membrana tympani to the auditory canal diminishes. Its average height is from 1.5 to 2 mm., and its average width at the base is from 1.5 to 2 mm. The causes of the formation of this pyramid of light, or its optics, have been variously described by a number of careful observers. From the most recent investigations,[2] it is conclusively shown that there are three elements indispensable to the formation of the pyramid of light—viz., a shining surface, the peculiar inclinations of the tympanic membrane, and its peculiar funnel or convolvulus-like shape. In these three conditions may be found the solution of three very important questions, viz.: 1. Why do we see such, or any reflection from the tympanic membrane? 2. Why do we see this one in the antero-inferior quadrant? and, 3. Why is its shape pyramidal?

1. We see a reflection because of the lustrous epithelium on the dermoid layer of the membrane. 2. The peculiar inclination of the tympanic membrane so places the latter that, by the modifications of its surface brought about by the traction inward at the umbo, or centre, the only possible spot from which light can be reflected is just where the pyramid of light is seen, as will be explained further on. 3. The funnel shape of the membrana tympani will explain the pyramidal shape of this reflection upon the physical laws of concavo-convex mirrors.

Not one of these conditions is sufficient of itself to produce a normal pyramid of light upon the tympanic membrane. That the lustre of the skin layer is an important factor in producing this peculiar reflection may be proved by syringing an ear in which this pyramid of light is visible. After a slight maceration and consequent dulling of the lustre of the outer surface of the membrana, the pyramid of light will have disappeared or become distorted.

In order to prove that the peculiar inclinations of the membrana tympani toward the walls of the auditory canal have also their part in the production of the pyramid of light at the point where it is normally found, *i.e.*, in the antero-inferior quadrant, it is necessary only to inspect a normal tympanic membrane during inflation by the Valsalvan or any other method. It will then be seen that the pyramid of light becomes altered in position respecting the malleus.

That this reflection can come only from the antero-inferior quadrant is shown by an experiment of Politzer, as follows: If the auditory canal be removed from the membrana tympani, so that the latter is attached only to the annulus tympanicus, and the membrane then be revolved so that other parts of its surface successively assume the position of that from which the pyramidal reflection formerly came, we shall perceive on each of these parts a reflection almost exactly like the original pyramid of light, excepting behind the manubrium, where, owing to the different curve of the membrane, the reflection in question will be somewhat different, both in shape and brilliancy.

The third important condition in the formation of the pyramid of light is the funnel shape of the membrana tympani, to which is due, according to Trautmann, the pyramidal shape of the reflection under consideration.

The cause of the pyramidal shape of the "reflection of light" from the membrana may be thus stated: The normal tympanic membrane has quite a high degree of lustre, is inclined at an angle of 45° in its vertical plane, and in its horizontal plane it is inclined 10° toward the right on the right side and 10° toward the left on the left side. Furthermore, it is drawn inward so as to form a concavo-convex funnel (page 583), the apex of which lies in the centre of the anterior part of the yellow spot at the lower end of the handle of the malleus. The angle at which the sides of this funnel meet is greater than a right angle, the depth of the funnel is equal to about 2 mm., and the distance from the apex to the periphery is from 2.5 to 3 mm. anteriorly and 3 mm. posteriorly. But a reflection of light from the surface of the membrana tympani, were it flat, could not reach the eye of an observer, because the rays of light from without, on account of the inclination of the membrana tympani, would fall upon the plane surfaces of the same at a very acute angle, and since the angle of reflection is equal to the angle of incidence, the rays of light reflected from the planes of the membrane, having an angle of 45°, would strike the inferior wall of the external auditory meatus, and in consequence would be unable to reach the eye of an observer from without. The relations, however, are different in a reflection from a concavo-convex tract. For, on account of the vertical inclination of 45° in the membrana tympani, and of its horizontal inclination of 10°, and also because of its concavo-convex shape, the antero-inferior quadrant of the tympanic membrane is drawn at right angles to the illuminating point. Since, now, the illuminating body and the eye are in the same line in examining the ear, only the rays of light which fall perpendicularly upon the antero-inferior quadrant can reach the eye, since all other rays are reflected at such an angle that they strike the walls of the auditory canal; therefore, the only reflection of light seen by the observer comes from the antero-inferior quarter of the tympanic membrane, and constitutes the "pyramid of light."[3]

Geometric Divisions of the Tympanic Membrane.—It has been suggested[4] to divide the membrana tympani into two grand tracts, the one above, the other below the folds of the drumhead (*ae, ed*, Fig. 1681). The upper tract is subdivided into three sectors: viz., *aeb, bec*, and *ecd*, Fig. 1681. The sectors are bounded below by the folds of the membrana tympani, and above by the annulus tympanicus and the segment of Rivinus, *bc*. The middle sector, *bec*, is separated from the other two on each side by the two suspensory ligaments *be, ec*, of the handle of the hammer. Between the anterior suspensory ligament *be* and the anterior fold of the membrana tympani lies the anterior sector, and between the posterior suspensory ligament and the posterior fold of the membrana lies the posterior sector. The inferior division of the membrana tympani, viz., that portion below the folds, is divided into an anterior segment, beginning at the anterior fold and extending to the pyramid of light, and the posterior segment, extending from the pyramid of light to the posterior fold of the membrana.

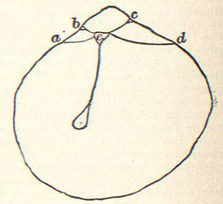

FIG. 1681.

It is said that the radial fibres in the tract of the pyramid of light of a normal membrane are shorter, and therefore tenser and more retracted, than those fibres which run directly backward and forward from the manubrium.

The Tendinous Ring (*Annulus Tendinosus*).—Before considering the membrana propria, the structure from which the fibres of this middle layer of the tympanic membrane originate, demands a short description. This is the so-called tendinous ring of Arnold. It is a mass of fibrous tissue around the periphery of the membrana tympani, effecting the union between the latter and the inner edge of the external auditory canal. This tendinous ring is wanting at the segment of Rivinus (upper pole of the membrane). It is, furthermore, not always visible from without, even when present in its normal position around the periphery, close to the annulus tympanicus.

The fibres of the membrana propria, the origin of which has just been explained, are not inserted directly into the bone of the manubrium, but into a cartilaginous groove which receives the manubrium and short process.[5] It presents in general the appearance of a deep groove, when seen from behind, after the removal of the malleus. Gruber has shown that this groove is closed at its upper end, so that it forms a cartilaginous cap, which covers in the short process on all sides; its lower end, on the contrary, is open behind, and it gradually becomes shallower or flatter, until lost in the substance of the membrana tympani. It extends from a little above the short process to a point half a millimetre below the spade-like end of the manubrium. The inner surface of this cartilaginous groove, which is in contact with the malleus, is lined by a very delicate layer of connective tissue, between which and the malleus there is found a small quantity of fluid resembling synovia. If this is so, there is here a kind of joint. Now and then cases are observed presenting, as it were, *two* short processes. Such an appearance is explainable as a result of a luxation upward of the malleus out of this cartilaginous groove. The upper one of the two is the true short process, in such instances. Kölliker[6] regards this hyaline cartilage as a remnant of fœtal life. He does not admit the presence of a normally developed, constant space between this cartilage and the malleus.

Membrana Propria: the Middle, Fibrous Layer of the Tympanic Membrane.—This layer may be subdivided into two distinct and very delicate layers, an *outer* one, composed entirely of radiate fibres, closely connected with the skin layer of the membrana, and an *inner* layer, composed entirely of circular fibres, in close relation with the mucous membrane composing the inner layer of the tympanic membrane. These are called the radial and circular layers of the membrana propria. The fibres of the first arise from the *annulus tendinosus* and the upper wall of the auditory canal, and are inserted into the handle of the hammer, centering for the most part at the umbo. The fibres composing the circular layer arise partly from the *annulus tendinosus*, but the majority arise from the substance of the membrana tympani itself (von Troeltsch). Some of them are inserted into the malleus. The circular fibres are most numerous a short distance from the periphery of the tympanic membrane. They are thickest in the upper third of the membrane, where they are twice as numerous as the radial fibres. The thickness of the circular layer at this point is 0.026‴, while that of the radial layer is 0.018‴ (Gerlach).

The circular fibres are much less numerous at the middle third of the space between the malleus and periphery, and almost wanting at the centre of the membrana. A knowledge of the arrangement of these fibres is important when considering pathological changes which may have taken place in the tympanic membrane, and also in explanation of its peculiar concavo-convex shape. For, "if its radial fibres were not united by transverse ones, they would be stretched in a straight line. In point of fact, however, they maintain a curved shape, with the convexity toward the meatus. Hence we conclude, that the radial fibres are drawn toward one another by circular fibres, and that the latter are also made tense at the same time. There is, in fact, in the membrana tympani at rest, no other force competent to hold the radial fibres in a curved position, but the tension of the circular fibres."[7] In addition to the two layers of the membrana propria, just described, there is still another layer composed of descending fibres (Gruber). They are external to the radial fibres, arise from the upper segment of the annulus tendinosus, and lying very close to one another, are inserted into the sides and median line of the cartilaginous groove of the malleus. The three layers of fibres entering into the composition of the membrana propria are lightly bound together by a very delicate connective tissue, but they cling very closely to the *annulus tendinosus*, cartilaginous groove, and the dermoid and mucous layers.

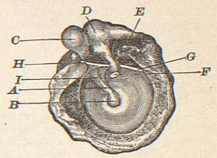

FIG. 1682.—View of Inner Surface of Membrana Tympani. (Gruber.) *A*, Manubrium of the malleus; *B*, the lower end of the manubrium; *C*, head of the malleus; *D*, body of the incus; *E*, short process of the incus; *F*, processus lenticularis of the incus; *G H*, chorda tympani; *I*, insertion of the tensor tympani muscle.

There is also in the membrana tympani a set of fibres arranged in a peculiar way, and first described and named by Gruber — the *dendritic* (*arborescent*) *fibrous* structure of the tympanic membrane. "They arise near the periphery, about in the middle of the posterior segment, pretty far apart, but as they proceed on their upward course in the posterior segment, they approach one another in order to divide again, at some distance from the manubrium of the malleus, into several branches, usually about three, which run in different directions, and are finally lost by intertwining with the fibres of the membrana propria."[8] These fibres are not confined to the posterior segment, but traces of them are found throughout the membrana tympani. The function of these fibres is considered by Gruber to be, in all probability, to relax the tympanic membrane, although it cannot be shown as yet that it is muscular. The membrana propria consists chiefly of connective tissue of that variety, half-way between the ordinary fibrillated and the homogeneous connective tissue of Reichert, as shown by Gerlach. The fibres are 0.004‴ broad, and 0.002‴ thick. Upon these ribbon-like fibres are found peculiar spindle-shaped corpuscles, once supposed to be peculiar to the membrana tympani, and named the "corpuscles of the membrana tympani," or the "corpuscles of von Troeltsch," after the observer who first called attention to them. They are, however, only the connective-tissue corpuscles of Virchow. They are 0.002‴ long, and about 0.005‴ wide at their broadest part, with two or three processes. They are found under two forms, the spindle shape and the stellate (Gruber).

Internal or Mucous Layer of the Tympanic Membrane.—The internal layer of the membrana tympani is of mucous membrane, a continuation of that lining the tympanic cavity. It is thickest at the periphery of the tympanic membrane, growing thinner as it approaches the centre of the membrana tympani, where it is extremely delicate. On the inner surface of the layer various investigators have found villous bodies (Politzer, Gerlach, Kessel). They resemble intestinal villi in appearance, and are usually found in delicate children. They are globular or finger-shaped, the former being from 0.10‴ to 0.12‴ in diameter, and from 0.12‴ to 0.14‴ in length. The finger-shaped villi vary in length from 0.10‴ to 0.12‴, and in width from 0.06‴ to 0.08‴ (Gerlach and Gruber). As no nerves have ever been found in these bodies, and as they are connected to the mucous membrane by means of pedicles, they should be regarded as villi rather than as papillæ (Gerlach). They are never found below the upper third of the malleus, nor are ever more numerous than eight. The finger-shaped ones are 0.02 mm. long by 0.05 mm. in breadth, according to Moos,[9] who asserts that they are prolongations or protrusions of the mucous membrane, covered by a single layer of ciliated cylinder