

Burnett (C. H.) & Blake (C. J.)
with the Compliments of
Clarence J. Blake. *Dr. Edward H. Clarke*

R E P O R T

ON THE

PROGRESS OF OTOLOGY.

BY

C. H. BURNETT, M. D.,

AND

CLARENCE J. BLAKE, M. D.

REPRINTED FROM THE

TRANSACTIONS OF THE AMERICAN OTOLOGICAL SOCIETY,

For 1874.



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THE preparation of the Report on the Progress of Otolology during the year that has passed has been shared by a committee of two, in accordance with a suggestion made by the committee of last year. The Report is divided into three parts: I. Anatomy and Physiology, by Dr. Burnett; II. Pathology and Therapeutics, by Dr. Blake; and III. Reviews and Book Notices, by each member of the committee.

There is a bibliographical record for the year appended to the Report, in which the articles forming the basis of the Report may be readily found by the alphabetical arrangement of the authors' names.

With the hope that it may prove acceptable to the Society, and all other readers, the following report is respectfully submitted by the committee:—

I.

ANATOMY AND PHYSIOLOGY.

¹ Prof. Gruber has extended his investigations concerning anomalies in the connection between the malleus and the membrana tympani, describing three more varieties of abnormal connection.

The first consists in a round vesicle extending over the upper part of the manubrium of the malleus and the antero-superior segment of the membrana tympani. This vesicle is nothing more than the result of a collection of fluid induced by hyperæmia or inflammation in the membrana tympani.

The second anomaly is only a higher grade of the first; ² is of rare occurrence.

By an extension of the vesicle downwards, parallel with

the handle of the malleus, the latter appears doubled. In such cases, Gruber thinks that the cartilage of the anterior portion of the manubrium of the malleus is loosened and pushed out of position.

The third form of anomaly is considered to be a combined result of the first two forms already mentioned.

In this form the short process appears dislocated upwards in a few cases, but more usually downwards and upon the posterior surface of the manubrium of the malleus. "Of course," says Gruber, "this is not a dislocation of the short process, but simply one of the upper end of the cartilage in connection with it." This dislocation, the author says, he has seen as a sequel of hypertrophic inflammatory processes in the mucous membrane of the middle ear. This condition is attended, furthermore, with alterations in the position of the membrana tympani and ossicles, viz. a retraction and simultaneous turning of the malleus about its long axis.

Prof. Gruber also calls attention to another change in appearance he has observed in cases of the abnormal position of the malleus just described. He says, "It appears as if the cartilaginous segment, extending from beneath the short process to the end of the manubrium of the malleus, were raised up and shrunken. The outermost edge of the manubrium in such cases assumes a wavy appearance."

Prof. Voltolini again calls our attention to his pneumatic aural speculum and its advantages. His first statement is that the usual aural mirror, which reflects ordinary sunlight into the meatus, is only of use to short-sighted aurists, whereas his speculum, in which the reflecting plane-mirror is only 3" from the membrana tympani, can be used by direct sunlight, as well as with simple daylight, by every eye.

He furthermore claims that with his speculum we are better able to see both the normal appearances and the manifold variations of the pyramid of light, all of which only serve as proof that the *funnel shape* of the membrana tympani causes the pyramid of light and not the inclination of the membrane to the axis of the meatus.

Its pyramidal shape is due to the fact that the membrana tympani, which in this connection must be regarded as a concave mirror, becomes smaller towards the centre, and therefore the reflected image, *i. e.* the parts of the pyramid of light, become smaller towards the centre of the mirror, *i. e.* of the membrane. In this article, Voltolini likens the membrana tympani to the tapetum of the choroid, which is practically a concave mirror, and reflects a minimum of the light falling into the eye. We have consequently a pyramid of light in the eye as well as in the ear, and our author says we may speak of "shining ears" as well as of "shining eyes."

Among the practical advantages of this speculum, we find that the author claims that if by its use we are unable to alter the appearance of the pyramid of light, we may safely conclude that the membrana tympani is adherent throughout its entire extent.

In the same article, Voltolini says that the normal color of the membrana tympani is pearl gray (a merely confirmatory statement of the observations of others), and that the membrane in its normal condition is only translucent, not transparent, even in the brightest sunlight.

In those cases where the contents of the tympanum are visible through the membrana tympani, we may conclude that the latter is more or less atrophied.

This speculum will also enable us to tell whether the membrana tympani is perforated, and if it be, we can by its use empty the tympanum of its fluid contents by suction; but the last two ends may be gained equally well by Siglé's pneumatic speculum.

The operations for tenotomy of the tensor tympani and loosening the adherent membrana tympani from the inner wall of the tympanum, may be performed by the aid of this speculum. Dr. Trautmann has investigated most thoroughly the optical causes of the "triangular shining spot," or the pyramid of light, on the membrana tympani, in an article which he calls "The Shining Spots of the Membrana Tym-

pani" ("Lichtreflexe des Trommelfelles"). This paper is admirably illustrated by nineteen diagrams explanatory of the optics of concave and convex mirrors, as well as the "shining spots" upon the inner and outer parts of the surface of the funnel or concave mirror formed by the natural membrana tympani.

Under the third head of this paper, the author sums up the following reasons for the "spots of light" (Lichtreflexe) which usually occur in membrana tympani.

He says, "The normal membrana tympani has quite a high degree of superficial lustre, is inclined at an angle of 45° in its vertical plane, and in its horizontal plane it is inclined 10° towards the right on the right side, and 10° towards the left on the left side. Furthermore, it is drawn inwards so as to form a funnel, the point or apex of which lies in the centre of the anterior periphery of the yellow, sickle-shaped expansion at the end of the anterior edge of the manubrium of the malleus; the angle at which the walls of the funnel meet is greater than a right angle, the depth of the funnel is equal to about 2mm. and the distance from the apex to the periphery is $2\frac{1}{2}$ -3mm. anteriorly, and 3mm. posteriorly.

Therefore a "spot of light" or a reflection of light from the plane surfaces of the membrana tympani cannot reach the eye of an observer, because the rays of light from without, on account of the inclination of the membrana tympani, fall upon the plane surfaces of the same, at a very acute angle. Since the angle of reflection is equal to the angle of incidence, the rays of light from the planes of the membrane which has an inclination of 45° , must strike the inferior wall of the external auditory meatus, and are in consequence unable to reach the eye of the observer.

The relations are, however, different, when we consider the "reflection of light" which is found in a funnel-shaped spot. On account of the vertical inclination of 45° of the membrana tympani and of its horizontal inclination of 10° , the antero-inferior quadrant of the membrana tympani is at right angles to the illuminating object. Since, now,

the illuminating body and the eye are in the same line,* the rays of light which fall perpendicularly upon the antero-inferior quadrant must reach the eye, and therefore the eye sees a "reflection of light" only in the antero-inferior quadrant, the reasons of which are more fully explained by the author under the second part of his paper. Since the walls of the funnel meet at an angle greater than a right angle, this triangular reflection is a direct one, as is fully explained under the aforesaid second part, which treats of the physical reasons for all prominent reflections of light (sich abhebende Lichtreflexe) occurring on shining or polished surfaces.

A number of anatomical modifications of the temporal bone have been pointed out by Zuckerkandl.

These modifications are shown to be the result of an extraordinary development of vessels which are usually small and insignificant, but which, by the aforesaid development, alter the structure of the temporal bone,— a fact of such importance that an investigation of two hundred and eighty skulls was made in order to arrive at some conclusion respecting the causes of these important modifications of the temporal bone.

The first modification is termed the sinus petrosquamosus, and is produced by a semi-canal in the line of the fissura petroso-squamosa, and connects, by means of a largely-developed vein, one of the middle meningeal veins with the sigmoid sinus.

The sinus petrosquamosus may be ambilateral or unilateral. That portion of it usually found on the anterior aspect of the temporal bone may be wanting as far as the canal of the posterior part of the petrous bone.

A converse modification is seen where the canal usually passing over the posterior part of the petrous bone to join the sinus petrosquamosus is wanting.

* The external auditory meatus is so narrow, that the observer and the source of illumination had better be in the same line. in order to obtain the best possible illumination of the membrana tympani.

This sinus may be very short, emptying into the sinus petrosus superior, instead of passing backwards as far as the sigmoid sinus.

In the second part of his paper, Zuckerkandl has pointed out some features of the sulcus petrosus superior, which give it the character of a diploëtic vein of the petrous bone. In the same division of this article he alludes to the modifications of the sigmoid sinus, and that portion of it denominated the bulbus of the sigmoid sinus.

This latter anomaly, says our author, in some few cases may assume a dangerous character by causing a thinning of the mastoid portion of the temporal bone lying over the aforesaid bulbus of the sigmoid sinus.

In one instance he found the soft parts of the scalp at one point separated from the bulbus of the sigmoid sinus by a layer of bone as thin as paper; and at another point the soft parts of the scalp were in direct contact with the bulbus of the sigmoid sinus.

In the third portion of the paper on "Anomalies of Development in the Petrous Bone," we find the following remarks on the anastomosis of the arteries of the labyrinth: "After the vestibular artery reaches its destination, it divides at the posterior wall of the vestibule into several branches which arch towards the outer wall of the vestibule. We possess no information respecting the connection between these vessels and the of those cochlea, although the anastomosis of these vessels can be seen by the removal of the anterior wall of the vestibule in any well-injected preparation of the temporal bone.

"The cochlear artery, which alone gives off 15 or 20 arterioles to the membranous portions of the cochlea, gives origin to a large branch, passing through the lamina spiralis ossea, *via* the modiolus, into the vestibule.

"This branch gives off three other branches:—

"1. One to that portion of the lamina spiralis membranacea et ossea lying behind the promontory.

"2. One to the superior wall of the vestibule, and

"3. A branch which anastomoses with the branches of the artery of the vestibule.

"Hence, we see that the *arteria auditiva*, whose connection with the ostium of the tympanum has never yet been demonstrated, forms a completely closed net in itself.

"The diploëtic substance which surrounds the labyrinth shows a similar richness in larger arteries."

Zuckerkindl has also described a constant and peculiar anatomical connection between the Eustachian tube and the constrictors of the pharynx, under the name of the *ligamenta salpingo-pharyngea*. He states that "upon opening the posterior wall of the pharynx and dissecting off the mucous membrane, along the periphery of the pharyngeal opening of the Eustachian tube and adjacent parts, we shall find three, four, or five or even more tendinous, rarely elastic cords attached to the pharyngeal end of the hooked cartilage of the Eustachian tube, and the outer wall of the same, which, in their fullest development, the author likens to the tendinous cords connected with the valves of the ventricles of the heart.

"This anatomical arrangement produces a free opening of the Eustachian tube at each contraction of the superior and middle constrictor of the pharynx."

We are also informed that "if the cavity of the tympanum is laid open, in a perfectly fresh specimen, the *ligamenta salpingo-pharyngea* of which have been dissected, we shall find upon stretching these cords downwards that the ossicles of hearing will be visibly moved, and that alterations of attitude in a drop of water placed in the cavity of the tympanum will also be produced." A similar natural tension is produced in these "tendinous cords" by the action of the *arcus palato-glossus* brought about by opening the mouth very widely.

At a meeting of the Boston Society for the Advancement of Medical Science, Dr. Blake described a peculiarity observed by Prof. Wyman first in the crania of Hawaiian Islanders, and subsequently in the crania of ancient Peru-

vians, consisting of exostoses of the external auditory meatus occurring uniformly on the superior and inferior lips of the lamina forming the posterior wall of the passage, the same peculiar growth being described by Welker as occurring in the crania of American Indians. Out of three hundred and thirty-four Peruvian crania examined by Prof. Wyman, these growths were found in six, and in various degrees, from a small pedunculated growth on the superior lip of the lamina to double growths on both lips nearly occluding the orifice of the passage. It was noticeable, moreover, that these growths were nearly uniform in size and shape on both sides. Out of eight Peruvian crania, belonging to the collection of Mr. Blake, in the Warren Museum, but one presented this peculiarity, and then only in the form of an elongated ridge upon the posterior wall of the meatus on one side. The supposition that aquatic habits might have to do with the presence of these growths, though applicable in the case of the Hawaiian Islanders, would not apply to the Peruvians, living as they did in a tract of country remote from the sea and remarkable for its aridity. That the occurrence of these growths is coincident with the development of the wall of the osseous meatus, as suggested by Dr. J. O. Green, is further supported by the fact that the location of the growths was a constant one.

Dr. Hasse has continued his researches into the "general plan upon which the peri- and endo-lymph of the inner ear is renewed." The results of his investigations upon this subject, in connection with all classes of vertebrates, I shall give to you in the author's own words, which may be found on page 768 of his "Anatomical Studies," No. xix:—

"All vertebrates possess a duct which originates in the vestibule; and in all animals, with the exception of the Plagiostomes, in which it passes directly to the surface of the skull, this duct enters the cavity of the cranium and there terminates either in a closed sac at the confines of an epicerebral lymph-cavity, or opens into the same. This is the ductus endolymphaticus or the aquæductus vestibuli with the

saccus endolymphaticus, the former of which, in most vertebrates, arises from the sacculus, that is, from the inferior portion of the vestibule. In fishes, the perilymphatic fluid is poured into the cavity of the skull without any special conduit, and empties into the epicerebral chamber; in Plagiostomes, it is excreted directly upon the skull; and in other vertebrates, a special way of excretion of the peri-lymph exists by means of a narrow canal, which empties either into the epicerebral lymph-chamber, or passes into a lymph-sac which lies in the foramen jugulare, which sac terminates on one side in a peripheral lymphatic duct, and on the other side passes into the epicerebral lymphatic space. This canal is the *canalis s. ductus perilymphaticus* with the *saccus perilymphaticus*, which leaves the auditory capsule (*Gehörkapsel*) either through the *foramen rotundum* or through the so-called *apertura aquæductus cochleæ*, and conveys the perilymph from the auditory capsule to the periphery."

After tracing the *aquæductus vestibuli* through all classes of vertebrates, and having established the existence of one simple fundamental form for all, the author then endeavors to explain the physiological function of this organ. He lays down three probable functions of this structure. 1. The endolymphatic duct and its sac are the source of the endolymphatic fluid in embryonal life. In this capacity the sac plays the more important part, through its epithelium and the vessels which are distributed to it, forming a kind of gland.

2. The *aquæductus vestibuli*, in adult life, may act as a conveyer of new material to the endolymph, either by means of endosmosis from the epicerebral cavities in those instances where the sac is closed, or by means of a direct current where the saccus is open.

3. We might reasonably suppose that the sac was useful as a reservoir for the liquor endolymphaticus in any case where the intra-labyrinthal pressure attains an excessive height. By the reception of the fluid into the sac in such a case the pressure would be reduced in the labyrinth.

The author also gives the following reasons for what he

considers an uncommon practical importance in the ductus endolymphaticus :—

“Every increased or diminished pressure of the fluid of the liquor cerebrospinalis in the subarachnoidal cavity will make itself felt per continuitatem through the saccus and the ductus endolymphaticus, in the interior of the auditory apparatus, in the endolymphatic cavity and upon the terminal apparatus of the auditory nerve found therein. We may thus explain most easily the impairment of hearing for high tones in cases of increased pressure.”

Furthermore, pathological processes in the subarachnoidal space are conveyed either by continuity or contiguity through the saccus and ductus endolymphaticus into the interior of the labyrinth, and vice versa, the latter instance, of course, being the rarer from the deep-seated position of the inner ear. Thus every alteration in the chemical constitution of the cerebro-spinal fluid necessarily produces a change in the liquor endolymphaticus, which alteration must exercise some influence in the occurrence of subjective acoustic perceptions as a result of disturbed nutrition; in any event it must have an effect upon the composition of the liquor endolymphaticus.

That portion of the treatise which traces out the comparative relations of the aquæductus cochleæ in the vertebrates closes with the following remarks by the author on the physiological importance of the perilymphatic cavity :—

“The cavum perilymphaticum is inserted into the lymphatic tract of all the vertebrates and is connected with the subarachnoidal cavity by means of the foramina acustica, and thence indirectly with the peripheric lymphatics, which in connection with the large nerve-trunks pass from the perilymphatic cavity by means of the ductus and saccus perilymphaticus. We can therefore perceive that all changes experienced by the liquor cerebro-spinalis, whether they be of a chemical or physical nature, must act upon the liquor perilymphaticus and thence upon the organ of hearing, causing subjective perceptions of sound.

"On the other hand, pathological processes which could transmit themselves, through the ductus endolymphaticus, from the cavum subarachnoideale into the interior of the membranous labyrinth, by virtue of their continuity or contiguity, could also exercise an influence in the cavum perilymphaticum, thus furnishing a not unsound anatomical basis for the elucidation of morbid conditions of the inner ear.

"This relationship between the liquor perilymphaticus and l. endolymphaticus supplies the possibility of an afflux and efflux of the fluid element, a renewal of the same, and the removal of the products of retrograde metamorphosis, and we are therefore justified in supposing that there is a constant circulation of lymph in the inner chambers of the membranous labyrinth as well as in the space between the membranous labyrinth and the auditory capsule (Gehörkapsel). The rapidity of this current is equal to that of the lymphatic stream in the lymphatic cavities with which it is connected, chiefly to that of the cavum subarachnoideale, perhaps less rapid. The consequences of this relationship will be shown in a forthcoming treatise."

This work of Prof. Hasse on the lymphatic system of the inner ear is based upon a series of observations on all classes of vertebrates, and from time to time he has published, in separate form, investigations on the auditory apparatus of a species which are now woven into the complete chain of reasoning which he has laid before the world of science.

Dr. Hasse alludes to the important aid he has derived from his predecessors in this field of study; especially prominent are the names of Cotugno, Meckel, Breschet, Windischmann, and Rathke.

The contemporaneous writers alluded to by Dr. Hasse are Clason, Ketel, Schwalbe, and Böttcher, from whose labors Dr. Hasse has gleaned, as he states, much that is of great value in carrying on his investigations, which have formed the basis of the theory contained in his new work. However, our author says, he does not claim to have established a positive and complete theory, — "On the contrary, it is only

a further developed investigation which is still under consideration, and does not claim to be a complete theory." "If it will stimulate others to produce something more complete, then my principal object will be attained," says this distinguished writer on the comparative anatomy of the auditory apparatus.

Dr. Curschmann has performed a series of experiments upon the relation existing between the semicircular canals and the equilibrium of the body. He has kept in view the following cautionary rules:—

1. The least possible destruction of tissue in the exposure of the semicircular canal.

2. Careful avoidance of excessive hemorrhage, especially from the venous sinus which accompanies the semicircular canals.

3. The least possible injury to the bony canals, since, from their intimate relation to the cavity of the cranium, they cannot be destroyed without a previous opening of the cranial cavity, with an immediate or secondary injury of the cerebellum.

With these precautions, after the bony canals were laid bare, small openings were made in the canals, and either the entire membranous canals, or pieces of them, were removed by means of the forceps.

The author draws the following conclusions from his experiments:—

- (1.) Injuries of the semicircular canals produce special disturbances in the equilibrium of the body. It is entirely incorrect to attribute the latter to the attendant injury of other parts.

- (2.) The manifestations produced by the lesions are, in general, proportional to the extent of the same.

- (3.) In all cases of disturbance in the equilibrium of the body of the animals experimented upon, we are not to consider the motor paralysis or spasmodic conditions, but we must always consider the *disturbances in the accommodation of muscular action*. This is usually denominated vertigo in the animals experimented upon.

(4.) According to the injuries inflicted upon the separate semicircular canals of the pigeon, we observe characteristic differences in resultant manifestations. It makes, also, a great difference, whether the structures upon only one or upon both sides are destroyed.

(5.) Regardless of the extent of the lesion, all the manifestations are more intense and more distinct, the more energetically the animal moves; so that in cases of the slightest injuries (simple section of the canal on one side of the body) the characteristic symptoms are seen only when the animal makes a vehement motion, whereas these motions are scarcely perceptible or may be overlooked when the animal is at rest or is performing ordinary acts of locomotion.

(6.) These manifestations of altered co-ordination in muscular motion are observed in the head, in the trunk, and in the extremities.

(7.) The supposition that the disturbances in the motions of the trunk are due to the defective equilibrium or defective position of the head is to be rejected for the following reasons:—

(a.) Because disturbances in the equilibrium of the body occur in cases of injury to the semicircular canals on one side, in which, as has been already stated, the pose and movement of the head are not materially altered.

(b.) Because that supposition would explain only general manifestations of vertigo, but it would not explain the characteristic partial disturbances in equilibrium which arise in connection with injury to separate semicircular canals; and—

(c.) Because certain experiments not described here, militate directly against such a theory.

Even after complete ablation of all three of the membranous semicircular canals, upon both sides, pigeons do not appear to be deprived of all power of directing their bodies.

Strong animals of this class regain, to a certain extent, while at rest or when moving very slowly, the power of posing their bodies.

(9.) After a simple section of a single canal, the resultant

symptoms vanish in from four to five days, unless the structure becomes secondarily diseased, which is hardly ever the case, if the experiment has been made with care. In these cases, however, a *restitutio ad integrum* does not always occur in the anatomical relations of the parts implicated. If only small pieces of the semicircular canals are removed, a marked recovery may ensue, more readily, however, for certain reasons, when the lesion occurs in a vertical canal than when it occurs in the horizontal canal.

(10.) The almost constant increment and frequent alterations in the original symptoms, which follow a large injury of the canals, are due to subsequent disease of the remnants of the wounded canals or to secondary alterations in the parts of the canals left intact.

(11.) The author is unable to give a comprehensive theory of the mechanism by which the semicircular canals exert this influence, which he has portrayed as occurring in cases of injury or disease.

The various hypotheses which have heretofore been offered in explanation of these symptoms are not tenable, in his opinion.

It is especially incorrect, in his estimation, to regard the semicircular canals as a kind of "organ of sense" for the equilibrium of the body.

(12.) The symptoms are the result of a *cessation of function*, not a result of an irritation, certainly not of a specific irritation of the acoustic nerve.

(13.) We are not to conclude, that, since the hearing is not materially altered by a removal of the semicircular canals, they are not correlated to it.

The anatomical and the physiological facts would show that they are connected with the function of hearing.

Prof. Lucæ, to whose able resumé of Curschmann's experiments I am indebted for the facts I have presented here, states that the various disturbances in equilibrium, produced in accordance with a section of the horizontal or vertical semicircular canal, were accurately demonstrated by the

author before the Medico-Psychological Society of Berlin, when Prof. Lucae was present.

The results of Prof. Cyon's investigations concerning the function of the semicircular canals are thus given in the M. F. O., December, 1873:—

(1.) In order to preserve the equilibrium, it is necessary that an animal have the correct conception of the position of his head.

(2.) The function of the semicircular canals is to inform the animal, by means of a series of unconscious (acoustic?) perceptions, of the correct position of its head in space, and for this purpose each semicircular canal has an exactly determined relation to a dimension of space.

(3.) The disturbances in motion, which occur after section of the semicircular canals, are of three kinds.

(a.) Disturbances in equilibrium as direct results of the artificial injury.

(b.) Involuntary movements, as results of the irritation of abnormal acoustic perceptions produced by this injury, and

(c.) Consecutive manifestations produced by the inflammation of the cerebellum, which sets in a few days after the operation.

Cyon has shown that a pigeon, in which both horizontal semicircular canals have been severed, will perform regular oscillations of its head in a horizontal plane. On the other hand, a pigeon in which the vertical semicircular has been severed will perform similar oscillations of its head in a vertical plane.

Dr. J. Breuer has published a very interesting and important work, concerning the functions of the semicircular canals of the labyrinth. Prof. Mach has published the results of his investigations into the same subject, and has come to nearly the conclusions as Breuer. The results obtained by both of these investigators are confirmatory of the well-known theories of Flourens and of Goltz. (*Archiv für Physiol.* 1870.) The theory may be again stated in these

words: "The semicircular canals are organs of the sense of equilibrium of the head and mediately of that of the entire body."

The experiments to illustrate the physical phenomena of the semicircular apparatus are given in the author's (Breuer's) own words:—

"A system of three tubular rings, at right angles to each other, are filled with fluid. We thus gain a fair representation of the semicircular canals. In such a system we shall find that with every rotary motion of the entire system (*i. e.* the head) currents of the contained fluid will occur in a direction opposite to that of the rotary motion of the head. The measure of this current in each canal depends upon the plane in which the head is turned, and upon the amount of rotation. Between the rotation of the head and the movements of the enclosed fluids, fixed relations exist. If the movements of the fluid are perceived, they will of course furnish exact information concerning every turning of the head." The acoustic hairs (Hörhaare) are brought forward as the possible perceptive apparatus of this movement, for they are situated at a broad, smooth spot in the canal and project at right angles into its calibre. Thus from their position they would be especially sensitive to the variations of the currents in the endolymph, and we know that they are connected with nerves, the terminations of which they represent.

The analogous terminal nervous apparatus in "the lateral organ" of the fish appears to act the part of an analogous organ of perception for the currents, resistances, etc., in the surrounding water. (F. E. Schulze.)

"If we wish to harmonize both of these facts with Goltz's theory we must *assume* that every current of the endolymph is perceived by the nerves of the ampullæ, and that it produces an idea of the rotation of the head in the plane of the semicircular canal most implicated, and in a direction opposite to the current; but that the perceptions of the six ampullæ of both labyrinths unite in forming a joint conception." (Breuer.)

Prof. E. Mach has contributed additional corroboration of the theories of Goltz and Breuer by a series of novel experiments upon man, which were published a short time before the results of Breuer's labors. I think I cannot do better than to give the description of these experiments in the words of Prof. Fick (*Archiv. f. O. N. F.* Band II, H. 4): —

"Mach suspended a chair in which a man could sit with ease, in a frame-work, so that the chair could be revolved about a horizontal axis and fixed at any inclination. In addition, the entire frame-work with the chair could be revolved about a vertical axis. In many of the experiments the chair was covered by a paper box, which, following all the motions of the chair, prevented the person sitting in it from observing with his eye the motions of the apparatus in which he was seated.

"The principal results of the experiments with this apparatus were the following: —

"A revolution about the peculiar vertical axis of the body is perceived by the person experimented upon only so long as it is accelerated.

"A continued and constant revolution is not perceived.

"Retardation of the revolution is perceived as a revolution in the opposite direction."

"It is apparent that these facts agree with the theories of Breuer. The sensation of revolution in the opposite direction is converted into the sensation of motion in the true direction, in two seconds, by a renewed acceleration of the original motion. This sensation, therefore, must continue a few seconds longer than the cessation of the retardation; for otherwise, the new acceleration should produce immediately a sensation of revolution in the original direction. If we accept Breuer's hypothesis, we must suppose that by the law of inertia the currents produced in the semicircular canals continue some seconds after the force producing them has ceased.

If during the revolution about the vertical axis the head is inclined forward and then suddenly elevated at the mo-

ment the revolution ceases, in those cases where the revolution has occurred from the left, forwards and towards the right, an impression will be gained that a revolution is occurring from the right, upwards and towards the left, and the person thus experimented upon will fear that he is about to fall towards the left. This fact is also in harmony with the hypothesis of Breuer, and proves most strikingly that the position of the head is a measure of the sensations of revolution, and that the organ of these sensations must be found in the head. These two fundamental facts have already been observed by Purkinje, but with less exactitude than by Mach. Furthermore, Mach has established, by the aid of his apparatus, the fact that we have, either with the body at rest or revolved with a constant velocity, a distinct consciousness of the direction of the resultant accelerating force without the assistance of the eyes. A man sitting in the chair was able to give, by means of an indicator projecting from the case, a tolerably correct statement as to the vertical direction in any of the variously inclined positions of the chair.

When the case containing the chair was revolved about a vertical axis situate at some distance from the chair, like the well-known "carrousel toy," and when the face of the one experimented with was turned towards this axis, the axis then given by him as the vertical one was in reality one inclined diagonally downwards from the axis corresponding to the resultant of the centrifugal force produced by the revolution with constant velocity, and the weight of the body revolved.

Certain facts of a similar nature, perceived prior to this, induced Breuer to add to his hypothesis already described, the supposition that we should consider the macula acustica with the otoliths as possibly an organ for the perception of the position of the head at rest, in respect to the direction of the resultant accelerating forces and the rectilinear motions. In this portion of the acoustic apparatus he perceives the fulfilment of the necessary conditions. He thinks we are justified in assuming that the otoliths are specifically heavier

than the endolymph, and that they consequently have a tendency to sink in it in the direction of the resultant accelerating force. According to the direction of this force in the head, the otoliths would drag, in various ways, upon the hairs with which they are connected, and thus produce a varied excitation of the terminal nervous apparatus.

In addition to this, the specifically heavier otoliths would have, at the beginning of a rectilinear motion, a tendency to remain behind the endolymph, and at the cessation of the same they would go in advance of it, and therefore they would, by mechanical action upon the cilia, produce a perceptive sensation.

Dr. A. H. Buck has written a brochure on the mechanism of hearing, in which he advances a new theory. He says: "My own investigations, so far as they go, favor the view that no communication exists between the two scalæ in the immediate vicinity of the cupola, unless the opening (helicotrema) spoken of so vaguely by the authors, be microscopic in size." Dr. Buck shows that a force applied to the fluid contents of the scala vestibuli, will be communicated to Reissner's membrane, and thence to the membrana basilaris. The displacement of the contents of the scala tympani, caused by the depression of the entire membrana basilaris, is provided for by the presence of an elastic membrane, the membrana tympani secundaria.

The author then goes on to say, that "the entire membrana basilaris, including high and low notes alike, is obliged to perform all the excursions which may be communicated to the stirrup or the membrana tympani by sonorous vibrations; or, to speak more minutely, with every tone sounded, every 'organ of Corti' must perform the excursions which belong to that particular tone.

"Although it must be true that, with every note sounded, all the organs of Corti must perform the excursions belonging to that note, yet it must be remembered that the semi-gelatinous membrana tectoria, which rests upon the cilia of the hearing-cells, will likewise be obliged to perform these same excursions."

"Over one particular region, however, of the membrana basilaris, this will not be the case, namely, in that portion where the thirty or more basilaris fibres are tuned to vibrate in sympathy with the note sounded. At this point the vibrations will be of sufficient vigor to throw off the membrana tectoria. So long, then, as that particular note is sounded, the cilia of the hearing-cells, in the region referred to, will receive a succession of taps from the membrana tectoria, or, to speak more strictly, will strike against this membrane."

These blows, Dr. Buck says, constitute the true irritation of the auditory nerve. "Wherever the blows do not take place, although the auditory nerve-filaments may be agitated in a direction at right angles to their length, then no sensations of sound will be communicated to the brain."

Dr. Buck also suggests an explanation of the function of the semicircular canals. He rejects the theory of Flourens and Goltz, and says: "The first thing that attracts our attention in the anatomy of these organs is the peculiar relation of the membranous to the bony canals, the former occupying scarcely a third of the calibre of the latter. Then, in the next place, the space between the membranous canal and the bony walls is filled, not with free fluid, as is the case, for example, in the cochlea, but with a reticulated connective tissue, rich in blood-vessels and made up of large meshes containing fluid. In the vicinity of the mouths of these canals, however, it should be noticed that the membranous tubes hug the bone more closely. If we examine the mode of construction of the membranous canals, we find that the outer elastic wall is lined with a sort of mucous membrane whose free surface undulates or is thrown into mounds, and carries a lining of ordinary pavement epithelium. Another point worthy of notice is the absence of the undulations or mounds on that "side of the canal which lies next to the bone, the side where dilatation cannot take place. These anatomical relations and the absence of nerves are certainly suggestive of the thought that the function of these canals must be a mechanical one. Is not their function, we would ask,

to protect the ductus cochlearis and the organs of Corti from injury in cases where the stirrup is driven too violently into the oval window? Any pressure made upon the utriculus can only find a yielding point in the elastic walls of the membranous semicircular canals; and furthermore, if the latter were lined with a smooth instead of an undulating epithelial surface, the distension would be followed by a rupture of the epithelial lining. Any sudden and loud noise, like the report of a cannon or a peal of thunder, would be likely to injure the cochlear structures, were not some provision made in the labyrinth for emergencies of this kind. As we have shown, the semicircular canals are not only admirably fitted to serve in the capacity of safety-valves, but their entire mode of construction, especially the absence of all nervous structures, would seem to exclude them from any higher office in the mechanism of hearing."

We presume that by the term *semicircular canal* Dr. Buck alludes to that portion of the canals above the usually included ampullæ; otherwise, his statement, that there is "an absence of all nervous structures" in these canals, would not be strictly correct. Granted, that the function of the major portion of each semicircular canal is to act as a safety-valve in cases of undue pressure upon the labyrinthine fluid, it seems that such function must be just as advantageous to the proximal nervous structures in the ampullæ as to those in the more remote cochlea. Possibly more so, if the nerves of the ampullæ are intended to receive the impressions produced in the air by the long, powerful waves of ordinary noises.

Furthermore, if the theories of Flourens and Goeltz, and latterly of Breuer and Mach, that the function of the semicircular canals, *i.e.* of their nervous contents, is to preside over the sense of equilibrium, be correct, a safety-valve may be all the more necessary in connection with the important nerves at their mouth.

Dr. Victor Urbantschitsch has pointed out the physiological nature of certain membranous and cord-like adhesions in

the cavity of the tympanum, which have heretofore been considered pathological. As the author states, Prof. Politzer was the first to express the opinion that such might be the case, and our author has verified this opinion by a series of careful and copious investigations on the cadaver of embryos, new-born children, and adults.

This writer has frequently found in the new-born child, membranous and cord-like connections between the inner side of the vertical shaft of the incus and the inner wall of the tympanum. This has been considered pathological by Toynbee and other authors; but Urbantschitsch has shown that these formations are remnants of an embryonic fold, running from the vertical ramus of the incus to the inner wall of the tympanum, enclosing entirely the stapes. This was seen eight times in embryos, fifty times in the new-born child, and sixteen times in fifty examinations of the tympanic cavity in the adult.

There is also an embryonal stapedia fold which sometimes leaves as residue small membranes or cords passing from the head and shafts of the stapes. But the writer does not assert that all of the connecting bands or membranes which he has described are always of a physiological nature; he believes that their occurrence, without any morbid changes in the tympanic cavity, would not justify the conclusion that pathological process preceded their formation. Similar connections between the posterior, anterior, and exterior surface of the vertical ramus of the incus with the structures of the tympanum are shown to be normal. The first point agrees with the investigations of Lincke; the second point agrees with the statement of v. Troeltsch.

The horizontal ramus of the incus may be joined to the external wall of the tympanum, and with the mastoid cells, by similar membranous connection. The union with the outer wall has already been shown by Zaufal to be a normal one. This was found by Urbantschitsch in 80 per cent of all the adults examined.

The membrane so frequently found between the tendon of

the tensor tympani and the antero-superior wall of the tympanum, as described by Prussak, Gruber, and Zaufal, has been observed in adults by Urbantschitsch, sometimes as a perfect membrane, and sometimes perforated in the middle or represented only by a few adhesive bands.

Hyrzl's discovery that osteophytes are regularly found in the tympanum of many of the mammals, is carried still further by our author, who shows that there is in the tympanum of man a series of membranous bands containing structures similar to osteophytes which are of a physiological nature. They were found in one third of all the adult tympana examined.

Hyrzl says that these osteophytes are formed in the tympana of animals during the early years of life; our author has found them in the tympanum of the new-born child sixteen times in fifty examinations.

These are usually found on the eminentia pyramidalis. They may also be found on the posterior-exterior wall of the tympanum, and on the border of the round window.

They are usually in connection with a membranous or cord-like structure. Meckel has described a bony bridge between the eminentia pyramidalis and the oval window. In one case, among fifty examined, Urbantschitsch found a bony growth from the eminentia pyramidalis to the inner wall of the tympanum.

The posterior wall of the tympanum often contains a bony formation resembling a lamella. "This forms, either alone or in combination with membranes, a partition which divides the posterior portion of the tympanic cavity into a superior, larger space, and an inferior, smaller one."

Dr. Kupper has related a curious case of clonic spasm of the muscles of deglutition accompanied by a peculiar objective noise in both ears. The friends of the patient could easily hear this noise, which occurred as frequently as one hundred and forty times in a minute, and closely resembled the snapping of the finger-nails. The noise would sometimes cease on one side, continuing on the other, and the noise in

at least one ear continued during sleep. The spasms of the muscles of deglutition continued without any remission. The hearing was not affected, the Eustachian tubes were pervious to the air-douche, but the mucous membrane of the nose and pharynx was greatly congested.

The *membrana tympani* is said to have shown no alteration in its curvature or position during the occurrence of the peculiar noises.

Mach and Kessel have performed experiments upon the "accommodation of the ear," the chief point in their investigations being a determination of the question "whether a traction upon the muscles of the tympanum will produce an alteration in the consonance of the auditory apparatus, for notes of various pitches."

The experiments performed were of two kinds: first, upon the cadaver, and second, upon the normal ear of living men.

The authors say: "Our results are in unison with those of former investigators. All observers agree that contraction of the tensor tympani, whether produced artificially or by natural causes, will render high notes more audible than the low ones." The experiments of Politzer show this. The experiments of Schrapinger are also in harmony with those of Mach and Kessel; for when S. shows that the voluntary contraction of the tensor tympani will render all tones less intense, he likewise admits that the prominence of the over-tones is only relative, since they are less affected by this contraction of the tensor than the lower ones.

Kessel's investigations concerning the influence of the muscles in the tympanum upon the movements and vibrations of the *membrana tympani*, in the cadaver, are divided into the following heads:—

I. The action of the muscles of the tympanum produced by traction upon them.

II. The stroboscopic movements of vibrating *membranae tympani* during a note of constant pitch.

III. The stroboscopic motions of the *membrana tympani*, vibrating with a fundamental note and its octave.

In the first part of this paper the author divides the membrana tympani into various sectors and segments, as follows :

1. Into two grand divisions, the upper and the lower, the dividing line being the one made by the two folds of the membrane. The upper division, *i. e.* above the line of the "folds," is subdivided into three sectors, while the lower division is subdivided into two segments. The three sectors of the upper division lie as follows : one between the anterior fold and the anterior suspensory ligament of the malleus, naturally termed the anterior sector, the middle sector, lying between the suspensory ligaments of the malleus, and the posterior sector, lying between the posterior suspensory ligament and the posterior fold of the membrana tympani.

In the inferior division of the membrana tympani the posterior segment lies behind the malleus, while the anterior segment lies in front of the malleus.

We are also informed that the radial fibres pass in two directions from the anterior suspensory ligament, increasing in their length. These pass upwards over the sectors and downwards from the anterior to the posterior segment of the membrana tympani. Hence we have in this case, two angular membranes connected with each other, and subdivided into unequal divisions.

In the inferior division the radial fibres are drawn into a convexity towards the meatus by means of the circular fibres, and they are maintained by the same means, according to Helmholtz, in a condition of tension and prominence.

At the umbo the circular fibres are not found, and Kessel calls this point the free, central portion of the radial fibres. The circular fibres are also wanting in the upper division (which is flat, excepting at the middle sector, which is somewhat concave) at the foramen of Rivini.

By means of Siglè's pneumatic speculum Kessel has determined the various degrees of tension in the different parts of the membrana tympani. He has found that the movements of the anterior and posterior segments of the membrana tympani are directly proportional to the length of the radial

fibres. In a positive pressure of air upon the membrane the manubrium of the malleus is enabled to revolve.

In a case of similar atmospheric pressure, the middle sector is seen to be more depressed than the other two.

In a case of negative pressure the converse of this is true. During rarefaction of the air in the auditory meatus the manubrium of the malleus moves not only outward and forward, but it moves so that the processus brevis is advanced upward and forward, and at the same time it makes a distinct rotation accompanied by a marked tension of the posterior suspensory ligament.

E. Mach and J. Kessel have performed a series of experiments upon the function of the cavum tympani and the Eustachian tube. Although their experiments were published in 1872, it is eminently proper to notice them here, for they are among important investigations which have not heretofore been brought directly before the Society.

The first proposition stated by these investigators is the following. I quote from the *Archiv. f. Ohrenh.* N. F. B. II, pp. 116, 121: "The waves of sound will produce the best effects upon the membrana tympani when it is unexposed on one side to the sound waves, *i. e.* when the Eustachian tube is closed."

On the other hand we must remember that a difference in the atmospheric pressure on both sides of the membrana tympani is a serious interference in the mobility of the membrane. Therefore, the Eustachian tube must be opened now and then in order to restore the equilibrium in the pressure of the air on each side of the membrane, which may have been interfered with by various physical causes.

The capacity of the tympanum must not sink below a certain limit, if variations in pressure of a certain amount are to produce vibrations of the membrana tympani of a certain amount; for if the capacity of the tympanum is small, then very slight excursions of the membrana tympani will produce considerable expansive power of the enclosed air, which will operate against further increase in the vibrations.

This is a very important circumstance in the consideration of the excursions produced by deep tones. In order that the latter may be received, the tympanum must have a certain depth and a generous capacity. Therefore the tympanum is in connection with the cavities of the mastoid process, and those of other portions of bone. A larger tympanum with perfectly regular outline and form would be impracticable from its great resonance. Therefore, the irregular, spongy, bony cavities, with which the ear is connected, appear of the greatest advantage.

Therefore, three conditions are favorable to the production of the largest possible excursions of the membrana tympani, by the waves of sound.

a. The Eustachian tube must be usually closed.

b. It must also be opened occasionally for purposes of ventilation.

c. The tympanum should be in connection with large, irregular cavities.

The first experiment was instituted to discover whether the Eustachian tube is closed. This was accomplished by the observer's placing himself in an air-tight box, in which the atmospheric pressure could be increased or diminished at will.

The alterations of the pressure within the box produced a distinct inward and outward movement of the membrana tympani, which is claimed as a proof that the Eustachian tube is usually closed.

The greatest differences in pressure which could be produced in the aforesaid box seemed to prove that, in the case of one of the observers, the tube was pervious; for the membrana tympani always gradually returned to their normal position, notwithstanding the continuation of any alteration in the pressure, and without any voluntary act on the part of the observer.

During these experiments other very interesting observations were made concerning the effect of augmented tension of the membrana tympani.

It was observed that during the increased tension of the membrana, deep notes, produced by organ-pipes, outside of the air chamber, or by the interruption tuning-fork, placed upon the air-chamber, disappeared or grew fainter in comparison to the higher notes.

In one instance the fundamental note was weakened, and the over-tones became very prominent.

Of course, the act of swallowing, during these experiments, would open the Eustachian tube and equalize the pressure on either side of the membrana tympani.

The third portion of the paper treats of the benefits of the closed Eustachian tube upon the amplification of the vibrations of the membrana tympani. Experiments showed that, if sound is conducted to the tympanum by means of the auditory meatus and the Eustachian tube at the same moment, the ossicles remain quiet; but if the sound-waves are suddenly cut off from the Eustachian tube, vibrations in the ossicles are instantly produced by the sounds conducted to them through the external auditory meatus. The unilateral conduction of sound appears to be, in general, necessary where vibrations of sound in an unlimited medium are expected to produce a stronger or amplified effect. Such, apparently, is the function of the natatory bladder of the fish, which, probably, represents the tympanic cavities. The communication of the air of the tympanum with that of the mastoid cells was demonstrated by means of an experiment devised by Kessel. The external surface of the mastoid process is bored through, and a T-shaped tube is placed in the hole thus formed. One of the arms of the T-shaped tube is drawn out into a point. Through the other arm ordinary burning gas is conducted, and lighted at the aforesaid pointed arm.

If, now, the membrana tympani be perforated, and the Eustachian tube closed, a gentle note from the organ-pipe, conducted into the meatus externus, will extinguish the flame. This latter fact shows that not only the vibrations are conducted to the mastoid cells, but that the latter are in

perfect communication with each other and the tympanum. If the membrana tympani lay too near the closed end of a tube, the other end of which is open, the relation would be similar to that of a membrane at the closed end of an organ-pipe, which shows no perceptible excursions. The latter will not appear until the membrane assumes a position at the open end of the pipe. It is manifest, therefore, that the considerable space behind the membrana tympani, viz. the cavum tympani, and the cavities connected with it, are of the greatest importance.

Rüdinger's endeavor to show that the Eustachian tube is always open by means of a capillary cleft in the superior part of the tube (the so-called "Sicherheitsröhre," or safety tube) is regarded with a certain amount of doubt by Mach and Kessel. It is regarded by them as a capillary tube filled with the secretion from the tympanum, and not as a conveyer of air. Since the air in the faucial extremity of the tube is alternately rarefied and condensed by the acts of respiration, the column of fluid contained in the aforesaid capillary tube (Sicherheitsröhre) will necessarily move inward and outward, causing similar motions on the part of the membrana tympani. These motions have been supposed by Lucaë and Schwartze to be caused by the direct aërial communication between the tympanum and the fauces, *i. e.* by the opening of the Eustachian tube at each respiratory act.

The majority of physicians suppose that the Eustachian tube is usually closed, being opened only at the act of swallowing, a view which is supported by Politzer.

The "Mechanism of Opening and Closing the Eustachian Tube," by C. J. F. Yule, is thus reviewed by Wm. Sterling, M. B., in the "London Medical Record," Feb. 18, 1874: "The author had a catheter passed into his Eustachian tube in order to compare the sensations felt in the normal ear with those in the catheterized one. He found that the sounds produced in the larynx were rendered very much louder. That the Eustachian tube opens during the act of swallowing is well known. The mechanism of the opening

of the Eustachian tube, when not complicated by swallowing, the author, experimenting upon himself, finds to be the following:—

"*First*, During the contraction for opening the tube, the velum palati does not change either its position or its shape; in fact, it remains unmoved, and further, it does not become tense, but hangs as soft and flaccid to the touch as at ordinary times of rest. (The tensor and levator palati muscles do not, therefore, participate in the opening of the tube.)

"*Second*, The only parts which do move are the posterior pillars of the pharynx; they both move inward simultaneously towards the middle line, moving from their old position from one half to three quarters of an inch. The action is steady and not spasmodic, and can be sustained for some considerable time at will. (The muscles most evidently concerned are the palato-pharyngei.) The sound which accompanies the opening of the tube is sharp and crackling, and is referred to some part of the tympanum, or, perhaps, the membrane itself. It can be easily imitated on the sheep. Then follows an anatomical description of the muscles involved.

II.

PATHOLOGY AND THERAPEUTICS.

Dr. Phillimore, in a series of remarks upon the occurrence of hæmatoma, observes that he has never found this disease unaccompanied by disease of the brain or its membranes, and furthermore, with regard to its location in the auricle, that in none of the cases under his observation has the tumor included the posterior surface of the pinna or the lobule. The note from which the above is taken appears in the "British Medical Journal" of April, 1874, and is called forth by a paper by Mr. Cobbold, which was published in the same journal in October, 1873, in which the author determined the presence of ossification and a series of Haversian canals in an ear examined by him

and affording the material for his paper. The observations of Mr. Cobbold in this respect are of interest as confirming those made by Mr. Toynbee as early as 1860, and reported in that year to the Pathological Society, substantially as follows: "The right ear was so very much thickened as to have lost its normal appearance, the only portions of cartilage which were not greatly thickened being the tragus and the thin narrow slip at the posterior portion forming the helix. Upon making a section of the cartilage it was found in some places half an inch in thickness, but not harder than natural. This thick portion of the cartilage presented no appearance of a cyst, and under the microscope was observed to consist of hypertrophied cartilage cells and intercellular matter. In some parts it was converted into true bone containing Haversian canals and well defined cells. This ossific matter was also found in the left ear, which was scarcely at all deformed, and had not passed through the cystic stage of the disease.

Dr. Harlan reports a case of malignant disease of the ear in the form of a round-celled sarcoma occurring in a girl three years of age. Two months before examination a bloody discharge was observed from the left ear, followed by pain on swallowing, and swelling about the ear, the face being drawn to the right. The appetite gradually failed from the time of the first appearance of discharge, and the child became feeble.

On examination the auditory canal was found to be closed by a firm globular polypus, with a fluctuating swelling below and behind the auricle. The removal of the polypus and a free incision behind the ear gave a discharge of sanious pus, but no dead bone could be detected; the left side of the face was much swollen, and the mouth drawn to the right on crying. The left half of the tongue was much swollen, and rough as contrasted with the right, which was normal.

The left eye was never closed, even in sleep; there was no congestion of the conjunctiva; the pupil was movable and the cornea clear and bright. The polypus was twice removed

subsequently, and the discharge from the swelling behind the ear continued. Twenty-eight days after the first examination this tumor was of the size of a hen's egg, lobulated, and having a bright red granular surface.

The upper lid of the left eye covered the eye almost entirely; the conjunctiva was congested; the whole cornea was hazy and its lower fourth infiltrated; there was also free sanious discharge from the right nostril. Seventeen days later there was a penetrating ulcer of the cornea with protrusion of the iris; the breathing through the mouth and right nostril had become laborious; and at the end of a week the patient died, apparently from exhaustion. There had been in addition to the other symptoms double convergent strabismus, which, however, diminished as the disease progressed, and had nearly disappeared on the twenty-sixth day after its appearance. After death, on removing the tumor behind the ear, the bone at its base was found roughened and eroded. The train of nervous symptoms in this case of Dr. Harlan's, taken in connection with the results of the autopsy, give it a special interest. Destruction of the inner tympanic wall and implication of the portio dura caused the earliest symptom. Paralysis of the sixth nerve increased the convergent strabismus, which was corrected, and the ball rendered immovable when the disease extended to the third nerve. The levator palpebrae was at the same time involved, and the eye, which had been widely opened, in consequence of paralysis of the orbicularis, was closed by the falling of the lid. Inflammation of the conjunctiva and cornea presented a typical case of neuro-paralytic ophthalmia due to paralysis of the fifth or its optic branch. The destructive inflammation, it is in this connection worthy of note, did not commence until after the closure of the eye from ptosis.

Prof. Wernher, of Giessen, reports at length a very rare and interesting case of pneumatocele cranii in a man twenty years of age. Four years previously, following an attack of forcible sneezing, a tumor about the size of a pigeon's egg appeared behind the right ear upon the upper portion of the

mastoid process. Slight pressure was sufficient to reduce the tumor, but it immediately returned when the pressure was removed, and seemed to fill with each expiratory movement. It increased very slowly, and when about the size of the fist could be only partially reduced. The tumor continued to enlarge, and at the time of the patient's admission to the Academic Hospital the whole of the right side of the scalp presented an enormous swelling, extending from the forehead over the temporal to about the centre of the occipital bone, measuring in this direction 28-c.m., laterally it measured 27-c.m., and extended from the upper portion of the right mastoid process to a point beyond the vertex. The base of the tumor was broad, and its upper surface divided into three rounded prominences, at the thickest portion of the tumor the scalp being raised from the bone for a distance of from $1\frac{1}{2}$ " to 2".

The tumor was entirely painless and could be compressed by the finger, and the underlying bone plainly felt; on percussion it gave tympanic resonance; the movability and resonance of the tumor showed plainly that it must contain atmospheric air, as the duration of the tumor precluded the idea of spontaneously generated gas; auscultation, furthermore, gave a free blowing sound, but no emphysematous crackle. On Valsalvian inflation, the tumor slowly expanded and became more tense. The size of the tumor could be somewhat diminished by tight bandages, but always returned to its former size. The outer and middle ears were nearly normal, and the hearing not very much diminished.

The treatment consisted in the continued application of an elastic bandage, which so far diminished the tumor that a further examination of the underlying bone could be made, and this examination revealed an opening in the superior portion of the mastoid through which air made its way from the middle ear. The first active treatment was directed to the closure of this opening, which was done by including by pressure this portion of the tumor and injecting iodine. Other portions were subsequently treated in the same way, and

twenty-five days later the patient was discharged with the tumor entirely gone and the integument everywhere in close contact with the cranium. Very little pain or irritation followed the use of the iodine.

Zaufal publishes an extended report of thirteen cases of traumatic injury of the membrana tympani, the paper being characterized by the careful analysis of the causes and symptoms in each case, with the conclusions to be drawn therefrom. These may be best cited in part in the author's own words:—

The injuries of the membrana tympani result either from the action of direct or indirect force: the former are induced by direct contact of the substance causing the injury with the membrana tympani; the latter are induced by the rarefaction or condensation of the body of air on either side of the membrana tympani, or by the communication of shock transmitted through the bones of the head. The results of direct injury are excoriations of the outer or inner coats of the membrana tympani, or a solution of continuity of all the coats, as in rupture of the drum-head; and the results of indirect injury are found also in the consequent inflammation of the membrana tympani, extravasation of blood upon the surface or within the inner coats, and subsequent rupture.

The location, size, and form of the injuries resulting from direct force are dependent upon the character of the instrument, the curvature of the membrana tympani, and its inclination to the walls of the auditory canal. Excoriations are found most frequently upon the posterior and inferior portions of the membrane and directed forward and inward.

The majority of the ruptures resulting from direct force are found in the anterior half of the membrana tympani; this was the case in six out of seven, and Shaw* found the same in each of three cases reported by him and Gruber, once in two cases mentioned in his "Lehrbuch der Ohrenheilkunde" Sharp-pointed instruments thrust quickly into the

* Shaw. Boston Med. and Surg. Journal, Nov. 1868.

ear may either cause a small perforation or an extensive rupture of the drum-head; but the latter form of injury is more common where the instrument is blunt. In size the rupture may vary considerably, and where the opening is a large one, it not uncommonly becomes bridged over by new growth, leaving several smaller openings.

Injuries of the *membrana tympani* by indirect force are most commonly caused by excessive positive and negative variations in the atmospheric pressure. *Commotio membranæ tympani* with consecutive meningitis is very difficult of diagnosis where there are no immediate signs of violence.

Echymoses may occur only secondarily; or where they occur as an immediate result of the injury, may come from the bursting of a superficial or interlamellar blood-vessel, with corresponding differences in appearance, and in subsequent effect upon the condition of the membrane; the former dry, and are removed by natural processes with the dermoid coat, often leaving, however, an excoriation which persists for some time.

Free extravasation of blood is found mostly upon the mucous coat, showing a bright red color through the membrane under good illumination, and varying in outline according to their position.

Interlamellar blood extravasations are generally flattened, but sometimes appear as a minute point, or as a line following the distribution of the fibres of one or the other layer of the *membrana propria*.

The location of ruptures of the *membrana tympani* resulting from indirect force is determined by the *locus minoris resistentiæ*; cicatrices, partial atrophy, and other pathological changes which invalidate the elasticity and resistance of the membrane often locate the rupture, and in but one of Zaufal's cases could no predisposing pathological change be discovered.

The left *membrana tympani* was the more commonly ruptured, corresponding more conveniently to the aggressive right hand which inflicted the injury. When the right

membrana tympani was ruptured, the aggressor either stood behind his victim, or was left-handed. In a series of experiments on the cadaver, where the air in the auditory canal was compressed by means of a rubber bag, the normal membrana tympani was rarely ruptured, but frequently so where the membrane had been affected by previous disease.

The ruptures found after death by hanging, and described by Wilde, Ogston, and Littre, may also be included under the heading of injury from indirect force, because, according to Ecker's observations in these cases, the soft palate and tongue are driven so far backward and upward into the nasopharyngeal space as to nearly fill it, producing an intra-tympanic pressure commensurate with the weight of the body. The length of the fall, the suddenness of the shock with which the noose closes around the throat, would be sufficient to produce extensive rupture. This may explain the rarity of rupture of the membrana tympani in cases of suicide by hanging, as in many of the latter cases the victim dies by strangulation, and not, as in judicial hanging, from the application of sudden force.

The form of the rupture varies, being either a narrow slit or a gaping opening; according to both Politzer and Zaufal, the latter is the more frequent form. Contrary to the generally received opinion, the amount of hæmorrhage is very small; where it is at all excessive, it is usually the result of accompanying injury of the tympanic mucous membrane, or, as Zaufal found in a case of fracture of the skull from a fall upon the head, from the rupture of large veins and arteries of the dura mater, the art. meningea media especially contributing to profuse arterial hæmorrhage from the ear. In regard to the cicatrization of the large openings, Zaufal is unable to confirm Politzer's observation of the projection of a cicatricial membrane from the mucous coat of the membrana tympani, and is inclined to the belief that the closure of the opening occurred from without. In this connection may be mentioned the observations of Gruber,* to which

* Lehrbuch der Ohrenheilkunde, p. 365.

Zaufal does not refer, in which the cicatrix is formed by growth of both the mucous and dermoid coats, a microscopic examination of the cicatrix, while showing an equal reproduction of these two coats, giving evidence of the absence of anything resembling a fibrous structure.

A rupture of the membrana tympani is in and for itself a slight injury, and may become a serious matter only through the occurrence of such complications as a suppurative inflammation of the middle ear or an injury to the labyrinth; and it should be borne in mind that the former complication following a rupture of the membrana tympani from indirect force is almost always the result of an unfavorable condition of the patient or improper treatment on the part of the surgeon.

Trautmann also reports a case of rupture of the left membrana tympani resulting from a fall from a horse, the patient striking upon his head upon the pavement, being taken up senseless with profuse hæmorrhage from the nose and left ear and dying in a few minutes. An examination with the aural speculum showed the posterior-inferior portion of the membrana tympani pressed outward and of a dark reddish color, and posteriorly to the malleus, beginning at the lower end of the manubrium and extending upward and backward, a fissure about $2\frac{1}{2}$ mm. long, through which oozed a bloody serum. The right membrana tympani was normal. In default of a further examination, which was not permitted, Trautmann concluded that a fracture of the base of the skull had occurred, with division of the internal carotid, the blood escaping through the rupture in the membrana tympani; in this connection the reader is referred to the observations of Le Bail already cited. Another rupture of the membrana tympani, reported by the same author, occurred in a young man who shot himself in the mouth, with the so-called water bullet, water being substituted for the ordinary missile. Aside from the injury observed in the membrana tympani, the post-mortem examination gave evidence of the destructiveness of the means employed to destroy life. The left

temporal bone was so entirely fractured that only a portion of the upper wall of the external meatus remained attached to the squamous portion; the remainder of the bone was distributed in splinters throughout the brain substance. The right temporal bone presented the following appearance: the tegmen tympani with the entire labyrinth wall were blown away, giving a clear view of the membrana tympani; the malleus and incus were in position, the stapes destroyed, with exception of the head and a portion of the posterior crus, with the musculus stapedius; the articulation with the incus remained, and in the membrana tympani a rupture extended from the lower end of the manubrium mallei upward to the periphery, $\frac{1}{2}$ mm. in width at its lower and 2 mm. in width at its upper end.

In the floor of the osseus meatus, close to the membrana tympani, was a nearly circular opening about the size of a pea.

Dr. Chimani makes an addition to the list of diseases of the external ear under the title "Aneurysma Cirsoideum of the Auricle and Meatus." Shortly after the birth of the patient, who was a strong, healthy boy, his mother noticed a small swelling, about 2 c.m. in diameter, in front of the left ear; it was soft and of a reddish-blue color. At five years of age the tumor had become as large as a walnut, and from that time until his fourteenth year increased rapidly in size, pressure and external application of astringents were of no effect, and at fifteen years of age the patient was brought to the Josephinum clinic for treatment. The tumor included the greater portion of the left half of the scalp, was soft, elastic, and slightly fluctuating, painless, pulsated distinctly, and could be diminished in size by pressure.

The integument covering it was of a bright red color and of a higher temperature than adjacent parts. The diagnosis was aneurysma cirsoideum of the Art. temporalis, occipitalis and posterior branch of the Art. auricularis posterior.

Long-continued pressure and application of astringents having proved ineffectual, repeated injections of iron chlo-

ride, some twenty in number, were made, and within a year the swelling had so far disappeared that the patient was discharged as cured. A short time thereafter, however, the temperature of the left auricle increased; it became somewhat swollen and pulsated slightly at various points. This continued until, four years later, the swelling on the posterior portion of the auricle and the subjective symptoms had so far increased that the patient again applied for relief. For his age, nineteen years, he was well and strongly developed, and with exception of the local trouble, in excellent health. The left auricle was nearly double the size of the right, of a pale red color, with exception of the more prominent portions, which were reddish-blue and dotted with small deep-red spots; the enlargement was principally an increase in thickness, the posterior surface especially being elevated above the cartilaginous base of the auricle.

The walls of the meatus were swollen, of a pale red color, and marked by dots and lines of a deeper red. The temperature of both auricle and meatus was considerably above the normal degree. By means of a stethoscope, pulsation could be plainly heard, and the Art. auric. ant. cap., the Art. auric. ant. inf., and the Art. auric. post. were enlarged, tortuous, and forcibly pulsating. The subjective symptoms consisted of headache confined to the left side, diminution of hearing in the left ear, continuous tinnitus aurium, and a sensation of heat and pulsation in the ear. The use of iron chloride being decided upon, an injection was slowly made, by means of a Pravaz syringe, of twelve drops of the fluid, to which was added soda carbonate, the point chosen for the puncture being the swelling behind the auricle. Considerable pain accompanied and followed the injection, requiring subcutaneous administration of morphine for relief.

The tumor became livid, and then of a deep-blue color. On the second day the pain ceased; on the fourth day a hard, black eschar had formed, which came away easily on the fifteenth day, leaving a deep furrow, the edges of which approximated and closed in a very short time. During the

following month two injections were made in the remaining portions of the tumor with like results, and the injection of one drop only of the fluid was then made in the meatus. This last application was followed by some inflammation of the lining membranes of the canal and the dermoid coat of the membrana tympani, but subsided under warm astringent instillations, phlebotomy being contra-indicated. The swelling on the upper portion of the canal was removed with the knife, and followed by polypoid granulations, very soft and bleeding easily; these were again removed and cauterized, and at the end of four months the patient discharged relieved of his subjective symptoms, and with considerable improvement of hearing.

Dr. C. Bail publishes an interesting monograph on the semeiological value of traumatic otorrhagia, and the conclusions at which he arrives may be briefly stated as follows:—

I. In injuries of the head the discharge of blood from the ear is by no means pathognomonic, and has absolutely no relative diagnostic value.

II. This discharge is a symptom common to several lesions of the organ of hearing, which differ as to cause, and are more or less serious in character.

These lesions are: *a.* Wounds of the external auditory canal, which generally accompany injuries to the face or lower jaw. The history of the case, the condition of the inferior maxillary articulation, and of the membrana tympani, and the integrity of the tympanic cavity, guide the surgeon in his diagnosis.

b. Injuries of the membrana tympani and mucous membrane of the tympanic cavity, which are a common accompaniment of injuries of the head, and are the result of either direct or indirect force. In these cases the progress of the symptoms enables the surgeon to decide as to whether he has to deal with a fracture, or with a simple injury of the middle ear.

c. Fractures of the petrous bone, which are accompanied ordinarily by a discharge of blood from the ear. A discharge which is in itself not pathognomonic, but which may present

peculiar conditions as to duration, intermittence, and repetition which in themselves are of great diagnostic importance.

Dr. H. D. Noyes reports a case of cerebral trouble following otitis media in a man *æt.* forty-five, who received an injury upon the side of the head three weeks before his admission to hospital, and complained of severe pain in the ear. After admission he had otitis media which soon spread to the mastoid cells; an opening was made into the mastoid followed by the discharge of pus. At the end of a month the patient was much improved, when brain symptoms set in, and he died after being comatose several days. On examination an abscess was found in the left middle lobe, which on being opened gave exit to a considerable quantity of thick greenish pus; throughout the whole left hemisphere at its base was marked pachymeningitis and a small, oblong, yellowish-white growth attached to the dura mater over the outer part of the petrous portion of the temporal bone. Over this region the membrane was loosened from the bone. Section of the brain showed pus breaking into the lateral ventricles destroying the septum lucidum, and entering the lateral ventricle of the right side. The primary abscess was situated beneath the outer and posterior border of the left thalamus opticus. The brain substance was everywhere pale and flabby, and at many points almost diffluent. There was also extensive caries of the inner portion of the petrous bone, and the outer surface of its inner half was irregular with several small perforations.

In a lecture delivered at St. George's Hospital, Mr. Dalby presented the case of a boy ten years of age, who was admitted to the hospital suffering from a discharge from the left ear. He had been supposed to have been suffering from ague, and was admitted to the hospital on that account. Three months before, in ordinarily good health, in consequence of a severe cold, he became deaf in the left ear. He continued pretty well, with exception of the deafness, until two weeks before admission, when he had an attack of pain in the left ear, lasting for two or three days and followed by discharge, and relief from the pain. Three days later he had

a shivering fit, and this was repeated each day for a week. Shortly after the first shivering the pain in the ear returned and soon involved the side of the head. On examination there was purulent discharge from the left ear with almost entire destruction of the membrana tympani. There was much pain, especially in the region of the ear; extreme tenderness on deep pressure over the mastoid; some redness but no swelling, and no tenderness in the course of the carotid sheath. Pulse 128, temperature 99.8, tongue brown and dry. Had had little or no sleep, and lay moaning, with his hand to his head, and every appearance of blood poisoning. There was an occasional dry cough, but no abnormal sounds in the chest except harsh respiration and increased voice sounds at the apex of the right lung. On the following day the pain in the head was so severe and the tenderness over the mastoid so much increased that, notwithstanding the absence of other local signs, an incision was made half an inch behind the ear. The periosteum and bone beneath were healthy. A small opening was then made through the bone, and a probe passed freely into the mastoid cells. No discharge of pus occurred at this time, or subsequently. On the day following the pain was less, but the general condition remained unchanged. There was more shivering and an occasional cough; signs of fluid in the right pleura developed, and the boy died sixteen days later. On examination, the anterior two thirds of the r. pleura were filled with pus containing flakes of lymph; in the lower lobes of the right lung were several abscesses with ragged walls filled with foul pus. The surface of the brain was somewhat congested, but otherwise healthy; there was no thrombus of the lateral sinus. Between the roof of the left tympanum and the dura mater was a small quantity of tough lymph. The membrana tympani was gone; the tympanic cavity filled with thick pus; the ossicles necrosed and lying loose. The roof of the tympanum was carious on either surface, and the roughness on the cranial surface extended back to the sulcus for the lateral sinus, — the symptoms and the subsequent examination plainly pointing to pyæmia, the

starting-point for which was a suppurating surface in the tympanic cavity.

Ménière is of the opinion that in all cases of otorrhœa great attention must be paid to the constitution, so that scrofula, syphilis, or other constitutional disease should be treated by appropriate general measures. In this lies an essential element of success in all instances. Cleanliness is a capital point, and nothing is better for this purpose than pure warm water injected with moderate force. In the early stage, when pain is present, Dr. M. suggests the use of a warm decoction of marsh mallow and poppy heads, and the application of leeches, and sometimes the application of a poultice. Later in the disease the usual astringents are employed. M. Giampière recommends in case of pain in such cases the instillation of a fluid containing one sixth gr. of aconitia to the ounce.

J. Patterson Cassels contributes a paper "On a Form of Disease of the Middle Ear in which the use of Alcohol is especially serviceable."

To Dr. Löwenberg, of Paris, belongs the merit of having first recommended the use of alcohol as a local application in certain diseases of the tympanic cavity.* From an experience of two years in the use of this remedy in catarrhal and inflammatory affections of the tymp., Dr. Cassels is inclined to confirm all that Dr. Löwenberg has claimed, but especially in the more advanced stages of simple catarrh when there is a lesion of the membrana tympani. This affection, according to the author, consists in a hyper-secretion by the lining membrane of the tymp. cavity unduly stimulated to increased action through causes that determine an over-abundant flow of blood to it. Under favorable conditions this condition terminates in resolution, but the hyperæmia continuing, the discharge becomes more abundant, and finally, bursting through the membrana tympani, makes its appearance as a catarrhal otorrhœa. At this stage the mucous mem-

* El. Pabellon Médico, Madrid, 1870.

brane of the tympanum is highly congested, and also hypertrophied and villous. To this condition Dr. C. gives the name polypous hypertrophy as best describing its appearance, and it is in this condition in which he has found the use of alcohol almost specific. The use of silver, as recommended by Schwartze, he considers as better adapted to more chronic cases.

Bezold contributes a comprehensive review of the various investigations on the subject of parasitic growths in the human ear; as necessary causes of these accumulations, there must be the introduction of the spores of the plants either directly from the air, or by means of the instillation of some medicament or introduction of some foreign body carrying the spores upon it; and in addition, as a still more important factor, there must exist a condition of the parts of the meatus and membr. tymp. favorable to the growth of the plant. That this proper condition is a rare one, is proved by the small number of cases of Otomykosis as compared with the extensive distribution throughout the atmosphere of the spores of such plants as are occasionally found growing in the ear.

Wreden * found that in fifty per cent of his cases the Otomykosis had been preceded by an exudative inflammation of the meatus or middle ear. Active discharge Wreden remarks is unfavorable to parasitic growth, a fact easily explainable on two grounds: firstly, that such soil is unfavorable to the development of the spores; and secondly, that they are washed away by the continued discharge. Schwartze † and Weber ‡ both agree with the statements of Wreden, but take a broader ground in considering any moist ceruminous or epidermal surface where the changes of decomposition have set in or occurred as affording favorable soil; and Mayer || presents the question as to whether the mykosis may not follow

* Myringomykosis aspergillina. St. Petersburg, 1868.

† Schwartze Arch. f. Ohrenheilkunde 11, p. 61.

‡ Weber. Monatschr. f. Ohrenheilkunde 11, 1.

Müllers Archiv. 1884, p. 404.

fermentation and decomposition of the cerumen, or the application of fatty substances to the ear.

Mayer has further proposed as a possible origin of extended Otomykosis the occurrence of cysts containing parasitic plants which served as the point of origin.

In the ten cases which Bezold has observed since his previous publication,* it was a noticeable point in the history that in seven cases oil had been employed as an application to the ear either recently or at some time before the appearance of the characteristic symptoms of the growth. In several of these cases oil was plainly discoverable at the time of the examination, and furthermore oil globules were found, on microscopic examination, not only enclosed in the meshes of the mycelium, but also within the delicate mycelial fibres. Wreden's twenty-four cases occurred in a clientèle of 1,600, while the ten cases of Bezold occurred in a clientèle of only five hundred patients. This increased percentage Bezold considers as largely due to the recent popularity of oleaginous applications advertised as remedies for deafness. As the oil becomes rancid it affords an excellent soil for microscopic plants, as shown by Prof. Hessling in his investigations upon articles of food, in which he found a series of growths in almond, olive, and salad oils. Böke, quoted by Bezold, lately reported two cases of Otomykosis, in both of which oil had previously been applied. In one case the patient had applied a popular remedy, a microscopic examination of which showed well-marked spores of the plant which finally attained its perfect growth in the ear. Concerning the extension of the growth to the epidermis and the excitation of the well-known symptoms which mark the true parasitic disease, Bezold agrees with other writers upon this subject who consider the initial stages as those of a saprophytous formation (analogous to the parasitic growths described by Virchow and others in gangrene of the lung), as the plant first fastens itself upon the effete epidermis and secretion in the

* Archiv. f. Ohrenheilkunde Baud v. Heft 111, p. 197.

ear, and finally pushes its roots deeper into the true lining of the canal.

This view is especially supported by observation of the progress of a case of Otomykosis in which the removal of the growth in the later stages of the disease leaves the surface beneath red, swollen, and often excoriated. The form of the plant in the majority of Bezold's cases was well-marked aspergillus, and the treatment employed consisted in the careful and repeated removal of the growth, and the use of carbolic acid as a parasiticide. As a review of the subject of Otomykosis, Dr. Bezold's paper is very thorough, and with the especial point in view of considerable practical value.

Wendt describes, as frequently found in his post-mortem examinations of the middle ear, a condition which he describes as polypoid hypertrophy of the mucous membrane. This condition occurs as the accompaniment of a mucous catarrh, in the course of which a hypertrophic condition of the mucous membrane of the tympanum is developed, accompanied by the formation of numberless polypoid growths of microscopic size, and the greatest variety of form, being of every shape, from a slight rounded elevation above the general surface, to a rounded body connected with the mucous membrane by a well-marked neck. The periosteal coat of the lining membrane was not, as a whole, hypertrophied, but the sub-epithelial coat was swollen and more or less rich in lymphoid cells; at some points cysts and cavities were discoverable, filled with fluid mucus. The polypoid prominences originated in the sub-epithelial coat. Wendt is of the opinion that these growths, when they do not subside spontaneously (several of those examined seemed to be undergoing that process), may increase until the whole cavity is filled, or, uniting in their growth, may give rise to the fibre and thread like growths which he describes in another article, being the case of a man in whom death resulted from miliary tubercle, and who had been exceedingly deaf for two months preceding his death. The examination showed that there had been a general inflammatory affection of the mid-

dle ear, of long standing, resulting in partial destruction of the membrana tympani, and in the tympanic cavity general thickening of the mucous membrane especially about the fossa of the fenestra ovalis and upon the membrane of the fenestra rotunda; there was, furthermore, union between the tympanic walls, the membrana tympani, and ossicula by means of strong bands to such an extent that the upper portion of the cavity was almost entirely isolated from the lower; the ossicula were also united to each other and to the surrounding parts by firm bands. A microscopic examination of the membrana tympani showed calcification in several places in the fibrous and dermoid coats and cellular infiltration of the mucous coat. The tympanic mucous membrane exhibited, in addition to more or less infiltration, simple hypertrophy of the connective tissue, accompanied by cystic cavities, and also general calcification, including the covering of the membrane of the fenestra ovalis and ossicula.

The same author presents an equally interesting observation, which has its bearing especially in the support of his opinion that embolism in the mucous membrane of the tympanic cavity may be the cause of sudden deafness. The case quoted was that of a girl who developed symptoms of pyæmia after an operation, and five days before death became suddenly deaf in the right ear, and two days before death lost the hearing of the left ear also.

A post-mortem examination showed that the labyrinth, auditory nerve, and internal auditory artery were in normal condition. There were some changes in the middle ear due to chronic trouble which would diminish the hearing somewhat, but not in so great a degree as was noticeable during the few days preceding death. There were, however, recent changes in that portion of both tympanic cavities which is most important to the transmission of sound, including the fenestra ovalis and fenestra rotunda, which would serve to account for the later deafness.

The epithelium was opaque and swollen, and discolored by the imbibition of the coloring matter of the blood, and con-

taining numberless red blood-corpuscles. The stapes was buried in the swollen mucous membrane, which covered also the membrana tympana secundaria. The remaining mucous membrane was hyperæmic and œdematous. Wendt considers embolism of a tympanic artery as the most rational explanation of these recent changes, a view which, even in default of the discovery of an embolus, is certainly supported by the character of the change observed, especially in the region of the fenestra ovalis and fenestra rotunda.

Dr. Frank, of Würtemberg, supports the views advanced by Weber-Liel in his work on progressive deafness by the results of an operation for cleft palate, and especially with reference to the secondary catarrhal inflammation of the middle ear, concavity of the membrana tympani, and contact of the tubal walls in consequence of relaxation of the tensor veli.

The patient, a boy sixteen years of age, had a congenital fissure of the soft palate, and suffered frequently from sub-acute catarrh of the middle ear. The fissure was triangular in form, and extended forward to the hard palate. The right membrana tympani was nearly normal but concave and immovable. The left membrana tympani was still more concave and also immovable. The operation completed by Dr. Frank was successful not only in closing the fissure of the palate, but also, as a secondary result, in so far restoring the normal action of the palatal muscles as to free the Eustachian tube, as was shown by the consequent mobility of the membrana tympani, and an increase of the hearing from a few centimetres to a full metre.

Voltolini has had opportunity to confirm the results of his previous experiments on Emphysema, resulting from catheterization of the Eustachian tube, in which he referred the fatal cases of Turnbull to the occurrence of Emphysema glottidis. The patient was a stout, full-blooded woman of forty-four years of age, who had been deaf for several years and suffered from severe tinnitus aurium, for relief from which she came under treatment, which consisted in the use of Weber-Liel's tympanic catheter with morphine solution. On one

occasion considerable resistance was offered to the passage of the catheter on the left side, and it was therefore repeatedly withdrawn and re-introduced, and finally followed by the air-douche, whereupon the left side of the face became suddenly swollen, and an examination gave emphysematous crackling over the left side of the face and neck down to the clavicle and especially below and behind the left ear.

Examination with rhinoscope and laryngoscope showed the following condition: The left velum was swollen from the uvula outward; the left tubal orifice was invisible on account of the swelling of the mucous membrane of the lateral pharynx wall; the left sinus pyriformis was scarcely visible; and the lateral glosso-epiglottic ligament much swollen; there was also slight swelling of the left vocal chord. On the following day the symptoms had not entirely disappeared, and the patient still complained of the sensation of pressure about the throat.

Voltolini also reports a case of living larvæ in the ear, in which considerable difficulty was experienced in their removal on account of the firm hold afforded by the mandibles of the larvæ; they were finally destroyed by instillation of a strong solution of alum and then taken out with the forceps.

Dr. Bing, in reviewing the location of perforations of the membrana tympani, has been led to certain conclusions as to the causes of the frequency of perforation of the inferior and anterior segments. The solution given by Toynbee, namely, the effect of pressure of air forced through the Eustachian tube as a predisposing cause of this peculiarity, is set aside by the author for a much more rational and satisfactory explanation of his own, which may be briefly stated as follows: Accumulation of secretion in the ear would exert pressure upon the membrana tympani; the shape of the tympanic cavity, narrowing towards its floor, and the angle of inclination of the membrana tympani, would bring the greatest pressure upon the inferior portion of the membrane, which, being extensible, would be pressed downward

in a horizontal direction, thus subjecting it to still greater pressure, which, as the membrana tympani is implicated in the inflammatory process, would place that portion under a condition more favorable to ulceration and final perforation.

To the long list of attempts at maintaining an artificial perforation of the membrana tympani, is to be added that of Voltolini, who replaces the eyelet of Politzer by a ring-shaped canula opened on two opposite sides, — on one side the ring being completely divided, and on the other connected by a slight bridge or band. Two incisions are made, one in front of and the other behind the malleus. The two open ends of the ring are then passed through the openings, and by pressing the two halves of the ring together, it is made to enclose the malleus and keep itself in place. The two inner ends of the ring do not completely appose, and the opening in the outer half of the ring permits the passage of the sound waves to the air within the tympanic cavity. Of the conditions which render this operation difficult of performance, and of the accidents which may occur in its execution, Voltolini speaks at length in his two later papers upon the subject. In the last communication is the description of the case operated upon eight months after the operation, the canula being firmly in place, without sign of any unfavorable change in the malleus or membrana tympani, and with considerable improvement in the hearing.

Weber-Liel presented before the Berliner Medicinische Verein in December last, a case of inflammation of the mastoid cavity, which is of especial interest, not only for the method of the operation undertaken for the relief of the patient, but also on account of the symptoms accompanying the course of the disease. The patient was a man 40 years of age, who had suffered from severe pain, especially at night, during six weeks. During the day the pain diminished, but was replaced by sensation of fulness in the right ear, and vertigo. The whole region of the ear was tender; there was tinnitus aurium, a high grade of deafness, and a slight purulent discharge from the ear. The posterior wall of the right external auditory

canal was reddened, swollen, and very tender upon pressure ; a small quantity of ill-odored pus oozed through a narrow slit. There was no pharyngeal catarrh, but the walls of the tube appeared to have collapsed, as it was only possible to force air into the middle ear by the use of the tympanic catheter, which gave a distinct perforation sound, and forced a quantity of their purulent fluid through the small opening in the meatus. It is evident that while there existed a perforation of the membrana tympani, this opening was not of sufficient size to allow the passage of all the secretion accumulating in the middle ear ; the swelling of the meatus presented a further obstacle, and as a consequence, the inflammation had extended to the mastoid cells. No improvement having been attained by ordinary treatment during a period of eight days, and the pain steadily increasing in severity, it was decided to perforate the mastoid ; and following a suggestion of Prof. Rüdinger, the point chosen for the incision was the posterior wall of the meatus, at the junction of the cartilaginous and osseous portions of the canal, at which point there was the greatest tenderness and swelling. A stout cartilage knife was employed, and easily pushed into the mastoid cavity, its withdrawal being followed by the liberation of a large quantity of most offensive pus, with great relief to the patient. The improvement, however, did not continue ; on the following night the pain was again severe and the purulent discharge had diminished. The perforation was filled with a yellowish-white mass, the attempt to remove which with the forceps caused great pain ; those portions removed resembled the coats of the so-called cholesteatoma. This mass was finally removed after patient bathing with soap-suds : syringing could not be borne on account of the resultant vertigo. With the continued discharge from the mastoid, the inflammatory symptoms gradually subsided, and during the day the patient was comparatively comfortable, the pain and other subjective symptoms having greatly diminished. At night, however, the pain increased, and continued until about 5 A. M. This con-

dition continued day after day, and a closer examination of the patient developed the fact that the advent of the pain in the evening was accompanied by a chill, and that the patient was subject to malarial fever. This, together with a further consideration of symptoms, led to the administration of quinine in 6 gr. doses at night, and the final cessation of the pain, and discharge of the patient.

Dr. J. Orne Green, whose observations on mastoid inflammation, published at various times, are of great interest, makes a further contribution in the report of three cases, read before the Boston Society for Medical Observation. The cases themselves, and the remarks appended to the report, are of sufficient value to warrant their being given in full.

I. — F. E., aged eight years, was seen on July 3d, 1871, at the request of Dr. E. H. Clarke, who was unable to visit her when first called. The patient, whose mother had died of phthisis, had been considered well, with the exception of slight occasional otorrhœa on each side, till some four weeks before, when she had an attack of intense inflammation of the left ear, followed by high fever, great prostration, and violent chills, which had continued daily, with increasing severity, for seventeen days. Intermittent fever had been diagnosed, and she had been on low diet, pilules and quinine, without relief. No attention had been paid to the ear, till a gradually increasing swelling over the mastoid forced that organ on the attention of the parents.

At my visit, she was in bed, so weak that she could not move; extremely emaciated; moaning continually and screaming at the least noise or light; intelligence good; pulse 130, weak; skin hot and dry; tongue coated. Behind the left ear was a large, diffuse abscess; the left meatus was filled with pus. Under ether, and with the assistance of Dr. Mann, who saw her then for the first time, an incision, two inches long, was made over the mastoid, and six ounces of thin and most offensive pus were evacuated. The whole bone was denuded for four inches towards the vertex and one inch behind the mastoid, but was not softened at any

spot. A cloth tent was inserted, and stimulants and narcotics ordered. Examination of the ears showed both drum-membranes completely destroyed, but the tympana were free from granulations or caries, as far as could be ascertained by the probe.

For the next week she improved slowly; the chills recurred but once, although there were several times a day exacerbations of fever; the appetite improved and the pulse came down to 100. A small abscess formed over the left scapula, and was opened. On July 11th, there was a recurrence of chills, not severe, with cough and brownish expectoration, rapid respiration and accelerated pulse, apparently relieved the next day by extending the original incision downwards and evacuating the pus which had formed there. A few days afterwards, great puffiness of the eyelids and a diffuse swelling over back of neck showed themselves; this swelling of the neck gradually extended over the left side, and, after five days, an abscess formed on the side of the neck and broke. This swelling of the neck was followed by extreme distension of all the superficial veins of the face, neck, and chest, which still remains, more than two years afterwards. An attack of pneumonia now supervened, but, fortunately, was not severe; and this was followed by a post-pharyngeal abscess, which burst, and by abscesses on the opposite side of the neck, the occiput, and temple, and by facial erysipelas. The wound over the mastoid healed, but had to be opened twice, under ether, on account of fresh collections of pus; the bone was not found softened at any time. Notwithstanding all of these complications, the patient gradually improved, and, early in September, I ceased regular attendance. On October 20th she was brought to my office; she had had, in the mean time, partial hemiplegia on the right side, the opposite side from the ear-disease, together with ptosis of the right eyelid; she was then recovering from both, but there was still very perceptible weakness of the right arm and leg. She was in good health, and more fleshy than ever before. The right side of the face was

much fuller than the left, and the superficial veins were very much enlarged; there was a fistula over the mastoid, with some discharge, but no bare bone could be detected. The fistula continued to discharge, and on January 9, 1872, the parents consented to an operation, when, with the assistance of Dr. John Homans, the mastoid was exposed by an incision through the fistula, and a small opening found to communicate with the cells; the walls of this opening were carious, and at the depth of an inch, on the inner wall of the cells, bare bone could be felt. The carious walls of the fistulous opening were removed with a gouge, and warm water syringed through the tympanum; the inner wall of the cells was not touched. From this time, everything went smoothly; no bad symptoms followed the operation, and in ten days the wound had entirely healed, and the patient has remained well to the present time, as far as the mastoid is concerned; the tympana remain in the same condition as at the first report, both of the membranes being lost; and the child is subject, when she takes cold, to a slight discharge from the exposed mucous membrane.

II. *Mastoid Inflammation; Trephining of the Healthy Bone on account of Dangerous Symptoms; Recovery.*

A. A., aged sixty-five, sister of charity, seen in consultation with Dr. Geo. S. Hyde, on the 8th of June, 1872, began to suffer with severe pain in the left ear six weeks previously; one week after the pain began, a free discharge from the meatus showed itself, and continued up to the time I saw her. The severe pain in the ear was but little relieved by the discharge, and she suffered constantly with pain, referred chiefly to the mastoid, but extending somewhat over the left side of the head; with this, there had been marked constitutional disturbance, high pulse, hot, dry skin, anorexia, and, within a fortnight, frequent nausea and occasional vomiting. At no time had there been marked swelling around the ear, or headache, other than nervous, to which

she had been subject for years. There were no chills. During the whole disease, the patient had been confined to her bed, and was extremely prostrated.

Examination showed an abundant purulent discharge from the left meatus, the left membrana tympani swollen and inflamed, with a large perforation on the posterior segment, equal to one fourth of the whole membrane. The tympanic mucous membrane was granular; by Valsalva's inflation, air was readily forced through the perforation. There was no swelling, or even tenderness, around the ear or over the mastoid. The pain, which was described as dull and heavy with an occasional lancinating shoot, was referred to the mastoid. Hearing was completely lost for both watch and voice. The skin was hot and dry, the tongue coated, the pulse 120, and weak.

The severe pain in the ear and the marked constitutional disturbance pointed to an active inflammation still going on in that organ; the large perforation of the membrana tympani and the pervious condition of the Eustachian tube precluded the tympanum proper from being the seat of retained pus, and the mastoid cells were alone left as the seat of the disease. The prostration of the patient demanded immediate relief, and I advised perforation of the mastoid cells.

June 9th. — With the assistance of Drs. John Homans and G. S. Hyde, the patient was etherized, and a perpendicular incision, one and a half inches long, made over the mastoid to the bone. The tissues were of their normal thickness and not œdematous; the bone normal and without any sinus. After incising the periosteum, it was scraped aside, so as to expose the bone, and a few minute vessels were compressed and a ligature applied to the posterior auricular artery. With a triangular borer, five thirty-seconds of an inch in diameter, I then perforated the bone, on a level with the middle of the meatus, to the depth of one third of an inch, before I felt it enter the cells; on withdrawing it, about two drachms of inoffensive pus were

evacuated. With a small-pointed syringe, warm water was forced through the perforation in the bone and returned through the meatus, and this was repeated till the cavity was cleansed. A cloth tent was inserted in the opening, and the wound covered with a wet compress.

Six hours after the operation the patient was very nervous from the ether, and complained of some pain in the ear; but the pulse had come down from 120 to 108. Ordered chloroform, gtt. xx.

June 10th.—Slept well, without pain; felt much better. Pulse 88. Skin cool and moist. Appetite much improved. Tympanum syringed through wound and meatus. Allowed beef tea and an egg.

June 11th.—Passed a "delightful" night, free from all pain, except an occasional dart; took no chloroform. Pulse 88. Slight discharge of pus from wound. Tympanum syringed as before.

June 12th.—Yesterday afternoon sharp pain, as of old, felt in the ear, which continued through the night, requiring chloroform, but it passed off towards morning. Pulse 88.

June 13th.—Passed a good night; no return of the pain. Pulse 88; tongue clean. Appetite good. Directed the tympanum to be syringed with warm water three times a day.

June 15th.—No pain, except for three hours last night. Discharge from both meatus and wound slight. Sat up to-day for the first time for seven weeks. Directed that the ear be syringed twice a day, and a solution of sulphate of zinc (gr. i. to $\frac{3}{4}$ i.) be instilled at night.

June 18th.—Patient reported that on the 16th pain returned in the ear, accompanied by a singing; at the same time there was severe pain in the frontal region and left eye. These pains continued through the 17th. On examination, the discharge was found to be much increased in quantity. The wound was looking well, but some fibrous tissue was sloughing; tongue clean; pulse 84; abdomen tympanitic from flatus; watch not heard on contact. Omitted the in-

stillation of zinc, and ordered poultice to wound, and two cathartic pills.

June 19th.—Free from pain; slept well, and this morning bright and cheerful. Pulse 82. To douche the tympanum three times a day with warm salt water. *R.* Quiniæ sulph., gr. i., ter die.

June 20th.—Sat up all day; some pain in the ear and through the back of head and left eye for several hours, not so severe as before. Pulse 72. Appetite and strength improving.

June 23d.—Quinine omitted, on account of headache and ringing in both ears; ligature removed and poultice omitted. Ordered iron.

June 26th.—Discharge from wound and meatus diminishing; scarcely a twinge of pain.

July 7th.—Rode out for the first time. No pain; very little discharge. Membrana tympani less swollen and granulations diminishing.

July 19th.—Occasionally slight pain in ear; no discharge from meatus, and the perforation healing. Wound healed, except a small fistula, which still discharged considerably, and through which bare bone could be felt. W. l. on contact.

From this time the ear-disease progressed favorably. The membrana tympani healed perfectly, and the discharge from the mastoid opening gradually ceased. The hearing, by the first of August, had improved to W. l. $\frac{3}{4}$ ". V. l. 10'. During the latter part of August, there were nausea and vomiting several times, with occasional vertigo, pain in the stomach, back, and lumbar region, and some swelling of the feet, but the patient had been subject to such attacks for years, and no disease was discovered; an analysis of the urine afforded no explanation. During these attacks of vomiting, there was a discharge of blood, in small amount, from the mastoid sinus.

I did not see the patient again till October 22d, 1873, nearly fourteen months afterwards, when she was complain-

ing of pain in the ear, due to a slight cold, and which soon passed off without treatment. She reported that, during the year, she had had no trouble with the ear, except slight and constant subjective noises. Her health had been about as good as usual; she had occasional sick headaches as ever, some chronic bronchitis, and, occasionally, a great determination of blood to the head, without known cause. During severe vomiting she had sometimes slight bleeding from the mastoid opening. Examination showed the membrana tympani without cicatrix, very much thickened, and drawn in and immovable. Over the mastoid was an opening half an inch deep and one eighth of an inch in diameter, lined with a continuation of the outer skin, which became in the deeper parts very delicate, and resembled mucous membrane; no opening existed through this into the mastoid cells. W. l. $\frac{3}{4}$ ". V. l. 8.

III. — *Mastoid Inflammation; Fistulous Opening through the Bone; Wilde's Incision; Rapid Recovery.*— C. G., aged 15, was sent to me on July 24th, 1872, with the history that two months before, during an influenza, he had had acute inflammation of the ear, with discharge. Since that time, the discharge had continued with a constant but slight pain in the ear, annoying tinnitus, and slight, constant vertigo till yesterday, when nausea and vomiting followed a marked increase in the vertigo; there had been no headache. When I saw him, the only symptoms complained of were a slight, almost constant pain in the left mastoid, with an occasional slight dart into the ear, a staggering gait, with a marked tendency to fall towards the right side, constant nausea, and occasional vomiting. The countenance was anxious; pulse 120, of fair strength; tongue clean. Examination of the ear showed a purulent inflammation of the tympanum and a perforation of the drum-membrane, with large polypoid granulations on its edges; the mastoid not red or swollen to the eye, but to the touch slightly fluctuating and a little tender. Watch not heard on contact. Extreme vertigo, with vomiting, resulted directly from the examination.

Under ether, the tissues over the mastoid were freely incised through the periosteum, and at the extreme lower part of the bone, a small fistulous opening passed into the mastoid cells; through this, thick grumous pus ran out. A tent was inserted in the wound, and douching of meatus and wound with warm water was advised. The vertigo and vomiting were immediately and entirely relieved; the pulse became normal within twenty-four hours. Four days after the operation, the patient not having been under observation, the wound was found to have healed, and the pain in the mastoid was slightly increased. On this account the tissues were again incised, under ether, and the bone, which had softened around the previous fistula, was cut through with a knife, opening the cells for a distance of a quarter of an inch; the tympanum was then syringed through the fistula. Examination of the ear, at this time, showed that the inflammation of the drum-membrane was much less, and the polypoid granulations had disappeared. W. I. $\frac{1}{4}$ ".

From this time, the recovery was rapid; two days after, the discharge, both from the wound and meatus, had ceased, and the perforation of the membrane was found to have healed. W. I. $\frac{3}{4}$ ".

Six days after, all pain and subjective noises had ceased, and the hearing was rapidly improving. W. I. $\frac{20}{100}$ ".

I have selected these three cases as illustrative of the more serious forms of mastoid disease; they show the course which the disease may take, and the way nature seeks to relieve herself, and thus point out the line of treatment.

Mastoid inflammation, although never primary, is now very properly described as a distinct disease, as it is always serious, and not uncommonly fatal, from involving the brain. The mastoid cells are but a part of the tympanic cavity, lined, like the rest of the cavity, by a delicate mucous membrane, which is in such close connection with the periosteum that the two cannot be separated or even distinguished. An

inflammation of the tympanum proper usually implies, also, an inflammation of the mastoid cells of a greater or less intensity, and if this inflammation is so severe as to cause an abundant secretion of pus, an outlet for the matter from the cells can only occur by its breaking through the bone, either externally or internally, while the matter in the tympanum proper only requires to break through the delicate drum-membrane. In the majority of cases the inflammation subsides and the pus is absorbed, but in some cases the inflammation is too intense for this to occur without the evacuation of the pus, and then nature attempts to form an outlet, as is seen in the first and third cases.

An examination of macerated bones shows, on the outer surface of the mastoid, numerous openings which serve for the passage of blood-vessels into the bone, and some of these undoubtedly are in communication with the circulation of the mucous membrane. Along these vessels the inflammation is transmitted from within to the external periosteum, and, as pus is only formed in the later stages of an inflammation, the first pus formed here will be next the bone where the inflammation is oldest. The pus having formed on the external surface of the bone, it meets with very firm obstacles to reaching the skin, for the whole mastoid serves for the attachment of the sternomastoid tendon, and the pus must work its way through this very firm fibrous tissue before coming to the subcutaneous tissue. This accounts for the very extensive burrowing of pus in the first case, for three weeks, without its having formed an outlet.

In examining a large number of temporal bones, it will be seen that the thickness and consistency of the mastoid varies very much, and also that, in some, the openings on the external surface are much larger and more numerous than in others. In some bones, it is impossible to see any of these foramina. Thus another obstacle exists here to the exit of the pus; for while, in the cases just spoken of, the bone becomes inflamed, softened, and disintegrated around the opening through which the inflamed vessel or vessels pass, in the

latter cases a new opening must be formed, a longer time is required, and the patient is consequently longer exposed to the risks of retained pus. In the second case reported, it is probable that the unusual thickness of the bone (one third of an inch) and the absence or very small size of these foramina, prevented any external inflammation; and it is also probable that this is the explanation of those cases in which, after death, the inner wall of the cells next the brain is found carious, while the external wall is healthy. This second case is also peculiar, from the fact that there was no tenderness on pressure of the bone, which I can only explain by supposing that the bone was so very solid that it had not become inflamed. The operation of trephining under these circumstances is, I believe, new; but the condition of the patient was so critical that I had no hesitation in advising it. In the first case, I have no doubt that weeks of suffering and danger would have been avoided if consent could have been obtained to a similar operation.

In the treatment of recent mastoid inflammation, we can generally hope for the subsidence of the disease by the local abstraction of blood and by appropriate treatment to the original cause of the trouble, the inflammation of the tympanum proper. Two to four leeches over the mastoid will often so reduce the congestion that the disease subsides, and warm fomentations to the bone will help the resolution. At the same time, if the tympanum contains pus, this should be evacuated. As a rule, the drum-membrane will rupture of itself in a short time; but if such a rupture does not take place, the membrane should be incised to give an exit to the pus, and the drum-membrane and tympanum treated by douching with warm water and by the use of the air-douche, to keep the tympanum free from the irritating matter.

If, however, an external periostitis has been set up, a free incision should be made down to the bone, for, if pus has already formed, it should be evacuated as soon as possible to prevent unnecessary injury to the bone; and if no pus has formed, the relaxation of the swollen tissues and the bleed-

ing from the incision both relieve the pain and assist in causing the inflammation within the cells to subside. At the time of the incision, the bone should be examined to see if any fistula exists in it, and if such is found it should be exposed and thoroughly syringed out. The place at which this fistula commonly forms is of considerable importance in aiding us in our search and also in deciding where the bone ought to be trephined, in case such an operation becomes necessary. In most of the cases which I have seen, this fistula has been nearly in the middle of the mastoid, not at the extreme tip or at the extreme upper part, although in both of these places the bone is very thin.

While the fistula is being sought, the bone should be tested, and it will frequently be found to be so softened that a probe, director, or even a knife can be thrust through into the cells, thus evacuating the pus. If the bone around the fistula is softened, the opening should be enlarged till healthy bone is reached. The first case is interesting as showing how necessary the removal of the softened bone is for a cure; for here the disintegrated bone, although so fine as to escape observation with a probe, kept the wound open for several months, while the removal of the affected bone with a gouge resulted in a cure within ten days. The second case shows how long the mastoid cells may be intensely inflamed without affecting the bone, and in these cases the operation of trephining is especially indicated, as the pus, if meeting with unusual obstacles to its escape externally, is more apt to affect the other walls of the cells and cause fatal disease of the brain.

The great object of treatment in mastoid inflammation is, then, the fulfilment of the well-recognized law of surgery to give free exit to the pus.

III.

REVIEWS AND BOOK NOTICES.

A PRACTICAL TREATISE ON THE DISEASES OF THE EAR, INCLUDING THE ANATOMY OF THE ORGAN. By D. B. ST. JOHN ROOSA, M. A., M. D. Illustrated by Wood-Engravings and Chromo-Lithographs. New York: William Wood & Co. 1873.

"This work is intended to be a guide to those who wish to treat diseases of the ear."

These are the words which open the preface to this very valuable work; and after a careful examination, we believe the intention of the author has been ably carried out. The work contains five hundred and thirty-five pages, and is divided into four parts, which treat respectively of the external ear, the middle ear, the internal ear, and deaf-muteness and hearing-trumpets. There is also a very interesting and accurate history of the progress of Otology from the year 460 B. C. to the present time, which precedes the description of the anatomy of the auricle and external auditory meatus.

The directions for examining aural patients are very explicit, and the chromo-lithographs illustrative of the appearance of the membrana tympani are exceptionally good. The perspective of the lithographs in this work is strikingly brought out by viewing them through any short tube, but preferably with the ordinary aural speculum.

Among the various methods of removal of foreign bodies from the external ear the "agglutinative method," recently revived by Löwenberg in Paris, is mentioned. This method has been very erroneously ascribed lately to Dr. Löwenberg, whereas the method is most explicitly given by Riverius and Celsus, and has been put into practice in a particular instance by a layman, Mr. Eli Whitney Blake, of Whitneyville, Conn., upon a boy employed in his carriage factory. (C. Hooker, M. D., Boston Journal, 1834.)

Riverius (Riverii Op. Med. Francofurti, M. DC. LXXIV., Cap. de Surditate, p. 261) says: "Si auriscalpium intronmitti nequeat specillum cotone involvatur in extima sua parte, deinde immergatur in terebinthinam, aut in aliquod aliud viscidum: post immitatur in aurem, ut agglutinet id, quod obstruit."

Celsus (edition of his works published at Strasbourg, 1806, p. 342) says: "Specillum lana involutum in refinam quam glutinosissimam, maximeque terebinthinam demittendum, idque in aurem conjiciendum, ibique vertendum est; utique enim comprehendet et eximet." These facts surely place the discovery of this method far beyond all modern claims.

Otitis parasitica, a disease which appears to be more common than heretofore supposed, is thoroughly explained by accurate wood-cuts and a fully-condensed experience of authors on this topic.

The chapter on Injuries of the Membrana Tympani shows that, although many injuries to this part of the ear arise from unavoidable causes, unskilled manipulation on the part of the laity, in their anxiety to relieve the patient, may perforate or destroy this delicate membrane, which might have been saved had the surgeon been called upon for relief. The chapters of this work which contain the author's experience and views upon chronic non-suppurative inflammation of the middle ear are the prominent feature of this treatise. The author divides the so-called chronic catarrh of the middle ear, or chronic non-suppurative inflammation of the middle ear, into—1, *chronic catarrhal inflammation*, and, 2, *proliferous inflammation*. The latter term is original with the author, or rather it is, as Dr. Roosa says, an original translation of the German word *Wucherung*.

This endeavor of the author to differentiate the forms of chronic disease of the middle ear is in perfect harmony with similar endeavors of Politzer, Gruber, Weber-Liel, and others, the first-named of whom divides chronic catarrhal diseases of the middle ear into secretory and non-secretory forms; the second authority has described an otitis media

hypertrophica; and the last-named writer has recently published his well-known work "On the Nature and Remediability of the Most Common Form of Progressive Hardness of Hearing," which malady, he says, cannot be referred to catarrhal causes, but even as a primary disease must be considered as a disease of the structures of the middle ear dependent upon "affections of the nerves which supply, and which stand in close relation to, the middle ear." In this attempt on all sides to describe a separate chronic disease of the middle ear, based upon a special group of pathological alterations of the component parts of the tympanum, we recognize the fact that there is a frequent form of deafness which cannot be referred to catarrhal causes at all. Therefore, Dr. Roosa endeavors to describe "a form of inflammation which shows a higher formation than the catarrhal," and, while admitting that catarrhal symptoms may precede this form of disease, he shows that there is a disease of the ear which tends towards a chronic progress, and which he has "ventured to designate the *proliferous form*."

These views of the author are based upon twelve varieties of tissue-changes which have been frequently found as a consequence of this form of ear disease, and in them we find that the prominent feature of the pathological processes is the formation of new tissue; and it is this fact that has induced and really warrants the application of the word "proliferous" to this form of ear-disease.

In the chapter on the Treatment of Chronic Non-suppurative Inflammation of the Middle Ear, Dr. Roosa says, "In one respect the treatment of the catarrhal may be fairly distinguished from that of the proliferous form. In the catarrhal form we must give a great deal of attention to the nasopharyngeal space, while in the other we need to pay very little to it." With this exception, the outline of treatment for both forms of the disease may be the following: constitutional and hygienic, local blood-letting, applications to the Eustachian tube, applications to the cavity of the tympanum,

and cutting operations upon the membrana tympani and the ossicula.

Under the head of the nasal douche the author expresses his views against its use, since he has found it to be "sometimes a troublesome and dangerous appliance."

This surely will be the case if the instrument is improperly used; but if the fluid injected into the nares *be warm, if the vessel containing the fluid be not higher than the patient's forehead, and if after using the douche the patient do not leave his room for at least fifteen minutes, we have yet to hear of any accident such as Dr. Roosa depicts.*

It is not stated, in the table which is given by the author to show the danger of the application of the nasal douche, whether *all* these rules were observed; and although it is implied that they were, still it is not clearly shown; for the instructor in the use of the douche, in thirteen cases of the sixteen unfortunate ones, is either unnamed or "unknown," and in several cases the nature and temperature of the fluid injected are also "unknown," except in one case, — that of Dr. Frank, — in which it is distinctly admitted that the injected fluid was cold, and, as we are prepared to hear, the result was an acute otitis media.

We cannot admit, as Dr. Roosa does, the statement that "the instructor in the use of the douche was a physician" as a sufficient guarantee of the correctness of the instruction, for our experience shows that as a rule the patients have failed to receive *all* of the aforesaid precautions. And even if the physicians who instruct the patients in the use of the douche give proper instruction, the patients themselves may fail to follow their directions. It is obvious where the blame rests in such cases.

Operations upon and through the membrana tympani, which now form some of the most important operations in surgery, are illustrated by history, cases, and wood-cuts of the various instruments employed, from "Cheselden's Experiments on Dogs to Weber-Liel's Operation upon the Tensor Tympani Muscle."

At the end of the fourteenth chapter we find a table showing the results of treatment of chronic non-suppurative inflammation of the middle ear, based on the observations of four observers, of whom Professor Roosa is one. In commenting on this table, Professor Roosa says, "I can only account for the fact that my percentage of *cures* is less than the others from the supposition that I have seen a proportionately larger number of neglected cases than falls to the lot of other practitioners."

We note, however, that the percentage of *improvement* in our author's cases is greater than that of the others. Dr. Roosa also states that he has made the standard of cure very high, and has not called a case "cured" which has only been greatly improved.

The chapter on Acute Suppuration of the Middle Ear serves to mark an era in the treatment of disease in general. Our author, firmly supported by the experience of modern Otology, shows that the treatment of this form of ear-disease is not only rational and successful, but is demanded, by the exigencies of the case and the evils of neglect, from every intelligent and conscientious physician. If any one should doubt the desirability of treatment in acute Otitis media, he has but to peruse the chapter on Chronic Suppuration of the Middle Ear and its fatal consequences, in order to have a good reason for changing his opinion.

"The general health of a patient affected with chronic suppuration of the middle ear is usually impaired, even if none of the serious consequences have occurred. Such a drain is not tolerated with equanimity by nature."

"Dr. Hackley has found albuminuria in a number of cases of chronic suppuration of the middle ear, where there was no apparent cause for the disease except the long-continued secretion of pus from the tympanic cavity."

One hundred pages are devoted to a consideration of the consequences of chronic purulent discharges from the tympanum, and the treatment in these very grave cases.

To this portion of the treatise Dr. Roosa has appended a

table, "compiled from various sources, which illustrates in a striking manner the fatal consequences of some cases of aural disease."

The portion of the work which treats of the middle ear and its diseases closes with these words, in reference especially to the table of cases already alluded to: "Taken in connection with the fact already stated, that suppuration of the ear is more frequently the cause of cerebral abscess than any other one disease, these cases form a complete justification, if one were needed, for the giving up so much space to the consequences of chronic suppuration of the middle ear. If the table should startle some mind hitherto inattentive to this subject into a realization of its grave importance, and lead to a more careful consideration of an ulcerated middle ear, it will have accomplished its object." The remaining pages of the book are devoted to the anatomy and diseases of the internal ear, and to deaf-muteness and hearing-trumpets.

True nervous deafness, "a primary affection of the auditory nerve or labyrinth, or of both," is said to be a rare disease. In fifteen hundred cases of aural disease observed by the author, only fifty-seven could be fairly considered as primary diseases of the internal ear. C. H. B.

DISEASES AND INJURIES OF THE EAR. By W. B. DALBY, F. R. C. S., M. B. CANTAB., Aural Surgeon to St. George's Hospital.

This book, of little more than two hundred pages, is divided into eleven short lectures on the more important features of "Diseases and Injuries of the Ear." Among the lectures we would single out the fifth as the best, if called upon to make any distinction; but they are all very good, and contain the substance of the diagnostic and therapeutical knowledge of the day so far as it pertains to Otology. The anatomical and physiological facts are but lightly touched upon; we suppose, because the author relies upon a preliminary knowledge on the part of those who constitute the class at St. George's Hospital.

In the fifth lecture, already mentioned, the diagnosis and treatment of non-purulent catarrh of the middle ear are carefully and clearly set forth, and furnish, therefore, a very valuable guide to any one who has to treat a case of this disease.

The subject of aural polypi is very thoroughly treated in the seventh lecture, accompanied by some "beautifully executed drawings, showing the structure of these bodies, by Dr. Whiphham." Under this head we notice that Dr. Dalby recommends the use of "fine fishing-gimp" instead of wire in the formation of the snare in Wilde's instrument. "After the removal of the polypus," Dr. Dalby says, "I am in the habit of using chloroacetic acid on a small camel-hair brush, and apply it very freely. At the same time, care must be taken not to touch any part of the meatus."

Those parts of the book which relate to mastoid diseases, to the obscure nervous affections of the auditory apparatus, both acquired and inherited, and to deaf-muteness, are full of interest; but we think more should be said concerning mastoid disease and its treatment, even at the expense of space which is given to deaf-muteness. So much has been done for the relief of mastoid disease, and it now constitutes so important a part of the aural surgeon's work, that no book on diseases of the ear is complete without a very thorough review of the diagnosis and treatment of this important and tractable malady, while deaf-muteness hardly falls within the province of the aural surgeon, at least not to the exclusion of more remediable troubles of the ear.

The great importance of chronic discharge from the ear is acknowledged and most forcibly enjoined in the following words, which close the eighth chapter:—

"But inattention to the discharge may at any time place the patient in a position of great peril. For this reason I believe that a discharge from the ear is regarded by insurance companies as an element against granting a policy, or, at any rate, demanding an increased premium. I can only say that, if it is not so regarded, it would be, if the companies consulted their own interests."

We can but terminate this short sketch by saying that the perusal of this book has been not only instructive but extremely pleasurable, and we are glad to acknowledge the addition of such a volume to the literature pertaining to Otology.

C. H. B.

DIE CORROSIONS ANATOMIE UND IHRE ERGEBNISSE. Hyrtl.
Vienna, 1873.

Hyrtl describes the casts taken from the labyrinths of a variety of animals.

1. That of *Troglodytes Grilla* is remarkable for the size of its posterior semicircular canal and ampulla; it resembles very closely that of the orang.

2. The *Aye-Aye* (*Chiromys madagascariensis*) is commonly classed with the *sciuridæ*; but its labyrinth is so entirely like that of the *lemuridæ* that Hyrtl does not hesitate to place it in the latter class.

3. *Ursus spelæus*, the cave-bear of the glacial drift. There is great difficulty in getting rid of the clay and sand that is packed into the aural cavities of pre-historic animals.

H. boils the temporal bones in vinegar for several hours, then dries them by a strong heat, and pounds the bone on some hard object to get the fragments out; this process must be repeated three or four times. The cavities are then to be cleaned by means of bristles, for introducing which he makes artificial openings at the cupola of the cochlea and the middle of the semicircular canals. The labyrinth of this bear is only distinguished by its size from that of the modern brown bear (*U. arctos*).

4. *Hyæna spelæa*, the cave-hyæna. Its labyrinth unites the characteristics of the *viverræ* and the cats.

5. *Trichecus rosmarus*, the walrus. The labyrinth differs from those of the other palmipeda in being somewhat smaller; it has much wider semicircular canals, and a monstrous, broad, low cochlea, with rather less than 2¹ turns.

6. *Latax stelleri*. The labyrinth is widely different from

that commonly found in seals; the semicircular canals are very narrow, and are placed somewhat as in the fish-otter.

7. *Rhinoceros tichorhinus*. There is only one point of distinction between this labyrinth and that of *Rh. africanus*, namely, the corkscrew shape of the aquæductus and cochlea; there is also great similarity to that of the one-horned *Rh. indicus*.

8. *Camelopardalis giraffa*. Very close resemblance to the cervina; much less to the antelopes. The preparation in the Musée Orfila at Paris shows an S-shaped bend of the upper canalis semi-circularis, which has been found to be due to the distorting effect of the acid used for corroding the preparation.

9. *Chelonius gigas*. The organ of hearing is exactly like that of the armadillos; the labyrinth shows also an affinity with that of the hedge-hog.

10. *Physeter macrocephalus*, the sperm-whale. The labyrinth combines the peculiarities of the herbivorous sirenidæ and of the phocæ; it is totally unlike that of the great baleen whales, and in all respects smaller than that of *Balæna mysticetus*.

11. *Orcinus orca*. This creature is ranked with the phocæne, but possesses the labyrinth of the narwhal; there is a great resemblance between this specimen and the labyrinth of the delphinidæ.

12. *Balæna mysticetus*, right-whale. The cochlea is the largest in Hyrtl's possession, though it must be called small in comparison with the gigantic size of the beast. It makes two turns, not touching one another, in the same plane. The modiolus is excessively thick, and its axis points directly downwards, which is the case with no other order of mammals. The canales semi-circulares are proportionally very small, not larger than in the domestic rat. It is a general law that their size is inversely proportional to the density of the temporal bone, and this bone, in the case of the right-whale, is hard enough to give a spark with steel, and is perfectly inaccessible to the ordinary methods of anatomical research with knife and chisel.

C. J. BLAKE.

Index to the articles mentioned in the Report, arranged in alphabetical order of the authors' names.

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