secondary to furunculosis of the vestibule as in the case described by Dan McKenzie (JOURN. OF LARYNGOL. RHIN. AND OTOL., vol. xxiv, p. 138).

The paucity of the symptoms produced is remarkable, and it would be interesting to ascertain how long spontaneous recovery would have taken and in what manner it would have been achieved. There was no pain or tenderness on examination, and the case is a good illustration of the fallacy of making the diagnosis of nasal disease without the use of the nasal probe. The case is also illustrative of the extent to which the rigid septal partition may be removed in doing a submucous resection of the nasal septum without the risk of significant facial deformity.

SOCIETIES' PROCEEDINGS.

ROYAL SOCIETY OF MEDICINE—OTOLOGICAL SECTION.

November 17, 1916.

H. J. MARRIAGE, *President of the Section, in the Chair.*

A Further Case of Otosclerosis associated with Otitis Media.—J. S. Fraser—(*continued*).

Microscopic Examination of Left Ear.

(1) *External Meatus.*—The sub-epithelial tissue in the roof of the meatus is swollen and the epithelium itself desquamating. *Drumhead:* The tympanic membrane is very thick in its upper part and is bound to the inner wall of the drum cavity by adhesions. The lower part of the membrane is perforated; at the edges of the perforation the epithelium is absent. There is marked small cell infiltration of the subepithelial tissue at the edges of the perforation. There is no extension of squamous epithelium from the outer surface of the drumhead round the edges of the perforation into the tympanic cavity.

(2) *Middle-ear Cleft.*—(*a*) Eustachian tube: The mucous membrane of the Eustachian tube is swollen and the submucosa infiltrated with small cells. A little pus is present in the tubal part of the tympanic cavity. The epithelium of the tube is clearly desquamated. (*b*) Tympanic cavity: There is great swelling of the mucosa of the attic, the submucosa being converted into granulation tissue. Cystic spaces containing pus are present in the attic and represent the remains of the attic cavity. The walls of these spaces show marked small cell infiltration. In the parts more remote from the attic cavity the bony walls show the usual fatty marrow, while nearer to the attic the marrow is more cellular and next to the submucosa the marrow spaces contain granulation tissue. The bony walls of the attic cavity show marked osteoporosis

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and stain deeply with basic stains. The mucous membrane in the niche of the oval window is thickened, congested, and infiltrated. The round window niche shows swelling of the submucosa with some cystic spaces and adhesions but no areas of osteoporosis. Ossicles: The malleus is almost normal. The long process of the incus is plainly eroded and in parts almost resolved into granulation tissue. There is marked ankyloses of the stapes to the anterior margin of the oval

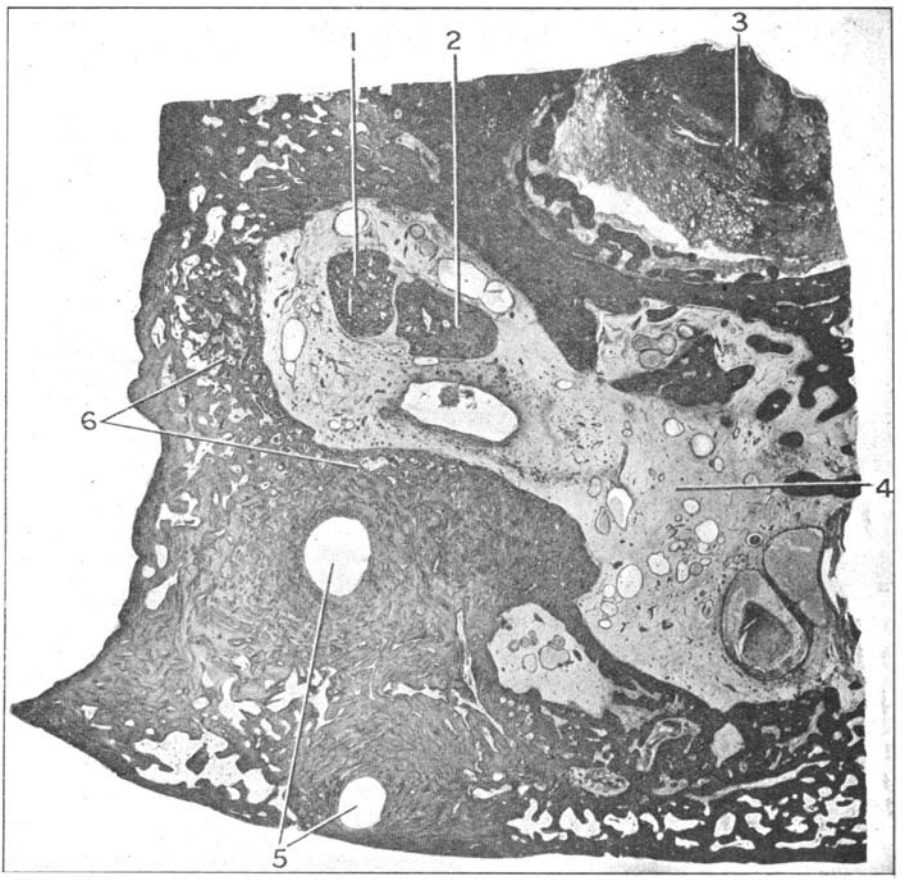


FIG. 5.—Otosclerosis associated with otitis media. A. W ——, female, aged sixty-three. Horizontal section through left ear in region of tympanic attic. No. 40.—1. Malleus. 2. Incus. 3. Swollen lining membrane of external auditory meatus. 4. Antrum filled up by swelling of submucous tissue. 5. Two ends of the superior vertical canal. 6. Areas of ostitis vasculosa in walls of attic due to inflammatory invasion of the bone from the submucous tissue. (× 6.)

window. The foot-plate itself is greatly thickened. The posterior part of the footplate is not ankylosed, but is jammed tight against the posterior margin of the oval window. Tympanic muscles: The tensor tympani appears to be rather more fatty than usual and the processus cochleariformis is eroded. The stapedius is healthy.

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(3) *Labyrinth Capsule.*—There is an *area of ostitis vasculosa in the bony prominence of the lateral (external) canal* as it lies on the inner wall of the auditus. The inflammatory change can be seen to pass in from the congested and swollen muco-periosteum on the inner wall of the middle ear. There is a second area of ostitis vasculosa or osteoporosis in the anterior margin of the oval window, where the promontory is much affected. Below the level of the oval window ostitis vasculosa

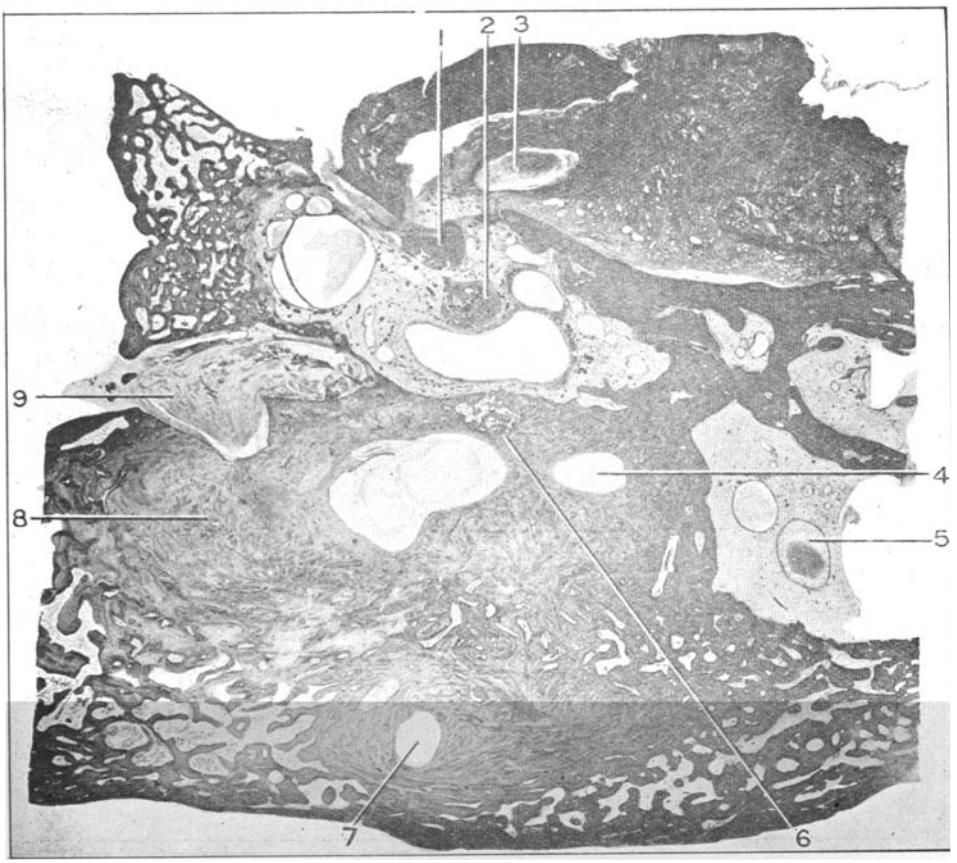


FIG. 6.—Otosclerosis associated with otitis media. A. W——, female, aged sixty-three. Horizontal section through left ear above level of oval window. No. 105.—1. Malleus (eroded). 2. Incus (markedly eroded). 3. Desquamated epithelium in external meatus. 4. Lateral canal. 5. Cystic space in antrum filled with mucoid material. 6. Area of ostitis vasculosa just above oval window. 7. Smooth end of superior canal. 8. Capsule of cochlea. 9. Geniculate ganglion of facial nerve. (× 6.)

is still present and bulges inwards, encroaching on the cavity of the vestibule. There is a third area of ostitis vasculosa at the apex of the cochlea just below the point where the tendon of the tensor tympani is attached. (It has already been stated that the processus cochleariformis showed marked erosion of the bone.) Elsewhere the labyrinth capsule is healthy. The veins of the fossa subarcuata are dilated.

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(4) *Labyrinth Contents.*—(*a*) Cochlea: Corti's organ appears to be well formed in all coils though the hair cells cannot be distinguished. The ganglion cells are very little, if at all, shrunken. The perilymphatic aqueduct is patent at both ends and is normal throughout. (*b*) Vestibule: The saccule and utricle with the endolymphatic duct are normal. (*c*) Canals: As on the right side the cristæ of all three canals are very low and the cupulæ are absent.

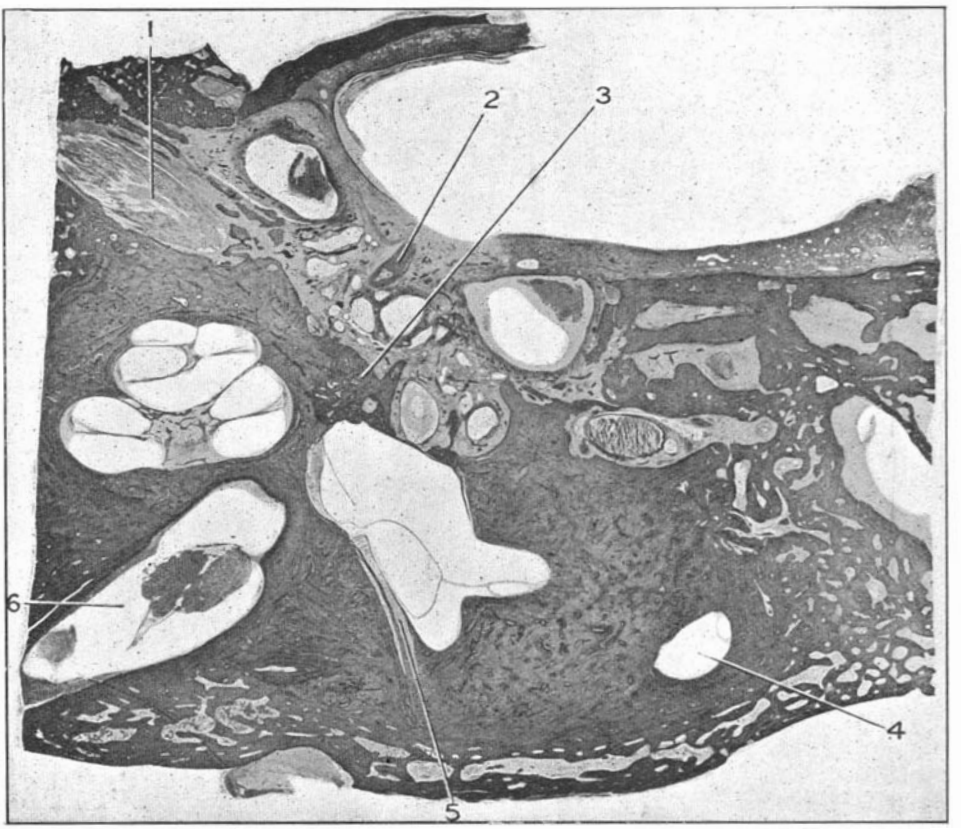


FIG. 7. Otosclerosis associated with otitis media. A. W——, female, aged sixty-three. Horizontal section through left ear in region of oval window. No. 210.—1. Tensor tympani. 2. Malleus handles. 3. Area of ostitis vasculosa (otosclerosis) in anterior margin of oval window, with anterior part of stapes ankylosed to it. 4. Posterior canal. 5. Endolymphatic duct. 6. Internal meatus. Note the marked adhesive process in the tympanic cavity. (× 6.)

(5) *Internal Meatus.*—There are a few small cells in the fundus of the meatus. The vestibular ganglion appears to be healthy, and the two divisions of the eighth nerve are normal. The usual corpora amylacea are present in the eighth nerve at the junction of the central and peripheral parts.

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Summary.

On the left side the changes in the middle ear and labyrinth capsule are much more pronounced. Otitis media (purulenta) is still present, and the drumhead is perforated. There is a marked chronic adhesive process in the upper part of the tympanum, with great thickening of the submucosa and erosion of the long process of the incus. The stapes is ankylosed to the anterior margin of the oval window. There

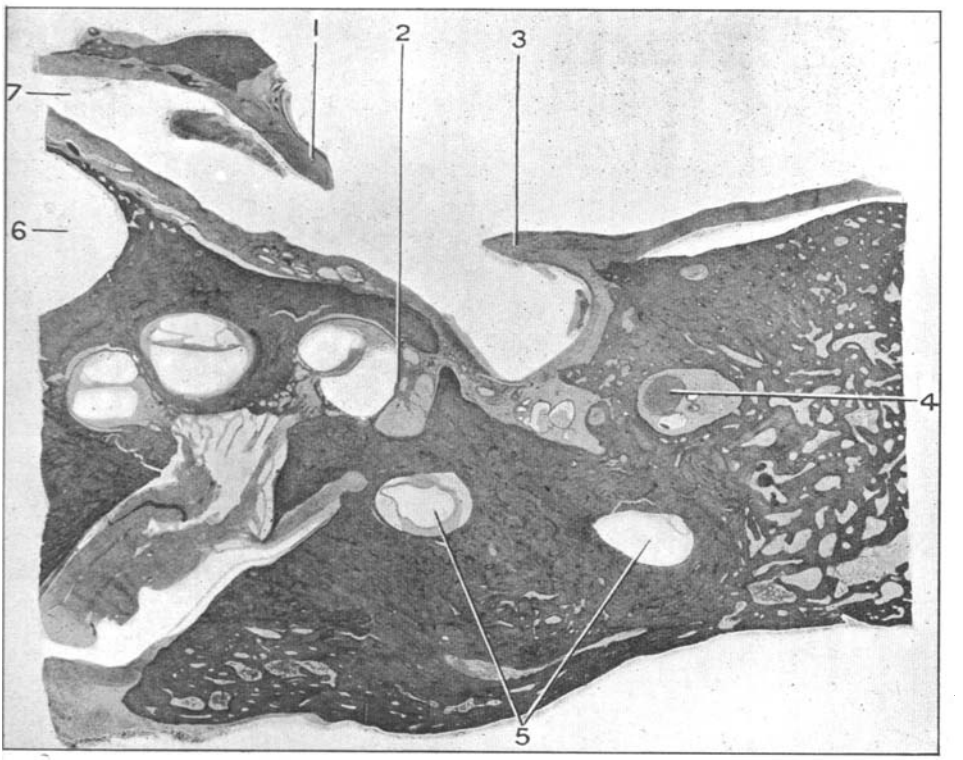


FIG. 8.—Otosclerosis associated with otitis media. A. W —, female, aged sixty-three. Horizontal section through left ear in region of round window. No. 265.—1. Anterior margin of perforation in drumhead. 2. Membrane of round window. 3. Posterior margin of perforation. 4. Facial nerve. 5. Two ends of posterior canal. 6. Carotid canal. 7. Eustachian tube. Note that niche of round window and sinus tympani are both filled up by swollen mucosa. (× 6.)

are three well-marked areas of ostitis vasculosa in the labyrinth capsule on the inner wall of the middle ear: (*a*) in the lateral canal; (*b*) in the anterior margin of the oval window; (*c*) at the apex of the cochlea. The labyrinth contents are normal.

I hold that in this case the otosclerosis on both sides was secondary to otitis media. On the right side the otitis media passed off, but left traces in the region of the tube and oval windows. In time the

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inflammatory process invaded the bone in the latter area, and resulted in otosclerosis with fixation of the stapes. On the left side the otitis media continued, and invaded the labyrinth capsule in three distinct areas as stated above.

Injuries of the Middle and Inner Ear in Fracture of the Cranial Base.—J. S. Fraser.—At the present time it is hardly within the province of the otologist to enter into the general question of the method of production of fractures of the base. In the—I hope

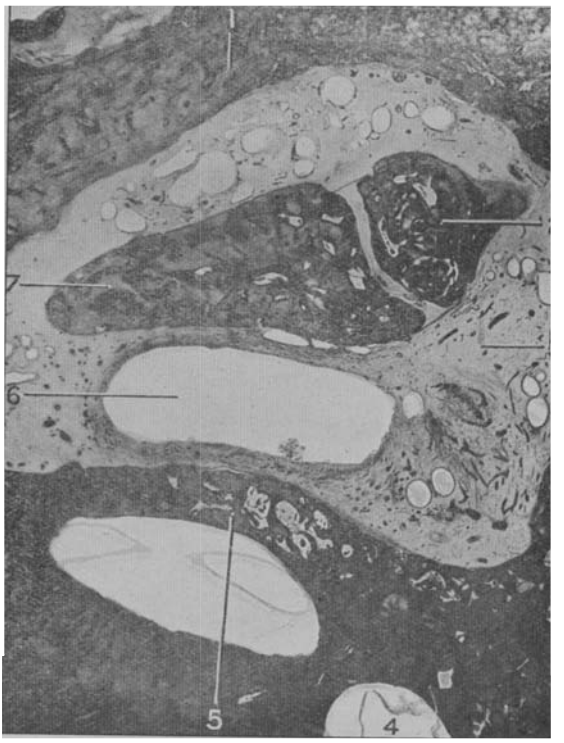


FIG. 9.—Otosclerosis associated with otitis media. A. W——, female, aged sixty-three. Horizontal section through left ear in region of attic. No. 65. —1. External wall of attic. 2. Malleus. 3. Swollen submucosa. 4. Ampullary end of superior canal. 5. Area of ostitis vasculosa in bony wall of lateral canal. 6. Remains of attic cavity. 7. Short process of incus. (× 12.)

near—future, when the otologist has developed into the cranial surgeon, it will be advisable for him to deal with the subject of "bursting" and "bending" fractures, and to indicate the direction of these fractures caused by falls on various parts of the head. At the present time it need only be said that fractures of the cranial base frequently involve the middle and inner ear. Brun[1] finds that there is disturbance of

[1] Brun, H., "Der Schädelverletze und seine Schicksale," *Beitr. z. Klin. Chir.* 1903, xxxviii, pp. 192, 289, 601.

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hearing in 14 per cent. of skull injuries and in 24 per cent. of basal fractures. The line of fracture may run parallel to the long axis of the petrous bone or at right angles to the long axis.

(1) Longitudinal fractures as a rule start in the orbit or region of the sella turcica, and pass backwards along the line of the middle-ear cleft, breaking the roof of the Eustachian tube and tympanic cavity. The fracture may then pass outwards to the external meatus and squamous region: if this is the case the inner ear is not involved, though the ossicles may be dislocated and the drumhead torn. On the other hand, the fracture, after reaching the roof of the tympanic cavity, may pass inwards through the petrous pyramid, and thus resemble in

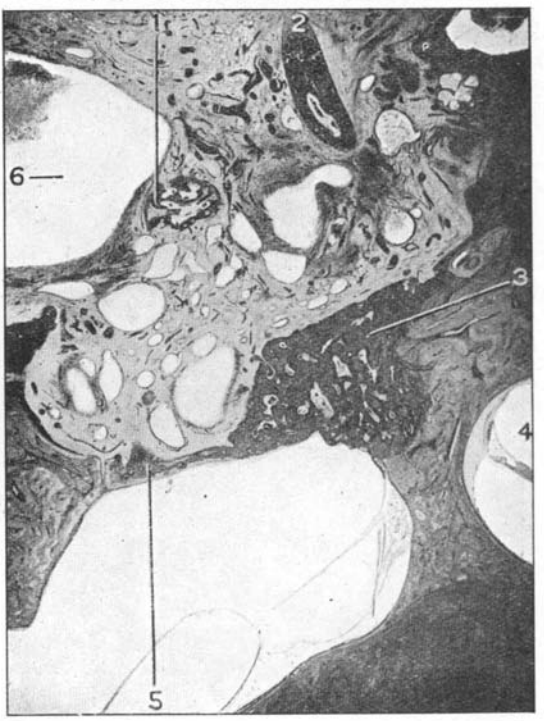


FIG. 10.—Otosclerosis associated with otitis media. A. W——, female, aged sixty-three. Horizontal section through left ear just above oval window. No. 175.—1. Malleus. 2. Processus cochleariformis. 3. Area of otosclerosis. 4. Utricle, 5. Facial nerve in shreds (artefact). 6. Eroded long process of incus. (× 12.)

some respects those fractures which run at right angles to the long axis of the petrous bone. The inner ear is of course involved in these latter cases. (Case 2 belongs to this second type.)

(2) Genuine transverse fractures of the petrous pyramid run at right angles to the long axis of the pyramid, and always injure the labyrinth. As a rule the fracture passes through the external meatus, roof of the tympanic cavity, vestibule, and internal auditory meatus, as

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this is the line of least resistance. The fracture may, however, pass further forward through the cochlea, or further back when the canals are involved.

If the patient survives the injury at the time, he is not out of danger, as meningitis may supervene as the result of infection from the middle-ear spaces, or of contamination of the blood in the external meatus and tympanic cavity. Such a complication is, of course, more likely if the labyrinth is involved in the fracture.

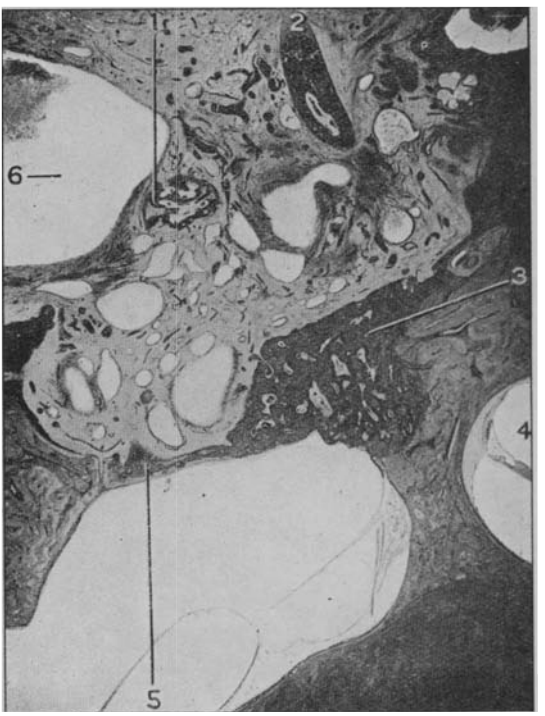


FIG. 11.—Otosclerosis associated with otitis media. A. W——, female, aged sixty-three. Horizontal section through left oval window. No. 205.—1. Long process of incus, showing ostitis vasculosa. 2. Malleus. 3. Area of ostitis vasculosa in promontory ankylosed to 5, footplate of stapes. 4. Cochlea. 6. Tympanic cavity. (× 12.)

Stenger[1] has experimented on rats, in which he produced labyrinthine concussion by blows on the head. After the injury the rats seemed stunned and lifeless, but soon recovered. The animals were killed at various periods after the injury. In slight cases microscopical examination of the inner ear showed hæmorrhage confined to the region of the round window and lower coil of the cochlea. After more severe injury the whole of the cochlea showed blood extravasation and also hæmorrhages in the cochlear nerve.

[1] Stenger, *Archiv f. Ohrenheilk.*, lxxix.

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From the point of view of microscopical anatomy, Nager[1] divides cases of labyrinth injury observed in the human subject, as the result of fracture of the base, into (1) recent and (2) old.

(1) The former cases are those in which the patient dies soon after the injury. In these Barnick[2] has shown that where the labyrinth capsule is injured, we have marked destruction of, and hæmorrhage into, the inner ear. Even in those cases in which the labyrinth capsule is not injured, we meet with hæmorrhage in the inner ear and eighth



FIG. 12.—Otosclerosis associated with otitis media. A. W——, female, aged sixty-three. Horizontal section through left cochlea. No. 245.—1. Area of ostitis vasculosa at apex of cochlea in region of processus cochleariformis. 2. Tensor tympani. 3. Area of otosclerosis below oval window. (× 10.)

nerve. The auditory nerve may be ruptured (Lange[3] and Link[4]), and the crura of the stapes torn from the footplate.

(2) With regard to the old cases, it appears that up to 1909, at any rate—the date of publication of Nager's paper—only two cases had

[1] Nager, *Med. Klin.*, 1909, No. 40.
[2] Barnick, *Archiv. f. Ohrenheilk.*, xliii.
[3] Lange, *Zeitschr. f. Ohrenheilk.*, liii.
Link, *Zeitschr. f. Ohrenheilk.*, lvii.

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been microscopically examined: (*a*) Manasse's[1] patient had suffered from fracture of the skull fifteen years before death, and yet on microscopic examination the line of fracture was still clearly visible—partly closed by fibrous tissue and partly by new bone. The break traversed the stapes and vestibule as in Case 2 recorded below. Manasse found

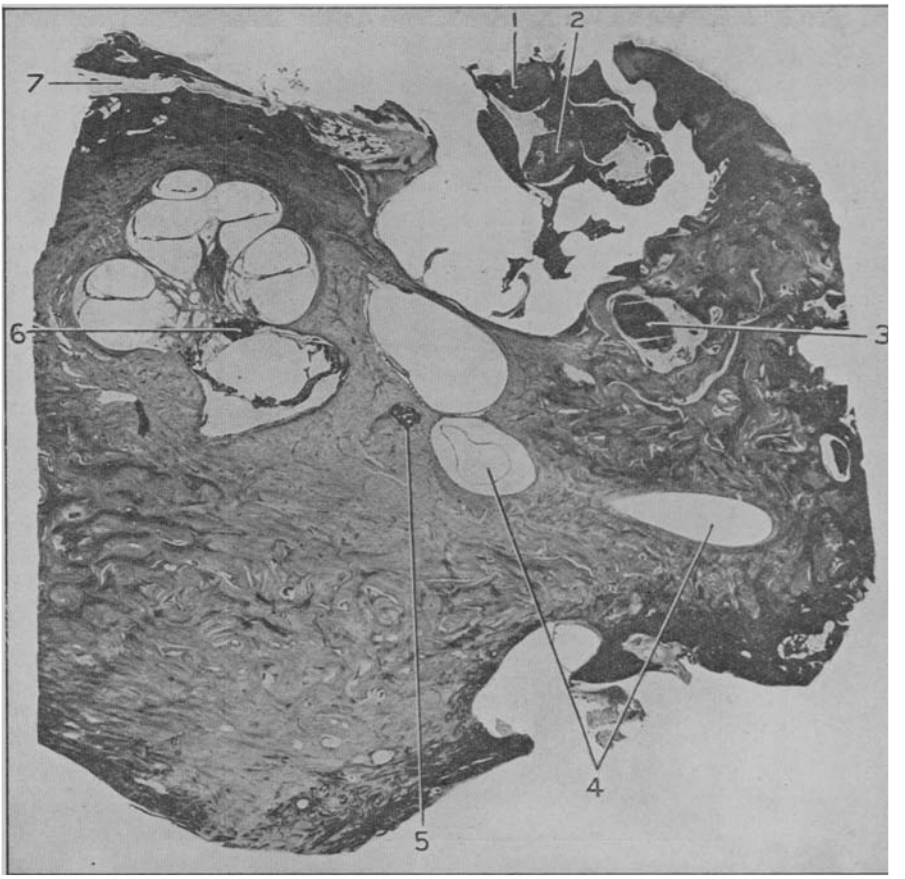


Fig. 13.—Fracture of cranial base without injury to labyrinth capsule. J. P——, male, aged fifty-four. Horizontal section through right ear. No. 122.—1. Malleus. 2. Incus surrounded by blood-clot. 3. Facial nerve. 4. The two ends of the posterior vertical canal. 5. Hæmorrhage in branch of vestibular nerve to ampulla of posterior canal. 6. Hæmorrhage in fundus of internal meatus. 7. Hæmorrhage in Eustachian tube. (× 6.)

new connective tissue and bone in the vestibule and in the basal coil of the cochlea. The scala media was dilated, and the sensory cells and nerves were atrophied. (*b*) Nager[2] himself has examined the ear of an

[1] Manasse, *Virchow's Archiv.*, clxxxix.
[2] Nager, *Zeitschr. f. Ohrenheilk.*, liv.

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old deaf-mute whose loss of hearing was due to an injury of the skull sixty years before death. In this case the line of fracture was not evident. The canals were obliterated by new bone, and the vestibule and basal coil of the cochlea filled up to a great extent by the same substance.

Case 1.

The first case I wish to show is that of J. P——, a male, aged fifty-

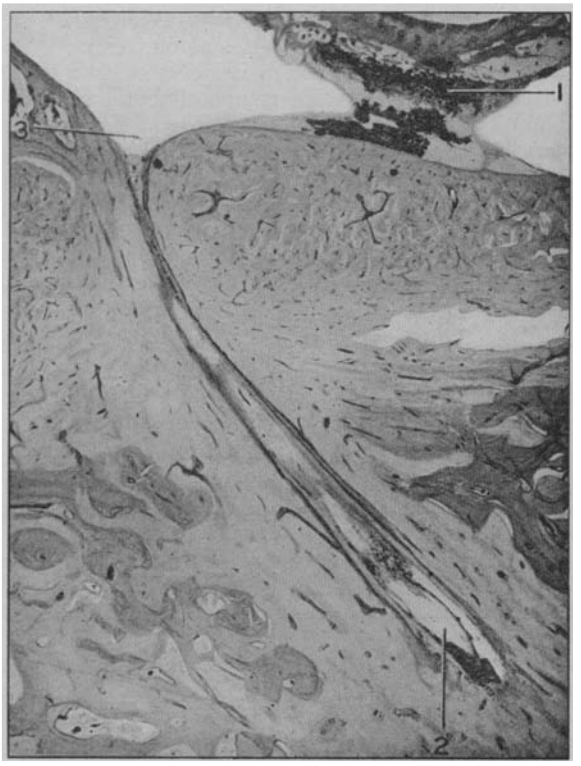


Fig. 14.—Fracture of cranial base without injury to labyrinth capsule. J. P——, male, aged fifty-four. Horizontal section through right ear. No. 170.—1. Hæmorrhage in modiolus. 2. Blood in perilymphatic aqueduct. 3. Cochlear opening of aqueduct. (× 12.)

four, who was admitted to the wards of Mr. Charles (now Colonel) Cathcart, at 2 p.m. on December 6, 1910. I am greatly indebted to Colonel Cathcart for his kind permission to record these cases. The history of the case was that, while stepping out of the way of an automobile, the patient was knocked down by a cable car. On admission to the infirmary the patient was pale, irritable, and restless; pulse 64, temperature 96° F., respirations 28. Swollen, bruised areas were present on the back of the scalp and above the left ear. There were no

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signs of injury to the body or limbs. There was profuse bleeding from the right ear, but *no flow of cerebro-spinal fluid* (as will be seen later, the labyrinth capsule in this case was not injured). The right pupil was more dilated than the left. Both reacted to light. Four hours after admission the patient became comatose and the breathing stertorous, The left arm was found to be more flaccid than the right. Operation at 7 p.m. by Mr. Cathcart. The right temporo-sphenoidal region was trephined, but no extradural clot was found. On incising the dura dark blood escaped, and a drainage-tube was inserted. Breathing was quieter for a time after operation, but again became noisy at 11 p.m. At midnight temperature 101·4° F., pulse 140. The patient died ten hours later.

Post-mortem.—The line of fracture runs along the roof of the middle-ear cleft. The middle meningeal artery is lacerated, and the roof of the tympanic cavity is splintered. The tympanum and mastoid cells are filled with blood. The jugular bulb is not injured. The fracture extends from the anterior part of the left middle fossa—where it crosses the groove for the middle meningeal artery—obliquely backwards through the squamous temporal and parietal bones to the lambda, and thence to the right parietal and squamous temporal regions. From here it passes down to a point behind the right petrous temporal, crosses the sigmoid sinus, and then runs along the anterior border of the right petrous bone.

Microscopic Examination of the Right Ear.

(1) *Middle Ear.*—The tympanic membrane is ruptured in its posterior part. Hæmorrhage is present in the mastoid antrum and cells and also in the tympanic cavity, but the joint between the malleus and incus appears normal. Blood is present in the sinus tympani and in the niche of the round window.

(2) The labyrinth capsule is not fractured, but hæmorrhage is present in the region of the geniculate ganglion, and the fibres of the seventh nerve are separated by blood. There is also some bleeding in the fossa subarcuata.

(3) *Labyrinth Contents.*—(*a*) The cochlea only shows slight hæmorrhages in the modiolus. The scalæ of the cochlea are free from blood, but there is a little hæmorrhage in the aqueduct of the cochlea towards its cranial end. (*b*) The hollow spaces of the vestibule are free from hæmorrhage, but there is a little blood in the ductus endo-lymphaticus just before it opens into the saccus. The stapes is normal in the oval window. (*c*) The canals show no hæmorrhage either in the peri- or endo-lymphatic spaces.

(4) *Internal Meatus and Nerves.*—Hæmorrhage is present in the fundus of the meatus where the cochlear nerves enter the modiolus. There are also bleedings in the vestibular nerve and its branches to the superior and lateral canals, the sacculus and the ampulla of the posterior canal (see illustrations).

(*To be continued.*)

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