A CASE OF ACUTE SUPPURATIVE OTITIS MEDIA, PURULENT LABYRINTHITIS AND LEPTOMENINGITIS WITHOUT RUPTURE OF THE TYMPANIC MEMBRANE.*

By J. S. FRASER, M.B., F.R.C.S.,
Assistant-Surgeon, Ear and Throat Department, Royal Infirmary; Lecturer on Diseases of the Nose, Throat, and Ear, School of Medicine of the Royal Colleges, Edinburgh; Aural Surgeon to Leith Hospital.

The following case seems worthy of record, because it shows that a child may suffer from acute middle ear suppuration, acute purulent labyrinthitis and leptomeningitis without having any discharge from the ear—in other words, that the pus in the tympanic cavity may penetrate into the labyrinth through the round and oval windows and from the labyrinth may infect the subarachnoid space before the purulent exudate in the tympanic cavity bursts through the tympanic membrane.

The patient was a boy, aged 12 years, who was admitted to Ward 32 under the charge of Dr. Edwin Matthew, in the absence of Sir Robert Philip. I am indebted to Sir Robert and Dr. Matthew for permission to record the case. Dr. Power, Resident House-Physician, kindly supplied the following notes of the case:

The boy was quite well till the morning of Monday (17th March 1913), when he refused breakfast on account of severe earache, a general feeling of "seediness," and slight frontal headache. The patient's sister stated that the boy had pain in both ears, but his mother thought that the pain was only in the left ear.

The boy vomited at 11 A.M., although he had had no breakfast, the vomited matter consisting of bile. The patient was put to bed and was visited by his doctor, who noted choreic movements of the hands.

Vomiting continued at short intervals until the following morning (18th March). After this it was not so constant, and the boy only vomited twice on the 19th of March and twice on the 20th, before admission to the Royal Infirmary.

The patient slept on and off during these first days of illness; he had frequent attacks of restlessness, and screamed if he were touched. At 1 P.M. on the day of admission (20th March) he lapsed into a semi-comatose condition.

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Personal and Family History.—The patient had always been healthy and had had no previous ear trouble. His father died of consumption at the age of 36. One brother, aged 18, committed suicide by cutting his throat three weeks before patient's illness began; this brother, who suffered from tubercular cervical adenitis, had been despondent for some time on account of severe deafness due to chronic suppurative otitis media.

Examination of Patient.—(4 p.m. 20th March). Temperature 102·4° F.; pulse 94; respirations 30. The boy is semi-comatose; pupils semi-dilated; conjunctival reflex present. Conjugate deviation of eyes to the left. Patient is very restless and will not answer questions; he lies mostly on his right side, with knees and hips flexed. He moans constantly but there is no distinct cry. Any attempt at examination is resented. The patient waves his hands about in a choreic manner—thumbs pressed to palms. The head is not markedly retracted, but any attempt at flexion is resisted. Knee and ankle jerks present; no ankle clonus; Kernig's sign present; plantar reflexes indefinite.

There was no discharge from the ears and no definite tenderness over the mastoid processes. (Unfortunately the tympanic membranes were not inspected, and the writer (J. S. F.) had no opportunity of observing the patient in life; it is, however, evident that it would have been impossible to carry out any functional examination of the ears.) Both tonsils were large and red, the left more so than the right.

The abdomen was slightly tense but not scaphoid.

At 7 p.m. temperature had risen to 103·4°, the pulse to 116, and the respirations to 32. Chloral and bromide were given.

Lumbar puncture yielded milky fluid under considerable pressure; on standing, a distinct layer of pus formed. Films of the pus showed many polymorphs and numerous capsulated diplococci, some in short chains. The report from the pathological department was to the effect that capsulated diplo-streptococci were present resembling pneumococci on culture.

11 p.m.—Patient very restless; temperature 103°. Heroin given. During the night temperature came down to 101°, but the pulse rose to 140 and the respirations to 36.

21st March.—Patient quite unconscious. Legs extended; deep reflexes absent; conjugate deviation has passed off.

5 p.m.—Cheyne-Stokes' respiration.

6 p.m.—Death.
A Case of Acute Suppurative Otitis Media

Post-Mortem Report.

(The writer is indebted to Dr. Murray Drennan for this report and also for the temporal bones.)

Brain.—Convolutions flattened; pus in subarachnoid space over both sides of cerebral cortex. Turbid cerebro-spinal fluid at base of brain and thick pus over the pons and in the interpeduncular space. Brain oedematous; small vessels congested; ventricles contain excess of turbid fluid. No thrombosis of venous sinuses.

Ears.—Mastoid cells on both sides filled with pus; mucous lining congested and thickened. The left inner ear was opened with the chisel and found to contain pus. The left internal auditory meatus was also full of pus. On the right side the middle ear spaces contained pus, but the labyrinth on this side was free from purulent exudate.

Nose.—The mucous membrane of the ethmoidal and sphenoidal sinuses was congested, but these cavities contained no pus.

Spinal Cord.—Yellow purulent exudate present under the dura throughout the entire length of the cord; substance of the cord oedematous and congested. Films from the pus show many polymorphs and Gram+ diplococci, some in short chains. (Dr. Drennan reports that on culture this organism showed the characters of the streptococcus mucosus; there was a well-marked capsule when stained with the capsule stain.)

Lungs.—On the right side there were haemorrhages in the pleura, emphysema of upper and middle lobes, adhesions at right apex: bronchial glands enlarged and congested. On section the right lung showed intense congestion and small congested collapsed areas. The left lung showed a similar condition. Adhesions were present over the posterior surface. The trachea and large bronchi were greatly congested and the mucous membrane covered with blood-stained sero-purulent fluid.

Heart.—Right side enlarged; agonal thrombus in right ventricle and pulmonary artery. On the left side an agonal thrombus extended into the aorta.

Spleen and Mesenteric Gland.—Enlarged and deep pink in colour.

Liver and Kidneys.—Showed cloudy swelling.

Microscopic Examination of the Left Ear.

(From the histological point of view it is unfortunate that on both sides the middle and inner ears were opened at the post-
mortem examination; on the left side the eighth nerve was removed. Enough, however, remained to show the condition of the middle and inner ears along with the paths of infection.)

External Meatus.—This is free from pus, but the lining membrane is swollen and the vessels engorged. The ceruminous glands show a dilated lumen.

Middle Ear.—(1) Eustachian Tube.—The lining membrane of the tube is swollen and the submucous tissue densely infiltrated with small cells. This is especially noticeable at the point where the cartilaginous tube joins the tubal part of the tympanic cavity. Under a high power numerous pus cells can be seen passing through the tubal epithelium into the cavity. It is interesting to note the difference between the contents of the Eustachian tube and those of the tympanic cavity; in the former the exudate consists largely of mucus with an admixture of pus cells, whereas in the latter the exudate is entirely purulent. The superficial mucous membrane is, on the whole, well preserved in the tube, and the cilia can be distinctly seen. In places, however, the superficial epithelium is desquamating.

(2) The Tympanic Cavity.—The mucous membrane lining the attic is swollen, congested, and infiltrated, and the attic cavity itself is filled with pus. The head of the malleus and the body of the incus are normal, but the joint cavity between them contains pus (this may be an artefact caused by the opening of the tympanic cavity with the chisel—in the writer’s opinion it is not an artefact).

In the middle part of the tympanic cavity the mucous membrane over the promontory is greatly thickened, and just in front of the oval window, where there is a slight exostosis of the promontory, it is so edematous and infiltrated as to form a long slender polypus which projects into the cavity. The whole of the tympanic cavity is filled with purulent exudate. The tympanic membrane is greatly thickened and its vessels are dilated, especially those which course between the epidermic and fibrous layers. The posterior part of the membrane bulges outwards towards the meatus, and, just external to the long process of the incus, this part is specially swollen and infiltrated. The epidermic layer is here seen to be desquamating and the fibrous layer is disintegrated by small cell infiltration. Pus cells can be seen forming a small abscess just beneath the desquamating epidermic layer (myringitis). It is obvious that at this spot rupture of the membrane was just about to occur.

Ossicles.—Although the mucous membrane covering the
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Fig. 1.—Horizontal section through normal left ear of infant, in region of oval window (×3 diam.). (1) Facial nerve; (2) long process of incus; (3) head of stapes; (4) handle of malleus attached to tympanic membrane; (5) Eustachian tube (tubal portion of tympanic cavity); (6) scala tympani of basal coil of cochlea; (7) internal auditory meatus with eighth nerve; (8) sacculus; (9) foot-plate of stapes; (10) utricle; (11) smooth end of external canal; (12) crus commune.

Fig. 2.—Horizontal section through left ear of present case, about same level as Fig. 1 (×3 diam.). (1) External meatus with desquamated epithelium; (2) incus; (3) malleus; (4) facial nerve; (5) tubal portion of tympanic cavity—the latter contains pus; (6) basal coil of cochlea; (7) internal meatus; (8) ruptured sacculus; (9) utriculus; (10) and (11) horizontal canal; (12) crus commune.

Fig. 3.—Horizontal section through normal left ear of infant, in region of round window (×3 diam.). (1) Facial nerve; (2) stapedius muscle; (3) niche of round window; (4) tympanic membrane; (5) scala vestibuli of basal coil of cochlea; (6) tubal part of tympanic cavity; (7) carotid artery in carotid canal; (8) scala tympani of basal coil; (9) membrane of round window; (10) ampullary end of posterior canal; (11) smooth end of posterior canal.

Fig. 4.—Horizontal section through left ear of present case, about same level as Fig. 3 (×3 diam.). (1) Facial nerve; (2) stapedius; (3) external meatus with desquamated epithelium; (4) thickened tympanic membrane—the tympanic cavity is full of pus; (5) carotid canal; (6) scala tympani of basal coil containing pus; (7) infiltrated membrane of round window; (8) ampullary end of posterior canal—the perilymphatic space shows a haemorrhage; (9) smooth end of posterior canal, normal.
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Fig. 5.—Horizontal section through left ear of present case (× 20 diam.). (1) Chorda tympani; (2) external meatus; (3) collection of pus beneath epidermic layer of tympanic membrane (myringitis)—the fibrous layer is perforated; (4) desquamated epithelium of tympanic membrane; (5) fibrous layer of drum-head; (6) promontory, covered by swollen, engorged, and infiltrated mucous membrane; (7) mucous layer of tympanic membrane; (8) pus in tympanic cavity.

Fig. 6.—Horizontal section through left ear of present case (× 20 diam.). (1) Incus; (2) bony wall of external attic; (3) malleus; (4) pus in external attic; (5) anterior ligament of malleus; (6) chorda tympani; (7) facial nerve—its bony covering is dehiscent; (8) pus in joint between malleus and incus; (9) pus in internal attic.

Fig. 7.—Horizontal section through left ear of present case (× 20 diam.). (1) Swollen mucosa over pyramid; (2) pus in niche of oval window; (3) footplate of stapes—to the right of this pus is seen entering the vestibule; (4) anterior crus of stapes; (5) internal meatus with pus cells (meningitis); (6) cavity of ruptured sacculus; (7) pus in perilymphatic space of vestibule; (8) pus and hemorrhage external to (9) the utriculus.

Fig. 8.—Horizontal section through left ear of present case (× 20 diam.). (1) Pus in tympanic cavity; (2) swollen mucosa over promontory; (3) pus in scala tympani of basal coil; (4) vein accompanying aqueduct of cochlea; (5) pus in cochlear opening of perilymphatic aqueduct; (6) pus in niche of round window—the central part of the round window membrane is infiltrated with pus; (7) ampullary end of posterior canal.
Fig. 9.—Horizontal section through right ear of present case (× 20 diam.). (1) Haemorrhage in perilymphatic space of vestibule close to utricular branch of vestibular nerve; (2) facial nerve; (3) crista of external canal; (4) cavity of utricle, which contains an air-bell (artefact); (5) neuroepithelium of utricle; (6) cavity of saccule.

Fig. 10.—Horizontal section through right ear of present case (× 20 diam.). (1) Haemorrhage in perilymphatic space of vestibule external to saccule; (2) pus in niche of oval window; (3) footplate of stapes; (4) haemorrhage in posterior part of perilymphatic space of vestibule—the latter contains a large air-bell; (5) utriculus, containing air-bell; (6) haemorrhage; (7) ductus endolymphaticus; (8) cavity of saccule.

Fig. 11.—Horizontal section through right ear of present case (× 20 diam.). (1) Cochlear duct of basal coil containing haemorrhage; (2) air-bell in scala vestibuli; (3) spiral ganglion; (4) haemorrhage in bony spiral lamina; (5) air-bell in scala tympani.

Fig. 12.—Horizontal section through right ear of present case (× 20 diam.). (1) Scala tympani of basal coil; (2) haemorrhage above membrane of round window; (3) niche of round window; (4) swollen membrane of round window; (5) pus in cochlear opening of perilymphatic aqueduct; (6) vein accompanying cochlear aqueduct.
ossicles is intensely congested and infiltrated like the rest of the tympanic mucosa, the ossicles themselves are healthy. The long process of the incus and the inco-stapedial joint are normal, though these parts are the first affected as a rule—at least in cases of chronic suppuration—on account of their deficient blood-supply. The foot-plate of the stapes is normal, but the anterior part of the foot-plate is tilted outwards, while the posterior part is tilted in as if by powerful contraction of the stapedius muscle. The annular ligament which joins the foot-plate of the stapes to the margins of the oval window is infiltrated with pus cells, which are finding their way through it into the vestibule. This is especially noticeable in the anterior part of the ligament.

The tympanic cavity, aditus, and antrum are all full of pus.

*Labyrinth Capsule.*—The labyrinth capsule proper, which is formed of cartilage bone, and contains interglobular spaces, is quite normal, but outside this the looser periosteal bone shows great vascular dilatation, and the marrow spaces surrounding the labyrinth capsule are intensely congested.

The facial nerve on the inner wall of the tympanic cavity appears normal, but the vessels which accompany it are greatly dilated.

*Labyrinth—Cochlea.*—All coils of the cochlea contain pus, but the scala tympani shows more than the scala vestibuli. In the basal coil the scala tympani shows a haemorrhage in addition to very numerous pus cells. The perilymphatic aqueduct contains pus at its cochlear end, but further down, where the duct becomes very narrow, few pus cells can be seen. Towards the cranial end, however, numerous small round cells are again visible. In all the coils the cochlear duct contains pus, and Corti’s organ is dis-integrated. In the middle and apical coils Reissner’s membrane has disappeared, but in the basal coil it may be seen in parts. The hollow spaces of the modiolus, which contain the nerves and ganglia, are infiltrated with pus cells, and the blood-vessels of the modiolus are greatly dilated; in the spiral canal of the basal coil haemorrhage may be seen.

*Round Window.*—The secondary tympanic membrane closing the round window is greatly swollen and infiltrated with pus cells, which may be seen making their way through it into the scala tympani. The mucous membrane lining the round window is greatly engorged and thickened.

*Vestibule.*—There is a considerable collection of pus in the perilymph space just internal to the foot-plate of the stapes. The
endosteum covering the inner side of the foot-plate is thickened. The outer wall of the sacculum is ruptured and the sacculum itself contains some pus cells. The utricle is dilated but not ruptured. There is a haemorrhage in the perilymph space of the vestibule between the utricle and the posterior wall of the cavity. The vestibular end of the endolymphatic aqueduct shows some small cell infiltration of its walls, and a few pus cells may be seen in the cavity of the duct.

Canals.—There is a haemorrhage in the perilymph space of the external canal and in the crus commune, but the canals themselves are almost free from pus. The posterior canal also shows haemorrhage in the peri- and endolymphatic spaces.

Internal Meatus.—The lower part of this space is seen to be full of pus cells, but unfortunately the seventh and eighth nerves were removed at the post-mortem, so that no report can be given on these structures.

Right Ear.

External meatus is free from purulent discharge.
Eustachian tube contains muco-purulent exudate.
Tympanic cavity is full of pus. The mucous membrane lining the tympanic cavity and attic is swollen, engorged, and infiltrated, but the joint between the malleus and incus is normal, as is also that between the incus and stapes. Pus is present in the niche of the oval window, but the annular ligament is intact and is not infiltrated with pus cells. The mucous membrane of the aditus and antrum shows a similar condition to that of the tympanic cavity. The secondary tympanic membrane closing the round window is moderately thickened but is not infiltrated.

Labyrinth Capsule.—As in left ear.
Cochlea.—There is a considerable amount of haemorrhage in the scala tympani and also in the scala media in the neighbourhood of the round window. The cochlear opening of the perilymphatic aqueduct contains pus which has apparently found its way up the aqueduct from the subarachnoid space. In the basal coil the cochlear canal is somewhat dilated, apparently by the haemorrhage which is present. A slight amount of coagulated lymph is present in the apical coil. Corti’s organ in the apical coil is almost normal, but in the middle coil it is disintegrated and the membrana tectoria is separated. A haemorrhage is present in the osseous spiral lamina of the basal coil. The modiolus and the nerve canals are infiltrated with pus which appears to have invaded from the subarachnoid space of the internal meatus.
Vestibule.—There is a large haemorrhage in the perilymphatic space of the vestibule between the foot-plate of the stapes on the outer side and the utricle and saccule on the inner. This haemorrhage is situated below the entrance of the vestibular nerve to the utricle. (Unfortunately the right inner ear is not well filled with celloidin.) Haemorrhage is present in the vestibular end of the endolympathic aqueduct, but towards its cranial end the duct is healthy and the saccus contains no blood.

Canals.—The superior canal is normal at its ampullary end, but the smooth end contains pus and chips of bone (artefact due to opening with chisel at post-mortem). There is a haemorrhage in the crus commune in the membranous canal, and also in the nerve which passes to the ampulla of the posterior canal.

Internal Meatus.—A considerable quantity of pus is present in the internal meatus and surrounds the cochlear and vestibular nerves; this has probably infiltrated beneath the subarachnoid sheaths of the nerves from the meningitis which existed at the base of the brain. The fundus of the internal meatus is full of pus, and the modiolus is infiltrated to a moderate extent with pus cells.

Remarks.

1. As appears from the post-mortem examination, the case was one of acute infection of the respiratory tract—nose, trachea, bronchi, and smaller air-passages, and also of the middle-ear clefts on both sides. The streptococcus mucosus was found in the pus in the ears and also in the cerebro-spinal fluid.

2. There is some evidence for believing that there was a tendency to severe disease of the ear in the patient's family.

3. It is interesting to speculate as to the outcome of the case if paracentesis had been performed early on the morning of the 17th March, when the illness began. Even then it would probably have been too late to avoid a fatal result, as signs of labyrinthitis and meningitis developed so rapidly.

4. The choreic movements of the upper extremity are interesting. On admission to the Royal Infirmary the choreic movements of the hands were still present. Similar movements, combined with cerebellar rigidity, in a case of tubercular meningitis have been recorded by Hughlings Jackson (Brit. Med. Journ., 1875, p. 636).

5. Unfortunately there is no note as to the presence or absence of cochlear symptoms in this case. The vestibular symptoms, though acute at the onset, rapidly diminished in severity, and the vomiting had almost passed off at the time of admission to the
Infirmary. It was noted on admission that the patient lay on his right side and that the eyes were turned towards the left. In this position the nystagmus would be least. At this time the patient was almost comatose, and the position of the eyes corresponded to the direction of the slow movement of the vestibular nystagmus due to purulent disease of the left labyrinth.

6. From a review of the literature (1903-1913), it appears that cases of labyrinthitis and meningitis occasionally occur in acute suppurative otitis media before rupture of the tympanic membrane. The present case, however, appears to be the first in which these conditions have been proved to be present by microscopic examination of the ear. Professor G. Alexander of Vienna has privately informed the writer that he has a similar case, as yet unpublished.

7. The route of infection from the tympanic cavity to the labyrinth appears to admit of no doubt, from the examination of the round and oval windows of the left ear. From the labyrinth the infection appears to have spread along the perilymphatic aqueduct to the subarachnoid space, giving rise to meningitis. The infection may also have spread along the branches of the cochlear nerve to the subarachnoid space of the internal meatus, as the left modiolus was infiltrated with pus.

8. In some ways the condition of the right ear is even more interesting than that of the left. There is still considerable difference of opinion as to the pathological conditions present in the first stages of labyrinthitis. Many suppose that at first there is a serous exudation into the perilymphatic space, while others believe that haemorrhage occurs. In the right ear of the present case there was a little curdled lymph to be seen in the apical coils of the cochlea, but the most marked changes were the haemorrhages which were seen in the perilymphatic space internal to the foot-plate of the stapes and, to a less extent, just above the secondary tympanic membrane. On this side the annular ligament and the membrane of the round window were not infiltrated with pus, and it would therefore appear that the haemorrhages were of toxic origin. The condition of the right ear (numerous haemorrhages) may possibly account for those cases of marked deafness which sometimes follow severe attacks of acute suppurative otitis media. It must not be forgotten, however, that pus was present in the scala tympani of the basal coil in the cochlear end of the perilymphatic aqueduct. This had undoubtedly found its way up the aqueduct from the subarachnoid space. The writer has found haemorrhages, similar to those in the present case, in the mucous...
membrane of the sphenoidal sinus in a case of acute pneumococcal infection.

9. Cases are on record in which labyrinth suppuration appears to have been due to retrograde infection from the subarachnoid space. This not infrequently occurs in epidemic cerebro-spinal meningitis. The present case cannot be regarded as one in which the labyrinth has been infected by this route, at least on the left side. On this side the otitis media is much more advanced than the labyrinthitis, and the state of the windows shows that the pus is passing into, and not out of, the labyrinth.

10. The presence of pus in the joint between the incus and malleus on the left side is probably not an artefact; both middle ears were opened with the chisel and yet only on the left side does the inco-malleal joint contain pus.

11. The early stages of perforation of the drum-head are well illustrated in the left ear of the present case. The whole tympanic membrane is thickened, engorged, and infiltrated. The fibrous layer is ruptured and a small abscess has formed just underneath the superficial epithelium, which is desquamating. Had the patient lived for a few hours longer, discharge from the ear would probably have occurred.

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THE ANGLO-INDIAN SURGEONS.

By FIELDING H. GARRISON, M.D.,
Medical Reserve Corps, U. S. Army.

WILHELM OSTWALD, a pioneer and trainer of pioneers in his own field, has divided men of science into two classes: the classicists (Klassiker)—deliberate, careful workers like Newton, Helmholtz, Harvey, and Darwin—men who, dealing with a limited number of ideas in their work, seek formal perfection and attain it, leaving no school of followers behind them, but only the effect of the work itself; and the romanticists (Romantiker)—men fertile in ideas, like Lavoisier and Liebig, Faraday, Maxwell, and Lord Kelvin—quick thinkers, rapid workers, bold explorers of unknown fields, leaving many followers and many loose ends of unfinished work which others complete. The distinction is purely arbitrary, and, at bottom, only temperamental. The classicists are the upbuilders of systematic science, the great mathematicians, the descriptive