The thesis for the degree of M. Ch.B. Edin.

Subject

The complications of Middle Ear Disease and their Treatment.

The subject of this thesis is the complications of Middle Ear Disease and their treatment illustrated by several cases which have come under my notice while at the Leeds General Infirmary. I am indebted to the Honorary Ophthalmic and Small Surgeons of the Infirmary.

I propose dealing with the subject under the following headings:— (1) The Anatomy of the Middle Ear and Mastoid Process. (2) The methods of injection of the Middle Ear. (3) The direction of spread of the infection from the Middle Ear with the resulting complications. (4) The Symptomatology of the various complications, and (5) A short discussion of their treatment without reference to operative details.
Anatomy.

The Middle Ear lies in the Temporal bone and is bounded internally by the Petrous bone, externally by the Tympanic and Squamous portions and lying over the Jugular Fossa. It is entirely surrounded by bone except where the Membrane Tympani is attached. The Rost of Tegmentum Tympani is formed by a translucent thin plate of bone forming part of the superior surface of the petrous bone. The bone and it separates the tympanum from the middle fossa of the skull; along it runs the petro-squamosal suture patent in infancy and transmitting small vessels from the inner plates to the tympanum.

The floor as mentioned above consists of the plate of bone forming the roof of the jugular fossa, it varies considerably in thickness and in rare cases is deficient.

The Inner Wall is formed by the anterior surface of the petrous bone; it presents the promontory containing the first turn of the cochlea and grooved by the tympanic plexus of nerves, above is the promontary containing the foot of the Stapedius muscle and the promin running covered with membrane in the recent state.

The Posterior Wall presents above the aorta, immediately below is a hollow are containing the Stapedius muscle. The roof and floor converge towards the Anterior Extremity which is low and is occupied by
two canals, the upper containing the Tensor Tympani muscle, the lower is the Eustachian tube (sore part) 3/4 long, this is continued for another inch in the cartilagineous portion of the tube which opens into the Naso-pharynx.

The Outer Wall is formed above by the squamous portion of the Temporal bone and below by the Membrane Tympani.

The Middle Ear may be divided into three parts:

1. The Attic i.e. that part above the level of the membrane tympani and containing the head of the Fallopio and the body of the Mucus and leading posteriorly into the Antrum.

2. The Tympanum proper in the same level as the tympani membrane and (3) The Hypo-tympani recess a part below the level of the tympanic membrane.

The Fallopian canal begins at the anterior angle of the superior fossa of the interval auditory meatus and turns forwards and upwards above the recticular portion of the interval ear for 1/5 to 3/5 mm, and is then dilated for the geniculate ganglion, it then turns backwards and runs in a horizontal ridge on the inner wall of the tympanum lying in the angle between it and the tegmen tympani immediately above the frame or wall and extending as far back as the additus where it comes into contact with the inferior aspect of the
projection caused by the external semicircular canal; here it turns vertically downwards in the angle between the internal and petrosal walls to end at the stylo-mastoid foramen. Sometimes the bony wall is deficient the nerve then only being covered by mucous membrane in the recent state.

The Mastoid Antmuum lies in the mastoid portion of the temporal bone. Its roof is formed by the tegmen tympani, its floor by the mastoid portion of the petrosal bone, its outer wall by the squamous portion of the temporal bone below the temporal ridge, anteriorly it is separated from the external auditory meatus by a bridge of bone forming the posterior wall of the auditory canal at the most point of which is the aartius, posteriorly is the lateral sinus separated from the antmuum by a layer of mastoid cells between the semicircular canals and the lateral sinus, the antmuum is separated from the dura mater in the petrosa fossa of the skull by a thin layer of bone only. The external semicircular canal projects from its inner wall.

It is well developed at birth and reaches its maximum at the third year after which it diminishes.
somewhat up to adult life. A canal, the 
Petrie-mastoid canal, occasionally leads through the 
Petrie bone to open into the remains of the sphenoid 
foramen.

Measurements of the Adult Pygmyranum:

Length 13 m. m.
Height 15 m. m.
Breadth 2-11 m. m.

Measurements of the Adult Antrum:

Length 12 m. m.
Depth 9 m. m.
Breadth 4.5 m. m.

Outer Wall 12.18 mm in thickness in adult
          1.8 mm in thickness at birth.

Mastoid Process is distinct about the first year and 
becomes pneumatic about puberty, but Professor Young and 
M. Millenium have shown that this occurs earlier than is 
usually thought now have shown them in a nine 
months foetus and one year old child.

The cells are arranged into two chief groups:

1. A vertical one extending downwards to the tip of the 
mastoid process.

2. A horizontal one posterior to the ant. and lying 
between it and the lateral sinuses. In old people
these cells may extend forwards into the roof of the zygoma and backwards into the jugular processes of the occipital bone.

Three types of mastoid process are described:
1. The _Oenomeutis_ in which the cells are large and few in number.
2. The _Diploa_ in which there are numerous small cells.
3. The _Compact_ in which the bone is extremely dense and it is probably due to osteosclerosis following chronic inflammation of the mastoid process. It is more often met with in old people.

The ossicles are three in number:

The _Balleum_ consisting of a head, which lies in the attic and articulates with the body of the incus, a neck and three processes; the handle a long process is directed downwards and backwards and is attached to the membrane tympani, the processes gracile runs downwards and forwards, the short process runs outwards.

The _Incus_ consisting of a body which lies in the attic and articulates with the head of the _Balleum_, a short process which runs backwards and is attached to the posterior wall of the tympanum by a ligament and a long process which runs downwards and inwards parallel...
with the long process of the Malleus and articulating at its tip with the Stapes.

The Stapes consisting of a head, disc-like resembling the head of the Radius, a short neck, two curves and a base which is fixed in the fenmen ovale by means of a membrane.

The mucous membrane of the tympanum lines the bony walls, ossicles, ligaments and membrana tympani and is thrown into some special folds by means of the ligaments etc. These folds subdivide the middle ear into compartments e.g. an anterior and posterior middle ear recess and a superior recess. In these recesses disease of the middle ear may be entirely localised.

The arterial supply comes from the tympanic branch of the internal maxillary which enters through the glossian foramen, the stylomastoid branch of the posterior auricular artery which enters through the stylomastoid foramen and the petrosal branch of the middle meningeal artery.

The veins are in three chief groups: (1) those opening into the lateral sinus directly or indirectly through the superior and inferior petrosal sinuses. (2) those running
though the petio-squamos sutures to the dorsal mater and to those running to reins outside the shell oo into the tempa maxillary rein or by means of the mastoid emissary rein into the occipital rein.
Methods of Infection of the Middle Ear and Antrum.

There are three routes of infection of the middle ear and mastoid antrum:

1. Through the Eustachian tube, this being by far the most common method of infection. The Eustachian tube is a canal about 1½ in. long running from the antrum to the pharynx. Its mucous membrane is continuous with that lining the tympanum and the pharynx; the orifice, which is oval, opens in the side of the nasopharynx on a level with the inferior meatus of the nose and 3½ in. behind the posterior end of the inferior turbinate bone. Normally, the bony part of the tube and a small part of the membranous part which is attached to the bony part are open permanently, elsewhere the wall alone in contact except when separated by the action of the tensor palatini in swallowing, etc. Infection of the middle ear is brought about by direct spread if infection along the mucous membrane or by the injection of secretions along the Eustachian tube and it occurs under the following circumstances:

   In acute nasal and postnasal catarrh, especially when adenoids are present, in some cases following the removal of adenoids. This is a frequent cause of
infects both in children and adults.

(6) A complication of the specific fevers especially those presenting throat symptoms as scarlet fever, diphtheria, measles, Typhoid fever, and influenza where it is particularly liable to lead to Bassa mastoid disease and intracranial complications as extra-dural abscess and meningitis.

(6) Following the entrance of fluid into the Eustachian tube from bathing or touching of the nose.

(6) From direct injection of the Eustachian tube arising to it in operating in the post nasal space or from using an infected Eustachian catheter or bongie.

2. Through the external auditory meatus following perforation of the tympanic membrane. This may occur in fractures of the base of the skull passing through the middle fossa and rupturing the tympanic membrane.

It may also be caused by the passage of sharp instruments as hairpins or pins along the external auditory meatus or from the passage of foreign bodies as beads or pessaries into the ear, misguised friends in their efforts to remove them often cause rupture of the tympanic membrane and injection of the middle ear. Bassett is an example of what a foreign body in the ear may lead to. A child aged 4 has a lead put into its ear by another child, attempts are made by
the father to remove the lead which is driven into the middle ear & broken. Three days later, the child is brought into hospital and the lead removed, three weeks later the child died from septic meningitis.

3. Blood infection of the middle ear or antrum is very rare but occurs in some cases of pneumonia and meningitis and then is only of secondary importance to the causative lesion.

The commonest organisms found in cases of infection of the middle ear and antrum, before secondary infection has occurred, is the pneumococcus; next in order of frequency is the streptococcus. Other less common organisms are the Typhoid bacillus, the Diphtheria Bacillus, the Tubercle Bacillus and the Influenza Bacillus. After perforation of the membrane a secondary infection is often added and then Staphlococci and other organisms are frequently found as well.
The Direction of Spread of the Infection and the Resulting Complications

The antrum may be very rarely affected alone in some cases of Pyogenic as the result of Specific Fever, in addition it may be affected primarily in Tubercle infection, a Hodgkin's otherwise it is invariably associated with middle ear suppuration.

According to Politzer in every case of acute middle ear suppuration the muco membrane lining the antrum is affected as well; where the drainage is sufficient this may subside but where it is insufficient the condition may persist as an acute or chronic inflammation of the mastoid process, this is likely to occur where the anatomical conditions favor insufficient drainage as is the case where the antrum is small and the antrum large or also where large mastoid cells are present. The disease may thus remain localized in the antrum a spread in various directions giving rise to different complications.

The method of spread of the infection may be:
1. By direct continuity of tissue, the infection spreading from the muco membrane to the bone and from the bone to adjacent structures as dura mater, meninges and brain etc.
2. Though the otitis without infection of bone, this occurs in children before the sutures have closed and may take place upwards through the petro-squamous suture or downwards through the squamo-mastoid suture.

3. Though the veins giving rise usually to sinuses themselves.

The directions of spread with the resulting complications are as follows:-

1. Upwards through the tegmen tympani or petro-squamous suture giving rise to:-(a) Meningitis

If the inflammatory process is slow merely a subacute meningitis extends results the Dura Mater being covered with a few granulations and no pus being present, in other cases pus forms in a localized manner the resulting lesion being an extradural abscess. If the infection progresses the inflammatory process spreads to the inner aspect of the Dura Mater resulting in adhesions forming between the membranes and thus the subdural space is protected from further invasion for the time being; if allowed to progress the dura mater and membranes may be eroded the abscess being then bounded by brain tissue which may also undergo ulceration,
the infection may spread laterally softening and breaking down the adhesions and giving rise to a diffuse basal lepto-meningitis. In some result the infection may be brought about by the abscess bursting into the sub-dural space. In other cases the infection spreads through the dura mater without any marked change in that membrane resulting in a diffuse lepto-meningitis limited at first to the base, in some cases the infection spreads chiefly to the base of the brain or the opposite side of the lesion in the ear and may be almost entirely limited to that part of the brain; later the infection may spread upwards to the vertex from the base.

(b) Temporo-Hemispherical abscess. This is usually situated near the surface of the brain, the infection usually being by direct continuity of tissue; where the abscess is situated deeper in the brain the infection may be spread by bloodvessels or lymphatics. Baréq is an example of a temporo-sphenoidal abscess following an middle ear suppuration; in this case the primary infection was improving and practically had recovered, the meninges having healed, and the ventricle being practically normal, when the abscess developed. Instead of an abscess a more or less diffuse encephalitis may result.
2. Downwards through the floor of the tympanum, which is sometimes deficient, leading to thrombosis of the bulb of the jugular vein, or through the floor of the antrum into the mastoid cells. This latter seems to be a somewhat common occurrence and may lead to an abscess of the mastoid bone or a sequestrum may form as in case 1. The patient may be equally ill as in case 3, or there may seem to be very little the matter with the patient though the local disease may be somewhat extensive as in cases 1, 2, 4, 5. In most of the examples of this condition I have given and in several others that I have seen what was most striking was the almost entire absence of disease in the middle ear and antrum, the disease being almost entirely localized to the mastoid cells and mastoid process.

In some of these cases the infection spreads further down and perforates the bone usually at the inner surface near the tip of the mastoid process leading to an infection of the cellular tissue in the neck deep to the sternomastoid muscle; a diffuse cellulitis a localized abscess may result. In case this had occurred and a small collection of pus had formed in the neck immediately below the tip of the mastoid process and deep to the sternomastoid muscle.
3. Outwards, either through the bone in adults or through the pericranial sinus without affecting the bone in young children, giving rise to a mastoid abscess behind the auricle and under the sternocleidomastoid. This sometimes occurs without perforation of the membranous usually, however, in children where the bone is thin and the sinus not closed so that little resistance is offered to the spread of the disease; in adults the bone is so thick that the membrane usually perforates before the bone is perforated.

4. Inwards. This is not such a common direction of spread as the others. It may give rise to:
(a) Pneumatisation of the outer wall of the external semicircular canal or of the outer wall of the promontory and this may lead to a labyrinthine suffocation with destruction of the internal ear and semicircular canals in some cases the internal ear may cave away as a sequela.
(b) Meningitis here being as in the spread upwards either a pachymeningitis or an extradural abscess or diffuse lepto-meningitis. The spread in these cases is through the internal auditory meatus. Case 7 is an example of diffuse basal lepto-meningitis resulting from infection spreading inwards, at the posterior examination in this case
fiz was seen euding from the irnral lineal solidus. (c) ocneleuual abces. Tis usualy onces in the ureeum inferio part of the lateral fold of the cerebllum. (d) fision of the bone over the facial ree leading to pressure on its nerves causing paralysis.

5. Backward through the mastoid cells giving rise to: (a) Meningitis. Thia as before mentioned may be a localized teachyoiditis externa or a localized extra dural abces; these may occur over the lateral sinus and the posterior semicircular canal, the lining only this plate of bone between the aurium and the dural matrix in this situation. Thia may also be a diffuse lepto meningeitis. (b) Thrombosis of the lateral sinuses, the infection may spread either by dried contynuity of tissue through the bone and dural matrix over the sinus, or by means of the vessels leading from the middle ear and aurium into the lateral sinuses.

The resulting clot may only partially occlude the sinus walls called friated clot or it may completely occlude the sinuses. The clot may mst be an infective clot a if infective it may only break down in the centre and being bound on both sides by non-infective clot no systemic infection will occur. Usually the breaking
down of the clot continues and infective particles are swept away into the blood stream giving rise to pyogenic symptoms and septicaemia.

(c) Sphenoidal abscess in the lateral lobe of the sphenoid. (d) Diffuse osteomyelitis of the occipital bone the disease being limited to the bone and not affecting the dura mater.

6. Forwards. Occasionally in an acute middle ear suppuration the pus may track down the wall of the eustachian tube into the pharynx simulating a retro-pharyngeal abscess.
Symptomatology.

1. Disease of the Mastoid Process. This may be either
   a) Acute or b) Chronic.

(a) Acute inflammatory of the mastoid process may be
    acute from the first or an acute exacerbation of a
    chronic condition, the latter being the more unfavourable
    of the two.

When acute from the first there is usually a
history of an acute middle ear suppuration lasting
three or four weeks with perhaps some slight rise
of temperature and general feeling of malaise though
these symptoms may be absent. There is usually
some earache which may be slight. The symptoms
of infection of the mastoid process may occur with or
without cessation of the otosclero. In cases where the otosclero
persists it may become more marked, there is often tenderness
over the mastoid process with projection of the ear
and pain and tenderness over the mastoid process,
with this there may be a rise of temperature; the
swelling over the mastoid process increases and
finally an abscess may form. In cases where the
otosclero ceases the infection is due to the retention
of pus; the symptoms are similar the cessation of the
discharge being followed by the reformation
behind the ear with pain and tenderness over the mastoid process and rise of temperature, though the pain and tenderness may be more marked and the rise of temperature greater than when there is a purpurea otitis.

The constitutional disturbances depend upon the severity of the process, when it is very acute and following rapidly on the middle ear injection the temperature is high, the pain severe with perhaps vomiting. When the involvement is slower the temperature may be normal and the pain slight, these only being some slight tenderness or pressure over the base of the mastoid; the chief thing which attracts the patient's attention is the swelling behind the ear. In cases 1 and 2 which illustrate this condition the temperature was normal in both. In case 1 the history was of eight weeks duration in case 2 of six weeks, in both the pain was slight and the constitutional disturbances nil. In case 1 there was injection of the mastoid process without a perforation of the membrane, this is common in children but may occur in adults in influenza; in this patient it seems to have followed a much prominent rhinitis. In these cases the meatus is often swollen, presenting a view of the deeper parts and in this case it was difficult to see the membrane owing to the swelling of the meatus.
Where an acute attack supervenes upon a chronic inflammation, the symptoms are usually more severe owing to the greater destruction of bone and to its septic condition and there is a greater risk of intracranial complications. There is a history of otoscopy lasting more years off and on, or persistent the whole time, the may also be a history of attacks of caracare following cessation of its dizziness and relieved when it begins again. One of these attacks persists and gives rise to the symptoms of an acute inflammation of the mastoid process, there is persistent caracare, rise of temperature with general malaise, there is swelling behind the ear with pain and tenderness over the mastoid which is more marked than in caracare from the first and there may be persistent headache. The bone disease is usually more marked than is suspected. Cases 3, 4 and 5 illustrate an acute attack supervening upon a chronic otoscopy. In case 3 there is a history of a previous attack of caracare which apparently ceased after removal of tumors and adenoids. The history of the acute attack was of one week duration with marked headache, the patient looked very ill and suggested some intracranial complication. At operation a diffuse osteitis of the mastoid process was found the bone having a very offensive odor but no pus was present in it, nearly the whole of the mastoid processes removed.
and next days the temperature was normal and the child appeared much brighter.

In cases Nos. 3 there is no history of a previous earache.
In case 4 the otitis had lasted off and on for 11 years and the acute attack a fortnight; there was constant headache, swelling behind and in front of the ear and bulging down of the roof of the external auditory meatus, marked tenderness over the mastoid and some elevation of temperature. In case 5 there is a history of a attack seven years previously followed by deafness in the right ear but no history of otitis until three weeks before admission to hospital but the condition of the membrane, the discharge and the pustula found at operation are more suggestive of a chronic infection which had probably passed unnoticed by the patient. In this case there was an abscess over the mastoid process, there had been earache for a month but no headache and the temperature was normal.

In acute inflammation of the mastoid you may get perforation of the mastoid process near the tip resulting in cellulitis of the neck deep to the sternomastoid muscle. It gives rise to a brawny swelling in the neck with indefinite infiltration of the subcutaneous tissues, fluctuation is not present at first but later indefinite fluctuation is
and next days the temperature was normal and
the child's appearance much brighter.

In cases nos. 5 there is no history of a previous septic.
In case 6 the stenosis had lasted 16 and on for 14
years and the acute attack a fortnight, there was
constant headache, swelling behind and in front of
the ear and bulging down of the roof of the external
auditory cavity, marked tenderness over the mastoid and
some elevation of temperature. In case 5 there is a history
of septic fever 23 years previously followed by deafness in
the right ear but no history of stenosis till three weeks
before admission to hospital. But the condition of the
membrane, the discharge and the auricular glands at
operation are more suggestive of a chronic condition which
had probably passed unnoticed by the patient. In this
case there was an abscess over the mastoid process, there
had been constipation for a month but no headache
and the temperature was normal.

In acute inflammation of the mastoid you may
got perforation of the mastoid process near the tip
resulting in cellulitis of the neck deep to the
Steng/Mastoid muscle. It gives rise to a brawny
swelling in the neck with indefinite infiltration of
the subcutaneous tissues, fluctuation is not
present at first but later indefinite fluctuation in
got. If it approaches the surface the skin becomes red, edematous, and fluctuation is more easily obtained, the head is usually held over to the affected side to relieve the tension. In case this has occurred to a slight extent, the chronic inflammation of the mastoid process. In this there is a history of persistent stubborn lasting in weeks with perhaps no symptoms till an acute exacerbation occurs; or there may be a history of repeated attacks of earache, giddiness, or feeling of faintness in the head with perhaps pyrexia and sometimes these resulting from some temporary blocking of the discharge. A history of such attacks is an indication for urgent operation owing to the risk of intracranial complications. Inspection of the tympanic cavity in these cases shows signs of chronic disease as granulation and polypi which were repeatedly after removal and are an indication of bone disease or infected material may be present.

Part 6 is an example of a chronic mastoid inflammation there was staphyloc for five years with occasional attacks of pain in the ear.

2. Facial Paralysis. It may occur in any case of middle ear suppuration and may be due to the swollen
numens membrane or the evagination pressing on the nerve especially in cases where part of the bony wall is deficient. It may be the result of a remitio from extension inwards of the disease. When there is no natural deficiency of the wall it is due to caries of the bony canal. It also occurs in Tubercular disease of the middle ear the nerve being then often destroyed, also it is common in Labyrinthine Tumefaction. It may result from pressure of a cerebellar abscess on the nerve inside the skull; it may be injured in being a radical mastoid operation the paralysis being noticed immediately after the operation or it may occur several days after operation being due to a pericarviceum, efferent of blood a pressure of the packing and in such cases it usually recedes. When it occurs with symptoms of Intracranial abscess it is suggestive of a cerebellar abscess, and when it occurs with symptoms of rapidly increasing internal ear deepness it is suggestive of labyrinthine Tumefaction. It may also occur from other causes not directly connected with middle ear disease.

The symptoms are obvious, the palsy may be slight or complete. If the lesion is below zero the chief symptome is given off. This is palsy of the muscles of the face on the same side only; if
between the origin of the chorda tympani and the nerve to the stapedius in addition to the paralysis, there is loss of taste on the anterior two-thirds of the tongue on the same side as the lesion; if between the origin of the nerve to the stapedius and the geniculate ganglion there may be an addition tinnitus, slight deafness and increased resonance. In his notes said to be due to paralysis of the stapedius muscle; this cannot be of much value in cases of middle ear disease. When the lesion is above the geniculate ganglion this is paralysis and in addition the eighth nerve is usually affected as well causing deafness of an interval ear type, taste is not affected.

3. Pachymeningitis Externa and Extra Dural Abscess. This is the commonest intracranial complication. It may occur above the tegmen tympani or in the posterior fossa round the lateral sinus. Pachymeningitis externa as a rule gives rise to no symptoms being discovered at operation or following up the case disease, though it may give rise to headache. In many cases of extradural abscess there may be no symptoms beyond those of the mastoid disease present and it is discovered at operation. In other cases the symptoms as was watched there may be a slight pyrexia, a normal temperature, the most characteristic
symptom is intense persistent headache which may be localized to the affected side and with this there is tenderness behind the mastoid process. If large it may give rise to symptoms of intracranial pressure e.g. vomiting and perhaps often neurotic but these are uncommon, there may be some sensory paralysis of muscles of the face if in the left side, if in the posterior fossa it may give rise to some stiffness and retraction of the muscles of the neck.

**Diffuse Letho Meningitis** is not a very common complication and it is usually secondary to some other intracranial complication. Cases 7 and 9 are examples of this, in case 7 it resulted from the impact of a lead in the middle ear and was present without any other complication being present the infection spreading through the internal auditory meatus. In case 9 it occurred two years and a half after a radical mastoid had been done; at first admission to hospital the patient had had several operations done including reflection of the brain for a suppurated cerebral abscess which was not found, he was left with a hernia cerebi behind the ear and a mass projecting through the external auditory meatus which was proved at operation to be in direct continuity with
some small cysts in the region of the hemis cerebri
and through them the infection must have taken
place leading to the patient's death. In case 9 the
meningitis was secondary to a temporal ophthalma-
algia being slight and a terminal symptom.
The symptoms of meningitis may be somewhat
vague and insidious in onset, this being
especially so in case 7. Symptoms suggestive of the
onset of meningitis are extreme restlessness, mental
irritability and high temperature which may be irregular;
rigor being absent; delirium, vomiting, convulsions
and head retraction with rigidity of the muscles of
the neck and spreading sometimes to the muscles of
the trunk may be present. Headache is the most
common symptom and it is persistent, gradually
getting worse and becoming almost unbearable, while
the patient is conscious it is usually the chief complaint.
and when semi-conscious the patient may groan and
put the hard up to the head. If the meningitis
spreads to the cerebellum there may be rigidity and
strain or twitching of the extremities which may last
a considerable time; when limited to the base
head retraction is most marked. Constipation is
usually present, in the later stages the urine and
faeces may be passed involuntarily. Photophobia
hypersensitivity of the skin, the cerebral tract and Kernig's sign may also be present. When occurring at the base there may be signs of pressure on the nerves; strabismus, a ptosis may occur, there may be paralysis of the seventh nerve or an anesthesia due to pressure on the fifth; the pupils are at first contracted later dilated and perhaps unequal, the deep reflexes are at first often increased later they may be abolished. Often remits is not uncommon in the basal form but is rare in cortical meningitis. As the condition progresses the headache gets worse and the patient gives utterance to a characteristic scream, he lies curled up in bed and resists any movement of the body, delirium becomes marked the excreta are passed in bed and finally death comes. The pulse may be increased in frequency at first but later becomes slow in relation to the temperature and later irregular, in the final stages it becomes very rapid. Rapid sweating may occur and it is doubtless due to disturbance of the cortical centers for metabolism. Leukocytosis is very valuable from a diagnostic point of view, the fluid may be turbid or present a large number of polymorphonuclear leucocytes are present and organisms can sometimes be found on microscopic examination or by culture.
5. Abscess of the Brain and Encephalitis. These two conditions present certain symptoms in common with differences in some instances sufficient to distinguish between them.

Abscess of the brain in middle ear disease may occur either in the tempo-occipital lobe or in the lateral lobe of the cerebellum, and usually near the surface though it may be somewhat deeply placed. In some cases bone disease can be traced right up to the dura mater covering the abcess and in rare cases a fistulous tract leading from the brain abcess to the diseased bone may be present. It is uncommon between 10 and 30 and is usually single though a cerebellar and tempo-occipital abcess may be present together or multiple abcess in the tempo-occipital lobe or cerebellum may occur; these are not common however. Statistics regarding the relative frequency of cerebral and cerebellar abcesses vary. Hunter Tod from 100 cases in the London Hospital found that in children under 10 years 87% were cerebral, 13% cerebellar, in adults 65% were cerebral and 35% cerebellar, a cerebral and cerebellar abcess being both present in 5% of the cases. E. T. D. Archard and Mr Balman quote Köhner's statistics showing that in 100 cases 91% referred to middle ear disease 62% were cerebellar, 32% cerebral, 6% being in both; of 33 cases collected
from St. Thomas's and Great Ormond Street Hospitals.

2. It was cerebellar in 11 cerebral and in 2 there was an absence in both cerebral and cerebellum.

The symptoms may be divided into four stages:

(a) The initial stage. (b) The latent stage. (c) The stage of manifested symptoms. (d) The terminal stage.

(a) In the initial stage the symptoms are vague and indefinite, there may be some headache and slight paresis with perhaps rigor and occasional vomiting. These symptoms may subside and the condition become latent as they may progress and give rise to manifested symptoms or they may rapidly pass to the terminal stage.

(b) In the latent stage, which lasts a varying time from a few days up to years in some cases, there may be no symptoms whatever the condition being lighted up into activity by a blow on the head or some minor operation. In other cases the latent stage may show some general symptoms of ill-health perhaps headache and some slight mental change as a change in the thinker a disinclination for work.

(c) The manifested symptoms are of three kinds:

1. General symptoms. 2. Symptoms of intracranial pressure and 3. Localizing symptoms. The first two are similar in both cerebral and cerebellar abscesses.
the third varies according to the site of the abscess.

The general symptoms are those of septicaemia i.e. general malaise, constipation and loss of appetite with the peculiar yellowish earthy breath due to chronic septicaemia, in addition there may be some emaciation.

The symptoms of intracranial pressure are headache, vomiting, often rectorrhinia, subnormal temperature, slow fall pulse and a change in the mental condition. The headache may be general or localised to the affected side and later becomes very intense. The vomiting may be occasional or lasting a day or two, it is usually rancid and has no relation to the taking of food. Often vomit is present in many cases usually on both sides though it may commence on one side of the lesion first and may be most marked on that side; it also occurs in meningitis, sinus thrombosis and may be present in mastoid inflammation without complications. The temperature is usually subnormal in this stage being about 97°F, whereas meningitis or some other complication is present it may be raised above the normal. The pulse is slower than normal and may be about 50 and it is of a bounding character. The mental change is one of slow though perfect cerebration, the patient is disinclined to answer
questions and also in giving the answer and understanding the question; later on increasing dullness occurs from increased intracranial pressure brought about by increase in size of the abscess.

3. The localizing symptoms depend upon the portion of the abscess whether temporo-sphenoidal or cerebellar.

In temporo-sphenoidal abscess, there may be evidence of paralysis of the opposite side of the body which may be partial or very slightly marked and hence unnoticed. If on the left side this may be aphasia or deafness of the opposite side from pressure on the auditory centre. These localizing symptoms are only present when the abscess is large and pressing on adjacent centres, as a rule they are rarely all absent.

In cerebellar abscess, the symptoms may closely resemble those of removal of the lateral lobe of the cerebellum, these are:—Paralysis of the upper extremity on the same side as the lesion; exaggerated knee jerk on the same side; conjugate deviation of the eyes to the opposite side; lateral nystagmus most marked on turning the eyes to the same side; a tendency to face to the side of the lesion while walking and to lie in bed on the side opposite to the lesion, the side of the face corresponding to the lesion suffers most; a tendency to stagger and fall to the opposite side.
In addition to these are vertigo, the vomiting is more marked than in cerebral abscess, the mental symptoms are less marked while those due to pressure on the respirating centre and the slowness of the pulse are more marked and in addition head retroflexion may be present. Facial paralysis may be present and also occurring in a case present symptoms of intracranial abscess it is in favour of that abscess being cerebellar.

In many cases the symptoms of an intracranial abscess are not so definite as to permit of accurate localization and in such cases unless the abscess disease leads to one of the other sites both situations must be excluded.

**d. The terminal symptoms are those.** Gradually increasing coma, rapid pulse and respiration in some cases glenane stigmas in character, death may occur suddenly for cessation of the respiration. In other cases the abscess may rupture into the lateral ventricle causing high temperature and delirium, or it may rupture into the subdural space giving rise to diffuse lepto-meningitis. In a few cases a spurious abscess has resulted from the abscess draining into the ventricle.

In case of the symptoms were somewhat indefinite, the condition began over acute supplicative ostitis media
for which paracentesis was done and antiseptic treatment carried out. For 40 days the temperature was irregular, going up at night and falling in the morning, the morning temperature reaching the normal level in a week, but the evening temperature continued to rise to 40.9 in 1888. The membrane healed, and the child seemed to be doing well except for the evening rise of temperature which continued for a further period of eleven days during the latter part of which he once a twice screamed out at night and was drowsy during the day. This seems to correspond to the initial stage. Then followed a latent period of five days, beginning with a single attack of vomiting during the night; during this period the child seemed well and played with his toys during the day and slept well at night, the temperature being normal and was up and getting about. At the end of this period the child was evidently not feeling well, went to bed in the afternoon, vomited twice the same evening and later during the night, sneezed several times and complained of pain in his head, the temperature went up and was unsteady. The next day a few days previously. This seems to correspond to the onset of the terminal stage due to meningitis, the stage of manifest symptoms not being reached. At operation the abscess was missed though the brain was inflated and two
day later the child died. At operation the
condition of the Anton was almost normal, there were
some slight granulations present but no bone disease,
or opening the dura mater and the brain bulged
into the wound and no cerebral fluid escaped.
Puncture of the brain revealed nothing, the abscess being
just mixed as was shown at the post mortem examination.
A lumbar puncture on the day following the operation
gave evidence of meningitis.

Encephalitis may be more a less diffuse and associated
with meningitis, the symptoms being those of meningitis,
but coma is early and well marked, so it may be
more localized, the symptoms being a combination of
that of cerebral congestion with that of septic intoxication.
It may begin with a rigor, which may be repeated,
there is intense headache, its intensity being only
exelled by that of meningitis, the headache may be
diffuse all over the head but was marked on the side of the
lesion, there is mental dullness and slow circulation.
The temperature is raised to 101°F or 101.4° and the pulse is
quickened but not to the extent that the general
condition of the patient would lead one to expect. If the
condition spreads, it leads to a further rise of temperature
the pulse becomes progressively weaker and more rapid.
and unless an operation is successful the patient becomes unconscious and carotid and finally death occurs.

6. Lateral Sinus Thrombosis. The symptoms depend upon whether the septic thrombus is completely off from the general circulation by an aseptic thrombus on either side of it, or not; in the former case in addition to the signs and symptoms of the local mastoid lesion there are those of a localized abscess under tension especially those of a subdural abscess with perhaps some tenderness along the line of the carotid should added; in the latter case you have symptoms of hypogemia.

When the clot is completely shut off from the circulation there may be an absence of special symptoms the condition being discovered at operation or there may be severe headache, tenderness behind the mastoid process, some rise of temperature and as mentioned above if the clot has extended along the jugular vein there will be tenderness in the neck along the sternomastoid muscle.

Where pieces of septic thrombus are being swept into the circulation the characteristic symptoms develop.

The onset is usually sudden and following a
Clandestine period of otosclerosis of more than a year's duration as a rule; the condition is ushered in by a rigour, headache, vomiting, constipation and general malaise; there is usually pain in the affected ear. The temperature rises considerably and may reach 103° F following the rigour and it remains high usually from 101°-102° but shows marked oscillations; the rigour may be repeated several times with a rise of temperature and followed by profuse sweating and the vomiting may be repeated daily. The pain in the head is chiefly in the affected side and this may be some natural delirium but little as mental dulness the patient's mind may remain unclouded till nearly the end; where however there is profound torpor and present the patient will be delirious and later become comatose. There is marked pain and tenderness behind the mastoid process and there may be some oedema over the mastoid process from the infection spreading along the mastoid emissary vein; there is often tenderness along the sternomastoid muscle and some thickening to be felt, due in most cases to the presence of enlarged lymphatic glands though it may be due to the thumbs having spread down into the jugular vein. The thumbs may extend
in several directions, thus it may extend along
the retro-orbital sinuses reaching the cavernous sinuses
when it gives rise to exophthalmos, chemoisis of the
conjunctivae, oedema of the eyelids and even to an
orbital cellulitis or panophthalmitis; it may
spread along the occipital sinuses to the deep veins
of the neck giving rise to an abscess situated
deeply in the back of the neck; it may spread
along the mastoid emissary vein causing oedema
and mastoid abscess; in rare cases it may
spread backwards to the temporal lobe of the
brain and even into the sphenoidal sinus or lateral sinus of the
opposite side. Often meningitis is present in
about 50% of all the cases.

In the late stages the symptoms are those of
pyaemia and may be of three types:-
(a) A Pulmonary type the symptoms being those
of a septic broncho-pneumonia or empyema.
(b) An Abdominal type, where the symptoms
resemble those of Typhoid Fever.
(c) A Meningeal type where meningitis supervenes and
masks the symptoms of sinus thrombosis.
In some cases pyogenic abscesses are obviously present
in the joints or subcutaneous tissues.

In case 10, an example of this condition, there was
A history of otosclerosis in childhood which had ceased; 10 years later there is a history of recurrent ear pain in the same ear which was removed and remixed later. Acute symptoms began three weeks before death with pain in the ear; ten days later her doctor removed a mass of cholesteatomatous material and profuse otosclerosis followed, a week after this the pain became much worse and headache was marked and a sight occurred the next day i.e. two days before admission to hospital. There was no vomiting. On admission to hospital there was profuse otosclerosis with perforation of the membrane, marked tenderness behind the mastoid process and along the sterno-mastoid muscle and some swelling over the upper part of the muscle. There was no optic neuritis and the temperature was 100°F. At operation very little disease was found in the mastoid process though there was firm under tension in the antrum; the sinus was exposed the dura mater over it being quite healthy and it seemed to contain fluid blood so it was not opened. During the night a sight occurred and a second the following morning so a further operation was done, the sinus that was not apparently healthy was opened and found to contain thrombus which was removed till healthy sinus was reached; the inferior vein in the neck was exposed and
a piece of healthy vein being exposed below and ligatured; the wound was then packed. The next day fluid was found in the right knee joint and in the tendon sheaths on the back of the right wrist; the patient died the following day with symptoms of septicemia no more rigor having occurred.

It was unfortunate in this case that the sinus was not explored at the first operation but the history of why we rigor, which the patient had very little stem on, might well have been accounted for by the retention of pus in the anterior dissection at operation. The tenderness behind the anterior process and along the neck was very suggestive but the complete entire absence of bone disease, the healthiness of the dura mater, and the fact that the sinus seemed apparently to contain fluid seemed to justify the non exploration of the sinus and led in this case to a fatal delay. Even at the second operation the sinus seemed perfectly healthy and containing fluid blood though when opened it was shown to contain thrombus, which proves that in some cases the appearance of the sinus may be absolutely deceptive and one has to rely entirely upon the symptoms for proof of thrombosis in the sinus.

At the post-mortem examination this was punctured
fluid in the right knee joint, there was no evidence of infection of any of the internal organs which showed signs of an acute septic infection only.

7. **Labyrinthine Suppuration.** Bacteria of the outer wall of the external semicircular canal is a not infrequent sequela of chronic middle ear suppuration and it is often accompanied by lateral nystagmus; caries of the promontory may also occur and from these two sites infection may spread and infect the whole or a part of the labyrinth the resulting infection being either acute or chronic.

In acute suppuration there is pyrexia, marked vertigo, yawning, deep seated pain in the ear, nystagmus and a rapidly increasing nerve deafness, with this there may be difficulty of coordination of the muscles on the affected side to the lesion chiefly affecting the upper extremity, the gait is staggering with a tendency to fall to the side of the lesion, the nystagmus is most marked on turning the eyes to the side opposite to the lesion.

The symptoms resemble somewhat those due to cerebellar abscess but are referred to the opposite side of the body to those in cerebellar abscess and the symptoms of increased intracranial pressure are absent.
In the chronic form the symptoms are not as well marked; the pain may be absent, the vertigo is not so characteristic and vomiting is not marked or may be absent; the other symptoms may be present however but the temperature is normal.

The rapid onset of severe deafness accompanied by nystagmus is suspicious of involvement of the internal ear; the additional presence of facial paralisis is also an important symptom.

8. Diffuse Osteomyelitis of the Occipital Bone: The symptoms of this resemble those of osteomyelitis elsewhere but they follow in a history of mastoid disease. The condition may be acute or chronic. If acute there are repeated signs and symptoms of pyrexia, marked pain in the head and tenderness over the affected bone, some oedema of the scalp and later perhaps a subcutaneous abscess may form; there is considerable rush of the infection spreading inwards to the meninges giving rise to an extradural abscess or diffuse lepto menigitis. In the later stages there is delirium, rapid pulse and respiration ending in coma and death from acute septicaemia.

In the more chronic variety, the temperature may be normal or very slightly raised, there is pain and
tenderness over the bone, the skin over it becomes oedematous and later fluctuation occurs. If the condition is explored and drained, no removal recovery may occur, but if not there is the risk that ultimately meningitis a cerebral abscess will occur and speedily result in death.
Treatment.

From the point of view of treatment the complications may be divided into: (1) cranial and extracranial and (2) intracranial.

1. This group comprises the following conditions:

   a) Disease of the mastoid process with or without a mastoid abscess.
   
   b) Facial Paralysis
   
   c) Labyrinth suppuration.

   a) Disease of the mastoid process requires the performance of either the simple mastoid operation known as Schwartze's operation or of the complete mastoid operation. In the simple operation, the antrum and mastoid process only are exposed by an incision behind the ear, in the complete operation, the bridge between the antrum and tympanic cavity is removed as well and with it the remains of the membrane and the ossicles, and the tympanum is unroofed out. At the close of the operation a flap is made out of the posterior wall of the external auditory meatus, cartilaginous part, and turned up and stitiched in position, the posterior wound is then closed unless especially contraindicated and the cavity packed from the front. The operative details and the question of
Skin-grafting later. I do not propose to discuss.

Speaking generally one may say that the simple mastoid operation is done only in acute inflammation of the mastoid process and in cases of mastoid abscess where there is no bone disease and granulations and polypi are absent. In all other cases the complete operation is done.

The following may be regarded as indications for the simple mastoid operation: 1. Abscess present after media with tenderness over the mastoid process and rise of temperature in which the tenderness and rise of temperature do not disappear three to four days after a paracentesis followed by careful treatment.

2. Cases with an obvious mastoid abscess. 3. Cases in which symptoms of meningitis or irritation follow a paracentesis, especially if of influenza origin in adults. 4. Cases in which there is evidence of involvement of the anterior mastoid cells or steam by bulging downwards of the upper posterior wall of the auditory canal. In some cases where otitis has persisted for a few months due to pus accumulating in the antrum, owing to the antrum being large and the level below the level of the aditus, in a few cases of chronic otitis due to end-range of the antrum without bone disease, this is uncommon as in most of these chronic cases there is
bone disease present.

Practically the above indications may be summed up as including all acute mastoid disease and a few cases of chronic disease in which the bone is not affected the disease being limited to the mucous membrane lining the anterio
and mastoid cells.

The following may be regarded as indications for the complete mastoid operation: in cases of mastoid disease chronic and presenting the following groups of symptoms, when an acute attack of inflammation of the mastoid process occurs in the course of a chronic otosclerosis; when during the course of a chronic otosclerosis there have been symptoms of retention of pus as shown by cough, hoarse etc., with cessation of the discharge and relieves when the discharge recurs; when otosclerosis persists for several years despite careful treatment and when granulations and tophi are constantly recurring showing the presence of bone disease; when there is a history of chronic otosclerosis and the patient is going away for medical aid, as a prophylactic measure; where rare obstruction to the outlet of discharge occurs in the external auditory meatus due to stenosis or exostosis; where this is formation of cholesteatomatous material as this almost invariably causes absorption of bone exposing the dura mater and leading to intracranial complications. I have seen a case of this followed by lateral sinus thrombosis
and death in which the cholesterol crystals material has not practically a complete mastoid operation on both sides.

1. **Facial Paralysis** which may be due to:
   - Carcin of the bone of the fallopian canal; pressure on the nerve, where the bone is deficient, by exudation; or swit the cause of a labyrinthine suppuration or development of a cerebellar abscess. It may also follow the mastoid operation.

2. **Labyrinthine Suppuration**
   - The presence of intracranial complications.

(b) Facial Paralysis. The treatment of this as indicated above consists in the performance of the radical mastoid operation. In the great majority of cases recovery is complete. In these cases following the mastoid operation when due to injury of the nerve, the prognosis is bad; but where occurring a few days later recovery is the rule.

Where after a six months interval there are no signs of recovery and the reaction of degeneration is present, one may then resort to nerve crossing or nerve anastomosis; nerve anastomosis is better than nerve crossing, as nerve crossing leads to total paralysis if the muscles supplied by the nerve which is crossed over is the injured nerve. The spiral accessory or hypoglossal
newer may be used; if the spinal accessory is used, movements of the face are apt to occur, as do associated with movements of the shoulder, at first and this may lead to awkward complication as the hypoglossal is lower, movements made by the tongue not being visible and its cortical centre is nearer to that of the facial than that hypoglossal. If the spinal accessory is tense, the cortical centre is quicker.

A nerve running over anastomosis are incision is made from the mastoid process along the anterior border of the sternum mastoid to the greater cornu of the hyoid bone, the facial nerve is found and divided as close to the styloid mastoid process as possible, the hypoglossal a spinal accessory are next found; if nerve crossing is to be done the peripheral end of the facial is united to the central end of the hypoglossal or spinal accessory nerve; if nerve anastomosis is done the peripheral end of the facial is united laterally to the hypoglossal a spinal accessory, a slit being made in the nerves a small flap turned up and united to the facial nerve.

If successful in three to six months the muscles at the angle of the mouth have recovered and later the muscles round the eye and the frontalis
receives the face being normal when at rest. It may be some years before emotional control is recovered, and in many cases recovery does not progress beyond this voluntary movement not being regained.

(e) Labyrinthine suppuration. The radical mastoid operation is first done and any fistula leading into the labyrinth looked for, usually it is found in the outer wall of the external semicircular canal over the promontory; the fistulous opening is enlarged and if no suppuration is found nothing further is done the patient being watched for several days to see if the symptoms subside; if they don't subside or if suppuration is present in the internal ear is explored, an opening being made through the promontory, and through the external semicircular canal opening the vestibule till a probe can be passed from one opening to the other, great care being taken to avoid injury to the facial nerve.

2. The intracranial complications include :-

   a. Pituitary abscess
   b. Meningitis
   c. Thrombosis of the lateral sinus
   d. Abscess of the brain and Encephalitis.
In all these complications the complete mastoid operation must be done, impossible before attaching the intramastoid complication, only in very urgent cases is the intramastoid condition treated alone without first doing a radical mastoid operation, as it is quite possible for a further complication to arise and prove fatal; the bone disease when followed up may lead to the site of the lesion, if not sufficient bone is removed to expose the lesion which is then dealt with as described below.

In these complications the posterior wound has usually to be left open for drainage purposes.

A. In extradural abscess the simple mastoid operation will sometimes suffice, the condition being more common in acute than chronic mastoid affections; the bone is then removed either upwards or backwards till the abscess is reached and sufficient bone is removed to expose an area of healthy dura mater all round, the cavity is then washed out with hydrogen peroxide or bichloride of mercury, then and packed with gauze.

B. In meningitis there is little hope of recovery but an operation gives the only hope; it should be done in all cases which are not malignant. The bone is removed so as to expose as large an area of dura mater as possible and an incision made into it allowing any humeral or semisulcoidal fluid to escape, the wound is
then packed without closing the dura mater.

c. In neither thrombus of the lateral sinus the bone is
removed posteriorly till the sinus is exposed, if
from the appearance of the sinus or from the symptoms
this is no doubt about the presence of the thrombus,
sufficient bone must be removed backwards till
healthy sinus is reached and downwards towards the
tip of the mastoid process removing the whole of the
mastoid process and reaching down to the bulb if
possible and necessary. If healthy sinus can be
reached on both sides of the thrombus, gauge packing
is put in between the bone and the sinus wall to
exclude it and the sinus is laid open and the
 clot extracted out and the wound packed. In doing
this the sinus must be tacked as little as possible,
til excluded at either side of the thrombus, in case any
particles of clot are dislodged and set free into the
general circulation. When we cannot get below the
disease, or when, though the sinus seems healthy, from
the symptoms there is obviously disease in the sinus or
perhaps in the bulb and cut (right), the internal jugular
vein must be ligatured in the neck before
interfering with the sinus. The vein is exposed
by an incision along the anterior border of the sterno-
mastoid muscle and ligatured and divided below th
disease, where the disease enters into the common
facial or other branches of the vein, they must be
ligatured and divided as well. The upper end
is dealt with either by excising it up to the sinus,
buts this presents difficulties in the region of the bulb
which is deeply situated; or by bringing it out at the
upper end of the wound; the sinus is then opened above
any clot emvreted away and the wound packed as
before.

If on exposing the sinus it seems perfectly healthy
and the sympotms are not sufficiently definite to
make the diagnosis of sinus thrombosis absolute, one is
in some doubt as to what to do. Two courses are open,
one is to pack the wound lightly and wait for the further
development of symptoms and if these arise expose the
internal jugular vein in the neck ligatured and divide
it and then open the sinus and emvret away any clot
as best; the other course, and which I think is the
wisest, where the symptoms are suggestive, is to pack
between the skull and sinus above and below and open
it to see the condition of the interior and then if necessary
the internal jugular vein can be ligatured.

1. In absence of the brain the direction in which the
tumor disease has spread may lead us to the site of the
abcess, if not we must rely upon the localising symptoms
and if these fail we must explore the temporo-ethmoidal
lobe and the cerebellum.

In exploring a temporo-ethmoidal abscess the bone
is removed in an upward direction till about an
inch of dura mater is exposed, this is then opened
in a cruciate manner, the brain may then bulge
through the dura mater from increased tension. The
brain may be explored by a trochar and cannula
the trochar being withdrawn about each 1/2 of penetration,
and a pair of sinus forceps may be used. The blower being
injected about every 1/2 an a glass tube may be used, the jet
is then seen to pass along the tube when the abscess cavity is
entered. The duration of exploration should be upwards
and downwards and if on reaching a depth of 1/2 the
abscess cavity has not been reached, the exploring instrument
is withdrawn and a fresh exploration made. When the
abscess cavity is reached a drainage tube is passed
in, the inner end being just inside the abscess
cavity, the outer extremity is then stitched to the skin
and the rest of the wound packed.

A cerebellar abscess may be explored in front or
behind the lateral sinus, in either case the bone is
removed backwards till a sufficient amount of dura
mater is exposed when it is opened as before. Where
exploring behind the lateral sinus the dura mater
is forwards upwards and inwards for about 2", if not found at the first exploration a second is inserted.

In exploring in front of the sinus, between it and the anterior semicircular canal, the direction taken is more inwards and care must be taken not to go too far inwards and forwards. A second abscess is sometimes present and it is then situated internal to the first. The method of exploration and insertion of the drainage tube are as in tempo-occipital abscess, the wound being finally packed.

In encephalitis the bone is removed in the necessary direction, the dura mater opened as before and the condition of the brain examined, if there is any pus present a drainage tube may be inserted as in an abscess. As a rule this is not sufficient and something further is necessary; a large area of bone is removed the dura mater further opened up, exposing the brain tissue, a large Volehrand's spoon is taken and the brain tissue scraped away till the sloughing tissues are widely exposed and removed in large fact, the cavity is then obliterated by the deeper part of the brain rising to the level of the dura mater; the wound is packed and any slough left will gradually separate and later on the wound may be closed.
by a plastic operation.

As an appendix I give a series of ten cases illustrating some of the complications mentioned above.

**Bibliography.**

Morris. A treatise on Human Anatomy.

Hunter Tod. Diseases of the Ear

Jacobson and Radclive. The Operations of Surgery.

Isler. The Principles and Practice of Medicine


Appendix.

Case 1.

P. H. Male, aged 32, complained of pain in the left ear and swelling behind it.

History. Patient was quite well until eight weeks ago when he noticed a little discharge from the left ear with some pain in it; he got lotion to irrigate the ear with and the discharge ceased. Three days before admission a swelling began to appear behind the left ear and this rapidly increased.

There was a large, hard, painless swelling behind the left ear, extending from the mastoid process down the neck to the carotid triangle. There is much discharge from the ear and slight pain in it. There is a perforation of the membrane in the posterior inferior quadrant.

Temperature was 98.5°; Pulse 76; and Respiration 24.

Operation was done the same day. There was some pus in the soft tissues below the tip of the mastoid and under the periosteum over the tip of the mastoid. A perforation was found in this tip of the mastoid process, the mastoid cells were opened up and found to be large and filled with polypoid granulations; a large sequestrum was lying loose in the mastoid process and removed. The mastoid process was sinuised leaving a large cavity. The mastoid antrum was explored and found to be
practically healthy as pus being present. The

dura mater was exposed over the lateral sinus and
found to be covered with granulation but the sinus
contained fluid blood. The complete operation was done
the bridge between the anterior and external auditory
meatus being removed; a flap was made to cover the

head closed and the cavity packed from the

front.

The next day the temperature was 99, pulse 75 and
respiration 24, the patient being most comfortable; the
ear was removed every second day and the after course
was quite uneventful.
8 Rowe, Female, aged 77. Complained of pain in the left ear with some swelling behind it.

History: Six weeks ago, patient had her left inferior turbinate cauterized, but till then she had been quite well. Following the operation on the nose, she had not felt very well but this was as definite symptoms, left arm, and headache for a day or two after the operation; this disappeared but there was some sense of pulsation in the ear. Eight days ago she noticed a tender swelling behind the left ear, but have been no discharge nor vomiting, and no itching. She has been deaf in the left ear the last six weeks. Polyps have been removed on several occasions from the right nostril; she has had no previous trouble until her ears.

Signs and Symptoms: Swelling of the posterior wall of the left external auditory meatus, preventing a view of the drum, pus in the canal, redness and tenderness on pressure on the left mastoid process.

There is a purulent discharge in the right middle meatus with oedema of the mucous membrane over the middle turbinal, the left nostril quite clear. There is much mucus in the mass of pharynx. Temperature normal. Operation was done three days later. The usual curved incision was made behind the ear in separating the
peristernum run off the mastoid processo the bone was found to be carious. The mastoid antrum was opened and the mastoid cells exposed, a large part of the mastoid process being removed. The lateral sinus was exposed and seen to be healthy. The simple mastoid operation alone was done the middle ear not being touched. The cavity was scrubbed out with peroxide of hydrogen and packed with gauge. The cavity was packed every second day and gradually filled up, the after course being normal.
Case III

F. R. Male, age 14. Complained of headache, pain in the left ear and swelling behind it.

History: Patient has had left otitis for 10 years off and on following measles. Five years ago he had encephalitis for a few weeks and later he had his tonsils and adenoids removed. A week ago he felt pain in the left ear, it got worse and a swelling began to appear behind the ear but did not increase much in size. He has had headache all the week preceding, he has been confined to bed the last three days.

Signs and Symptoms: Patient is drowsy, looks extremely ill. Temperature 103.4°. Pulse 108. Respiration 26. This is purulent otitis, left, the left mastoid region swollen and very tender, no fluctuation.

No Otitic Membranes.

Operation was done next day. The usual incision was made and the antrum opened and no pus found. The dura mater was found in the middle fossa and over the lateral sinus and seem to be normal. On reflecting the peristium over the back of the mastoid a few drops of pus escaped, the mastoid cells were opened and no pus found, but the bone was soft and with a very fetid odor. The greater part of the mastoid was removed and the complete operation done, the cavity being packed a few behind and some but in front the frontal, the wound behind was partially closed and mastoectomy applied four hourly.

The next day the pulse, respiration and temperature were normal.
the toy was bright, the dull stupid appearance having disappeared. The wound was dressed every second day, the temperature never rose again and the afternoons were of uninterrupted improvement.
Case 17

F. M. Female, 18. complained of pain in the right ear and swelling behind the ear.

History. Patient had fever when four years old followed by earache started off and on since then. A few weeks before admission to hospital she had right earache which got worse, a week before admission the discharge ceased and a swelling began to appear behind the ear. This got gradually larger, there was no vomiting but constant obstruction for the week previous to admission.

Signs and Symptoms. Temperature 100.6, Pulse 120, Respiration 24. The right auditory canal bulged down from above and the nasal discharging pus present, the membrane was not visible. There was a swelling present in front and behind the ear with marked tenderness over the mastoid region.

Operation was done the same night. The usual curved incision was made and the ear drum forwards, pus was found under the peristeme, extending forwards along the zygoma. The antnx was opened and granulations excised away from it, the bridge of bone between it and the tympanic cavity was removed and the tympanic excised. The lateral sinus was entered behind and found to be healthy, the dura mater was exposed above and seen to be covered with
granulations or less was removed all non healthy
area was exposed. A flap was then made and the
 cavity packed from the outside. The upper part of the
 skin incision was closed, sutures being put in the laser
 part but left untied and a small piece of packing
 was put in and parenteral antibiotics were given.
 The next day the temperature was 98.7, pulse 88 and
 respiration 24, the pain had disappeared.
 Two days later the packing beneath was removed and the
 sutures tightened. Four days later the stitches was
 removed and the packing in front changed and dressing
 then being done every second day. The afternoon
 was quite normal.
Case V

L. D. Female, Age 21. Complained of right earache and swelling behind the ear.

History: Patient had scarlet fever when four years old, and her mother told her that it had left her deaf in the right ear. Earache began on the right side one month previous to admission to hospital, and lasted the whole time the hearing part of the right ear having got worse. A week after the onset of the earache discharge appeared in the right ear and lasted a few days and this was followed by the appearance of a swelling behind the ear which gradually increased in size. There have been no vomiting nor headache.

Signs and Symptoms: The auricle was protruding and slightly oedematous and there was fluctuating swelling on the face of the mastoid process. There was a foul smelling discharge in the external auditory meatus and a large perforation in the drum the remains of the drum being covered with nodular epithelium.

Operation was done the same night. The usual curved incision was made down to the periosteum which was elevated with a periosteum elevator. The articular and mastoid cells were opened and the cancellous bone was found to be extensively diseased and granulations were present almost down to the tip of
the mastoid process, the diseased bone was removed, and the complete operation done, the tympanum being removed as well; the cavity was washed out with peroxide of hydrogen and packed firmly with gauze. Five days later the wound was closed, and sutures put in the lower part but not tightened, a small gauge drain being put in. Sterile dressings were applied, four daily. Two days later the gauge packing behind was removed and the sutures tightened. Five days later the sutures were removed, the packing changed, and the dressing done every second day. The afterwards was quite normal.
Case VI


History: Patient had had stable otitis media for five years following an attack of measles, with occasional pain in the ear; tonsils and adenoids had been removed three years ago but this caused no improvement in the ear condition, which had been under treatment since.

Signs and symptoms. Both ears showed pus present in the external auditory meatus with granulations in the membrane and granulations on the promontory in the case of the left ear. Deafness was slightly more marked in the left ear as shown by the fact that tuning forks were less well heard and whisper was heard at three feet and at four feet in the case of the right ear.

Operation. The usual incision was made behind the left ear. The periosteum was greatly elevated and the cavity was found to be filled with granulation tissue. The complete operator was done and the tympanum found to be also filled with granulations, the walls and rims being buried in them. Both tympanum and antrum were removed and the cavity washed out with peroxide of hydrogen. A flap was turned up and the cavity packed with the reat with the wound being closed.
Entirely closed.

Seven days later the stitches were removed and the

gauze packing changed; this being done every second
day, the cavity being sprayed with hydrogen peroxide
lotion and alcohol and insane drops being instilled and
then the cavity packed. The after course was normal.

Two months later the cavity was almost healed and
the hearing power the same as before operation.
F. A. Male 63. Complained of a large foreign body put into the left ear.

**History.** Three days before admission to hospital a lead was put into the patient's ear by another child; attempts had been made to remove it but unsuccessfully. There had been pain in the ear since. An attempt was made to remove it in the outpatient department under chloroform but failed owing to the depth of the lead, so the child was admitted to hospital.

On admission under chloroform the ear was syringed out and examined, the drum was seen to be detached and the lead was seen lying on the floor of the middle ear. It was in two pieces which were removed. They were lying on the floor of the tympanic membrane below the level of the floor of the external auditory meatus. The patient remained in hospital a week; the treatment consisted of hydrogen peroxide, lotions and alcohol and boric drops. The temperature was only one above normal, but that was the day before discharge when it rose to 101.0°F but fell again to normal.

A week later the child was re-admitted with a temperature of 110°F, pulse 168 and respiration 36. The tongue was purple and he had been vomiting before readmission but no headache and no rash. There was no otitis media, atelectasis was slight, there was no mastoid
tenderness but an enlarged gland was felt below the tip of the xanthostom.

Two days later the patient seemed a little better, the temperature was 100°F, pulse 132 and respirations 28. The cheeks were slightly flushed, lips little cyanosed and for some time his lungs had a cough rather moist but he did not bring up much sputum. Examination of the chest showed a few friction rubs behind, no dulness in front but over the right apex.

Four days later the child showed some signs of bronchitis, especially on the right side but there was no evidence of any involvement of the smaller air passages nor did there seem to be enough in the lungs to account for the child's undoubted grave condition. The temperature was 103°F, pulse 116 and respirations 32, vomiting had occurred three.

At 5:45 pm the same day the child had general convulsions lasting a short time, at 6:30 pm they started again and at 7:30 pm chloroform inhalation was given intermittently for about half an hour and the convulsions ceased. At 7:30 they again began, the temperature rapidly rose to 105°F, after a cold bath at 9:30 pm the convulsions ceased. The left eye started well marked opisthotonic with intense engagement of the retna.

The next day the child was much worse with marked rigidity of the members of the neck but this was no

was convulsions. Death occurred at 7:30 am eight days after
his recognition during which he wasted somewhat rapidly.

Postmortem examination showed suppuration left to meningitis occupying the inner surface of the cerebellum. The cerebellum was adherent and spreading along each Sylvian fissure; there was no further spread and the vertex was normal. The exudate was fluid containing mainly polymorphonuclear leukocytes amongst which were chains of streptococci. On superficial examination no evidence of tubules was found in the meninges.

In the chest there were no adherions, the left lung in its lower lobes was occupied by several large areas of bronchopneumonia, most of which tubercular. The abdomen showed marked tuberculous of the mesenteric glands and forming large calicular masses.

The meningitis was apparently of recent origin and in removing the brain its most clearly edges from the left internal auditory meatus; there was no obvious disease elsewhere in the temporal bone.
Case VIII

J.B. G. male Ad 18 admitted to the Leeds General Infirmary on Oct 11th, 1903.

History: Patient had had right stenosis many years, he had had an operation on both ears at 15 years of age. 4 months, he had had much pain for four or five days before admission. He had had scarlet fever at six followed by right stenosis, left stenosis annual later. He had had both inner canals cutaneous autografts...

Admission: temperature was 98.4°, pulse 96, and respiration 20.

Operation: under the same day. The usual incision was made, the mastoid pneumatia small and wide and no mastoid cells were present; the cartilage was separated from the anterior by soft osteoclast bone, after, and was close up to the antrum. Under the mastoid process, it appeared healthy and was only separated from the surface by a layer dense bone 3 to 4th thick. The antrum was filled with pus. The complete operation was done and the wound closed.

The temperature remained normal till the 15th when it rose to 103.5°F in the evening but fell to 101° in the morning of the 16th. The pulse being 133 the respiration 27.

On the 16th the wound was opened the floor of the antrum found with a slightly thick wall and opened but it contained
fluid blood, it was packed and the wound left open and packed.

The patient had rigors on the 15th, 17th, 19th, and 19th and then the temperature left off and dropped to the 26th ranging between 97°F and 100°F. when it remained steady till Nov 10th. then a slight evening rise occurred 100°F and continued, on the 11th, it was 103°F and remained above normal till the 19th.

On Nov 16th, both joints were normal, there was a slight bronchitis which had gone by the 21st. On the 26th, headache was complained of but there was still no otitis serous; on the 27th, he had intense headache, was drowsy and both ears were swollen but there were no leading symptoms. On Dec 2nd, the temperature was 99.2°F on the 5th it was 101°F. headache was still present and the ears still swollen; there was less certification only increase by aperients since Nov 19th. On Dec 6th the temperature was normal on the 7th, there was slight cough but no chest sign.

On Dec 9th, on account of the continued headache, otitis serous and obtrusive constipation a further operation was done. The wound was kept open, bone removed at the upper part and the dura matter exposed, the tentorium sphenoidal lobe was explored, there was hemorrhaging but no pus was found.
On Dec 13th. the condition of the patient was much the same he was brighter in the morning falling away as the day advanced and often dark complained of the gas lights. There was no pus in the wound but brain tissue was lying outside the dura mater. On the 15th he was improving but there were large hemis cerebri; on the 21st his condition was rather more satisfactory but hemorrhage and photophobia were still present. As often remissions still occurred the wound was granulating.

On Jan 1st, 1907 he was much better, in the 11th the edges of the disc could not be seen the veins were large and congested in comparison with that which were much smaller than normal. All other inflammatory appeared to have subsided and there was no pho-
tophobia. On the 22nd he had been getting up for some time and his gait was steady but weak with no ataxia; the hemis cerebri was less and being covered with epithelium. On the 30th the discs showed minor resolution, the right more than the left though there was still some swelling of both, he was sent to a convales-
cent house. On April 3rd on his return from the house his general condition was very good, no discharges from the cavity but at the back and upper part of it was a projecting, soft semi-circular swelling; the hemis cerebri was less and covered with granulations which were rapidly being covered with epithelium. He was discharged on March 6th.

He was readmitted on September 24th 1907 and the projecting mass in the external auditory meatus above described and
was discharged on the 14th nothing having been done
he continued to attend as an outpatient afterwards till
his admission on Feb 11th 1909 with a history
that during the night before at 11.30 pm he was suddenly
seized with vomiting and about 3.0 am he became
unconscious.
When seen at the hospital he was semiconscious with
some rigidity of the muscles of the arms and legs; he lay on
his side with his legs and arms flexed there was a tendency
to external strabismus in the right eye with wide
photophobia. There were no other sequelae. The swelling
behind the ear was more prominent than it had been
two weeks previously when seen as an outpatient; clear
fluid was exuding from the right ear and there was a
whisk mass filling up the auditory meatus. The force
jucks were increased. The Temperature was 102.5°, Pulse 100
and Respiration 24.

Operation was on the same day. A curved incision was
made through the skin with hemis cerebri then through
a mass cerebellar brain tissue exposing a cystic swelling,
which after opening discharged clear fluid; a second larger
cyst was found above this and surrounded by pulsating
brain tissue. The mass filling up the auditory meatus
was removed and found to be continuous with the cerebellar
brain tissue. A flap was cut in the middle wall and the
cavity packed, the front the wound being closed completely.

On the 5th, the dressing was moist with clear fluid and the outer dressing was changed. The patient was more conscious though this was rare twitching of the right side of the face. On the 6th, the twitching had gone, but he was unconscious and vomiting continually.

Death occurred on the 7th at 10:35 pm.

The post-mortem examination showed acute meningitis, with congestion of lymphatics at the base of the brain and also on the upper surface of the cerebellum and medulla oblongata. The temporal cerebral body on the right side was somewhat soft and engorged, section of the brain revealed no gross lesion whatever.

The lungs were very congested, the other organs normal.
Case 18

S.F., male, aged 7, complained of pain in his left ear.
He was admitted to the State General Infirmary on Feb 20th, 67.

History. For some days before admission the patient had complained of deafness and the face became swollen.
Signs and Symptoms. The face was much swollen around the ear, there was tenderness over the left mastoid. The left membrane was inflamed, bulging outwards together with the inner part of the roof of the naso. Temperature was 100.2, Pulse 132.

Respirations 27.

Paracentesis of the left membrane tympani was done the same day and the patient put on syrup with carbolic acid lotion, glycerine and carbolic acid drops and injection of 1 per cent.
The temperature was irregular from a few days going up at night, the highest being 103°F two days after admission, and falling in the morning. It gradually fell and on the 27th was normal. The child seemed to be doing well the discharge ceased and the drum healed, but every evening the temperature rose to 99.5°F in the evening and fell in the morning and nothing could be found to account for it. This evening rise continued till March 19th and then the temperature remained normal till two days before death on the 26th.
March 12th. Patient vomited twice during the night. During the past three or four nights he has sat up in bed and screamed and has not slept during the night, but has been very drowsy during the day. Diuresis was examined and found sound, the urine was clear.

March 13th. Diuresis clear, slightly thickened and reddened, having face with watch 1/4. He has slept well the last four nights and has not been any more screaming; he has been up the last three days.

March 17th. He went to bed at 4.00 p.m., vomited twice at 7.00 p.m. The temperature rose to 101.7° Fahrenheit from 80 to 98. About 11.00 p.m., the child sat up and screamed and complained of pain in his head.

March 18th. Temperature still 101.7° F. The child screamed six times during the night; he last slept at 9.00 a.m. when he became restless and weepy. At 9.30 a.m. child was semiconscious, face just present equal and slightly exagerrated, the pupils were dilated equal and reacted to light, there were slow movements of the eyes from side to side but no squint. Oto screeches were present on the left side. At 10.00 a.m. the temperature was 100.7° F. and at 2.00 p.m. 99° F. with pupils 24, the child was more conscious and answered questions clearly with but little delay, and said he felt better though the eyes were kept shut.

Operation. Usual incision made and cataract opened and found fairly normal, some slight pumelations being present.
The dura was the lateral sinus and dura was exposed and found normal. The dura also was raised, no fluid escaped but the brain bulged out, it was exposed without a negative result. The dura over the cerebellum was opened and some clear cerebrospinal fluid escaped. The cerebellum was explored also with a negative result. The complete operation was done and the party packed four hours behind.

At 6:45 p.m. the temperature was 85°, but at 7:45 p.m. it had risen to 89°F.

Mental, Lumbar puncture, normal and no smell of slightly turbid cerebrospinal fluid drawn off. On examination it was found to contain staphylococci and polynuclear leukocytes only. A diagnosis of purulent menigitis was made from this.

At 10:30 p.m. the temperature was 100.5° and pulse 176 and remained at this level til death at 3:30 a.m. on the 24th.

The postmortem examination showed purulent menigitis at the base and tumor at the left side. The anterior rectus externum of the left temporal subtemporal hole was nothing more than a sac containing pus, the appearance of the pus was like the neighborhood of the temporo-parietal sinus. The appearance of the ventricles was normal. On section through the abdomen, it was found the size of a large chestnut, being smooth and thickened, and contained not particularly, and suggesting a recent formation. The pus was of medium consistency.
greenish and inoffensive. The abscess cavity came very near the surface on its inner aspect and was partly lacunated in removal of the brain, but the meninges almost certainly took origin from this thin area.

The explorator was immediately posterior to the abscess being missed it by about half an inch.

The other organs were normal.
Case X

V.F.W. Female Act 52 complained of earache on the left side and severe headache.

History: No child, the patient had left otitis media following measles, this ceased and she had no trouble until her ear for 7 years when she had deafness due to common cold which was removed, this had to be repeated more years later. She had no further trouble till three months ago when she became a little deaf in the left ear but had no pain. Three weeks ago following a cold she had pain in the left ear which got worse, she presented it for ten days then a cholesteatoma mass was removed by her doctor and the ear began to discharge freely. Three days before admission the pain got very bad and the next day she came and she had a rigor which she herself laid little stress on. She had had headache four days before admission but no vomiting. Signs and symptoms. There was pus in large quantity in the left external auditory meatus and the membrane was perforated behind. There was no pain over the mastoid process but marked pain behind it and below along the stem of the mastoid, there was some swelling in the neck and the upper part of the sternocleidomastoid. There was no other remittent, the temperature was 100° F, pulse 96, respirations 24. Operation was done the same night. The usual cured.
incision was made and the anterior opened and pus was found under tension. The anterior cells were opened and very little disease found. The dura was exposed above and found healthy and 3" of the lateral sinus was exposed behind, the dura over it seemed quite healthy and the sinus seemed to contain fluid clear so it was not exposed. The complete operation was done the wounds stitched up and the cavity packed from the first.

The patient had a fever during the night and a record the following morning, the temperature rising to 103° during the night, so a further operation had to be done.

The wound was opened up behind and a further area of the lateral sinus exposed, it still seemed to be healthy. Gauze packing was put in between the skull and the sinus and the sinus opened it was found to contain black thrombus which was removed till healthy sinus was reached posteriorly. The internal jugular vein was opened in the neck and found to contain thrombus, it was ligatured below the sinus and 3" excised the offer and long also ligatured. The wound in the neck was stitched up and the wound behind the ear packed.

The next day fluid was found in the right knee joint and in the tendon sheaths on the back of the right wrist the temperature varied from 100° to 103° and pulse from 96 to 130. In the evening she became restless and delirious requiring
The following day she was much worse and breathing difficulties continued and she died at 12:00 noon the day after admission.

The postmortem examination showed the internal jugular vein, the ligature to be quite healthy, about one inch below the ligature there was a little adherent necrotic thrombus. Above the ligature the wall of the vein was yellow and sloughy and contained pus; the sinus behind the packing was healthy and no other sinuses were affected. There was purulent fluid in the right knee joint. The other organs showed no marked change except that due to an acute infectious condition. No emboli were seen.